Project title

Investigating butterfly communities for biodiversity monitoring.

Promoter: Serena Corezzola (National Forest Service-CNBFVR, Italy)

1. Aim (for LTER)

a. investigate butterfly communities in LTER sites to estimate invertebrate biodiversity
b. use butterfly communities as a bioindicator for long term processes (e.g. effects of climate change, human activities)
c. provide data to management and policy makers

2. Research questions and Hypothesis (500 words)

Changes in rural land use, like agricultural intensification, abandonment of grasslands in mountains, loss of wetlands, habitat degradation and fragmentation are the main drivers behind the decline of biodiversity of open habitats (Khun et al. 2005; Van Swaay et al. 2010a). As a consequence, butterflies, which mainly live in these open sites, such as grasslands, have suffered in recent decades. Approximately 19% of all European species are threatened or near threatened and almost a third (31%) of the butterflies have significantly declining populations (Van Swaay et al. 2010b).

As the majority of open habitats in Europe (e.g. grasslands, heathlands) require active management by humans, biodiversity also depends on the continuation of these activities. Re-starting traditional harvesting techniques in abandoned sites or converting agricultural land to organic farming might reverse the current decline in grassland biodiversity. The possible positive effects of these actions however need to be verified by monitoring.

Butterflies, have been found to be a particularly useful indicator group in grasslands and in other open habitats (e.g. Thomas, 2005; Van Swaay et al. 2008.). They also react to pressures such as climate change (Parmesan et al. 1999; Van Swaay et al. 2010a). The diversity of this taxon has been found to be generally related to plant diversity, but other pressures, such as insecticide exposure, habitat fragmentation, and land management, are also important drivers of butterfly community composition (Hawkins et al. 2003; Brückmann et al. 2010; Levanoni et al. 2011). Additionally, it has been found that butterflies show a much reduced “extinction debt”, when compared to plants, and they are thus better indicators for short term effects (Morris et al. 2008; Kuussaari et al. 2009; Krauss et al. 2010). Butterflies are well suited as an indicator group also because experts, which are able to carry out the monitoring work, are available in most areas of Europe.

Long term butterfly community monitoring is a powerful tool to measure biodiversity patterns in relation to various pressures and can aid in defining management measures aimed to conserve and/or increase biodiversity. A prerequisite for this is to apply a monitoring method which is standardized, has a known precision and is used in many sites throughout Europe. Only this combination would allow to extrapolate general trends with high degree of confidence.

3. Spatial and temporal coverage

Grasslands and open habitats across Europe.Past data if present and at least 3 years of monitoring.

4. Parameters used/needed*

Parameter group (theme)	Selected parameter	Details about the parameter	Should be taken from existing data (yes/no)	Feasibility/constraints regarding existing data	Should be recorded in field (A5 work) (yes/no)	feasibility/ constraints regarding field sampling
1) Climate and physical variability						
2) Biogeochemistry data						
3) Structure and function of the ecosystems, communities and populations	Butterflies	Abundance data per plot per year, degree of habitat specificity, vagility, rarity, percent of typical species	Yes	Existing data can be used if recorded with a suitable standard method	Yes	Minimum basic knowledge about butterflies identification is required
4) Human population and economy	Land use	Type of management	Yes	The parameter has to be available for the same sites of the butterfly surveys	No	-

5. METHODS USED

Butterfly surveys.
Generally butterfly monitoring methods can be divided into three approaches: 1. transect walks, 2. plot walks and 3. timed walks, all of which have specific advantages and disadvantages (Pollard et al. 1993; Royer et al. 1998; Nowicki et al. 2008; Kaldec et al. 2010).
We present example data based on the "plot walk" method, which is particularly suitable for studies of butterfly communities in well defined areas and in relation to specific vegetation types. A preliminary research on the methodology, which analyzed frequency and time span employed for each survey date, allowed to estimate the total number of butterflies present in each site. In a second step these data were used to define a reduced effort standard protocol which specifies the number of surveys and the average survey time. The experimental data allowed to estimate the completeness of these reduced effort surveys.
The same research on the methodology can easily be applied in other European countries to define a common standard protocol with a known precision of a standard method applied in LTER sites.

6. EXPECTED RESULTS

Gather valid and reliable data on butterfly communities with a known precision. These data will allow to:

- define a common standard protocol;
- compare communities and processes of different study sites across Europe;
- extrapolate general trends about butterfly status;
- obtain information about biodiversity loss;
- analyse effects of long term processes such e.g. climate change, human activities;
- provide data to management and policy makers

7. REFERENCES

Brückmann S.V., Krauss J., Steffan-Dewenter I., 2010. Butterfly and plant specialists suffer from reduced connectivity in fragmented landscapes. In: Journal of Applied Ecology, 47: 799–809.

Hawkins B. A., Porter E. E., 2003. Does herbivore diversity depend on plant diversity? The case of California butterflies. In: The American Naturalist, 161: 40-49.

Kadlec T., Tropek R., Konvicka M., 2001. Timed surveys and transect walks as comparable methods for monitoring butterflies in small plots. In: Journal of Insect Conservation, Online publication date: 16-Jun-2011, pp. 1-6.

Kühn, E., Feldmann, R., Thomas, J.A. & J. Settele (Eds) 2005. Studies on the Ecology and Conservation of Butterflies in Europe. Vol. 1: General Concepts and Case Studies. 128 pp.

Krauss J., Bommarco R., Guardiola M., Heikkinen R.K., Helm A., Kuussaari M., Lindborg R., Ockinger E., Pärtel M., Pino J., Pöyry J., Raatikainen K.M., Sang A., Stefanescu C., Teder T., Zobel M., Steffan-Dewenter I., 2010. Habitat fragmentation causes immediate and time-delayed biodiversity loss at different trophic levels. In: Ecology Letters, 13(5):597-605.

Kuussaari M., Bommarco R., Heikkinen R.K., Helm A., Krauss J., Lindborg J., Öckinger E., Pärtel M., Pino J., Roda` F., Stefanescu F., Teder T., Zobel M., Steffan-Dewenter I., 2009. Extinction debt: a challenge for biodiversity conservation. In: Trends in Ecology and Evolution Vol.24 (10): 564-571.

Levanoni O., Levin N., Pe'er G., Turbé A., Kark S., 2011. Can we predict butterfly diversity along an elevation gradient from space? In: Ecography, 34(3): 372–383.

Morris W.F., Pfister C.A., Tuljapurkar S., Haridas C.V., Boggs C.L., Boyce M.S. et al., 2008. Longevity can buffer plant and animal populations against changing climatic variability. Ecology, 89, 19–25.

Nowicki P., Settele J., Henry P.Y., Woyciechowski M., 2008. Butterfly Monitoring Methods: The ideal and the Real World. In: Israel Journal of Ecology and Evolution, 54:69-88.

Parmesan, C., Ryrholm, N., Stefanescu, C., Hill, J.K., Thomas, C.D., Descimon, H., Huntley, B., Kaila, L., Kullberg, J., Tammaru, T., Tennent, W.J., Thomas, J.A. & Warren, M. 1999. Poleward shifts in geographical ranges of butterfly species associated with regional warming. *Nature*, 399: 579–583.

Pollard E., Yates T., 1993. Monitoring butterflies for ecology and conservation. Chapman and Hall.

Royer R.A., Austin J.E., Newton W.E., 1998. Checklist and “Pollard Walk” Butterfly Survey Methods on Public Lands. In: The American Midland Naturalist, 140:358-371

Thomas, J.A., 2005. Monitoring change in the abundance and distribution of insects using butterflies and other indicator groups. In: Phil. Trans. Soc. B. 360: 339-357.

Van Swaay C.A.M., Strien A.J. van, Julliard R., Schweiger O., Brereton T., Heliölä J., Kuussaari M., Roy D., Stefanescu C., Warren M.S., Settele J., 2008. Developing a methodology for a European Butterfly Climate Change Indicator. Report VS2008.40 - De Vlinderstichting, Wageningen

Van Swaay, C.A.M., Van Strien, A.J., Harpke, A., Fontaine, B., Stefanescu, C., Roy, D., Maes, D., Kühn, E., Õunap, E., Regan, E., Švitra, G., Heliölä, J., Settele, J., Warren, M.S., Plattner, M., Kuussaari, M., Cornish, N., Garcia Pereira, P., Leopold, P., Feldmann, R., Jullard, R., Verovnik, R., Popov, S., Brereton, T., Gmelig Meyling, A., Collins, S., 2010a. The European Butterfly Indicator for Grassland species 1990-2009. Report VS2010.010, De Vlinderstichting, Wageningen

Van Swaay, C.A.M., C., Cuttelod, A., Collins, S., Maes, D., López Munguira, M., Šašiæ, M., Settele, J., Verovnik, R., Verstrael, T., Warren, M., Wiemers, M. and Wynhof, I. 2010b. European Red List of Butterfies. Luxembourg: Publications Office of the European Union.

Van Swaay, C.A.M., Harpke, A., Van Strien, A., Fontaine, B., Stefanescu, C., Roy, D., Maes, D., Kühn, E., Õunap, E., Regan, E.C., Švitra, G., Heliölä, J., Settele, J., Musche, M., Warren, M.S., Plattner, M., Kuussaari, M., Cornish, N., Schweiger, O., Feldmann, R., Julliard, R., Verovnik, R., Roth, T. Brereton, T. & Devictor, V., 2010c. The impact of climate change on butterfly communities 1990-2009. Report VS2010.025, Butterfly Conservation Europe & De Vlinderstichting, Wageningen.