# ECOLOGICAL POPULATION EXPANSION OF THE INTRODUCED CRAYFISH, *ORCONECTES VIRILIS*[1]

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Meredith and Schwartz (1960) reported the occurrence of the introduced crayfish *Orconectes virilis* (Hagen) from five clustered localities near Woodstock, Maryland. Recently an apparent population expansion displaced the associated crayfishes within the Patapsco River drainage to the extent that *O. virilis* now occupies virtually the entire drainage. The following comments are based on an equally intensive resurvey of the Patapsco River drainage between March 2 and December 5, 1961 (fig. 1). We wish to call attention to the environmental conditions which these crayfishes presently tolerate, the effects of this population change, and its possible implications.

The range of *Orconectes virilis* is largely confined to the watersheds of the Upper Mississippi River and Great Lakes drainages from Saskatchewan to Ontario,

TABLE 1

*Physical description of stations in the Patapsco River drainage where the crayfish* Orconectes virilis *was collected*

| Station* number | Stream width (in feet) | Average depth (in feet) | Maximum depth (in feet) | Bottom types |
|---|---|---|---|---|
| B1 | 40 | 3 | 5 | Gravel, rubble, with some silt and sludge |
| B2 | 15 | 2 | 3 | Sand, mud, rubble |
| B3 | 125 | 2 | 4 | Rubble, gravel |
| B4 | 150 | 5 | 8 | Gravel, silt |
| B5 | 125 | 2 | 3 | Rubble, gravel |
| B6 | 100 | 3 | 5 | Bedrock, mud |
| H1 | 125 | 3 | 4 | Mud, sand, gravel |
| H2 | 150 | 3 | 5 | Mud, sand |
| H3 | 150 | 2.5 | 5 | Gravel, rubble buried under 4–12″ of organic sludge |
| H4 | 200 | 2.5 | 5 | Rubble |
| H5 | 30 | 2 | 4 | Mud, sand, gravel |
| H6 | 150 | 2.5 | 4.5 | Rubble with silt and sludge |
| C1 | 75 | 1.5 | 2.5 | Gravel, rubble |
| C2 | 30 | 1 | 3 | Gravel, rubble |
| C3 | 30 | 1 | 3 | Sand, rubble |
| C4 | 30 | 1 | 2 | Sand, rock, gravel |
| C5 | 45 | 1 | 3 | Sand, gravel |
| C6 | 350 | 3 | 5 | Sand, mud, silt |
| C7 | 50 | 2 | 4 | Sand, mud |
| C8 | 150 | 2 | 4 | Rubble |
| C9 | 30 | 2 | 4 | Mud, sand, gravel |

*See text for explanation.

[1]Contribution No. 233. University of Maryland, Natural Resources Institute, Solomons, Maryland.

Canada, and Montana and Wyoming to New York (Crocker, 1957; Hobbs, 1959; Holthuis, 1962; Huntsman, 1915; Pearse, 1910; Pennak, 1953; Turner, 1926). Hobbs and Zinn (1948) reported *O. virilis* from Wyoming but not as far south as Texas (Penn and Hobbs, 1958) as earlier reported by Hagen (1870) and Faxon (1885; 1898). The nearest natural populations of this species occur in New York's Hudson River tributaries just north of New York City (Crocker, 1957). Its introduction into Maryland and the Patapsco River may have occurred as early

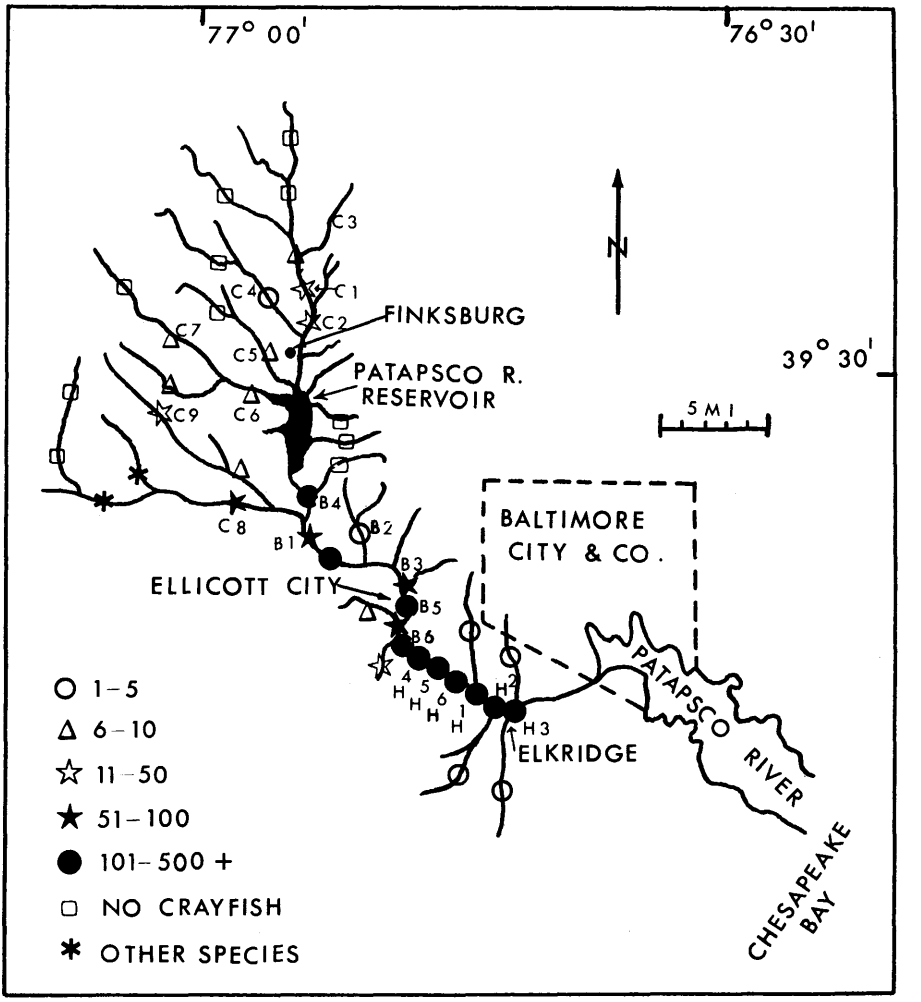


FIGURE 1. Patapsco River Watershed illustrating stations and number of *Orconectes virilis* collected per 100 ft .

as 1885 (Faxon, 1885) when it could have escaped or been used as bait from shipments, then prevalent, to the New York and Baltimore food markets where it was esteemed as food.

Van Deusen (1954) classified the area of the Patapsco River upstream from Elkridge to Finksburg, Maryland, on the main river, as a bass, carp, catfish stream. Tributaries to this system were categorized as bass feeder, dace trickle, sucker,

and trout streams. The area from Elkridge downstream for 12 miles to its mouth is subject to tidal action. Today, these gravel-rubble tributaries are virtually the same (table 1). However, the main stream H1–6 (table 1) has changed greatly in that it is a polluted, sludge-bottomed, silt-laden stream.

Pearse (1910) found *O. virilis* in lakes and larger streams in Michigan. Creaser (1931) likewise found it in stony-bottomed streams and in "even the coldest streams where the fish fauna is limited to *Cottus*, the miller's thumb, and *Salvelinus*, the brook trout." Crocker (1957) took *O. virilis* in 1952 in New York from Kayaderosseras Creek, which is 30 ft wide, 3 ft deep, and is characterized by scattered boulders, dense silt, slow current, and slightly dark water. He also found it in Lake George outlet where the bottom consisted of silt, scattered boulders,

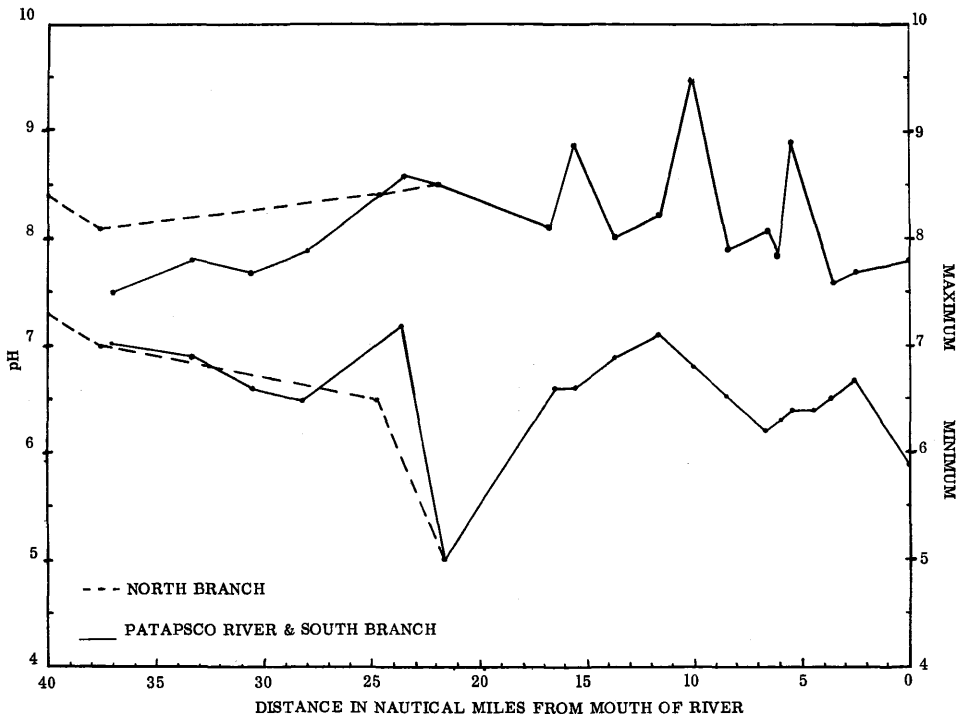


FIGURE 2.A Maximum and minimum water pH observed March 3 to November 7, 1961, along the Patapsco River.

and considerable rubbish. Creaser (1934) noted the capture of *O. virilis* from the extreme depth of 104 ft in Lake Michigan.

An intensive seining survey of the Patapsco River (fig. 1) produced some startling results. Hundreds of 39 to 111 mm total length *O. virilis* were encountered in 1961 at almost every collecting site. Likewise, changes in the abundances of *O. limosus* and *C. b. bartonii*, which were listed as common associates of *O. virilis* in the Patapsco River (Meredith and Schwartz, 1960) were noted. Only one female *O. obscurus* and one first form male and two female *C. b. bartonii* were collected in a tributary on Maryland Route 27. Two second form males and one female *C. b. bartonii* were collected at Sykesville on Maryland Route 32. Both original associates have apparently been displaced in the main Patapsco River. *C. b. bartonii* is now restricted to the headwater tributaries of the system

while *O. limosus* is restricted to the two watershed subtributaries; namely, the Glenn Falls and Jones Falls Creeks.

A paucity of information exists regarding natural ecological conditions tolerated by Orconectid crayfishes (Bovbjerg, 1952; Smart, 1962; Waterman, 1961). Comments on ecology of this species in the Patapsco River could possibly explain the present dramatic change in *O. virilis* population structure. Temperatures, pH's, D.O.'s, B.O.D.'s and coliform counts were noted during the period of March 2 to December 5, 1961 (fig. 2, 3) for various stations along a 40-mile length of the

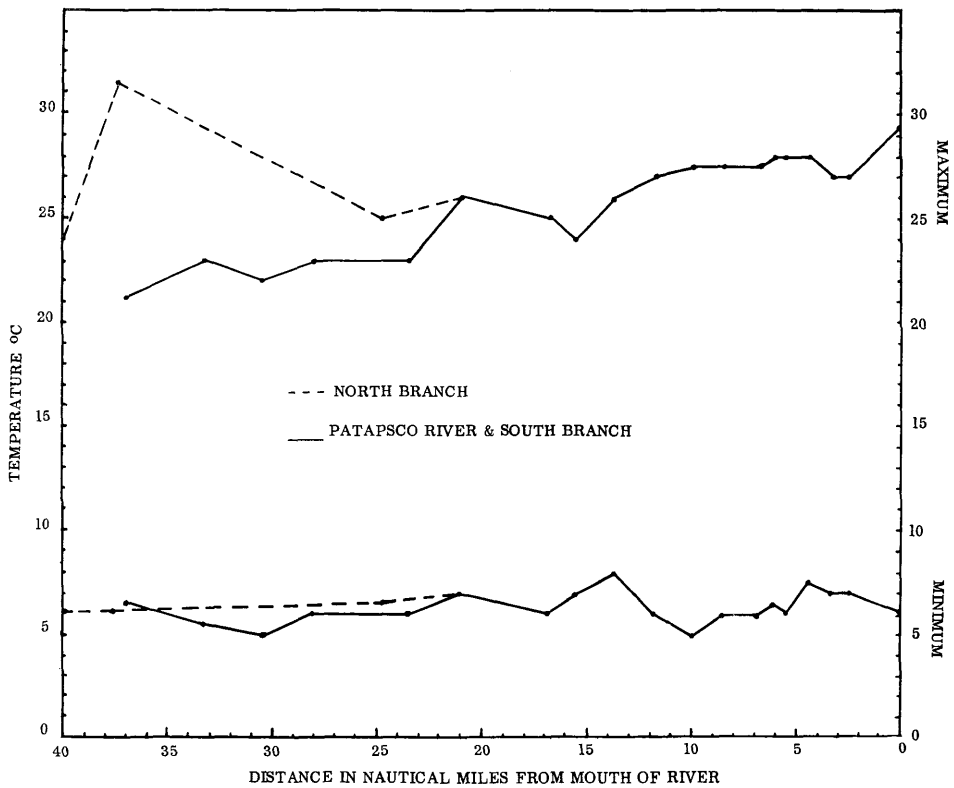


FIGURE 2B. Maximum and minimum water temperature observed March 3 to November 7, 1961, along the Patapsco River.

Patapsco River and its main branches. During this period *O. virilis* experienced and tolerated water temperatures ranging 5 to 31C and pH's 5 to 9.5 (fig. 2). Low pH's were often recorded below the Patapsco River Reservoir, 22.5 to 31.5 miles, where the south branch joins the north branch to form the main river. Dissolved oxygen conditions, in the upper tributaries, ranged 8 to 12 ppm. However, conditions below 2 ppm were common (fig. 3) in the tidal portion of the river 12 miles below Ellicott City, Maryland. With the lowered pH and oxygen conditions the B.O.D., 2 to 6 ppm, of the tidal area increased indicating large bacterial populations overlying the silt-sludge bottom (table 1). This was borne out when high 23,000 to 2,400,000+ coliform counts were obtained for this section of the river (fig. 4). Except for the South Branch which possesses some domestic and industrial sewage, the upper tributaries were relatively free of con-

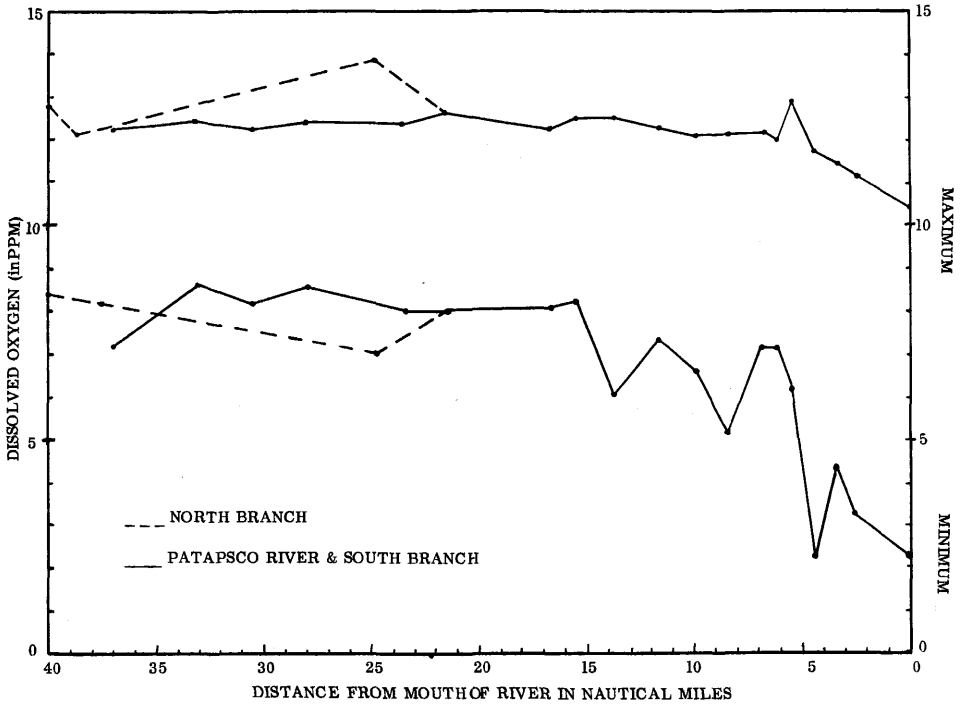


FIGURE 3A. Maximum and minimum dissolved oxygen at 20C observed March 3 to November 7, 1961, along the Patapsco River.

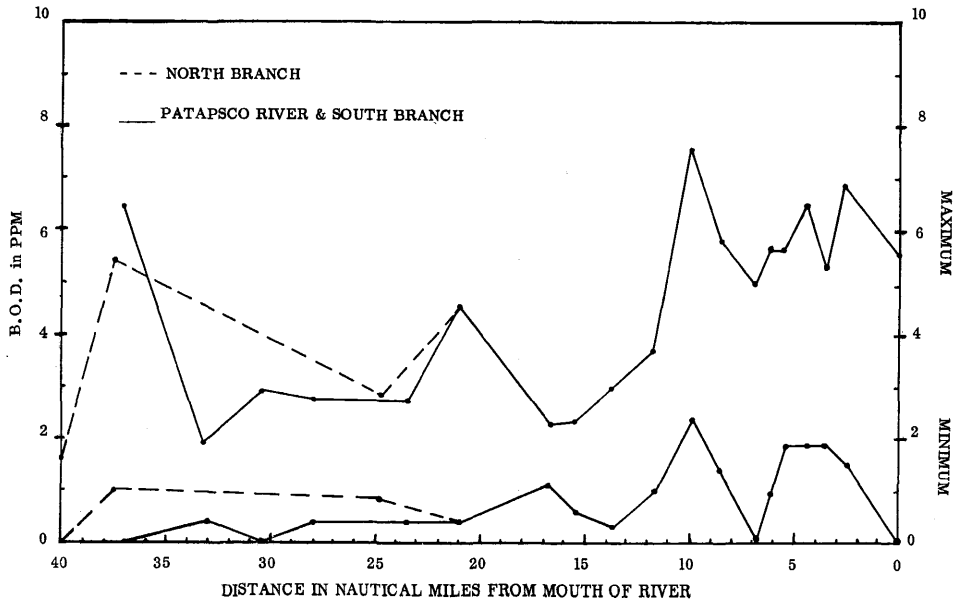


FIGURE 3B. Maximum and minimum B.O.D. at 20C observed March 3 to November 7, 1961, along the Patapsco River.

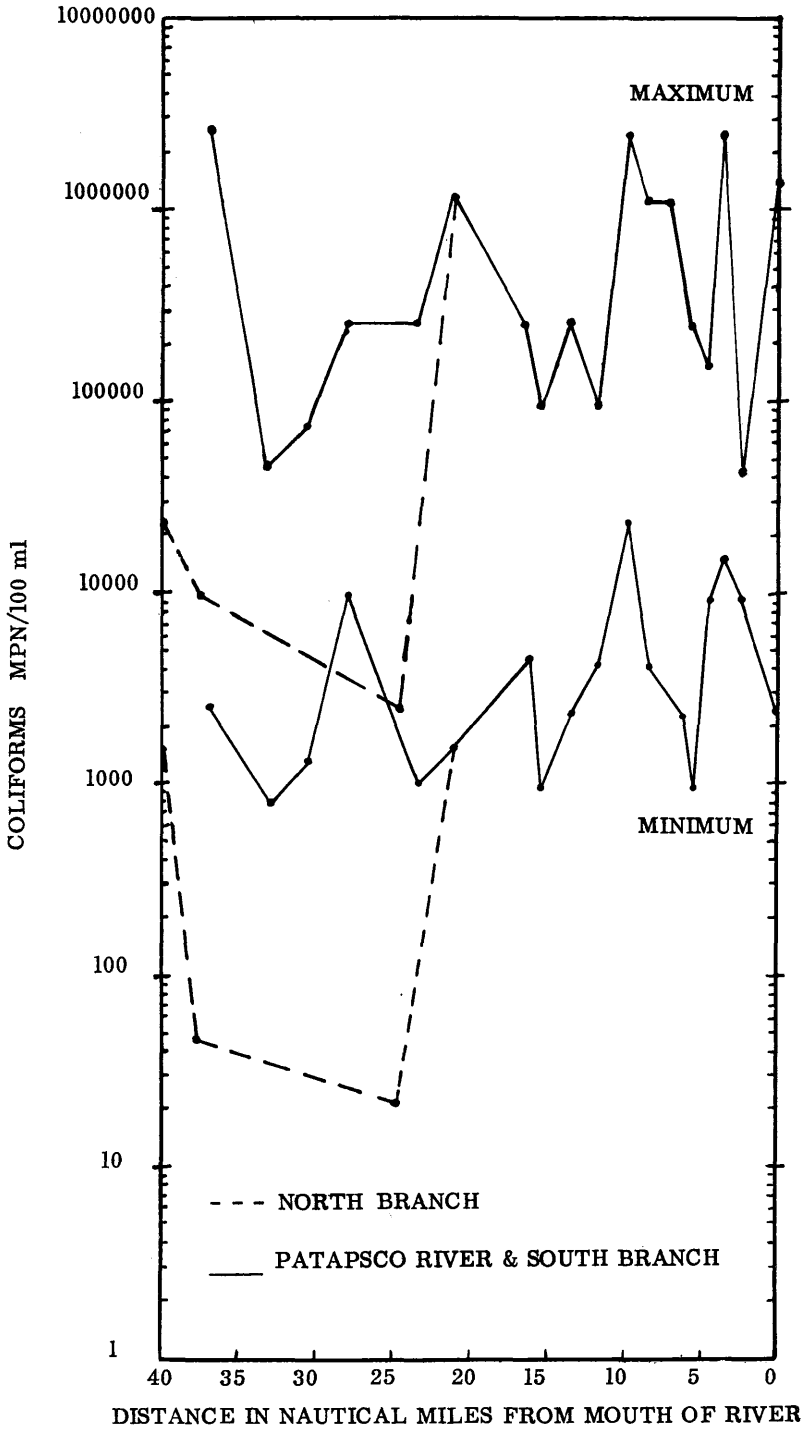


FIGURE 4. Maximum and minimum coliform counts recorded March 3 to November 7, 1961, along the Patapsco River.

tamination or sludge conditions (table 1) and possessed low coliform counts (fig. 4). Similar or intermediate environmental conditions prevailed at the sites where crayfishes were collected (table 2).

Apparently the above ecological conditions have permitted tolerant *O. virilis* to expand its population size in the Patapsco watershed, especially into that portion north and west of the river at Ellicott City and the Patapsco River Reservoir. To our knowledge, no use of this species has been made as bait. Likewise, no recent shipments of this species are known to have arrived at the Baltimore area market. Further expansion of *O. virilis* into other portions of the watershed or elsewhere will depend on its ability to cross the 5 to 10 ppt salinity barrier (Stroup, Pritchard and Carpenter, 1961) of the lower Patapsco River near Baltimore. Its introduction into other tributaries or watersheds of the State can come through man's activities or entry via overland migrations.

TABLE 2

*Ecological environmental conditions noted for selected stations along the Patapsco River where crayfish were collected*

| Station number | Date | Time | Air temp. °C | $H_2O$ temp. °C | pH | D.O. ppm | B.O.D. ppm | Suspended solids ppm | Dissolved solids | Total solids | Color | Turbidity | Coliform | *E. coli* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B1 | 3/ 2/61 | 1310 | 11.0 | 7.0 | 6.5 | 12.15 | 2.17 | 7 | 66 | 73 | 25 | *100 | —— | —— |
| B1 | 10/ 9/61 | 1325 | 22.0 | 16.0 | 7.4 | 8.80 | 4.56 | 11 | 63 | 74 | 25 | *100 | 23,000 | 9,300 |
| B3 | 10/ 9/61 | 1538 | 25.0 | 16.0 | 8.65 | 11.08 | 0.60 | 9 | 66 | 75 | 25 | *100 | 9,300 | 2,300 |
| B4 | 10/ 9/61 | 1615 | 21.0 | 18.0 | 7.8 | 9.90 | 0.75 | 9 | 62 | 71 | 25 | *100 | 4,300 | 93 |
| B5 | 10/10/61 | 1315 | 28.0 | 17.0 | 7.3 | 7.7 | ** | 40 | 56 | 96 | 50 | *100 | 1,100,000 | 460,000 |
| B6 | 3/ 3/61 | 0950 | 12.0 | 6.0 | 6.8 | 12.25 | 3.46 | 45 | 74 | 119 | 25 | *100 | —— | —— |
| B6 | 10/10/61 | 1340 | 24.0 | 22.0 | 7.4 | 8.9 | 1.1 | 60 | 52 | 112 | 35 | *100 | 23,000 | 4,300 |
| H1 | 10/10/61 | 1200 | 25.0 | 17.0 | 7.4 | 8.1 | ** | 92 | 8 | 100 | 80 | *100 | 2,400,000+ | 640 |
| H2 | 10/10/61 | 1015 | 21.0 | 16.0 | 7.2 | 9.1 | 1.9 | 14 | 72 | 86 | 25 | *100 | 93,000 | 4,300 |
| C2 | 10/ 9/61 | 1155 | 22.0 | 14.0 | 7.2 | 8.34 | 1.69 | 7 | 91 | 98 | 20 | *100 | 150 | 43 |
| C8 | 11/ 6/61 | 1400 | 8.0 | 6.5 | 7.2 | 9.86 | 0.91 | 6 | 66 | 72 | 20 | *100 | —— | —— |
| C9 | 10/ 9/61 | 1450 | 25.0 | 16.0 | 7.5 | 10.76 | 1.49 | 13 | 59 | 72 | 25 | *100 | 93,000 | 4,300 |

*—Less than.
**Trace.

In view of the rapid expansion of *O. virilis* in the Patapsco River watershed at the expense of the once abundant *O. limosus*, re-evaluation of the effects of crayfish introductions or shifts in species populations in other parts of the nation should be given consideration. Likewise, investigations of the environmental limits which *O. limosus* tolerate will be of extreme importance in order to understand the changing crayfish faunas of Maryland streams.

Thanks are due Dr. H. H. Hobbs, Head Curator Zoology, U. S. National Museum, Washington, D. C., for encouragement, comments regarding the introduction of *O. virilis* into Maryland and a review of the manuscript; and Mr. J. Witherspoon, Western Maryland College, Westminster, Maryland, for collections and Station C2–8 observations.

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