12-1-1957

Fifty-Eighth and Fifty-Ninth Annual Reports of the Commission of Fisheries of Virginia

Virginia Commission of Fisheries

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VIRGINIA

COMMISSION

OF

FISHERIES

VIMS ARCHIVES

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Virginia Institute of Marine Science

58th & 59th
Annual Reports
FIFTY-EIGHTH AND FIFTY-NINTH ANNUAL REPORTS

of the

Commission of Fisheries of Virginia

for the

Fiscal Years Ending June 30, 1956 and June 30, 1957

Commonwealth of Virginia
Division of Purchase and Printing
Richmond
1957
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Commission of Fisheries

Charles M. Lankford, Jr., Commissioner.........................Franktown, Va.

ASSOCIATE MEMBERS

W. Collin Chilton...........................................Kilmarnock, Va.
James B. Martin.............................................Gloucester, Va.
Charles R. Bagnell.......................................... Eclipse, Va.
Richard B. Kellam...........................................Norfolk, Va.

OFFICE

Lena S. Cosby, Accountant
Elizabeth M. Corson, Confidential Secretary
Mildred Hundley, Clerk-Typist
Thelma W. Liberty, Clerk-Stenographer
Stella Turlington, Clerk-Stenographer
Harry N. Jones, Janitor

ADMINISTRATION

George H. Badger, Jr., Civil Engineer.........................Franktown, Va.
Charles J. Kerns, Assistant Engineer.........................Gloucester, Va.

Ben T. Gunter, Jr., Attorney.................................Accomac, Va.

GENERAL OFFICE OF COMMISSION—NEWPORT NEWS, VA.

* Also shown under Inspectors.
### OYSTER INSPECTORS AND DISTRICTS

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<th>Name</th>
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<td>Stafford and Fairfax</td>
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<td>S. G. Deal</td>
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<td>Lancaster and Richmond</td>
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<td>M. H. Hogg</td>
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<td>Gloucester, King and Queen, and</td>
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<td>George E. Brooks</td>
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<td>J. V. Shipley</td>
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<td>E. T. Wallace</td>
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<td>Richmond, Va.</td>
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<td>Chesterfield, Henrico, Prince</td>
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<td>William and New Kent</td>
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<td>Willis Wharf, Va.</td>
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<td>Herman Osley</td>
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<td>W. D. Steelman</td>
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<td>A. C. Johnson</td>
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*Also listed under Police Boat Captains.

*Also listed under Administration.

### DEPUTY INSPECTORS AND DISTRICTS

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<td>H. C. Doggett</td>
<td>Monaskon, Va.</td>
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<td>James F. Onley</td>
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<td>L. R. Dixon</td>
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<td>H. C. Ellis</td>
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<td>N. E. Wessels</td>
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*Also listed under Police Boat Captains.
REPORT OF THE COMMISSION OF FISHERIES

AIRPLANE PILOT AND CREW

George H. Colonna, Jr., Pilot ................................................. Johnstown, Va.
C. E. Charmock, Co-pilot .................................................... Warwood, Va.

POLICE BOATS, POLICE BOAT CAPTAINS AND MATES

<table>
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<tr>
<th>Name of Boat</th>
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<td>&quot;Dawn II&quot;.............</td>
<td>W. B. Marchant</td>
<td>Frank Marders</td>
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<tr>
<td>&quot;Bonnie&quot;..............</td>
<td>A. M. Cross</td>
<td>Bernard Miller</td>
<td>Weems, Va.</td>
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</tbody>
</table>

*Also listed under Deputy Inspectors.
†Also listed under Inspectors.
To His Excellency, Honorable Thomas B. Stanley,
Governor of Virginia, and
The General Assembly of Virginia.

Pursuant to statutory requirement, the Commission of Fisheries of Virginia submits the following report for the fiscal years ending June 30, 1956, and June 30, 1957, respectively, showing the amount of revenue derived from the fish and shellfish industries under the supervision of the Commission, all expenditures by the Commission, and the condition of the fish and shellfish industries of the Commonwealth under the supervision of the Commission.

Self-explanatory schedules and reports for the named fiscal years are included herewith, as follows:

1. Receipts from the fish and oyster industries.
2. Expenditures for administration, enforcement, and repletion work.
3. List of recorded oyster planting ground.
4. Areas in which repletion work was done.
5. Comparative statements of expenses for the past ten years.

Exhibit A—Reports of J. T. Meyer, Superintendent of Hatcheries.
Exhibit B—Report of Dr. John L. McGuire, Director, Virginia Fisheries Laboratory.

These schedules and reports offer a detailed account of the activities covered thereby.

Enforcement

The Commission presently operates the following patrol boats owned by the Commonwealth, and the generally assigned area of each of said boats is shown opposite the name thereof.

“Chesapeake”.................Tangier and Pocomoke Sounds and Chesapeake Bay
“Ken di Lai”..................James River
“Will F. Kellam”..............James River
“Nomini”.....................James River
“James River”................James River
“Celia”......................Newport News Boat Harbor
“Bonnie” .................. Rappahannock River
“Mobjack” .................. York River and Potomac River
“Hornet” .................. Plankatank and Rappahannock Rivers
“Glamour Girl” ............ Potomac River
“Dawn 11” ................. Potomac River
“Ranger” .................. Potomac River
“Sea Bee” .................. Chesapeake Bay
“Wasp” .................... Chesapeake Bay and Rappahannock River
“Hon” ...................... Ocean side of Accomack and Northampton Counties
“Willisett”................ Chesapeake Bay

The foregoing boats, with exception of the Willisett, are equipped with radio telephones and each is thereby enabled to maintain contact with the other, as well as with the Commission patrol plane and the Newport News office. The stationing of these boats in the areas named makes for adequate enforcement of the seafood laws.

In conjunction with the large boats the Commission operates a number of small patrol boats, equipped with large outboard motors, making for economy and efficiency in enforcement work.

In addition to Commission-owned patrol craft, twelve boats are leased from and operated by various Inspectors in their respective districts.

The “James River” has recently been added to the patrol fleet, with the thought that the “Celia” will eventually be sold.

Oysters

The Virginia oyster industry is in a healthy condition. In fact Virginia is apparently one of the few oyster producing states along the Atlantic Coast where the supply has remained fairly constant. While the supply of oysters from the public rocks has decreased, production from private beds has gradually increased. The acreage of leased oyster planting ground has not increased during the biennium; for, while new acreage has been leased, certain ground has been abandoned due to storm damage rendering the ground unfit for continued planting of oysters.

The demand for seed oysters has continued good and the Commissioner has refused to issue permits for out-of-state shipments of seed oysters wherever there has been a demand therefor by Virginia oyster planters. This policy conforms to the statute laws of Virginia for such cases made and provided. The James River beds continue to produce about 2,000,000 bushels of seed oysters yearly.

An interesting chart showing the trend of leased oyster planting ground during the past fifty-seven years is attached to and made a part of this report.

During the first year of this biennium a record number of shells were planted on the public rocks. However, during the year ending June 30, 1957, fewer shells were so planted, due to the high price thereof and scarcity of shells. A great many of the Virginia oyster planters use their own shells for cultch on their leased grounds.
Numbers of acres of oyster ground under lease in Virginia from 1900 to 1957—1900: 26,845.99 acres; 1957: 128,216.94 acres. Compiled from records of Commission of Fisheries by George H. Badger, Jr., Engineer.

It appears that the industry has largely recovered from the severe damage wrought by storms two years ago. Virginia continues to produce about thirty per cent of the oysters grown in the United States, according to reliable statistics.

The Virginia Fisheries Laboratory is doing a fine work in studying the oyster drill, which has been a virtual menace to oyster growing on the ocean side of Accomack and Northampton Counties. We confidently expect that some method will soon be developed to control this predator.

This Commission believes that the policy of encouraging private planters to expand their operations has been fully justified, and the result thereof reflected in the increased production of oysters from year to year.

**Crabs**

The Virginia Fisheries Laboratory has continued a cooperative research crab program with its counterpart in Maryland and the United States Fish and Wildlife Service.

The supply of crabs during the 1955-1956 dredge season was almost unprecedented. However, the supply during the past season was somewhat diminished, which decrease was forecast by our biologists.

Scientists from Maryland, Virginia, and the Fish and Wildlife Service have again agreed that no additional crab conservation measures are needed for the present.

**Fish**

Continued studies have been and are being made in an effort to determine the causes of fluctuation in the supply of finfish from year to year.

We are happy to report that the supply of certain species of finfish has in-
creased, notably the croaker. Overall, we think it can be fairly said that the catch of fish during the past biennium has been satisfactory. In spite of the contention of some, it has not been proved to date that overfishing has been a factor of any real consequence in connection with the fish population of Virginia waters. Continued basic research is needed in this field. Eventually, we will learn the relationship between natural mortality and fishing mortality.

The menhaden fishery has enjoyed a period of prosperity, and makes a real contribution to the Virginia economy, the catch being second in value of Virginia seafoods and surpassed only by the oyster industry.

The Commission has continued the operation of shad hatcheries on the Mattaponi, Pamunkey and Chickahominy rivers. While these hatcheries may be of doubtful value, the fishermen approve them and the cost involved is relatively small.

Pollution

The problem of pollution continues to plague the seafood industry despite the fine work of the State Water Control Board and the Hampton Roads Sanitation Commission. The discharge of industrial waste into the waters of the Commonwealth by established and new industries poses a real problem. However, these matters are receiving constant attention from state, federal and private agencies.

Atlantic States Marine Fisheries Commission

This agency continues to render a real service to the Atlantic Coastal States, acting as a clearing house for information and striving to promote uniformity of legislation wherever consistently possible.

Virginia Fisheries Laboratory

The work of the Virginia Fisheries Laboratory, under the leadership of Dr. John L. McHugh, its capable Director, continues to be of a high order. The staff is competent and the work of the laboratory is generally recognized for its excellence. Too, those engaged in the seafood industry in Virginia have learned to depend on the Director and his staff for assistance with their various problems. Since a report of the activities of the laboratory is appended hereto we will not go into detail relative thereto.

Legislation

The Commission will recommend to the General Assembly of 1958 legislation to promote the seafood industry of the Commonwealth.

We record our appreciation to Honorable Thomas B. Stanley for his support of this Commission in every way.

Also, we acknowledge the cooperation of the Director and Staff Members of the Virginia Fisheries Laboratory, the Commission employees, the United States
Fish and Wildlife Service, and those fine people who carry on the seafood business of Virginia.

Respectfully submitted,
COMMISSION OF FISHERIES OF VIRGINIA
By:

Chas. M. Sanford
R. B. Bagwell
W. L. Brooke
C. W. Ballard

Members
Statistical Tables
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<th>DISTRICTS</th>
<th>Oyster Licenses</th>
<th>Tax From Public Rocks</th>
<th>Tax From Leased Grounds</th>
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<th>Crab Licenses</th>
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*Recording fees do not represent revenue. They are paid out immediately to Clerks of Court for the account of the lessee.
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<th>Tax From Leased Grounds</th>
<th>2B Bushel Tax</th>
<th>Tax for Carrying Out of State</th>
<th>Crab Licenses</th>
<th>Crabs and Scallop Licenses</th>
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TABLE 2

Expenditures for Year Ending June 30, 1956

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Expenses for Year Ending June 30, 1957

Administration

Salaries:
- Office personnel ........................................ $ 26,157.60
- Members of Commission .................................. 230.00
- Counsel and expert services .......................... 2,200.00
- General repairs .......................................... 498.25
- Motor vehicle repairs .................................. 33.60
- Light, heat, power and water .......................... 627.46
- Traveling ................................................. 1,063.28
- Transportation ......................................... 2.50
- Communication ........................................... 1,895.50
- Printing .................................................. 139.35
- Other expenses .......................................... 102.90
- Fuel supplies ........................................... 397.24
- Office supplies .......................................... 344.36
- Laundry, cleaning and disinfecting supplies ....... 4.95
- Agricultural and botanical supplies ................. 3.27
- Other supplies ........................................... 49.10
- Office equipment ........................................ 83.40
- Other equipment ......................................... 88.99
- Rent ....................................................... 24.00
- Insurance ................................................ 46.35

Total for Administration .................................. $ 33,976.50

Inspection and Policing

Salaries ....................................................... $ 156,261.79
Wages ....................................................... 605.50
General repairs ........................................... 71.60
Motor vehicle repairs .................................... 16,209.74
Light, heat, power and water ................................ 22.00
Traveling ................................................... 27,609.50
Transportation ............................................. 66.14
Communication ............................................. 1,290.08
Printing ..................................................... 2,580.12
Other expenses ............................................ 347.78
Laundry ..................................................... 239.51
Food supplies .............................................. 1,290.50
Fuel supplies .............................................. 824.08
Office supplies ............................................ 182.75
Medical and laboratory supplies ......................... 10.63
Laundry, cleaning and disinfecting supplies ........... 199.19
Refrigerating supplies .................................... 373.01
Motor vehicle supplies ................................... 23,532.85
Wearing apparel ............................................ 1,944.15
Other supplies ............................................ 374.99
Building material ......................................... 231.75
Other materials ............................................ 332.05
Marine materials .......................................... 8,927.51
Office equipment .......................................... 88.20
Household equipment ..................................... 344.01
Boats and nautical equipment ............................. 29,581.89
Rent ......................................................... 7,136.00
Insurance ................................................... 46.35

Total for Inspection and Policing ......................... $ 284,914.49

Repletion of Oyster Beds

Salaries ....................................................... $ 2,800.00
Wages ....................................................... 7,156.00
Motor vehicle repairs ................................... 114.50
Traveling ................................................... 1,057.93
Printing ..................................................... 297.58
Other expenses ............................................ 120,834.22
Marine materials .......................................... 105.87
Rent ......................................................... 859.87

Total for Repletion of Oyster Beds ....................... $ 133,325.97

Repletion and Restoration of Oyster Beds

Wages ....................................................... $ 7,700.00

Total for Repletion and Restoration of Oyster Beds .... $ 7,700.00

Grand Total for Expenditures ................................ $ 450,916.96
### TABLE 3

**Recorded Planting Ground**

*Year Ending June 30, 1956*

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<td>4,063.14</td>
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<td>5,545.33</td>
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<td>10,351.91</td>
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<td>7</td>
<td>4,357.97</td>
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<td>15,753.94</td>
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<td>9</td>
<td>2,785.37</td>
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<tr>
<td>10</td>
<td>3,601.62</td>
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<tr>
<td>11</td>
<td>10,162.85</td>
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<tr>
<td>12</td>
<td>3,987.40</td>
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<tr>
<td>13</td>
<td>5,381.65</td>
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<tr>
<td>14</td>
<td>2,786.48</td>
</tr>
<tr>
<td>15</td>
<td>3,161.69</td>
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<tr>
<td>16</td>
<td>4,676.37</td>
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<tr>
<td>17</td>
<td>6,249.57</td>
</tr>
<tr>
<td>18</td>
<td>3,736.44</td>
</tr>
<tr>
<td>19</td>
<td>9,718.65</td>
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<tr>
<td>20</td>
<td>7,111.93</td>
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<tr>
<td>21</td>
<td>4,772.65</td>
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<tr>
<td>22</td>
<td>5,967.24</td>
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<tr>
<td>23</td>
<td>3,647.16</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>126,183.14</strong></td>
</tr>
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*Year Ending June 30, 1957*

<table>
<thead>
<tr>
<th>Districts</th>
<th>1957 Number of Acres</th>
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<tbody>
<tr>
<td>1</td>
<td>2,321.57</td>
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<tr>
<td>2</td>
<td>3,832.23</td>
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<tr>
<td>3</td>
<td>2,584.10</td>
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<tr>
<td>4</td>
<td>3,770.29</td>
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<tr>
<td>5</td>
<td>10,381.99</td>
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<tr>
<td>6</td>
<td>4,348.63</td>
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<tr>
<td>7</td>
<td>15,857.95</td>
</tr>
<tr>
<td>8</td>
<td>3,069.10</td>
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<tr>
<td>9</td>
<td>674.60</td>
</tr>
<tr>
<td>10</td>
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<td>12</td>
<td>4,074.36</td>
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<td>5,629.81</td>
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<td>14</td>
<td>2,786.48</td>
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<td>19</td>
<td>9,706.62</td>
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<td>20</td>
<td>7,533.88</td>
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<tr>
<td>21</td>
<td>5,878.89</td>
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<tr>
<td>22</td>
<td>5,789.68</td>
</tr>
<tr>
<td>23</td>
<td>3,642.96</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>126,216.94</strong></td>
</tr>
</tbody>
</table>
### TABLE 4

**Statement of Oysters and Shells Planted**

**Fiscal Year Ending June 30, 1956**

<table>
<thead>
<tr>
<th><strong>RAPPAHANNOCK RIVER</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>15,696 bu. shells planted on Monasion Bluff</td>
<td>$ 2,197 44</td>
</tr>
<tr>
<td>13,718 bu. shells planted at Pinney Island</td>
<td>2,060 22</td>
</tr>
<tr>
<td>7,200 bu. shells planted at Dunaway’s Bay</td>
<td>1,008 00</td>
</tr>
<tr>
<td>5,418 bu. shells planted at Hog House Bay</td>
<td>758 52</td>
</tr>
<tr>
<td>5,408 bu. shells planted at Ball Point</td>
<td>537 12</td>
</tr>
<tr>
<td>30,514 bu. shells planted on Waterview Bar</td>
<td>4,271 96</td>
</tr>
<tr>
<td>8,000 bu. shells planted on Week’s Bar</td>
<td>1,120 00</td>
</tr>
<tr>
<td>10,000 bu. shells planted on Corbin Hall Bar</td>
<td>1,400 00</td>
</tr>
<tr>
<td>11,625 bu. shells planted in Hog House Bay</td>
<td>1,927 50</td>
</tr>
<tr>
<td>27,263 bu. shells planted at mouth of Mill Creek</td>
<td>3,816 82</td>
</tr>
<tr>
<td>35,946 bu. shells planted in Sander’s Bay</td>
<td>5,022 44</td>
</tr>
<tr>
<td>30,778 bu. shells planted in Burhan’s Bay</td>
<td>4,308 92</td>
</tr>
<tr>
<td>35,306 bu. shells planted at North End Ridge</td>
<td>4,955 44</td>
</tr>
<tr>
<td>29,288 bu. shells planted at Middle River Bay</td>
<td>4,101 76</td>
</tr>
<tr>
<td>1,100 bu. shells planted on Parrott’s Rock</td>
<td>154 00</td>
</tr>
<tr>
<td>22,266 bu. shells planted Before the House</td>
<td>3,117 24</td>
</tr>
<tr>
<td>Total amount.</td>
<td>$ 49,267 08</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>CORROTOMAN RIVER</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5,000 bu. shells planted on Island Bar</td>
<td>$ 700 00</td>
</tr>
<tr>
<td>20,134 bu. shells planted at Ferry Marsh</td>
<td>3,691 86</td>
</tr>
<tr>
<td>38,609 bu. shells planted on Millenbeck Bar</td>
<td>5,412 40</td>
</tr>
<tr>
<td>69,814 bushels</td>
<td>Total amount.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>NOMINI CREEK</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>11,500 bu. shells planted at Nomini Cut</td>
<td>$ 1,610 00</td>
</tr>
<tr>
<td>11,500 bushels</td>
<td>Total amount.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>PIANKATANK RIVER</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>19,183 bu. shells planted on Herring Rock</td>
<td>$ 2,973 68</td>
</tr>
<tr>
<td>13,240 bu. shells planted on Pullis Bar</td>
<td>2,652 20</td>
</tr>
<tr>
<td>18,307 bu. shells planted at Hole in Wall, Milford Haven</td>
<td>2,846 39</td>
</tr>
<tr>
<td>19,030 bu. shells planted at Cape Toon Bar</td>
<td>2,949 65</td>
</tr>
<tr>
<td>69,820 bushels</td>
<td>Total amount.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>CHESAPEAKE BAY</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1,495 bu. shells planted on Public Ground, about 20 miles from R. A. Billups’ shucking house</td>
<td>$ 231 73</td>
</tr>
<tr>
<td>1,495 bushels</td>
<td>Total amount.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>MOBJACK BAY AREA</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>15,000 bu. shells planted in Severa River</td>
<td>$ 2,350 00</td>
</tr>
<tr>
<td>18,505 bu. shells planted at East River</td>
<td>2,590 70</td>
</tr>
<tr>
<td>45,000 bu. shells planted in Mobjack Bay</td>
<td>6,750 00</td>
</tr>
<tr>
<td>28,400 bu. shells planted in Ware River</td>
<td>4,402 00</td>
</tr>
<tr>
<td>106,905 bushels</td>
<td>Total amount.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>YORK RIVER</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>59,348 bu. shells planted on Public Ground No. 30</td>
<td>$ 8,396 72</td>
</tr>
<tr>
<td>1,000 bu. shells planted on Wormley’s Rock</td>
<td>140 00</td>
</tr>
<tr>
<td>60,348 bushels</td>
<td>Total amount.</td>
</tr>
</tbody>
</table>
REPORT OF THE COMMISSION OF FISHERIES

EASTERN SHORE

17,513 bu. shells planted on Buoy Rock, Pocomoke Sound ........................................ $ 2,636 80
6,625 bu. shells planted in Deep Creek ................................................................. 1,060 00
31,000 bu. shells planted in Simoneston Bay ............................................................ 4,909 00
2,028 bu. shells planted in Bradford’s Bay ............................................................... 224 48
10,000 bu. shells planted in Northeast Cove, Cedar Island Bay .................................. 1,690 00
4,230 bu. shells planted at Head Channel Rock, Bradford’s Bay ................................ 676 80
10,290 bu. shells planted in Mesongo, Pocomoke Sound ........................................... 1,641 00
4,478 bu. shells planted in Hunting Creek ............................................................... 718 48
7,700 bu. shells planted in Guilford Creek ............................................................... 1,232 00

93,833 bushels Total amount ......................................................................................... $ 14,838 16

GREAT WICOMICO RIVER

14,900 bu. shells planted at Long Point .......................................................................... $ 2,160 50

14,900 bushels Total amount ......................................................................................... $ 2,160 50

JAMES RIVER

30,371 bu. shells planted at Blount Point ................................................................. $ 4,724 52
18,900 bu. shells planted at Day’s Point .................................................................. 3,660 00

57,371 bushels Total amount ......................................................................................... $ 7,784 52

COAN RIVER

2,432 bu. shells planted on Big Bar ............................................................................... $ 340 48

2,432 bushels Total amount ......................................................................................... $ 340 48

Total amount spent for shells for Eastern Shore and Western Shore ......................... $112,270 87

NOTE: The number of shells shown above were actually planted during this fiscal year, though some of the vouchers for same were paid after the close of the fiscal year.

3,516 gals. of screwworkers were caught and destroyed during this period at a cost of ........ $ 4,018 00

STATEMENT OF OYSTERS AND SHELLS PLANTED
Fiscal Year Ending June 30, 1957

RAPPAHANNOCK RIVER

20,028 bu. shells planted on Wyatt’s Bar ................................................................. $ 3,064 20
12,270 bu. shells planted in Dunaway’s Bay ............................................................... 1,841 40
17,700 bu. shells planted between Camp Ground and Corrotoman Point .................. 2,655 00
20,705 bu. shells planted on Monoskon Bluff ............................................................. 3,106 20
13,404 bu. shells planted on Piney Island ................................................................. 2,010 00
66,962 bu. shells planted on Camp Ground Bluff ....................................................... 10,044 75
32,250 bu. shells planted inshore of Ridge ................................................................. 4,837 50
22,623 bu. shells planted at Goose Point ................................................................. 3,393 30
15,000 bu. shells planted on Ware Rock ................................................................. 2,250 00
11,470 bu. shells planted at Smokey Point ................................................................. 1,729 50
29,028 bu. shells planted north of Rappahannock River Bridge ......................... 4,354 20
20,181 bu. shells planted east of Middle River Buoy .............................................. 2,905 25
21,978 bu. shells planted at Upper Cedar Bar ......................................................... 3,452 01
18,630 bu. shells planted on Stiff’s Bar ................................................................. 2,795 40
7,590 bu. shells planted at Parrott’s Island ............................................................... 1,125 00
6,000 bu. shells planted on Parrott’s Bar ................................................................. 900 00

335,746 bushels Total amount ......................................................................................... $ 50,305 31

PIANKATANK RIVER

12,600 bu. shells planted on Brickhouse Bar ............................................................ $ 2,016 00
13,161 bu. shells planted at Hawk’s Nest ................................................................. 2,106 24
16,200 bu. shells planted on Braxton’s Bar ............................................................... 2,592 00

41,964 bushels Total amount ......................................................................................... $ 6,714 24

CORROTOMAN RIVER

12,771 bu. shells planted on Black Stump Bar ......................................................... $ 1,915 65

12,771 bushels Total amount ......................................................................................... $ 1,915 65

COAN RIVER

7,500 bu. shells planted at Honest Point ................................................................. $ 1,125 00
1,580 bu. shells planted on “Darlings” ................................................................. 237 00

9,080 bushels Total amount ......................................................................................... $ 1,362 00
REPORT OF THE COMMISSION OF FISHERIES

MOBJACK BAY AREA

10,000 bu. shells planted in East River.......................... $1,500.00
6,000 bu. shells planted in West River.......................... 900.00
15,400 bu. shells planted in Severn River......................... 2,541.00
31,400 bushels Total amount....................................... $5,031.00

YORK RIVER

49,250 bu. shells planted on Public Ground No. 30................ $7,387.50
49,250 bushels Total amount....................................... $7,387.50

YEOMANIC RIVER

7,744 bu. shells planted in Palmer's Cove........................ $1,161.60
2,112 bu. shells planted at Rams Horn............................ 316.80
9,856 bushels Total amount....................................... $1,478.40

GREAT WICOMICO RIVER

1,092 bu. shells planted on Middle Ground......................... $180.36
1,092 bushels Total amount....................................... $180.36

EASTERN SHORE

3,315 bu. shells planted on Head Channel Rock, Bradford's Bay.... $563.55
1,098 bu. shells planted in Northeast Cove, Swash Bay........... 186.66
1,911 bu. shells planted on Mears Flats, Upshur Bay.............. 378.18
10,129 bu. shells planted on Brantling Gut Flats................ 1,729.40
10,000 bu. shells planted in Cedar Island Bay.................... 1,700.00
620 bu. shells planted on Middle Gap Rocks, Upshur Bay........... 117.00
16,347 bu. shells planted at Swash, Pocomoke Sound.............. 2,541.22
2,400 bu. shells planted in Guilford Creek....................... 408.00
1,250 bu. shells planted in Hunting Creek......................... 212.50
2,541 bu. shells planted in Deep Creek........................... 431.97
4,500 bu. shells planted on Flat Rock, Messong Creek........... 810.00
5,250 bu. shells planted in Onancock River........................ 945.00
59,382 bushels Total amount....................................... $10,298.78

Total amount spent for Eastern Shore and Western Shore.......... $84,763.24

Note: The number of shells shown above were actually planted during this fiscal year, though some of the vouchers for same were paid after the close of the fiscal year.

7,428 gals. of screw boringers were caught and destroyed during this period at a cost of............. $14,856.00

TABLE 5

COMPARATIVE STATEMENT OF EXPENSES BY YEARS
(Expenditures in Repletion Fund Not Included)
July 1, 1957 to June 30, 1957

<table>
<thead>
<tr>
<th></th>
<th>Office and Administration</th>
<th>Field Inspection</th>
<th>Boats and Nautical Equipment</th>
<th>Total Expenses</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 1, 1947 to June 30, 1948</td>
<td>$22,938.10</td>
<td>$138,065.01</td>
<td>$49,164.18</td>
<td>$161,663.11</td>
</tr>
<tr>
<td>July 1, 1948 to June 30, 1949*</td>
<td>44,431.76</td>
<td>130,842.32</td>
<td>29,029.75</td>
<td>204,294.09</td>
</tr>
<tr>
<td>July 1, 1949 to June 30, 1950</td>
<td>33,024.80</td>
<td>146,564.65</td>
<td>58,166.18</td>
<td>202,676.63</td>
</tr>
<tr>
<td>July 1, 1950 to June 30, 1951</td>
<td>29,648.67</td>
<td>180,675.87</td>
<td>60,303.92</td>
<td>204,074.59</td>
</tr>
<tr>
<td>July 1, 1951 to June 30, 1952</td>
<td>31,634.52</td>
<td>206,882.75</td>
<td>69,303.92</td>
<td>200,820.79</td>
</tr>
<tr>
<td>July 1, 1952 to June 30, 1953</td>
<td>32,323.41</td>
<td>230,269.17</td>
<td>72,166.18</td>
<td>205,425.82</td>
</tr>
<tr>
<td>July 1, 1953 to June 30, 1954</td>
<td>38,176.78</td>
<td>252,270.09</td>
<td>35,123.32</td>
<td>344,223.19</td>
</tr>
<tr>
<td>July 1, 1954 to June 30, 1955</td>
<td>37,380.32</td>
<td>254,300.09</td>
<td>40,052.64</td>
<td>329,769.37</td>
</tr>
<tr>
<td>July 1, 1955 to June 30, 1956</td>
<td>36,185.67</td>
<td>268,447.91</td>
<td>48,155.20</td>
<td>357,458.98</td>
</tr>
<tr>
<td>July 1, 1956 to June 30, 1957</td>
<td>33,976.50</td>
<td>264,532.60</td>
<td>29,581.89</td>
<td>328,559.99</td>
</tr>
</tbody>
</table>

*Total includes $29,000.00 transferred from Building Fund to Repletion Fund.
†Total includes $100,000.00 transferred from Building Fund to Repletion Fund.

*Air-conditioning installed in office building during this period.
HON. CHARLES M. LANKFORD, JR., COMMISSIONER,
Commission of Fisheries of Virginia,
Newport News, Virginia.

DEAR MR. LANKFORD:

I submit herewith my report covering the shad hatching work on the Chickahominy, Mattaponi, and Pamunkey rivers for the season 1956, as follows:

The Chickahominy River Hatchery was in operation from May 7th to May 25th inclusive (19 days), during which time forty-eight (48) spawning roe shad were caught and stripped, from which we received a total of 1,580,000 eggs, decrease of twenty-four (24) spawning roes caught and 835,000 eggs under the total of 2,415,000 eggs collected during the 1955 season.

The Mattaponi River Hatchery was in operation from April 18th to May 25th inclusive (38 days), during which time two hundred and thirty-four (234) spawning roe shad were caught and stripped, from which we received a total of 2,702,000 eggs, increase of twenty-nine (29) spawning roes caught and 632,000 eggs over the total of 2,070,000 eggs collected during the 1955 season.

The Pamunkey River Hatchery was in operation from April 18th to May 25th inclusive (38 days), during which time two hundred and sixteen (216) spawning roe shad were caught and stripped, from which we received a total of 3,068,000 eggs, decrease of one hundred and thirty-four (134) spawning roes caught and 628,000 eggs under the total of 3,634,000 eggs collected during the 1955 season.

From the total of 7,288,000 eggs, we received the usual hatch from 80 to 85%. All young shad were immediately released in the above named rivers after hatching.

The number of spawners caught and eggs collected and hatched this season shows an over-all decrease of one hundred and twenty-seven spawners caught and 831,000 eggs under the total of 8,119,000 eggs collected and hatched during the 1955 season.

The shad run in all three rivers was very large during the entire 1956 season and the market glutted, prices down to rock bottom, low as 25¢ and 30¢ for roes and 5¢ for bucks after Lent. This condition forced the commercial fishermen to
quit fishing much earlier than usual, which naturally cut down the number of spawners caught during late season, especially on the Chickahominy river.

Conditions on the Mattaponi and Pamunkey rivers were different in the above respect, as we have the Indians fishing on these rivers who fish the season through and after the market drops so low that there is no sale for the fish, they continue to fish for their own supply and this enabled us to secure eggs on these two rivers throughout the entire season.

The number of spawners caught in the Pamunkey river was eighteen (18) less than the number caught in the Mattaponi river during the 1956 season, but they produced 304,000 more eggs.

Due to the illness of Mr. Claude Binn, operator of the Chickahominy River Hatchery, we were unable to start this Hatchery in operation until May 7th and due to the short period of time we had to operate and the majority of the fishermen hanging up their nets early, we did not have sufficient time to do very much on this particular river. I was unable to get anyone to take Mr. Binn's place at the Hatchery early in the season. You will no doubt recall that I took the matter of the Chickahominy Hatchery up with you and you requested that we do the best we could when Mr. Binn was able to operate the Hatchery.

As far as the supply of shad was concerned, the 1956 season was one of the best we have had for years and had the market and prices held up, making it worth while for all of the fishermen to fish the entire season, I feel that we would have been in a position to collect and hatch more eggs than we have been able to do in the past seasons, but it seems that it is impossible to have all the necessary conditions to prevail at the same time that would permit us to obtain a near one hundred per cent results.

Looking back over the years and the size of the shad run then as compared with the run at the present time, there is no doubt in my mind that the shad hatching work we have been doing for the past twenty years or more is largely responsible for the large increase in number each year, which has very much pleased and satisfied both the commercial and non-commercial fishermen on the rivers where the work has been carried on. The interest of all fishermen still remains high and they are cooperating to the fullest extent to make the work as successful as possible, and as I have previously stated, they are very grateful to our Commission for making the shad hatching work possible.

I had hoped to render a much better report this season and cannot say that I am pleased with results obtained this year, but as stated in the past, all we can do is to keep on hoping that seasons to come will bring forth better working conditions.

If you can offer any suggestions that you feel will improve the work in any way, I will be very happy to receive them, as my desire is to do the best job possible.

Should there be any further information you may desire, please advise and I will gladly forward same.

Trusting that this report will have your approval and with the very best of regards, I am

Yours most sincerely,

J. T. Meyer,
Superintendent of Hatcheries
REPORT OF THE COMMISSION OF FISHERIES

Honorable Charles M. Lankford, Jr., Commissioner,
Commission of Fisheries of Virginia,
Newport News, Virginia.

Dear Mr. Lankford:

I submit herewith my report covering the shad hatching work on the Chickahominy, Mattaponi and Pamunkey Rivers for the season 1957, as follows:

The Chickahominy River Hatchery, with Mr. Linwood W. Orange in charge, was in operation from April 15th to May 15th inclusive (31 days), during which time eighty-two (82) spawning roe shad were caught and stripped, from which we received a total of 2,268,000 eggs, increase of thirty-four (34) spawning roes caught and 688,000 eggs over the total of 1,580,000 eggs collected during the 1956 season.

Mr. Orange is a new man, replacing Mr. Claude Binnis, who passed away since last season. Mr. Orange was found to be very efficient and his services satisfactory.

The Mattaponi River Hatchery, with Mr. Will Custalow in charge, was in operation from April 15th to May 25th inclusive (40 days), during which time two hundred and sixty-one (261) spawning roe shad were caught and stripped, from which we received a total of 3,309,500 eggs, increase of twenty-seven (27) spawning roe shad caught and 607,500 eggs over the total of 2,702,000 eggs collected during the 1956 season.

The Pamunkey River Hatchery, with Mr. Ivy Bradby in charge, was in operation from April 15th to May 25th inclusive (40 days), during which time ninety-seven (97) spawning roe shad were caught and stripped, from which we received a total of 2,182,500 eggs, decrease of one hundred nineteen (119) spawning roe shad caught and 823,500 eggs under the total of 3,006,000 eggs collected during the 1956 season.

From the total of 7,760,000 eggs, we received the usual hatch of from 80 to 85%. All young shad were immediately released in the above-named rivers after hatching.

The number of spawners caught and eggs collected and hatched this season shows an over all decrease of fifty-eight (58) spawners caught and increase of 472,000 eggs over the total of 7,288,000 eggs collected and hatched during the 1956 season.

The spawners caught this season, as a whole, produced a better percentage of eggs than usual.

The shad run in the Mattaponi River was better than the other two. The run in the Pamunkey River was fair, but not as good as the Mattaponi, and the number of spawners caught fell far below last season. The run in the Chickahominy River dropped off for some unknown reason. The spawners caught in the Chickahominy River shows an increase of thirty-four (34) over last season, but this hatchery operated twelve days more during the 1957 season than it did during the 1956 season.

As mentioned above, we had the misfortune to lose Mr. Claude Binnis, operator of the Chickahominy River Hatchery, by death during the past year, which
was not only a great loss to the writer but to our Commission, due to his experience in handling of the shad work. I feel assured that Mr. Orange will do as well after he has had several years' training with the work. Due to Mr. Binns' illness last year, and having to break in a new man this year, we did not receive the results from the Chickahominy River Hatchery that I had expected for the past two years.

After the close of the Lenten season the prices begin to drop, and drop fast, and the majority of the shad fishermen hang up their nets, as the low market does not justify them to keep on fishing. However, on the Mattaponi and Pamunkey Rivers a fair portion of the Indians keep on fishing for their supply, which naturally helps to keep up production on these two rivers.

While the shad run in all three of the rivers this season was smaller than usual, we had more than a sufficient number to take care of the market; and as long as we can maintain such a supply, I feel that we have nothing to worry about and are getting somewhere with the work, notwithstanding the fact that we have and can expect good and bad seasons.

Looking back over the years and the size of the shad run then as compared with the increased size of the run at the present time, there is no doubt in my mind that we have made a big headway increasing the number of shad over the years and the work has paid off by supplying the fishermen and the public more fish, which has very much pleased not only the commercial but the non-commercial fishermen, and sportsmen as well, as you know that shad fishing for sport has become a big thing within the past several years.

The interest of all fishermen still remains very high, and they are cooperating with me to the fullest extent to make the work as successful as possible, as they now realize that their part in the work has been of much benefit to them, and they appear to be very grateful to our Commission for making the shad hatching work possible.

I had hoped to render a much better report this season, and cannot say that I am pleased with results obtained this year, but will keep on hoping that the next season, and the seasons to come, will bring forth better results.

If you can offer any suggestions that you feel will improve the work in any way, I will be very happy to receive them, as my desire is to do the best job possible.

Should there be any further information you may desire, please advise and I will gladly forward same.

Trusting that this report will have your approval, and with the very best of regards, I am

Yours most sincerely,

J. T. Meyer,
Superintendent of Hatcheries
EXHIBIT B

Report of the Virginia Fisheries Laboratory

VIRGINIA FISHERIES LABORATORY
GLOUCESTER POINT, VIRGINIA

September 1, 1957

The Honorable Charles M. Lankford, Jr.
Commissioner of Fisheries
Newport News, Virginia

Dear Mr. Lankford:

I have the honor to submit herewith the report of the Virginia Fisheries Laboratory for the biennium 1 July 1955 to 30 June 1957.

Again we are pleased to report substantial progress in our investigations of oysters, clams, and their enemies and diseases, the blue crab and other crustaceans, and the migratory fishes. Several special investigations have been completed or are under way, and the staff has undertaken joint investigations with other agencies within and outside Virginia.

Publications based on results of the research program are being issued at a steadily-increasing rate. For your information, a list of reports published since 1943 is included.

I wish to extend my sincere thanks to you and the members and staff of the Commission of Fisheries for the generous assistance that has been offered on many occasions.

Respectfully submitted,

Director
Figure 1.—The new building, shown on the left, will provide urgently-needed laboratory space, and accommodations for students and summer staff.

Virginia Fisheries Laboratory

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Edward T. Jenkins .......................................... Utility Serviceman
Oysters

Biologist in Charge: Dr. Jay D. Andrews
Consulting Biologist: Dr. Willis G. Hewett
Associate Biologist: Dexter S. Haven
Laboratory Aide: Curtis C. Leigh

Oyster Mortality

Detailed records of the death rates of oysters in trays have been accumulated since 1952, and the results of much of this work have been published in several scientific and popular articles listed at the end of this report. The investigation has been expanded to include observations on tray-held oysters in other parts of Virginia, and studies of oysters from other regions, from New Jersey to South Carolina, have been continued and extended. We have assumed that mortality estimates based on oysters held in trays are not far different from conditions on planted bottom, and this hypothesis is being tested by parallel observations on oysters on the bottom and in trays. The use of self-contained diving apparatus has been invaluable in planting and recovering marked oysters from the bottom.

The fungus disease Dermacystidium marinum continues to be the major cause of death of adult oysters on planted bottoms in the Virginia waters of

Figure 2.—Construction of the new laboratory building is well under way.
Chesapeake Bay and the lower part of the estuaries. In the James River seed area, the upper Rappahannock River, the seaside of the Eastern shore, and certain other regions, the disease is of little importance or absent entirely.

The incidence and intensity of fungus disease have varied considerably from year to year. The death rate was particularly heavy in 1954, when more than 50 per cent of the acclimated native Virginia oysters in trays at Gloucester Point died. In 1956, on the other hand, the death rate was the lowest on record, much less than half as great as in 1954. Direct observations, and the results of experiments under controlled temperature conditions, have led us to believe that warm winters and long summers favor the disease, whereas cold winters and cool, short summers hold the disease in check and reduce the mortality. On this basis we have predicted heavy losses from fungus on many oyster grounds in 1957, and so far this prediction has been confirmed, though the death rate may be reduced if cool fall weather comes early.

No direct method to control the effects of the disease has yet been developed and none is foreseen. We continue to recommend that oystermen carry their crops through as few summer periods as possible, for it is in the four-month period July to October that most deaths occur. Where growth is good, an excellent yield of market-sized oysters may be attained as early as 18 months after planting James River seed.

Figure 3.—The death rate of oysters in Chesapeake Bay and the lower parts of the estuaries is highest in summer and lowest in winter and early spring. Most of the deaths of adult oysters are caused by a microscopic fungus called Dermocystidium marinum, which in some years, as in 1954, reaches epidemic proportions.
The Rappahannock River Catastrophes of 1949 and 1955

In 1949, many oyster grounds in the upper Rappahannock River suffered serious losses from an unexplained mortality. The losses were not discovered immediately, and by the time scientific investigations began the conditions that had caused the deaths had long since disappeared. Oystermen and biologists were alerted, however, and when a more serious mortality occurred in 1955, the catastrophe was discovered and scientific observations were intensified before the adverse conditions were gone.

Investigations before and after the 1955 mortality revealed a natural scarcity of oxygen in the deeper waters of the lower Rappahannock River each summer. Usually only the deeper waters in the channel are affected, but occasionally, when the unfavorable conditions are intensified or persist for an unusually long time, renewal of oxygen is insufficient to replace what is lost and the volume of oxygen-deficient water increases, filling the channel and spilling over the relatively shallow banks on which the oyster grounds are located. In the absence of oxygen a whole chain of chemical changes takes place, producing conditions harmful to oysters.

The events that gave rise to the 1955 calamity were the passage of two hurricanes over the area within a five-day period, spilling great quantities of rain over the Rappahanock watershed, and causing the greatest mid-summer runoff ever recorded. The layer of fresh water on the surface prevented the normal transfer of oxygen to the salty water below, and biological activity and unusual amounts of organic material washed down from farmlands, swamps, and other areas of the watershed hastened depletion of the oxygen that remained. A similar sequence of events probably occurred in 1949, though the cause was not sudden hurricane-caused floods but an average annual flow of record proportions.

Study of past river flow records suggests that such extreme conditions should not arise very frequently. Nevertheless, natural depletion of oxygen in the River every summer, especially in the region from Morattico to Hoghouse Bar, is a source of danger. There is no evidence that industrial and domestic wastes from the vicinity of Fredericksburg contributed significantly to the 1949 and 1955 mortalities, for the River recovers from its polluted condition long before the water reaches oyster grounds. We believe that the situation in the lower Rappahannock has a natural origin. Similar conditions exist in the lower Potomac, and other rivers, and also in Chesapeake Bay itself.

Some oystermen have felt that the proposed Salem Church dam on the Rappahannock would provide sufficient flood control to eliminate the causes of such mortalities. This probably is true, and planters on the upper parts of the river would benefit. We believe, however, that the effects of the dam on salinity changes farther down river would tend to increase the damage caused by drills and by fungus, so that oystermen farther down the River would suffer. The addition of substantial new discharges of wastes should be avoided, especially in the lower part of the River. Oystermen should recognize that these catastrophes may visit the area again, especially when heavy and prolonged runoff from rains occurs in summer.

Oyster Growth

Observations of the rate of growth of oysters held in trays at the Laboratory pier have shown that there are two periods of relatively rapid growth each year,
in spring and in fall. In winter and in summer growth reaches a minimum and sometimes ceases altogether. Young oysters grow more rapidly than older oysters, and after a few years the annual increase is negligible. The growth rates of individual oysters vary tremendously, and usually those whose initial growth is slow continue to grow slowly throughout life. Dying oysters usually stop growing, or even lose weight, for some time prior to death.

Oyster Condition

It has been known for some time that the condition or fattiness of oysters varies considerably with locality and time. Variations in condition can have tremendous effects upon the volume of shucked meats obtained from a given volume of oysters in the shell, and thus upon the oysterman’s margin of profit. It has been known in a general way that some areas such as the Rappahannock River consistently produce fat oysters, whereas in others, such as the upper York, oysters are usually poor. It has also been known that in early fall, when the oystering season opens, oysters are in their worst condition both as to fatness and flavor, while in early summer, when most shucking houses have ceased operations, the oysters are at their succulent best, and yield the largest volumes of meats.

About two years ago a systematic program was initiated to obtain information on fatness and yield of oysters in Virginia. It is not easy to select a good measure of fatness, for there are so many factors that prevent consistent results, and all methods yet developed have their faults. But there is no doubt that important differences exist when equal numbers of uniform-sized oysters are shucked into glass containers and compared side by side.
Similar variations in fatness occur in any one locality throughout the season, and there is a regular seasonal cycle in which oysters usually are at their best in spring and early summer and poorest in late summer and early fall. The fall minimum is caused by the effects of spawning, and by the weakening action of diseases and pests. Recovery is fairly rapid, and weight and volume of the meats may increase 35 to 40 per cent by December. There are also changes in fatness with age, and young oysters usually are relatively in better condition than old.

The Seed Oyster Supply

One of the greatest wonders of the seafood industry is the continued high production of the James River seed beds in spite of the harvest that is reaped from these grounds each year. The success of spawning, setting, and survival of spat in the James River varies from year to year, but in the history of the fishery there never has been a failure. This is particularly surprising in face of the large variations in abundance that affect most of the other seafoods in Chesapeake Bay. In areas such as the Rappahannock River, fluctuations in oyster setting have important economic effects. Above Towles' Point, for example, the annual set usually is by no means sufficient to maintain a large fishery, but occasional good sets, as in 1954, provide fairly good oystering for a time.

Information on the characteristics of seed from other areas would save planters much time and expense if the availability of seed from the usual sources in Virginia were to decline. The Laboratory has experimented with seed from other areas and the information is available to oystermen on request.

The most convenient source of seed outside the James River is an extensive area along the seaside of the Eastern Shore where setting is prolific. Most oystermen are aware that this seed does not survive well when it is transplanted to the Bay, but this information has been obtained by trial and error, and costly experiments undoubtedly will be tried again if the need for seed becomes urgent. Controlled experiments at the Laboratory have confirmed the high mortality rate of seaside seed and have revealed the reasons. The heavy deaths are caused by the fungus, *Dermocystidium*, which is prevalent in the Bay, but almost entirely absent from the James River seed beds and the seaside area. James River seed is resistant to infection, and the death rate from fungus is not unduly heavy. Seaside oysters, on the other hand, have little resistance to the fungus, and by the end of the second summer, deaths have been so heavy that only a small fraction of the original oysters remain. Unless the prevalence of fungus in the Bay becomes substantially and permanently reduced, the planting of seaside seed is not recommended.

Another source of seed for Chesapeake Bay is the south Atlantic coast, where in many areas underexploited heavy sets of oysters occur regularly. One such source is the coastal waters of South Carolina, and we have obtained considerable information on the survival and growth of this seed in local waters by growing South Carolina spat to market size in trays suspended from the Laboratory pier. Growth is rapid and quite satisfactory at first, but lags behind the growth of local oysters after about two years. Survival, on the other hand, is much better in summer, for these oysters are highly resistant to infection with *Dermocystidium*. In winter, however, the survival rate is poor, and in cold winters the death rate
may be heavy. Yields in terms of bushels of market-sized oysters per original bushel of seed seem to be somewhat lower than for local seed, but South Carolina seed is probably superior to seed from the seaside of the Eastern Shore for planting in Chesapeake Bay. We believe that under normal conditions local seed is best for local planting, but if additional supplies are needed, experiments on a commercial scale with South Carolina seed might be profitable if economic conditions and the export regulations of the State of North Carolina are favorable.

**Contribution of Oyster Research to the Economy of the Industry**

Studies of mortality, growth, and condition of oysters all serve to confirm previous conclusions that for maximum yields, oystermen who plant grounds in the Bay and lower parts of the estuaries have commonly been holding their crops on the grounds too long. After the first summer, losses usually are so heavy each warm season that they exceed the amount that is added by growth of the survivors. Where growth is good, most of the crop will be sufficiently large for market by May or June of the second year after planting. Growth during the ensuing summer usually is slow and deaths from fungus and other diseases and pests will almost invariably produce a net loss. Furthermore, even if summer mortality did not occur, the loss in volume of shucked oysters caused by the usual decline in fatness from a maximum in May or June to a minimum in September or October, would reduce the final yield considerably.

Perhaps the time is not yet ripe to consider seriously the possibility of taking the major oyster harvest in late spring rather than delaying it until fall, as is now done commonly. There are still several problems to be solved, such as the danger of losses from pink yeast, and the adverse price pattern associated with reduced market demand in late spring. But these problems do not seem insoluble, and there are attractive advantages to be gained. Ways and means of surmounting these difficulties should be sought. Improved sanitation, better standards of quality, and technological and marketing research might produce results which, applied in conjunction with the biological findings reviewed here, could bring great benefits to the industry.

**Clams**

The shellfish laboratory of the U. S. Fish and Wildlife Service at Milford, Connecticut, headed by Dr. V. L. Loosanoff, has been experimenting for some years with artificial breeding of mollusks. They have been particularly interested in hybrid clams, on the hypothesis that, as in agriculture, hybrids may be more vigorous and produce better crops than the native or wild varieties. Dr. Loosanoff and his staff have been successful in interbreeding two hard clams, the common one of the Atlantic Coast, and its counterpart that ranges from North Carolina to the Gulf of Mexico. We have cooperated with Dr. Loosanoff by studying the growth and survival of both parent species and their hybrids in Virginia.

The clams when received were so small that special containers had to be made to hold them. These were shallow wooden boxes, covered with plastic screen, suspended from the Laboratory pier in the trays that are used in oyster studies. Four lots of clams were held, progeny of the southern species, progeny
of the northern species, hybrids of a southern male and a northern female, and hybrids of a northern male and a southern female.

Both hybrids and southern clams grew at about the same rate, but the northern clams grew much more slowly. The southern clams all died by the end of the second winter. The hybrids experienced some mortality, especially in cold weather, but after three years they still exceed the northern species in total weight of survivors. Under the conditions of this experiment, the hybrids produced the best yields. These promising results will be followed up as time permits.

**Oyster Drills**

*Biologist in Charge* ................. WILLIAM J. HARGIS, JR.

A grant of approximately $26,000 for a three-year period was received from the Fish and Wildlife Service in July 1955 for a biological study of the oyster drills or screwborers. The purpose of the contract was to learn as much as possible about the lives and habits of these destructive snails, since it is only through such knowledge that methods of controlling pests can be developed. The project is part of a larger investigation in which studies are being made in

Figure 5.—Oyster drills have a flexible proboscis, the end of which is armed with an efficient rasping device by which the drill penetrates the oyster shell. The proboscis then pushes through the hole and can be extended to all parts of the internal cavity, rasping and swallowing the oyster meat. Here two drills have penetrated an oyster. The proboscis of one is already devouring the meat, most of which already has been eaten, the other is just entering.
several areas of the Atlantic and Gulf coasts. In addition to the staff of the Virginia Fisheries Laboratory, two biologists of the Fish and Wildlife Service were stationed at the Laboratory for about two years, investigating methods of controlling drills on oyster ground.

Our studies have embraced spawning, embryonic development, age and growth, feeding, and many other phases of the life-histories of the two kinds of drills that live in Virginia waters. Particular attention has been paid to the lesser-known of the two, which is dominant on some grounds, and our knowledge of this species has been advanced considerably.

Abundance of Drills on Eelgrass Beds

In the York River drills are much more abundant in eelgrass beds near shore than on oyster grounds. The eggs are attached to the grass, and the drills themselves often feed on other animals on this vegetation. These large populations of drills may serve as sources of infection from which large drills move or are carried by currents to nearby oyster grounds, or from which small drills and egg cases are carried to oyster grounds on detached eelgrass as it drifts about. This means that control measures on oyster grounds may be ineffective if uncontrolled populations of drills exist on eelgrass beds nearby.

The numbers of drills in the eelgrass zone are astounding. With a few traps of galvanized chicken-wire, containing seed oysters as bait, more than 50,000 have been captured in a small area near the Laboratory at Gloucester Point, and catches as great as 70 drills per trap per day have been made. It is extremely difficult to determine the numbers of drills on a piece of ground. The only accurate method so far devised is to place a metal frame of known area upon the bottom, and to remove all material that lies within, going deep enough to be sure that no drills are missed. The material is washed and screened to remove mud and fine particles, and the drills are then picked out by hand. This is very tedious and time-consuming, but it is necessary to provide a basis for the development of a faster method. In the vicinity of Gloucester Point the average density is 40 drills per square yard. A mile or so farther downriver the average count is 172 per square yard. These are equivalent to more than 100 million and 500 million drills per square mile. More than 90 per cent of these drills belong to the species *Urosalpinx cinerea*, which is the common variety on most Virginia oyster grounds.

Spawning Habits

The eggs of both kinds of drill are enclosed in membranous cases which are attached by the drills to eelgrass, oyster shells, and other firm objects. Details of the formation and deposition of egg cases, the numbers of cases laid by each female, and the numbers of eggs in each case, have been studied. It has been found that females can carry living sperm through the winter, presumably transferred from a male the previous fall, and that they can lay fertile eggs the following season without having been inseminated again.

Food and Feeding Habits

Drills feed on a variety of animals other than oysters. Young clams, slipper limpers, snails, and barnacles are especially favored. It is obvious that in the eel-
grass zone there are few or no oysters on which to feed and therefore in this environment, which seems to be a favorable one for drills, they do not merit the name commonly applied to them, "oyster drills."

The act of drilling the shell and feeding on the oyster meat has been observed many times in the laboratory. Once the snail has penetrated the shell it can extend its long, flexible proboscis to all parts of the cavity. If fishes, crabs, and other drills are excluded, the tiny drill can rasp the meat away in small pieces with the same apparatus that drilled the shell, and can consume an oyster several times its own size in a short period.

**Biological Control Methods**

Some attention has been given to the question of biological control methods. One promising method, used effectively in eradicating the screw-worm, a parasite of cattle, from the island of Curacao, involved the liberation of sterilized males, which mated with females to produce eggs that did not hatch. The techniques employed with drills were somewhat involved, requiring first the development of a method to determine the sex of living drills, next determination of the amount of radiation required to kill the snails, then working back to find the dose that will sterilize but not kill. This stage has not been reached with male drills, but some irradiated females survived, and these deposited eggs that died before hatching. These experiments have been carried on only in winter, and further work is planned this year. Much of the work has been conducted at the Medical College of Virginia with the assistance of several staff members of that institution.

Other methods of biological control would be the introduction of parasites, diseases, or predators that would reduce the abundance of drills, or perhaps destroy them completely. Some parasites have been found in the bodies of drills, but we know little of their effects upon the host. Other organisms may prey upon the developing eggs. Some egg cases contain large numbers of microscopic animals that may affect the development of eggs, others have been penetrated by holes of characteristic shape by which it may be possible to identify the enemies that made them. Still others have had their tips pinched off, and laboratory experiments have shown that crabs will cause similar damage. These clues are being pursued further.

Drills carry many other living things upon their shells, and the study of these may also uncover useful information. For example, one species almost always carries a prolific growth of sponge upon its shell, the other variety almost never is affected. The explanation of this mystery may reveal important differences between the two kinds of drill.

**Blue Crabs**

*Biologist in Charge* ............................................... W. A. Van Engle
*Assistant Biologist* ............................................ FRANK J. Wojcik

**Rate of Growth and Shedding**

By holding crabs in floating cages in the York River and providing them with an abundant food supply it has been possible to duplicate normal growth in
Captivity. Crabs ranging from less than one inch to about five inches in width have been measured before and after shedding and it has been found that the increase in width, as measured from tip to tip of the large spines, is about 30 per cent, no matter what the original size. Crabs less than an inch in width will shed every two weeks or more often; at a width of 4 inches they shed about once a month; in a normal growing season a young crab, hatched the previous summer, will shed about eight times, and will become an adult in late summer when it is about 14 months old.

Figure 6.—After hatching, young blue crabs move up Chesapeake Bay and up the estuaries, where they spend their first winter and most of the following year. The location of greatest abundance varies with season, and the average size of the crabs varies up and down the rivers. The results of trawling surveys in the York River in October 1956 and August 1957 show two stages in this migration, and illustrate the variation in size along the river. The black areas are the regions of greatest abundance, the sizes of the crabs are roughly proportional to the average sizes of immature crabs in the river, about one inch from tip to tip of the long spines in the Pamunkey River, about two inches near West Point, and three inches or more in the lower York. The surveys did not cover the other major tributary, the Mattaponi River.

Abundance of Young Crabs

Accurate estimates of the abundance of crabs before they are large enough to enter the fishery would be valuable in making forecasts of the crab catch, and would provide information useful in explaining the causes of fluctuations in abundance. Several methods have been tested, with the object of finding the most efficient and accurate measure. Sampling near shore at Gloucester Point with a beam trawl at regular time intervals through spring and summer was not satisfactory because the average size of crabs caught remained constant. Obviously, larger crabs were continually leaving the area and smaller crabs were constantly coming in.

Samples taken by otter trawls at regular time intervals from the mouth of the York River to a point in its tributary, the Pamunkey, about 30 miles upriver, gave
an entirely different picture. A migration pattern was revealed similar to that described for the croaker in a previous report. Some of the young crabs that hatch in the lower part of Chesapeake Bay in summer migrate up the York River in fall, and apparently remain in the vicinity of West Point, 25 miles above the mouth, over winter. In winter we have not yet located these crabs in the river with trawls or dredges, but since they are taken again in the same area in spring, it is assumed that they bury in the bottom and cannot be caught in the usual gear. They reappear in the catches in spring, and as they grow, shift slowly down river, so that the greatest abundance of young crabs in September centers around Page's Rock, 15 miles below West Point. By the following winter, many of the female crabs have moved into the lower part of the Bay, where they are caught by the winter dredge fishery. Since the blue crab, like many of the fishes that use the Bay and estuaries as a nursery ground, shifts its position with the seasons, any attempt to measure its abundance must be planned to follow these movements.

There is some reason to believe that the movement of crabs up and down the Bay and rivers is in response to changing requirements for water of certain salinity. Thus the point of greatest abundance of crabs up the rivers may vary from year to year in response to the amount of fresh-water runoff. In 1957, a very dry year, most young crabs were farther up the York River than in 1956. These variations also may be important in determining future abundance of crabs, for they may affect the amount of space and food available for growth and survival.

**Studies of Blue Crab Abundance**

A series of estimates of the abundance of crabs in the winter dredge fishery is available now for a continuous period of 26 fishing seasons. In recent years similar indices of abundance have been computed for the scrape fishery for soft crabs and peelers in the Tangier Island area, and for the crab pot fishery. The winter dredge fishery takes about 18 per cent by weight of the total annual catch in Virginia, the scrape fishery takes 3 per cent, and the pot fishery 61 per cent. The indices calculated from catch records of these fisheries do not agree closely, and this is not surprising, for the accuracy of each index as a measure of the true abundance of crabs is affected more or less by several variable factors, such as the temperature and salinity of the water, the proportion of the entire supply of crabs that each fishery removes from the waters, and the market situation. The pot fishery has been growing steadily in importance, and now accounts for 60 per cent or more of the total Virginia catch, but it has not been possible to obtain good records of this fishery because until recently each license holder has been required by law to fish not more than 50 pots.

This law has never been strictly observed, and on the recommendation of this Laboratory it was repealed at the last session of the General Assembly on the grounds that although this is now the most important crab fishery in Chesapeake Bay, no useful information on the catch could be obtained, since no crabber could be expected to reveal the true number of pots that he fished. Information at hand shows that the numbers of pots in operation have not increased since the limitation was cancelled, and we are now obtaining reliable records from the pot fishery for the first time. This important advance in our study of this fishery
may prove eventually to be the step that led to an understanding of the major problems of the Chesapeake Bay crab industry. The average catch per pot in 1957 has been about one-third less than in 1956.

Protection of Sponge Crabs

"Protection" of sponge crabs, by placing legal restrictions on their capture, has long been a popular remedy for the troubles of the crab industry. Maryland has always urged further limitations upon the taking of sponge crabs by Virginians, on the grounds that this is the only way in which Maryland can be assured of an adequate crab supply. Because there is such a widespread and firm conviction that sponge crabs should not be caught, this Laboratory has given special consideration to this question, and although we do not claim that the blue crab resource is impossible, we have no evidence that the present rates of fishing are harming the resource. We see no particular merit in the protection of sponge crabs as a conservation measure, and believe that further restrictions would be a needless interference with the blue crab industry. It is probable that additional restrictions would decrease the catch and add to the expense of harvesting the resource, two results that are completely contrary to the purposes of fishery management.

Movements and Spawning History of Crabs

One phase of the life cycle of the blue crab on which we have no information is the extent to which crabs migrate in and out of Chesapeake Bay. Experiments have been made with various types of tags, to develop a satisfactory method for this purpose, but a tagging program has not yet been started. Meanwhile there are indirect methods that may give useful information. Each year, in midsummer, crabs bearing abundant marine growth on their shells appear in the area of Lynnhaven Inlet, Hampton Roads, and the lower York River. A characteristic growth is a particular kind of acorn barnacle that lives only on the shells of crabs. When these barnacles are present, that crab almost invariably has already spawned at least once. Crabbers call these "sea-run" crabs, and believe that they have migrated from the ocean. Other adult females caught in the Bay in summer have a particular kind of small, goose barnacle on the gills. Crabs in this condition also almost invariably show evidence of at least one previous spawning. We are investigating the possibility that the presence of these organisms on crabs can be taken as evidence that they have been outside the Bay.

Shrimp

Eleven different kinds of shrimp inhabit the waters of Chesapeake Bay. These include the three important commercial species of the Atlantic coast, the white or green shrimp, the brown-spotted, and the brown shrimp. Occasionally fairly large catches of white shrimp are made by pound nets, and these always stimulate interest in the possibility of developing a commercial fishery. In recent years several temporary permits have been issued to fishermen to explore for shrimp in the Bay, and Laboratory personnel have accompanied these expeditions, but none has succeeded in catching commercial quantities, though a few shrimp
have been taken. The known distribution of these varieties is off the town of Cape Charles, Lynnhaven Inlet, York River, and off New Point Comfort. The white and brown-spotted shrimp are about equally abundant, the brown shrimp is quite rare. Fishermen have been reluctant to fish their nets at night for fear of snagging, but night hauls should be tried. Our present knowledge does not suggest that these shrimp exist in commercial quantities in the Bay.

Another shrimp of some commercial value in other areas, the river shrimp, is known from Virginia waters. The Laboratory has two specimens, both caught in the James River, and has received occasional reports of catches by commercial fishermen. There is no evidence that river shrimp are present in commercial quantities.

Another shrimp, closely related to a species of commercial importance on the west coast, is present in fair numbers in some areas of the Bay. We do not have adequate knowledge of the distribution and abundance of this variety, and so cannot estimate the prospects for commercial exploitation.

Elgrass beds often harbor large populations of small shrimp, sometimes called “grass shrimp.” These are too small to be useful as food, but they may have some value as bait for sport fishing.

Migratory Fishes

Biologist in Charge................WILLIAM H. MASSMANN
Assistant Biologists................CLARENCE E. RICHARDS
                        ANTHONY L. PACHECO
                                JAMES P. WHITCOMB

Distribution and Abundance of Fishes

Several methods have been used to gather information about the marine fishes of Virginia. Records of catches were obtained from commercial and sport fishermen, and samples of fish from these catches were examined in detail. Surveys were made from the air to count the numbers of boats and nets in operation. The Laboratory research vessel made cruises at regular intervals over the Virginia waters of the Bay and estuaries, catching fishes with trawls and other types of net. The recovery of tagged fishes gave information on movements, abundance, and the numbers of fish caught by the different gears.

The original plans for regular trawling surveys have been hampered considerably by breakdowns of the old Virginia Lee and extended delays in construction of the new vessel. However, valuable information was obtained on the distribution and variations in abundance of seventy different kinds of fish in the 10 surveys completed between August 1954 and March 1957. Information on only the more important commercial and sport varieties are included here. Many of the species not valued by man are important as food for other fishes, and studies of their habits and variations in abundance will help to interpret fluctuations in abundance of desirable varieties. Already, large variations in the abundance of some of the forage fishes have been observed. Because these species are not exploited by man, their changes in numbers cannot have been caused directly by fishing.
The large fluctuations in abundance that occur in most marine fisheries raise serious problems. A major purpose of scientific investigations is to measure and explain these variations, so that the fishery resources can be utilized for maximum benefit. Many different kinds of information are necessary to achieve this objective, but with limited resources not all can be gathered at once. The level of our knowledge of each species determines which type of information should be obtained first.

**Shad**

Investigations of the shad fishery have been confined almost entirely to the York River system. Recovery of tags attached to adult shad in 1953 showed that about half the fish in the run were caught and about half escaped to spawn. In succeeding years the catch and spawning escapement have been estimated from detailed records supplied by fishermen. In the four-year period 1952-55 our estimates of the catch in the York River have been fairly closely proportional to the Virginia catch as recorded by the U. S. Fish and Wildlife Service, suggesting that the York River shad runs are representative of Virginia as a whole.

Estimates of the success of spawning of those fish that escape the fishery each year are being made in two ways: from the abundance of young shad in the tributaries before they migrate to sea in fall, and from the abundance of the same brood when they return as adults to spawn. Obviously this is a long-term investigation, and as yet we have not had time to trace a complete brood through the fishery. The 1952 brood, though it did not return in any great abundance in 1954 as two-year-old fish, nor in 1955 as threes, in 1956 contributed about one-third of
the catch, and in 1957 was expected to be the most important group in the
fishery. The catch usually consists of fish ranging from 2 to 8 years old, and this
1952 brood probably will not disappear from the fishery until after 1960.

The ages of shad in each year’s run are estimated by examining scales from
samples of the catch. From the scales it is possible also to tell how many times
each fish has spawned. On the average, about two-thirds of the shad in recent
years were spawning for the first time, about one-quarter for the second time,
and one-twelfth for the third. A few spawned as many as 4, 5, or even 6 times.
The annual rate of decrease in the numbers that return to spawn again and the
decrease in numbers of fish of successive ages in the catch lead us to believe that
the total annual mortality of shad from all causes is perhaps as high as 75 or 80
per cent.

Croaker

Evidence is accumulating that the croaker is an extremely variable resource.
Past records suggest that abundance was low in the early 1930’s, high in the late
30’s, low in the early 40’s, but very high in the mid-40’s. The great abundance in
the late war years, together with unusually high prices stimulated by meat rationing
and lack of price controls on seafood, created an extremely lucrative fishery.
The sharp decline in availability of fish and in prices that followed the war was
disastrous for the croaker fishery.

Following the record catch of more than 55 million pounds in 1945, landings
declined abruptly to less than 4 million pounds in 1952. In the last few years
there has been an equally sharp rise, and croakers now may be almost as abundant
as they were in 1945. In average size, croakers have been larger in 1957 than for
some years past.

This improvement in the supply of croakers has been caused by an unusually
successful spawning in 1952, mentioned in the 54th and 55th Annual Reports, and
by another successful spawning in 1953. The 1954 and 1955 spawnings apparently
were poor, and this may cause a temporary decline in the fishery later, but large
numbers of young from the 1956 spawning have been taken in experimental
trawl hauls this year. These fish are considerably smaller than croakers usually
are as they approach the end of their first year of life, and this usually is another
sign of great abundance. Some of these fish will be caught in the 1958 fishery,
and by 1959 they should form an important part of the catch.

Tags were placed on 1968 croakers in the first half of 1957. So far only about
5 per cent of these have been returned, suggesting that the croaker resource is not
heavily exploited.

Gray Sea Trout

The trout, like the croaker, varies considerably in abundance. The fishery
reached a peak in Virginia in 1945, with a catch of more than 22 million pounds,
then declined abruptly to less than 2 million pounds in 1952. The catch has risen
slightly in the past few years, but there is no sign of a recovery similar to that
described for the croaker.

Because the gray sea trout once supported important fisheries in the middle
Atlantic region, and is also highly prized as a sport fish, investigations have re-
cently been started in New York, New Jersey, and Delaware. We are planning our work in cooperation with these other state agencies.

Samples of the Virginia pound-net catch have shown that about two-thirds of the gray sea trout are one year old and about one-third two years old. Older fish, forming only a very small portion of the catch, are taken mostly in spring.

In the trawling surveys of 1954 and 1955 the abundance of young gray sea trout remained steady, but in 1956 and 1957 trout became progressively more scarce. There are no indications that the supply will improve in the immediate future.

**Spotted Sea Trout**

The limited tagging program that began in 1954 was repeated in 1955. Tags were placed on 298 fish, 67 in 1954 and 231 in 1955. Only 9 of these have been returned, 5 from the Lynnhaven area, one from Virginia Beach, and 3 from the North Carolina coast.

**Spot**

As a commercial resource the spot is of secondary importance in Virginia. Since the mid-1940's annual landings have fluctuated about 4 million pounds, although in 1949 over 8 million pounds were landed. There is an important sport fishery, second only to croakers in the numbers of fish landed. There is no evidence that the resource has been over-exploited, but considerable numbers of undersized fish are taken by the commercial fishery, and these have little economic value.

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Figure 8.—The Pathfinder is equipped with radio telephone, radio direction finder, and recording fathometer.
Spawning occurs in mid-winter, in the ocean probably not far from the mouth of Chesapeake Bay. Young first appear in the Bay and estuaries in spring, and they remain well up the estuaries until fall. Some yearlings may spend the winter in the Bay, but most fish migrate to the ocean in winter and return to the Bay in spring. Most of the fish caught in Virginia are in their first or second year of life, and few, if any, live longer than four years. Spot are about 7 inches long at the end of the first year of life, 8½ inches at the end of the second, and 9 inches long and about half a pound in weight at the end of the third.

Of 444 spot tagged in 1957, only 14 have been recovered to date. This suggests that the fisheries are not taking a very heavy toll of this resource.

**Striped Bass**

Virginia biologists have continued to assist in the cooperative research program of the Atlantic coast, coordinated by the U. S. Fish and Wildlife Service and the Atlantic States Marine Fisheries Commission. Most of the participating states receive funds to finance their share of the work from the proceeds of excise taxes on fishing tackle, under the provisions of the so-called Dingell-Johnson Act, but Virginia’s share of these funds is committed to research on fresh water sport fisheries.

In the spring of 1957 a concerted effort was made to test the feasibility of tagging large numbers of striped bass. The entire staff of the migratory fish investigations, with some help from other staff members, spent several weeks on this project. Tags were attached to 1425 fish, and by the end of June 252 had been recovered, mostly from Virginia waters. Out-of-State returns included three from Maryland and one each from New Jersey, Rhode Island, and Maine.

**Menhaden**

The sampling program that began in 1954 has been carried forward through 1957, by examining samples of approximately 100 fish each week from the York River pound-net fishery. A consistent pattern of seasonal changes in size and age was characteristic of each year in this four-year period. In spring the catch consisted mainly of fish in their second and third years of life. The average size of each of these two groups of fish increased, but the older group became less and less important in numbers as the season advanced. In August or September a new group of small fish in their first year of life appeared in the fishery, and by that time the three-year-olds had almost disappeared. By October or November, when the pound-net fishery ceased, these young fish made up the major portion of the catch, and they reappeared in the fishery the following spring as fish in their second year of life, accompanied by a smaller group of fish in their third year, the survivors of the two-year-olds from the previous year.

The pound-net catch of menhaden is insignificant in comparison to the purse-seine catch, which in 1955, the latest year for which we have complete records, landed more than 300 million pounds of fish worth nearly four million dollars to the fisherman. But the young menhaden that first make their appearance in the pound-net fishery in late summer, when they are less than one year old, are the
mainstay of the late summer and fall purse-seine catch the following year. The limited studies that we have made of the menhaden catch by pound nets suggests that by systematic sampling of this fishery it will be possible to forecast the availability of menhaden for the purse-seine fishery a year in advance.

The Sport Fisheries

Sportfishing in tidewater Virginia and in the ocean beyond the Bay entrance has grown remarkably in popularity since the war. New methods of fishing and the exploration of new grounds are continually bringing neglected species into importance as sport fishes. Sport fishing for shad is now popular in many tidewater streams in early spring, cobia and channel bass are drawing many sportsmen to the Bay, a new fishery for marlin is developing in the ocean off Virginia's shores, and possibilities of finding tarpon in the waterways of the seaside of the Eastern Shore are being investigated.

The sport fishing survey, which began in 1954, has concentrated up to now on the bottom fisheries, which take primarily croakers, spot, gray sea trout, and flounders. The first complete year of observations was 1955, when it was estimated that sport fishermen took about 1,768,000 pounds of croakers, 287,000 pounds of spot, 158,000 pounds of gray sea trout, and 50,000 pounds of flounder. In 1956 the croaker, spot and flounder catches increased to about 2,414,000 pounds, 386,000 pounds, and 60,000 pounds respectively, and the trout catch dropped to 127,000 pounds.

An interesting sidelight on the sport fishing investigations is the discovery that the catching rate of croakers per boat does not increase as the number of fishermen in the boat increases. This means that, assuming he knows where the best croaker fishing grounds are, a fisherman will be most successful if he goes out alone. If there are two fishermen in the boat, each will only catch half as many, and so on. This information should be useful to the operators of party boats, for their reputations and their incomes may be related to the numbers of people they take along on a trip.

Preliminary Results of 1957 Tagging

Although tag returns are by no means complete, some preliminary conclusions can be drawn to illustrate some of the various kinds of information that tagging can provide. According to the records of the U. S. Fish and Wildlife Service, in recent years pound nets have taken almost 50 per cent of all croakers caught by commercial gears in the Virginia waters of Chesapeake Bay. Of the tagged croakers caught in commercial gear to date in 1957, almost 50 per cent have come from pound nets. The numbers of tags recovered in haul seines also are roughly proportional to reported haul-seine catches. This is valuable confirmation of the relative accuracy of the catch records.

Tag returns also are useful in confirming our estimates of the sport catch. So far, about one-third of the tagged croakers recovered have been caught by hook and line. This means that sport fishermen catch about as many croakers as do all the pound nets, or all the haul seines that operate in Virginia's Bay waters. Approximately the same conclusion has been drawn from our sport fishing survey.
Special Investigations

Fish Kills

Staff members have investigated the usual number of complaints about fish kills, and have been successful in tracing the causes of most of these. A typical example was a mortality, described by many observers as the worst they had ever seen, in the lower Bay near Hampton Roads. Investigations showed that two menhaden boats had lost their catch at the same time. Miles of beach were littered with the dead fish, which by the time they had drifted to shore had lost their heads and tails to crabs and other fishes, and the prominent black spot that lies behind the head of menhaden led many observers to believe that large numbers of spot were included in the kill.

A more important kill, not yet satisfactorily explained, occurred in many areas of the Bay in the spring of 1957. Each spring, just as the water begins to warm, we have observed dead anchovies on the beaches, and have come to recognize this as a regular phenomenon. In 1957, however, the quantities of fish were much greater, and the kill included young croakers, spot, menhaden, and other species of commercial and recreational importance. Complaints were received from Virginia Beach, Ocean View, Hampton Roads, York River, Mobjack Bay, and Piankatank River, and we suspect that most, if not all areas of the Bay were affected. Such kills may have a significant effect upon the future abundance of these migratory fishes, and the phenomenon deserves careful investigation.
An adequate investigation is beyond the resources of the Laboratory without disrupting other important projects. We suspect that disease may be the cause, and plan to investigate such kills as best we can under the circumstances.

**Hampton Roads Bridge-Tunnel**

With the completion of dredging operations in the spring of 1957 the contract with the State Highway Department to investigate the effects upon oyster grounds in the vicinity was terminated. Reports describing the investigations made by the Virginia Fisheries Laboratory and the Chesapeake Bay Institute have been completed and submitted to the Highway Department.

On Hampton Bar certain oyster grounds adjacent to the artificial north portal island showed evidence of unusual accumulations of silt, and oyster mortalities were in excess of what would normally be expected. Now that dredging has been completed, an equilibrium will be established, and some of the grounds probably will be suitable for planting. In the Willoughby Spit area there was no evidence of silt deposition on oyster grounds near the artificial south portal island, and no unusual mortality of oysters.

**Rappahannock River Oyster Mortality**

The catastrophic oyster kills that occurred in the Rappahannock River in 1949 and 1955 have already been described in this and previous reports, and it has been mentioned that the situation is not peculiar to the Rappahannock. Similar oxygen deficits occur in summer in the saline regions of the Potomac and Patuxent Rivers, and the deeper waters of Chesapeake Bay in southern Maryland usually are completely devoid of oxygen in summer. There is no evidence whatsoever that pollution contributes significantly to any of these situations, and it is believed that they existed long before the area began to develop industrially. The condition in the Patuxent River and in the Bay itself was known as early as 1936.

Although we have a general knowledge of the conditions that lead to the removal of oxygen from the water many details are not yet clear. We should have more knowledge of the source of the oxygen-removing substances, to learn, for example, how swamp and marsh drainage, runoff from farm land, and biological activity affect the environment. We should also have information on the tolerance of oysters for low quantities of oxygen, so that we will know what constitutes a dangerous condition.

**Industrial Pollution of Tidal Waters**

Recent establishment of two major industries in tidewater, the refinery of the American Oil Company on the York River, and the Dow Chemical Company on the James, added to existing pollution problems of long standing in each of the major estuaries, has emphasized the threat that pollution offers to the survival of all our fisheries. New industries probably do not raise such troublesome problems as do those that were in existence before the State Water Control Board was established, for they must satisfy the Board that their wastes will be given adequate treatment before they can obtain permission to operate. Nevertheless, treatment
does not remove all the foreign substances from wastes, and permission to discharge must be based on scientific knowledge of the amounts that the receiving waters can absorb safely without interference with other uses of the water.

For these reasons it is necessary to know at what concentrations the various components become harmful to marine organisms. Considerable knowledge has been accumulated for the fresh waters of lakes and rivers, but almost nothing is known of effects in marine waters. Consequently, the advice that we are able to give is often little better than a guess, and thus may be detrimental to the interests of the commercial and sportfishing industries, and the economy of the State as a whole.

It is customary to think only of oysters when we consider the effects of pollution in the estuaries, but we are finding that the estuaries are important nursery grounds for croaker, spot, sea trout, blue crabs, menhaden, as well as spawning grounds for shad, striped bass, and other species. Some of these, particularly trout, menhaden, and striped bass, support important fisheries outside Virginia, therefore the effects of localized pollution may be very far-reaching.

It is customary also when we think of the effects of pollution to visualize only the gross effects, by concentrations severe enough to kill. But there may be results much more subtle, yet equally harmful, that influence spawning, feeding, growth, survival, and other important life-processes.

Manufacturing industry usually is considered to be the chief cause of pollution, and often other sources are forgotten. Except in a few places, the problem of sewage disposal is under control, but the effects of detergents and other chemi-
erals that go through sewage treatment plants unchanged, and the highly toxic insecticides and weed-killers that can be carried into the rivers by rains, are almost unknown and should be investigated.

Other problems, similar to those caused by pollution and hence confused with pollution, such as the situation in the oyster-growing area of the Rappahannock River, require much more attention. We lack two essential kinds of information for our fisheries, a detailed knowledge of the environment as a whole, and a knowledge of the effects of changes in this environment upon the animals that live in it. Somehow, we must gather this knowledge at a much faster rate than we now do, for otherwise we may fail to give our fisheries the protection they need.

**Chesapeake Bay Institute**

*Director..................Dr. Donald W. Pritchard*

Founded in 1948, and financed jointly by the States of Virginia and Maryland and the Office of Naval Research, this Institute has made important advances in our knowledge of the waters of Chesapeake Bay and its tributaries. Foremost among these accomplishments has been an investigation of the depletion of dissolved oxygen in the deeper waters of the Bay and several of its estuaries. As early as 1936 the phenomenon was known to exist in Chesapeake Bay, but it first arose as a problem for fishermen when crab potters who fished the deeper waters in Maryland found that their catch was dead when hauled to the surface. Subsequently the catastrophic oyster kills of 1949 and 1955 in the Rappahannock River were traced to similar phenomena.

A detailed discussion of the causes of removal of dissolved oxygen from certain waters of the Bay in summer will be published later. Briefly, the trouble arises because biological activity in hot summer weather removes oxygen from the water more quickly than it is renewed, and the oysters are unable to breathe. In the Bay the process reaches dangerous levels every year, but in the estuaries conditions become critical only when heavy rains bring unusual amounts of organic material into the lower reaches, and high temperatures cause rapid oxidation. There is no evidence that pollution in the upper reaches of the Rappahannock or other rivers contributes significantly to the oxygen deficit in the lower reaches or in the Bay. Cooperative investigations by the Virginia and Maryland laboratories with the Chesapeake Bay Institute have produced results that would not have been achieved by individual effort.

An important by-product of the work of the Chesapeake Bay Institute has been the development of new techniques and new instruments. Many oystermen in the Rappahannock River believe that pollution from the Fredericksburg area caused the mortalities of 1949 and 1955. They logically wonder, if their losses were caused by natural forces, why two such catastrophes should happen within seven years, when no such serious troubles are remembered prior to this period. The saltiness of the river water at any place is determined to a large extent by the amount of fresh water draining from the watershed, and records of runoff are available for many years back. The complicated process of deducing the salt content of the river from past records of runoff has been worked out experimentally on an existing model of the Delaware River Basin, and the results should
help to tell us whether conditions similar to those that killed oysters in recent years also developed in the past. This in turn will help to settle the question of oyster kills in the Rappahannock.

Figure 11.—The Rappahannock River has a peculiar circulation pattern that causes a stagnation of the waters in the oyster-growing region in summer. Stagnation, like pollution, causes a depletion of oxygen in the water, which under certain conditions may be sufficient to harm marine life. The Rappahannock has two zones of oxygen depletion, one caused by pollution in the Fredericksburg area, the other related to the layering of fresh and salt water in the lower reaches. The vertical bars represent the total amount of oxygen the water can hold, the black portions represent the actual amounts present in a typical summer season. The situation becomes dangerous for fishes when the water contains less than half the amount of oxygen it is capable of holding. Oysters apparently can tolerate lower amounts.

The measurement of temperature, salinity, and dissolved oxygen of the waters are important in predicting and explaining the fluctuations in the supply of marine resources in Chesapeake Bay. The measurement of temperature has required complicated and expensive thermometers, and time-consuming and expensive chemical analyses are necessary for the measurement of salinity and oxygen. The Chesapeake Bay Institute has pioneered in the development of simpler and more effective devices for these purposes and soon will be supplying these time- and money-saving instruments to the State Laboratories.

Another recent innovation in the work of the Chesapeake Bay Institute has been the development of techniques and instruments to study the effects of environment upon marine animals. These techniques are being employed to study the influence of oxygen depletion and other adverse factors upon oysters, crabs, and other important resources. They will increase our knowledge of the marine
resources of Chesapeake Bay immeasurably, and will lead eventually to a clearer understanding of our problems.

We again urge support of the Chesapeake Bay Institute by the Commonwealth of Virginia. The work of this group has contributed in many ways to the economy of the State, and the investigations now under way have even greater promise. The small investment that Virginia makes each year in this important enterprise produces large dividends.

**Public Education**

*Biol ogist in Charge..................... ROBERT S. BAILEY*

The training program for school groups at the Laboratory continues to be popular, as testified by the 125 classes containing nearly 3900 students and teachers, and more than 4700 casual visitors that have come to the Laboratory in the past two years. Forty-four scout groups, 10 groups from Virginia colleges and universities, and 3 special groups have also paid visits and heard lectures.

Many requests for teaching aids, literature, and general information have been received. In the fiscal year ending June 30, 1957 alone, the first year in which we have kept accurate records, over 900 pieces of literature were loaned on request, and inquiries from 148 students, 82 teachers, and 48 miscellaneous correspondents were answered.

Many talks have been given to service clubs, fishermen’s organizations, and other public groups. Assistance has been given with courses in Resource Conservation at Virginia Polytechnic Institute and the College of William and Mary, a course in Sampling Biological Populations at VPI, and with the 4-H Club Camp at Virginia Beach.

Assistance was given to the Virginia Resource Education Council in preparing a booklet on the natural resources of the State, and to the State Film Production Service in preparing three films on the seafood industry. The films and the booklet have been received with great enthusiasm.

More than 60 press releases have been issued on various phases of the Laboratory’s activities, and these have appeared widely in the Virginia press and the trade magazines of the fishing industry. Staff members have worked with representatives of the Richmond and Newport News press, the Washington Post, Baltimore Sun, New York Herald-Tribune, and other papers in the preparation of feature articles.

The popular series of television programs has been continued, sometimes as a feature program and sometimes as a part of a sports program. Thirty-four appearances have been made on WXEX, Petersburg; 16 on WVEC, Hampton; 6 on WRVA, Richmond; 4 on WTVR, Richmond, and 1 on W TAR, Norfolk.
Figure 12.—The Virginia Fisheries Laboratory exhibit at the State Fair in Richmond draws large crowds each year.

Facilities

The new research vessel *Pathfinder* was delivered to us in June 1957, about 14 months after laying the keel, and more than six months later than the contract stipulated. The long delay caused serious disruptions of the migratory fish investigations and unexpected expenses to keep the old *Virginia Lee* in service, in addition to considerable extra costs in travel, telephone, and architect's expenses. The contractor, Curtis-Dunn Marine Industries, Inc., of West Norfolk, otherwise did an excellent job, and took great interest and care in all phases of construction. We were well pleased with the services performed by the architect, George E. Meese, of Annapolis, Maryland, and recommend him to the Commission of Fisheries if the services of a Naval Architect are required. The name *Pathfinder*, selected with the approval of Governor Stanley and the Board of Administration of the Laboratory, is doubly appropriate, for it describes the exploratory nature of the work in which the vessel will be engaged, and perpetuates the name of the famous Virginian, Matthew Fontaine Maury, the “Pathfinder of the Seas,” who was America’s first oceanographer. She is 55 feet in length, 16 feet 8 inches in beam, 5 feet in draft, and is powered with a Caterpillar Diesel engine.

The contract for the new Dormitory-Dining Hall-Laboratory building was signed in June 1957 with the M. E. Howard Construction Company of Richmond, and construction is now well underway. Because the original low bid exceeded the amount of the appropriation, it was necessary to make several deletions and substitutions in the original plans and specifications. This eliminated all the cast
stone and the penthouse shown in the accompanying artist's sketch, and the drive-
ways, parking areas, and seawall extension. Costs also were cut by arranging for
our own buildings and grounds staff to do the interior painting and installation of
built-in furniture.

Graduate Instruction

Anthony L. Pacheco completed his graduate studies in the spring of 1957
and received his M.A. degree from the College of William and Mary. He is now
a member of the permanent staff of the Laboratory.

Roy J. Washner has completed all necessary course work for his degree, and is
now working on his thesis in his spare time. He also has joined the permanent
staff.

Sung Yen Feng has completed all course work and is finishing the final draft
of his thesis. He is now a student at Rutgers University, working toward the
Ph.D. degree, and expects to return to Gloucester Point in the winter of 1957 to
take his final examination for his M.A.

William B. Smith left the Laboratory before completing his studies, and is
now employed by the J. S. Darling Oyster Company.

Two new graduate students have been enrolled, Clyde L. MacKenzie from
the University of Massachusetts and John W. McMahon from the University of
New Brunswick, Canada. Mr. MacKenzie has completed his course work and is
now writing his thesis. He expects to receive his degree in the fall or winter of
1957.

Numerous applications have been received for admission to graduate study.
We have followed our policy of rigid screening of such applications, and have
refused more than we have recommended for acceptance. Several applications
still are pending.

Personnel

The Laboratory has lost several valued administrative employees during the
biennium. Dennis K. Cogle, Office Supervisor, resigned early in 1956 to accept a
more remunerative position. The vacancy was filled temporarily by Mrs. Olive
Clark, formerly Confidential Secretary. Through a series of illnesses in her
family, Mrs. Clark was forced to resign later in the year. The position is now
occupied by Roy Washner, a former graduate student, who also has a college
degree in Business Administration and considerable experience in that field. The
position of Confidential Secretary was filled by the promotion of Mrs. Barbara
German, formerly a clerk-stenographer. Her former position has been filled by
Miss Patricia Conner, and an additional clerk-typist, Mrs. Jeanie Cook, has been
employed to assist Mr. Bailey and to act as a part-time librarian.

The acquisition of the new boat and construction of a new building, in ad-
dition to growing maintenance problems, have resulted in the creation of a new
position, Buildings and Grounds Supervisor. We were fortunate to secure the
services of Thomas A. Chapman, who has had considerable experience in the
building trade, to assume responsibility for the care and maintenance of buildings,
grounds, boats, and machinery.
Hudnall R. Croasdale resigned from the scientific staff in 1956. He was replaced by James P. Whitcomb of Woods Hole, Massachusetts. A vacancy on the staff of the migratory fish investigations was filled by the appointment of Anthony L. Pacheco, a former graduate student. A new position created by the award of a Federal grant for research on oyster drills was filled by Dr. W. J. Hargis, Jr., of Richmond.

As usual, the staff is augmented in summer by visiting professors and student assistants. Dr. Willis G. Hewatt of Texas Christian University, and Dr. Robert W. Ramsey of the Medical College of Virginia have returned each year to teach courses and assist in the research program. The policy of employing students in Biology from the College of William and Mary as summer assistants has been followed as far as funds were available, and a nucleus of several students interested in Biology as a profession is now available for future summers.

**Summary and Recommendations**

**Shellfish**

We are justifiably proud of the accomplishments of the oyster research program. These investigations have shown that under recent conditions oystermen who plant in the lower parts of the Bay and estuaries probably have been leaving their crops on the grounds too long, and we believe that many oystermen will realize greater yields by harvesting sooner. We have shown that the time of maximum yield probably occurs in late spring or early summer, when oysters are in their best condition, so that the planter who can harvest his crop in late spring benefits twice, by avoiding heavy summer mortality, and by realizing the maximum volume of meats per bushel of oysters in the shell. We believe that these findings will be of maximum benefit to the oysterman when technology has advanced to the point that oysters harvested at this point of maximum yield can be marketed at the time of maximum demand and profit.

Studies of the growth and survival of seed oysters from other areas have provided information that will be useful in future if additional sources of seed are needed. Investigations of growth and survival of hybrid clams may also be of practical value.

The oyster drill research program is based on the thought that our knowledge of the biology of these pests must be increased greatly if we are to develop successful control methods. The discovery that eelgrass beds may harbor large populations of drills that can act as a source of infection for oyster grounds is a practical demonstration of the merit of this approach, and is only one of the many promising results of this program. The oyster drill contract expires in June 1958, and we are requesting funds to transfer Dr. Hargis to the permanent staff. It would be a great mistake to lose him and to allow his research program to expire.

**Blue Crabs**

The recent decline in the catch of blue crabs was not unexpected, for the record catch of 1950 could not be expected to be maintained indefinitely unless the intensity of fishing were to increase substantially. Like most of the other
marine resources of Chesapeake Bay the blue crab is highly variable in abundance and we see no immediate cause for alarm. We do not recommend additional protection of sponge crabs, for we believe that even if it had been proven necessary to restrict the catch of egg-bearing females, the sanctuary and the areas closed to fishing by the Navy in the lower part of the Bay constitute an effective barrier to free exploitation.

We again recommend that Section 28-172 of the Code of Virginia, insofar as it applies to the taking of hard crabs, be amended to exclude mature females, distinguished by a broadly rounded rather than a triangular apron. Females with this characteristic apron will not shed again, and therefore will not increase in size, and there is no point in banning their capture. Legislation perhaps is not necessary so long as the law is interpreted with this point in mind.

Migratory Fishes

The repeal of the ban on possession of striped bass over 25 pounds in weight at the last legislative session was an encouraging expression of faith in the recommendations of this Laboratory. We see no reason on biological grounds why the ban should not be lifted also for commercial fishermen, but recognize that the retention of this law may have merit as a social measure. We have no other recommendations to offer at this time regarding the migratory fishes, except to call attention to the growing importance of the sport fisheries as a source of income to the State.

Personnel

The Laboratory is failing to meet its full responsibility in several directions, chiefly through inadequate salaries in the professional grades and insufficient personnel. Modification of the present program would not improve the situation, since it would merely shift emphasis from one important group of problems to another. Continuation of the present program of research on oyster drills is necessary, and it would be short-sighted indeed to drop this promising research when the present Federal Government contract expires.

Much more effort than we are now able to muster should be directed to the investigation of questions relating to pollution of tidal waters, to the effects of specific pollutants upon marine animals, and to the serious natural kills of economically valuable animals that occur from time to time. New industry brings additional tax receipts to the State, and it seems only proper that at least a portion of these receipts should be invested in studies of the effects of these industries upon our natural resources. A modest investment in research personnel and in adequate salaries can go a long way toward the solution of some of these urgent problems. The support of the Commission in this request is respectfully solicited.

Chesapeake Bay Institute

The relatively small sum that is invested each year by Virginia in support of this agency has been more than repaid in assistance on pressing problems, advice on technical matters, and increasing knowledge of the physical and chemical characteristics of the Bay and estuaries. Virginia benefits also by the joint interest of the State of Maryland and the U. S. Navy in this oceanographic research. The
members of the staff of the Chesapeake Bay Institute are recognized internationally as authorities in their field and Virginia is fortunate to have the services of these scientists, and the privilege of consulting with their colleagues at the Johns Hopkins University, at nominal cost. Continued support of the Institute by Virginia is urged.

### Scientific Articles and Reports

**Issued Since 1948**

**Published Articles**


**ANDREWS, JAY D.** and **WILLIS G. HEWATT.** 1951. The oysterman can be his own scientist. Southern Fisherman, Vol. 11, No. 8, pp. 77-79.


**MASSMANN, WILLIAM H.** and **ERNEST C. LADD.** 1952. Variation in numbers of fishe seized before and after a storm. Copeia, No. 1, p. 49.


*These articles, published in various scientific and technical journals, are given consecutive numbers in a series entitled Contributions from the Virginia Fisheries Laboratory. The first paper listed above is Contribution No. 29, and the others follow in sequence. At regular intervals these are bound and distributed to libraries of Laboratories and Universities all over the world, in exchange for the publications of those agencies. Three volumes of bound contributions have been issued to date, for 1951-52, 1953-54, and 1955-56.*


Special Scientific Reports*

No. 1. MARSHALL, NELSON. 1948. The shrimp fishery in North Carolina considered in terms of productivity potentialities. 2 pp.


No. 3. MARSHALL, NELSON. 1948. Report on past and current fisheries research activities directly relating to Virginia. 5 pp.

No. 4. MARSHALL, NELSON. 1949. A summary statement of the status of our knowledge of the marine fisheries of Virginia. 4 pp.

No. 5. VAN ENGEL, W. A. 1950. Records of the Chesapeake Bay blue crab fishery. 23 pp.


No. 9. ANDREWS, JAY D. 1954. Memorandum to oystermen and inspectors who aided in getting samples of oysters for a study of distribution of the fungus Dermocystidium marinum in 1954. 5 pp.

No. 10. ANDREWS, JAY D. 1956. Memorandum No. 2 to oystermen and inspectors who provided samples for a study of the fungus disease of oysters, Dermocystidium marinum. 5 pp.

No. 11. ANDREWS, JAY D. 1956. The status in Virginia in 1956 of Dermocystidium marinum, the fungus disease of oysters. 5 pp.


Dissertations†

MacGREGOR, JOHN S. 1950. Some hydrographic conditions found in winter in lower Chesapeake Bay and their possible effects on the blue crab (Callinectes sapidus Rathbun) population. 56 pp.

*These reports are issued in limited numbers, usually in mimeographed form, in response to special local demands for information. They sometimes contain restricted or tentative results, and are not intended for general distribution. They do not have the status of scientific publications.

†Copies deposited in the libraries of the College of William and Mary and the Virginia Fisheries Laboratory.


OGLESBY, RAY THURMOND. 1955. Age and length of menhaden (Brevoortia tyrannus) in the waters of Chesapeake Bay, with comments on the rate of growth. 27 pp.

PACHECO, ANTHONY LOUIS. 1957. The length and age composition of spot, Leiostomus xanthurus, in the pound net fishery of lower Chesapeake Bay. 34 pp.

Educational Series 

No. 5. ANONYMOUS. 1955. Wealth from the sea. 4 pp.


* Previous numbers in this series, published prior to 1948, are no longer available for distribution.