How do the pollinators' flower preferences affect the features of the pollination network?

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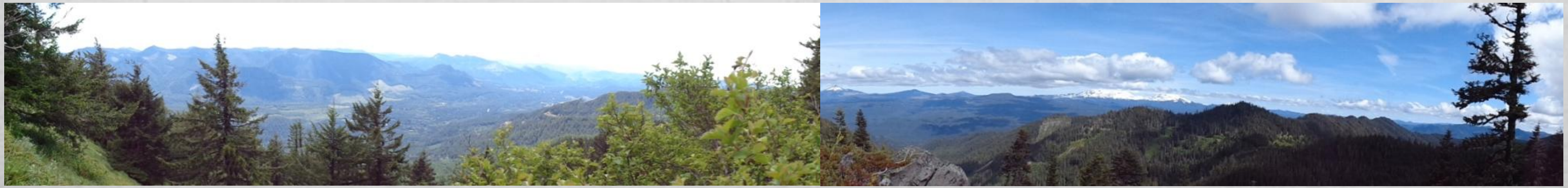
Pollinators Research Project

HJ Andrews Experimental Forest and Oregon State University



Research Question

How is the ecological health of the pollinator network in a montane meadow ecosystem, measured in terms of

- sustaining biodiversity
- stability
- resistance to species extinction

affected by the composition of generalist and specialist pollinators:

- all generalists
- all specialists
- reality-reflecting combination of specialists and generalists

Method

- Scope of research project: data from 2011-2013
- Size of data: 147 flower species, 466 pollinator species
- R Program:
  - flower abundance, pollinator abundance
  - pollinators' flower preferences
    - all generalist, all specialist, both generalist and specialist according to mentor Andy Moldenke
  - Function that outputs the pollinator-flower interaction matrix: 3 interaction networks based on pollinator preference

```
IntMat = function (FlowerAbName, PollAbName, PollPrefName, TotNumPoll, IntMatName) {
  prefmat = read.csv(PollPrefName, row.names = 1)
  flowerab = read.csv(FlowerAbName, stringsAsFactors = FALSE)
  pollab = read.csv(PollAbName, stringsAsFactors = FALSE)

  nflower_ab = nrow(flowerab) #147
  nflower_pref = ncol(prefmat) #147
  npoll_pref = nrow(prefmat) #466
  npoll_ab = nrow(pollab) #466

  if (nflower_ab != nflower_pref){
    stop("Error: number of flower species from the two files must be equivalent")
  }

  if (npoll_ab != npoll_pref){
    stop("Error: number of pollinator species from the two files must be equivalent")
  }

  intmat = prefmat
  for (x in 1:nflower_pref){
    intmat[,x] = (intmat[,x] * flowerab[x,2])
  }
  for (x in 1:npoll_pref){
    intmat[x,] = intmat[x,]/sum(intmat[x,])
  }
  for (y in 1:npoll_pref){
    intmat[y,] = as.integer(intmat[y,] * pollab[y,2] * TotNumPoll)
  }
  write.csv(intmat, file= IntMatName)
}
```

```r

# Create CSV of Pollinator Abundances (estimate) from 11to13Interactions spreadsheet

polldata = read.csv("11to13Interactions.csv")
pollspecies = levels(polldata$VISSP_NAME)
pollspecies = pollspecies[c(-1)]
npoll = length(pollspecies)

totalpoll = length(polldata$VISSP_NAME)

install.packages("hash")
library("hash")

pollhash = hash(keys = pollspecies, values = 0)
for (poll in 1:length(polldata$VISSP_NAME)) {
  if (nchar(as.character(polldata$VISSP_NAME[poll])) > 0) {
    pollname = as.character(polldata$VISSP_NAME[poll])
    pollhash[[pollname]] = pollhash[[pollname]] + 1
  }
}

pollmatrix = matrix(0,nrow = npoll, ncol = 2)
for (poll in 1:npoll){
  pollmatrix[poll,1] = pollspecies[poll]
  pollmatrix[poll,2] = pollhash[[pollspecies[poll]]] / totalpoll
}
header = matrix(c("Poll_SPP","Abundance"),1,2)
pollmatrix = rbind(header,pollmatrix)

sum(as.numeric(pollmatrix[,2][-c(1)]))

write.table(pollmatrix, file="pollabundances.csv", row.names=FALSE, col.names=FALSE, sep = ",")

```

Method

- R Bipartite package:
  - Compute indices: links per species, nestedness, weighted nestedness, niche overlap, and extinction slope
- Sustaining biodiversity : links per species, nestedness, weighted nestedness
- Stability: links per species, niche overlap
- Resistance to species extinction: extinction slope
- Three concepts interrelated, all indices could be used to measure, chosen the most apparently fitting indices to quantify each concept, for simplicity and ease of analysis

Results

- Three interaction matrices based on the three cases of pollinator preference; subsets

	Erigeron.foliosus	Eriogonum.compositum	Eriogonum.nudum
Megachile melanophaea	25	126	48
Megachile perihirta	178	885	337
Megachile pugnata	12	63	24
Megachile sp 2	21	105	40
Megachile sp 4	4	21	8
Megachile sp 5	4	21	8
Melanostoma mellinum	38	189	72
Melissodes rivalis	63	316	120
Melissodes sp 1	63	316	120
Micromoth metallic	76	379	144
Mirid sp 1	148	737	280
Mirid sp 10	8	42	16
Mirid sp 11	8	42	16
Mirid sp 15	8	42	16
Mirid sp 16	59	295	112

All Generalists

	Saxifraga.oregona	Saxifraga.sp	Sedum.oreganum	Sedum.spathulifolium
Megachile melanophaea	0	0	0	0
Megachile perihirta	0	0	0	0
Megachile pugnata	0	0	0	0
Megachile sp 2	0	0	0	0
Megachile sp 4	0	0	0	0
Megachile sp 5	0	0	0	0
Melanostoma mellinum	0	0	0	0
Melissodes rivalis	0	0	0	0
Melissodes sp 1	0	0	0	0
Micromoth metallic	0	0	0	0
Mirid sp 1	0	13974	0	0
Mirid sp 10	0	0	0	0
Mirid sp 11	0	0	0	0
Mirid sp 15	0	0	0	0
Mirid sp 16	0	0	0	0

All Specialists

	Erigeron.foliosus	Eriogonum.compositum	Eriogonum.nudum
Megachile melanophaea	0	0	0
Megachile perihirta	3505	0	0
Megachile pugnata	250	0	0
Megachile sp 2	21	105	40
Megachile sp 4	4	21	8
Megachile sp 5	4	21	8
Melanostoma mellinum	38	189	72
Melissodes rivalis	0	0	0
Melissodes sp 1	1252	0	0
Micromoth metallic	76	379	144
Mirid sp 1	148	737	280
Mirid sp 10	8	42	16
Mirid sp 11	8	42	16
Mirid sp 15	8	42	16
Mirid sp 16	59	295	112

Generalists and Specialists

Results

- Indices

	All Generalists	All Specialists	Both
Links per Species	**<u>55.693</u>**	0.766	**51.873**
Nestedness	5.027	**2.02**	**<u>1.789</u>**
Weighted Nestedness	**<u>0.816</u>**	NaN	**0.782**
Niche Overlap	0.927 - 0.999	**<u>0.000 - 0.007</u>**	**0.868- 0.875**
Extinction Slope	**<u>144.972 - 82.324</u>**	2.784 - 0.991	**134.009- 63.100**

Key: **<u>Most favorable</u>**, **Second-Most favorable**, Least favorable

Conclusion

- Sustaining biodiversity: generalist pollination network, closely followed by mixed pollination network
- Resistance to extinction: generalist pollination network, closely followed by mixed pollination network
- Stability: inconclusive
- Overall most ecologically healthy pollination network: generalist pollination network
  - Pollination network with both generalists and specialists according to reality: reasonably ecologically healthy

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Questions

Thanks for coming!