Dear mr. Dover and reviewer,

We carefully considered your recommendations, and did our best to answer each of your requests satisfactorily.

Rev 1-1: In my view, PCA is a weak analysisapproach. It does not easily allow predictions to be developed/applied to a new area, nor formally test for the relative importance/significance of individual traits or groups of traits (biological versus climatic).

PCA, initially frequently used to reduce strongly correlated data groups or layers, has been increasingly used in various fields of investigation and for different tasks. In the field of applied insect and plant conservation, PCA has been used to distinguish numerically and visually associations among species properties (e.g. size, shape, habitat use, climate affinity) and the functional organization of community structure along environmental gradients (e.g., environmental filtering, trait continua, trade-offs).

The use of principal components as independent variables in a regression analysis is useful in situations where the original variables display high levels of collinearity. Since the principal components are orthogonal (uncorrelated), there is no multicollinearity in the regression. Subsequent use of PC values in predictive models for species ***occurrence, distributions and vulnerability is not uncommon*** (insects: besides Wallis deVries 2014: e.g., Shreeve, et al 2001, Maes et al. 2003, Kitahara and Fujii 2005, Summerville et al. 2006, Lütolf et al. 2009, Dapporto & Dennis 2013; for plants: Keddy et al. 2002, Oyarzabal et al. 2008).

Following these and other studies, the use of PCA appears justified. We first eliminated various variables using PCA, such a measure of elevation ranges (4 groups), aesthivation (binary) and food-plant growth form (4 groups). We incorporated regression models following standard procedures. Note, however, that interpretations of regression coefficients are not always clearly defined or obvious. Our impression is, we are quit cautious in the discussion making generalizations. In addition, we made the list of species specific PCA values available for interpretation. This study may serve as a reference to follow-up studies which may show our strategy contain flaws.

Rev 1-2: It is widely accepted that species traits can be phylogenetically conserved.  The phylogenetic analysis in this paper is not sufficiently robust.

Non-independency among species traits within taxonomic subsets is considered to be a combination of long-term natural selection favoring particular sets of traits in the prevailing environmental conditions as well as phylogenetic conservancy (Houle, 1992, Westoby *et al*. 2002, McGill *et al*. 2006).

Positively and negatively correlated traits can be a signal of environmental selection and trade-off structure of life-history traits, though correlated functional traits may be actually unrelated and represent independent strategies of environmental adaptation (Wright et al. 2006). Besides, we recognize that common traits of closely related species can originate from common ancestry rather than through independent evolution. Thus, statistical methods that treat traits as independent may be problematic. Therefore, a better understanding of phylogenetic relationships can potentially improve our understanding of ecological traits resulting from environmental filtering. Independent contrasts analysis is most frequently used, and together with cross-species analysis, independent contrasts can reveal important evolutionary underpinnings of patterns emerging across present-day species (Cadotte et al. 2005). For instance, if a significant negative cross-species correlation between wing size and egg size disappears in independent contrasts analysis, this indicates that the present-day relationship is the result of one or a small number of independent, correlated evolutionary divergences between wing and egg size.

However, most phylogenetic control procedures available have not extensively been tested for robustness and statistical artefacts arising from phylogenetic corrections may cloud our judgment (e.g. Freckleton 2000), reliable database of phylogenetic material are often hard to come by, and we are not sure if insight into the evolution of traits is entirely relevant within the scope of our study. Additionally, numerous studies have previously shown that correlative patterns among traits of European Lepidoptera remain largely undistorted after applying a correction for phylogenetic dependency; such result may indicate little taxonomically driven artefacts present in uncontrolled methods (Matilla *et al.* 2006, 2008, 2011, Päivinen *et al*. 2005, Pavoine *et al*. 2012, Bartonova *et al*. 2014, Leingärtner *et al*. 2014).

At the time we submitted the paper, there was no satisfactory available database of phylogenetic material that covered a satisfactory portion of European butterfly species. As mentioned, the present study covers more European butterfly species than any other study available presently. By strengthening the team with Rutger Vos (Naturalis Leiden) and Frank van Langevelde (Wageningen University), we were now able to incorporate a reliable dataset of butterfly phylogeny and apply a phylogenetic correction. Unfortunately, the phylogenetic dataset does not cover all species (238 out of 397), but is the most complete set so far known to us.

**EDIT….e.g., justification methods…**

Rev 1-3. The climatic traits are based on distributional data, likely to be similar distributional data used to assess vulnerability.  There is therefore circularity in the main conclusion that climatic traits are more influential than biological traits.​

Vulnerability variables used in our study, were previously assessed and published by other authors. We will not go into detail in each of the variables here (please see the literature for how vulnerability indices are determined), but we do want to point out some examples to underline vulnerability indicators and climatic data are not founded on the same variables. To illustrate, Range size, just one of the criteria used for some vulnerability indices, is not equal to locality and distribution data that had been used to assess climatic variables. Rangesize and distribution capture spatial elements but far from identical. However, it is not surprising that if Range size becomes smaller, the variability in climatic niche also becomes smaller (at least in terms of Ranges in Temperature and Precipitation). In this sense, interpretation should be done carefully. However, this is not wrong, neither circular reasoning. If we look at it the other way round, it is clear that it will be difficult to predict species’ Range size (and the same goes for RL status, Endemicity, Habitat specificity and Preference for anthropogenic landscapes), based on based on climatological variables. An important vulnerability indicator, the Red List status, is actually assessed in large extent by expert knowledge on habitat deterioration and population trends from decades of monitoring. In conclusion, we recognize there is influence of Range size in variability in species specific Climate conditions, but we do not agree that these cause circular reasoning in the methodology.

**Literature**

Bartonova A, Benes J & Konvicka M (2014) Generalist-specialist continuum and life history traits of Central European butterflies (Lepidoptera) – are we missing a part of the picture? Eur J Entomol 111:543-553

Cadotte MW, Murray BR & Lovett-Doust J (2005). Ecological patterns and biological invasions: using regional species inventories in macroecology. Biol. Inv. 8 (4) 809–821

Dapporto L. & Dennis RLH (2013) The generalist–specialist continuum: Testing predictions for distribution and trends in British butterflies. Biological Conservation 157, 229–236

Freckleton RP (2000) Phylogenetic tests of ecological and evolutionary hypotheses: checking for phylogenetic independence. Funct Ecol 14: 129–134.

Houle D (1992) Comparing evolvability of quantitative traits. *Genetics* 130: 195-204.

Kitahara M & Fujii K (2005) Analysis and understanding of butterfly community composition based on multivariate approaches and the concept of generalist/specialist strategies. Entomological Science 8 (2), 137-149

Keddy P, Nielsen K Weiher E & Lawson R (2002) Relative competitive performance of 63 species of terrestrial herbaceous plants. Journal of Vegetation Science 13: 5-16

Oyarzabal M, Paruelo JM, del Pino F, Oesterheld M & Lauenroth WK (2008) Trait differences between grass species along a climatic gradient in South and North America. Journal of Vegetation Science 19: 183-192.

Leingärtner A, Krauss J, Steffan‑Dewenter I (2014) Species richness and trait composition of butterfly assemblages change along an altitudinal gradient. Oecologia 175:613–623

Lütolf M, Bolliger J, Kienast F & Guisan A (2009) Scenario-based assessment of future land use change on butterfly species distributions. Biodiversity and Conservation 18 (5), 1329-1347

Maes D, Gilbert M, Titeux N, Goffart P & Dennis RLH (2003) Prediction of butterfly diversity hotspots in Belgium: a comparison of statistically focused and land use-focused models. Journal of Biogeography 30 (12), 1907-1920

Mattila M, Kotiaho JS, Kaitala V, Komonen A (2008) The use of ecological traits in extinction risk assessments: A case study on geometrid moths. Biol Conserv 141:2322–2328

Mattila N, Kaitala V, Komonen A, Kotiaho JS,Paivinen J (2006) Ecological determinants of distribution decline and risk of extinction in moths. Conserv Biol 20:1161–1168

Mattila N, Kaitala V, Komonen A, Paivinen J, Kotiaho JS (2011) Ecological correlates of distribution change and range shift in butterflies. Insect Conserv Diver 4:239–246

McGill BJ, Enquist, BJ, Weiher E & Westoby M 2006. Rebuilding community ecology from functional traits. *Trends Ecol. Evol*., 21, 178–185.

Päivinen J, Grapputo A, Kaitala V, Komonen A, Kotiaho JS, Saarinen K, Wahlberg N (2005) Negative density distribution relationship in butterflies. BMC Biology 3:5

Poorter L & Bongers, F (2006) Leaf traits are good predictors of plant performance across 53 rain forest species. Ecology, 87(7), 1733–1743

Shreeve TG, Dennis RLH, Roy DB & Moss D (2001) An ecological classification of Brittish butterflies : ecological attributes and biotope occupancy. Journal of Insect Conservation 5 (3), 145-161

Summerville KS, Conoan CJ & Steichen RM (2006) Species traits as predictors of lepidopteran composition in restored and remnant tallgrass prairies. Ecological Applications 16 (3), 891-900

Westoby M, Falster DS, et al. (2002). Plant ecological strategies: some leading dimensions of variation between species. Annu. Rev. Ecol. Syst., 33, 125–159.