Suitability of Ground Squirrels as Prey for Golden Eagles in a Changing Climate

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Our Target

- Show how climate change may affect prey species for Golden Eagles, in particular California Ground Squirrels

- Present a general methodology for evaluating impacts of climate change on Golden Eagle breeding distribution

Motivation

Questions:

- Under what conditions are Ground Squirrels suitable as main prey items for Golden Eagles?

- How can we predict the effects of climate change on their distribution?
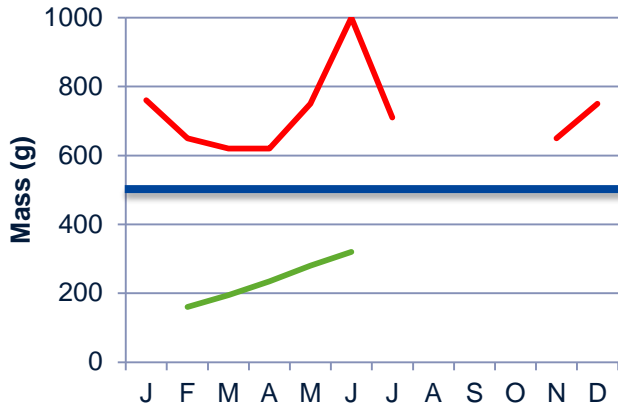
Golden Eagle prey

ASSUMPTION: Golden Eagles require a diurnal <u>main</u> prey item with a body size in the 0.5-4 kg range at the time they have young in the nest.

Ground squirrels (*Urocitellus spp.*) seasonally achieve large body sizes (e.g. *U. richardsonii* and *U. elegans)* and can serve as a main prey item, as can hares (*Lepus*) marmots (*Marmota*) and prairie dogs (*Cynomys*).
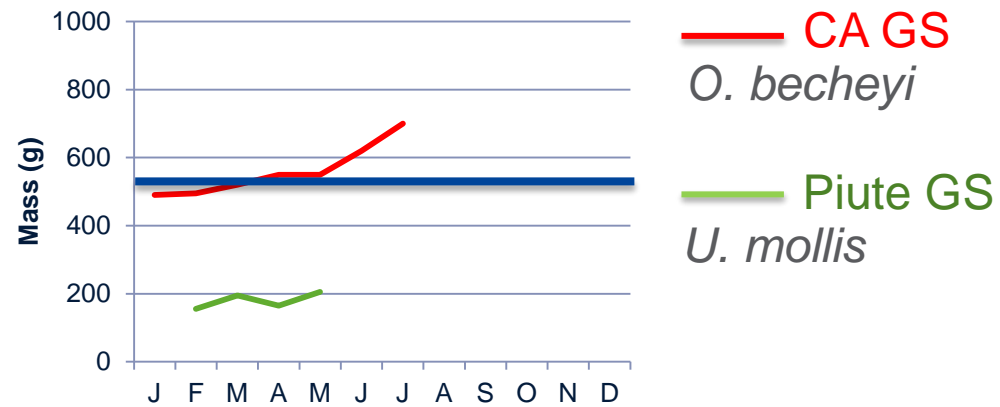
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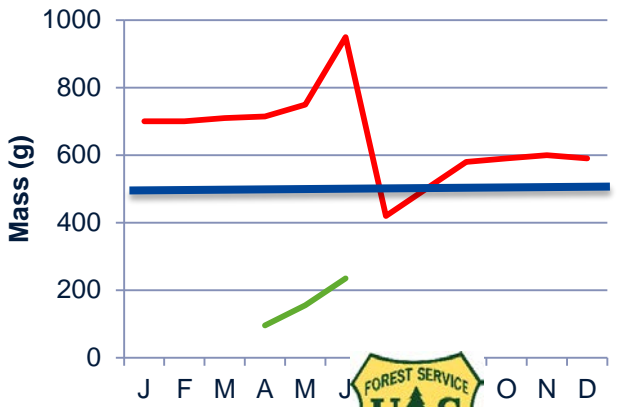# California Ground Squirrels
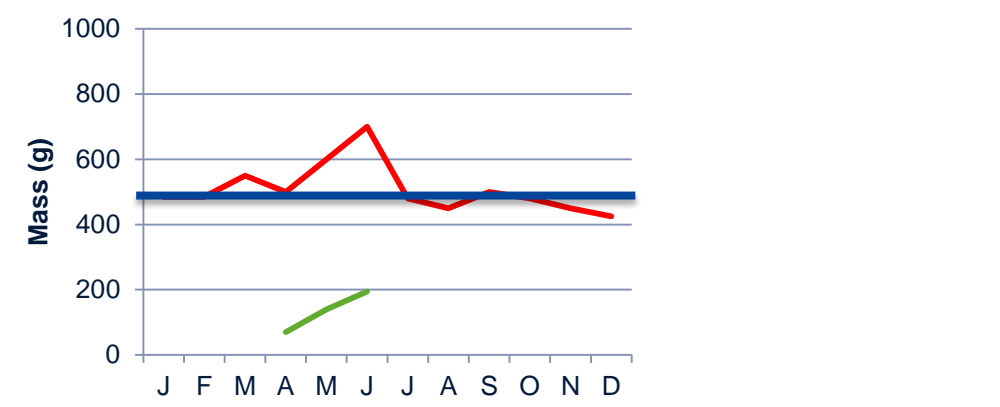## as prey of Golden Eagles (v. Urocitellus spp.)

California Ground Squirrels
as prey of Golden Eagles (v. Urocitellus spp.)

California ground squirrels (*Otospermophilus*):

- Found near the west coast of north America (*Urocitellus* are found further inland in drier habitats)

- At the Altamont Pass, they comprise ~70% of the prey biomass of Golden Eagles (Hunt and Culp 1997)
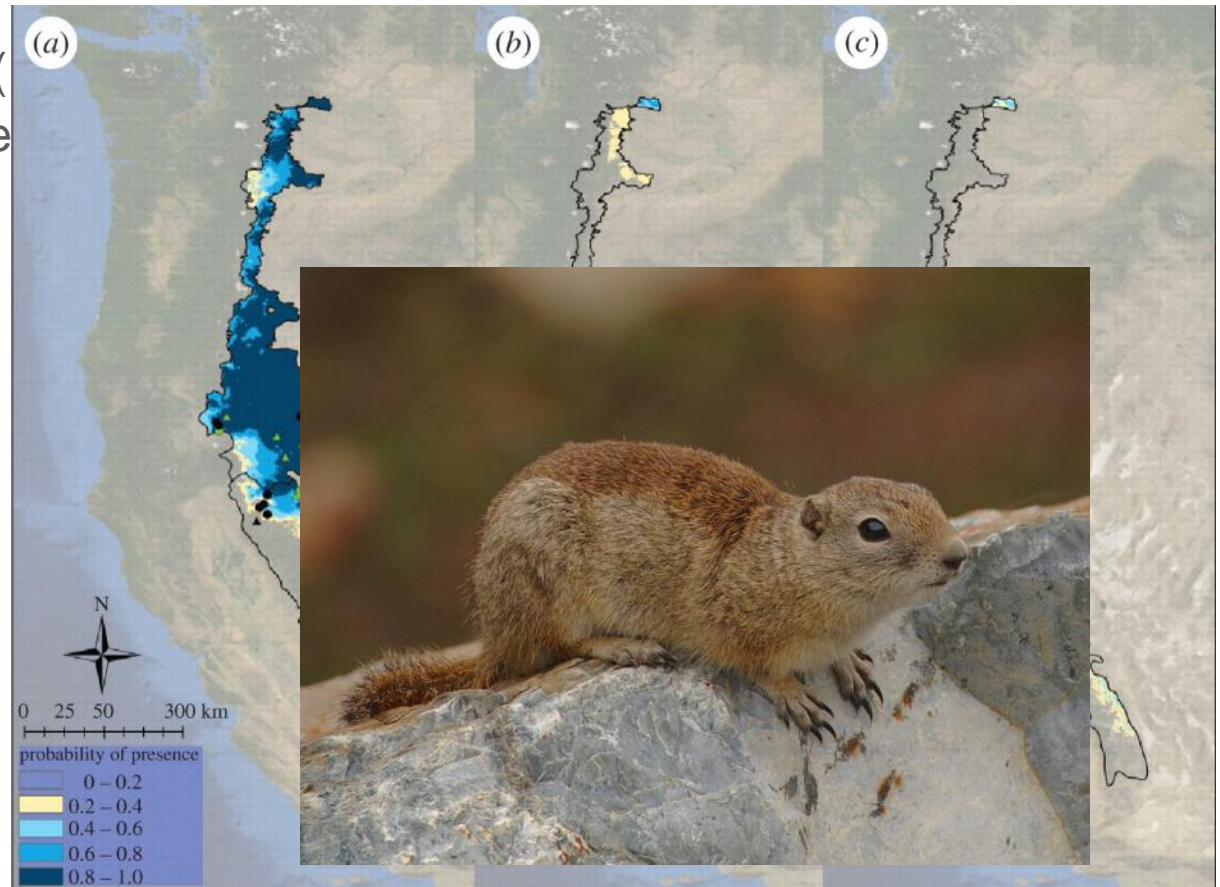
What impacts can we expect from climate change?

Belding's ground squirrels ([obscured] Golden Eagles. Their range [obscured]

Into the future…

Morelli et al. (2012) predict a 50% additional range retraction.

Probable cause: Loss of winter snow cover and increased precipitation - rain appeared to contract the range at higher elevs.

What impacts can we expect from climate change on California Ground Squirrels?

- Generalists in diet, habitat and climate (found at 0 – 3,300 m asl)

- Already expanding northward and upslope

- Are they climate change winners?
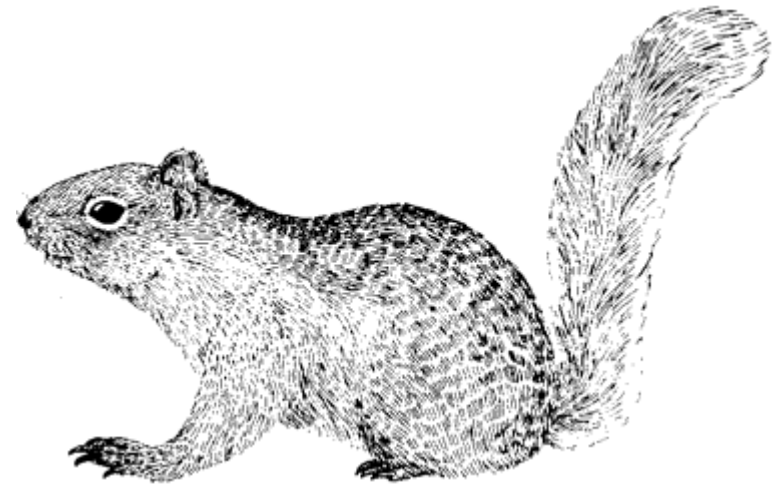
Data compilation and analysis

- A two-step approach: occupancy model from VertNet data + landscape-level boosted regression tree model from occupancy estimates

- Occupancy model: estimated from repeated surveys in each 2-km cell in the past 100 yrs.

- Landscape model: estimated using vegetation and climate covariates, at 2-km cell size

  o For historical (20th century) climate data: WorldClim.

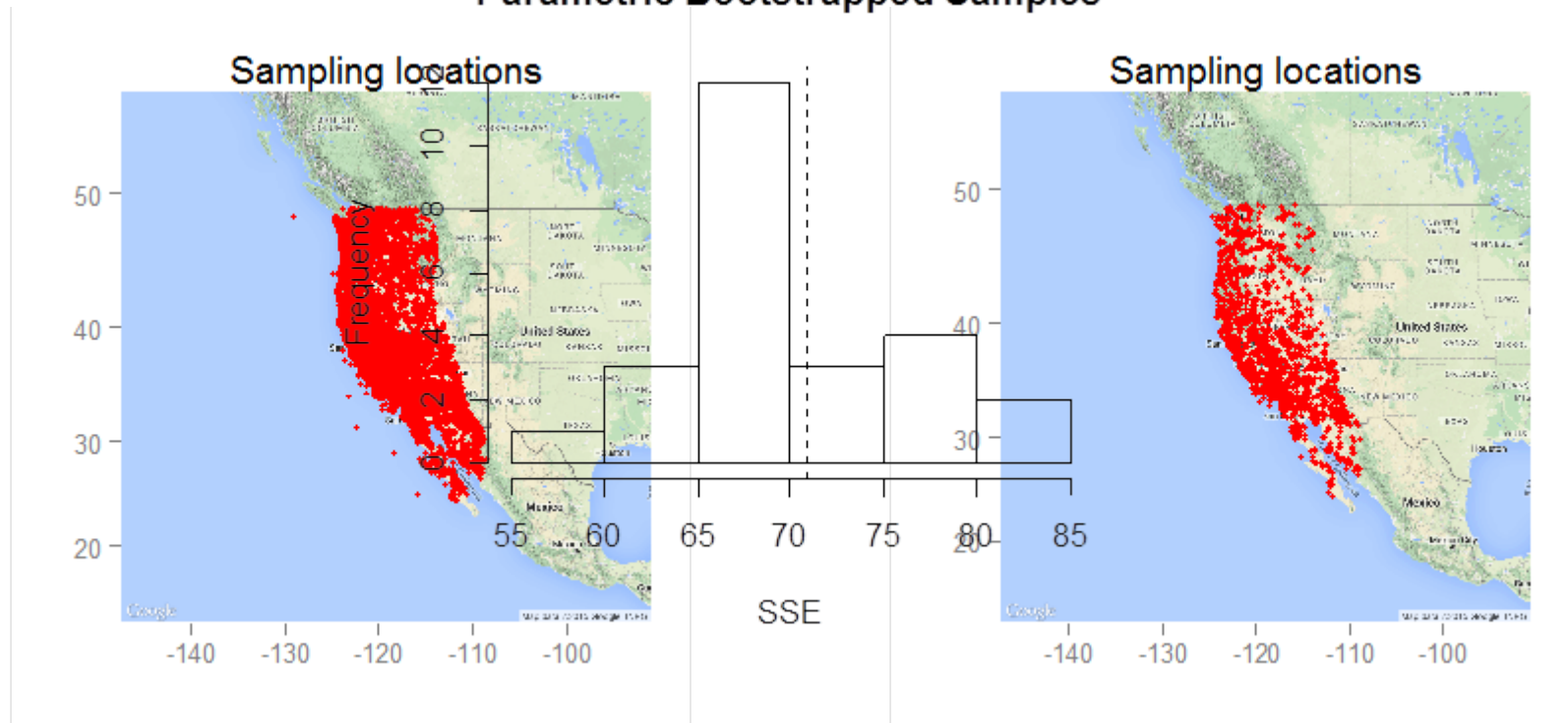 o For future climate data: climate projections by Conservation International, from five GCMs.

Occupancy model results
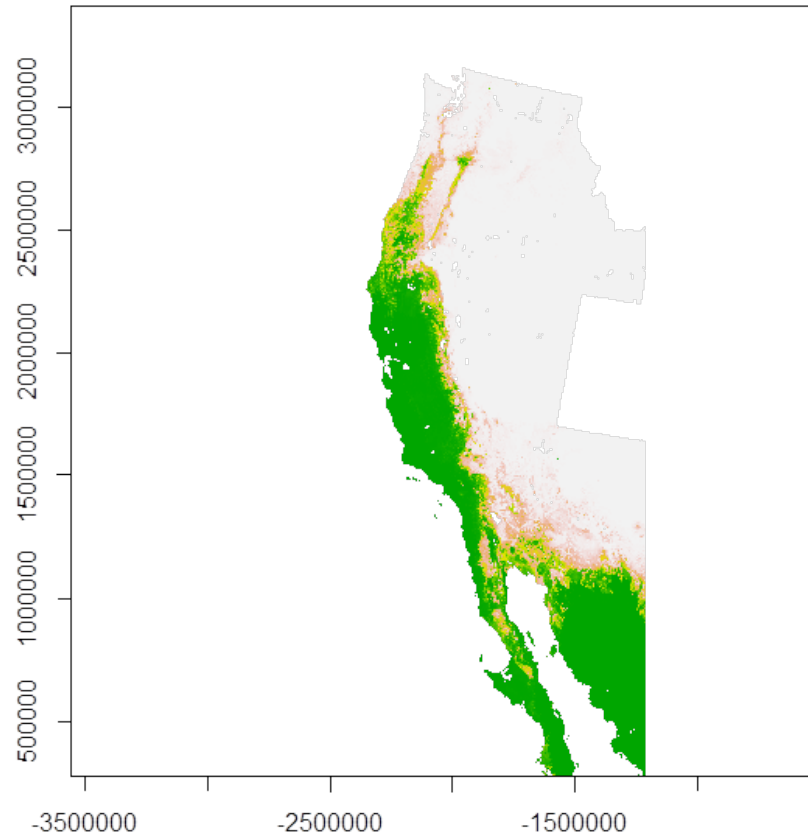
Full set of surveys in data   vs.   Filtered for >= 7 events/cell

Historical predicted occupancy
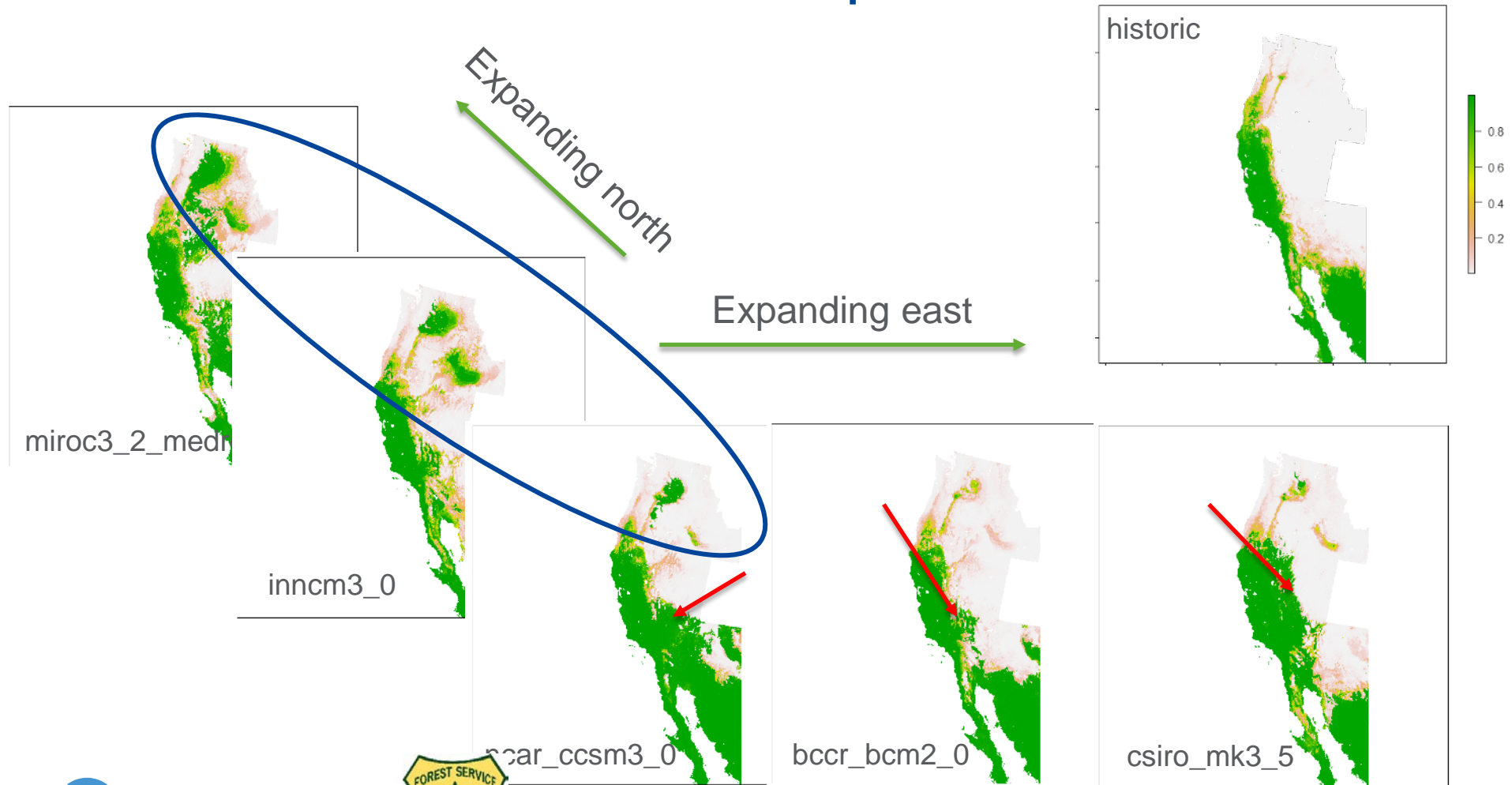## for California Ground Squirrels

PRELIMINARY

Note predicted high occupancy in Southern Baja (incorrect).

Poor training set?

Lack of information on competitive exclusion by *O. atricapillus*?

Future predicted occupancy
for California Ground Squirrels

miroc3_2_medr

inncm3_0

bccr_ccsm3_0

bccr_bcm2_0

csiro_mk3_5

historic

Expanding north

Expanding east

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What next?

Targets:

- Show how climate change may affect CA Ground Squirrel distribution

- Present general methodology to understand future climate change impacts on Golden Eagle breeding distribution
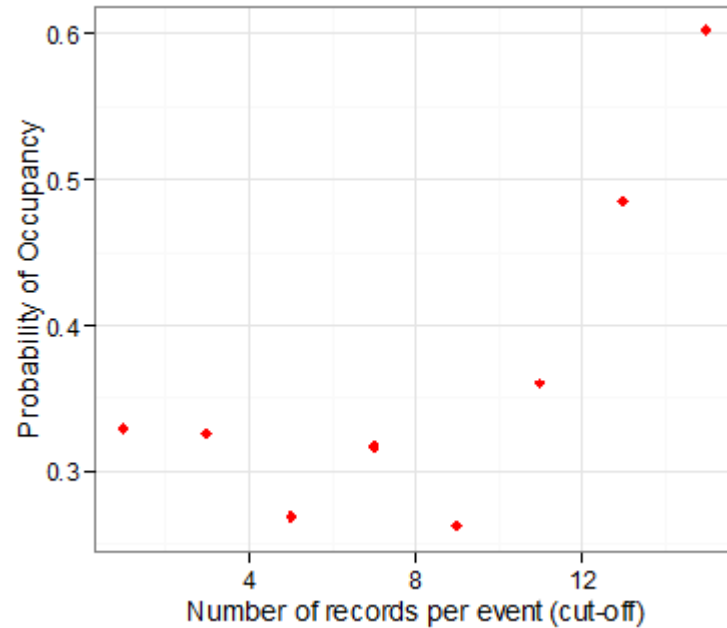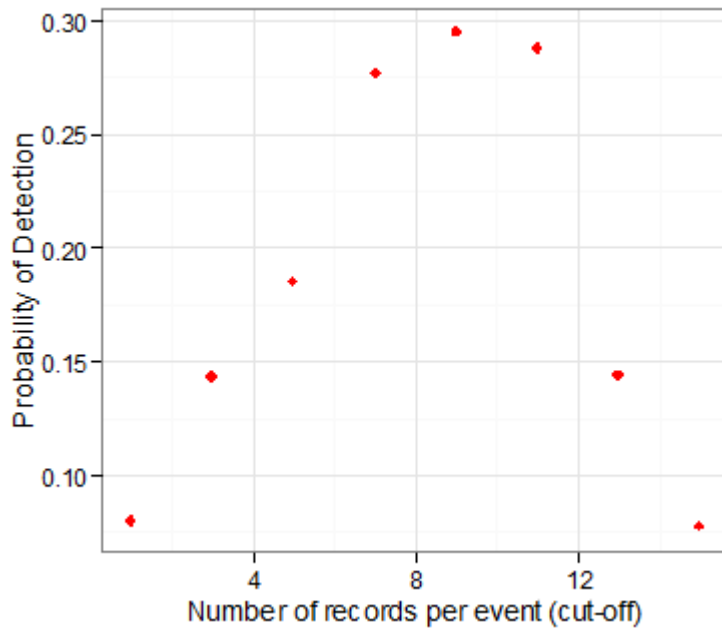
With these in mind…

- Review and resolve predictive inaccuracies in South Baja and NW Mexico (Sonora)

- Test historic model predictive accuracy

- Extend approach to other potential Golden Eagle prey

- Summarize predictive outputs on prey availability and postulate possible future changes in eagle breeding distribution

Thank you!

Questions?

More info on occupancy

More info on occupancy