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)









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Pollard walks



Abundance index proportional to population size?

Population index from transect counts Melitaea cinxia R² = 99%, p < 0.001 Actual population size estimated by capture-mark-recapture on 4 sites Reproduced from Thomas (1983)





Detectability

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

C = N 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





 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











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





