Effects of habitat fragmentation along altitudinal gradients on two monophagous insects in Tongariro National Park, New Zealand

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Background:

Climate change and the loss of habitats caused by shifts in land use and landscape fragmentation are currently the two major threats for global terrestrial biodiversity. In particular, habitat size, habitat quality and isolation are influenced by climate change and landscape fragmentation. Within the concept of meta-population biology, the occurrence and long-term survival of species in fragmented landscapes are mainly due to these three environmental factors.

To cope with an increasing temperature, stenotherm species such as mobile insects may migrate to higher and therefore cooler regions. However, at increasing altitudes, habitat quality can change. Spatial and temporal “bottlenecks” are a particular risk, especially for monophagous insects e.g. if the appropriate host plants are still restricted to lower altitudes. In addition, altitude related abiotic factors influence species performance in terms of morphology, survival, reproduction, and dispersal.

Research Questions:

Do increases in meta-population dynamics along an altitudinal gradient result in species requiring improved and increased habitat quality and habitat size?

To what extent are the spatial distribution dynamics of monophagous insects and their host plants affected by predicted climate change scenarios?

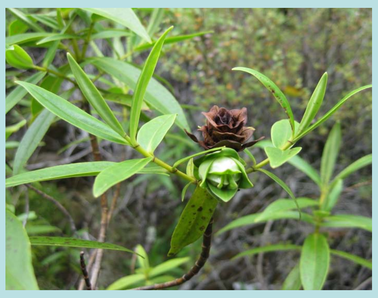
Study Area:

Mangahuia Stream , Tongariro National Park, New Zealand.

Mapping of all plant individuals >0,5m² along an 8km river section, Altitude 890-1250m, Jan-March 2010.

Model species:

***Hebe stricta*, Scrophulariaceae**
Native scrub species up to 4m tall. In the study area frequently found near riverbanks and in wet open areas from 700m to 1400m.



***Hebe terminal bud gall sp. 'stricta' of Martin* 2003, (Cecidomyiidae, Diptera), causing galls on the stem of *Hebe stricta*.**

***Trioza obscura* Tuthill 1952 (Hemiptera: Psyllidae), causing shoot distortion on *Hebe stricta*.**

Data set (1st field season 2010):

Landscape level (host plant patch)
- Patch size & location (GPS)
- Altitude (Altimeter + GPS)
- Aspect & inclination
- Surrounding vegetation (type, height & shade)
- Number & density of host plants
- Climate data (temperature, per elevation band)
- Occurrence of insects

Plant level (measured within patches)
- Plant size
- Abundance of insects
- Fitness (flowers & ratio of dead branches)
- Shading by canopy

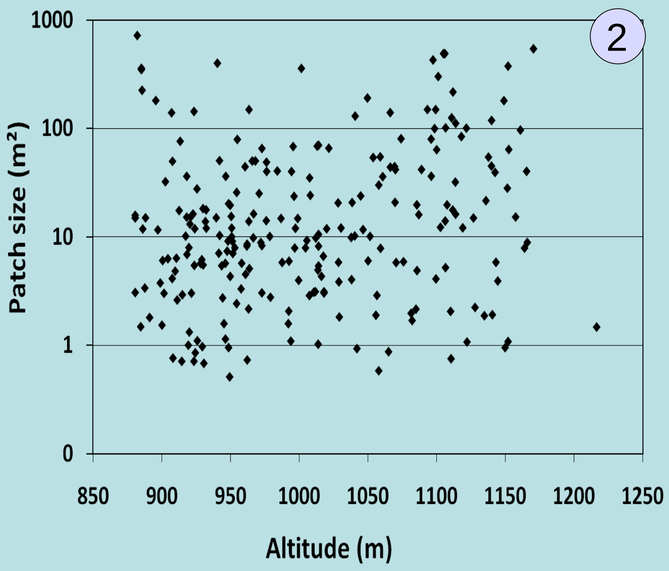
Data set (2nd season 2011):

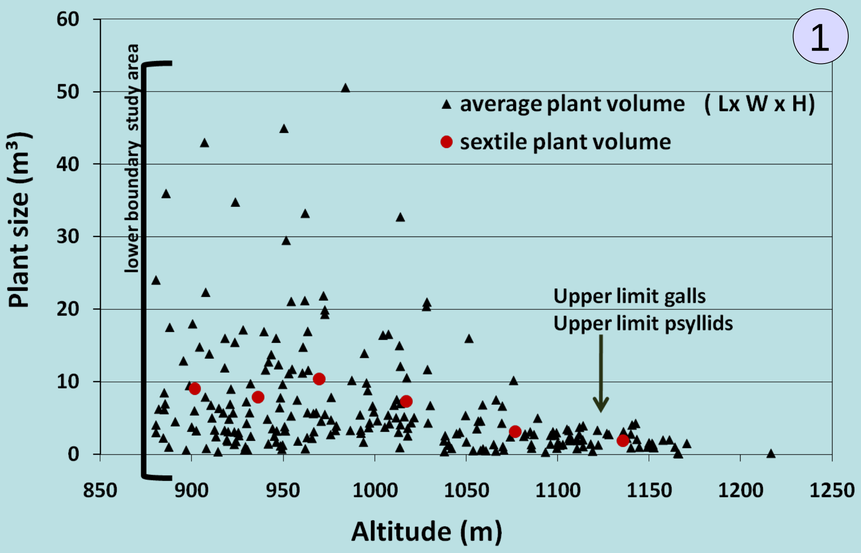
Landscape level (host plant patch)
- Re-mapping of 1st season patches to identify turnover rates & species dynamics
- Extension of altitudinal gradient to river sections further downstream.
- Replication with 2nd stream system

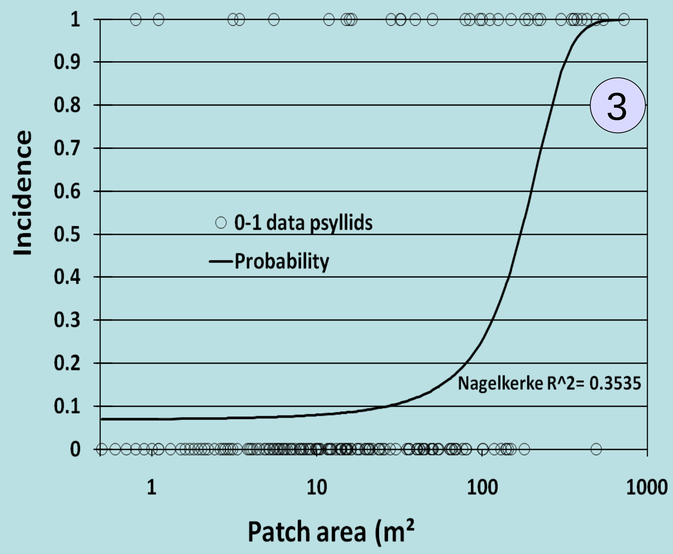
Plant level
- C/N ratio as proxy for habitat quality
- Parasitism rates in *Hebe* galls

Results (1st field season):

235 *Hebe stricta* patches with in total ca. 1400 plants plants were found in the study area. 595 individual plants were sampled within these patches. As expected, average plant size decreases with altitude (fig.1), but no effect of altitude on patch size was observed (fig.2).
Trioza obscura show a strong positive response to patch size (fig.3) and prefer exposed patches, while the gall midge is not affected by parameters on the landscape level.







A combination of patch area and patch shading explains most of the variation in the data for the psyllid *Trioza obscura*.

Coefficients and Standard Errors...

Variable	Coeff.	StdErr	p
Area(m²)	0.0137	0.0028	0.0000
Shade(%)	-0.0504	0.0166	0.0024
Intercept	-1.0821		
Nagelkerke R^2=	0.4149		

Discussion & Outlook

Preliminary results of the distribution of *Trioza obscura* show that big patches with sun exposed plants are most suitable for the psyllid. Remapping in the upcoming season will give us information about the spatial and temporal turnover rate of this less mobile species.
As none of the surveyed environmental parameter explains the spatial distribution of the galls, it might be that the gall midge chooses it’s hosts on a smaller scale, for example plant location or chemical composition. Also, dissection of galls revealed high infestation rates with parasitic wasps (Hymnoptera : Chalcidoidea), which needs further investigation.

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