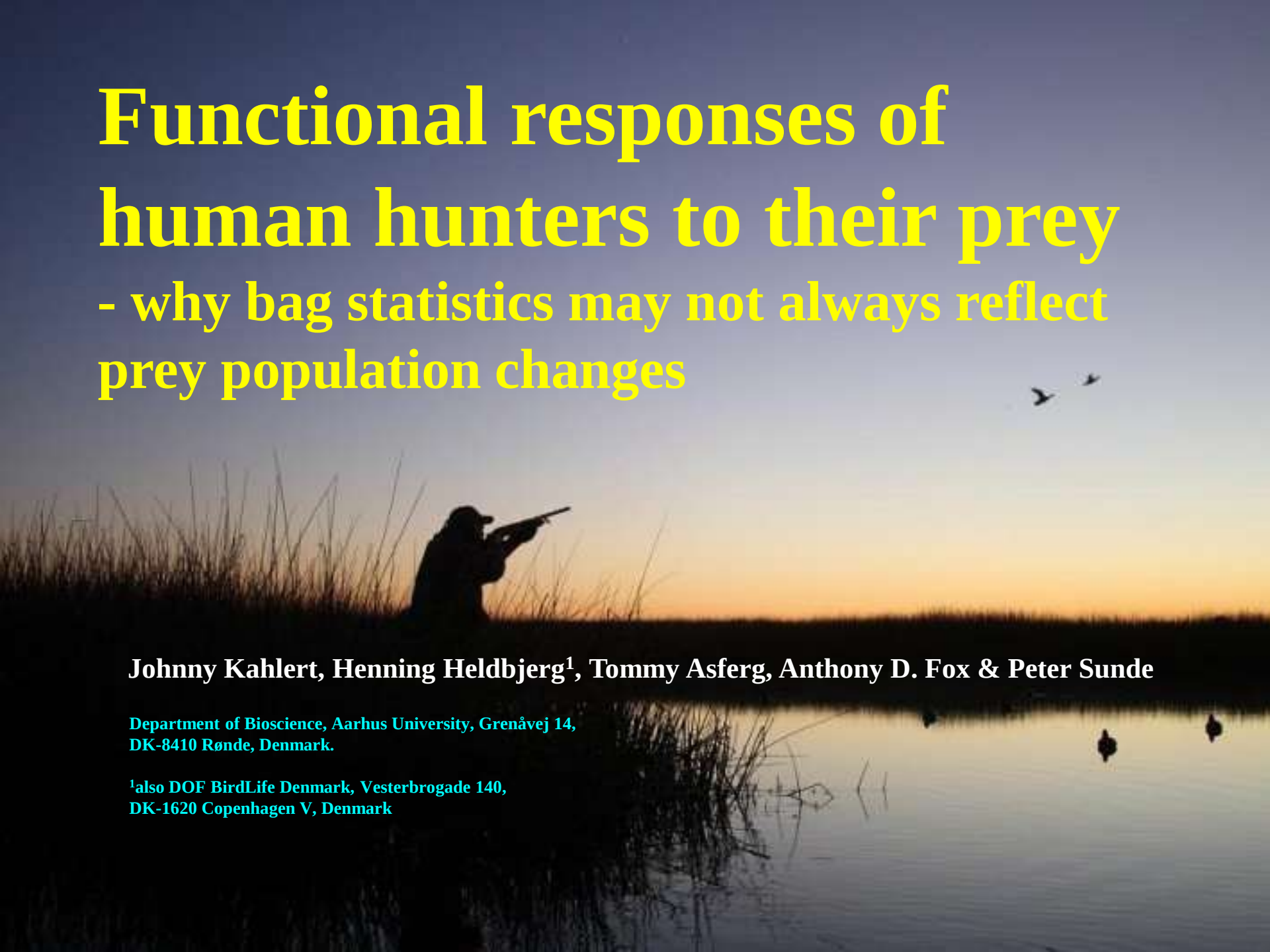
Functional responses of human hunters to their prey

- why bag statistics may not always reflect prey population changes



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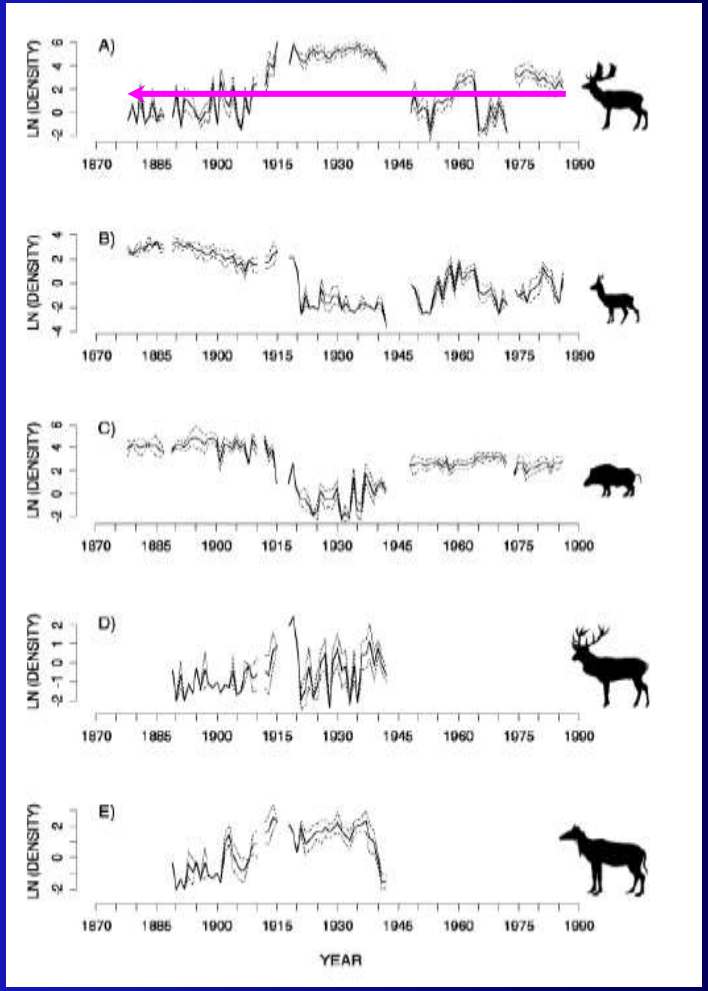
Harvest records often assumed to be an indirect measure of population abundance



Fallow Deer *Dama dama*

Roe Deer *Capreolus capreolus*

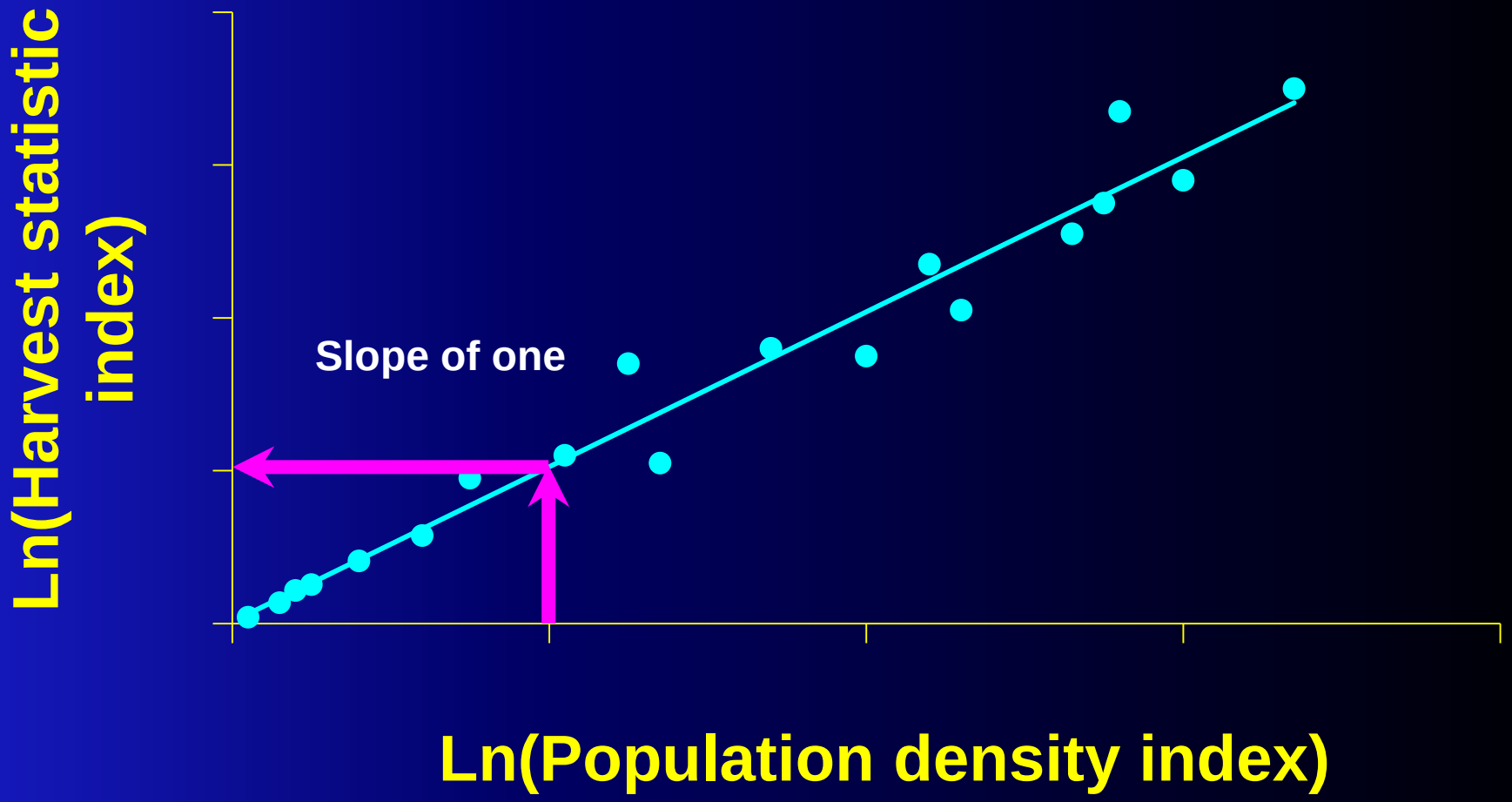
Wild Boar *Sus scrofa*

Red Deer *Cervus elaphus*

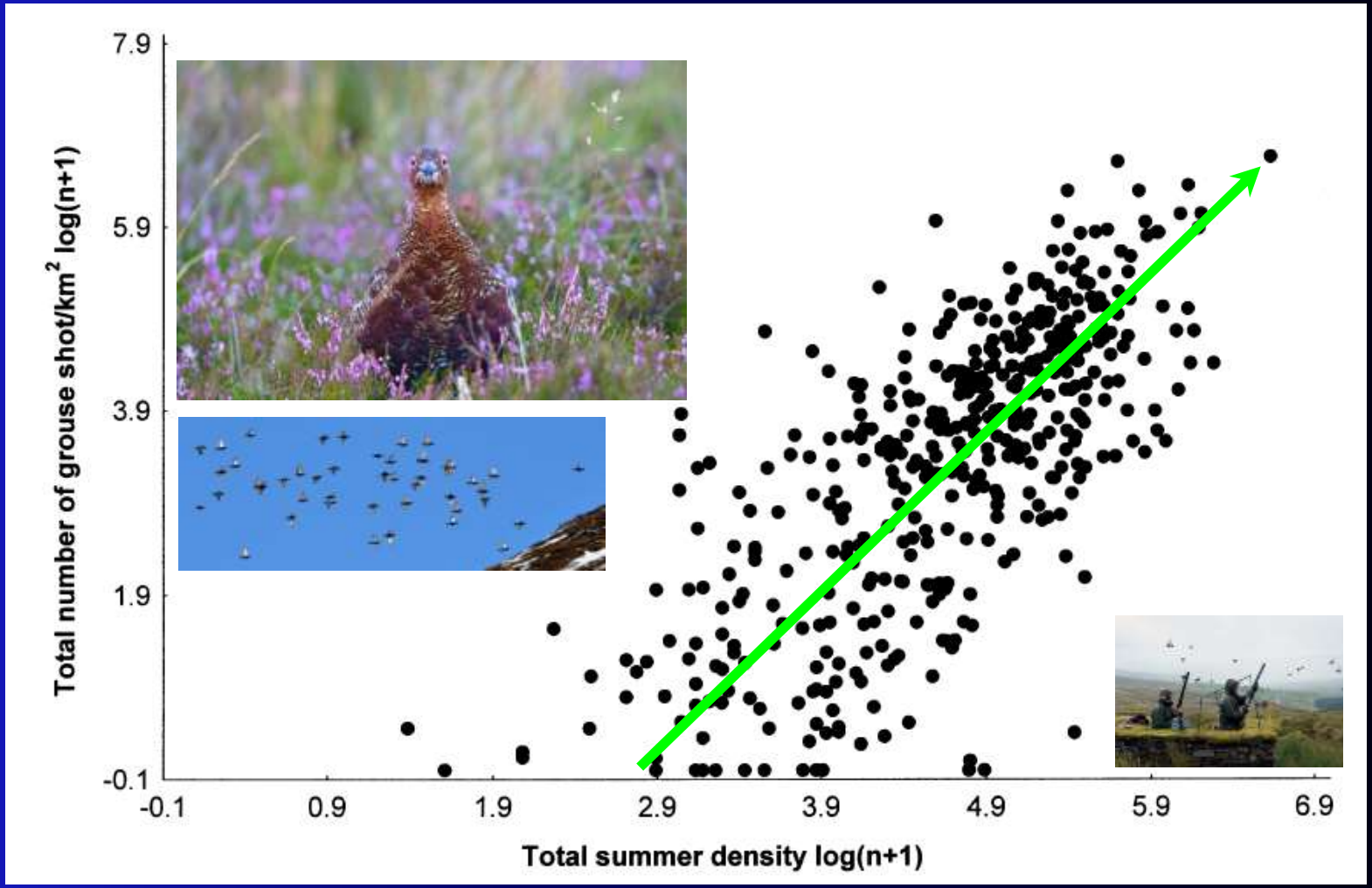
Nilgai *Boselaphus tragocamelus*

Imperio *et al*. (2010) *Wildlife Biology* 16: 205-214

Harvest records often assumed to be an indirect measure of population abundance

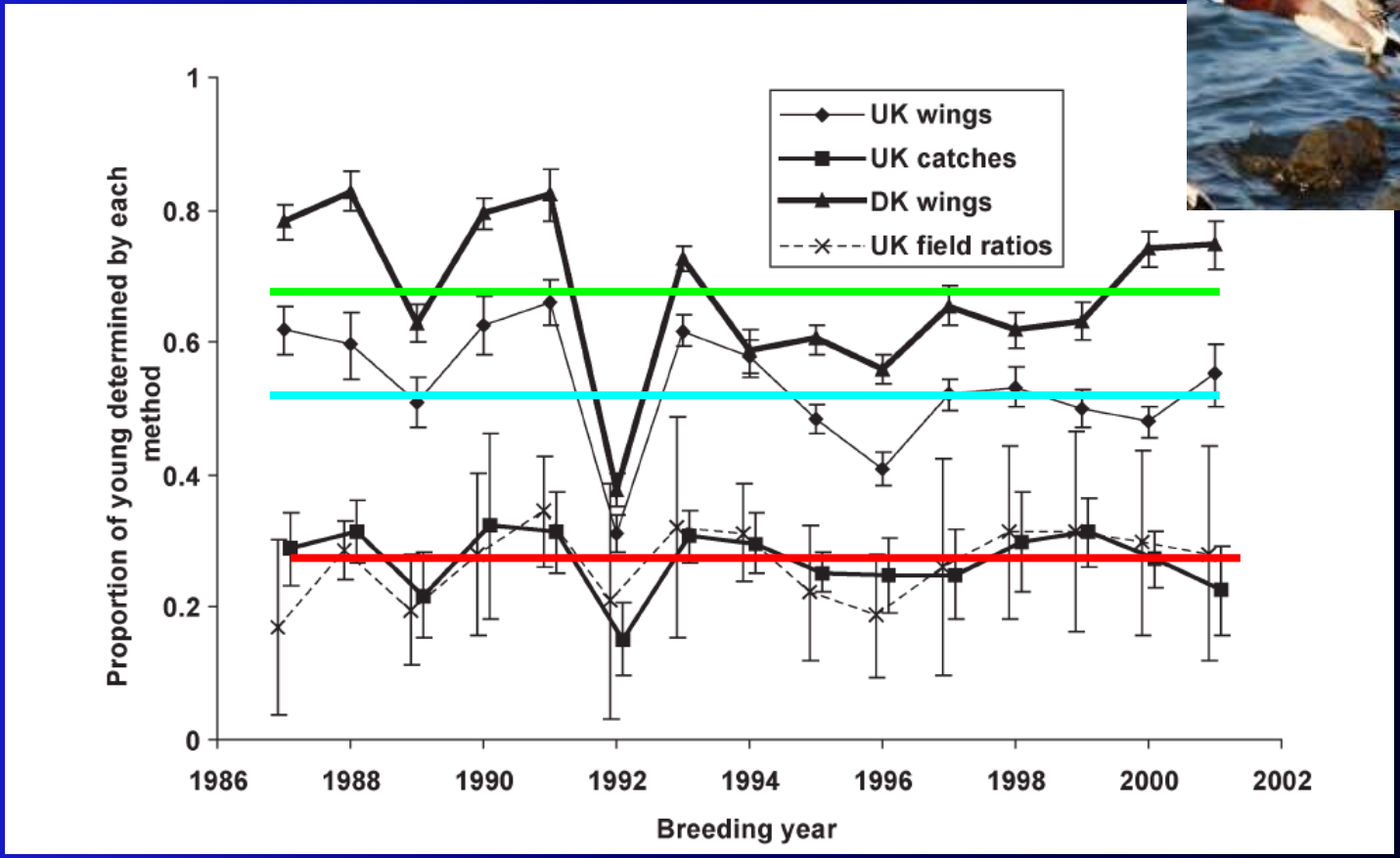


Harvest records may in some circumstances be an indirect measure of population size



Cattadori *et al.* (2003) *Oikos* 100: 439–446

But the composition of harvests does not always reflect that of the population as a whole…



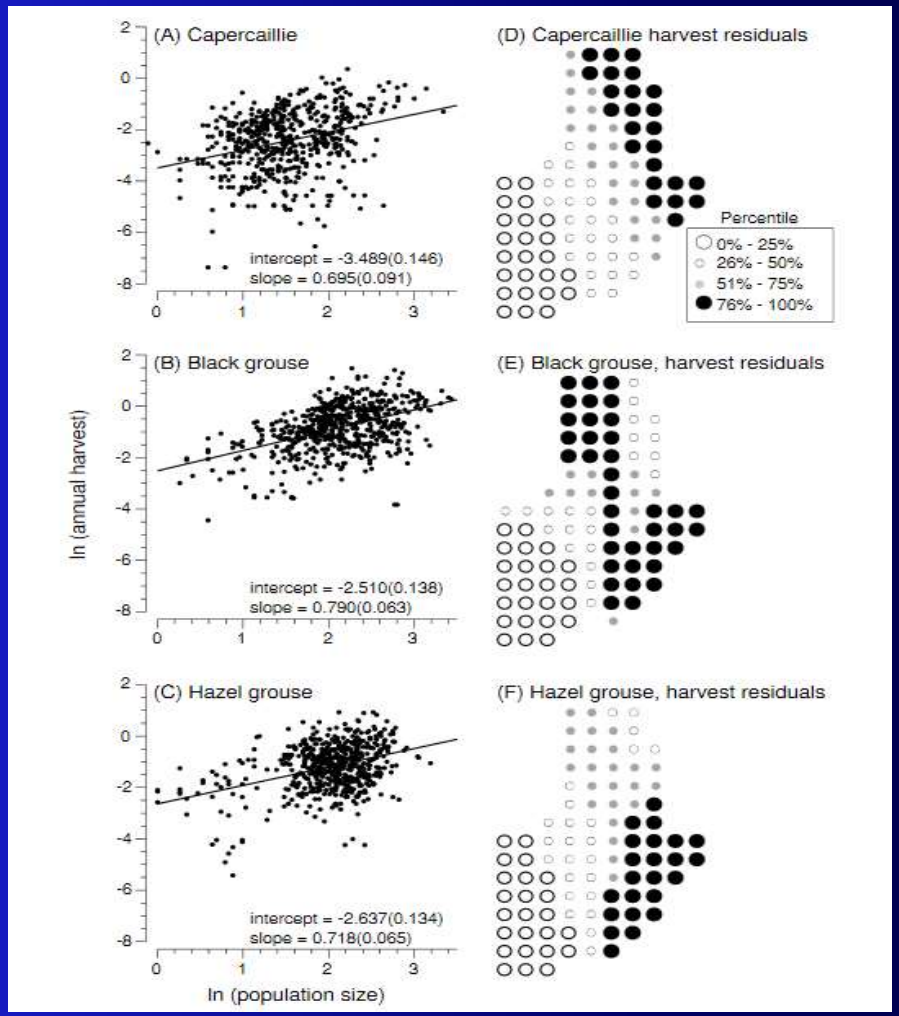
Danish killed

UK killed

UK in the field

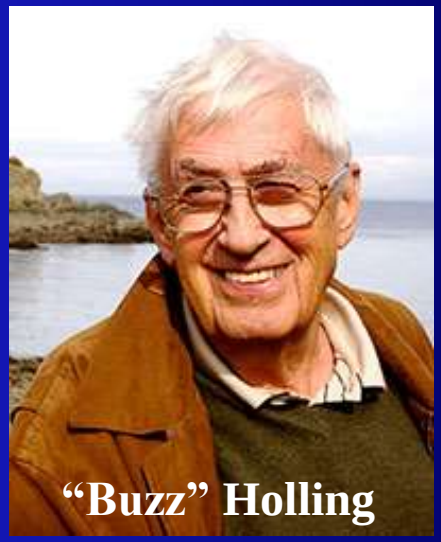
Mitchell *et al.* (2008) *Bird Study* 55: 43-51

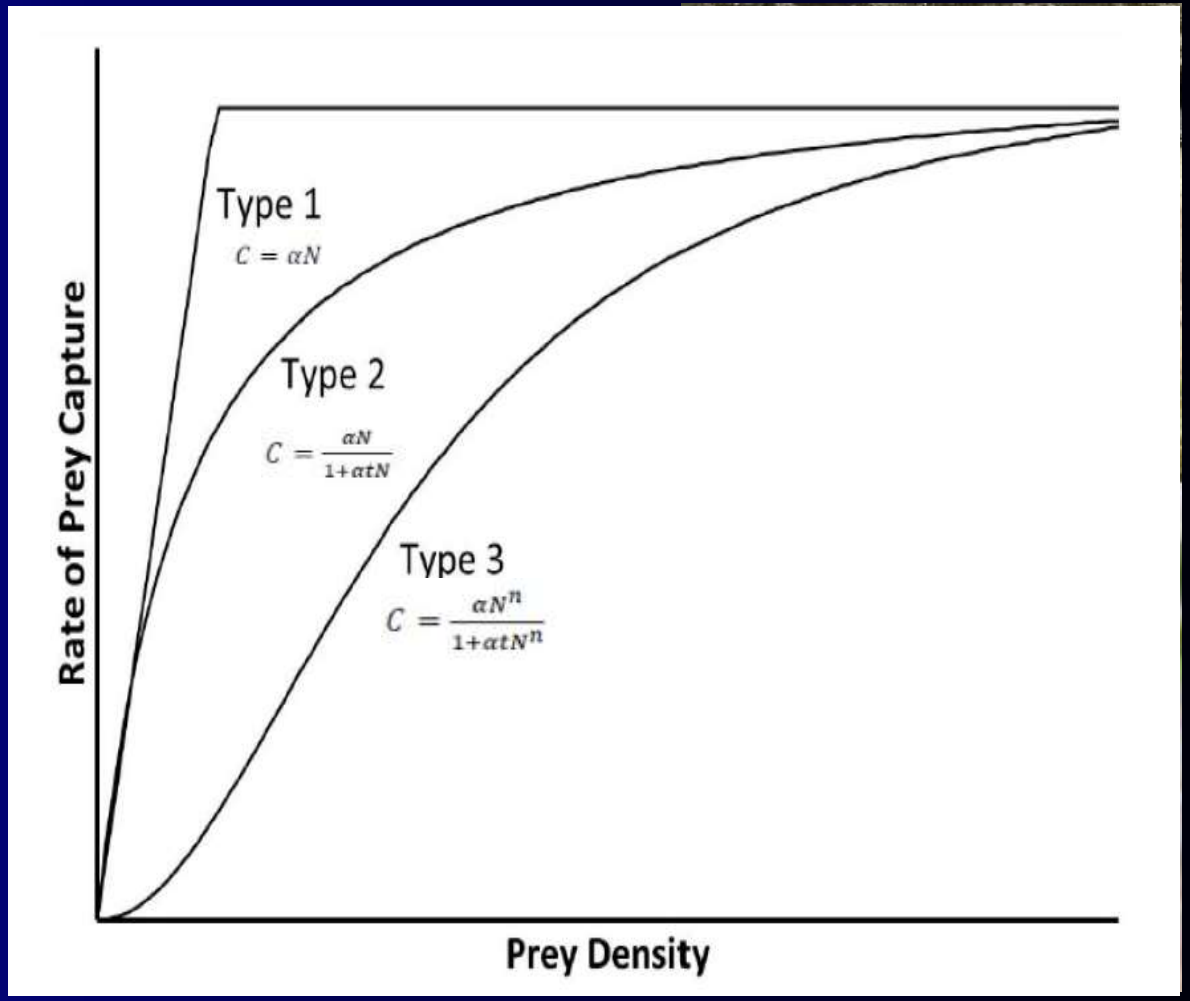
Linear regressions of annual grouse harvest against counts were reasonable fits but slopes < 1 in every species



Ranta *et al.* (2008) *Oikos* 117: 1461–1468

Could hunter harvest rates vary in response to prey population size and different ways?

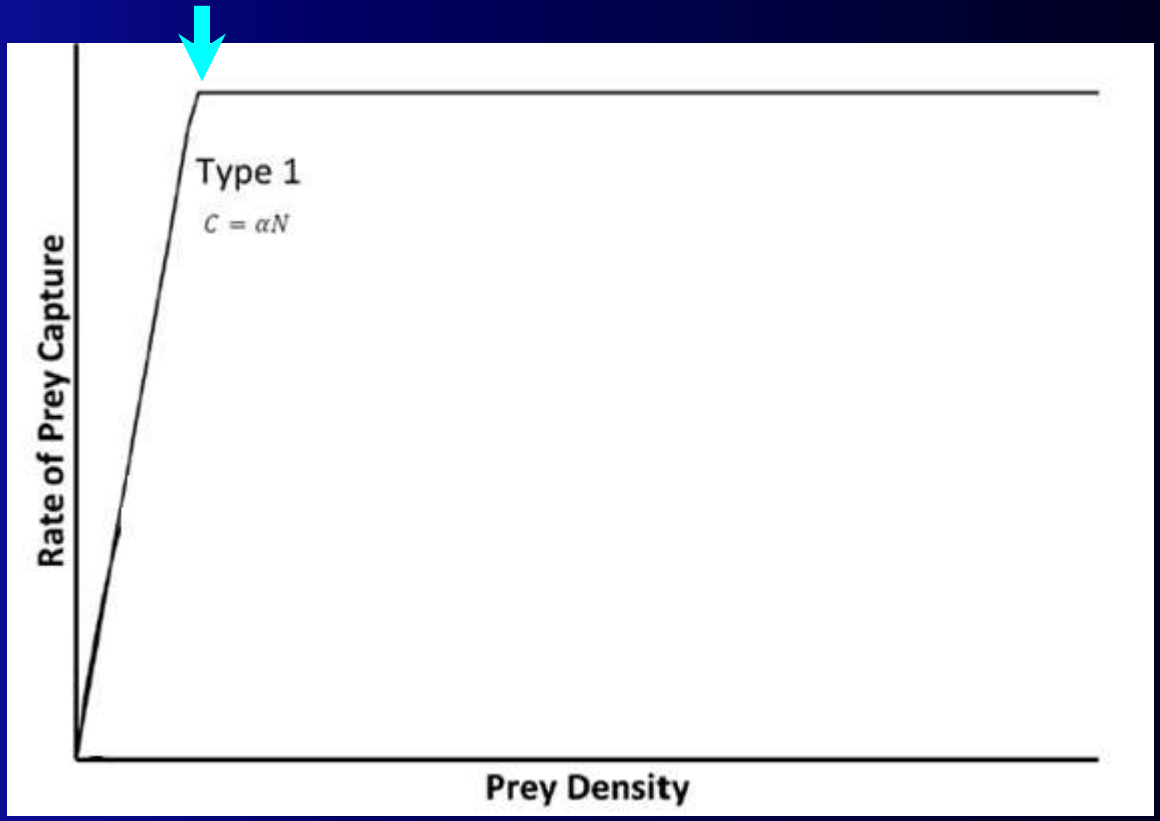




Holling (1959) *Canadian Entomology* 91: 293-320 & 91: 385-398.
Holling (1965) *Memoirs of the Entomological Society of Canada* 45: 5-60.

Classic Type I functional response

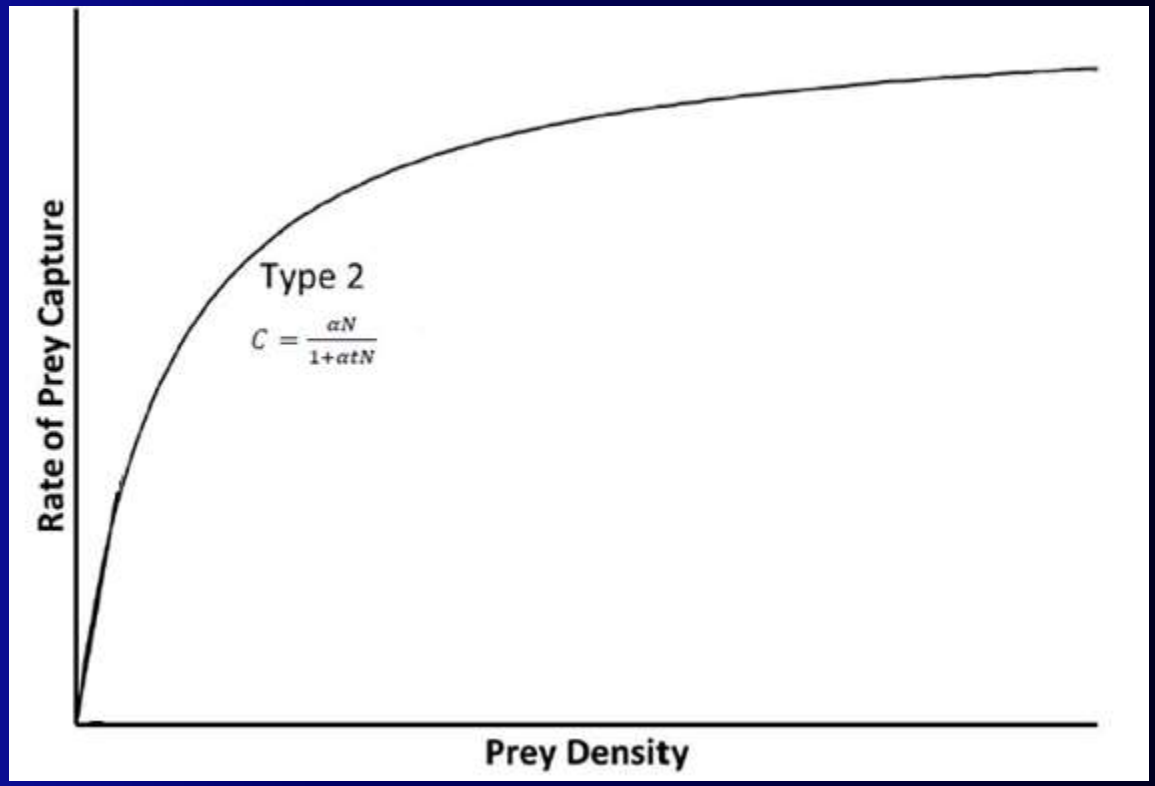
A simple linear relationship between capture rate *(C)* and prey density (*N*) up to certain level *P*



Holling (1959) *Canadian Entomology* 91: 293-320 & 91: 385-398.
Holling (1965) *Memoirs of the Entomological Society of Canada* 45: 5-60.

Classic Type II functional response

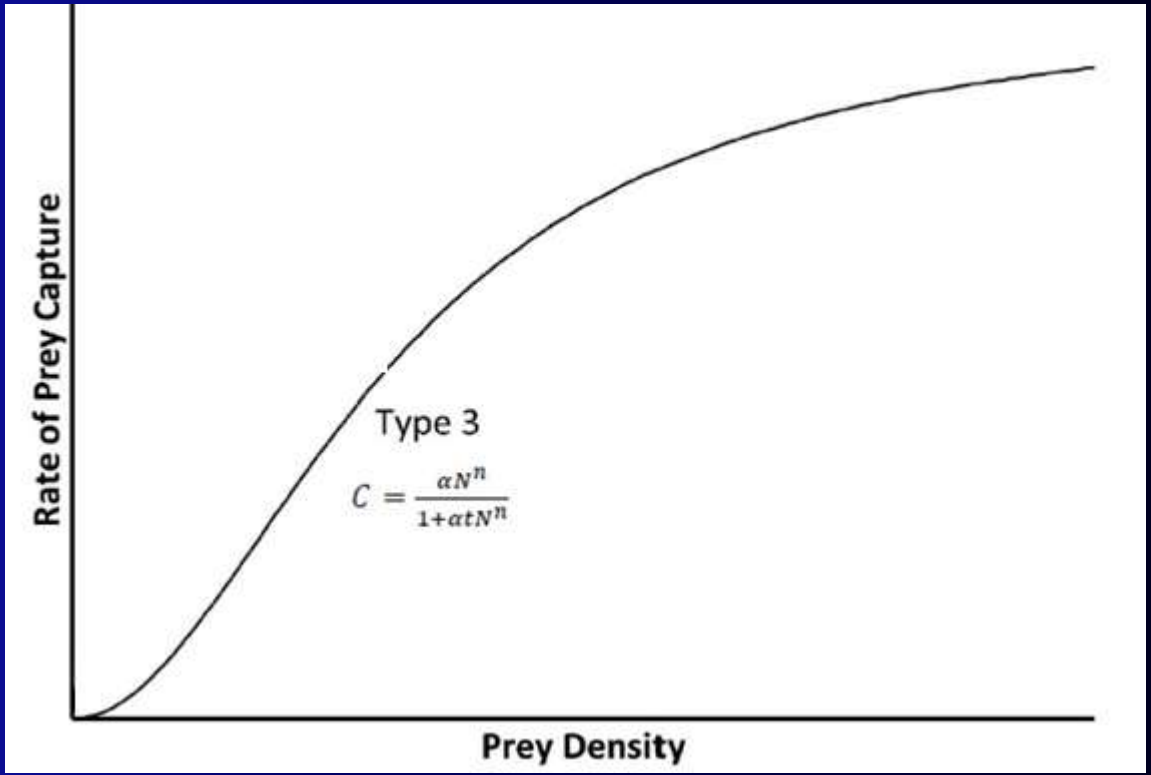
Introducing handling time *(t)* where $t > 0$ where hunters become time limited or less disposed to continue having killed a certain number



Holling (1959) *Canadian Entomology* 91: 293-320 & 91: 385-398.
Holling (1965) *Memoirs of the Entomological Society of Canada* 45: 5-60.

Classic Type III functional response

Hunters may switch to other species and/or refrain from killing species that show dramatic declines. This results in little change in the hunting yield at low population density, as population densities increase, such quarry species will become more popular to hunt (enhanced hunting effort), until they become so abundant that saturation effects would take over



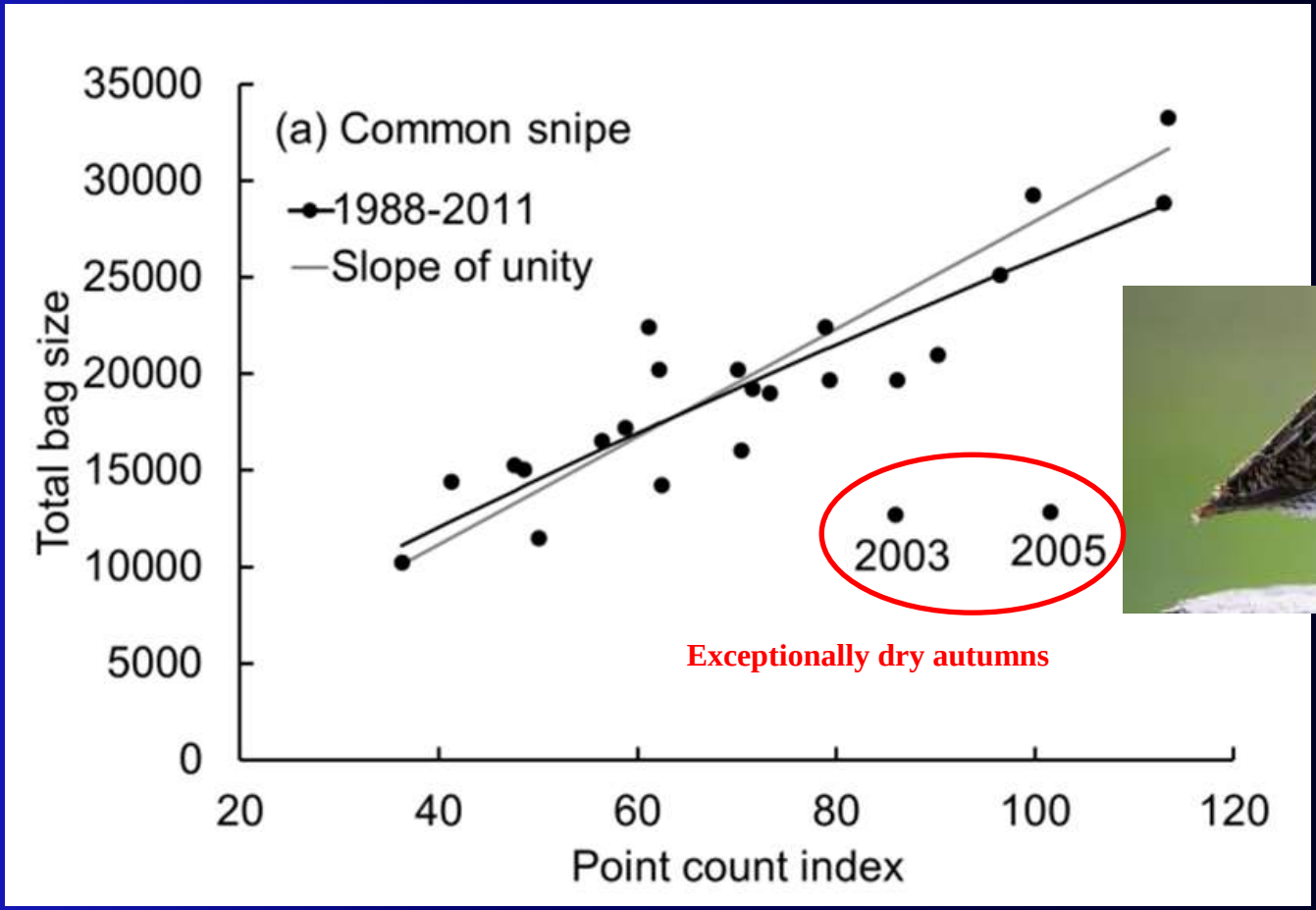
Holling (1959) ***Canadian Entomology*** **91: 293-320 & 91: 385-398.**
Holling (1965) ***Memoirs of the Entomological Society of Canada*** **45: 5-60.**

We test to see if we can find such functional responses

…by comparing the annual Danish hunting bag statistics (as a measure of prey capture) with DOF (BirdLife Denmark) point count indices (as a measure of annual species abundance) in four avian and two mammalian quarry species

Classic Type I functional response

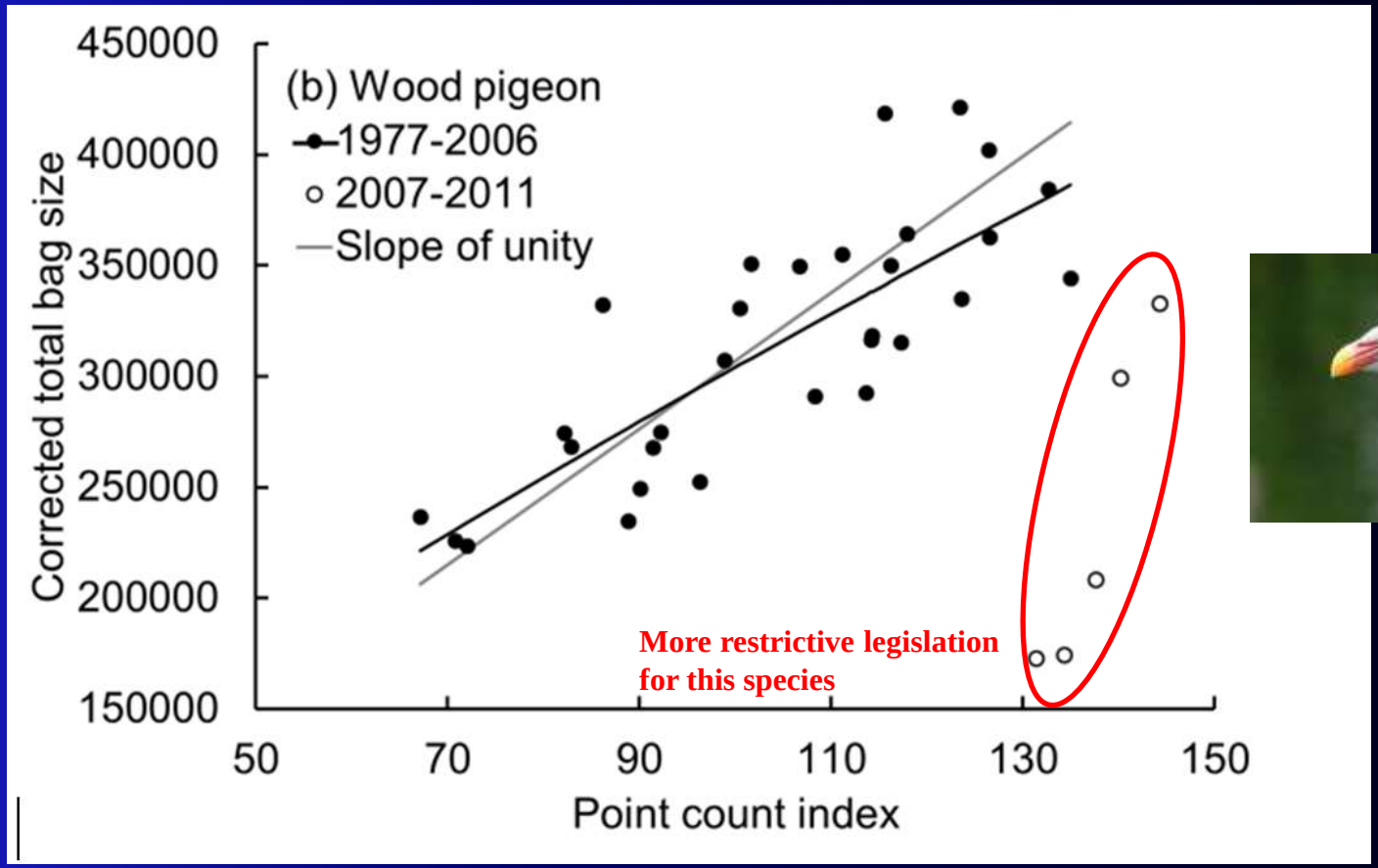
A simple linear relationship between capture rate *(C)* and prey density (*N*)
slope equal to unity



Exceptionally dry autumns

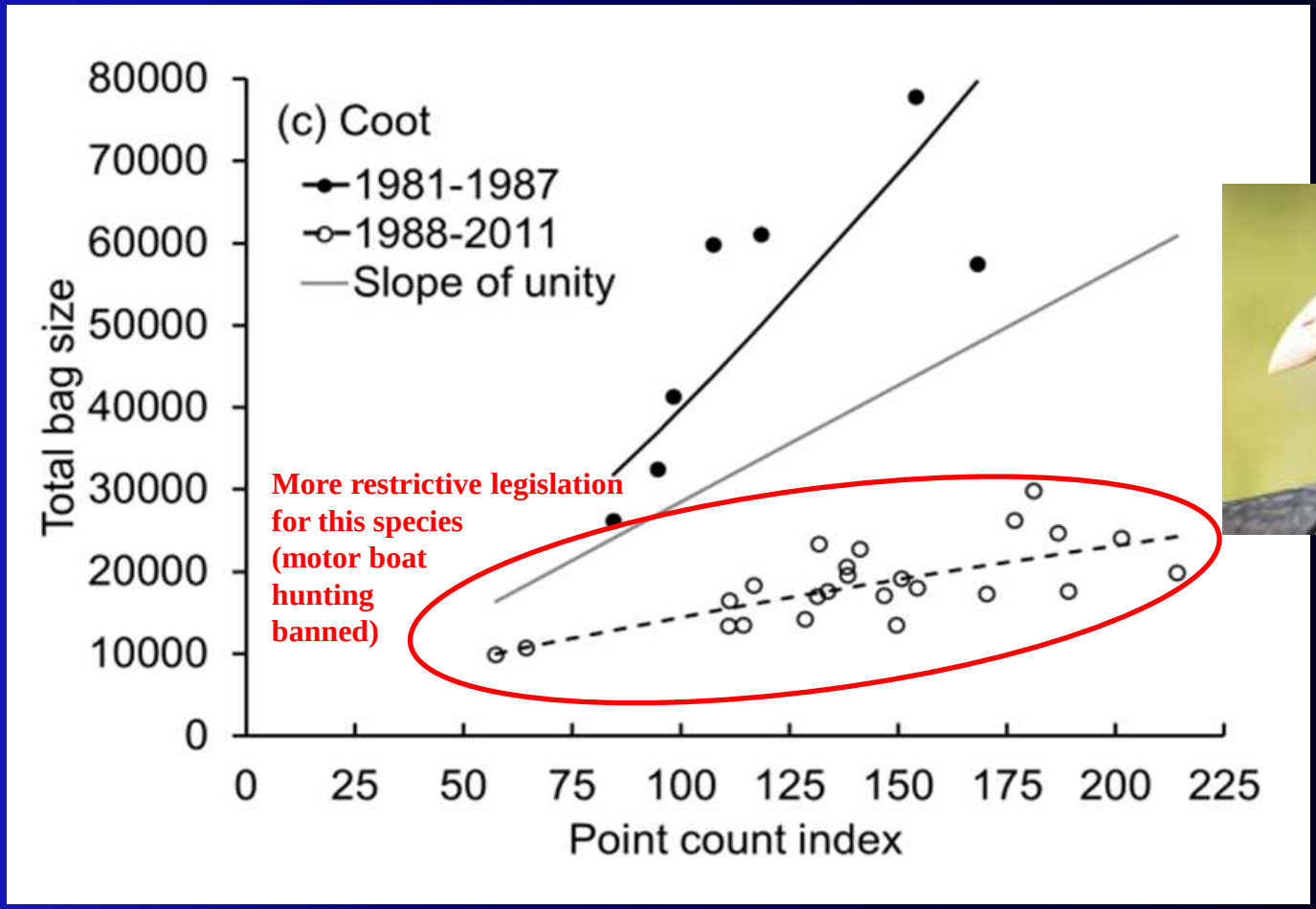
Classic Type I functional response

A simple linear relationship between capture rate *(C)* and prey density (*N*)
slope equal to unity 1977-2006, major response to law change



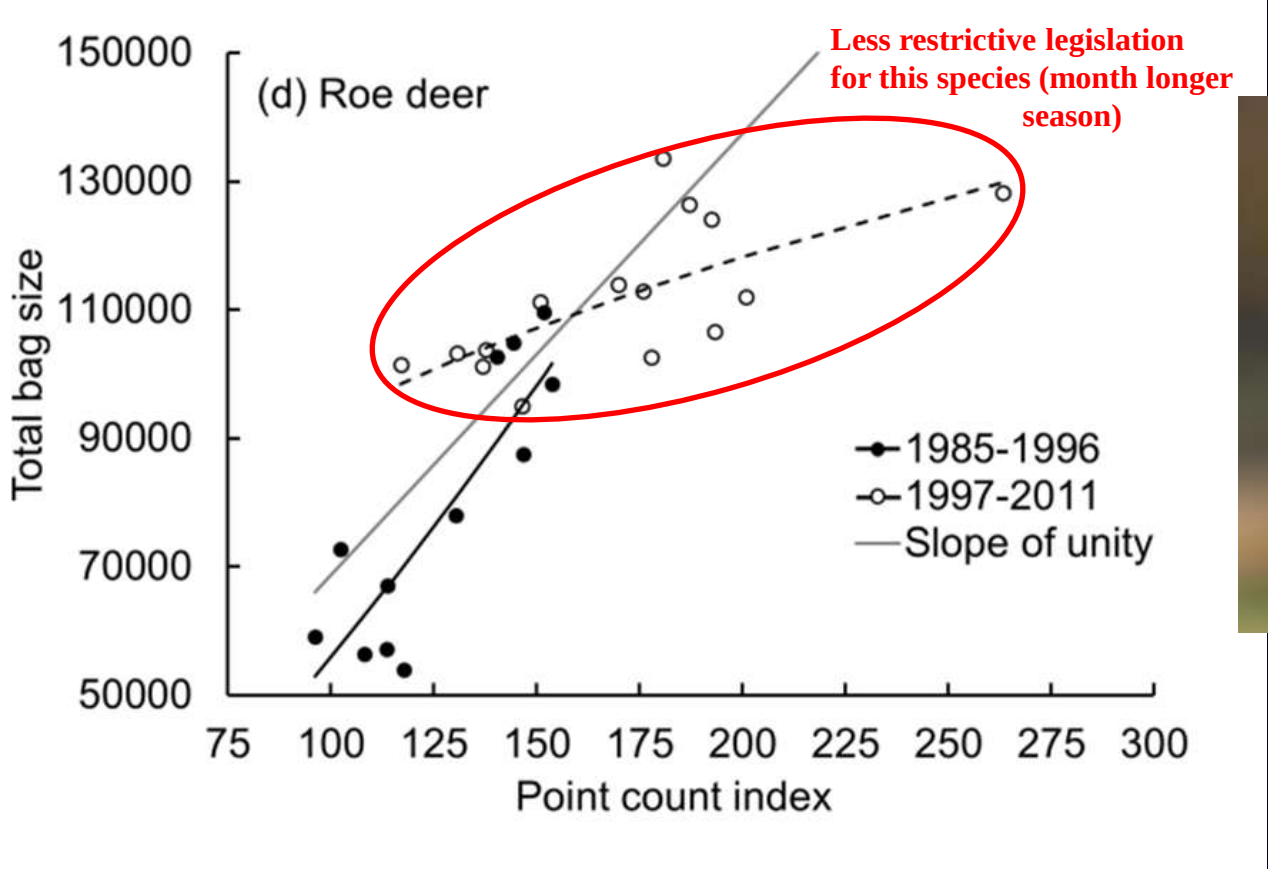
Tends to Type I functional response

A simple linear relationship between capture rate *(C)* and prey density (*N*) but slopes not equal to unity, major response to law change



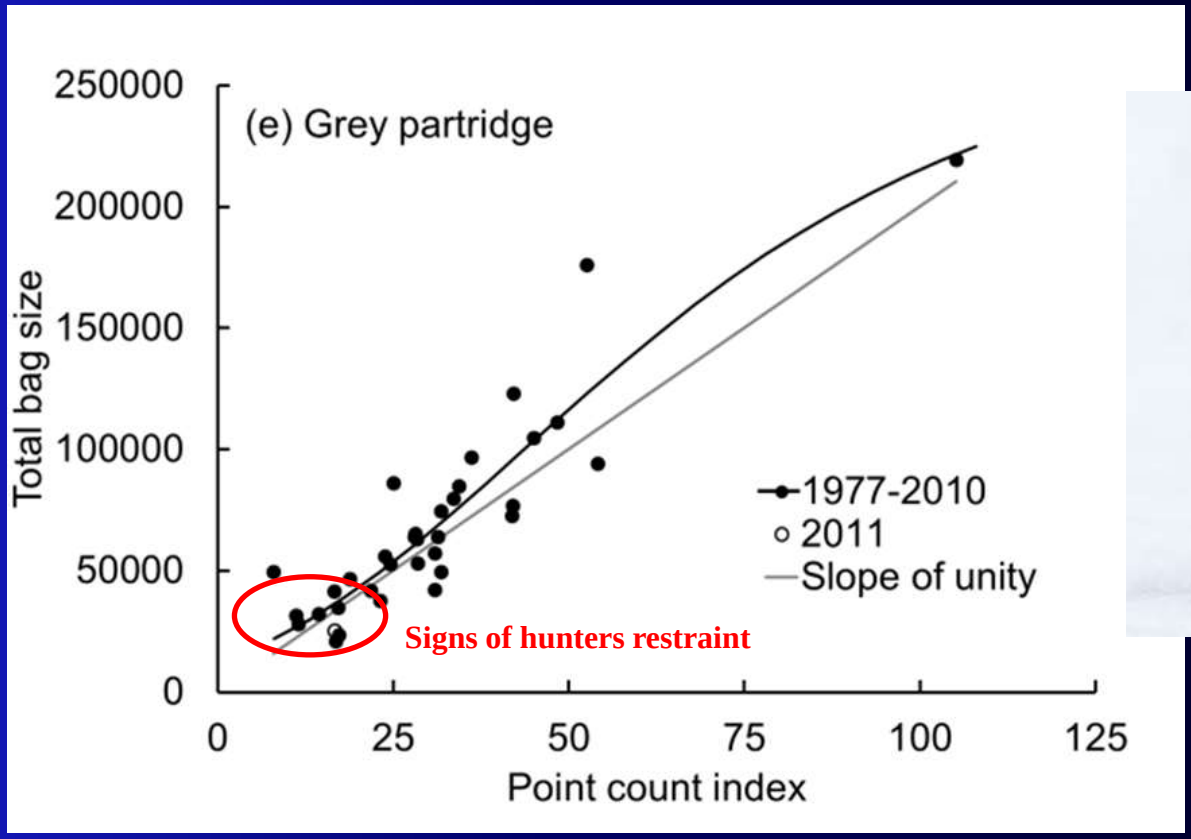
Formerly classic Type I functional response

A simple linear relationship between capture rate *(C)* and prey density (*N*) slope equal to unity 1985-1996, now departs following major response to law change



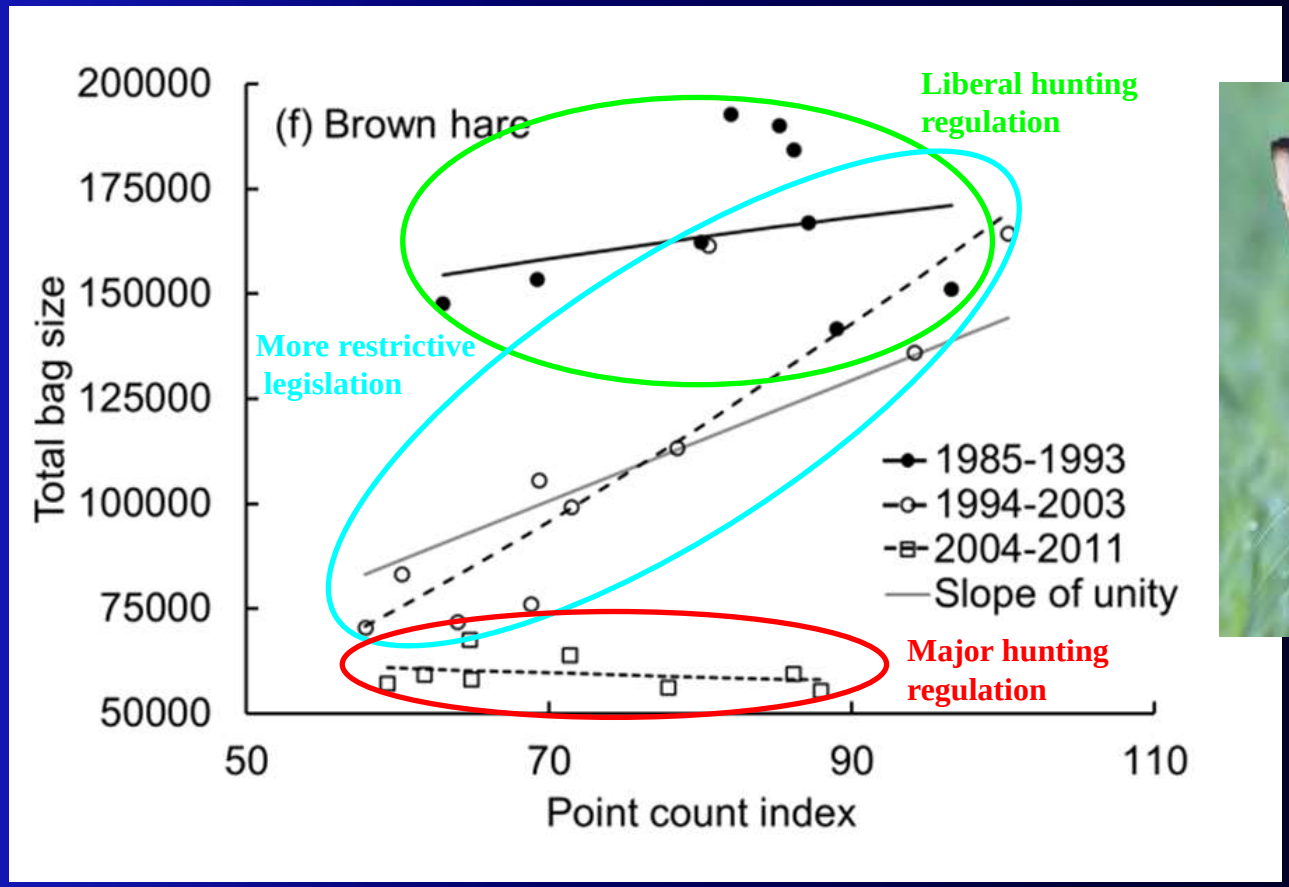
Classic Type III functional response

Sigmoid relationship between capture rate *(C)* and prey density (*N*) slope equal to unity 1977-2010, shows signs of hunter restraint in the absence of regulation



Too complex to model functional responses

Much affected by major responses to law change



Take home messages

- Using bag statistics (as a proxy for kill rate) and point count indices (as a proxy for population abundance) have their limitations!
- Relationships between bag statistics and point count indices varied greatly between species
- Although some species (notably Common Snipe) suggested sustained Type I Holling responses, this was the exception rather than the rule
- Clearly changes in hunting law had major effects on levels of hunting effort that must be taken into account if hunting statistics are to be used to reflect total abundance in any form
- Grey Partridge data also hinted at a Type III response as might be expected given the great concern amongst hunters for this species which has declined rapidly due to changes in agriculture
- The latter case shows that “predator” behaviour affects relationships between prey density and kill rate and this too needs to be accounted for if hunting statistics are to be used to reflect population size

Conclusions

- **Care MUST be exercised before bag statistics are ever considered as reliable indices of population abundance**
- **While possible for some species, this relationship has to be investigated to adjust for changes in hunter effort before harvest records are considered as indices of population size and change**
- **ESPECIALLY because hunter behaviour may affect bag statistics, for instance exercising restraint (*e.g.* the case of Grey Partridge) with species of concern and as a result of saturation effects relating to very abundant species**
- **Despite this, there are very powerful arguments for collecting harvest records, which are vital for this type of exercise, assessing the impact of hunting on populations and ultimately in the effective adaptive management of hunting in a sustainable fashion**
- **We also advocate innovative sociological studies to better understand the factors that affect hunting effort and decision-making amongst hunters**

Watch out for the upcoming publication on this due out in the journal *Wildlife Biology*!

Thanks to the thousands of "Citizen Scientists" who count birds and report hunting bags to generate these data, and to the Danish Nature Agency for funding the collations of data and analysis presented here…

…and thank you so very much for listening!