

Knipling E F. Possibilities of insect control or eradication through the use of sexually sterile males. *J. Econ. Entomol.* 48:459-62, 1955.
[Entomology Research Branch, Agricultural Research Service, USDA]

The paper describes the effect on the dynamics of insect populations subjected to competitive mating by the release of insects sexually sterilized. Simple simulation models depict the increasing adverse impact on reproductive success as the natural population declines, a type of suppressive action not produced by conventional control methods. [The SCJ[®] indicates that this paper has been cited in over 150 publications since 1961.]

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"The Citation Classic paper describes how pest populations are controlled when subjected to sterile insect releases. The same issue of the journal contains a publication (Baumhover *et al.*¹) reporting results of the method applied against the screwworm (*Cochliomyia hominivorax*), an important livestock pest. The experiment confirmed the feasibility of a method I had proposed in 1937. The screwworm is highly susceptible to cold weather. Prior to its elimination from the eastern US, populations in summer normally increased to one hundred million or more and spread into several states,¹ but in winter I estimated that populations declined to about one million per week and existed only in southern Florida. A relevant factor was that Melvin and Bushland² succeeded in rearing screwworms by the millions. It was reasoned that if lab reared flies would inhibit reproduction in nature this would offer a new method of control, especially when populations were low. A colleague, R.C. Bushland, and I considered accomplishing this by releasing flies sterilized with a chemical, or by releasing strains that transmitted genes incapable of survival in a natural environment. Indeed, Serebrovsky,³ of the USSR, proposed in 1940 that detrimental genetic translocations might be useful in insect control. Research on the idea was delayed by involvements in other proj-

ects prior to and during World War II. However, the 'autocidal' approach was discussed with other scientists. The general reaction ranged from skepticism to ridicule. Nevertheless, after having been assigned responsibility for directing USDA's research on livestock pests in 1946, I made efforts, to no avail, to obtain funds for research on the concept. Then, another colleague, A.W. Lindquist, called my attention to Muller's paper⁴ describing the sterilizing effects of X rays on drosophila. I wrote to Muller describing my theory of screwworm control by releasing sterile flies in natural habitats. He had reservations about certain ecological aspects, but expressed confidence that screwworm flies could be sterilized by X-ray exposure. Accordingly, Bushland was urged to undertake research on the effects of X rays on the screwworm. Bushland and Hopkins⁵ not only found that X-ray treatment sterilized the flies, but sterile egg masses were proportional to the ratio of sterile to fertile flies in caged populations. A vital question remained: would sterile flies perform their mission in natural habitats? The dramatic results reported by Baumhover *et al.*¹ answered this question. Thus, the sterility technique was eventually used to cope with the screwworm problem, and has saved the livestock industry several billion dollars.

"I received a number of awards for my role in developing the technique. But it was particularly gratifying to have participated in research on a concept that few scientists regarded as technically and operationally feasible. Looking to the future, scientists are making use of the technique against other costly and dangerous pests, as evidenced by a recent International Atomic Energy Association report.⁶ The basic principles of pest population regulation by genetic mechanisms are sound. The technology required to put such a system into practice is slowly being developed. It remains to be seen if the pest management community will take full advantage of the potential this unique ecologically desirable method offers for managing many of the world's most costly and formidable insect pests."

1. Baumhover A H, Graham A J, Hopkins D E, Dudley F D, New W D & Bushland R C. Control of screwworms through release of sterilized flies. *J. Econ. Entomol.* 48:462-6, 1955. (Cited 115 times.)
2. Melvin R & Bushland R C. A method of rearing *Cochliomyia americana* C and P on artificial media. Washington, DC: US Department of Agriculture, Entomology and Plant Quarantine Bureau, 1936. ET-88.
3. Serebrovsky A S. On the possibility of a new method for the control of insect pests. *Zool. Zh.* 19:618-30, 1940. (Cited 75 times.)
4. Muller J H. Radiation damage to the genetic material. *Amer. Sci.* 38:33-60, 1950.
5. Bushland R C & Hopkins D E. Experiments with screwworm flies sterilized by X-rays. *J. Econ. Entomol.* 44:725-31, 1951.
6. Sterile insect technique and radiation in insect control: proceedings of the International Symposium on the Sterile Insect Technique and the Use of Radiation in Genetic Insect Control. Vienna: International Atomic Energy Association, 1982. 494 p.