Correction of phenology measure

The referee suggests that the phenology measure could be biased if visits to the first and last sites are made some days apart. I have checked that and actually the difference between the first and last visited populations is 10 days in 2010 and 20 (!) in 2011. I didn't recall the difference being so big, but I think it could indeed affect the results (although not for the analyses where data is standardized within populations, i.e. the selection analyses in Table 1 and 2 and Fig. 1 are OK with the other measure). But it might be important for comparing among populations.

Moreover, we say in the text that a one-unit increase in the phenology measure would correspond to one week earlier development... but then we are comparing measures taking more than one week apart.

I came up with this correction:

213 is the Julian date used as reference (01-Aug)

If we suppose the duration of each stage is one week:

In populations sampled 1 week before 🡪 + 1 to phenology measure

In populations sampled 1 week after 🡪 -1 to phenology measure

Last column in this table shows the value that should be added in each population/year

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| LokalID | sampling date | sampling julian date | year | stage of most advanced bud + … |
| Ale001 | 30/07/2010 | 211 | 2010 | 0,285714286 |
| Ale010 | 04/08/2010 | 216 | 2010 | -0,428571429 |
| Bor012 | 29/07/2010 | 210 | 2010 | 0,428571429 |
| Göt009a | 31/07/2010 | 212 | 2010 | 0,142857143 |
| Göt009b | 31/07/2010 | 212 | 2010 | 0,142857143 |
| Göt016 | 02/08/2010 | 214 | 2010 | -0,142857143 |
| Her003 | 01/08/2010 | 213 | 2010 | 0 |
| Her004 | 01/08/2010 | 213 | 2010 | 0 |
| Her005 | 01/08/2010 | 213 | 2010 | 0 |
| Ler010 | 05/08/2010 | 217 | 2010 | -0,571428571 |
| Mar001 | 03/08/2010 | 215 | 2010 | -0,285714286 |
| Par003 | 02/08/2010 | 214 | 2010 | -0,142857143 |
| Sve001 | 27/07/2010 | 208 | 2010 | 0,714285714 |
| Sve005 | 27/07/2010 | 208 | 2010 | 0,714285714 |
| Sve011 | 27/07/2010 | 208 | 2010 | 0,714285714 |
| Sve013 | 29/07/2010 | 210 | 2010 | 0,428571429 |
| Tra001 | 03/08/2010 | 215 | 2010 | -0,285714286 |
| Tra002 | 03/08/2010 | 215 | 2010 | -0,285714286 |
| Vår004 | 28/07/2010 | 209 | 2010 | 0,571428571 |
| Vår009 | 28/07/2010 | 209 | 2010 | 0,571428571 |
| Ale001 | 23/07/2011 | 204 | 2011 | 1,285714286 |
| Ale010 | 08/08/2011 | 220 | 2011 | -1 |
| Bor012 | 09/08/2011 | 221 | 2011 | -1,142857143 |
| Göt009a | 24/07/2011 | 205 | 2011 | 1,142857143 |
| Göt009b | 24/07/2011 | 205 | 2011 | 1,142857143 |
| Göt016 | 26/07/2011 | 207 | 2011 | 0,857142857 |
| Her003 | 27/07/2011 | 208 | 2011 | 0,714285714 |
| Her004 | 27/07/2011 | 208 | 2011 | 0,714285714 |
| Her005 | 27/07/2011 | 208 | 2011 | 0,714285714 |
| Ler010 | 24/07/2011 | 205 | 2011 | 1,142857143 |
| Mar001 | 09/08/2011 | 221 | 2011 | -1,142857143 |
| Par003 | 25/07/2011 | 206 | 2011 | 1 |
| Sve001 | 22/07/2011 | 203 | 2011 | 1,428571429 |
| Sve005 | 22/07/2011 | 203 | 2011 | 1,428571429 |
| Sve011 | 21/07/2011 | 202 | 2011 | 1,571428571 |
| Sve013 | 21/07/2011 | 202 | 2011 | 1,571428571 |
| Tra001 | 28/07/2011 | 209 | 2011 | 0,571428571 |
| Tra002 | 28/07/2011 | 209 | 2011 | 0,571428571 |
| Vår004 | 20/07/2011 | 201 | 2011 | 1,714285714 |
| Vår009 | 20/07/2011 | 201 | 2011 | 1,714285714 |

I used this measure to correct analyses where we compare among populations (with very similar results to the ones before)

Table 3 🡪 data should not be standardized here!

Figure 3 and Table 4 🡪 General path models and table with coefficients of models for each population (because we want to compare them among populations)

Analyses using population as the level of replication (referee’s suggestion) – using the corrected phenology measure

Differences in mean flowering phenology (corrected measure) among populations with and without predator – not very clear

|  |  |
| --- | --- |
| **year=2010**    p = 0,9416 | **year=2011**    p = 0,0854 |

Both years together

|  |  |
| --- | --- |
| **Including population D in 2016**    p = 0,1378 | **Excluding population D in 2016**    p = 0,0837 |

Within the populations with the predator, earlier-flowering populations tend to have greater attack rates

(sum of number of eggs per population /year vs corrected phenology measure)



(proportion of plants attacked per population/year vs corrected phenology measure)

 p=0.0530 - marginal

But, within the populations with the predator, selection for late flowering (negative selection gradient) is stronger in later-flowering populations! (despite of having lower attack rates)

(selection gradient for phenology for each population/year vs corrected phenology measure)

p=0.0517 - marginal

Early-flowering plants in early-flowering populations and late flowering plants in late-flowering populations are able to escape predation (and thus have higher fitness)?

I.e. the butterfly preference for early-flowering plants is stronger in later-flowering populations?

(plot coefficient phenology🡪n\_eggs from path models vs corrected phenology measure is not significant)

 p = 0,3082

BUT butterfly preference for early-flowering plants is stronger in populations/years that have higher attack rates

(plot coefficient phenology🡪n\_eggs from path models vs proportion of plants attacked per population/year)

 p = 0,0019

Why is the direct effect of phenology on fitness negative in populations with the predator?

(plot coefficient phenology🡪n\_intact\_fruits from path models vs corrected phenology measure)

 p = 0,0324

Referee suggestion: Very early-flowering populations could escape butterfly attack, but still experience selection against early flowering due to temporal mismatch with pollinators, poor seasonal climate, etc.

BUT the graph shows the opposite! –Early-flowering populations show selection FOR early flowering.