

Frame size and caribou population cycles: Does size matter?

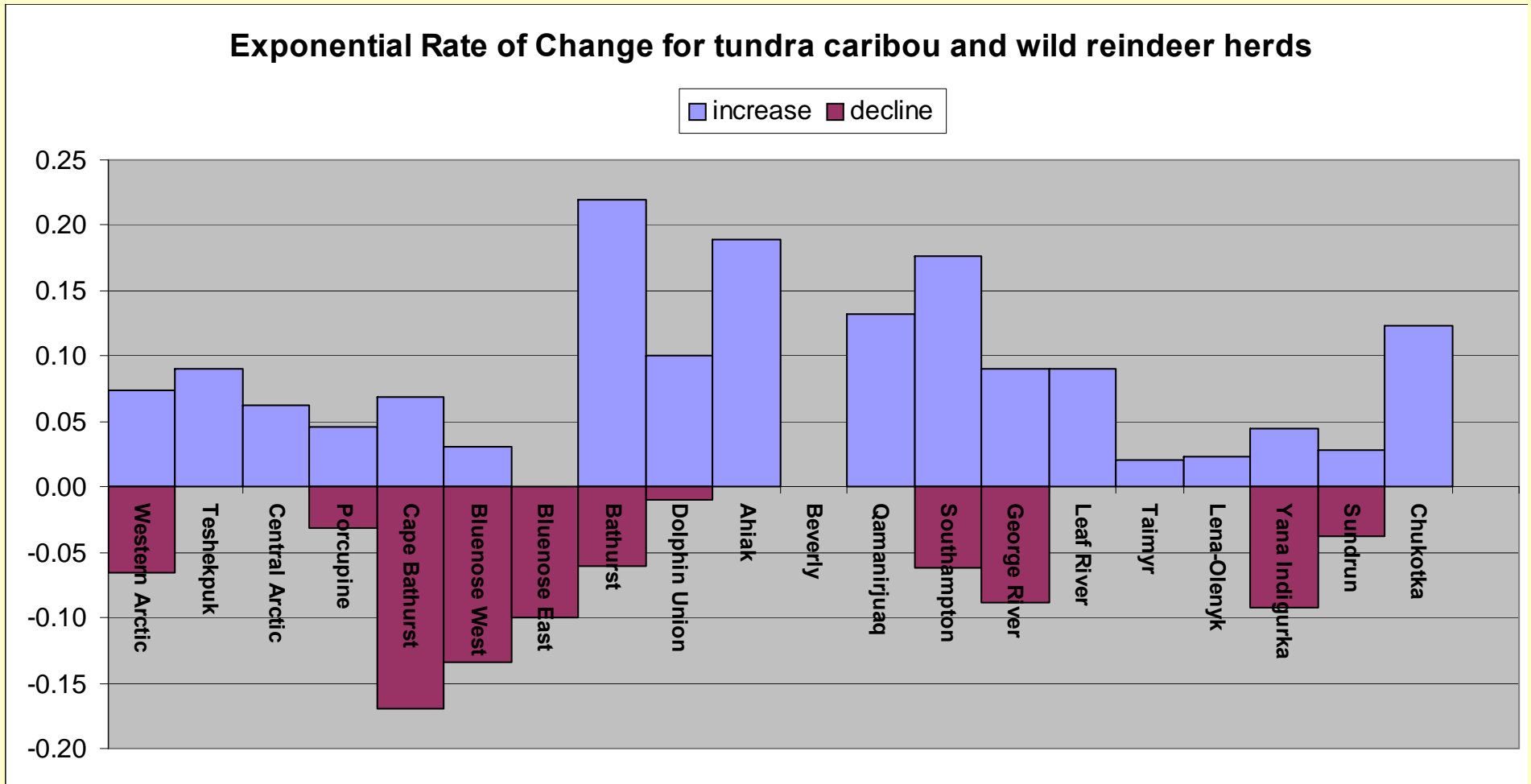


***Don Russell, Yukon College
Craig Nicolson, Univ of Massachusetts
Robert White, Institute Arctic Biology
Anne Gunn, Salt Spring Islander***

Caribou herds cycle

- There is a suggestion that herds more or less cycle in synchrony
- Important question is not only why do caribou herds cycle but why do some herds cycle more dramatically than others.
- Some herds in NWT have declined 75% in last 5 years while the PCH has declined only 30% in the last 12 years

Some herds cycles more dramatically



DOES SIZE MATTER?

- Bigger the mother the bigger the calf birth weight
 - \int maternal protein reserve
- Big calves have a better chance of surviving to 1 year
 - \int birth weight
- Big yearlings/2 year olds have better chance of breeding at younger age
 - Age of first reproduction \int body weight in 2nd or 3rd autumn
- Therefore when resources are plentiful, large bodied animals and their offspring are at an advantage.
- However...large bodied animals require more energy to exist
 - basal metabolic rate, maintenance, activity \int body weight^{0.75}
- How does the whole system perform through time when resource availability cycles

So in times of plenty...

- Nursing mothers can regain their protein reserves in the summer and put on sufficient fat to survive and reproduce into the next year
- Survival of both large and small bodied females is similar
- Calves of large bodied calves have higher survival
- Calves of large bodied cows have earlier average age of first reproduction

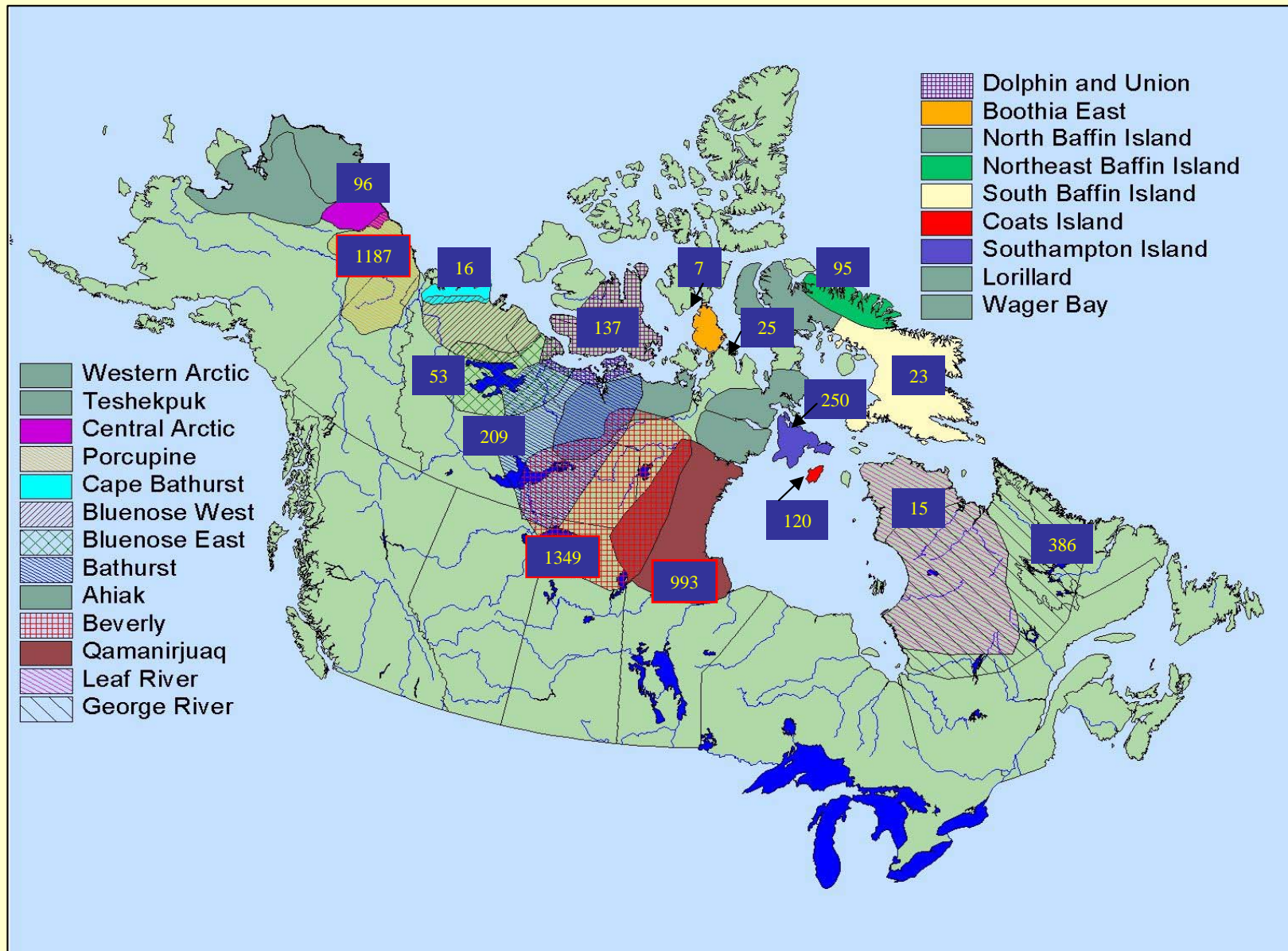
But when resources are limited...

- Large bodied animals, will sacrifice milk production to regain their protein reserves
- Small bodied animals, requiring less energy for maintenance, will be able to devote more resources to milk production
- Calves of small bodied cows will have higher on average survival
- More large bodied cows extend lactation to compensate low fall weight of calves and thus experience more breeding pauses

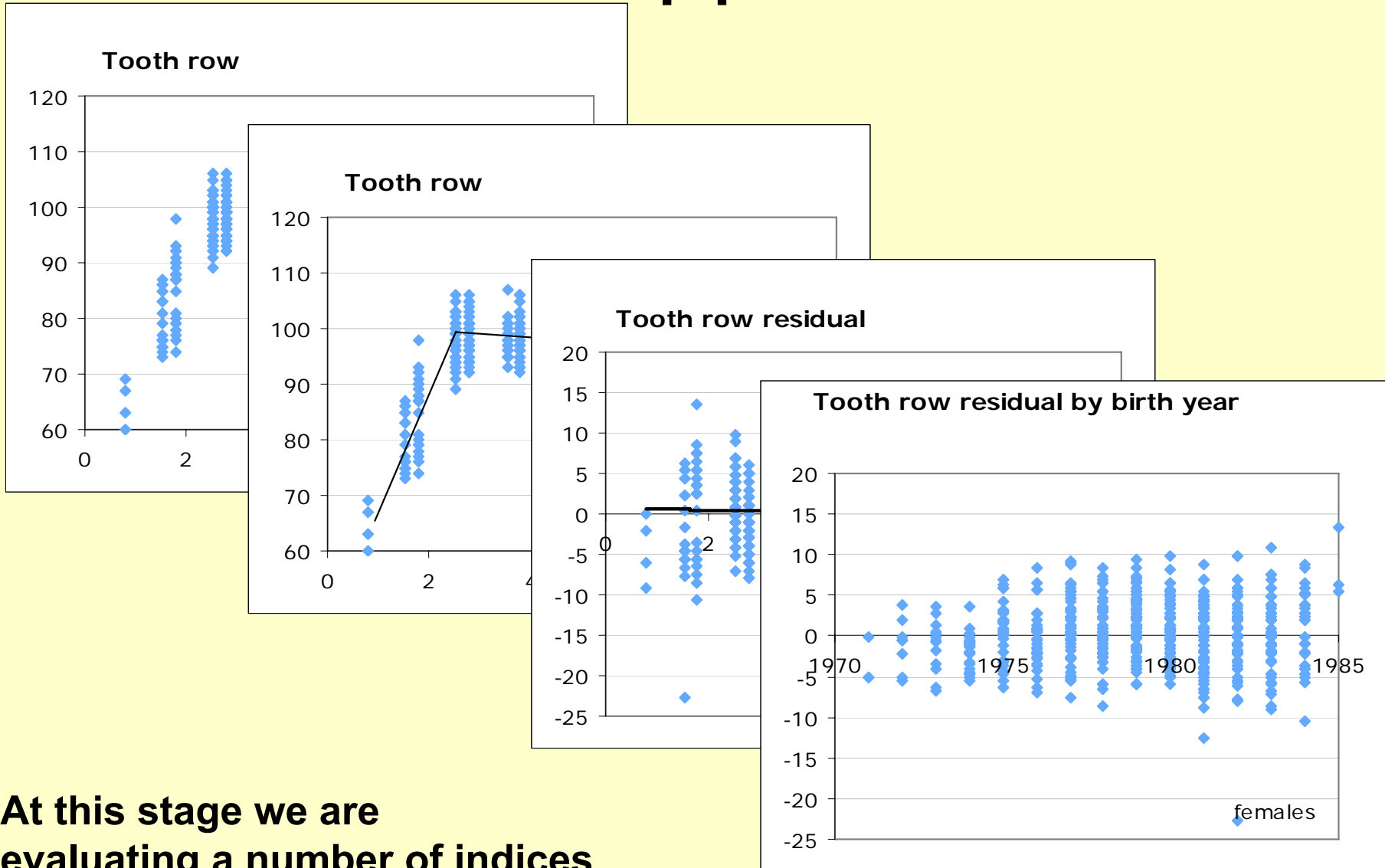
Goal of caribou frame size model

- Build a simple frame size model that incorporates our knowledge of caribou energetics and the links between energetics and productivity
- Explore changes in body condition at different phases of the cycle
- Use existing North American database to validate model output
- Use the model output and validation to better understand caribou cycles

Number caribou (by herd) in body condition dataset

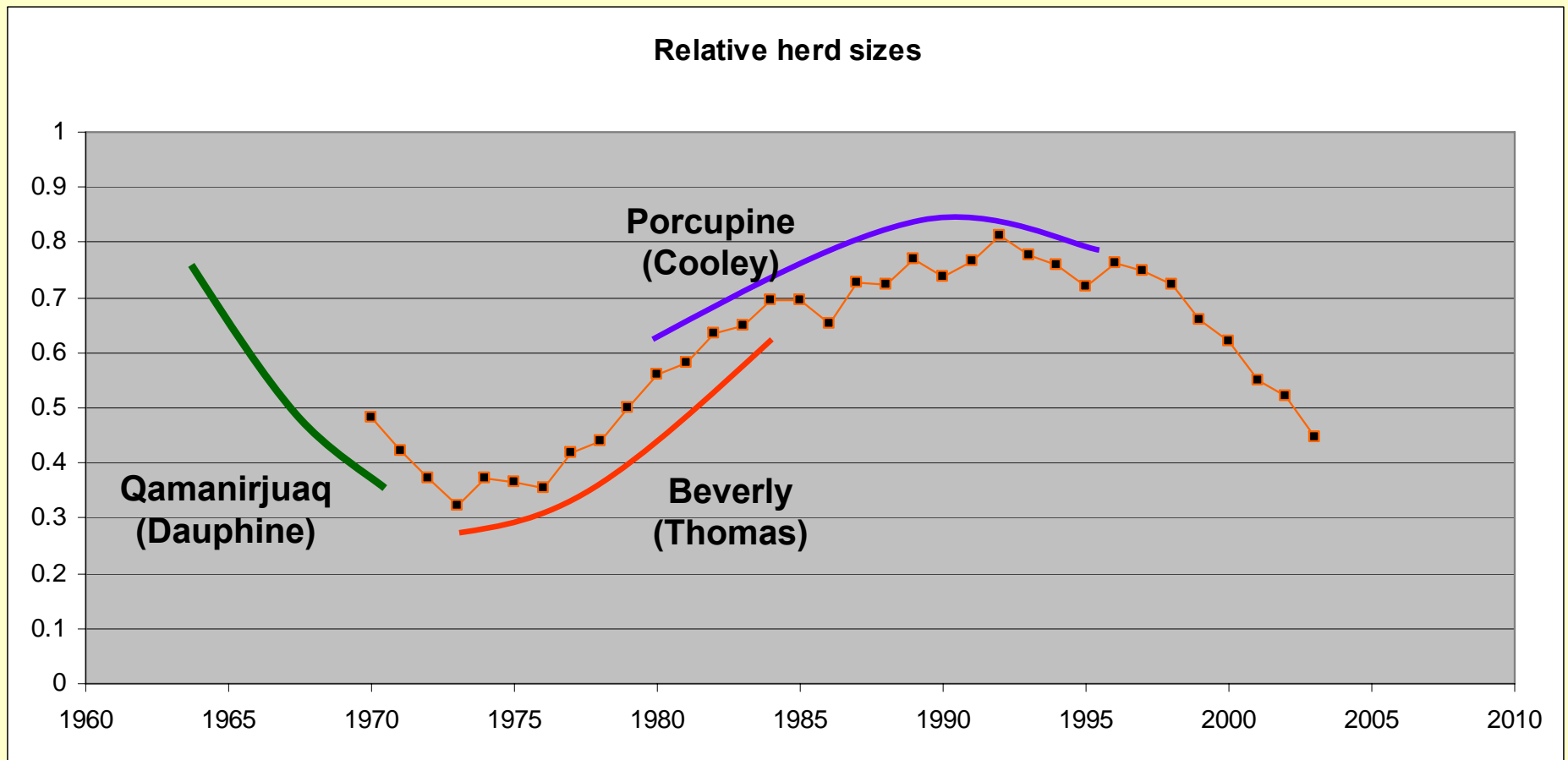


Our approach

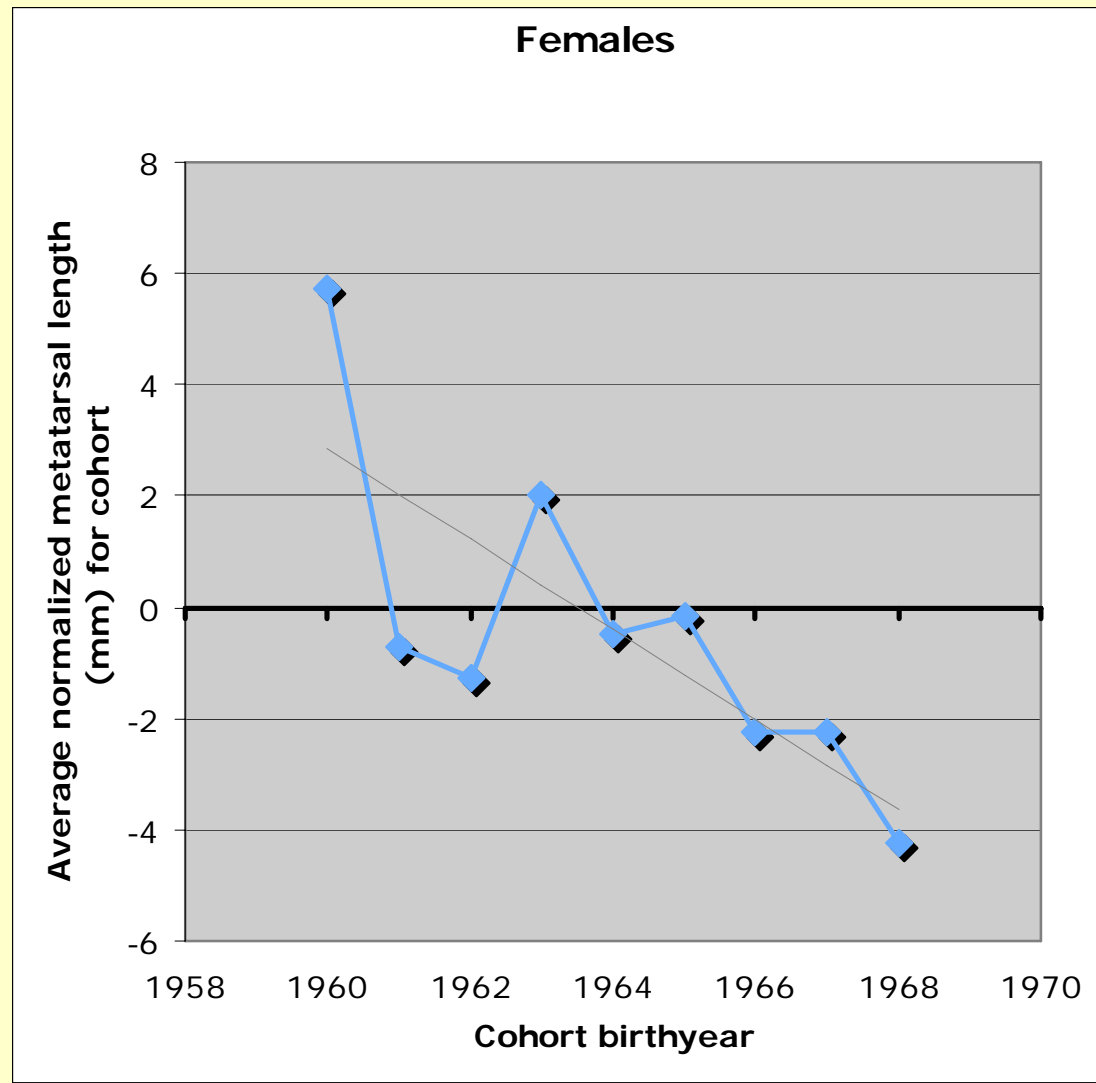


At this stage we are evaluating a number of indices of frame size

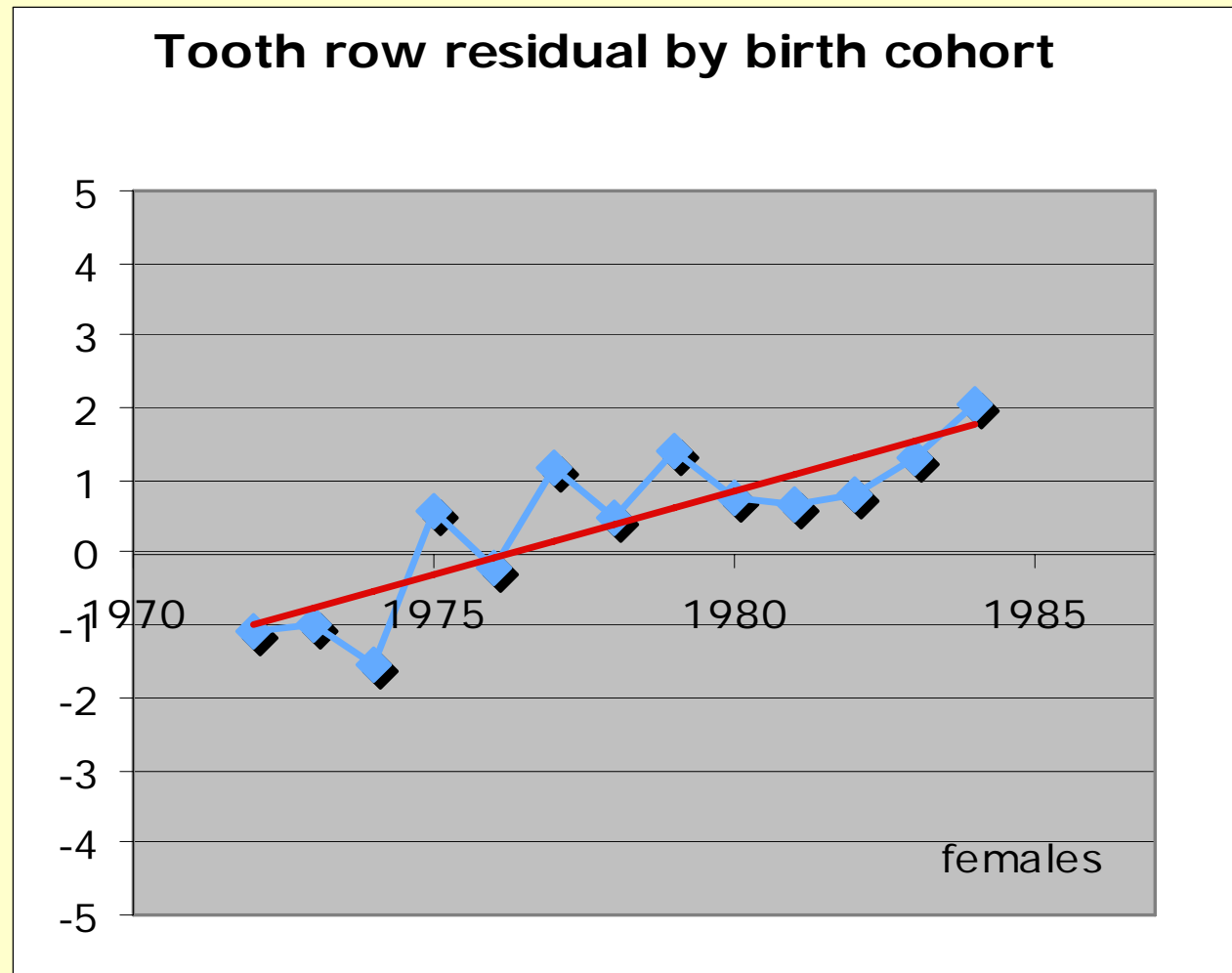
Validation data throughout the cycle



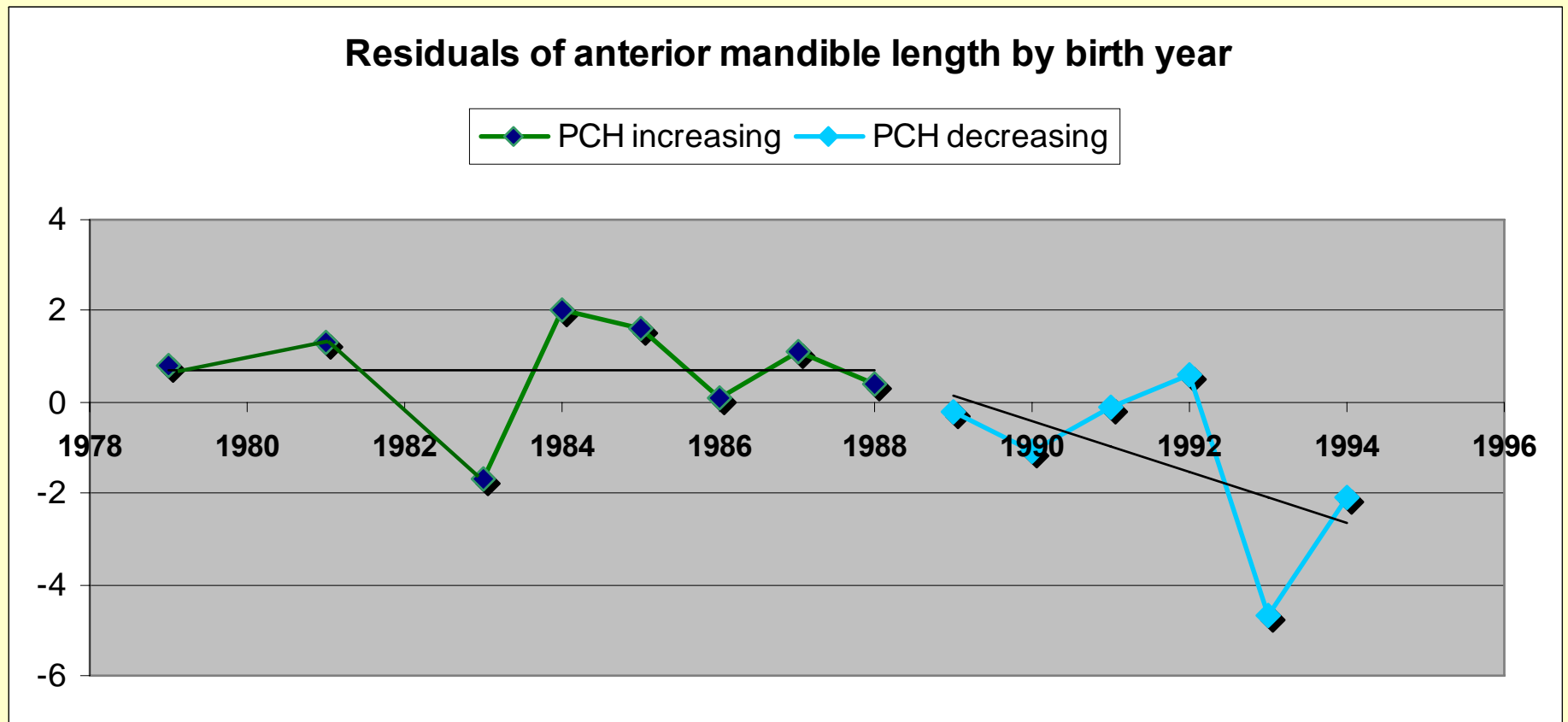
Qamanirjuaq metatarsal residuals



Beverly tooth row residuals

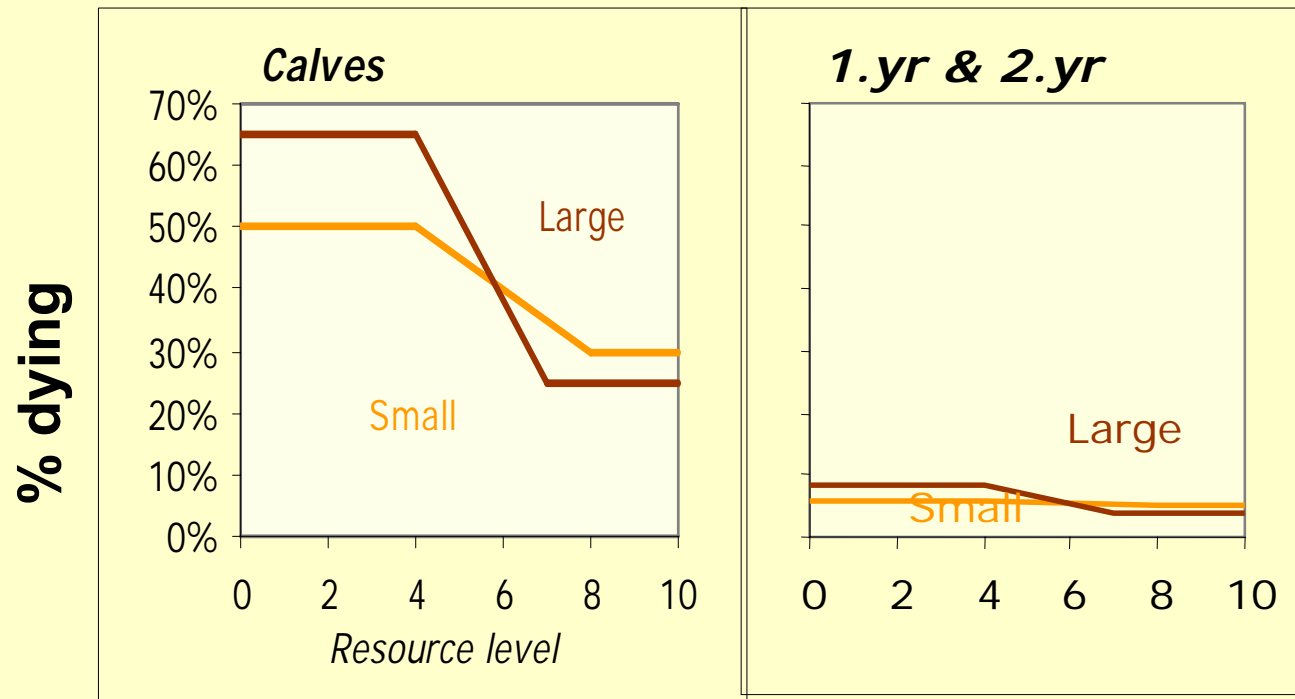


Porcupine herd anterior jaw residuals by birth year



Mortality rules

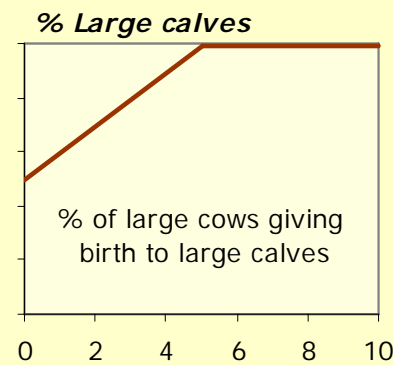
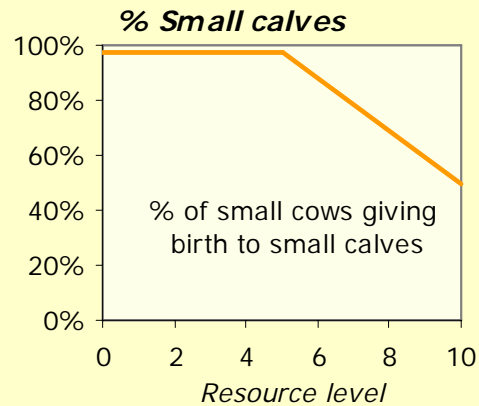
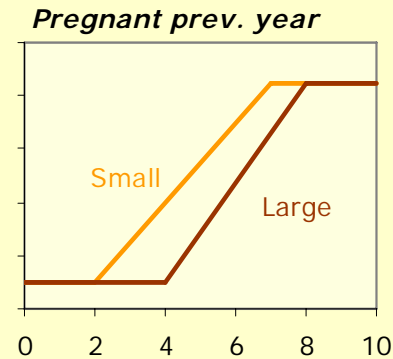
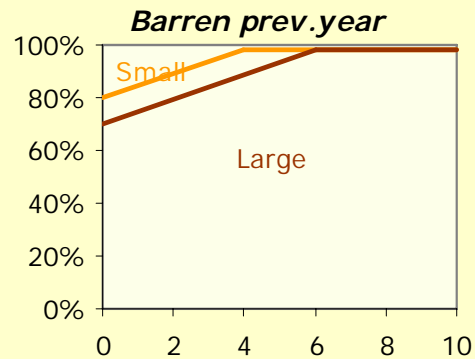
1. Cohort mortality (small & large framed sub-adults)



Reproduction rules

2. Adult pregnancy and Calf Size

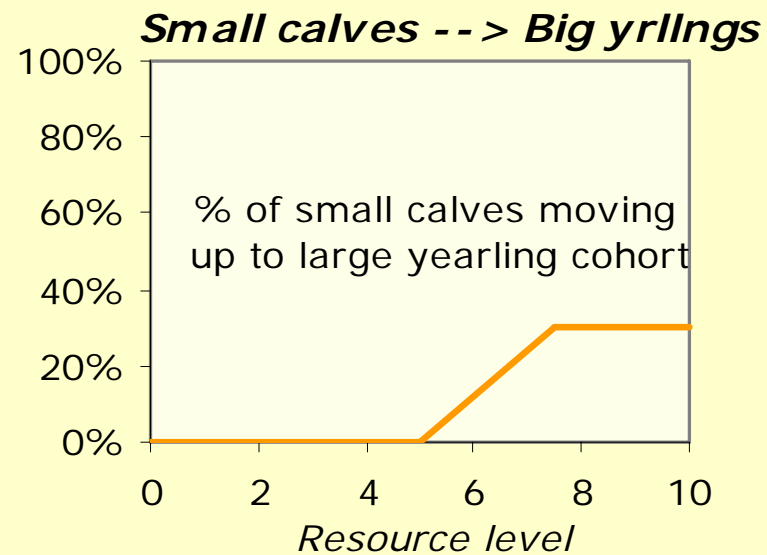
% pregnant



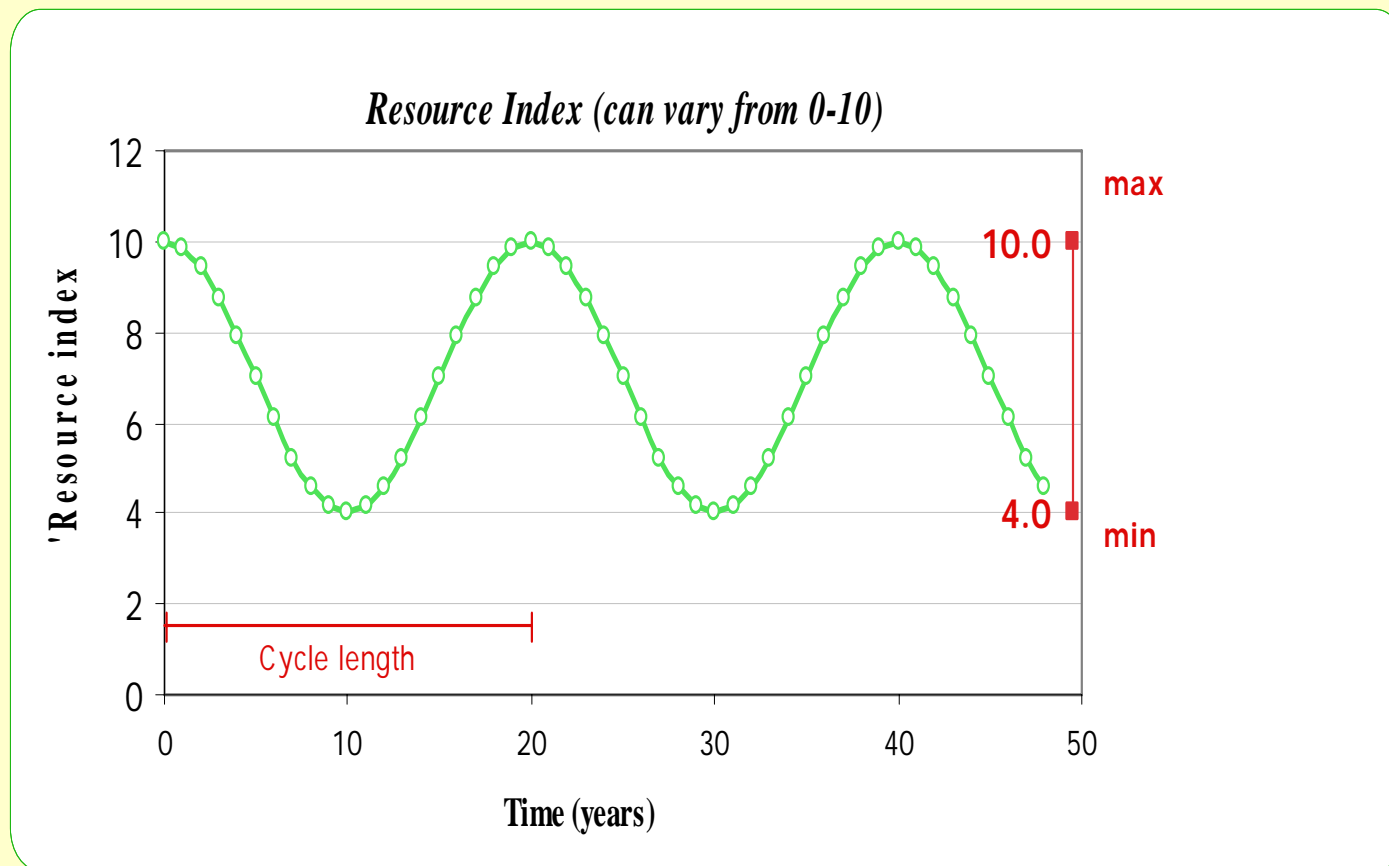
Resource level

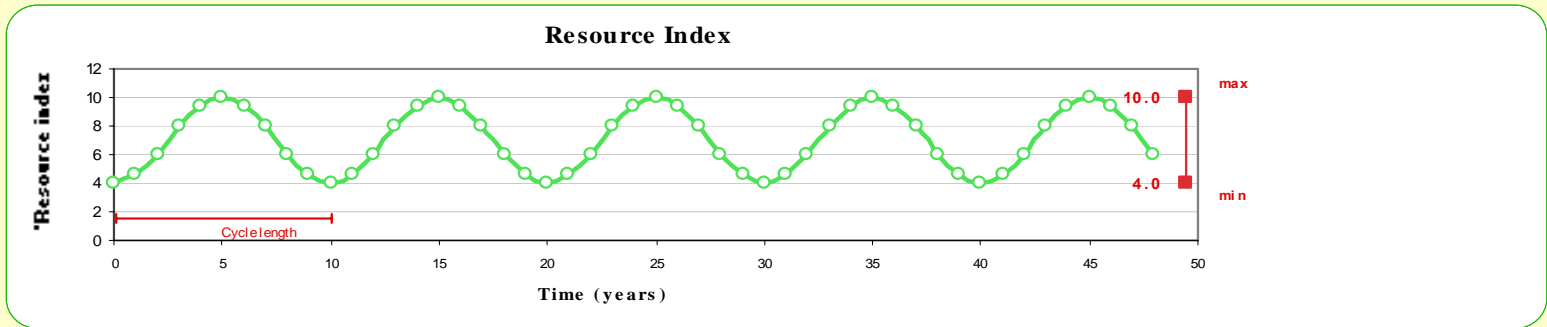
Recruitment and Growth Rules

3. Calf growth rate in good years

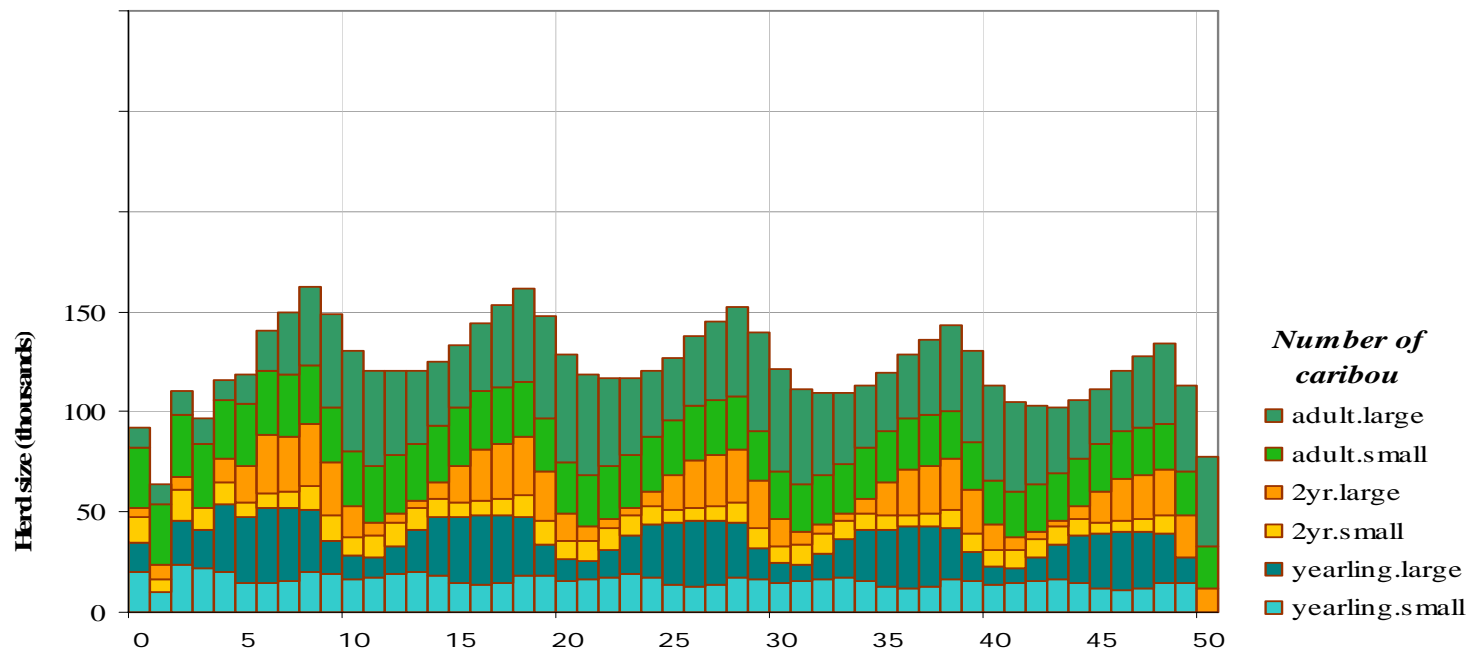


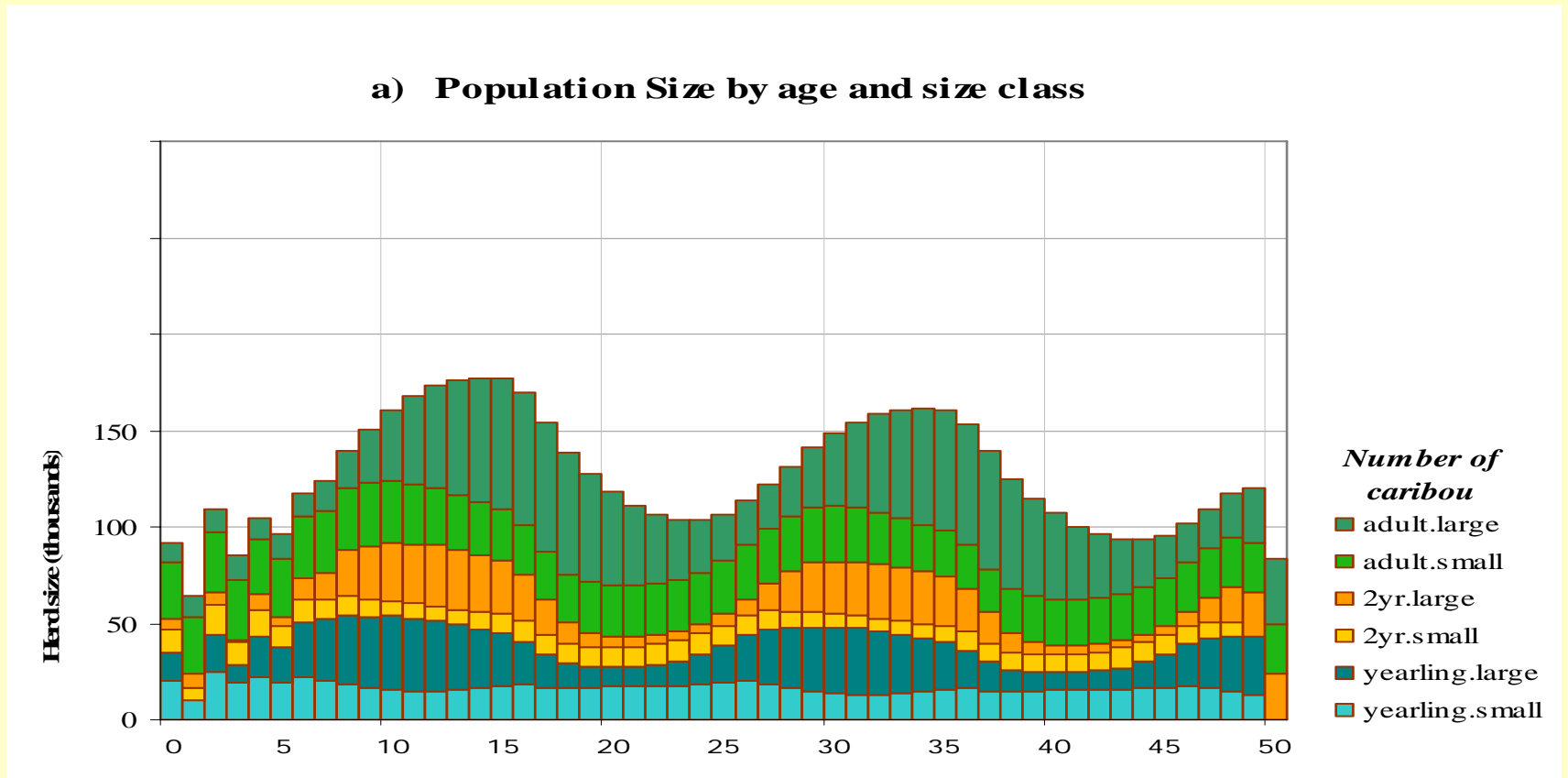
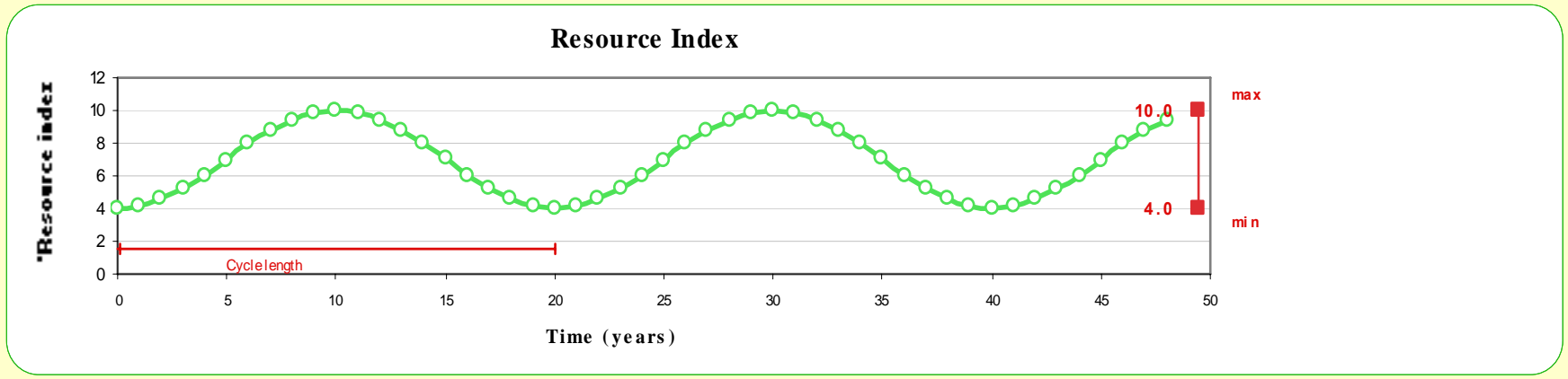
User can vary amplitude and length of resource cycle





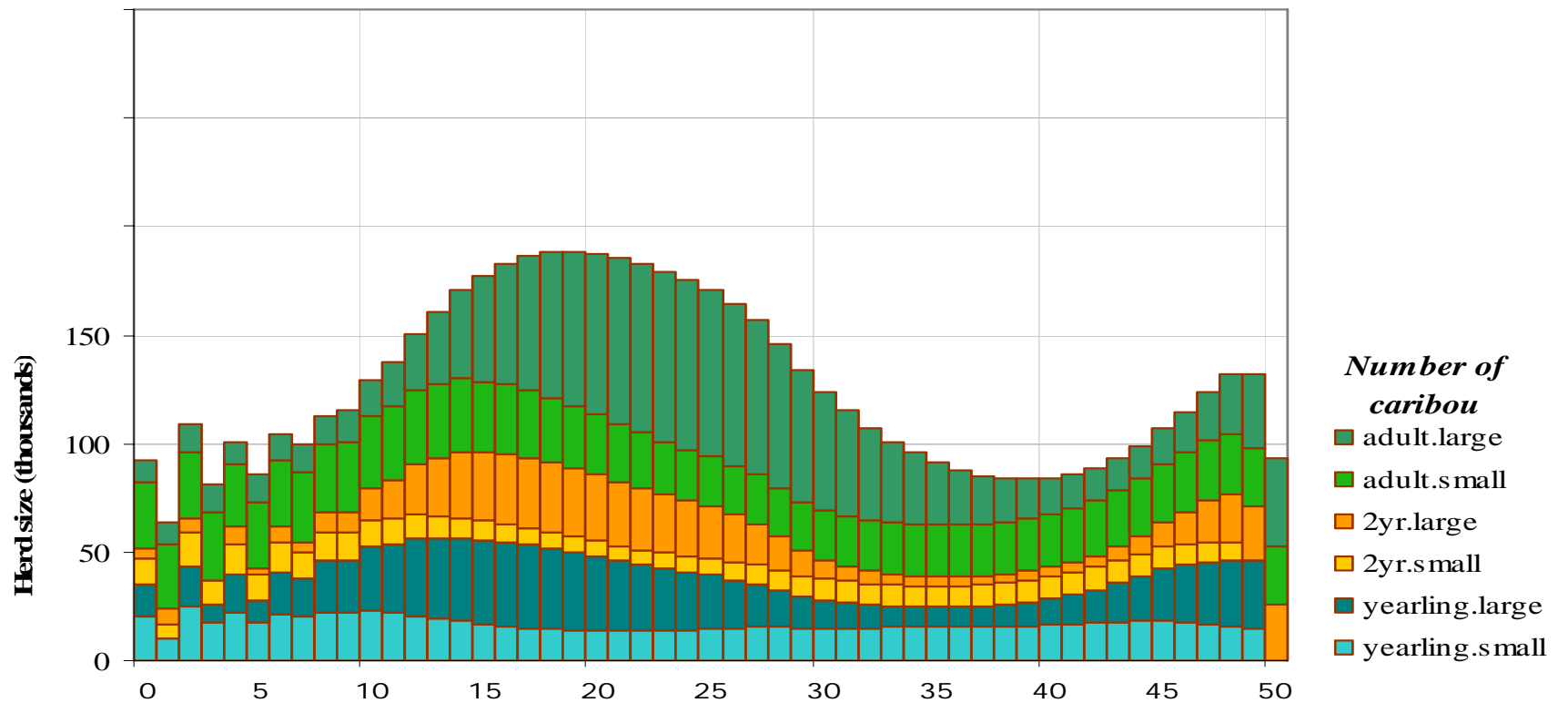
a) Population Size by age and size class

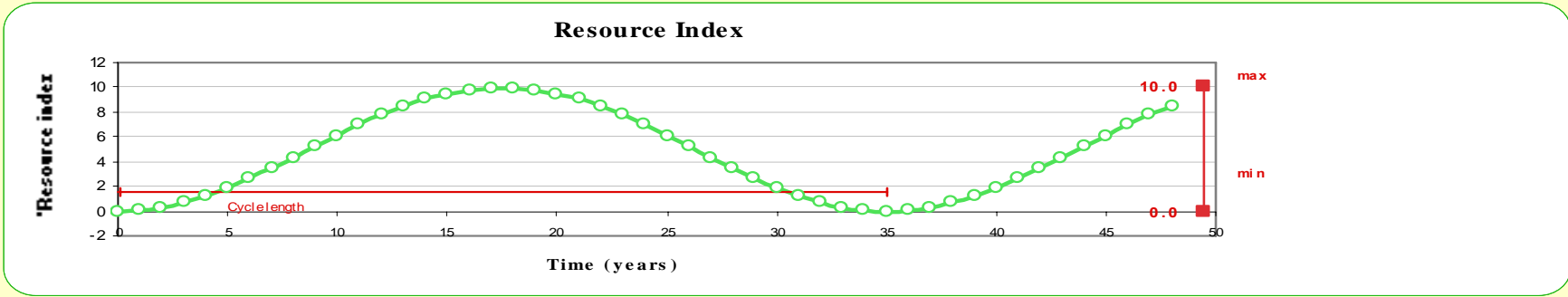






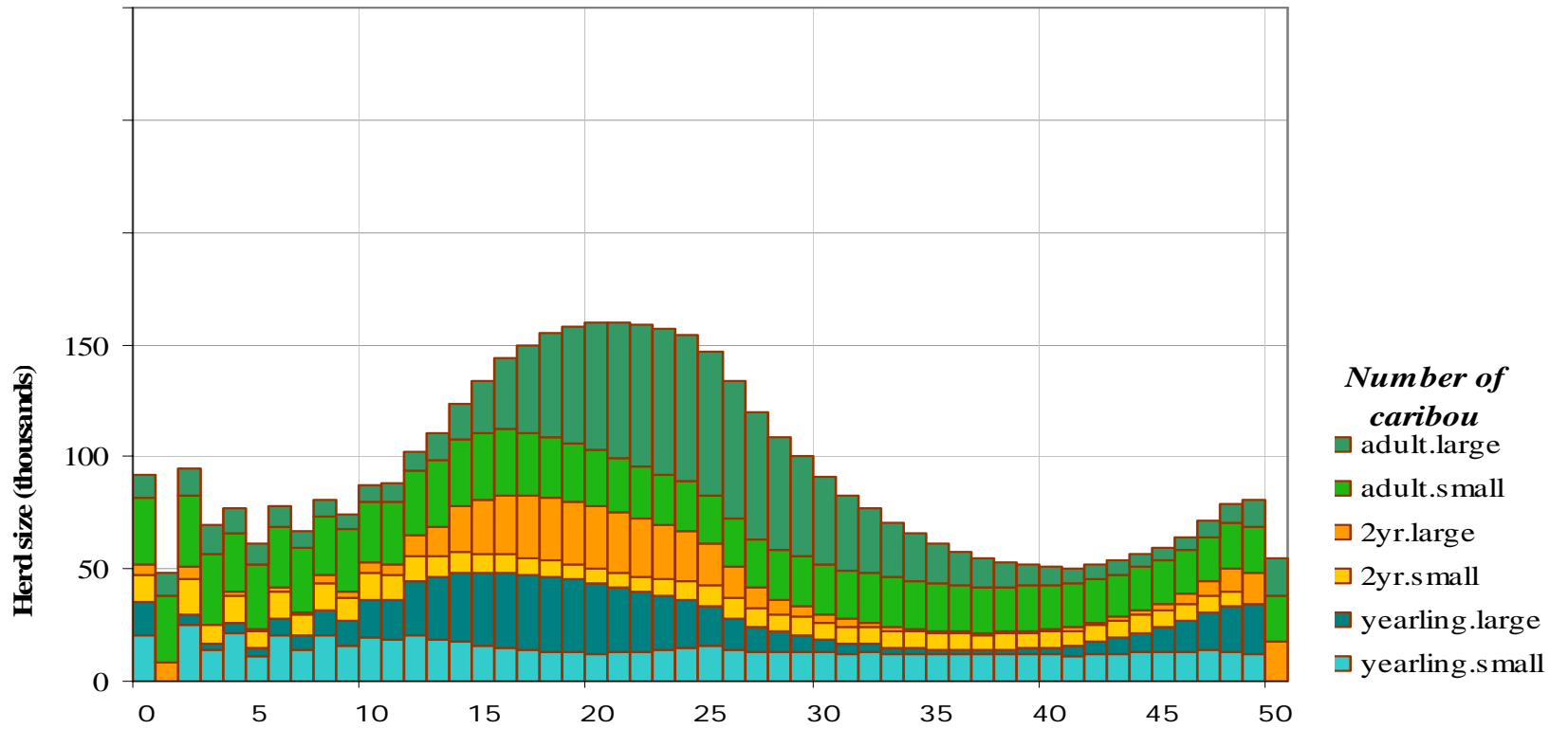
a) Population Size by age and size class





OUTPUTS

a) Population Size by age and size class



??Questions to explore??

- What are the characteristics of body weight/frame size through the cycle?
- Can we use frame size monitoring as a predictor of cycle dynamics, ie predict where we are on the cycle?
- How does altering the level of feedback between habitat (resource availability) and mortality/productivity dampen or accentuate the population cycle?
- Do herds that cycle most dramatically (George River, Western Arctic), exhibit major differences in body size through the cycle, or conversely do herds that don't cycle dramatically (Porcupine) exhibit little variation in frame size?
- Can we say that herds that have cycled dramatically (eg the dramatic decline of Bluenose West and Cape Bathurst) without exhibiting variations in frame size, are being "controlled" by size-independent mortality factors, e.g. harvest, predation, accident?
- How does this help us understand the dynamics of caribou cycles and the vulnerability of these herds to global change drivers?