

tips of young trees, both conifers and hardwoods, particularly of Aleppo Pine, Incense Cedar, Big Tree, Black Locust, Arizona Ash and Carob. They also damage trees by trampling and rolling, and by making runs and beds throughout the plantations. Practically all the plantations are within a game refuge. On one plantation, in sample areas of staked Aleppo Pine and Carob, all of the trees were eaten; on another, 90 per cent of the trees died as a result of deer injury.

The subject of control of deer damage will not be discussed here. Of the three principal methods of control—fencing, the killing of deer doing damage, and the use of repellents—the former has been made the subject of a previous paper.\* The killing of marauding deer has been made possible by recent legislation but, as yet, there are no results in hand upon which a discussion of the effects of that procedure can be based. A discussion of the use of repellents is of sufficient importance to warrant separate consideration and will, therefore, be made the subject of another paper.

## OYSTER PESTS IN CALIFORNIA†

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CALIFORNIA has a native species of oyster (*Ostrea lurida*) which has great commercial possibilities but which has never been utilized to any great extent. From the beginning of the industry exotic species have been brought into the State with varying degrees of success. The growers have been encouraged to bring in the foreign oysters and their investments have been protected by legislation. There has, however, been no provision made for the inspection of incoming shipments and as a result some of the California bays have become heavily infested with the Eastern drill (*Uro salpinx cinereus*, Say) and the slipper shell (*Crepidula fornicata*, Linnaeus). The drill is always destructive but the slipper shell on its native heath, in the presence of its natural checks, is not harmful. When transplanted the slipper shell may become a serious pest in the new environment. The native oyster industry in particular has suffered from its introduction, and it is important that due consideration be given this species in the administration of the oyster resources of California.

The American slipper shell or "quarter deck" is normally scattered along the New England coast and southward to the Gulf. They usually inhabit tide pools and shallow water, clinging to rocks, shells and other solid objects. They appear most frequently in clusters of six to ten individuals attached one upon another to a single object. The life history and embryology of this form have been of interest to scientists for some time, and the facts concerning its growth and development of the species have been well worked out. Only in recent years has it become of economic importance as a pest on the oyster beds.

\* Storer, T. I., and True, G. H., Jr., Deer Proof Fences in California, California Fish and Game, Sacramento, Vol. 17, No. 3, pp. 264-269.

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Recently the American slipper shell was introduced in the oyster producing waters of Great Britain through transplanting of American seed oysters. They have reproduced rapidly and have become a great menace to the oyster industry. In the lower end of Puget Sound where the native is produced in large quantities the slipper shell has become established. On the natural beds where the land has not been graded and diked the slipper shell does not grow in large numbers; on the artificial beds they are a serious problem.

The artificial beds are made up of a series of terraces each level of which is surrounded by a low dike which keeps two to fifteen inches of water over the bed at low water. The bottom is solid and covered with shell and oysters, making an ideal breeding place for the slipper shell. The damage by the pests is from three causes: (1) culling is made slow and difficult, (2) the pests occupy a large proportion of the room in the dikes designed for the oysters, and (3) from the condition of the oyster from infested areas it appears that the food of the oyster is taken by the slipper shell.

In the harvesting of some beds over half of the labor involved is in the handling of pests. More equipment is necessary to maintain production and the cost per bushel for harvesting is increased. If left on the beds the slipper shell would fill the dikes to the water level in a short time and prevent the growth of oysters therein. Removal of the pests from the beds is also necessary to prevent depletion of the food supply of the oysters.

It is possible that some means of biological control will eventually be worked out but at present removal by hand is the only relief. It is important, whenever possible, to prevent the introduction of pests of all kinds and avoid the serious loss which follows. At the present time we have no diked areas in California, but it is proposed to cultivate the native oyster in Humboldt Bay by this method. This place offers an ideal set of conditions for the industry and is entirely free from natural and imported pests. The introduction of detrimental species should be carefully avoided if the beds are to be made to produce to capacity.

Since the seed imported from Japan has been subjected to inspection the quality has greatly improved. At present practically nothing accompanies the oyster that is large enough to be visible. As an added precaution it would be well worth while to isolate imported seed as far as possible, and grow one species in each bay. In the case of Humboldt Bay it is strongly recommended that no opportunity be given to pests to establish themselves there. No foreign seed should be planted at any time regardless of its condition or the inspection it has been through.