Summary of Eradication Efforts and Lessons Learned

With the assistance of Michael J. Shannon, Jeffrey Stibick, and Thomas E. Wallenmaier of the Animal Plant and Health Inspection Service, I examined eradication efforts against 42 species or groups of species of introduced arthropods (Appendix). Doubtless various state agencies have records of additional eradication efforts; indeed, Frankie et al. (1982) list 38 species of Homoptera that have been eradicated from California. Eradication succeeded against 23 species, failed totally against 9 species, and for the remaining 10 species, the eradication efforts succeeded in some parts of the United States and failed in others (Table 2).

Principles for Designing Systems of Population Suppression

In developing the theoretical basis for screwworm eradication, Knipling (1966) used simple models. The release of sexually sterile males was predicted accurately by the model to have a progressively greater effect as the population declined from one generation to the next. The model indicated that the sterile insect release system is inefficient and impractical as a means of population control against high-density populations, but that it is highly efficient and practical against low-density populations.

These findings led Knipling and his colleagues to examine the effectiveness and efficiencies in relation to pest population density of parasites, predators, pathogens, pheromone traps, light traps, host plant resistance, and other methods of control as a basis for integrating them into robust and efficient systems for eradicating or managing entire populations on an area-wide basis (Knipling 1966, Knipling & Klassen 1976). Examples of characteristics of insect control measures in relation to selectivity, effectiveness, and efficiency are shown in Table 3. Control measures that tend to destroy the same percentage of a pest population regardless of its density and for which the cost efficiency per arthropod destroyed increases with density include insecticides, resistant plants, synthetic attractants in traps (such as trimedlure), insect pathogens, chemical arrestants of fruiting, trap crops, light traps, food baits, cultural measures, and inundative releases of predators or parasites.

When predators and parasites of a pest are released in an inoculative manner, they usually are effective only against moderate and high-density populations, and their cost efficiency increases with increases in the density of the pest population.

Control measures that are practical only against low-density populations and whose cost efficiency increases with decreasing pest population density include released, sexually sterile insects; sex pheromones in traps; and sex pheromones as mating disruptants and inhibitors of responses to pheromones.

In designing a system of control measures to eradicate a pest population, the following principles apply:

(1) Whenever possible, highly selective measures should be chosen. (2) Methods that are effective against high-density pest populations and methods that are effective against low-density populations should be integrated in such a way that the former potentiate the latter. However, combinations of such control measures are not always available. Pests can sometimes be eradicated with a single control measure or with combinations of control measures that tend to be cost efficient only against moderate and high-density populations. An example of the latter was the use of fruit destruction and broad-spectrum insecticides against the medfly in the 1929 campaign in Florida.

Factors That Influence the Ease of Achieving Eradication

Experience has shown some of the factors that may influence the ease of eradication of introduced pests are as follows:

- Earliness of detection and speed in mounting an eradication campaign.
- Degree of preadaptation of the invading pest to its new environment.
- Genetic plasticity of the invading pest.
- Number of host species.
- Number of generations per year.
- Reproductive capacity (*r*-selected)
- Ability to compete for niches (e.g., predatory behavior).
- Adaptations that protect against natural enemies and adverse physical factors.
- Availability of sensitive methods to detect low population densities.
- Availability of powerful methods to suppress the pest.
- Public perceptions of potential economic or public health importance of the pest.