A Marsh is a Marsh is a Marsh . . .
But not Always to a Salt Marsh Harvest Mouse

by Howard Shellhammer, Phd.

Salt Marsh Harvest Mouse © Photo by Dr. Howard Shellhammer

Scientific names are often quite illuminating Reithrodontomys raviventris, for example, means the "grooved-toothed mouse with a red belly" but most of us call the animal the salt marsh harvest mouse. These mice, who live only in the salt marshes of the San Francisco Bay, are listed as an endangered species at both the federal and state levels because so much of their habitat has disappeared in the last 150 years. The salt marsh harvest mouse does have grooved upper front teeth, and many of them living in the southern end of their range have reddish bellies. Unusual for land mammals, the salt marsh harvest mouse can tolerate quite salty water and food. Mice of the northern subspecies can survive on sea water but prefer fresh, while those of the southern subspecies prefer water midway between fresh and salt.

Salt marsh harvest mice are what scientists call "cover dependent species" in that they only live under thick vegetation, and possibly as a result are much calmer-acting than their grassland cousins, the western harvest mice, and most other mice for that matter. Salt marsh harvest mice are among the smallest rodents in the United States; the body of an adult mouse is about the size of your thumb and weighs a bit less than a nickel. Try holding one nickel in your hand and imagining a complicated, active, furry, small mammal weighing that little. Since they are so small, salt marsh harvest mice do not live long; a life time of nine months is an exceptional one. The average female has one litter of three to four young, although a few mice may have two litters during their short lives. Biased as I am after many years of studying salt marsh harvest mice, I think they are beautiful - small, relatively calm animals with big eyes and appealing faces. So, why are such innocuous and charming animals on the endangered species list? The simplest answer is that the salt marsh harvest mouse has slowly disappeared as humans have modified what has long been considered that "worthless marshland along side the Bay".

The salt marshes of the 1850s had, and a few marshes today still have, three broad zones of vegetation bordering the grasslands that surrounded the Bay: cordgrass (*Spartina foliosa*) in the lowest, most tidally influenced zone; pickleweed (*Salicornia virginica*) in the middle; and an upper zone of various peripheral halophytes (or salt tolerant plants) that grow along the Bay's upper edge. Historically, there were also small ponds located in the upper zone. Migratory waterfowl and shorebirds used those natural

ponds, tidal channels and mudflats much like these birds use artificial salt ponds and adjacent channels and mudflats today. The marshes of the 1850s were much more extensive and contiguous than today's, reaching into the grasslands on all sides of the Bay. Similarly, the branching tidal channels were more prevalent and complex.

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Today, many of the Bay's marshes of may look like complete marshes to the general public but are probably not an acceptable marsh as seen by the salt marsh harvest mouse. Unacceptable marshes for mice have resulted primarily from changes to the vegetation zones. The South San Francisco Bay marshes in particular have been affected by a triple whammy of human-made changes. First, almost all of the upper edges of most marshes have been filled in, covered over, or converted to salt ponds reducing the peripheral halophyte zone to narrow, near vertical bands along leeve banks with no connections to adjacent grasslands (if any exist); without this zone the salt marsh harvest mouse no longer has cover from predators when high tides push them out of the middle zone. Second, salt marsh zones are subject to subsidence and increased tidal coverage resulting from ground water pumping hence the broad pickleweed zone, favored by the salt marsh harvest mouse for habitat, diminishes. Lastly, non-saline sewage effluent being discharged into the Bay changes marsh vegetation by benefiting plant species that prefer fresh or brackish water (like cattail and bulrush) and are not used by the mouse. If the cordgrass zone increases due to one or more of the above factors, salt marsh harvest mice do not reap any reward as cordgrass is too often covered by tides and inaccessible.

With years of habitat loss and modification new predators have been introduced into the salt marsh harvest mouse's environment. Given that most remaining marshes share an upper side with a leveed salt pond, business park, or subdivision, access to the marshes is much easier for feral cats, house cats and non-native red foxes. These animals prey on the mice in addition to native predators like hawks, owls, herons, and clapper rails. The California clapper rail, interestingly enough, is one endangered species that eats another endangered species...I guess they don't read government bulletins.

While the salt marsh harvest mouse continues to fight for survival, a few marsh areas within the boundary of Don Edwards San Francisco Bay National Wildlife Refuge, like Calaveras and Dumbarton Points, Greco Island, and New Chicago marsh, provide hope for the species. Research indicates that mouse populations may be sustaining themselves in some of these areas. How many mice, you might ask, are necessary for the long term survival of the species? To answer this question, scientists need to know

about the degree of genetic variability in a population as it relates to the level of adaptability of that population.

Salt marsh harvest mice, like humans, other animals and plants, adapt over time to changes in their environment by variations in genetic make-up. Genetic variability allows animals with appropriate genes to respond to changes in the environment, like temperature fluctuations for example, by producing more surviving offspring. If an environmental shift takes place over many generations a population will become less and less variable for the genetic trait involved; to put it another way, a population's success is highly correlated with uniformity. There is a downside however, to this type of success. If the population becomes totally uniform for the trait it is likely that it will not be able to adapt when the same environmental factor swings to a different extreme in the future. With temperature, the quicker a shift in climate moves from one level to another, the faster a population of mice with inappropriate genes dies off. It is for these kinds of reasons that conservation biologists think that genetic variability is necessary for adaptability of organisms if they are to survive over the long run.

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If we could estimate the effective population size of the salt marsh harvest mouse, we might be able to predict how small populations could get before they lose their capacity to keep adapting. Unfortunately, we have almost no genetic information on this species. Indeed, we may already be dooming many populations of the mouse to genetic death by confining them to small, isolated, inhospitable marshes where their population sizes are restricted. Without adequate information about genetic variability researchers and land managers, like U.S. Fish and Wildlife Service, need to err on the side of the mouse, the California clapper rail, and other endangered species that use or are limited to the marshes of San Francisco Bay by designing and reconstructing larger more complete marshes that would allow for larger species populations. Opportunities for creating these types of marshes throughhabitat acquisition and restoration do exist in the Bay area but are limited. Scientific and technological approaches to marsh reconstruction are debated by the experts routinely and need to be explored further.

Our children may see a different looking Refuge in the years to come, especially in the South San Francisco Bay where large marshes with internal ponds and deep upper edges might be possible through continued restoration and management efforts. The overall biological support base will be greater and more diverse if these efforts are successful. Perhaps in the Refuge of tomorrow, a marsh will be a marsh will be a marsh to all its inhabitants including the salt marsh harvest mouse, the beautiful little grooved tooth mouse with the red belly.

Howard Shellhammer, Ph.D, Professor of Biology at San Jose State University, 1961-1996. Currently, teaching Spring semesters only as part of Faculty Early Retirement program. Dr. Shellhammer received his degree in Zoology from University of California at Davis and has studied the salt marsh harvest mouse for over 35 years. As an active participant in the effort to create Don Edwards San Francisco Bay NWR, Dr. Shellhammer was one of the original group that petitioned Congress to pursue its establishment.