Hayfields
Floral resources and pollinators

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Archived at http://orgprints.org/26592

Background

- Pollinating insect populations are generally declining at local, national and global scales, and several wild pollinator species are extinct or endangered.
- Almost half of the Danish bumblebee species are on the red list.
- Such declines present a critical threat to future agricultural production, but biodiversity of pollinating insects and insect-pollinated plants is also at risk.
- Organic grasslands with a high proportion of herbs may provide a significant better habitat for pollinating insects, and in particular, well-managed hayfields with species flowering during the entire growing season.

EcoServe project

- Multi-functional hayfields may
  - produce hay of high quality for cattle
  - increase the health of the cattle
  - improve the milk quality especially for cheese production - production of the so-called ”hay-cheese”
  - provide a good feeding habitat for pollinating insects throughout the season

EcoServe project

WP2 Floral resources and pollinators

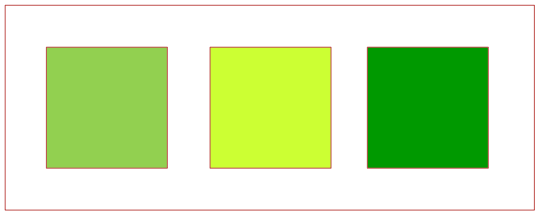
- PART 1: Floral resources and pollinators in well-established hayfields (2011)
- PART 2: Potential of individual plant species as resources for pollinators and influence of cutting regime (2012)

Hyptheses

- Greater diversity of flowering herbs results in greater diversity of pollinating insects
- Greater diversity of flowering herbs provide continuity of food (pollen and nectar)
- Sustainable pastures that are not converted frequently, result in greater floristic diversity
- Greater density or cover of bee-flowers results in greater abundance and diversity of pollinators
- Absence of fertilization results in greater diversity of plants including bee-plants
- Late first cut (after July 1) and few cuts results in greater abundance and diversity of flowers throughout the season

PART 1: Floral resources and pollinators in well-established hayfields (2011)

Selection of hayfields



Young (2-3 years) hayfield

5-10 years hayfield

Old (> 10 years) hayfield

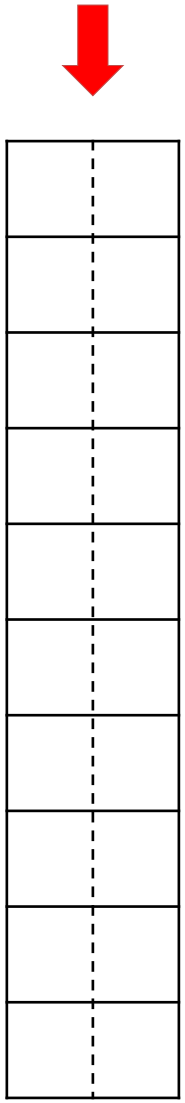
Hayfields for analyses of floral resources and pollinators

- 18 hayfields have been selcted
- 3 areas with 3 hayfields of varying age – all fields were visited four times during the period primo May- ultimo August 2011 (Bording, Funder, Harbovad)
- 1 area with 5 hayfields of varying age – only visited once (Stavad Enge)
- 2 areas with 2 hayfields each of the same age and sourounded by forest, visited 3 times (Fussingø, Salten Skov)

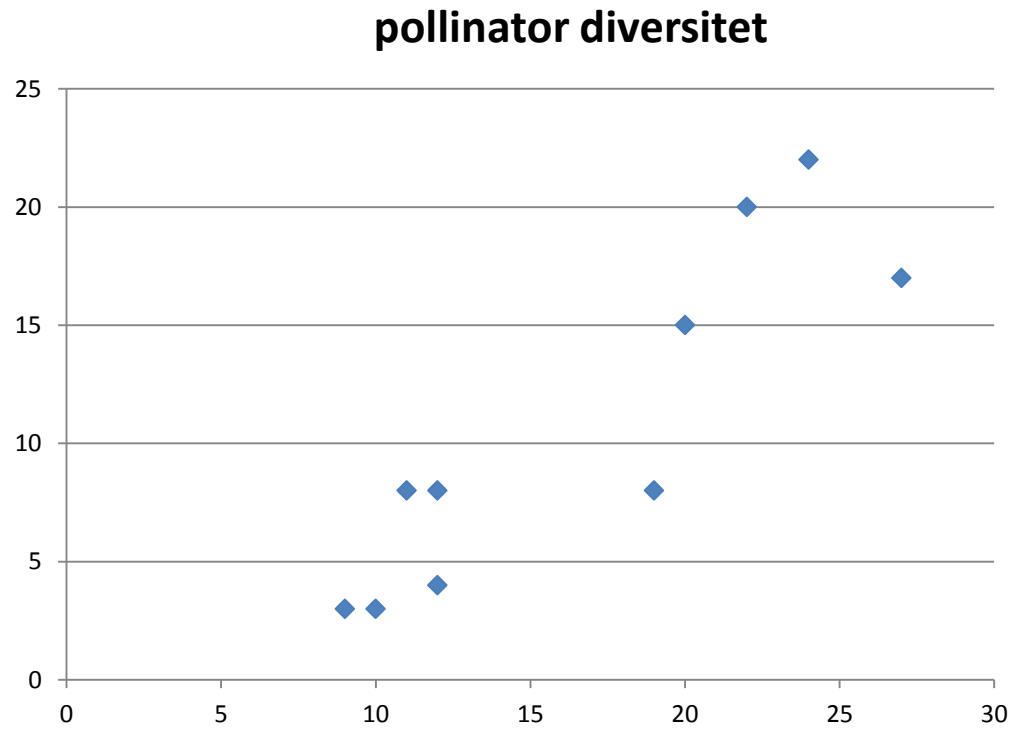
Hayfields

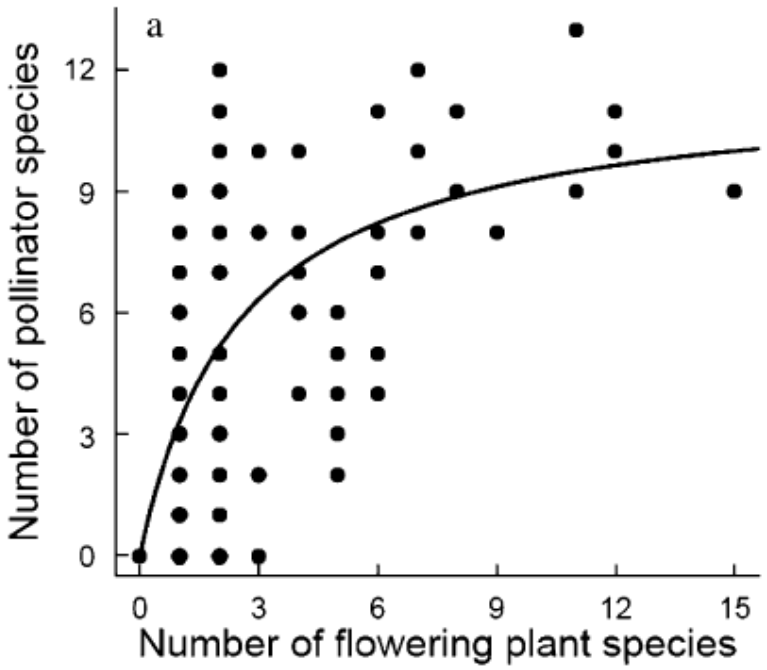
Data collection

- 20 transect walks (each covering an area of1x 10 m)
- Flower-visiting bees, butterflies and hoverflies were identified and counted
- Density of bee-flowers per. m^2 were counted using a 1-5 scala, where 1=no flowers and 5 > 50 flowers per. m^2



First hypothesis: Greater diversity of flowering herbs results in greater diversity of pollinating insects

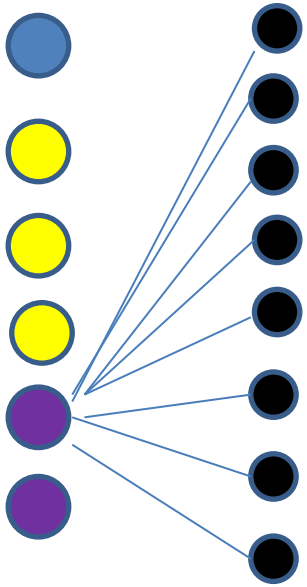




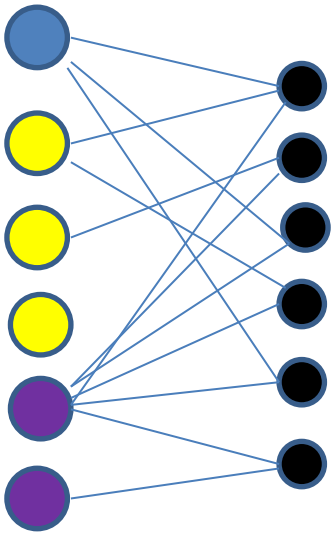
Network: plants -pollinators

Old hayfields
Large diversity of flowering bee-plants

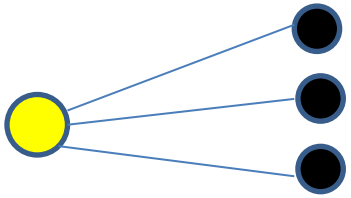
Young hayfields
Low diversity of flowering bee-plants

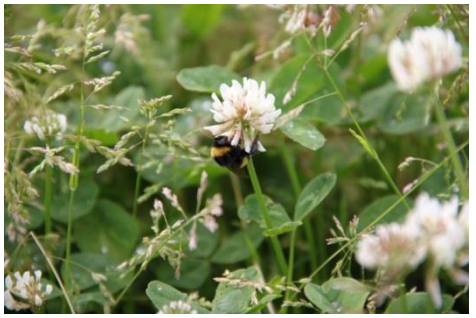


Stavad

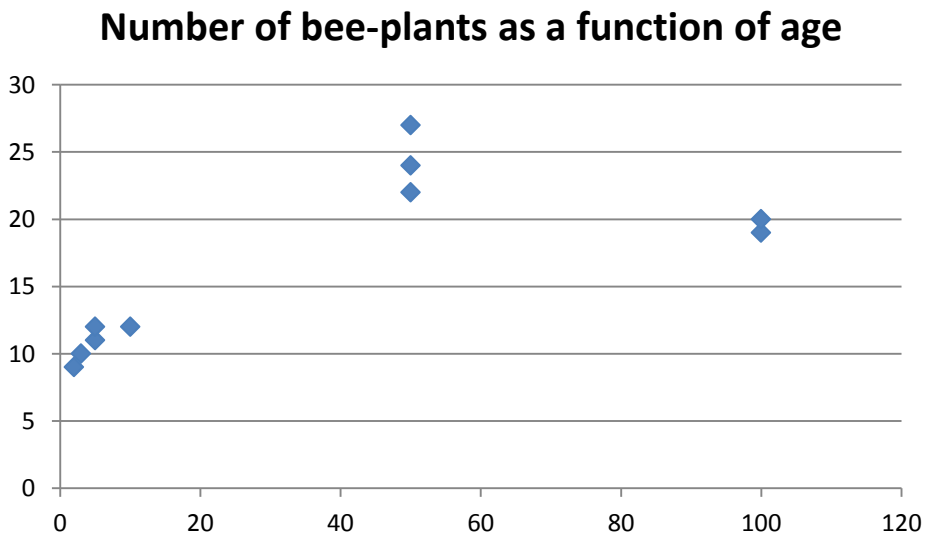


Harbovad eller Salten





Third hypothesis:
Sustainable pastures that are not converted frequently result in greater floristic diversity



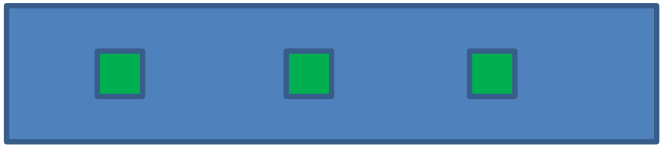
PART 2: Influence of cutting regime on floral resources

Treatment 1: Standard mix (=ryegrass (*Lolium perenne*), red clover (*Trifolium pratense*) and white clover (*T. repens*)
Treatment 2: Standard mix + common chicory (*Cichorium intybus*)
Treatment 3: Standard mix + plantain (*Plantago lanceolatum*)
Treatment 4: Standard mix + cumin (*Cuminum cyminum*)
Treatment 5: salad burnet (*Sanguisorba minor*) + bird's foot trefoil (*Lotus corniculatus*)
Treatment 6: salad burnet (*Sanguisorba minor*) + alfalfa (*Medicago sativa*)
Treatment 7: salad burnet (*Sanguisorba minor*) + red clover (*Trifolium pratense*)
Treatment 8: dandelion (*Taraxacum sp.*) + bird's foot trefoil (*Lotus corniculatus*)
Treatment 9: dandelion (*Taraxacum sp.*) + alfalfa (*Medicago sativa*)
Treatment 10: dandelion (*Taraxacum sp.*) + red clover (*Trifolium pratense*)

Test of three cutting strategies (St.1-3)

Harvest			1		2		3		4		5		6		7		8		9					10
week	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
St. 1		x	★	x		x		x	★	x		x		x	★	x		x		x				★
St. 2		x		x	★	x		x		x	★	x		x		x	★	x		x				★
St. 3		x		x		x	★	x		x		x	★	x		x		x	★	x				★

May June July August September



Data collection:
Number of flowers per 0.5x0.5 m

Blanding	Strategi	Parcelnummer	Blanding	Strategi	Parcelnummer	Blanding	Strategi	Parcelnummer	Gent
St-Ko	1	67	St	2	34	St-Ci	3	1	1
Bi-Lu	1	68				Bi-Rk	3	2	1
St	1	69	St-Ko	2	35	Mæ-Kæ	3	3	1
Mæ-Kæ	1	70	St-Ve	2	36	St-Ko	3	4	1
						St-Ve	3	5	1
LU-bi	1	71	Mæ-Kæ	2	37	St	3	6	1
St-Ci	1	72	Mæ-Lu	2	38	Bi-Lu	3	7	1
Bi-Kæ	1	73	St-Ci	2	39				1
Mæ-Rk	1	74	Mæ-Rk	2	40	Mæ-Lu	3	8	1
Bi-Rk	1	75	Bi-Rk	2	41				1
			Bi-Kæ	2	42	Bi-Kæ	3	9	1
Mæ-Lu	1	76	Bi-Lu	2	43	Mæ-Rk	3	10	1
St-Ve	1	77	LU-bi	2	44	LU-bi	3	11	1
St-Ko	3	78	Bi-Rk	1	45				2
			St	1	46	Mæ-Kæ	2	12	2
St-Ve	3	79	Mæ-Rk	1	47	St-Ko	2	13	2
Mæ-Lu	3	80	Mæ-Kæ	1	48	Bi-Rk	2	14	2
			Bi-Kæ	1	49	St-Ci	2	15	2
Mæ-Rk	3	81	St-Ve	1	50	Mæ-Lu	2	16	2
M-Kæ	3	82				Bi-Lu	2	17	2
Bi-Lu	3	83	LU-bi	1	51	LU-bi	2	18	2
LU-bi	3	84	St-Ko	1	52	St-Ve	2	19	2
St-Ci	3	85	St-Ci	1	53				2
St	3	86				Bi-Kæ	2	20	2
Bi-Rk	3	87	Bi-Lu	1	54	Mæ-Rk	2	21	2
Bi-Kæ	3	88	Mæ-Lu	1	55	St	2	22	2
LU-bi	2	89				Bi-Rk	3	23	3
St-Ci	2	90	Mæ-Lu	1	56	St-Ko	3	24	3
St-Ve	2	91	Bi-Lu	1	57	Mæ-Kæ	3	25	3
St	2	92	St-Ko	1	58	St-Ve	3	26	3
Bi-Rk	2	93	LU-bi	1	59	St	3	27	3
Bi-Lu	2	94	Mæ-Rk	1	60				3
Mæ-Kæ	2	95	St	1	61	Mæ-Lu	3	28	3
			St-Ci	1	62	LU-bi	3	29	3
Mæ-Rk	2	96	St-Ve	1	63	Bi-Lu	3	30	3
Mæ-Lu	2	97				St-Ci	3	31	3
St-Ko	2	98	Bi-Kæ	1	64	Bi-Kæ	3	32	3
Bi-Kæ	2	99	Bi-Rk	1	65				3
			Mæ-Kæ	1	66	Mæ-Rk	3	33	3

PART 2: Influence of cutting regime on floral resources

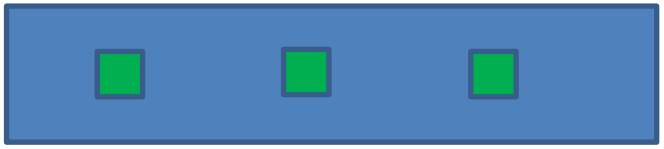
PART 2: Floral resources and pollinators

Treatment 1: Standard mix (=ryegrass (*Lolium perenne*),
red clover (*Trifolium pratense*) and white clover (*T. repens*)
Treatment 2: All species
Treatment 3: common chicory (*Cichorium intybus*)
Treatment 4: bird's foot trefoil (*Lotus corniculatus*)
Treatment 5: field scabious (*Knautia arvensis*)
Treatment 6: dandelion (*Taraxacum sp.*)
Treatment 7: phacelia (*Phacelia tanacetifolium*)
Treatment 8: ribwort plantain (*Plantago lanceolatum*)
Treatment 9: cumin (*Cuminum cyminum*)
Treatment 10: salad burnet (*Sanguisorba minor*)
Treatment 11: common yarrow (*Achillea millefolium*)
Treatment 12: chive (*Allium schoenoprasum*)
Treatment 13: red clover (*Trifolium pretense*)
Treatment 14: sainfoin/esparcet (*Onobrychis viciifolia*)

Test of two cutting strategies (St.1 and 2)

Harvest			1		2		3		4		5		6		7		8		9					10
week	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
St. 1		x		x	★	x		x		x	★	x		x		x	★	x		x				★
St. 2		x		x		x		x		x		x		x		x		x		x				★

May June July August September



Data collection:
Number of flowers per 0.5x0.5 m
Number of flower-visiting insects in 5 min.

Data analyses

- PART 1

  Transect data on flowering density and pollinator numbers and density

  Landscape information for a 500m circle around each field

- PART 2

  Flowering and pollinator abundances

  Information on cutting regimes

  Nectar production of each species