

# Identifying the Consumptive and Competitive Impacts of Introduced House Mice (*Mus musculus*) on a Seabird Island Ecosystem

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Photo: NOAA's Greater Farallones National Marine Sanctuary



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Background:

# The Farallon Islands: California's Galapagos



(Photos from PRBO)

Background:

# The Farallon Islands: California's Galapagos





Background:

# Eurasian House Mouse

## (*Mus musculus*)

- Introduced in late 19<sup>th</sup> century
- Some of the highest recorded densities on any island
  - 60k mice on a 0.3 km<sup>2</sup> island



Background:

# What are the ecosystem impacts of introduced mice on the Farallon Islands?



Background:

# What is Known?

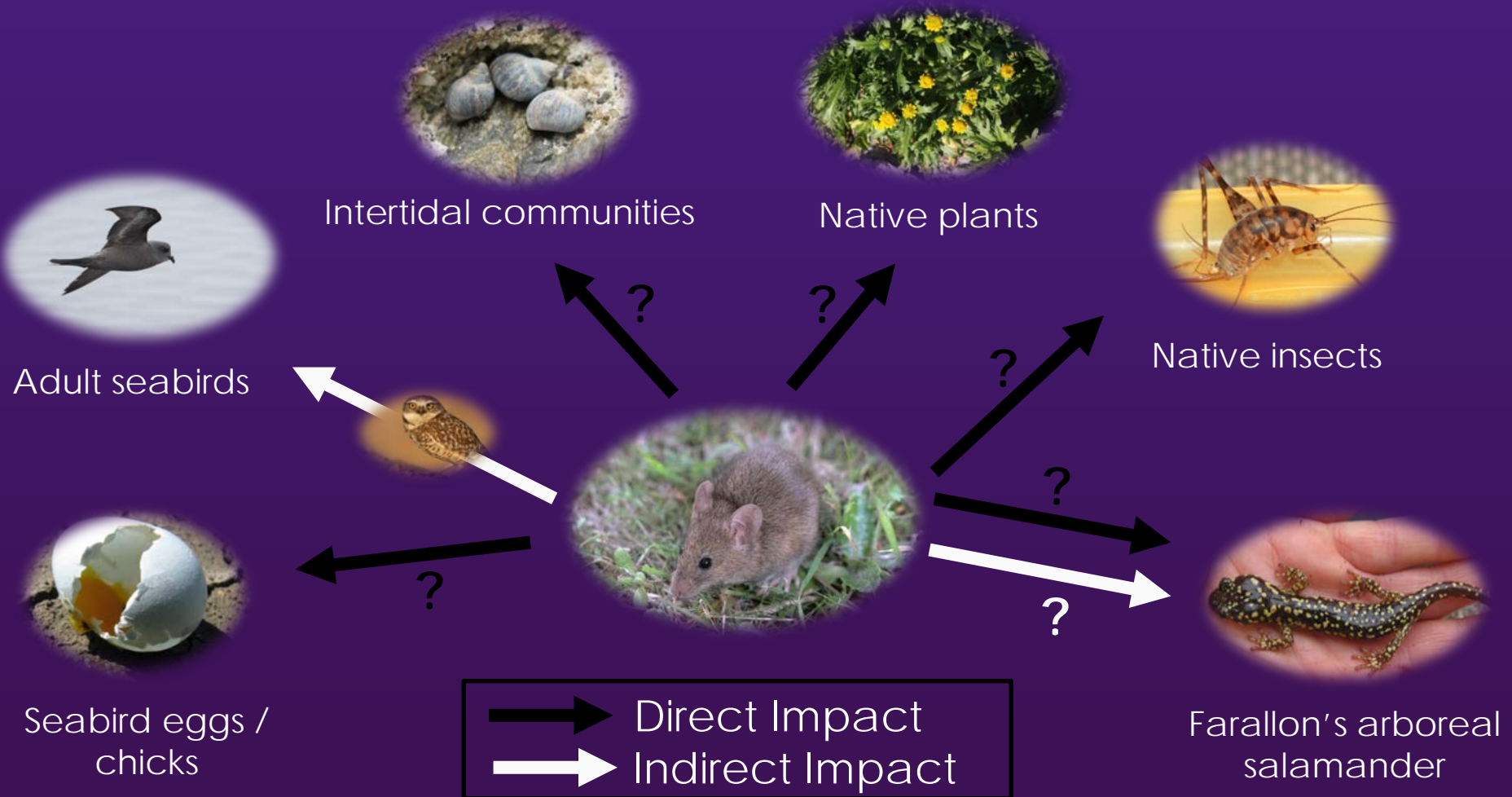
Mice indirectly impact adult seabirds via facilitated predation by Burrowing owls



Chandler, S. L., Tietz, J. R., Bradley, R. W., & Trulio, L. (2016). Burrowing Owl Diet at a Migratory Stopover Site and Wintering Ground on Southeast Farallon Island, California. *Journal of Raptor Research*, 50(4), 391-403.

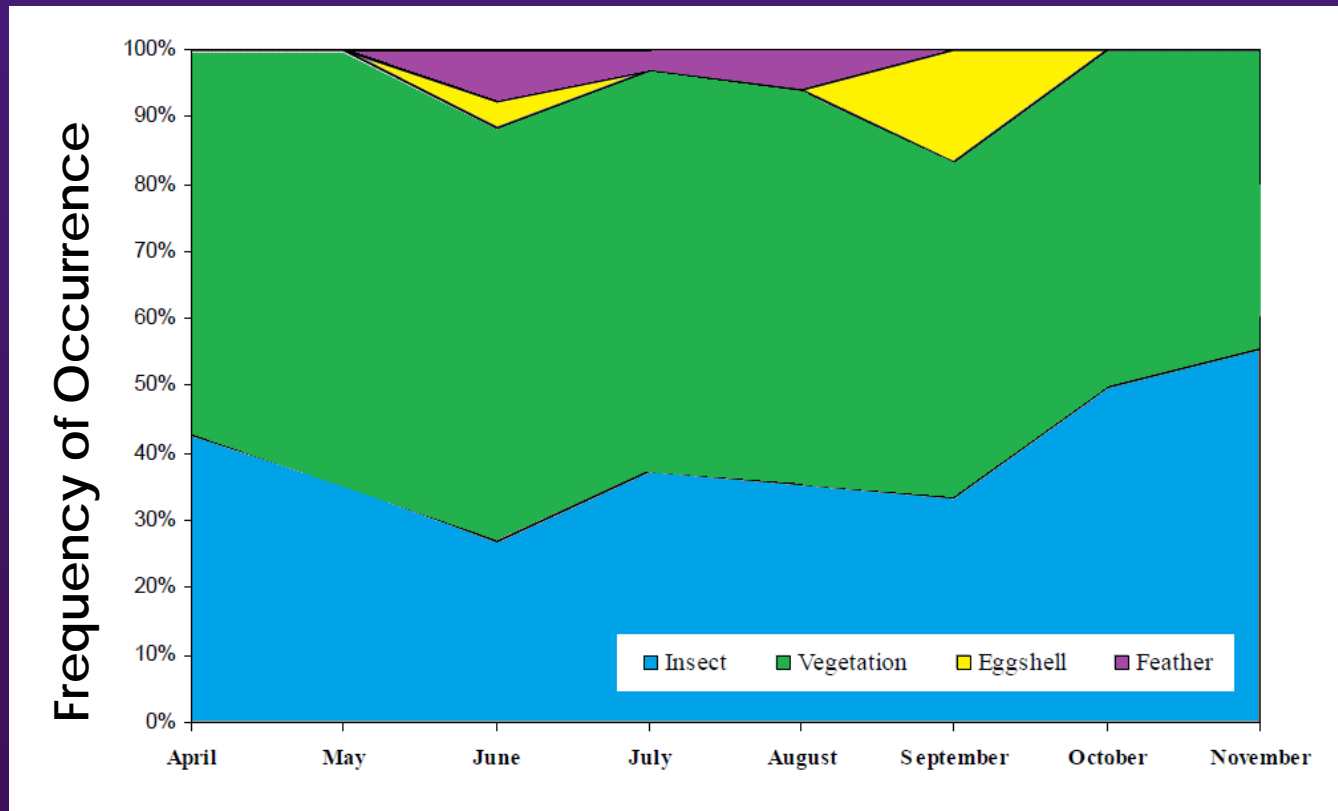
Background:

# What is Unknown?



Background:

# A prior dietary study focused on stomach contents



Jones, M.A. and R.T. Golightly. 2006. Annual variation in the diet of house mice (*Mus musculus*) on Southeast Farallon Island. Unpublished report. Department of Wildlife, Humboldt State University, Arcata, CA U.S.A





# Objective:

Use stable isotope analysis (SIA) to quantify the diet & ecological niche of invasive house mice on the Farallon Islands

Tissue SIA provide an integrated record of diet that avoids many of the biases of stomach contents



# Questions:

1. How does mouse abundance and resource availability change seasonally?
2. How does mouse diet respond to seasonal changes?
3. What are the direct (consumption) and indirect (competition) impacts of mice?

## Methods:

# Mouse abundance & resource availability

## Seasonal trends:

- Mouse abundance (trapping success): 2001-2017
- Vegetation (precipitation): 2001-2017
- Insect density: 2014
- Seabird abundance (carcass counts): 2001-2017
- Salamander abundance: 2008-2017



## Methods:

# Mouse diets & ecological niche

Spring/Summer/Fall 2013

## Tissue collection:

- Mouse liver & muscle
- Prey tissues: plants, seabird, salamander (tail clips), insects, intertidal sp. (snails)

## Data analysis:

- $\delta^{13}\text{C}$  &  $\delta^{15}\text{N}$
- Isotopic mixing model  
(Parnell et al. 2010)
- Isotopic niche overlap  
(Jackson et al. 2011)

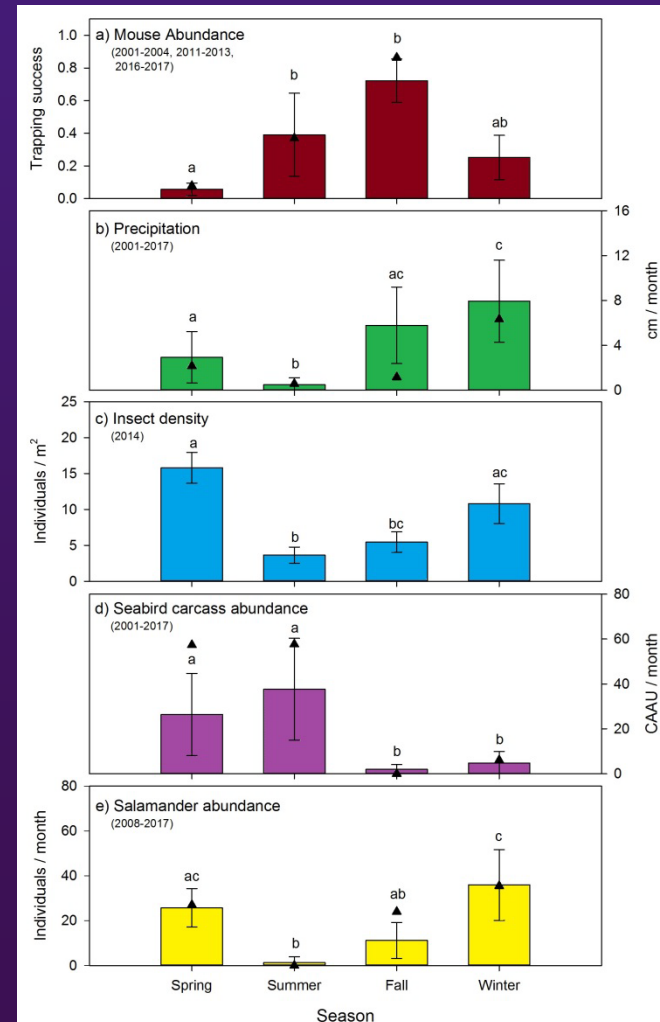




## Results:

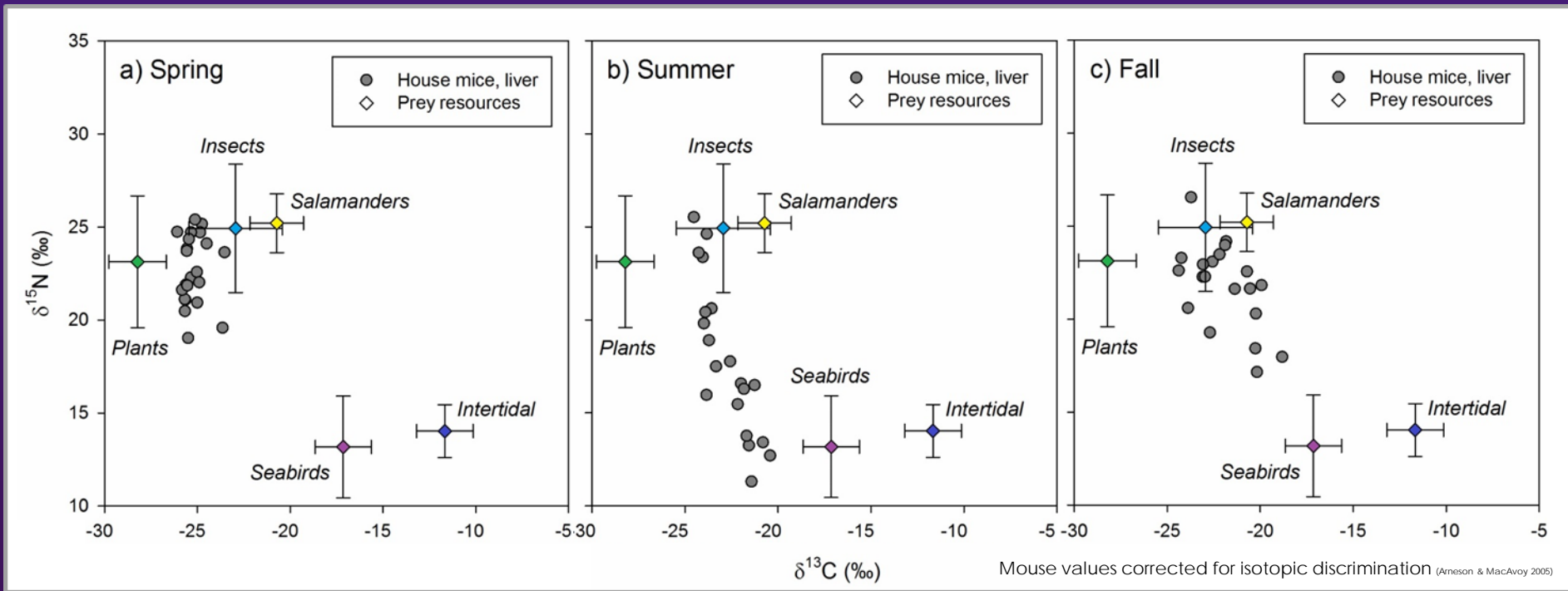
# Mouse abundance & resource availability varies seasonally

- Spring:** Mouse abundance is lowest. Insects and veg. cover are high following heavy rain in the fall/winter.
- Summer:** Seabird abundance peaks. Salamander & insect abundances are lowest.
- Fall:** Mouse abundance peaks. Veg. cover and seabird abundances are lowest.
- Winter:** Mouse abundance crashes with heavy rain. Salamander abundance peaks.



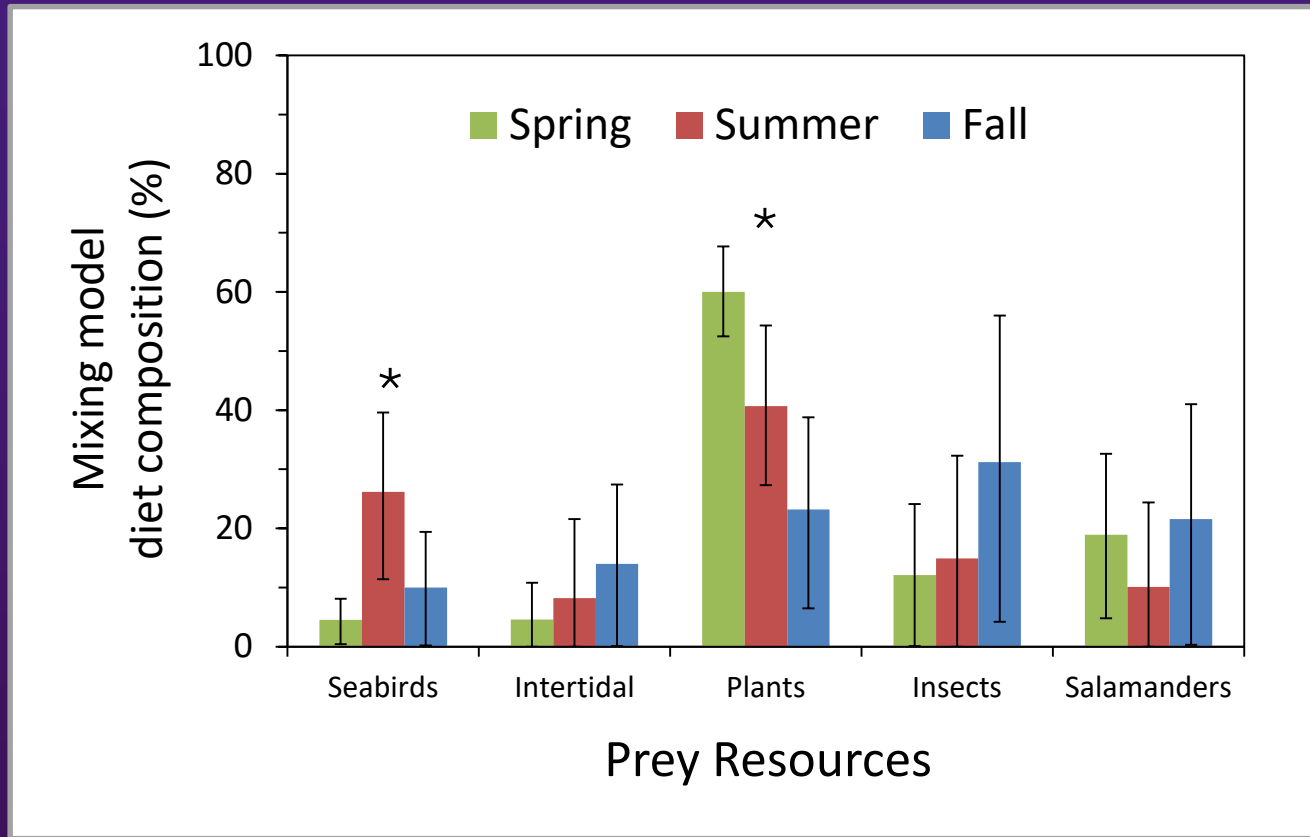
## Results:

# Mouse stable isotope values vary seasonally



- Mouse SIA values differ between seasons  
( $\delta^{13}\text{C}$ :  $F_{2,126} = 66.61$ ,  $p < 0.001$ ;  $\delta^{15}\text{N}$ :  $F_{2,126} = 26.60$ ,  $p < 0.001$ )
- Liver and muscle tissue SIA values strongly correlated  
( $\delta^{13}\text{C}$ :  $r = 0.908$ ,  $p < 0.001$ ;  $\delta^{15}\text{N}$ :  $r = 0.946$ ,  $p < 0.001$ )

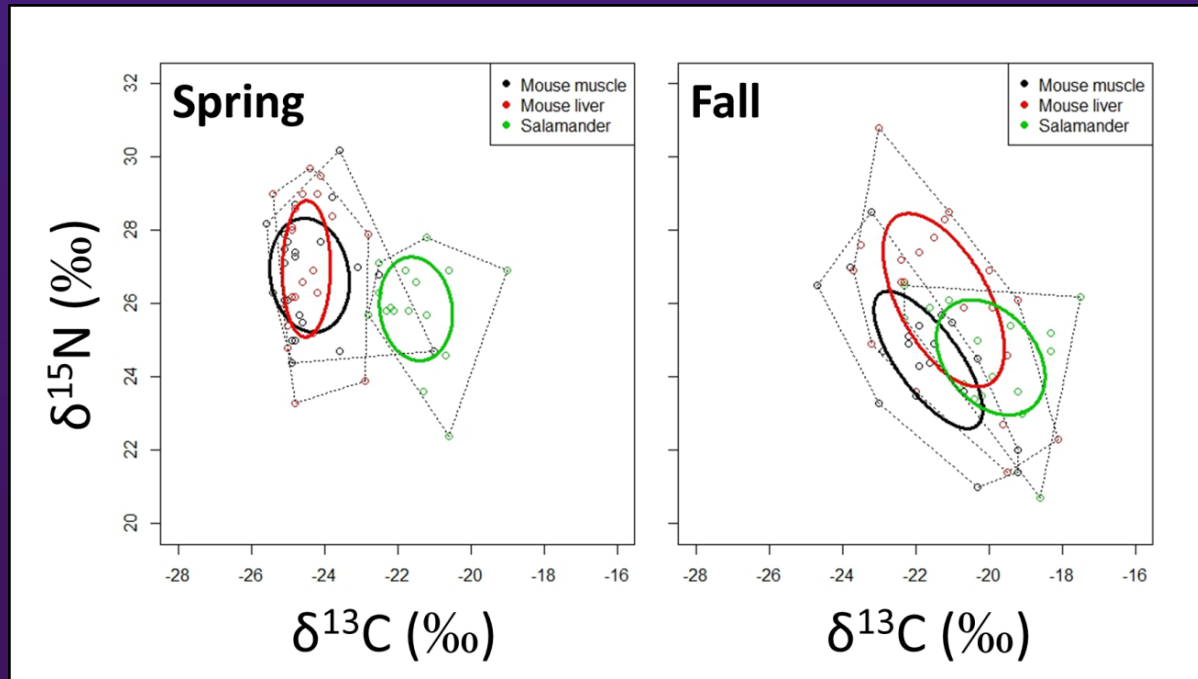
# Mouse diets shift seasonally



- Plants are always important and peak in diets during **Spring**
- Seabirds peak in diets during **Summer**
- Insects possibly peak in diets during **Fall**

## Results:

# Isotopic niches of mice & salamanders overlap in the Fall but not Spring



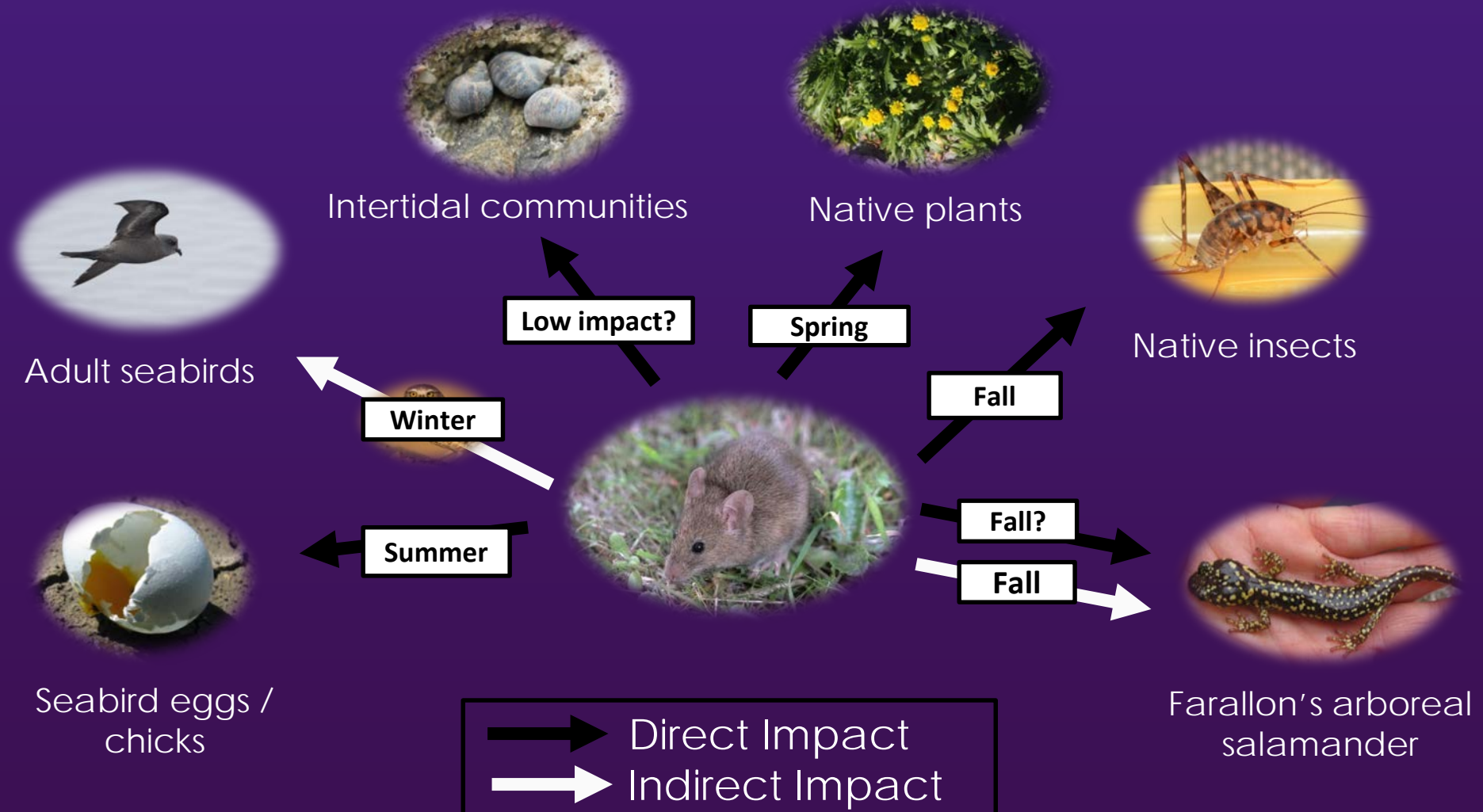
Mice & salamanders both consume insects:

Highest isotopic niche overlap in the Fall when mouse populations peak and other food sources are low



Summary:

# Mouse diets (& impacts) shift with seasonal changes in resource availability



## Conclusions:

# Mice have consumptive & likely competitive impacts on the Farallon Islands ecosystem

- Seabirds increase in mouse diet during seabird breeding season (predation or scavenging?)
- Mice may compete with salamanders for insect prey, direct predation is possible as well
- Uncertainty remains
  - Relative vs. absolute abundance
  - Winter diets?
  - Native vs. non-native plants in diets?

Conclusions:

A final thought:

How will community members respond if mice are eradicated?

## Feds Propose Showering Farallon Islands With Poison To Kill Mice And Save Ecosystem

The Huffington Post | By Lydia O'Connor

Posted: 08/20/2013 1:54 pm EDT | Updated: 08/20/2013 4:07 pm EDT

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# Questions?

## Thank you!

- ESA Organizing Committee
- US Fish & Wildlife Service
- Farallon Islands National Wildlife Refuge

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