THE POTOMAC ESTUARY

biological resources

trends and options

Edited by
William T. Mason
Kevin C. Flynn

Commission on the Potomac River Basin / Maryland Power Plant Siting Program

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Proceedings of a Symposium
Alexandria, Virginia
June 4-6, 1975

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Department of Natural Resources
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April 1976

The Shellfish Fisheries of the Potomac River

Dexter S. Haven

The Potomac and its tributaries support many species of molluscs which are important sources of food for benthic invertebrates, fish, and waterfowl. However, only two species, the American oyster *Crassostrea virginica* and the soft clam *Mya arenaria* are harvested for commercial purposes. A third species, the brackish water clam *Rangia cuneata* occurs locally in tremendous concentrations, but it is not utilized as a food source. Nevertheless, this species is regarded as a potential source of food for people.

During the past six to eight years, commercial landings of both the oyster and the soft clam have dropped from high to extremely low levels. The cause of this decline may be partially explained for oysters, but the reason for the decline for soft clams is not apparent. The brackish water clam *Rangia*, a recent introduction into the Potomac, remains at high levels of abundance.

In this discussion, emphasis will be placed on the oyster since this species has received the most study.

Administration of the Potomac

The shellfish fishery of the Potomac and its tributaries is largely a public fishery as distinguished from one in which 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 (313 hectares) under lease (F. Sieling, Pers. Comm., 1975). In the Virginia tributaries in 1973 there were 8,709 acres (3,527 hectares) under lease (Virginia Marine Resources Commission, 1973).

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 (PRFC) which administers the main stem of the Potomac. Enforcement of laws and regulations is by joint action of the Maryland and Virginia agencies.

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This complex system of administration evolved over may years. In 1906 the Haman Act of Maryland authorized a survey of its tidewaters and proposed that waters in Maryland and in the main stem of the Potomac (which was also "owned" by Maryland) be classed as either natural bars which would be maintained for the public or barren bottom which would be open for leasing, plus an additional classification for crabbing and clamming (Christy, 1964).

The leasing of bottoms under the Haman Act met with considerable opposition by many of the Maryland watermen. Consequently, legislation in the 1914 session of the Maryland legislature (the Sheppard Bill) called for a resurvey of the barren bottoms and as a result 54,000 acres (21,870 hectares) were added to the natural bar classification and removed from potential lease holding. The process for further reclassification was also established at the time so that resurveyed oyster bottoms could be reclassed as barren and vice versa (Christy, 1964).

Until 1947 the reclassification of natural oyster bars could be accomplished by the straightforward action of the Tidewater Fisheries Commission. As a result of a court decision in 1947, the system of reclassification from public to leasable bottoms was made more difficult making it virtually impossible to lease bottoms in any area in Maryland including the main stem of the Potomac.

Subsequent to 1947 and through 1957 there was little change in leasing or administration. Maryland owned and policed the Maryland tributaries and the main stem of the Potomac, and all but a few acres were classed as public bottoms. Fisheries regulations relating to the main stem were formulated by each state and were often in conflict with each other. As a result, much confusion in enforcement existed.

A major change in administration occurred in 1958 with the inception of the "Potmac River Compact of 1958." This resulted in the formation of a commission consisting of six members, three from Maryland and three from Virginia, whose function was to administer the fisheries in the main stem of the Potomac exclusive of the tributaries. In the provisions of the compact, the Commission could issue licenses, formulate regulations, collect taxes, conduct repletion activities, receive grants, etc. A significant stipulation of the compact was that leasing could be authorized only if such authorization was granted by action of the legislatures of both Maryland and Virginia. As a result of the ratification of the compact by Virginia in 1959 and by Maryland in 1962, the Potomac River Fisheries Com-

mission began operation in January 1963 with headquarters in Colonial Beach. This bi-state agency began for the first time to collect statistics on landings of shellfish from the main stem of the river.

While the formation of the PRFC was a major improvement, problems in respect to managing the fishery remained. A major problem was that the PRFC inherited from Maryland the concept of public ownership of its shellfish resource as a management policy. Such a publicly owned resource is known to economists as a common property natural resource. The characteristics of such a resource have been studied by many competent economists. Christy (1964) states that the exploitation of a common property resource generally proceeds to the point of depletion unless laws or regulations are passed to limit production. The individual producer (harvester) has no incentive to reduce his rate of use and no incentive to invest in the future of the resource by cultivation or management techniques. Any restraint on this waterman's part represents to him a loss and not a postponement of harvest. Also the profit goes to the harvester and except for a tax is not reinvested in the fishery.

The Oyster Producing Areas

The main stem of the Potomac has extensive areas of bottom suitable for growing oysters extending from Upper Cedar Bar in the upper estuary 54 miles (100 km) 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 ft (1.2-8.6 m), but most are located at depths ranging from 5 to 18 ft (1.5–5.5 m). 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 become almost completely devoid of oysters as a result of a freshwater 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 Viginia 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 and its tributaries have several unique characteristics which make them 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. Beavin (1960) summarized twenty years of salinity data for the Patuxent River, Maryland (which is similar to the area at the mouth of the Potomac) and showed a mean annual value of 13.6 perts per thousand (ppt). This average is regarded as being below the mean value where MSX and *Dermocystidium* cause excessive mortalities (Andrews, 1957; Andrews, 1967). The predatory gastropod *Urosalpinx cinerea*, which often kills 100% of the spat in salinities above 15 ppt (Beavin, 1958; Carricker, 1955), is absent from the river.

Meat quality is high and oysters are usually single and well-shaped. These two characteristics 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 July and sometimes in September. However, in most areas and during most years setting is too sparse or irregular to provide a dependable crop. The Potomac as well as many of its tributaries yield production ranging from almost zero to over one million bushels (36,000 m^3) of oysters annually. From 1942 to 1963 set in the upper Potomac averaged only 8 spat per bushel (.3/m^3) of bottom cultch and 14 spat per bushel (.5 spat/m^3) 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 in the St. Mary's River where average set during the period was 78 spat per bushel (2.8 spat/m^3) (Beavin, 1954; Beavin and Andrews, 1964). Recent studies by VIMS, the Chesapeake Biological Laboratory (CBL) and the MDNR indicate no change in the basic pattern of setting or setting intensity. A good crop 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 (Frey, 1946; Beavin, 1958; Beavin and Andrews, 1964; and Haven, Davis and Kendall, 1975). Although these exceptional years produced stocks which were harvested by watermen over many years, production again dropped to very low levels. 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 1 million bushels of oysters annually.

The uppermost oyster bars of the main stem of the Potomac as well as in several tributary creeks are subject to freshwater kill during years of excessive freshwater runoff. 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 for the system.

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 (Hires, Stroup and Seitz, 1963). In the lower Potomac the

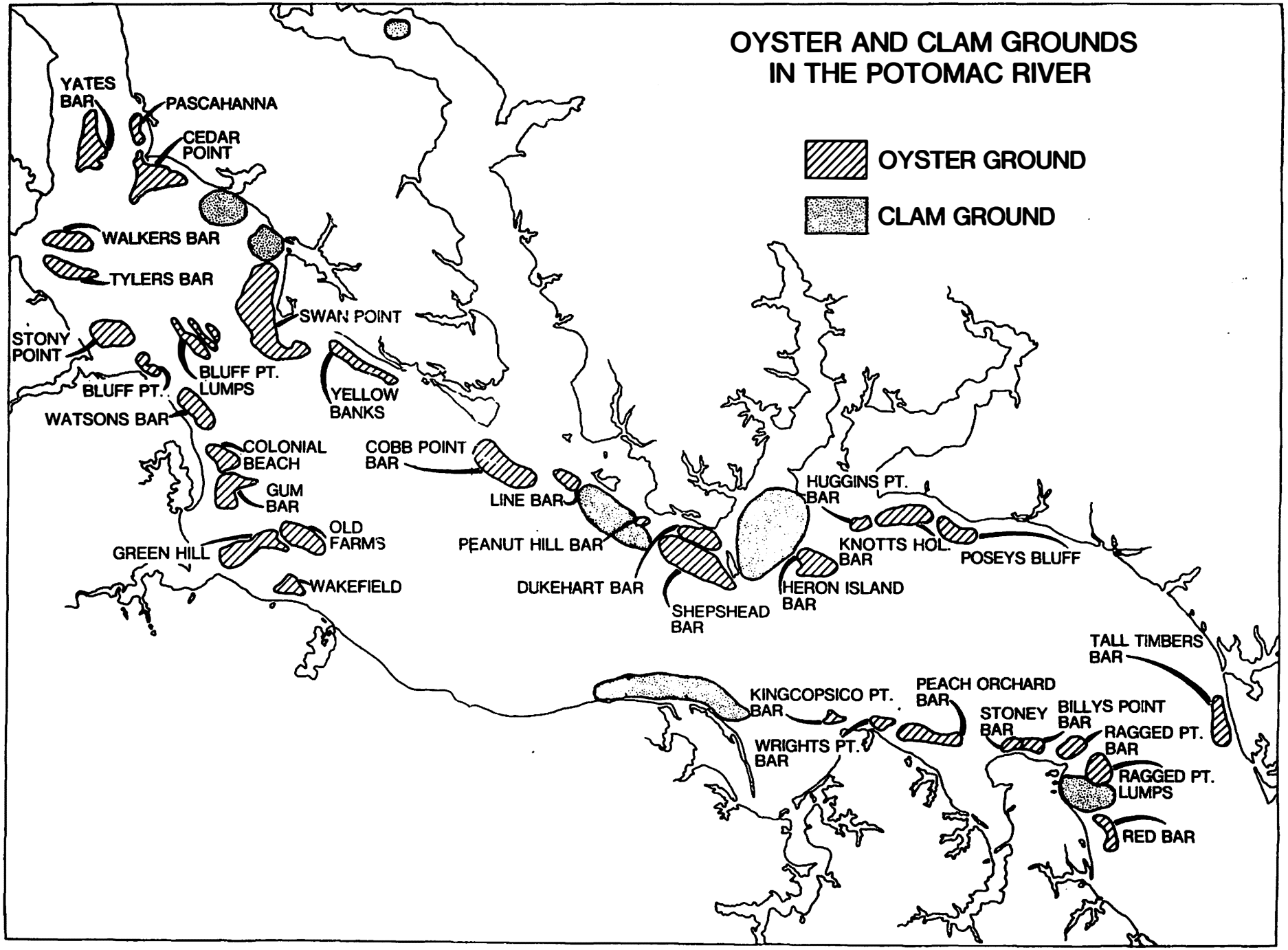

FIGURE 1. Locations Where Oysters and Soft Clams Occur in the Upper Potomac River

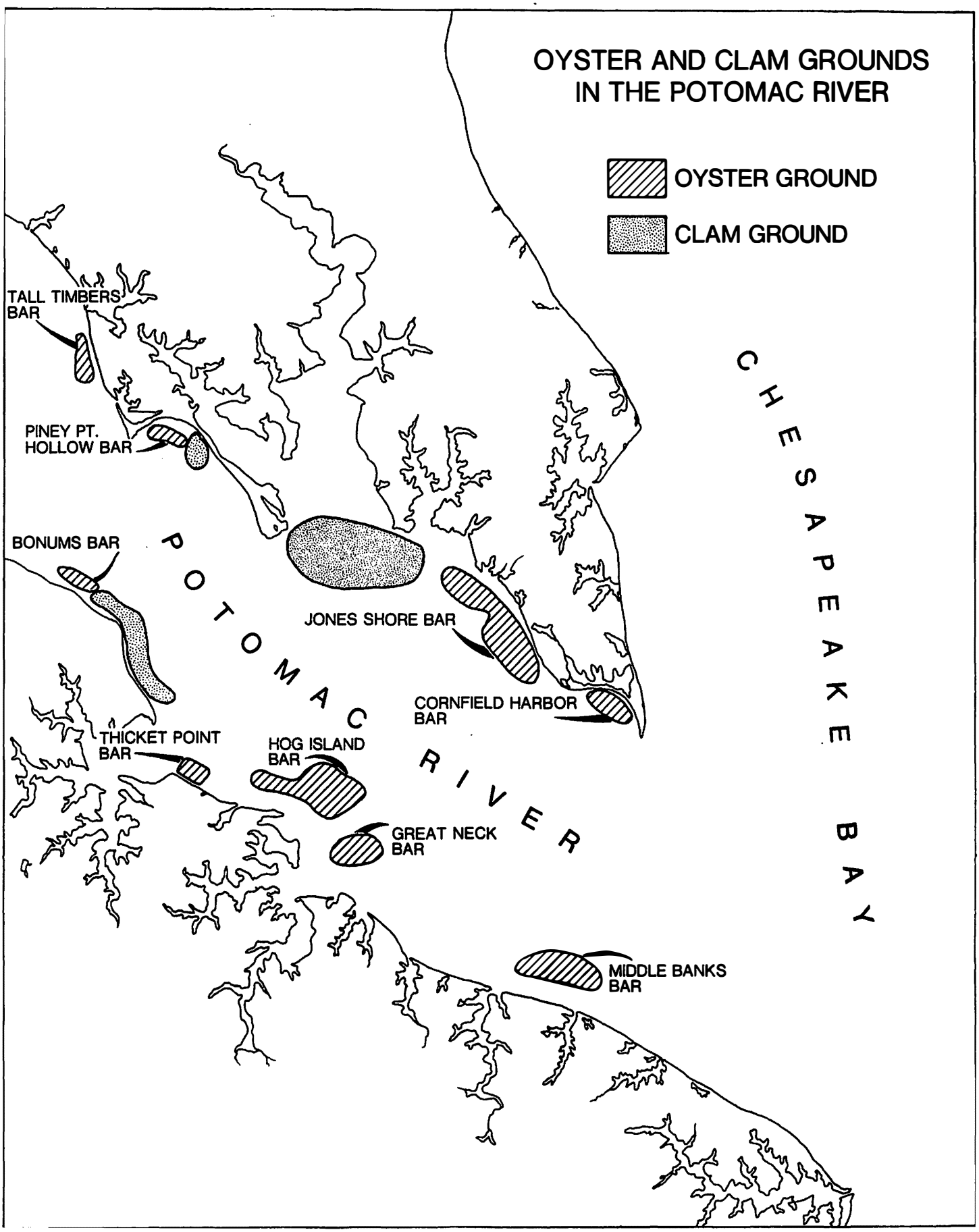

FIGURE 2. Locations Where Oysters and Soft Clams Occur in the Lower Potomac River

amount of dissolved oxygen limits oyster survival in the deeper water. Studies completed prior to 1958 often indicated that for 40 miles (74.1 km) upstream from the mouth oxygen concentration beomes zero at 50 ft (15.2 m). In one year out of every three it became zero at all depths over 40 feet (12.2 m) (Beavin, 1958). Oysters cannot survive to maturity under these conditions. The condition is becoming more severe because of higher organic loading of the system from sewage discharge systems. In September 1973 dissolved oxygen was zero at 18 feet (5.5 m) or deeper over over wide areas in the lower Potomac and a significant mortality of oysters occurred (Haven and Davis, 1973).

Shell cultch, which provides a substrate for oyster larval attachment, is becoming less abundant in the Potomac 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 meters 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 aspect undoubtedly has reduced yields in the system.

Commercial Landings of Oysters

Statistics on landings of oysters for the Potomac River and it 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 a 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 11 of the Rivers and Harbors Act of 1922 (Frey, 1946).

Data on soft clam landings are available from the NMFS

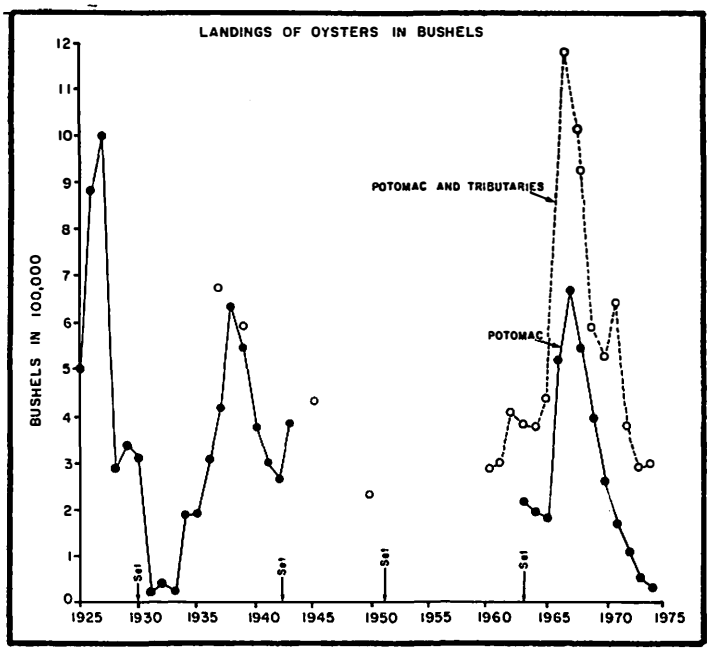

FIGURE 3. Landings of Oysters in the Potomac River 1925-75

from 1955 to the present and from the PRFC from 1963 to the present.

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 (36,000 m^3) were followed five years later by a production of less than 25 thousand bushels (900 m^3). A second peak in 1938 of about 625 bushels (22,500 m^3) was followed four years later with a low of about 275 thousand bushels (9,900 m^3). In 1967 over 650 thousand bushels (23,400 m^3) were landed but this was followed by a rapid decline to only 36 thousand bushels (1,296 m^3) in 1974. In all instances, it can be seen that good setting years in the mid or upper estuary were followed four or five 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 (10,188 m^3) in that year to 1,196 thousand (43,056 m^3) in 1966; thereafter, production rapidly declined to only 295 thousand bushels (10,620 m^3) 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 one half to one third 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.

The Soft Clam

The Potomac River and its tributaries may have produced large numbers of soft clams during historic times, but it was not until a hydraulic soft clam harvester was perfected by

Mr. Fletcher Hanks in the early 1950's that soft clams were landed from the Potomac (Christy, 1964).

The soft clam exists on many areas of moderately firm sand-clay bottoms throughout the system over about the same range as the oyster (Figures 1 and 2). The spawning seasons occur during May and September (Pfitzenmeyer, 1962). Setting intensity has not been studied in the Potomac with any degree of regularity, but occasional surveys indicate that it may be as erratic as oyster setting and that major strikes occur only once every 10 to 15 years. Shell is not necessary as substrate for clam larvae to attach at setting time, so it is not a limiting factor.

After the soft clam harvester was introduced, landings of soft clams increased dramatically from nearly zero to about 174 thousand bushels in 1966 for the Potomac and its tributaries and to over 140 thousand bushels (5,040 m^3) for the Potomac main stem. By 1967 however, production had declined abruptly and today few soft clams are harvested in the Potomac or its tributaries (Figure 4). A recent survey by VIMS, the PRFC and the CBL in 1974 found no significant populations in the river. The reason for the decline is unknown.

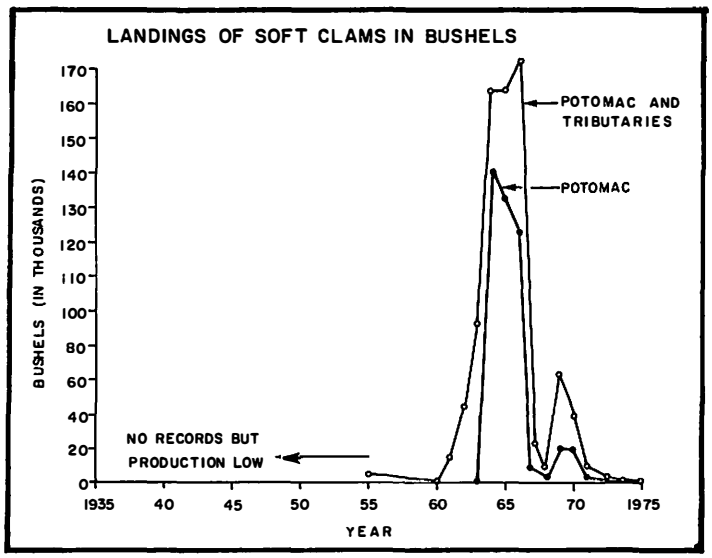

FIGURE 4. Landings of Soft Clams in the Potomac River 1935-75

The Brackish Water Clam *Rangia*

The brackish water clam *Rangia* is abundant in many low salinity bays and estuaries of southern Chesapeake Bay. Its range extends from upper Chesapeake Bay to Mexico. This species is a recent introduction to the Potomac, and it was probably introduced into the area along with seed oysters around 1960 (Pfitzenmeyer and Drobeck, 1964). Today this species occurs in tremendous abundance from about Swan Point to below Colonial Beach, often in concentrations which exceed several hundred per square yard. It is found in depths ranging from at least 2 ft to 30 ft (0.6–9.2 m).

The species is not used commercially and represents one of the major unutilized resources of the Potomac. There are problems, however, with using this species as a food. It is small (average size 1 to 1.5 inches = 2.54 to 3.81 cm) and it has a musty or muddy taste. However, this condition may eventually be overcome by the development of new processing techniques.

Summary

The oyster and soft clam resources of the Potomac and its tributaries are a common property natural resource. Except for repletion activities the magnitude of the standing crop in this system depends largely on the success or failure of a fortuitious set or strike of larvae.

Exceptional setting years, on which the oyster fishery has depended for most of the harvest, have occurred about five times in the last 50 years. Therefore, annual landings from the main stem system have fluctuated widely from over 1 million bushels (36,000 m^3) annually to less than 36 thousand (1,296 m^3). Landings for the main stem plus the tributaries show similar fluctuations which coincide with that of the main stem. The last peak of abundance for oyster production which occurred in 1966 and 1967 was associated with a major set occurring 1963. It is noted that the decline in landings were already at low levels when tropical storm Agnes destroyed about half of the remaining stocks in 1972. That is, this catastrophic storm accelerated a decline in landings which had began some years vefore.

Much less is known about reasons for fluctuations in abundance of soft clams than is known about oysters. However, evidence obtained since 1950 suggests that cyclic pattern in setting exists for soft clams as well as oysters.

At present landings of both species are at an all time low. The MDNR, the PRFC and the VMRC have all attempted to reverse this trend by repletion activities (Statistical data from VMRC, PRFC and the MDNR). From 1963 to 1973 the VMRC has planted in the Virginia tributaries 117,214 bushels (4,220 m^3) of seed worth $84,513 and 614,031 bushels (22,105 m^3) of shell worth $100,044. The PRFC has expended $1,936,418 between 1963 and 1974 on 6,036,801 bushels (217,325 m^3) of shell and 899,617 bushels (32,386 m^3) of seed oysters and about 2 million hatchery seed. From 1963 to 1973 the MDNR has spent in the Potomac and its tributaries $1,038,231 for 2,595,585 bushels (93,441 m^3) of seed and $772,853 for 5,145,693 bushels (185,245 m^3) of shell. In summary, from 1963 to 1974 at least 3,602,416 bushels (129,687 m^3) of seed and 11,796,947 bushels (424,690 m^3) of shell worth $3,931,077 have been planted in the Potomac and its tributaries. These efforts have undoubtedly been of benefit to the fishery. They have not, however, been successful in compensating for the lack of regular natural reproduction, or the adverse effects of Tropical Storm Agnes.

Under the present system of public management the future production of oysters and soft clams in the Potomac will be dependent largely on fortuitous sets or continued expenditures for repletion activities by Maryland, Virginia and/or the Potomac River Fisheries Commission. That is, production will increase only if the subsidy is increased.

The degree to which pollution has contributed to this decline is unknown, but it is logical that increased loading of organic matter has intensified the oxygen depletion problem noted previously. The aspect has undoubtedly lowered survival of larvae as well as adults.

A possible method of increasing production is by allowing leasing by private individuals as was originally suggested by

the Haman Act of 1906. This is now allowed in the Virginia tributaries, but not to any extent in Maryland or in the open Potomac. It is noted that such action may be instituted only if approved by legislative action of both Maryland and Virginia. While leasing will not alleviate the chronic shortage of seed in the system it would permit culture of hatchery raised seed or seed obtained from other systems.

In summary, the Potomac still has a vast potential for shellfish production but it is not being realized at the present time.

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