SHINY APP NOTES:

* Keep it as simple as possible

Active Questions:

* If we are linking chuk/sg to harvest, does it make sense to include covariates? For example if I used index for ravens for all three, is that confounding? Or does it make sense to just
* Autocorrelation in Unemployment/Residence License Sales
  + Chart, scatter chart

    Description automatically generated
  + Chart, scatter chart

    Description automatically generated
* Change Point in Gas
  + Chart, scatter chart

    Description automatically generated
* Heteroskedasticity in Rabbits
  + Chart, scatter chart

    Description automatically generated
  + Chart, scatter chart

    Description automatically generated

ACTIVE TO DO:

* Re-run individual models with different indexing for covariates to see if the year matters
* Assess whether to more directly link log.r. to sg and chuk
* Assess rabbit as cov versus rabbit as part of covmatrix

5/26/22 – Erik/Dan Meeting

* Forecasting options

5/18/22

* Going through and making decisions about what is the best method to project each covariate forward into the future
* Got the non-predict model to return a non NA value for $calculate(), moving to adding NA for predicts then test run?
* Model with predict returned non NA for calculate, running test run to assess model

5/17/22

* Fine tuning the model has revealed some underlying issues with the Chuk models initial values which are leading to initialization issues. Need to figure out what is going on there.

5/13/22 Notes

* I am taking some time check the indexes again.
* Preparing the final full model, without predictions, for a run to assess convergence. Next step will be to work in predictions.
* Starting on Shiny App development, largely designing

5/12/22 End of Day Notes

* The chukar model, minus the link of the log.r.harv, is now initializing correctly, going to add covariates and finalize.
* Spending some time quadruple checking all the indices. Things may have been shifted around as we adjusted things
* I have gone back through the individual models to check the indexing and negative binomial coding, reran outputs with additional BBS covariates. Now working to bring the models together after rerunning for individual model outputs. (didn’t rerun harvest because no changes were made)

5/9/22 End of Day Notes

* I found that the specification of the negative binomial distribution may have been incorrect (related to the parameterization used by Nimble compared to that used by Dan)
* Working to combine the models but am having trouble initializing the solo chukar site model, some issue related to the C parameter returning non-finite/NA values at initialization.
* TOMORROW: Figure out the final issues with the full model, then work on bringing in the BBS data.

April 11 Meeting Notes

* It isn’t a beta coefficient for the spline, it’s a differencing coefficient. Change nomenclature in code and do some reading
* Want to start braingstorming an alpha idea for the shiny app, look into coding options
* Use reproductive success index for sage grouse, not count. Ratio of adult females to juveniles (male and female). Use binomial model where juvenile is the data and female to juvenile ratio is the frequency. Don’t include breeding males
* BBS Raven and Raptor data, can use the bbsbayes package
  + https://openresearchsoftware.metajnl.com/articles/10.5334/jors.329/
  + <https://drive.google.com/drive/folders/1nT8zD0Fmet3CVuoOFwOTUEeWFWMyv0-P>
* Need to fix Spline for total harvest
* Double check the global model.

Topics/Questions for April 11 Meeting

* Individual covariate performance/any reasons for region specific beta coefficients?
  + Try one with and without regional to identify
  + Or add a reginal modifier
  + Blue grouse is essentially different species
* Is using the hunter numbers to generate the b-splines for total harvest account for variation in hunter effort within total harvest variation?
  + If not, we need to brainstorm how to deal with this
* Periods of autocorrelation within traceplots, most notably spline pred/beta
* Birds per hunter as a single covariance matrix to validate model?

Erik meeting 3-28-22

* Need to incorporate harvest

Analysis Citations/Code/Resources:

* Structural Equation Modeling
  + Specifying correlation matrix
    - <https://groups.google.com/g/hmecology/c/3eBTXq903iI>
    - Barnard et al. 2000
  + Model Validation
    - Fan et al 2016 - https://link-springer-com.wv-o-ursus-proxy02.ursus.maine.edu/content/pdf/10.1186/s13717-016-0063-3.pdf
* Spline Regressions
  + http://ce.esalq.usp.br/sites/default/files/Crash\_course\_handout.pdf
* Autoregressive Function
  + https://atsa-es.github.io/atsa-labs/sec-jags-univariate.html#sec-jags-ar1

3-23-2022 – Looking for covariates

* Hunter Numbers
  + Current:
    - Spline – general temporal trends
    - Regional Drought Index
    - Unemployment
  + Proposed
    - Winter Severity –
    - Onset of Winter -
* Harvest Numbers
  + Current:
    - Spline – general temporal trends
    - Regional Drought Index
  + Proposed
    - Winter Severity –
    - Onset of Winter -
* Chukar Abundance
  + Proposed
    - Rabbit/Hawk Densities – have rabbit harvest numbers already.
    - Nest Predators?
    - Nesting Habitat – Star Thistle

Erik Meeting Notes 3-7-22

Chukar Update

o   Hawkwatch – raptor count stations

§  We care about year to year variation

o   Pulling in more potential climatic variables and different ways they could be worked with

§  Winter severity – may want to consider for harvest side too (pushes chukar down into greater densities). Lots of differences between NW and NE

§  Lags/More complex structures

o   Fire Severity

§  Initial decline but could create great habitat, not normally during nesting season

§  Number of square acres burned, region level may need to be proportional to region size

o   Would Model validation

o   Lots of reading

o   Starting over trying to teach myself SEM

o   By Mid June want a deliverable to pass back to Shawn

Hypotheses

* Chukar abundance fluctuates with peak raptor migration timing or regional raptor abundance
* Predation of chukars increases following declines in rabbit densities.
* Chukar abundance declines with the expansion of yellow starthistle into nevada as it affects nesting habitat

NOTES

Chukkar

* Ratti and Giduice 2001
  + Summary of Chukar ecology, lots of references
  + <https://docs.idahopower.com/pdfs/relicensing/hellscanyon/hellspdfs/techappendices/Wildlife/e32_07.pdf>
* Robinson et al 2010
  + Two week survival was lower during peak raptor migration
  + Two-week estimates of survival during the reproductive period differed directionally from estimates outside this time period and the peak raptor migration (smaller hawks = Cooper’s, red-tailed, and sharp-shinned)
  + Lower chukar density may encourage more prey switching by raptors as happens inversely when rabbit densities are low (Manosa 1994).
* Mackie and Buechner 1963
  + Description of reproductive process
* Lindbloom et al. 2003
  + Most reports of Chukar renesting are supported only by the preponderance of late-hatch chicks in the fall, often occurring after an unusually wet spring
  + [Yellow starthistle invasion in Idaho affecting nesting habitat?]
  + renesting has not been well studied but is of importance when the peak of the hatch occurs during prolonged periods of inclement weather, which may result in severe chick loss
* Walter 2000 (Masters thesis)
* Christensen 1970
  + Although no quantitative data are available, comparisons of production data with timing of precipitation during nesting and hatching suggest that unseasonable rains and snows can significantly lower nest success and chick survival
* Lindbloom 1998 (masters thesis)
* Christensen 1952
  + Heavy snowfall in combination with cold temperatures can result in substantial overwinter mortality, especially in areas where elevational movements are restricted
* Galbreath and Moreland 1953
  + estimated 65-75% mortality due to severe winter conditions in Washington during in 1949-50. However, heavy losses from winter storms are usually erratic in nature and populations often recover relatively quickly through immigration and the high reproductive potential of survivors
* Ullah and Khan
  + Increased human population has a negative impact on the Partridge’s population and habitat (Bhattacharya et al. 2009)
* Gruychev 2016

Hunter Effort

* Robinson et al 2010
  + …hunter take is self-regulating because hunting effort decreases when abundance is low and increases when abundance is high (Christensen 1958, 1970).
  + Hunter effort decreased substantially in 2006 and generally mirrored fluctuations in chukar abundance (Utah Division of Wildlife Resources 2006).
* Molini 1976 (Nevada State Species Plan)

GENERAL GOOD PAPERS

Questions for April 11 Meeting

* In the original code, is there a mistake in which ZZ is applied to which mu?
* Region specific beta coefficients?
* Linking growth between total harvest, wingbee, and chukar site abundance

Notes on Readings

* Bayesian Structural Equation Modelling

<https://academic-oup-com.wv-o-ursus-proxy02.ursus.maine.edu/condor/article/123/1/duaa065/6053195?login=true>

<https://mcusercontent.com/71d4ba85fe261d411f0d2a098/files/f4ffb14d-14ee-8d1b-4359-e937646e50de/2021_NV_Chukar_Forecast.pdf>

* Chukar Update
  + Hawkwatch – raptor count stations
    - We care about year to year variation
  + Pulling in more potential climatic variables and different ways they could be worked with
    - Winter severity – may want to consider for harvest side too (pushes chukar down into greater densities). Lots of differences between NW and NE
    - Lags/More complex structures
  + Fire Severity
    - Initial decline but could create great habitat, not normally during nesting season
    - Number of square acres burned, region level may need to be proportional to region size
  + Would Model validation
  + Lots of reading
  + Starting over trying to teach myself SEM
  + By Mid June want a deliverable to pass back to Shawn

Hey Matt and Erik,

I've gathered some of the remaining data sets that we talked about (and tried to resolve some lingering locality issues). Attached to this email is the 1) sage-grouse lek count database (updated 2021), 2) the sage-grouse wing-bee database (circa 2004 - 2020); and 3) a minorly edited chukar brood survey database.

Feel free to poke around with the lek database to your heart's content, but some careful thought will be required if we decide to use sage-grouse leks in regards to how to partition the data across space and time.

For the wing-bee data (SG\_wingdata), the total database is on the 2004-2020 tab, and I have tried to set a hierarchy of spatial organization that can be used to relatively seamlessly connect the wing data, the lek counts, the chukar covey counts, and the total upland harvest data together (depending on the respective grain size for each data type). Another piece of information that may be informative is that it is possible to coarsely determine female reproductive success from the sage-grouse wing-bee data as females that terminate reproductive activities earlier in the season are further along in their molt cycle than females that may be tending to broods. Thus, during the wing-bees, biologists record whether the 9th/10th primaries are fully developed (unsuccessful) or not (successful), which is used to infer reproductive success. It's not perfect, and the raw ratios are sensitive to harvest susceptibilities biases, but it is something to consider using. If we were interested in correcting for harvest susceptibility, our options are limited as there are only really two datasets out there that could reasonably do this at the moment. A 4-5 year band-recovery data set from central Nevada from the early 2000's and a 20 year band-recovery data set from North Park, Colorado (this is brownie example from Program Mark). If we decide that the reproductive status information would improve inference, we can think more about how to correct for some of the biases associated with it.

Lastly, I updated the chukar survey data to include the population management units/biological management units that I think each area fell into. As Erik mentioned on the zoom, there are new surveys being conducted using different methods at different locations (some overlap). We may need to link these data sets together spatially, which may require asking Shawn to let us know what hunt unit each of these surveys were previously conducted in to see if they are relatively match the new survey locales.

Here is a good starting point for structural equation models

<https://jslefche.github.io/sem_book/index.html>

and a less user-friendly crash course on splines

<http://ce.esalq.usp.br/sites/default/files/Crash_course_handout.pdf>

I am searching for what sources I based my spline code on. I will get back to you on that!

-Dan