

## Novel Foraging Behaviors of the Salt Marsh Harvest Mouse and Competitors

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**Received:** May 12, 2026; **Accepted:** May 22, 2026; **Published:** May 28, 2026**ABSTRACT**

The salt marsh harvest mouse (*Reithrodontomys raviventris*; SMHM), an endangered species endemic to the San Francisco Estuary, coexists and competes with other native and invasive rodents for resources.

**Keywords:** Salt Marsh Harvest, Live trapping, Data Mining**Introduction**

The salt marsh harvest mouse (*Reithrodontomys raviventris*; SMHM), an endangered species endemic to the San Francisco Estuary, coexists and competes with other native and invasive rodents for resources. While intensive studies in recent years have revealed more about the ecology of these species, little is known of the impacts of interspecific competitive dynamics on daily ecological functions. Similarly, there has been minimal research on intraspecific interactions of SMHM. Rodents may compete for refuge territory, nesting habitat, and forage resources throughout the year.

While it was previously believed that SMHM consumed a small number of plants, primarily pickleweed (*Salicornia pacifica*), recent studies have shown SMHM to have a highly flexible diet which indicates that they are foraging widely throughout their core and peripheral habitat, potentially bringing them into conflict with upland associated rodents. Unfortunately, the foraging behaviors of SMHM are not well understood, and less is known about the foraging of sympatric rodents in the marsh habitat that SMHM typically occupy. A poor understanding of ecological interactions can hinder management and restoration activities by creating conditions where SMHM are less competitive than other native and non-native rodents in their range.

**McInnis Marsh Study Area****Methods****Live Trapping**

Live trapping small mammal surveys were performed at six survey areas across McInnis Marsh, a mixed wetland area, in the spring and fall annually between 2020 and 2025. Two of the trap grids were placed in tidal marsh, two in diked managed marsh, one was split between tidal and managed wetland, and one was in an upland area. Standard small mammals trapping protocols were followed. Traps were set at sunset, and checked at sunrise. Opportunistically trail cameras were placed within or near all trap grids overnight to document rodent behaviors throughout the study area. Both live traps and trail cameras were baited with birdseed and ground walnut.

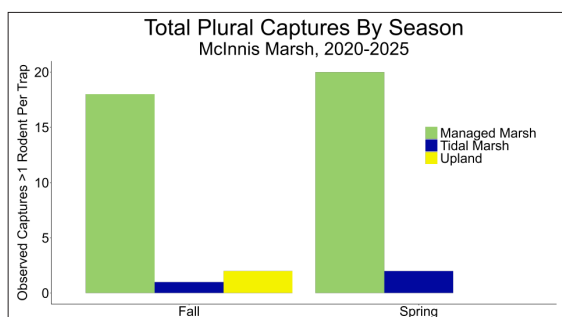
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Following surveys, camera trap photos were reviewed for wildlife presence and behaviors. Live trapping data was reviewed and instances where >1 rodent were captured (plural captures) in the same trap was recorded.

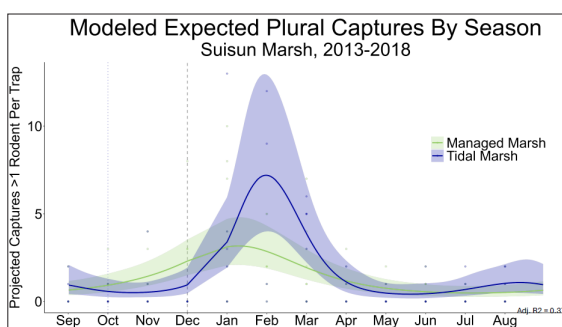
### Data Mining

Since all trapping at McInnis Marsh occurred during relatively cool periods, a long-term monthly trapping study in Suisun Marsh (spanning 2013-2018) was also analyzed. As for the McInnis Marsh dataset, the live trapping data was reviewed and all instances of plural capture were recorded. This data was then analyzed for correlations with seasonality and site characteristics utilizing a generalized additive model (GAM) with a Poisson distribution.

### Results



Plural captures of rodents were relatively rare overall (n=43), and substantially more were observed at managed wetlands at McInnis Marsh than the other habitat types. There was no clear pattern of seasonality, though the two survey periods typically had relatively similar weather conditions. Opportunistic camera trapping documented multiple SMHM foraging together on multiple occasions, and in the spring of 2023 three individuals were documented foraging together non-aggressively at the Managed Southeast grid (top right photo). In the fall of 2024, three house mice were documented foraging together with minimal aggressive interactions (bottom right photo).



During the Suisun Marsh study many more plural captures occurred (n=214). The greatest proportion of total captures consisting of more than one rodent occurred in winter. In December 2.44% of capture events were plural, followed by 6.66% in January, 4.70% in February, and 3.35% in March. Plural captures accounted for <2% of all capture events in all other seasons, and were rarest in July (0.62%), a peak breeding period when king tides also occur. Results of a GAM that tested for effects of year, month, habitat type, and site confirmed that month, habitat type, and site had significant impacts on the occurrences of plural captures. It indicated strong seasonal variation that interacted with wetland type. Interannual variation

was negligible, suggesting consistent seasonal patterns across years from 2013 to 2018. In contrast, significant site-level variation indicated persistent spatial differences in capture rates among trapping locations.

Plural ~ s(Month, by = Habitat, bs = "cc") + s(Year, bs = "re") + s(Site, bs = "re")				
Smooth term	EDF	Ref. df	$\chi^2$	p-value
s(Month): Habitat (Managed)	2.83	8	150.41	< 0.001
s(Month): Habitat (Tidal)	4.93	8	658.00	< 0.001
s(Year)	~0	1	0.00	0.920
s(Site)	5.90	6	24.19	< 0.001



### Discussion

Though SMHM researchers have long observed anecdotally that plural captures seemed more common during cold periods, this is the first analysis to confirm it. Analysis of long-term monitoring data at sites in San Pablo Bay and Suisun Marsh indicate that this occurs regularly, and most often during winter months. Both studies also demonstrated differences by habitat type. At McInnis Marsh plural captures were dramatically higher in the managed marsh than in the tidal marsh, while the opposite was true during many months in Suisun. This is likely due to differences in habitat management activities in the managed wetlands. Further investigation is warranted.

Observations of up to three rodents foraging together at McInnis Marsh on trail cameras demonstrates that the implication of communal behavior observed with higher proportions of plural captures can translate to actual group foraging. This has consequences for live trapping; more bait and bedding are recommended when trapping on cold nights. Further, camera observations of harvest mice avoiding areas where house mice have foraged or are actively foraging support assumptions that house mice are an important competitor of SMHM.

Additional investigation of foraging behavior by SMHM and their competitors could improve management and restoration actions by identifying methods for reducing competition on SMHM and discouraging marsh habitat use by non-native rodents.



Salt marsh harvest mice foraging together in Managed Southeast grid at McInnis Marsh.



Non-native house mice foraging together in Managed Northwest grid at McInnis Marsh.

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