Ecological impact of marshland recirculation ditches

Vincent H. Resh □ Steven S. Balling □ Mark A. Barnby □ Joshua N. Collins

The salt marshes of the United States comprise a 12-million acre "ribbon of green" that serves as the transition from land to sea. Global in distribution, salt marshes are far less extensive along the Pacific Coast than along the Atlantic or Gulf seashore, partially because the West does not have a coastal plain. However, to the early settlers of the San Francisco Bay Area, the marshlands must have seemed vast by western standards. For today, even though 75 percent of its marshes have been lost by filling and dredging, San Francisco Bay still has more than three times as much natural marsh as all other bays, estuaries, and lagoons in California combined.

Public concern about the fate of coastal marshes and wetlands has increased greatly during the past two decades because of increased understanding of the ecological importance of salt marshes. For example, San Francisco Bay marshlands filter suspended sediments from rivers and streams, play key roles in nutrient cycling, support several unique plants and animals, supply oxygen to the bay waters, and influence local climate.

Regulatory agencies and conservation groups have shown considerable interest in protecting the remaining lands. Some concern has been focused on the physical control practices used by mosquito abatement districts to reduce populations of salt marsh mosquitoes. Until fairly recently, post-World War II mosquito control practices in salt marshes and many other habitats consisted of a preventive schedule of pesticide applications. However, evidence suggested that these methods were expensive, insufficient for mosquito control, and environmentally unsound. Therefore, mosquito abatement districts returned to a control method first used in 1904, the addition of recirculation ditches to reduce the breeding habitat of mosquitoes and to increase access to these habitats by predatory fish.

What other consequences do ditches have on marsh life? In Atlantic coastal marshes numerous studies have attempted to delineate their effects. Unfortunately, because of differences in soil structure, vegetation type, and ditching method, the results of these studies are not fully applicable to the West Coast situation and add little to our understanding of the effects of ditching on California marshes. Therefore, a joint research effort between faculty and students of the University of California, Berkeley, and personnel of the California Mosquito and Vector Control Association Coastal Region Mosquito Abatement Districts was begun in 1977.

The philosophy underlying this study has been to develop experimental designs that will analyze the most fundamental and definable relationships in the marsh environment, in particular those subject to the physical changes caused by recirculation ditches, and then to examine their influence on basic biological processes, such as productivity and diversity of marsh biota. The experimental design includes pilot studies, field sampling programs, and data analysis to be conducted over a four-year period. Information on tidal cycles, water table, weather patterns, and physical and chemical factors is being correlated with the results obtained from examination of the responses of the flora and both the vertebrate and invertebrate fauna to ditching activities.

In choosing study sites, we had to consider in detail the influence of salinity and marsh elevation on the resulting salt marsh type or composition. San Francisco Bay, like all estuarine environments, is characterized by increasing salinity toward the ocean. These salinity differences, along with the relative height of the marsh above the local mean high tide level, greatly affect marsh plant communities. The two major "high" marsh communities in the San Francisco area are those dominated by (1) pickleweed, *Salicornia virginica* L., and (2) salt grass, *Distichlis spicata* (L.), and wire grass, *Juncus balticus* Willdenow. We have chosen marshes along the Petaluma River in San Pablo Bay and along Albrae Slough in south San Francisco Bay as sites representing the first marsh type. The second type is represented by a tidal marsh at the base of Potrero Hills in northern Suisun Bay.

A frequent explanation for the effectiveness of recirculation ditches in controlling salt marsh mosquitoes is that the ditches may improve access by predatory fishes. A recent study completed as part of this project has indicated that greater fish diversity and higher densities exist in recirculation ditches than in the natural salt marsh channels. However, this result depends on the physical design of the ditch, which must be constructed so as to allow water retention at low tides and thus provide adequate refuge for fish and their food sources.

In summary, our approach in analyzing the effects of ditching on salt marsh ecology is to develop questions that lead us to an examination of the biological relationships directly linked to the habitat changes caused by recirculation ditches. We are confident that such an approach will provide information needed by all concerned parties — mosquito abatement districts, regulatory agencies, and conservation groups — to make decisions that will maximize mosquito control yet minimize environmental disruption of these ecologically important habitats.

Vincent H. Resh is Associate Professor, Steven S. Balling and Mark A. Barnby are graduate students, and Joshua N. Collins is an undergraduate student, Division of Entomology and Parasitology, University of California, Berkeley, CA 94720.