

Monitoring butterfly abundance: beyond Pollard walks

Jérôme Pellet

Antoine Gander (Grande Cariçaie)

David Parietti (UNIL)

Patrick Heer (Unibe)

Daniel Cherix (UNIL)

Raphael Arlettaz (Unibe)



Background

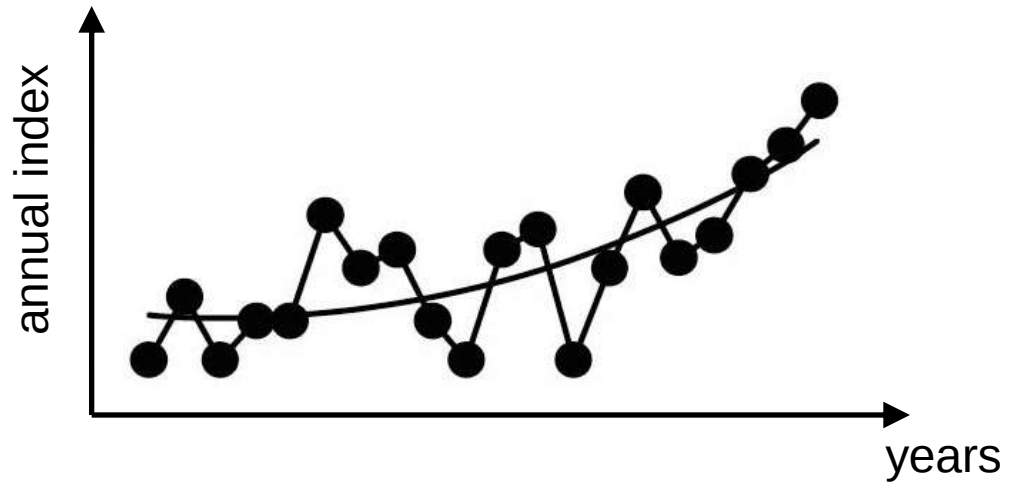
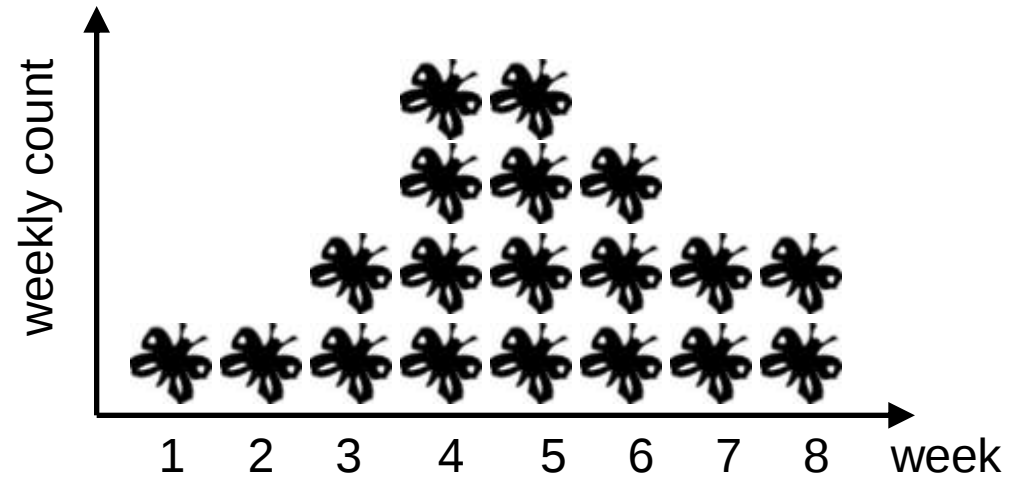
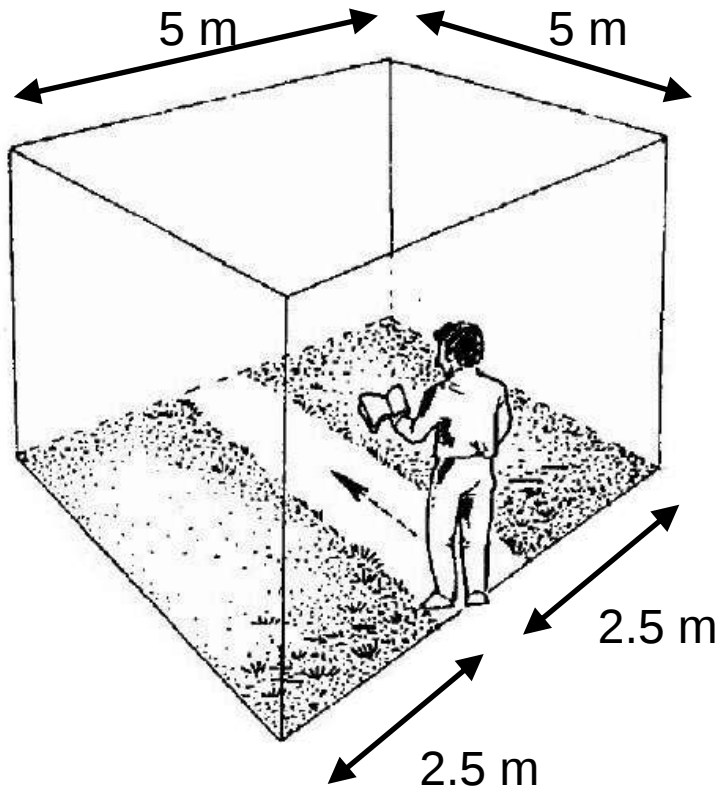
- Butterflies and day-flying moths species are widely used as ecological sentinels
- The indicator metric is often based on counts of individuals
- Transect counts (Pollard walks) is the most widely used method in conservation (~75% of published papers)



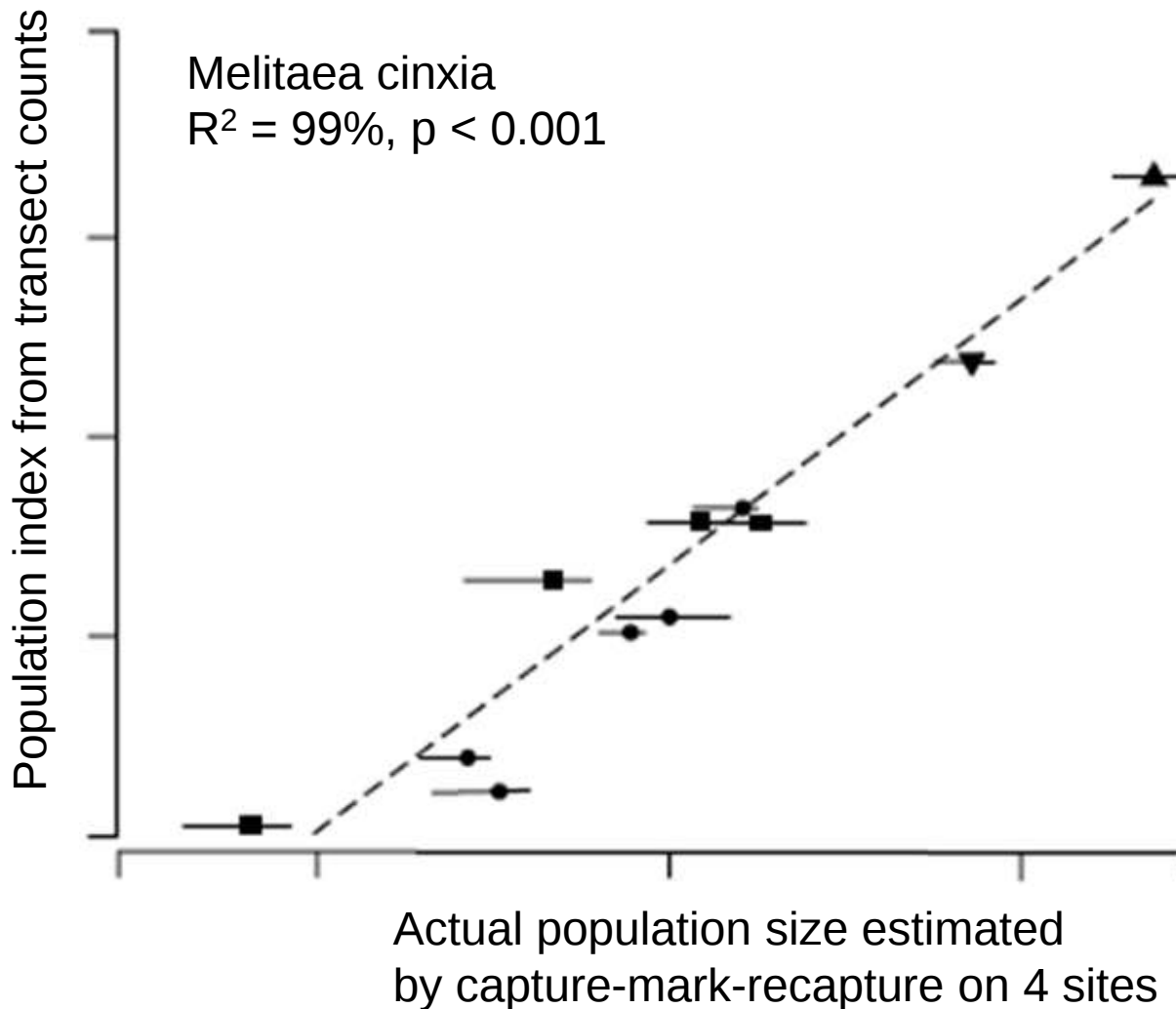
Ernie Pollard ~1973

1. 1.5
17-07-2017
usually 3
18-07-2017

Pollard walks



Abundance index proportional to population size?



Detectability

- Abundance indices are based on counts
- Counts (C) are a sample of the population (N)

$$C = N \cdot p$$

- Detectability is imperfect: $0 < p < 1$
- Most programs are standardized in order to keep p fixed so that changes in C reflect changes in N



Sources of variability in detectability

- Vegetation succession
- Varying ability of the observer to detect a cryptic species
- Species behavior change in response to density (males more mobile with high densities)
- Season, time of day, temperature, weather
 - Even under standard survey conditions, detectability will vary in space (sites) and time (years)
 - it thus remains unclear how counts reflect population sizes and trends



Measuring detectability p

- Estimate the "true" population N :
 - Capture-Mark-Recapture (population size)
 - Distance sampling (effective strip width and density)
 - Replicated counts (N-mixture models)
- Evaluate the assumption that detectability is reasonably constant



Capture-Mark-Recapture

- Based on capture histories of individuals (e.g. 011101)
 - Assumptions
 - Equal likelihood of capture
 - Correct identifications
 - Open population (emergences and immigrations, deaths and emigrations)
- Estimates total and daily populations, daily survival, catchability and recruitment



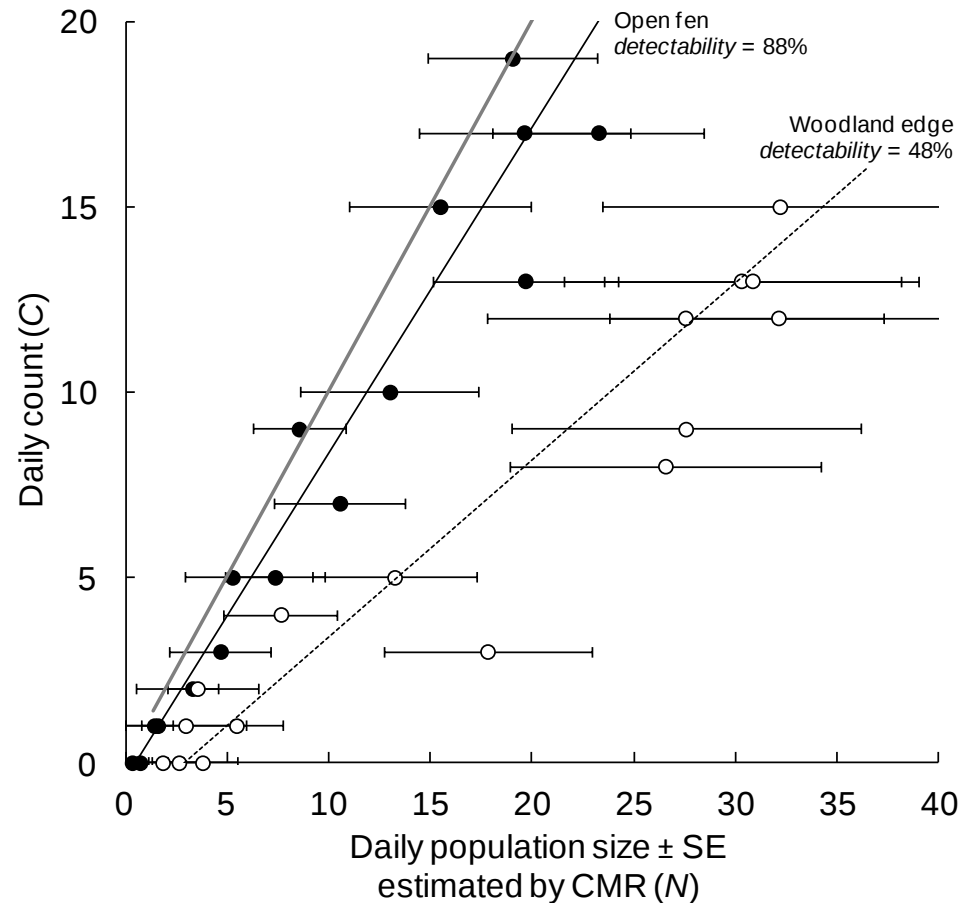
Habitat-induced detectability change



Open fen

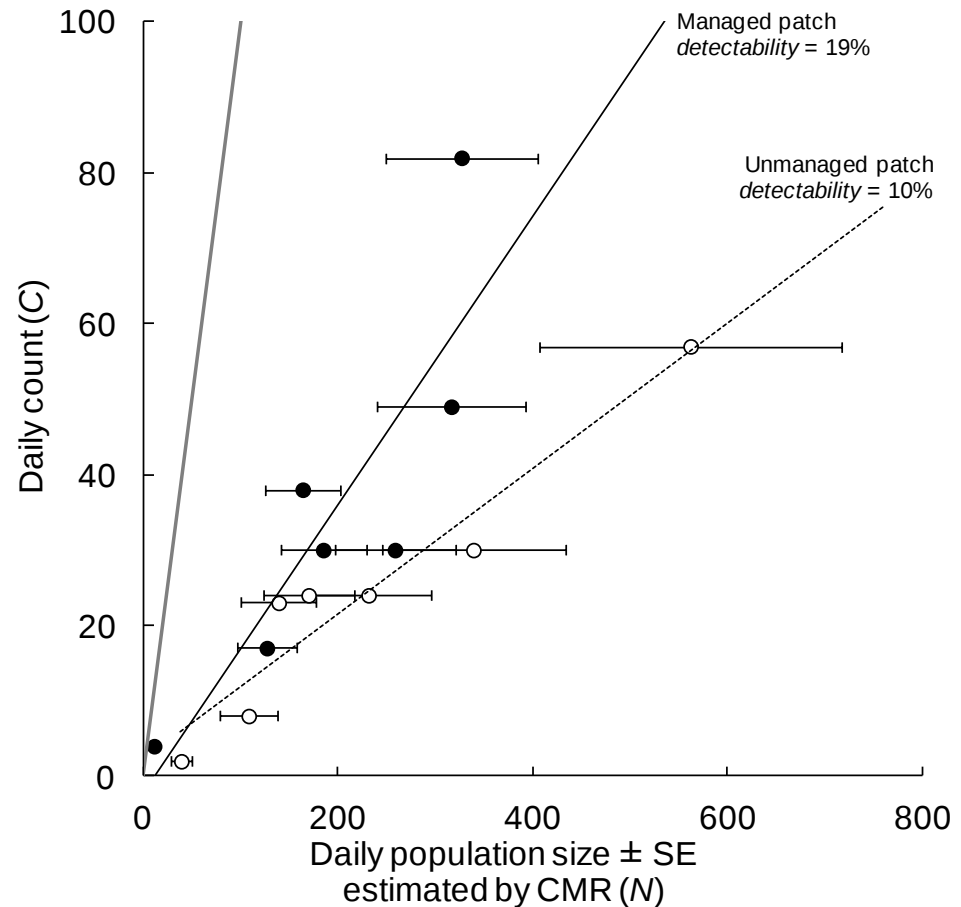


Woodland edge



- Individual detectability is almost two times greater in the open fen

Management-induced detectability change



- Individual detectability is two times greater in the managed patch

Advantages and disadvantages

Method	Advantages	Disadvantages
Capture-Mark-Recapture (CMR)	• Absolute population size and uncertainty • Catchability • Daily survival • Home range	• Human resources • Analytical difficulty • Mortality? • > ~30 individuals and recapture rate > ~30%
Pollard walks	• Easy to conduct	• Simplistic assumptions • No uncertainty
Distance sampling	• Population density and uncertainty • Detectability incorporated	• Analytical difficulty • > ~30 observations • Assumptions limitations
Replicated counts	• Easy to conduct • Detectability incorporated	• Analytical difficulty • Needs a large sample size (multiple transects and observations)



Conclusion

- Testing the validity of a count index once and for all is not sufficient: detectability changes!
- Whenever possible, detectability should be explicitly incorporated in survey protocols
- With limited resources, distance sampling or replicated counts provide an optimal solution

