**Isle Royale facts and questions**

* Chance / stochastic factors seem to play an important role. What is the probability for the wolves to drive moose to extinction and how likely is it for the wolves to go extinct on Isle Royale as given by the data we have so far.
* How will this be affected by potential Climate Change Scenarios (less cold winters, more hot summers)?

**Available sources:**

Website of national Park Service:

<https://www.nps.gov/isro/learn/nature/wolves.htm>

Wikipedia Page:

<https://en.wikipedia.org/wiki/Wolves_and_moose_on_Isle_Royale>

Wolf project page:

<http://www.isleroyalewolf.org>

* In 1980: Canine parovirus lead to a decline from 50 to 14 individuals
* With predation low during the late 1980s and early 1990s, moose lived longer and gave birth to more calves.
* During the winter of 1996, **lack of forage** for the moose, an **outbreak of moose ticks** , and **severe winter** all conspired against the moose. The winter had been more severe than any in over a century. The moose population **collapsed** from its all-time high to just 500 moose.
* During the winter of 1997, a wolf from Canada immigrated to Isle Royale. He crossed on an ice bridge that occasionally forms between Isle Royale and Canada.
* His arrival also explains, in part, why wolves did pretty well from 1998 to 2004, during a time when it was relatively difficult for wolves to capture moose.
* Then, a series of **very hot summers** struck. During hot summers moose feed less, as they spent more time resting in the shade. Having fed less, the **undernourished moose** were less prepared to **survive the winters**. **Warm temperatures also enabled severe outbreaks of moose tick**. Weakened by heat and ticks, moose dropped to their lowest observed levels. Wolves took advantage of weakened moose, fueling high rates of predation. During the first decade of the 21st century, the moose population steadily slid to its lowest levels.
* With moose becoming increasingly rare, capturing food becomes increasingly difficult.
* DNA analysis of wolf scats collected at kill sites indicates no more than two adult females in the population. If they were to die before giving birth to new females, the wolves would be committed to extinction. (one could have wolves have age and sex)
* fluctuations of wolves and moose on Isle Royale are not explained by either simple top-down or bottom-up explanations.  The true explanation is quite a bit more complex.
* More moose / wolf 🡪 higher kill rate ( we can use the relation from the diagram)
* Wolf population variations are caused not only by kill rate but obviously also by disease, inbreeding depression, and demographic stochasticity

Vucetich & Peterson 2004 OIKOS

* The most important predictor of wolf growth rate is the abundance of old moose (i.e.􏰅/9 years).
* Calf abundance, which reflects another important aspect of prey age structure, does not appear to importantly influence wolf population growth rate (Table 4).
* it may be that the consequences of calf predation are relatively unimportant to wolf population dynamics, but quite important to moose population dynamics.
* The second most important source of variation in population growth rate is demographic stochasticity, which accounts for approximately 30% of the variation in wolf growth rate (Fig. 6).
* Much of the variation in wolf growth can be explained only if the population crash of 1980 is taken into account (Table 3, 4). After the population crash, carrying capacity decreased, the strength of density dependence increased, and the influence of old moose decreased (Eq. 5, 7; Fig. 3, 5).
* It is plausible that the observed dynamics reflect a strong interaction between disease and inbreeding
* The indirect influence of winter climate on wolf population growth rate is important, insomuch as winter climate is an important predictor of kill rate (Vucetich and Peterson 2004b) and prey abundance
* However, after accounting for these indirect effects, the direct effect of winter climate on wolf population growth rate appears to be of little or no importance (Fig. 6)
* Applying population models based primarily on density-dependent kill rates for the management and prediction of wolf􏰀/prey dynamics (Messier 1994, Boyce 1995, Eberhardt and Peterson 1999) seems of limited value to the extent that wolf growth is poorly predicted by kill rate (Fig. 2), and to the extent that kill rate is poorly predicted by densities of predator and prey