1957

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SOME EFFECTS OF HIGH-FREQUENCY X-RAYS ON THE OYSTER DRILL UROSALPINX CINEREA[1]

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Scientists of the Department of Agriculture (Bushland et al. 1955) recently announced the successful eradication of the screw-worm, Callitroga hominivorax, from the Dutch Island of Curacao. This was accomplished by releasing x-ray sterilized males, which competed successfully with normal indigenous males for the females. After such matings the monogamous females deposited only sterile egg masses. Although several releases were necessary, eventually no fertile eggs were detected at any of the numerous observation points. Subsequent checks failed to reveal any live flies.

Because existing information concerning ecology and reproduction of drills appeared favorable, our group was encouraged to investigate this technique as a possible control method for oyster drills. The present paper is a report of a series of experiments which were designed to determine the lethal dose.

Specimens collected from the York River, Virginia, were transported to Richmond wrapped in moist cheesecloth, and held in perforated plastic dishes in a covered, aerated, thirty-gallon aquarium of seawater which was constantly filtered. Locations of dishes in the all-wood rack were randomized in order to eliminate possible position effects. The animals were fed for several hours once a week by placing pieces of oyster meat in the dishes. During the irradiation period both control and experimental animals were transfered to small plastic boxes and handled in the same manner except for the actual x-ray exposure of the latter. Moist blotting paper was placed in each box to prevent desiccation. Following the last dose the blotting paper was removed and both controls and irradiated drills were returned to their regular containers in the tank.

The x-ray source was a beryllium window 1000 KVP machine located at the Medical College of Virginia. The snails were placed around the periphery of a circular wooden platform which was rotated at approximately two revolutions per minute. Dose rate measurements were made under the same conditions, with a thimble chamber substituted for one of the plastic

[1] This reserach was conducted under a contract with the U. S. Fish and Wildlife Service, No. 14-19-008-2372, Study of Oyster Drills in Chesapeake Bay. Contributions from the Virginia Fisheries Laboratory No. 75.

Reprinted from PROCEEDINGS OF THE NATIONAL SHELLFISHERIES ASSOCIATION, Volume 47, 1957

boxes. Two millimeters of aluminum filtration were added to remove the very soft components of the beam. The half-value layer in lead is 1.3 millimeters under these operating conditions. At a dose rate of 576 roentgens per minute the minimum dosage of 3,000 r required an exposure of 5 minutes and 12 seconds. Larger doses were secured by increasing, doubling, tripling, etc., the exposure time. For convenience higher levels were obtained by successive increments of 3,000 r each.

Series I

On February 3, 1956, six groups of drills not segregated by sex were irradiated at dose levels from 3,000 r to 18,000 r. Subsequent daily observations made over an 81-day period yielded the cumulative mortality data illustrated in figure 1. Mortalities exceeded 40 per cent only in the 6,000 r group. The others were near or below the level of the controls. Although there is this single exception to the general mortality curve pattern it seems evident that, under the conditions of the experiment, dose levels up to and including 18,000 r do not have a marked lethal effect on U. cinerea.

Series II

The cumulative mortalities of four groups of males and six groups of females irradiated in April were greater than those of the controls (Fig. 2). Of the dose range administered, from 21,000 r to 48,000 r, we are able to conclude that the lethal dose for this group of drills is from 24,000 r to 27,000 r. Although there are some slight discrepancies between these curves (e.g. the 48,000 r ♀♀ experienced lower mortalities than lower dose groups) we may assume that, given a longer observational period, all the drills receiving doses higher than 27,000 r would have died.

These data suggest that there may be a sexual difference in susceptibility to x-ray injury. All three of the high dose levels administered to males produced total mortality by the sixty-fourth day after irradiation. In comparison, only one group of females had been eliminated by the same time. None of the female groups which received doses in excess of 33,000 r was eliminated by the sixty-ninth day when the experiment was terminated. The experiments were not designed to test this point, however, and the data are not amenable to statistical analysis.

This phase of the experiment was terminated when the remaining irradiated drills and some of the controls were sacrificed for gonad smears. Although these smears appeared to indicate some adverse effects produced by radiation, the small number of subjects involved and the uncertainties of the interpretation render further conclusions unwise.

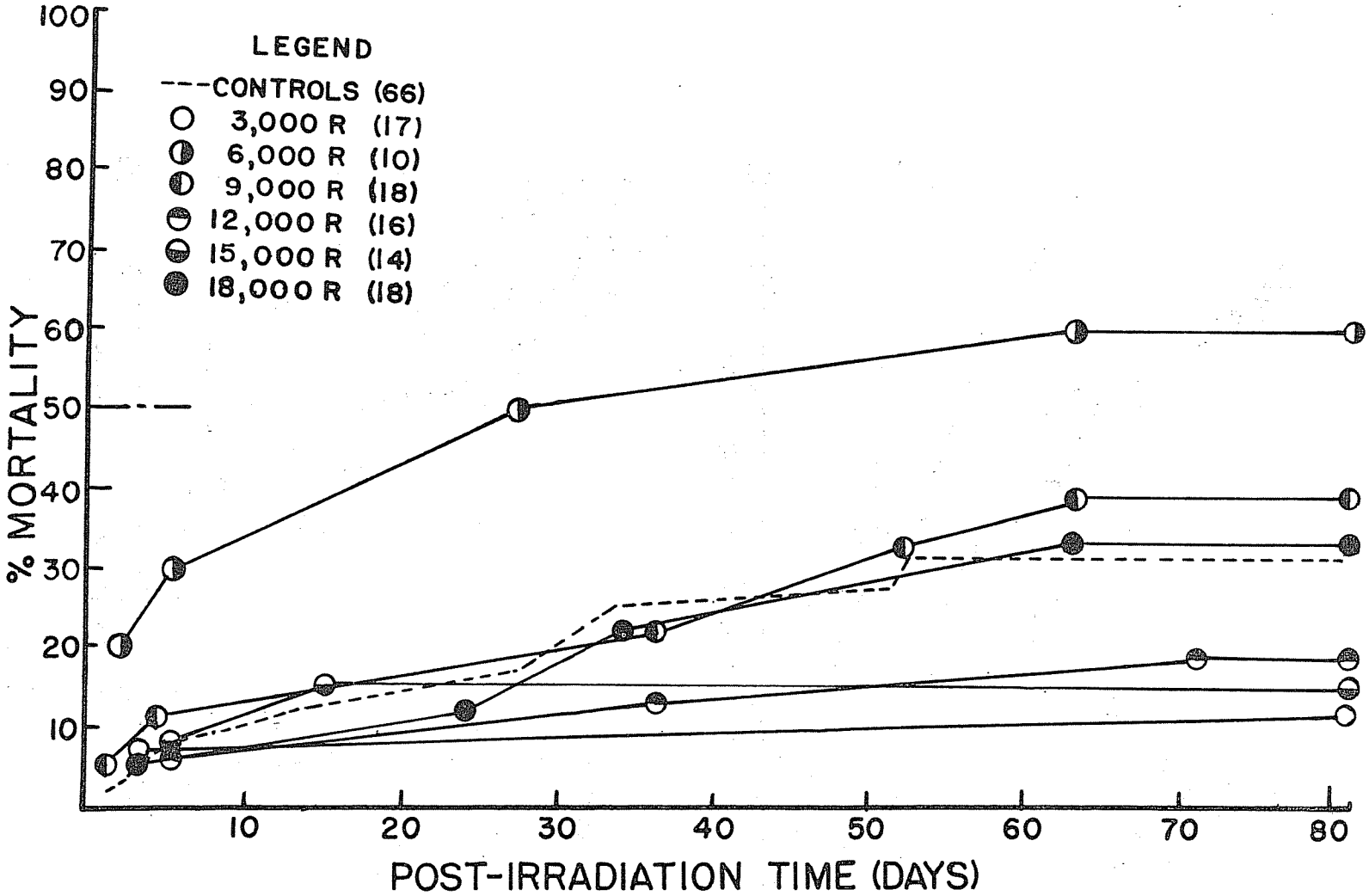

Fig. 1. Series I. Percentage mortality occurring in six groups of oyster drills, Urosalpinx cinerea, which were subjected to varying dosages of high-frequency x-rays. The numbers in parentheses are the individuals in each group.

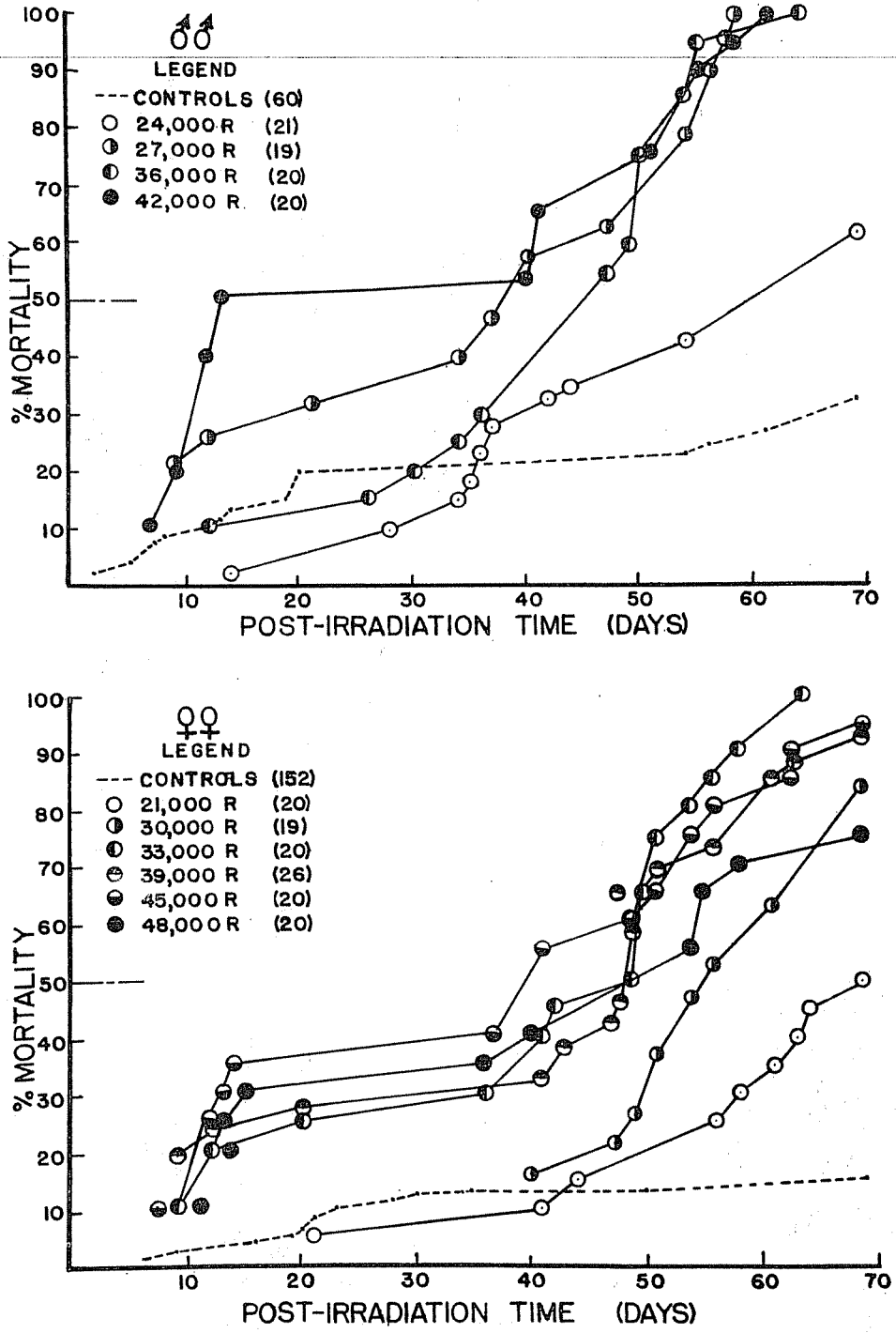

Fig. 2. Series II. Percentage mortality occurring in ten groups of oyster drills, Urosalpinx cinerea, which were subjected to varying dosages of high-frequency x-rays. The numbers in parentheses are the individuals in each group. Isolated points on graph indicate points of two or more curves which are identical.

We have shown that Urosalpinx cinerea from the York River, Virginia, can tolerate high dose levels of high-frequency x-rays. Like many invertebrates, drills survive irradiation for longer periods of time than mammals usually do. It is interesting that Bonham and Palumbo (1951) found that the gastropods Radix and Thais withstood large doses of high-frequency x-rays.

Even if irradiation is applicable as a control tool, the costs of handling and treating with an x-ray machine would be prohibitive. However, more economical sources, such as Cobalt-60, could probably be made available for commercial dosages.

Literature Cited

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