Islay Pollinator Initiative:

Islay Development Initiative in partnership with Islay Natural History Trust

Roadside Verges Project: Floral Biodiversity and Pollinators 2017/2018

Report August 2019

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Contents:

Roadside verges project: Floral biodiversity and pollinators

Summary

100km of roadside verge on the Isle of Islay, Scotland (mainly in the area of the Rhinns) was surveyed for floral biodiversity, flowering abundance and pollinator usage and diversity over the years 2017 and 2018. The roadside verges were divided into 13 routes and each route into discernible sections for recording. Single track roads were treated as single routes, varying the observer effort between both sides of the road. For dual traffic roads each side of the road was treated as a separate linear route/section.

The project employed one full time botanist for four months and supported two part time roles through the summer period and was assisted by four volunteers.

Methodology Vegetation surveys: Quadrats recording all flowering species, cover values and the number of flowering units of each species were sited for every 200m along survey routes, recording associated parameters (grazing, cutting, adjacent habitat and usage). For each 200m section the number of flowering units were recorded on both vegetation and pollinator surveys as a record of flowering abundance.

Vegetation surveys

- 877 quadrats were surveyed across routes and season, resulting in 9307 individual species records
- 857 200m sections were surveyed for flowering abundance
- 167 flowering species were identified. 86 1km grid squares were covered providing data for the Islay Natural History Trust (INHT) recording database and fed into the national recording system.

Methodology Pollinator usage and abundance: 200m were walked at a steady pace within the criteria set out for butterfly and bumblebee survey recording (Temp.>13°; dry; wind <F5 (Beaufort); between times 1100 - 1600). All pollinators (bees, butterflies, hoverflies, beetles, flies) where possible were identified down to species and recorded.

Pollinator surveys

- 1498 200m sections were recorded across routes and months
- 76 of 77 1km grid squares gained survey data of identifiable species for input into the INHT records database and fed into the national recording system.
- 1673 butterflies were recorded over 100km of verge, with Green-veined White as the most prolific butterfly across all months (May to September).
- 4147 bumblebees were recorded, with Common Carder Bee the most frequent
- Flies were recorded in flowers in 93% of the surveyed sections.

What influences species richness?

Species richness was found to be a factor of grass height, grazing and adjacent management. Adjacent areas of natural habitat favoured more species rich verges, whilst grazed areas were found to be favourably rich in species diversity (grasses not being given the chance to dominate), and on some routes increases in grass height did favour species richness but this was not consistent for all routes. Species richness did not provide a significant guide to the value of a route for floral richness.

What influences flower abundance?

There was however greater positive correlation with sward height and mean flower abundance with six routes increasing flower abundance with increased height (GO-CD-SG; GO-F; GO-R; GO-SAL; GR-AR; GR-USK). A sward remaining uncut for much of the season provides greater opportunity for flowering before being eaten by grazers or mown.

The abundance of pollinators positively reflected increases in flowering across all genera, indicating that verges with more flowers are favoured by more pollinators. This provides a scientific impetus that the goal of more flowers will aid pollinator usage and providing corridors along the road verges would be of positive benefit.

Aim:
To record the floral species interest in the roadside verges of Islay; categorise their habitat and ecological value; monitor and record pollinators; monitor and record invasive species; assess the biodiversity value of these as a habitat; and suggest a means for managing cutting times to enhance the quality of flowers and use by pollinators.

Introduction:
The Islay Pollinator Initiative investigated the need to create 'pollinator corridors'. There has been a loss in wildflower meadows nationally of around 97% (REF) since 1930 with intensive farming needing more and more space to produce financially viable crops. Roadside verges have become dead zones, filled with grasses which are expensive to manage for the local authority. There are many miles of roadside verge across Islay, with long sections of straight road which could be managed differently and negate the need for regular mowing, save the council money and create wildflower corridors which could benefit both pollinators and provide a positive visual spectacle for road users.

The Islay Natural History Trust became partners in the project to lend its scientific expertise to ensure sound survey structure and recording was delivered and that the verges were expertly assessed, and further management advice was delivered, fully analysed and with full biological benefit. The data collected from the survey would add greatly to the biological records database that it feeds into the national recording systems. Pollinators, particularly bee species are not a well recorded group, and this would be valuable data on species distribution across Islay.

Funding was provided by The Botanist Foundation, a charitable entity of Bruichladdich Distillery which uses foraged botanicals from Islay in the production of its Botanist Gin.

Methods:

<u>Route classifications</u>
The same route categories were used for the vegetation and the pollinator surveys. Routes were split into definable areas, either between villages or where clear beginning and end points existed. These were then subdivided into sections where specific landmarks, houses, junctions or bends in the road would signify to a recorder that a section was complete. 13 linear routes were identified covering 109.5Km [Route maps - Appendix 1]

There are two sides to a roadway, for the most part these are very similar in vegetation character:

- Single track roads were monitored as one linear route alternating quadrats either side of the roadway and pollinators were recorded either side by walking down the centre of the road or alternating side to side as flowers presented themselves (being mindful of traffic);
- Two-way traffic roadways were classed as two linear routes recorded as 1L (left) or 1R (right) travelling in order from the start of sections.

Estimates of the number of 200m sections within the routes and estimated distances were made using online map and directions software, this provided an estimation of the length of sections and the area that was being surveyed. One main section (Bridgend to Ballygrant) was removed from the planned surveys due to health and safety concerns, it being a well-used trunk route of fast-moving traffic and deemed unsafe.

Start point	End point	Dist. (Km)	Road type **S**ingle **D**ual	Distance to survey (Km)	Veg survey: No. Quad per section @ 200m interval 1.25x3m Quad.
Rhinns:					
Port Charlotte	Portnahaven	11.2	S	11.2	56
Portnahaven	Via Kilchiaran to Port Charlotte	15.6	S	15.6	78
Port Charlotte via Bruichladdich	Foreland road end	5.8	D	11.6	58
Foreland road end	Loch Gorm circuit	16.0	S	16	80
Foreland road end	Carnain	4.7	D	9.4	47
Gruinart:					
Uiskentuie via Coulabus	Carnain back to Uiskentuie	9.9	S	9.9	49.5
Corsopol via RSPB	Ardnave	7.3	S	7.3	36.5
Gorm	RSPB Gruinart	3.2	S	3.2	16
Bridgend/Kilmeny:					
Carnain	Bridgend	2.8	D	5.6	28
Bridgend	Kynagarry	5.1	S	5.1	25.5
Bridgend	Ballygrant	7.3	D	14.6	73
	Totals:	88.9		109.5	
			Total distance road:	**88.9 Km**	
			Total distance- verge:	**109.5 Km**	

All recorders were issued with hi-vis vests and were instructed to walk with care and be mindful of the traffic during their work. This was most important for the botany surveys as time spent looking into quadrats may have resulted in less vigilance of the traffic.

Vegetation monitoring

Vegetation recording concentrated mainly on flowering plants, grasses were identified if simple to do so, otherwise just recorded as 'grasses'. Species lists were composed per 200m with one 1.25m x 3m quadrat per 200m resulting in five quardats in a 1km stretch – GPS was used to record distance and grid ref of quadrat, marking for repeatable survey at a second visit in the season.

Quadrat:
Vegetation Characteristics:

- Species
- % cover values of each vegetation type/species in the sward
- Vegetation Height (cm)
- NVC categorisation (if skills permitted)
- Score of flowering abundance (count of flowers of each species within quadrat)
- Note/comment on changes in habitat characteristics between quadrat samples
- Map vegetation types along the verges

- Photo of quadrat

Characteristics of verge to record:

- depth of verge
- boundary type - fence; wall; ditch; hedge; none
- Grazed/un-grazed
- vegetation cut/not cut (cutting timing/no cuts - info from council)
- adjoining habitat - farmland (crop type); natural grassland; moorland; woodland.....
- Stock within adjacent areas
- note any changes in adjacent land management

200m sections between quadrats

Any additional species to the quadrats were recorded.
The number of flowers were counted within the 200m section or the distance to count 1000 flowers whichever was sooner – the values were converted to no. flowers per m.

- What constitutes a bloom per plant: single flower (daisy/Dandelion/cuckoo flower); Flower head (devils-bit scabious/clover); Flower spike/raseam (bluebell/mint/dead nettle); Umbel (pignut/hogweed).

Timing of visits:

There are about 2-3 phases of flowering with late spring/early summer species and mid/ late summer species. Funding was possible for two recording visits through the summer. These were undertaken from 5th May to end June and July/August. Most species were able to be identified from their vegetative forms if not flowering, either pre or post flowering, if present. Flowering is staggered and some early flowering species may be lost in the process as well as some flowers with few vegetative features. If plants had seed heads these were recorded as a record that flowering had occurred.

Pollinators

Each route was walked and surveyed on a 4-6 week interval, this ensured recording all likely species. The survey protocols mirrored the standard criteria for bumblebee and butterfly surveys which although vary slightly in timing and temperature were as follows:

Time of day: between 11am – 4pm
Weather :

- Avoid wind conditions above F5
- Avoid temperatures below 13°C; If 13 - 17°C there must be at least 60% full sun
- Avoid counting in rain

Method:

- Walk each section at a steady pace facing into the traffic
- All pollinator species were counted and quantity recorded over 200m, then a new section was started. [Recording form Appendix 2]
- For single-track routes record everything within 2m either side and 4m ahead, zig-zagging between verges as flowers present themselves.
- For two-way traffic routes recording window is 2m into the verge and 4m ahead.
- Any changes were noted that were felt to be important or worth noting (habitat change; mown grass; ditches; bushes; or prime forage in use).
- Nets and pots were used to capture and help in identification, releasing creatures immediately after. ID sheets and books were used as required and photos taken for later clarification.

- Count was made of flowers in bloom for the 200m or count up to 1000 blooms and record the distance (results in a value of flowers/m).

General data recorded:

- Date; route code; recorder; start time; finish time; temperature (either by thermometer or from car sensor); wind speed and direction; weather conditions (sun/sun+ cloud/cloud); if weather changed during survey, the section was noted where the change occurred.

Pollinator Recording:

- each species and number of flying butterflies within the recording parameters ($2m^2$ box)
- each species and number of flying bees within the flying parameters ($2m^2$ box)
- species and number of bees on flower heads
- numbers of each variety of hoverfly (if able identify to group or species)
- numbers of each variety of beetle (if able, identify to group or species)
- presence of ants on flower heads
- No. of flies on flower heads (not essential to ID to species, if there is an obvious range of species note in margin)

Training was provided for staff and volunteers in survey technique and in species identification. A photographic reference sheet to all recorded Islay bee species was provided, ensuring good identification skills for bees (Bumble, solitary and honeybee species). The Field Studies Council guide to butterflies was provided to aid surveyors in butterfly identification.

Results

<u>Survey outcomes:</u>

- Training in pollinator identification
- Data analysed and all species records entered onto the Islay Natural History Trust's database and fed into national recording networks.
- Talks/presentations and displays are in development around the project to inform and educate the public on progress and outcomes, to be delivered in INHT centre - June 2019.
- A report and guidance on best practice management of verge areas will be supplied and delivered to Argyll and Bute Council to influence and guide verge cutting practices for future benefit to biodiversity of the island's road transport routes.

Verge Vegetation

In total 91.7km of roadside verge was surveyed for flowering plants. This encompassed 877 quadrats with 9370 individual species records. A species list of 167 flowering species were identified [Appendix 3]. Species records from the quadrat analysis were simplified into presence/frequency in 1km O.S.map grid squares for database recording, providing records for 86 1km squares.

Seasonally prominent flowering species amongst those recorded in the route sections were selected that represent key seasonal flowers and mapped on the route sections where present.

- Early spring flowering species (Bluebell and Lesser Celendine) indicate verges with a woodland element to their flowering complement and indicate good early forage potential for pollinators.
- Brambles represent good opportunity for attracting and supplying forage for pollinators during the mid-summer months
- Yarrow, Sneezewort and Devil's-bit Scabious are late summer/autumn flowering species and would suggest sections where late cutting is traditional and potentially provide a full summer of forage.

Species	Quadrat records (end June – Sept)	In flower during flowering period	% of plants found in flower during
Yarrow	72	12	16.6%
Sneezewort	8	4	50%
Devil’s-bit Scabious	2	2	100%

- Yellow Rattle (being an annual) is indicative of grassland traditionally managed, with late cutting where seed production and dispersal from flowers is possible.

Map 1: Bluebell & Celendine Distribution within Route Sections

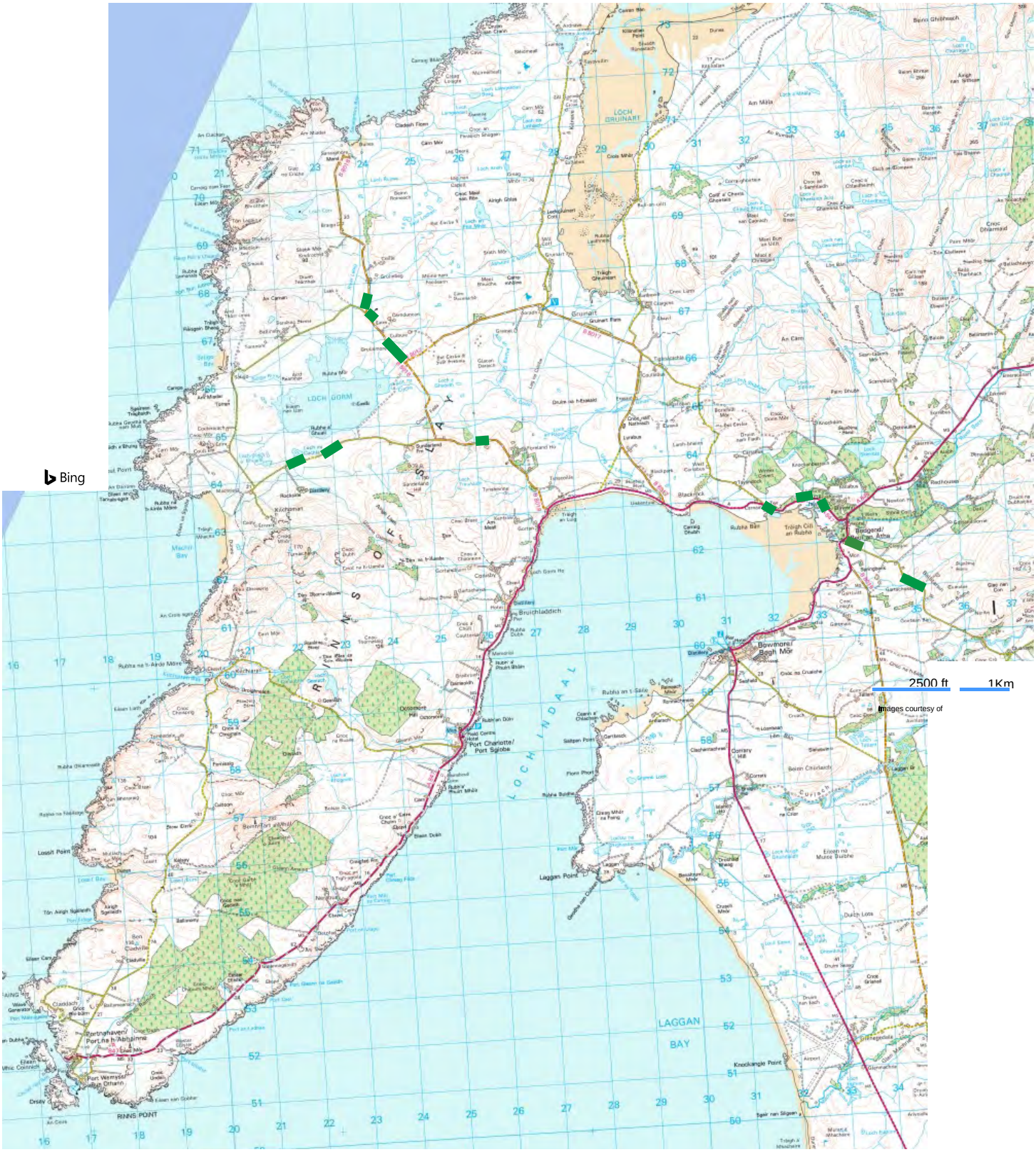
Indicative of Spring flowering forage areas.

Lesser Celendine Bluebell

Map 2: Distribution of Yarrow within Route Sections

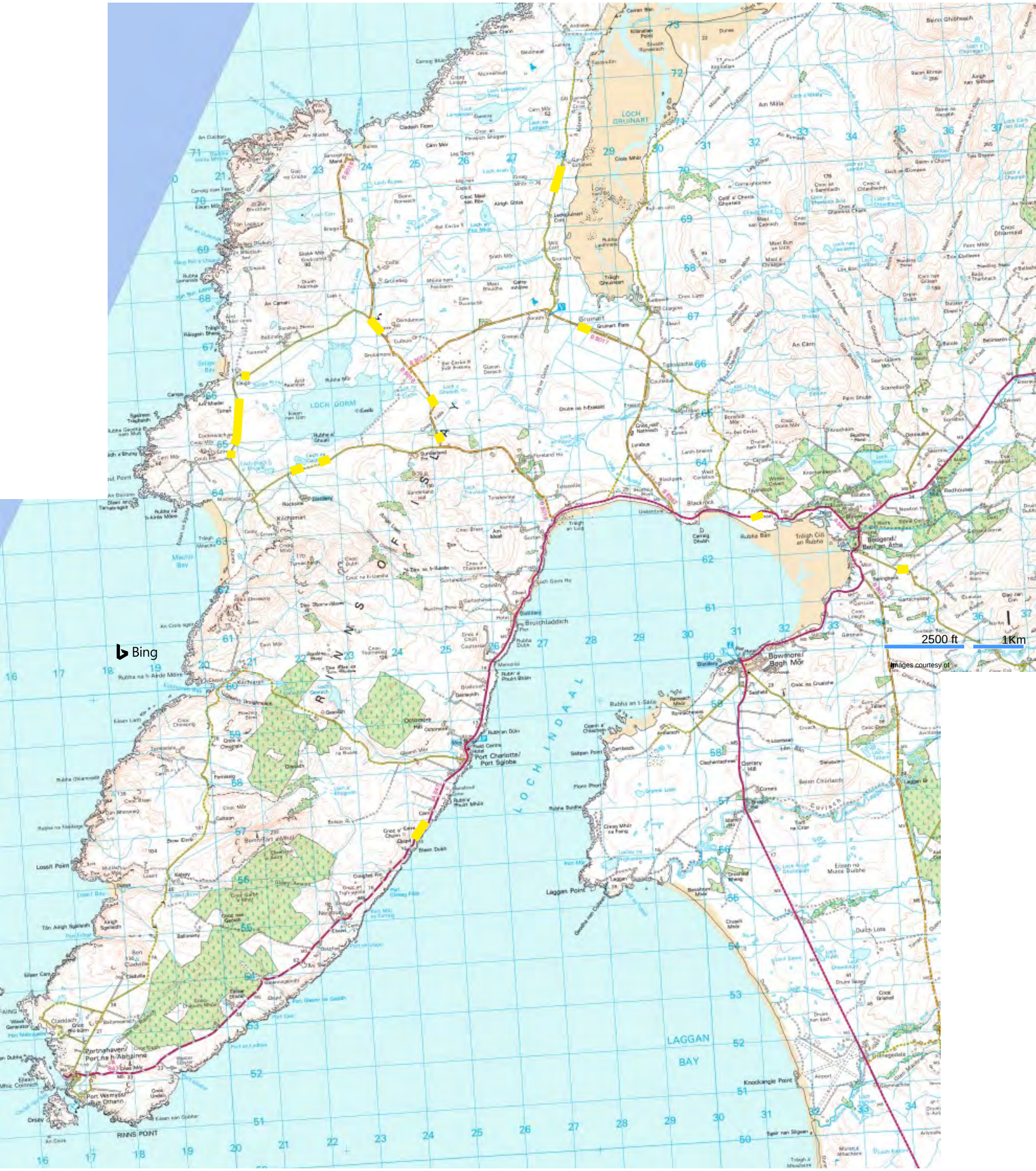
Indicative of Autumn flowering forage areas.

Yarrow

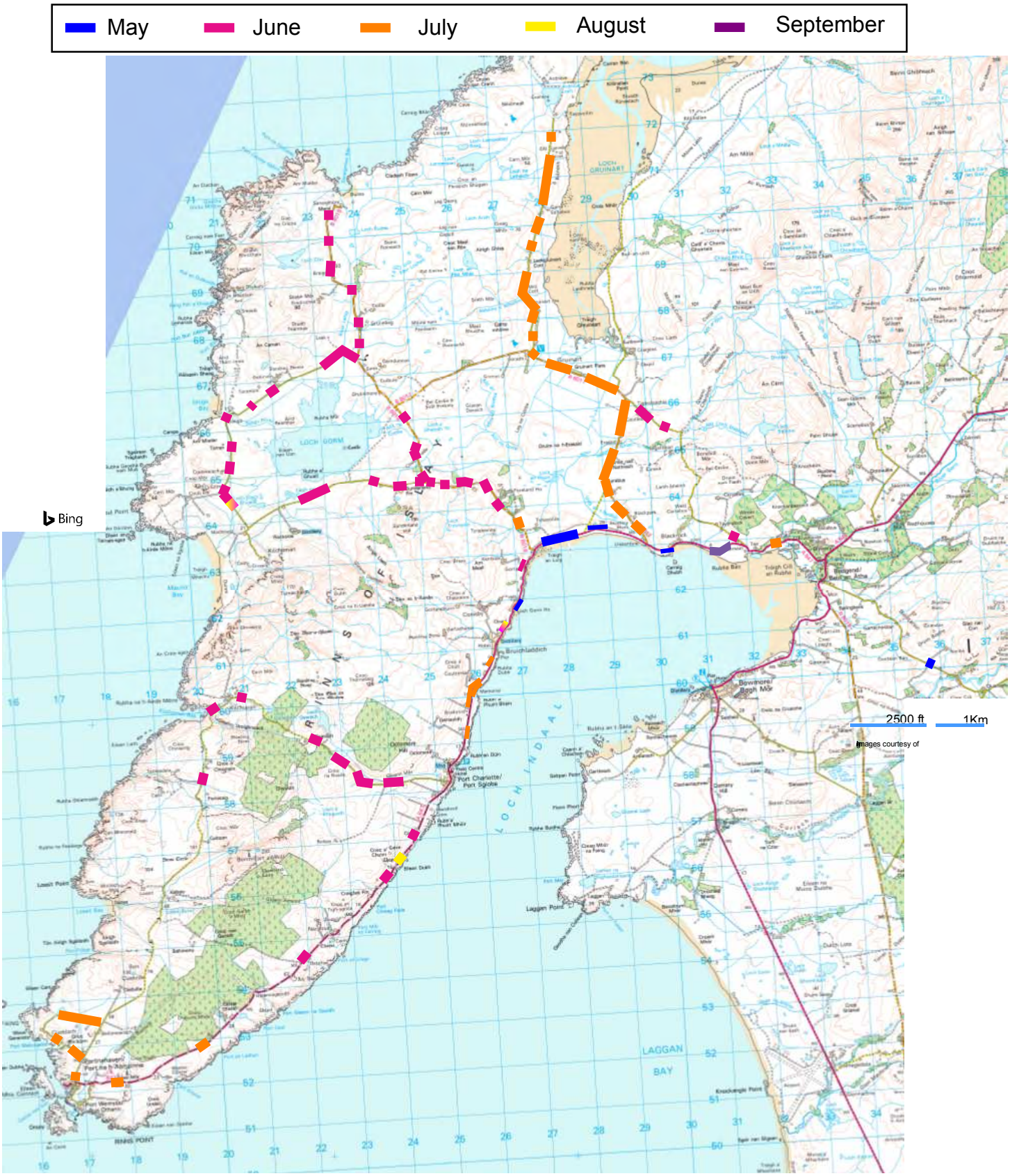


Map 3: Yellow Rattle Distribution within Route Sections Yellow Rattle

Indicative of late cutting, suitable for establishment of traditional grassland species rich meadow



Map 4: Distribution of Route Sections where flowering abundance per 200m was greater than 100 blooms/m



What characteristics favour good species richness and floral abundance?
This is the ultimate question. If the value of a verge is to be maximised, knowing where and what management affects these within a grassland verge habitat will influence the potential management that can be targeted to improve them.

We recorded/measured the following variables:

DATE	Grid Ref.	1km grid sq	Obs. erver	Depth of verge (m)	Grazed/ ungrazed (G/U)	Grass ht (cm) (median of 9)	Boundary Type	Adj. Habitat	Verge cut timing	no. flowering spp. within Quad	% COVER	No. blooms per spp.

The verge characteristics and parameters measured were analysed through modelling against floral abundance and richness for each of the route sections. Elements found to have significant impact on the value of the verge's floral diversity were:

- Grass height due to cutting – species diversity
- Grazing – floral abundance/species richness
- Adjacent management – affecting species richness/floral abundance

Each of the sections were analysed using Simpsons index of diversity and floral abundance with smoothing of data by Kernel density estimation These data distribution graphs use a kernel density estimation (KDE), which is a way of 'smoothing' so as to estimate results in the 'spaces' between data points or, in this case, quadrats. Hence, instead of condensing precious data into a single number, such as an average or total, these distribution graphs show the data in a more complete sense – showing both a mean and variation.

The variance in species diversity and floral abundance along the route sections was compared before and after verge cutting to determine what changed and value for pollinators, a sward may show high diversity but is only profitable if allowed to flower.

Each graph includes quadrats recorded before and after their respective verge cut times. Since the cutting times of verges were imprecise, to determine if a quadrat was recorded before or after a cut, I used the following cutting times: June – "01-06-2018"; Mid-late July – "15-07-2018"; and Mid-August "15-08-2018", with the following estimation to determine when each verge was cut - GO-R section 3 was labeled as a control. However, bearing all this in mind, these cutting times may not truly represent when they were actually cut (as evident on route PCH-PH), but let it serve as a guide.

There was variation in some sections but overall it can be viewed that diversity of the sward is greater before the verges have been cut. Areas with grazing where grasses never grow tall often retain high diversity the effect of mowing is insignificant, later flowering was sometimes greater. There was a control along section GO-R3 where the verge was left uncut for two consecutive seasons. GO-SAL was surveyed before cutting over the whole 2018 season and PCH-PH survey windows (except section 8) occurred in June following the vegetation cut, the second round of cutting would therefore be many weeks post cutting and some recovery in the sward diversity is evident.

Fig. 1-14: Graphs - Species Richness Density in each survey route

Fig. 15-29: Graphs - Floral Abundance Distribution in each survey route

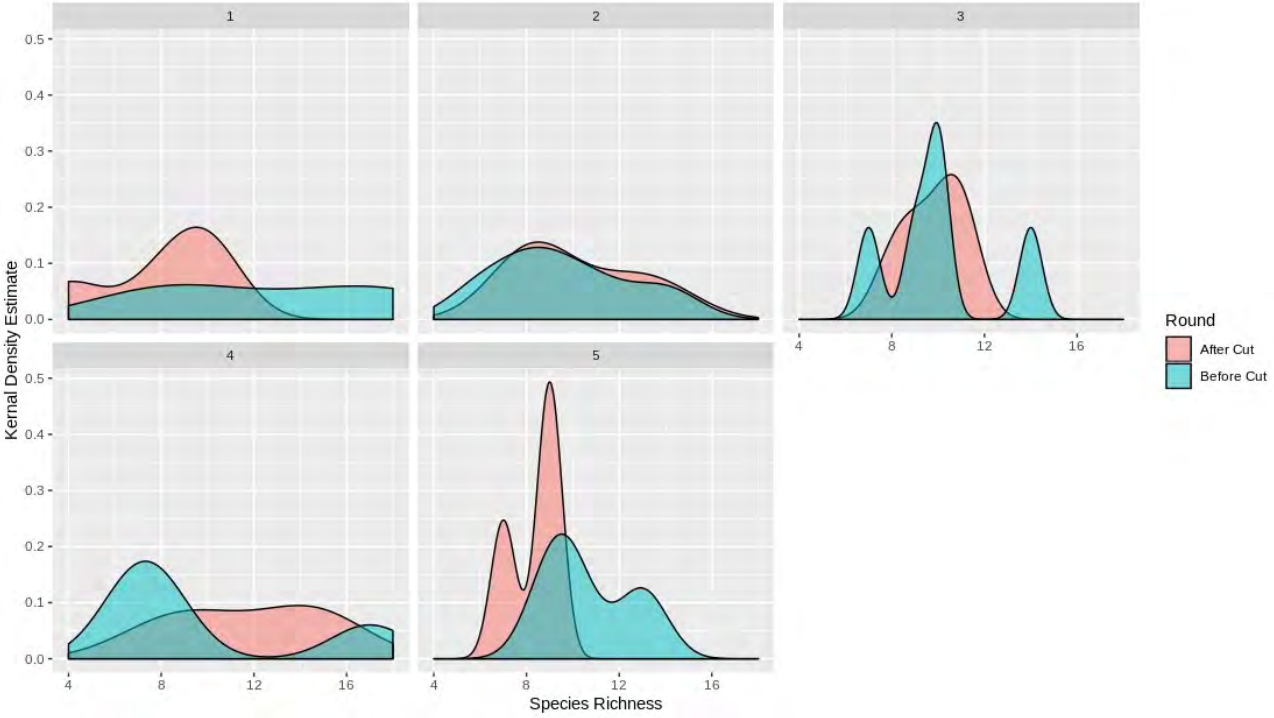


Figure 1: Species richness on different sections of BR-KY before and after cutting.

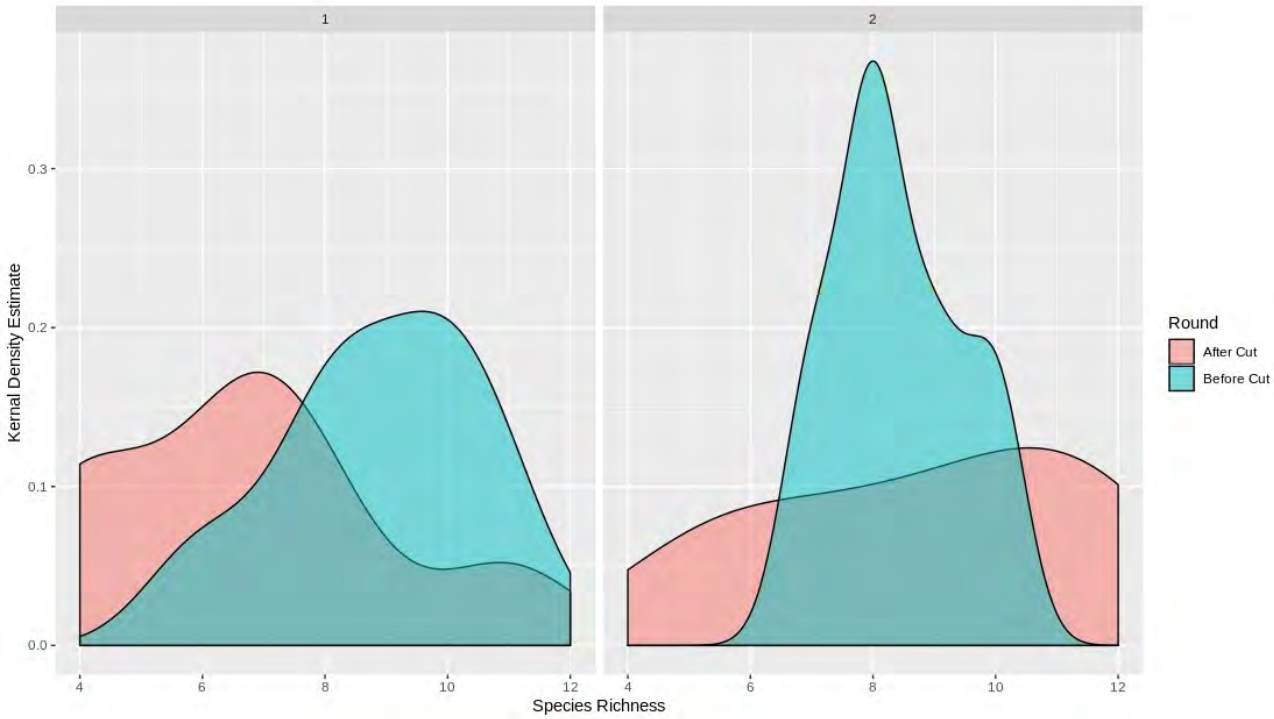


Figure 2: Species richness on different sections of BRW-BR before and after cutting.

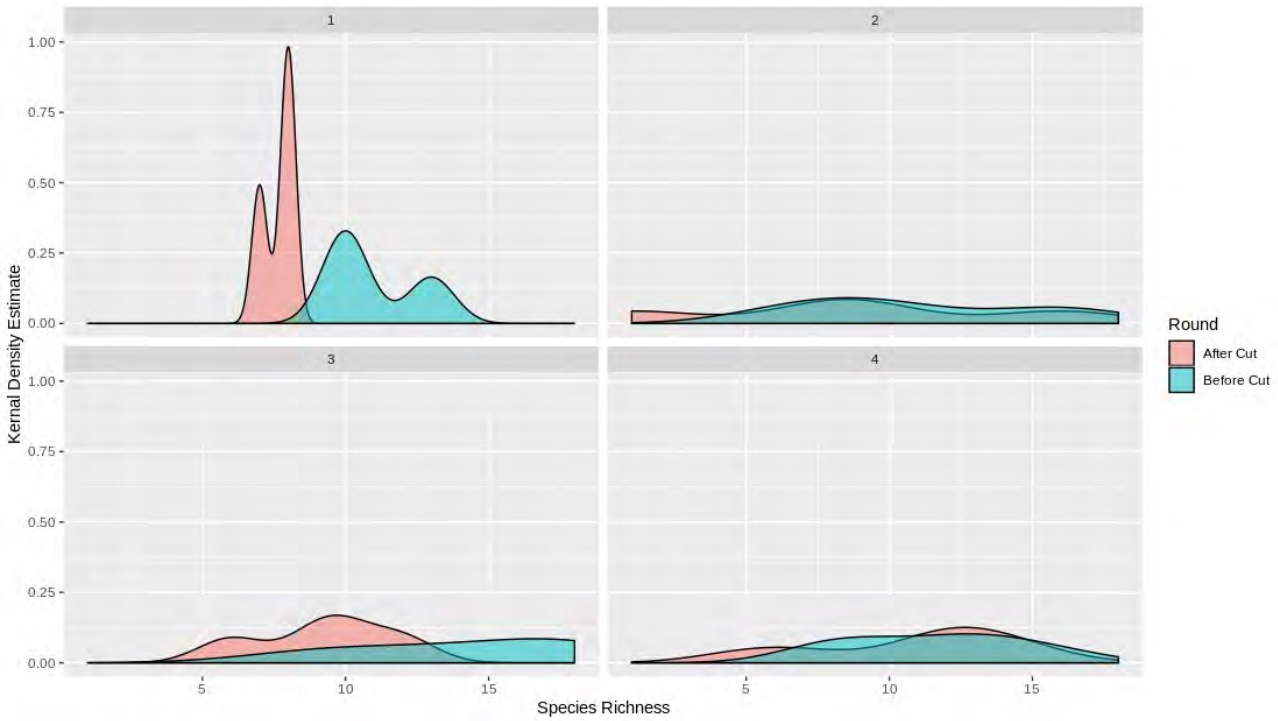


Figure 3: Species richness on different sections of GO-CD-SG before and after cutting.

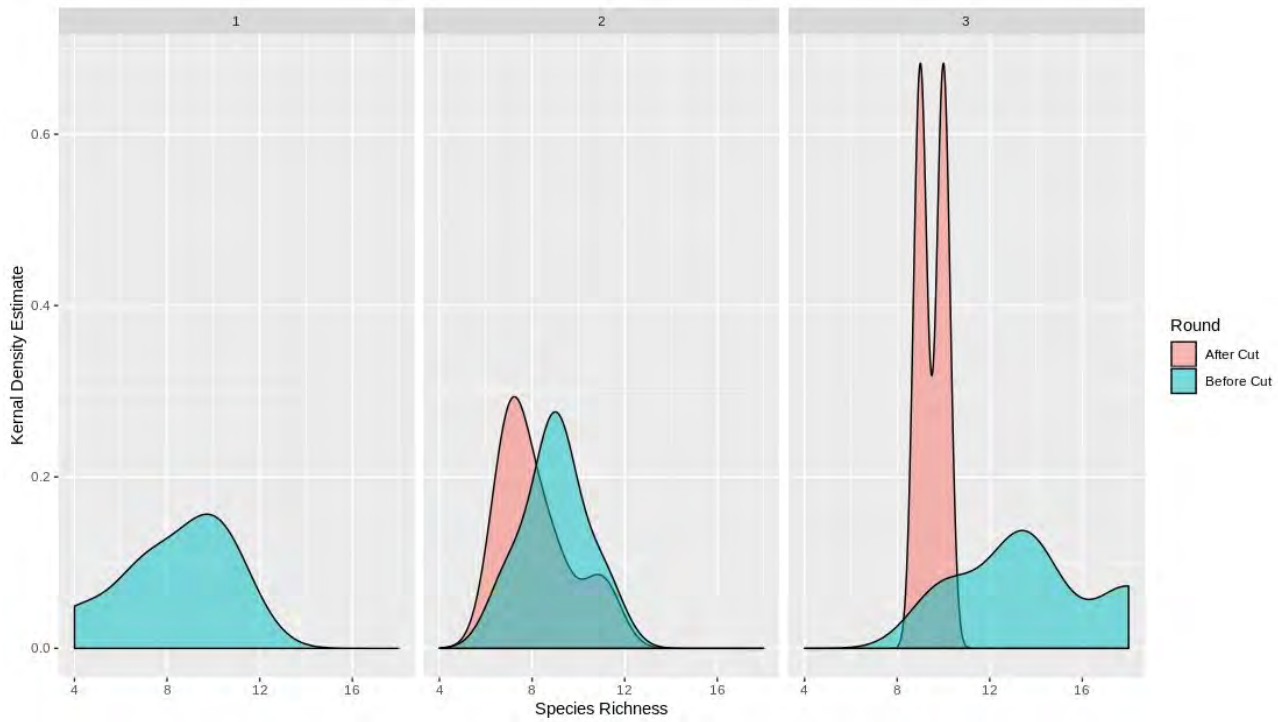


Figure 4: Species richness on different sections of GO-CD before and after cutting.

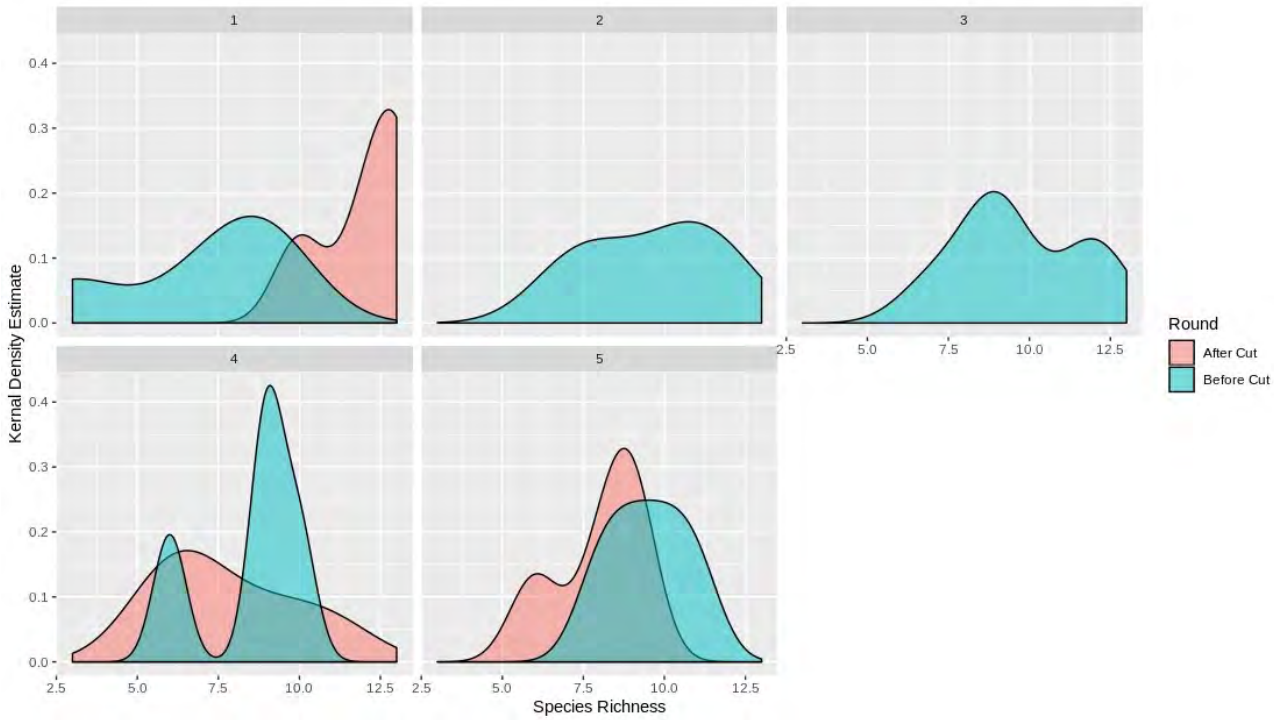


Figure 5: Species richness on different sections of GO-F before and after cutting.

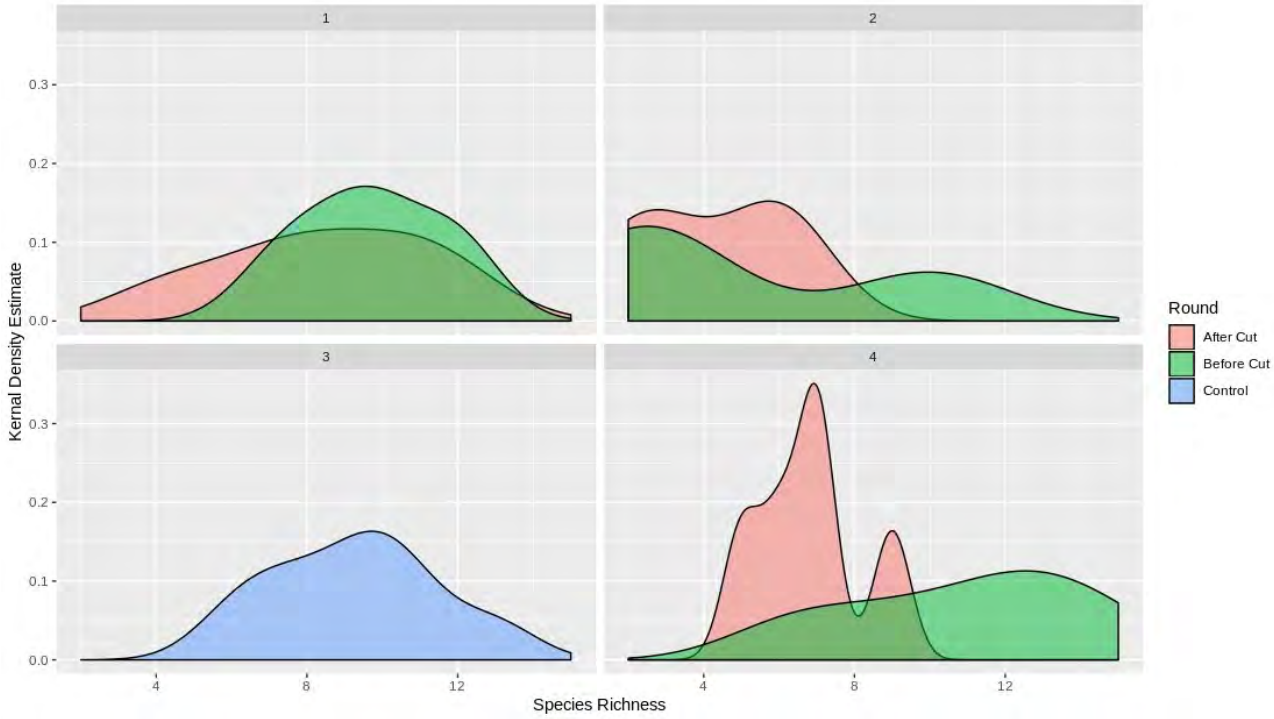


Figure 6: Species richness on different sections of GO-R before and after cutting.

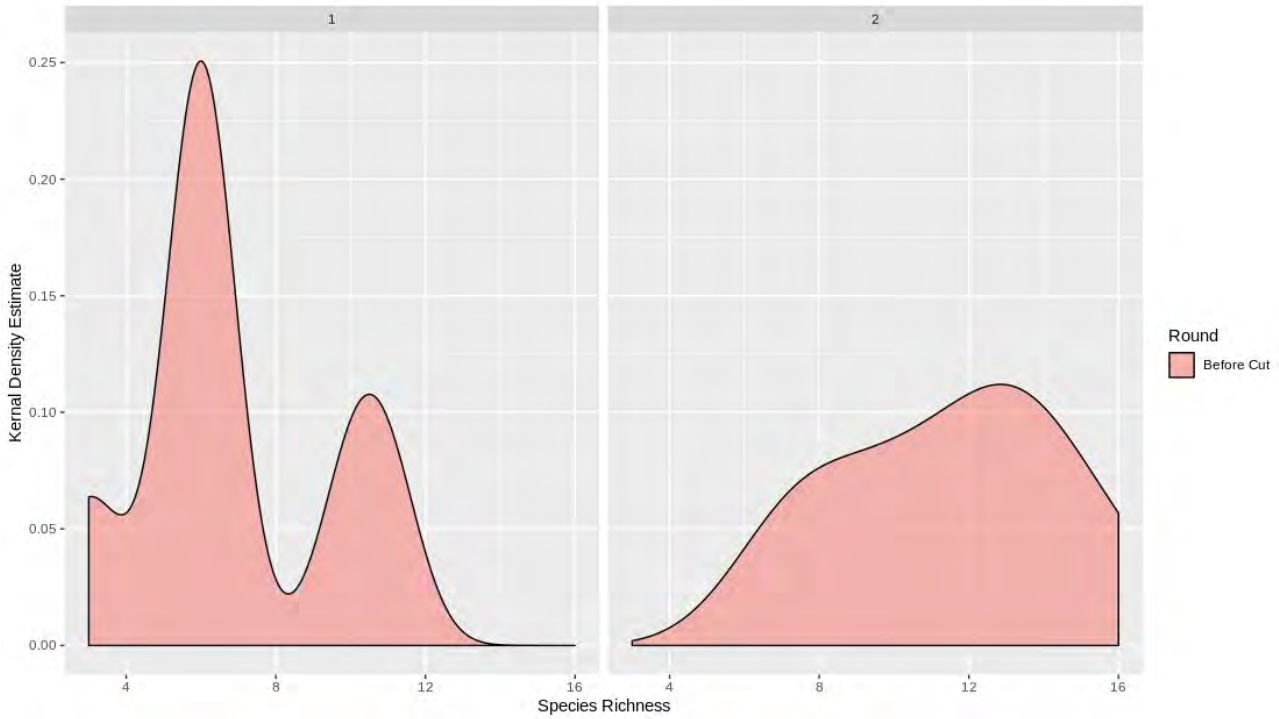


Figure 7: Species richness on different sections of GO-SAL before and after cutting.

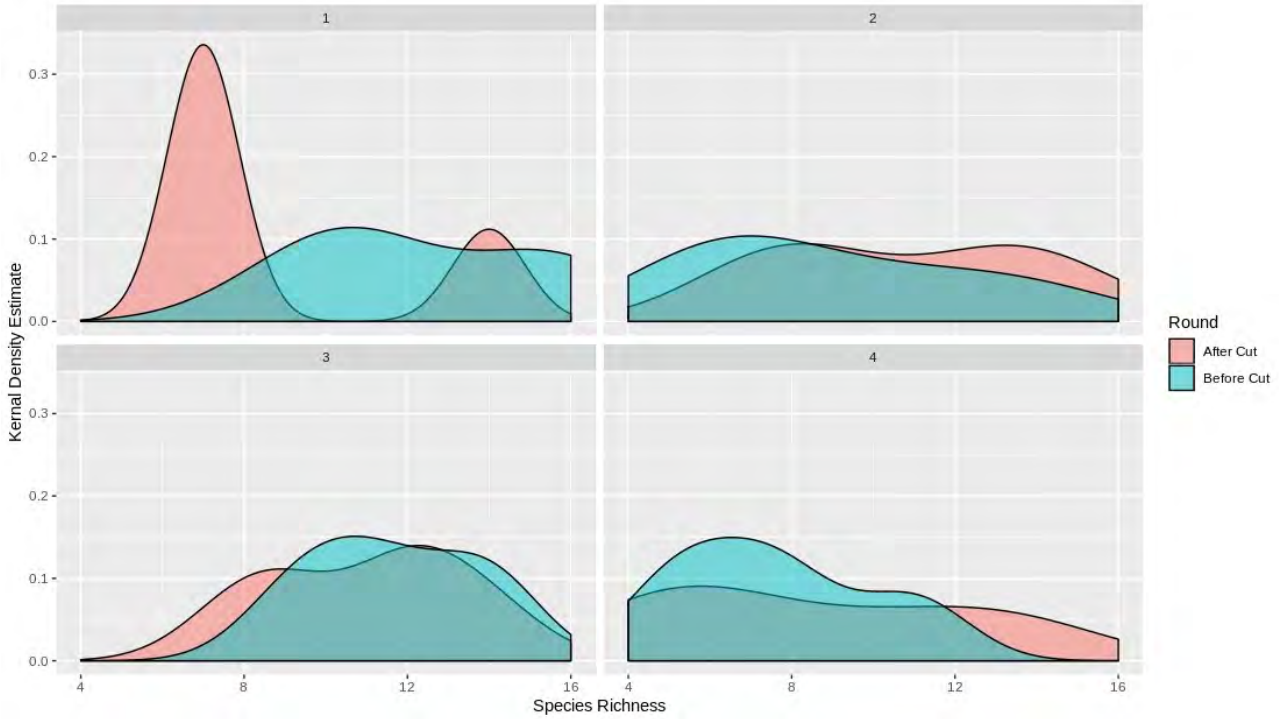


Figure 8: Species richness on different sections of GR-AR before and after cutting.

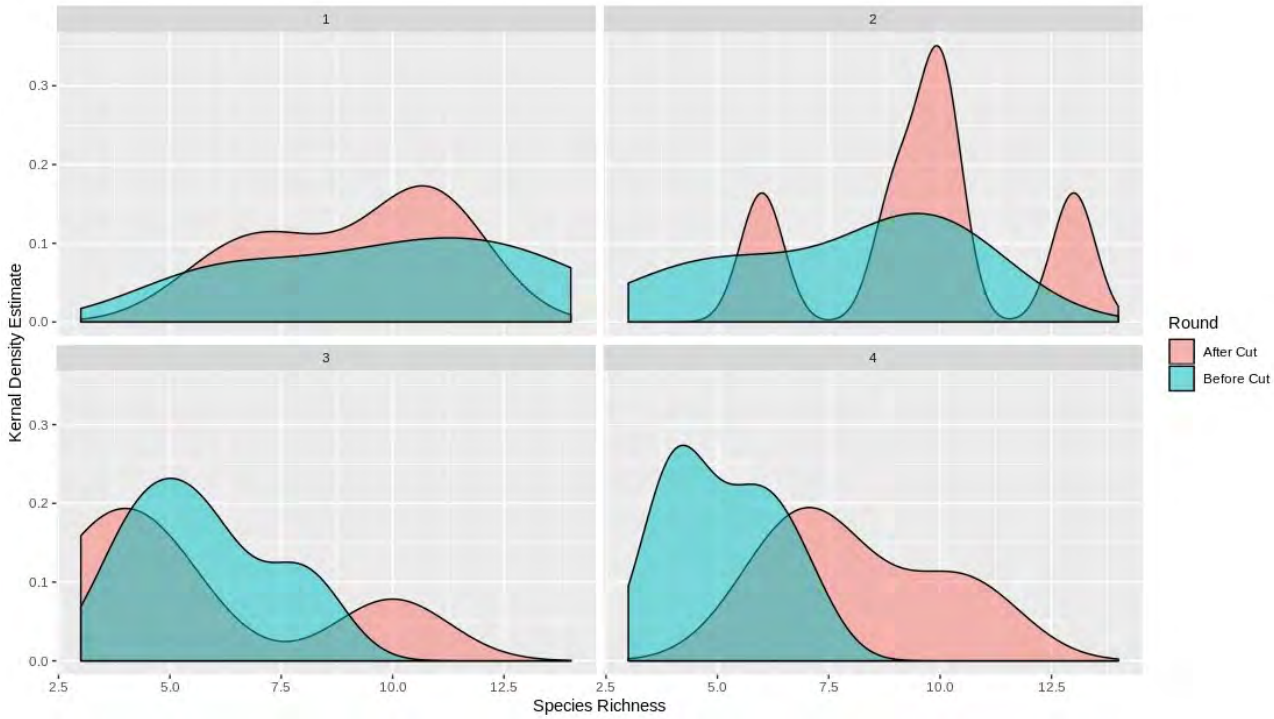


Figure 9: Species richness on different sections of GR-CR before and after cutting.

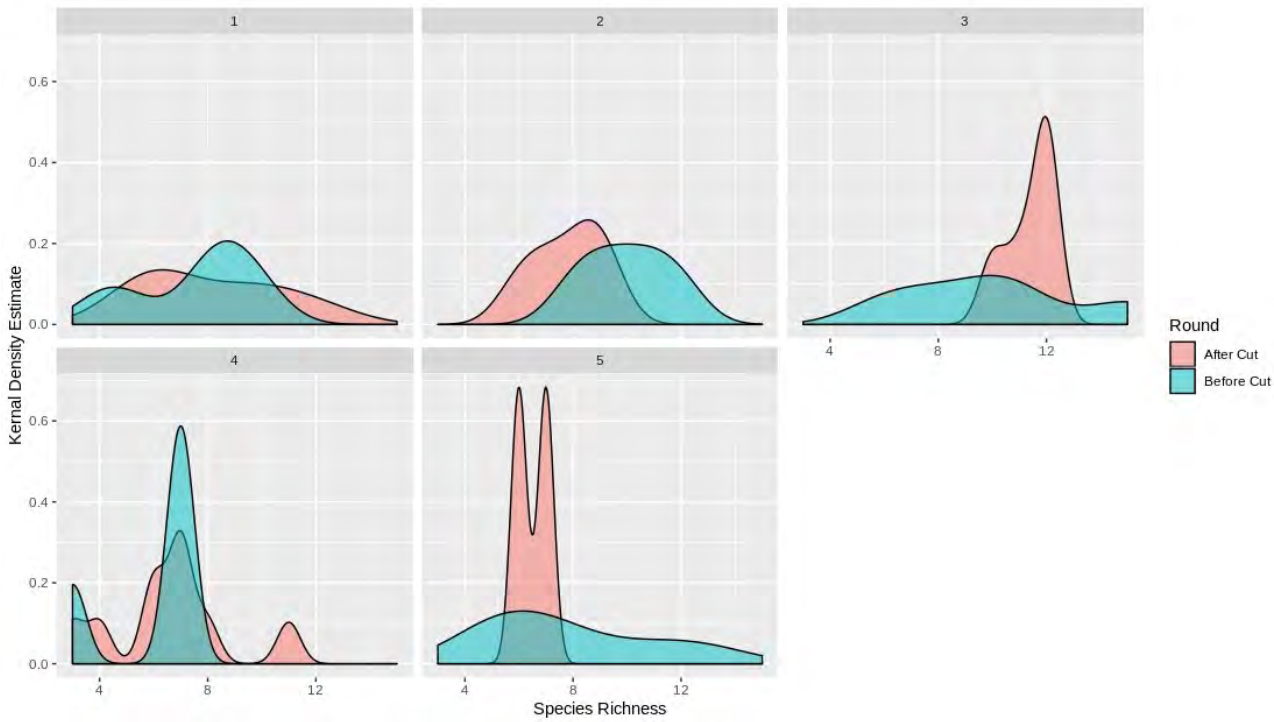


Figure 10: Species richness on different sections of GR-USK before and after cutting.

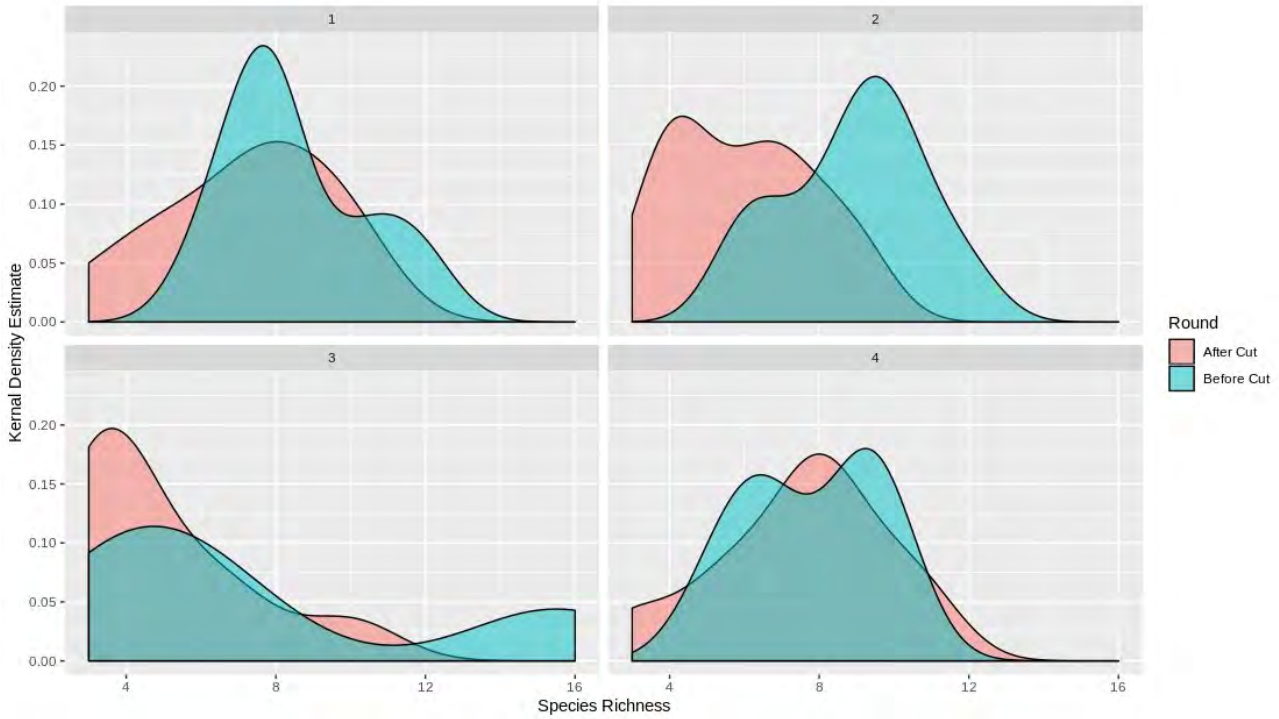


Figure 11: Species richness on different sections of KW-BR before and after cutting.

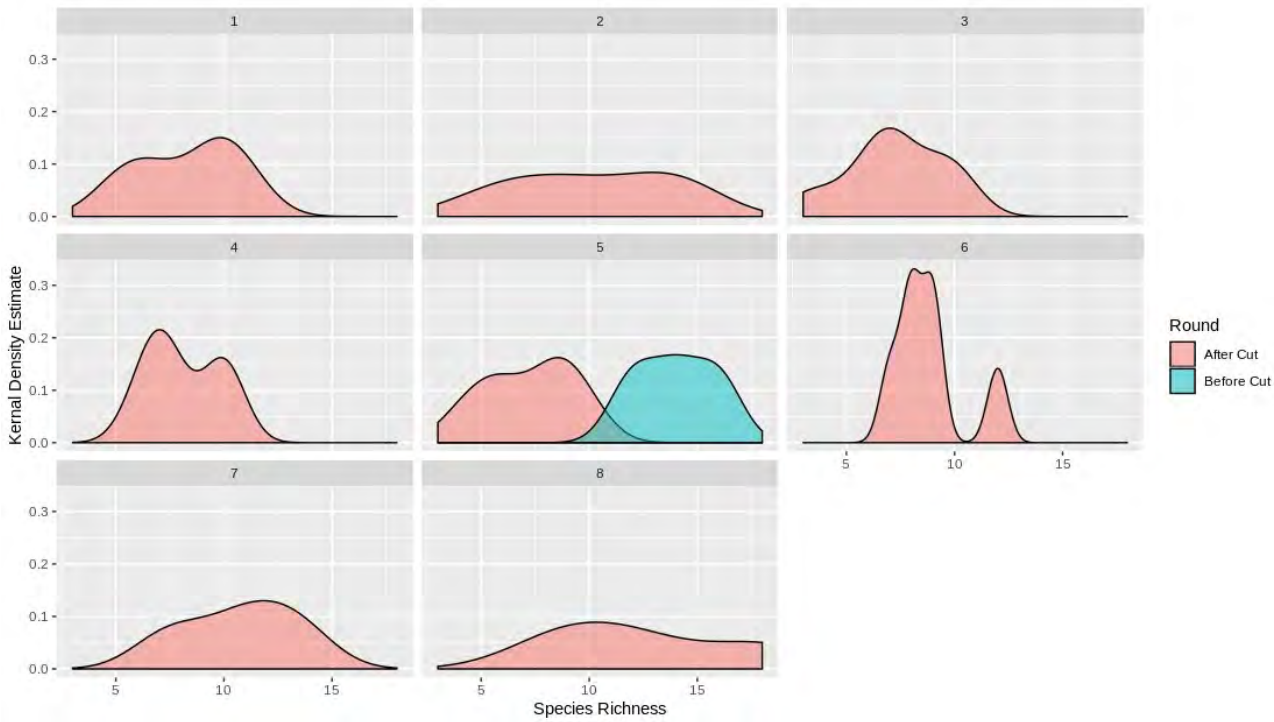


Figure 12: Species richness on different sections of PCH-PH before and after cutting.

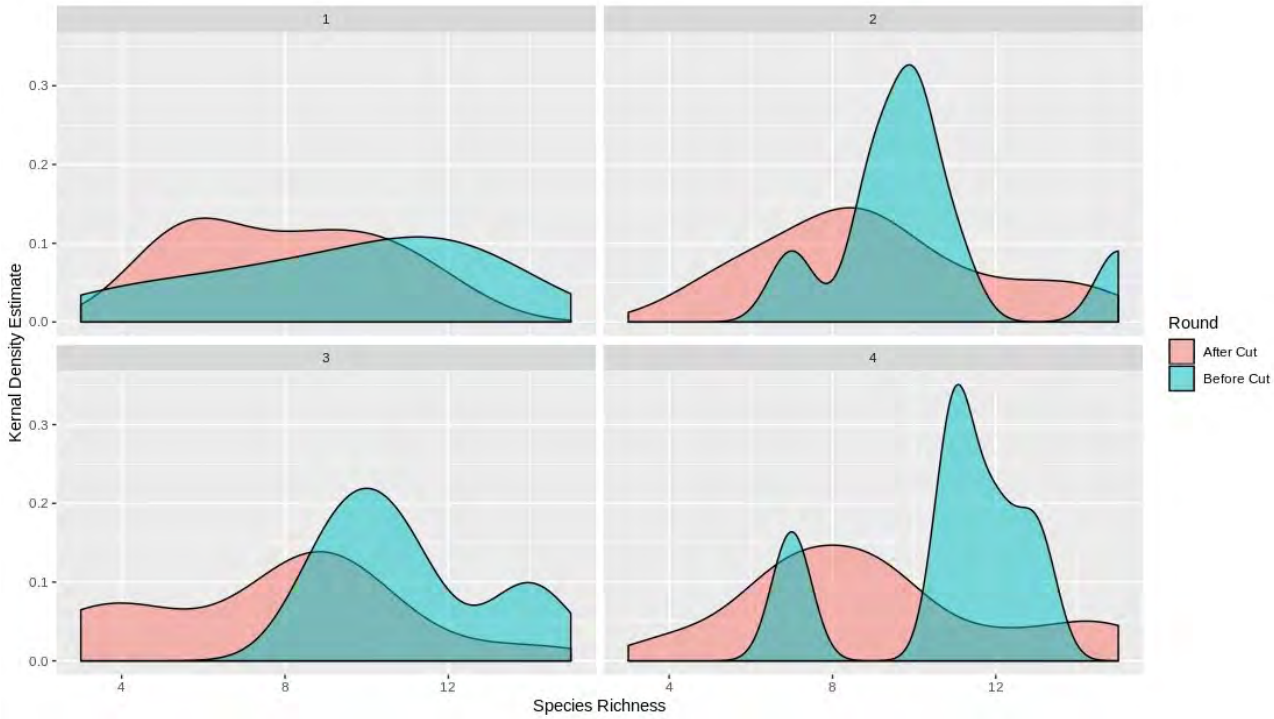


Figure 13: Species richness on different sections of PC-K before and after cutting.

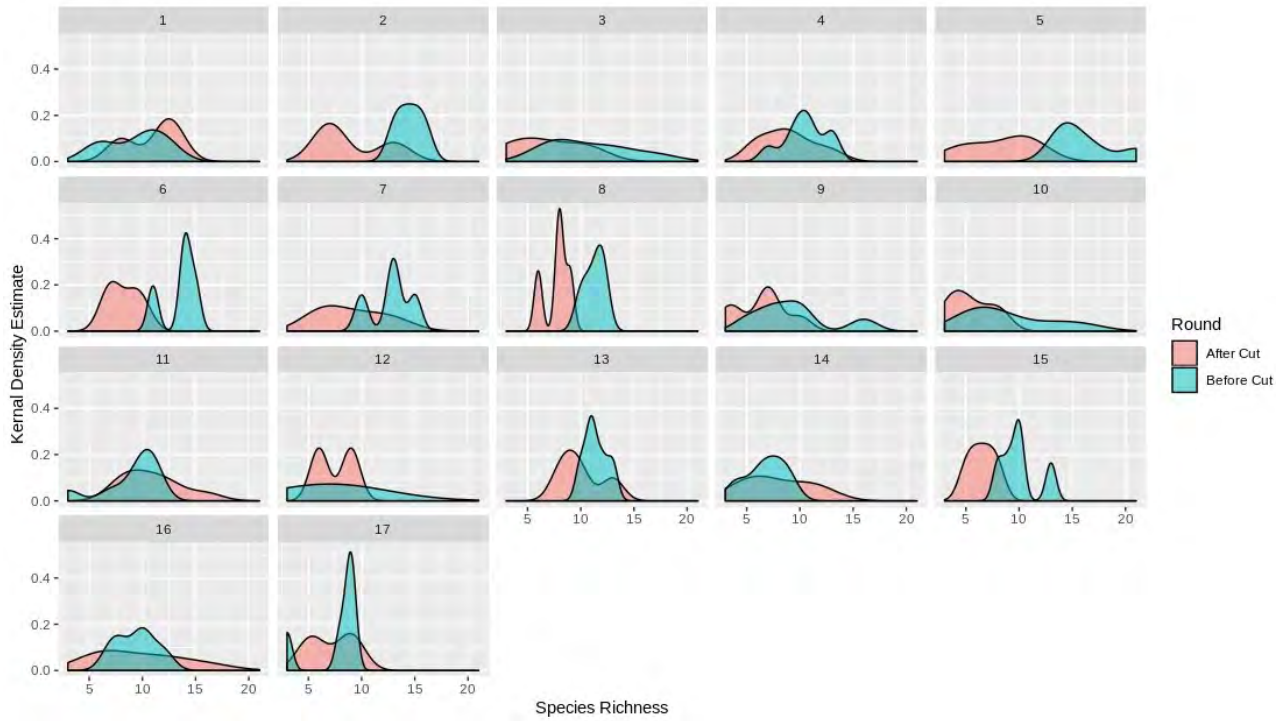


Figure 14: Species richness on different sections of PH-PCH(KI) before and after cutting.

Data Distribution of Quadrats and their Flower Abundance

Flower abundance on each route

Figure 15 shows the distribution of quadrat flower abundance with each route, before and after the respective cutting times. Routes “PC-K”, “GR-CR” & “PH-PC(KI)” show little change before and after cutting. Routes “BRW-BR” & “PCH-PH” show that quadrats in these sections are more variable after cutting, showing both low and high flower abundances. Routes “BR-KY” & “KW-BR” also show very little change in flower abundance before and after cutting. Routes “GO-CD-SG” & “GR-AR” show a higher flower abundance before cutting. From this is it not easy to say whether cutting itself has an effect on flower abundance, or whether the changes here are due to confounding factors i.e. temporal, seasonal, geographical etc.

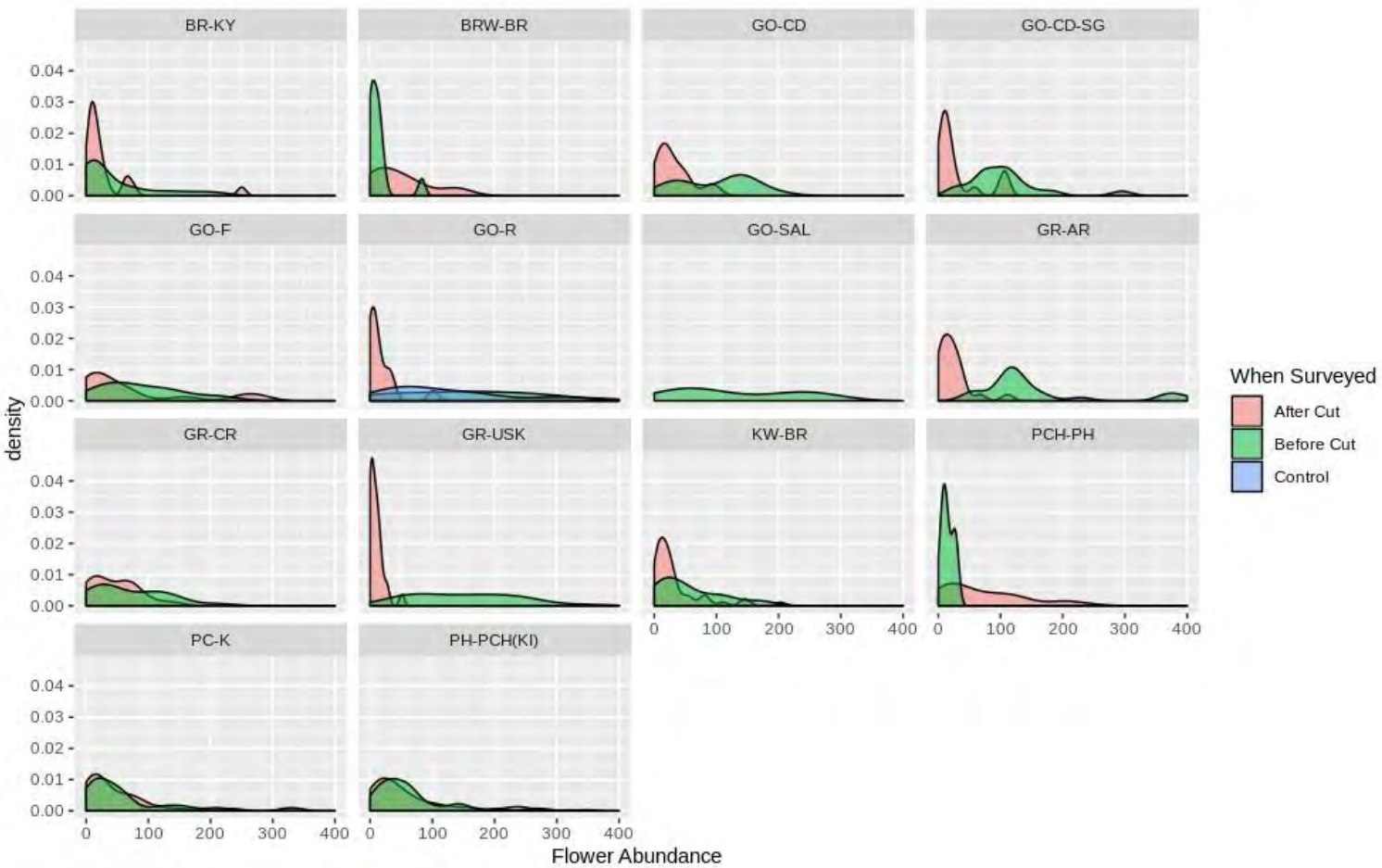


Figure 15: Graphs showing the data distribution of flower abundance in each quadrat. Each separate graph is the data for each route section. Additionally, flower abundance before (green) and after (red) cuts are shown, with the control (blue). Instead of a typical histogram, a kernel density estimate smoother was used in order to predict values between data points. Approximately 25 outliers were removed from the data so data could be seen clearly. Visually, graphs suggest that after cutting, flower abundance is reduced for most route sections, however, some routes show the opposite (PCH-PH, BRW-BR). Routes GO-F, GR-CR,PC-K and PH-PCH(KI) show very little change before and after cut.

Figure 16: BR-KY Sections Kernel Density Plot

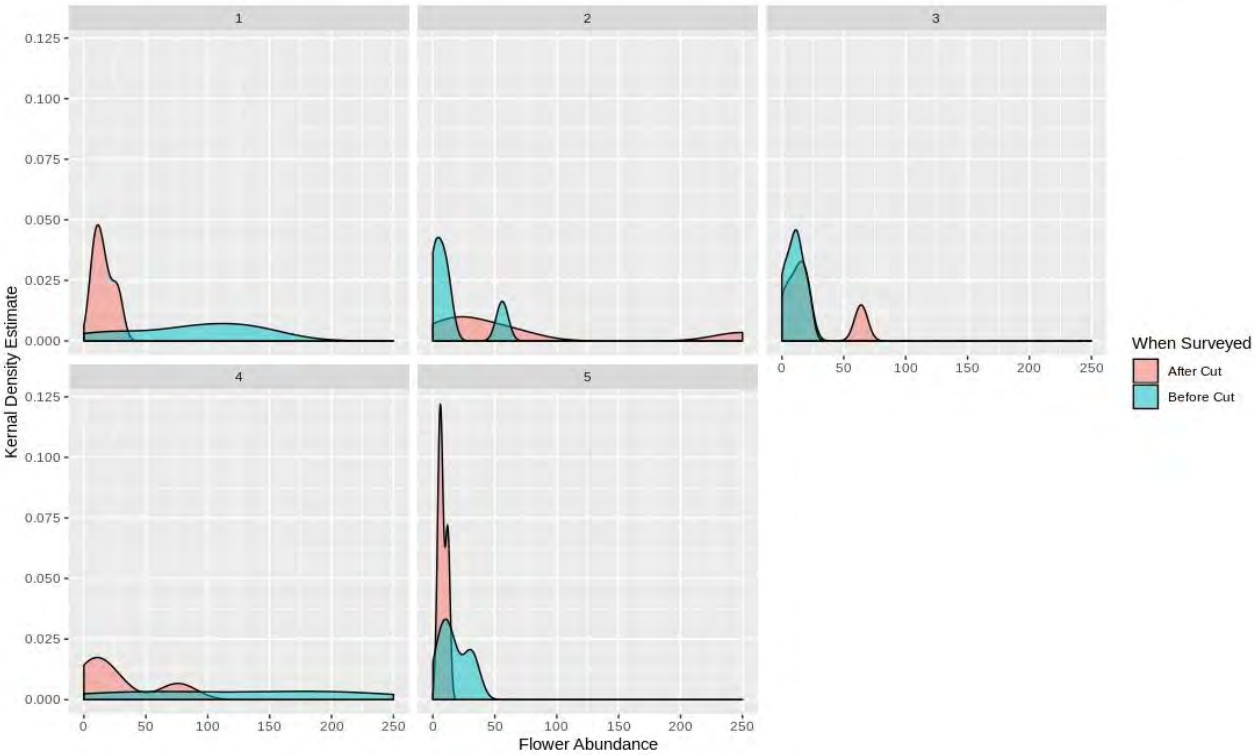


Figure 16: split into 5 sections of the BR-KY route. These graphs show the frequency of quadrats with their corresponding flower abundances, and also split into before and after cutting dates.

Figure 17: BRW-BR Sections Kernel Density Plot

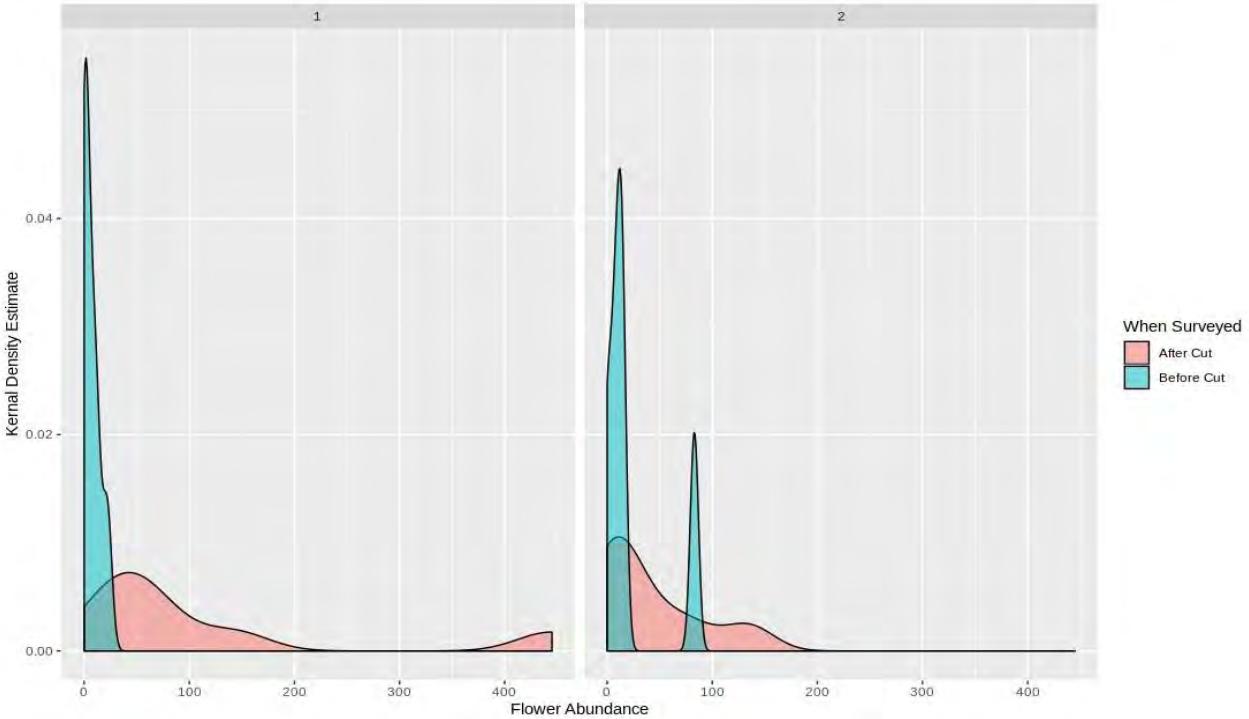


Figure 17: split into 2 sections of the BRW-BR route. These graphs show the frequency of quadrats with their corresponding flower abundances, and also split into before and after cutting dates. **For this route data was collected from three sections, however, only two are shown here. The third section had too few data points to be included in the Kernel Density estimates (i.e. only one data point). Verge on this section was narrow and dangerous to collect data from.**

Figure 18: GO-CD Sections Kernel Density Plot

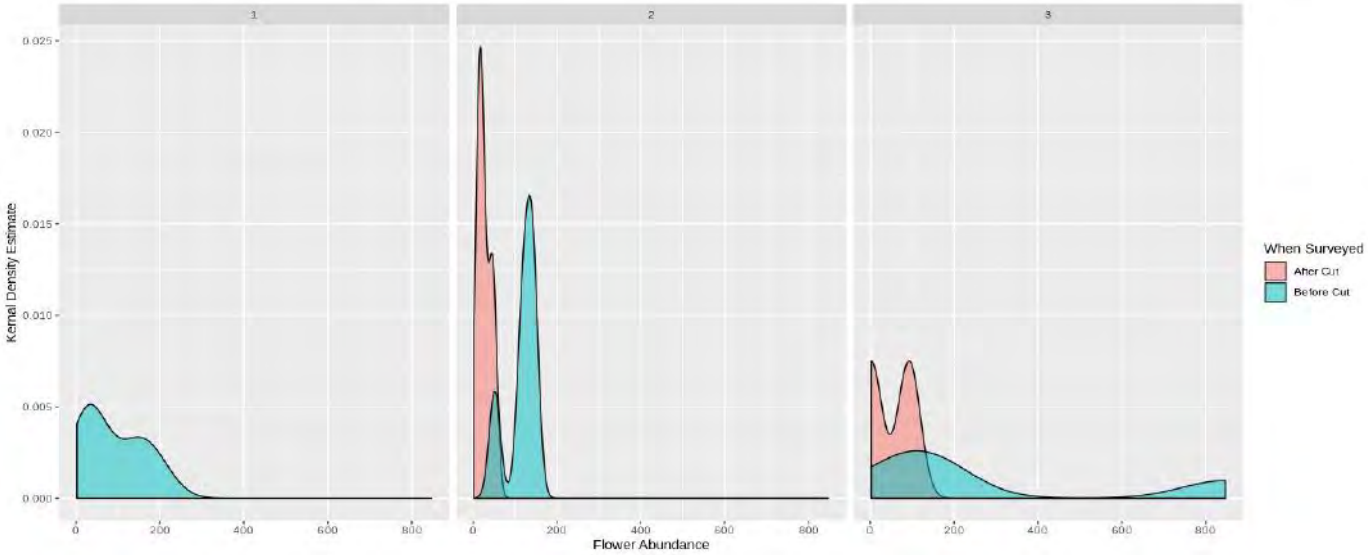


Figure 18: split into 3 sections of the GO-CD route. These graphs show the frequency of quadrats with their corresponding flower abundances, and also split into before and after cutting dates.

Figure 19: GO-CD-SG Sections Kernel Density Plot

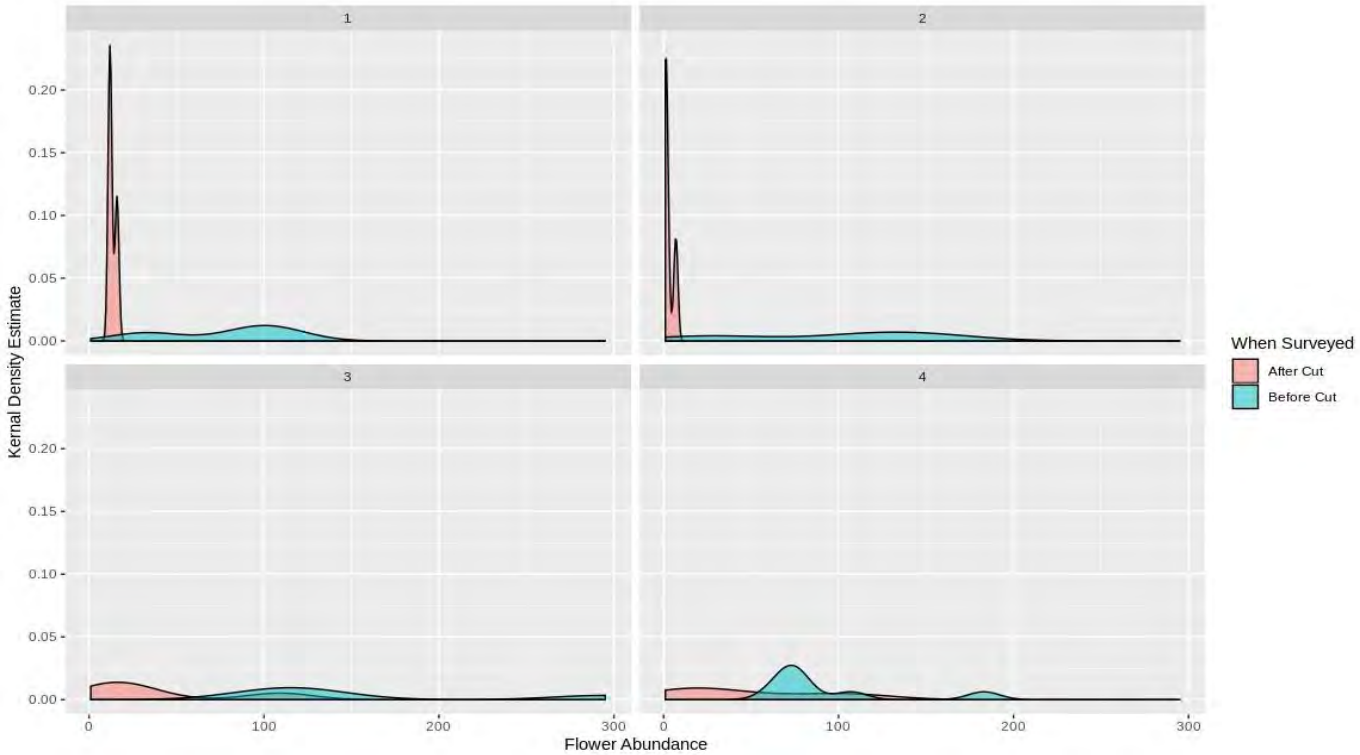


Figure 19: split into 4 sections of the CO-CD-SG route. These graphs show the frequency of quadrats with their corresponding flower abundances, and also split into before and after cutting dates.

Figure 20: GO-F Sections Kernel Density Plot

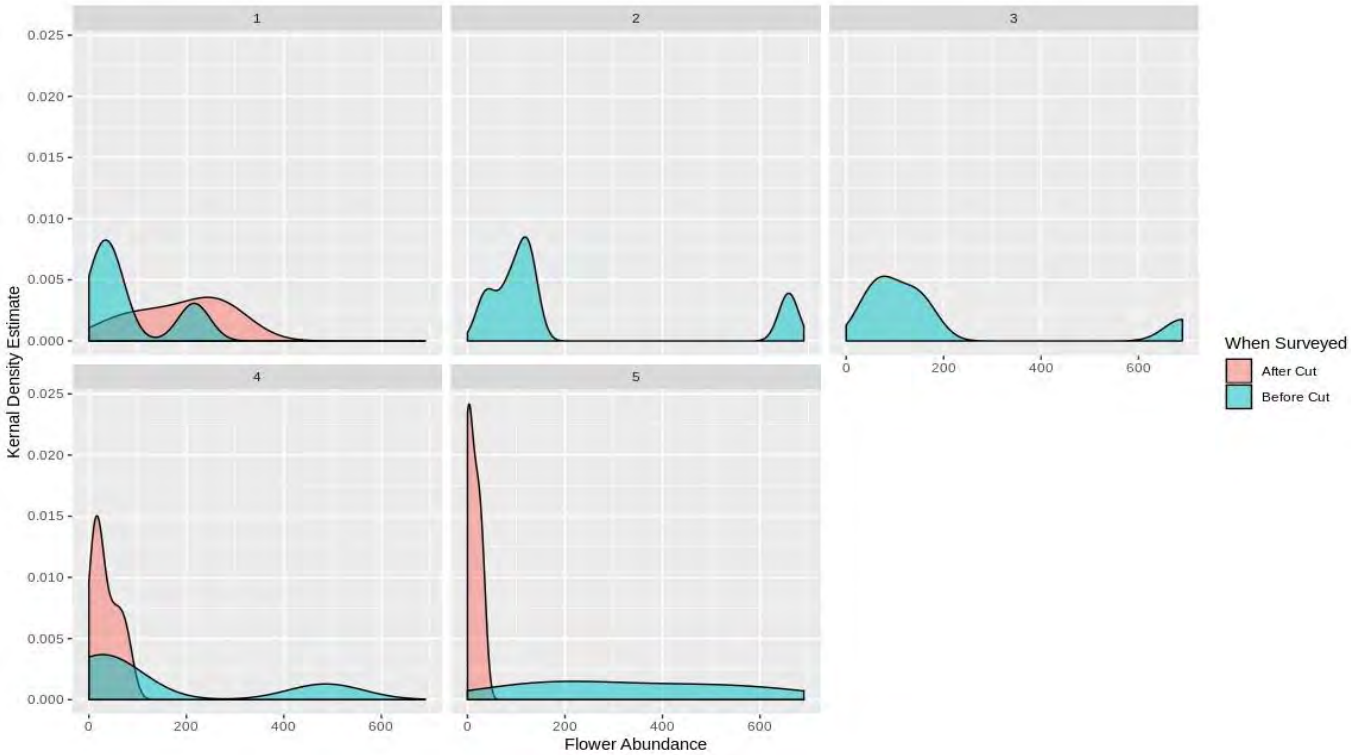


Figure 20: split into 5 sections of the GO-F route. These graphs show the frequency of quadrats with their corresponding flower abundances, and also split into before and after cutting dates. **No data was gathered after cutting on sections 2 & 3.**

Figure 21: GO-R Sections Kernel Density Plot

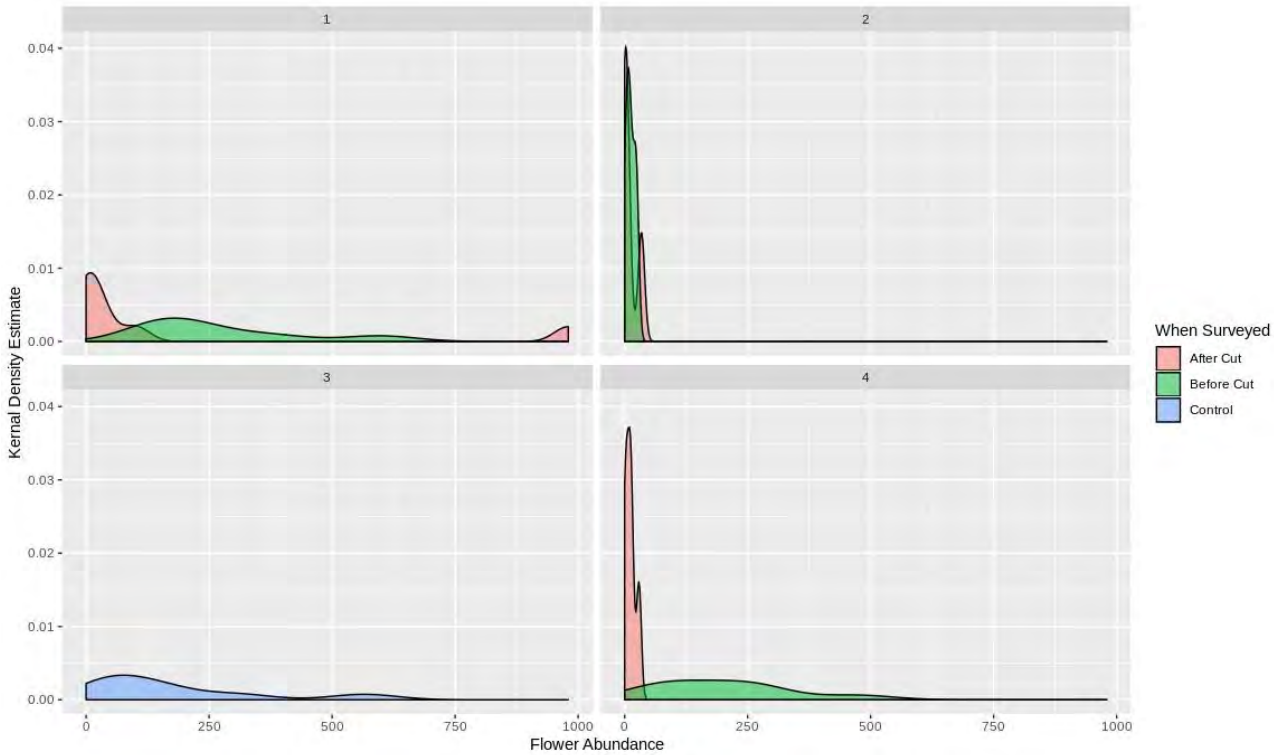


Figure 21: split into 4 sections of the GO-R route. These graphs show the frequency of quadrats with their corresponding flower abundances, and also split into before and after cutting dates. **GO-R section 3 was the control section, so doesn't have data collected after cutting.**

Figure 22: GO-SAL Sections Kernel Density Plot

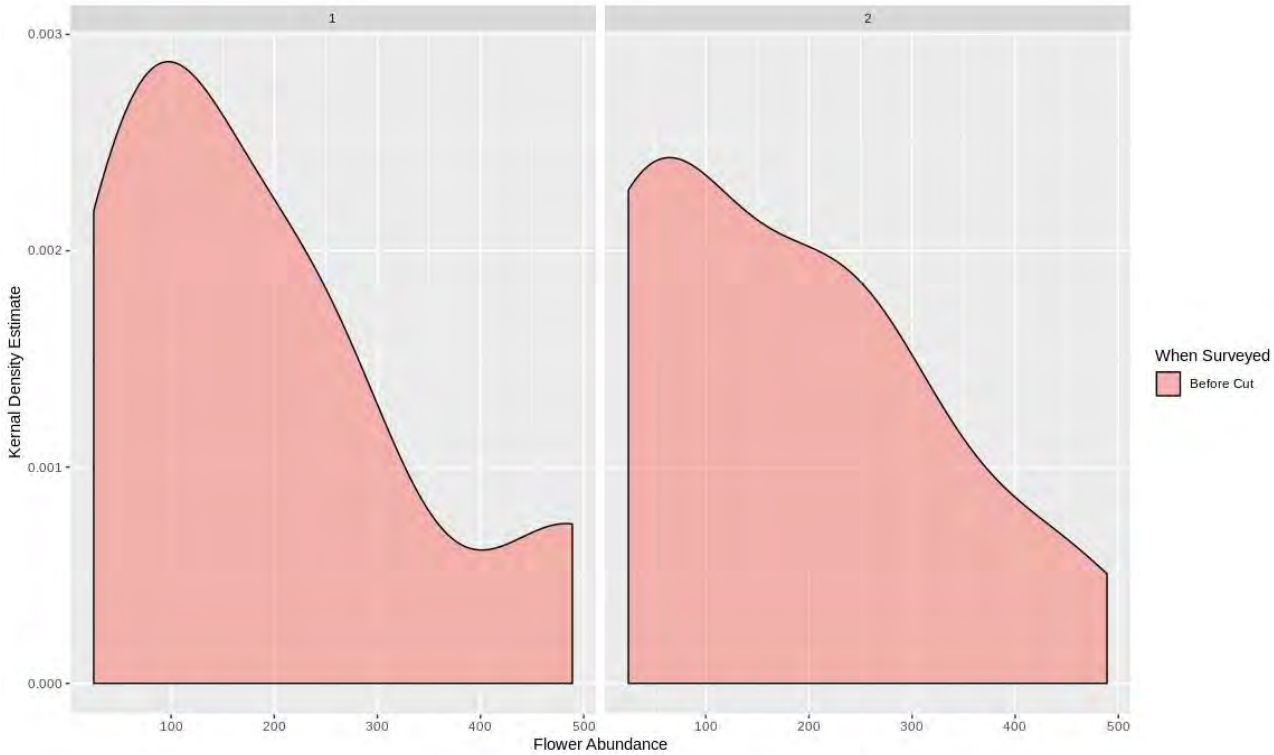


Figure 22: split into 2 sections of the GO-SAL route. These graphs show the frequency of quadrats with their corresponding flower abundances, and also split into before and after cutting dates. **No data was gathered for GO-SAL after cutting dates for either section of this route.**

Figure 23: GR-AR Sections Kernel Density Plot

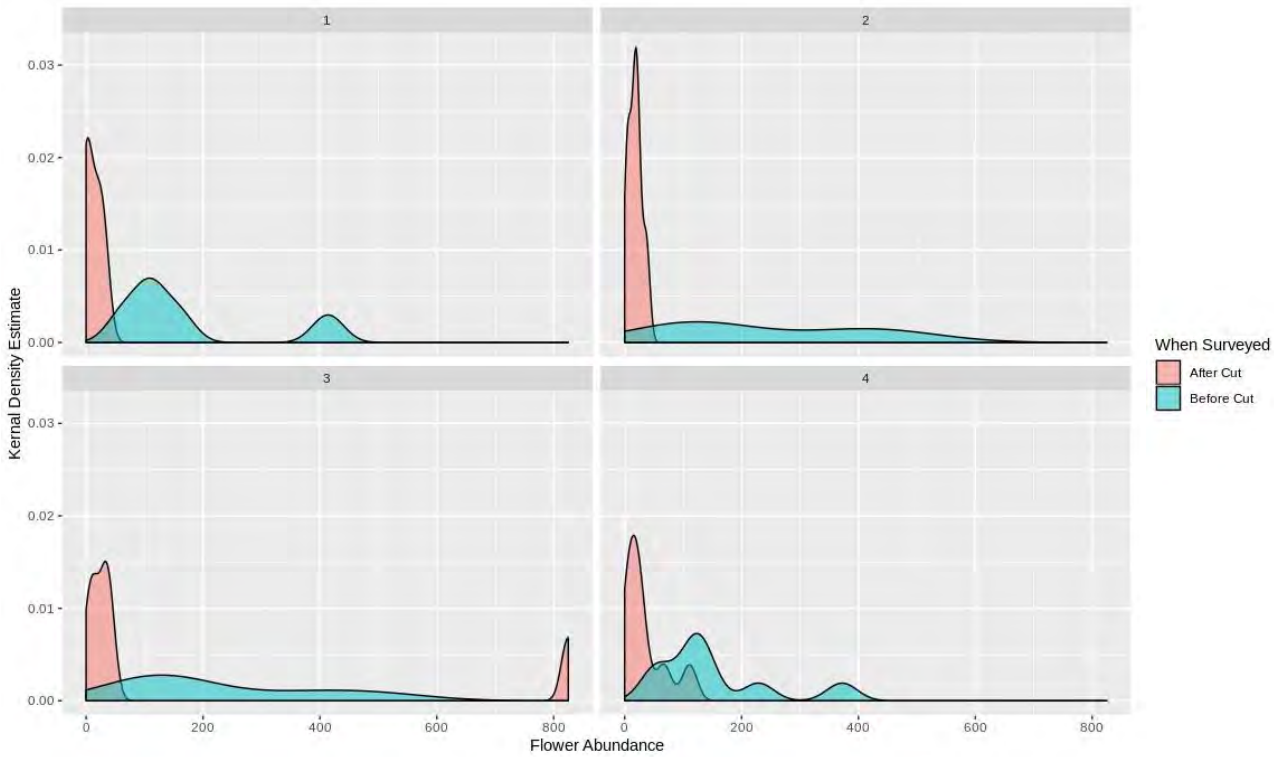


Figure 23: split into 4 sections of the GR-AR route. These graphs show the frequency of quadrats with their corresponding flower abundances, and also split into before and after cutting dates.

Figure 24: GR-CR Sections Kernel Density Plot

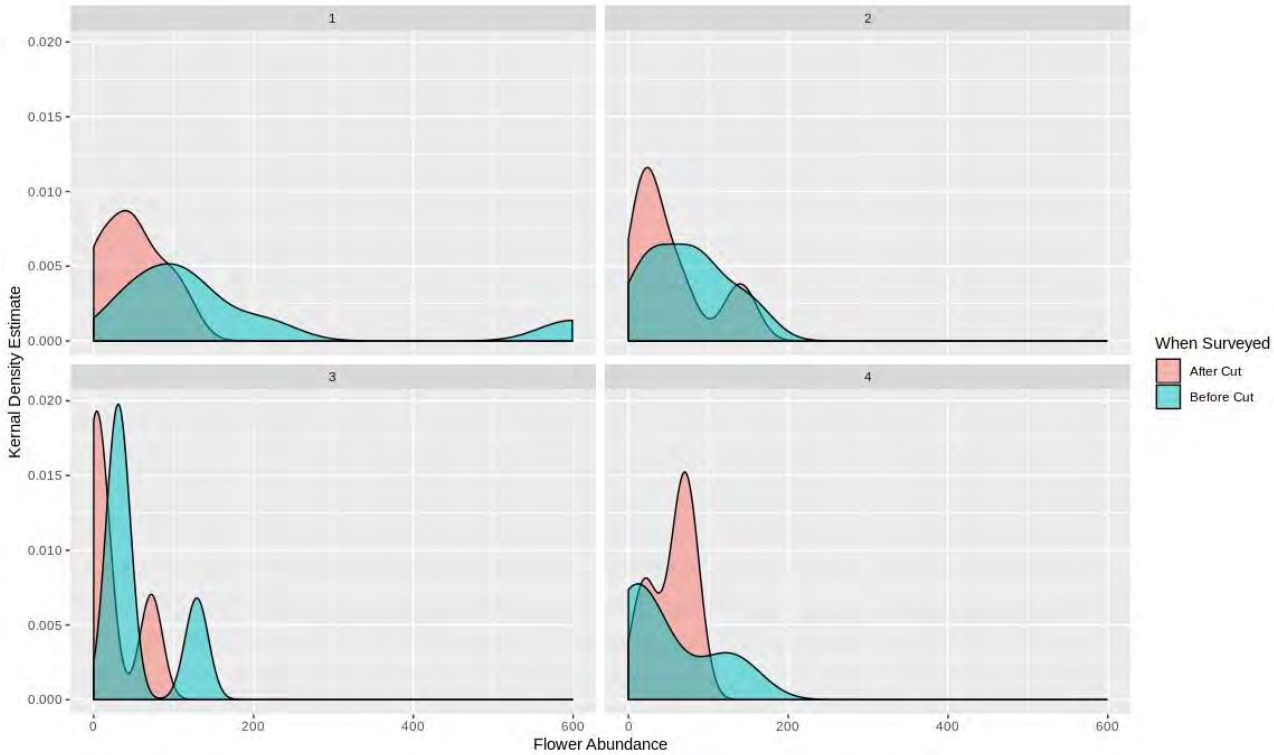


Figure 24: split into 4 sections of the GR-CR route. These graphs show the frequency of quadrats with their corresponding flower abundances, and also split into before and after cutting dates.

Figure 25: GR-USK Sections Kernel Density Plot

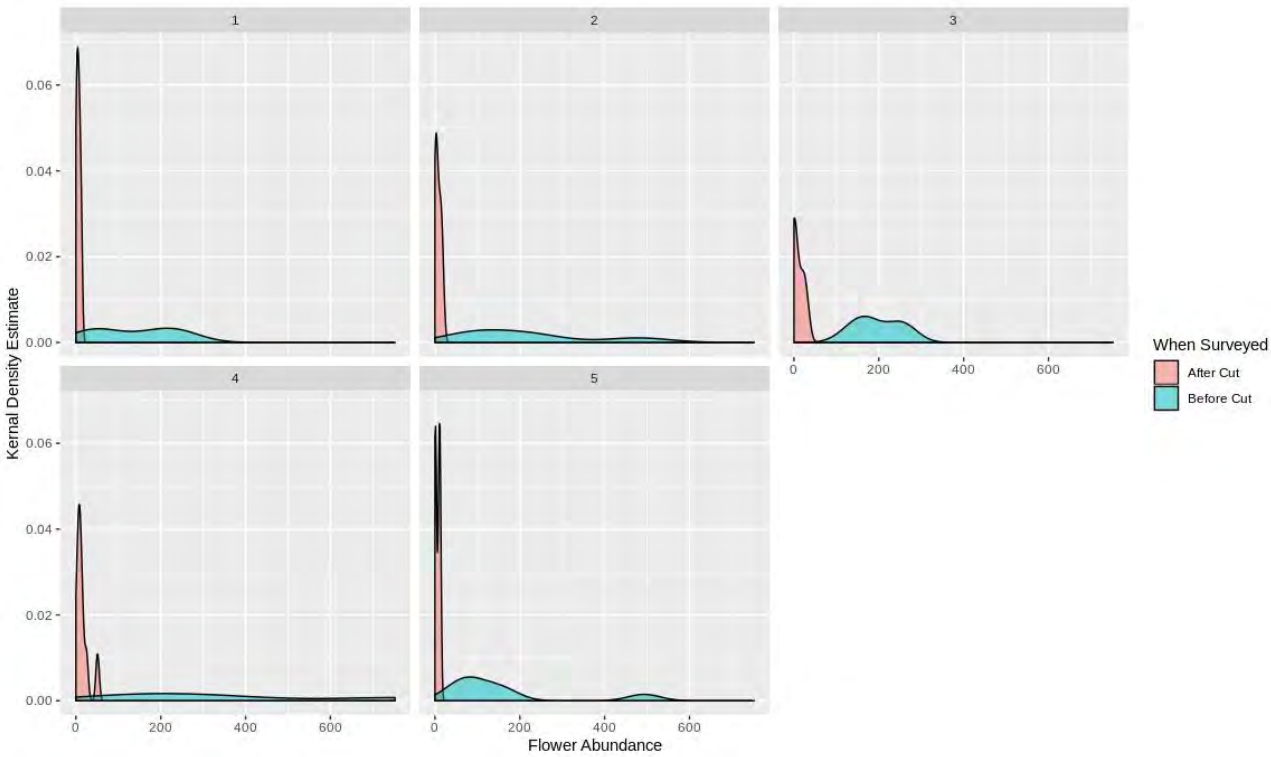


Figure 25: split into 5 sections of the GR-USK route. These graphs show the frequency of quadrats with their corresponding flower abundances, and also split into before and after cutting dates.

Figure 26: KY-BR Sections Kernel Density Plot

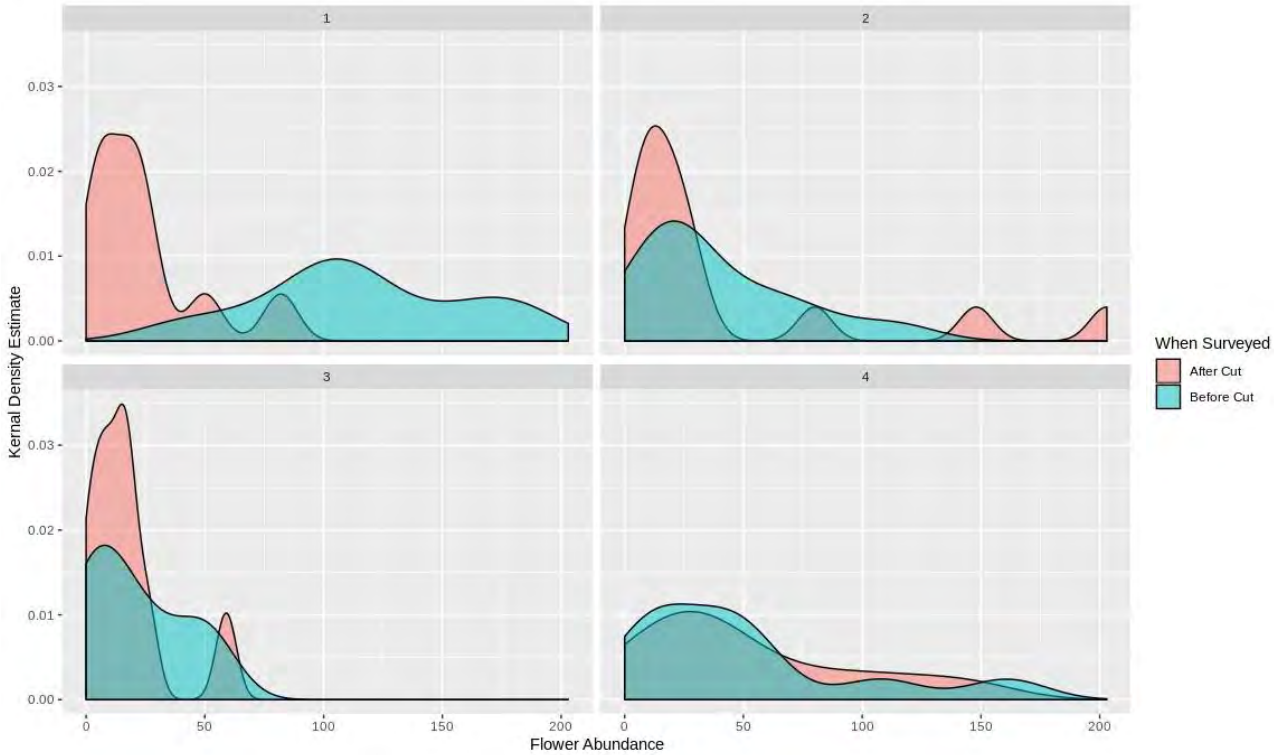


Figure 26: split into 4 sections of the BR-KY route. These graphs show the frequency of quadrats with their corresponding flower abundances, and also split into before and after cutting dates.

Figure 27: PC-K Sections Kernel Density Plot

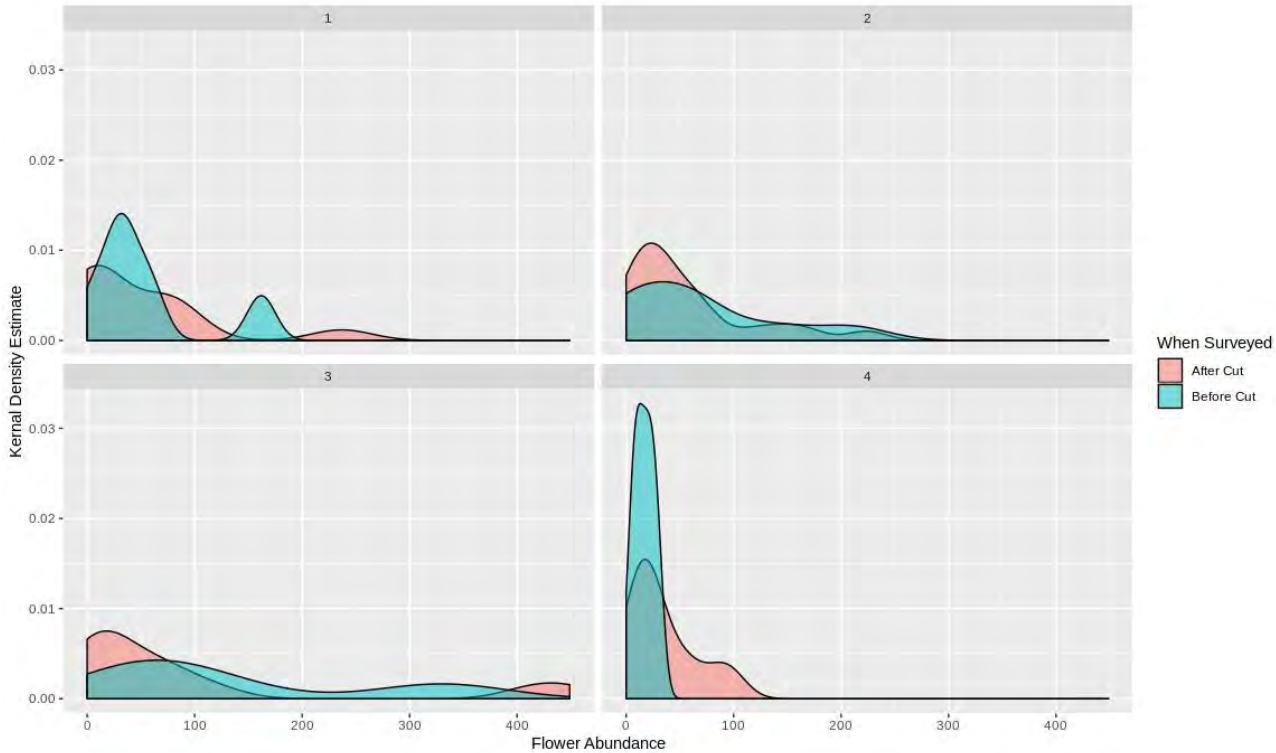


Figure 27: split into 4 sections of the PC-K route. These graphs show the frequency of quadrats with their corresponding flower abundances, and also split into before and after cutting dates.

Figure 28: PCH-PH Sections Kernel Density Plot

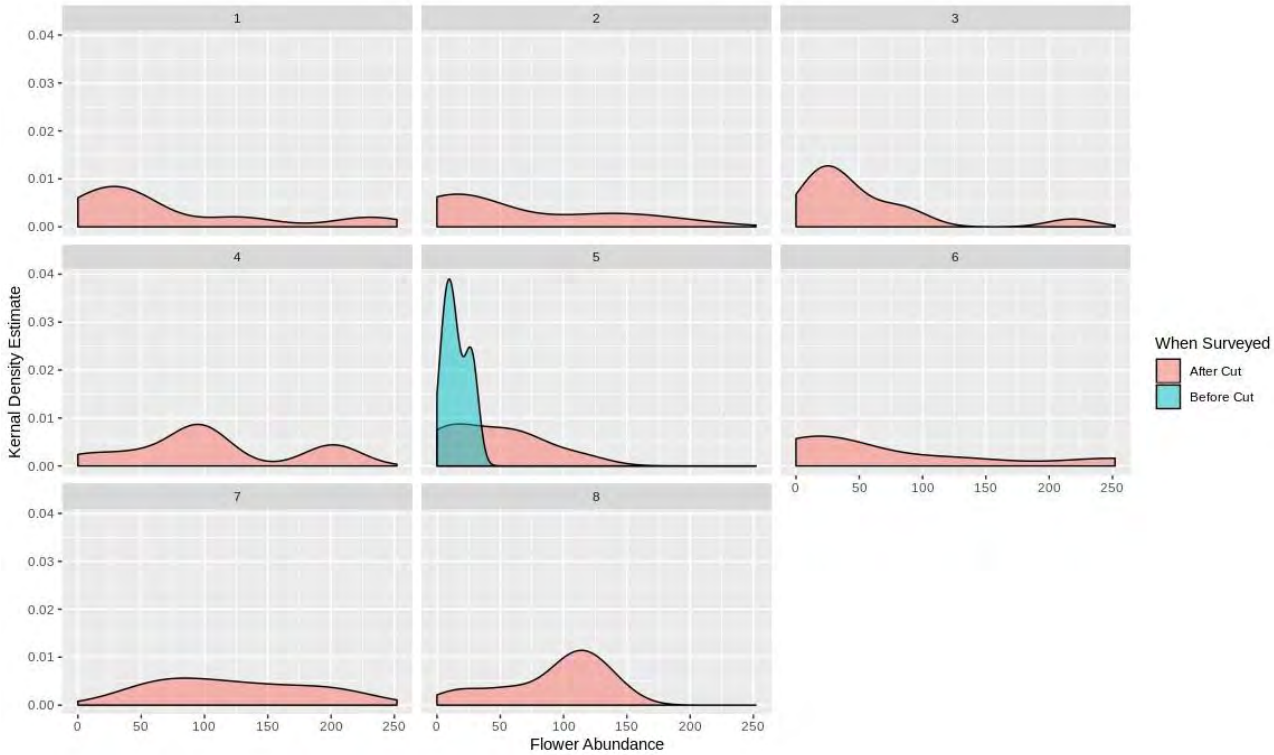


Figure 28: split into 4 sections of the PCH-PH route. These graphs show the frequency of quadrats with their corresponding flower abundances, and also split into before and after cutting dates. **Due to inaccurate verge cutting times data collected looks as though it was collected after cutting; however, this was not the case.**

Figure 29: PH-PCH(KI) Sections Kernel Density Plot

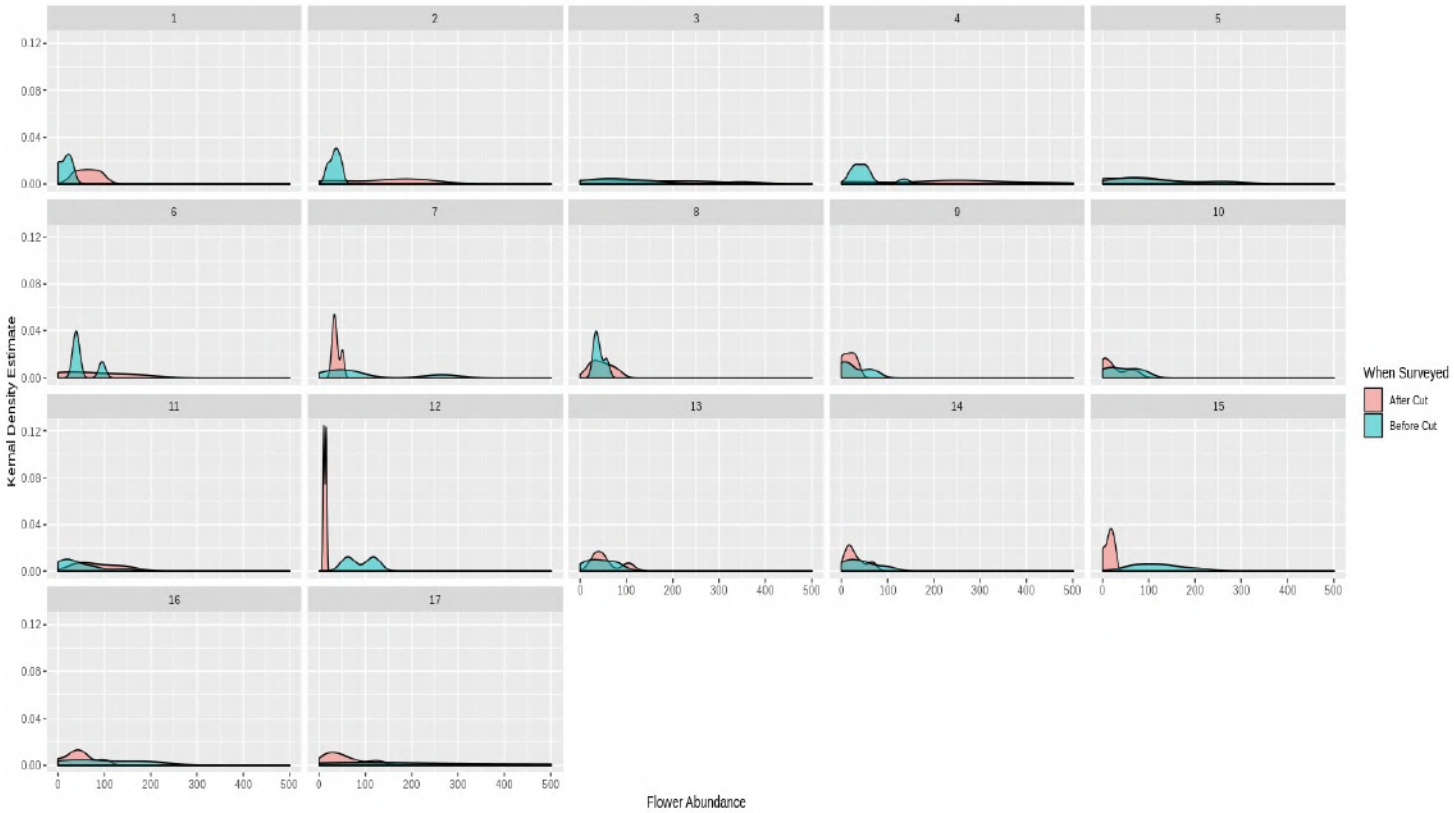


Figure 29: split into 17 sections of the PH-PCH(KI) route. These graphs show the frequency of quadrats with their corresponding flower abundances, and also split into before and after cutting dates.

Grass Height

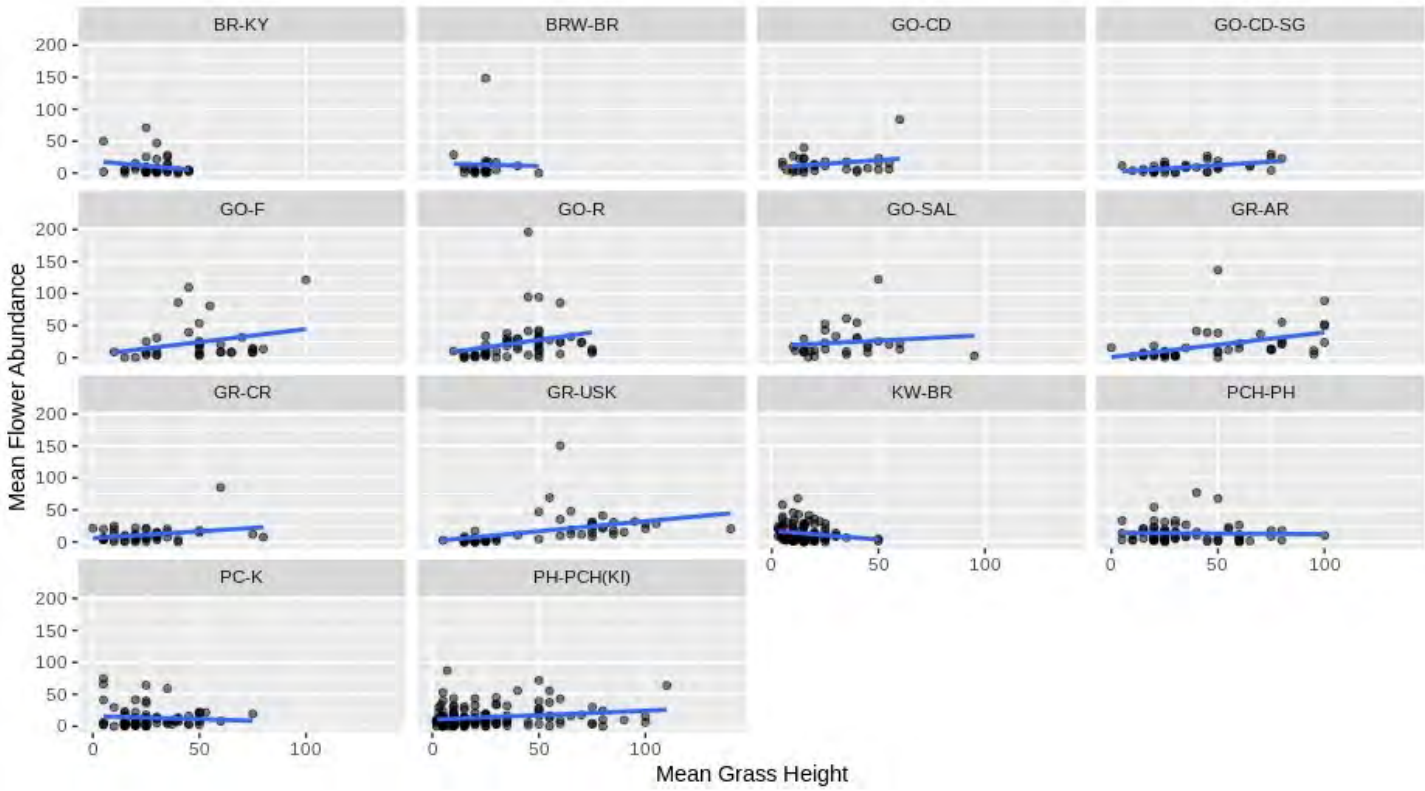


Figure 30: Mean grass height and mean flower abundance at different Routes

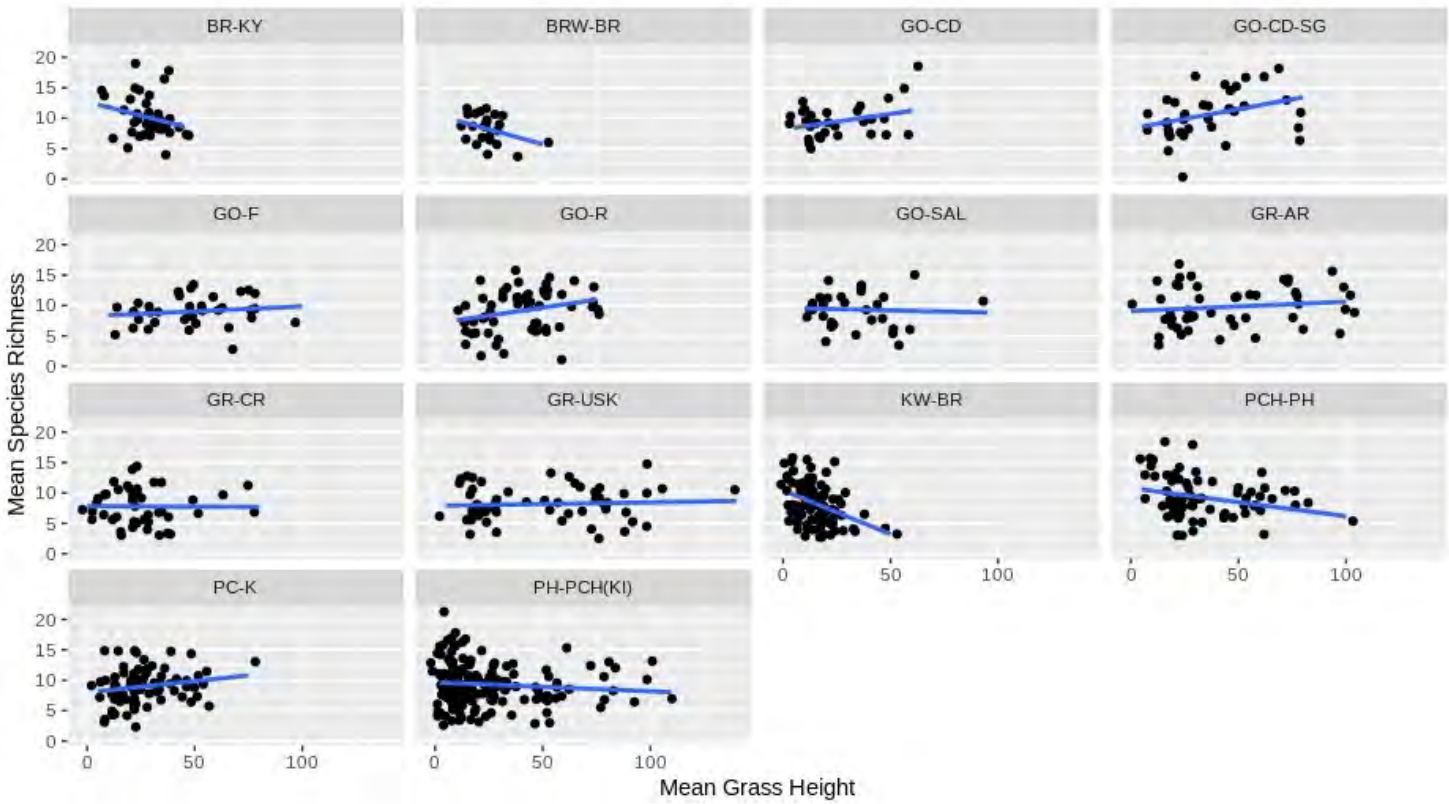


Figure 31: Mean grass height and mean species richness at different Routes

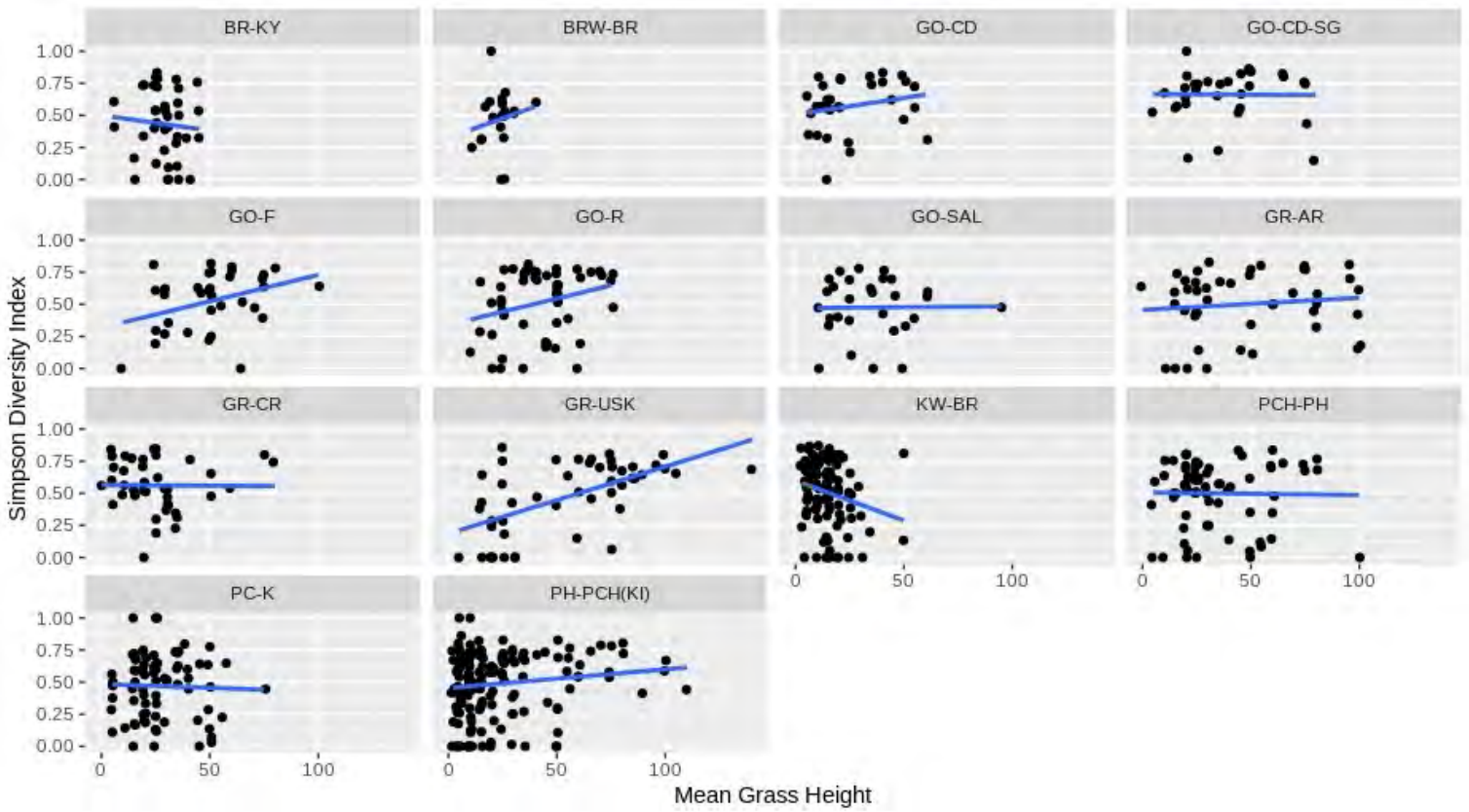


Figure 32: Mean grass height and mean Simpson Diversity on different routes

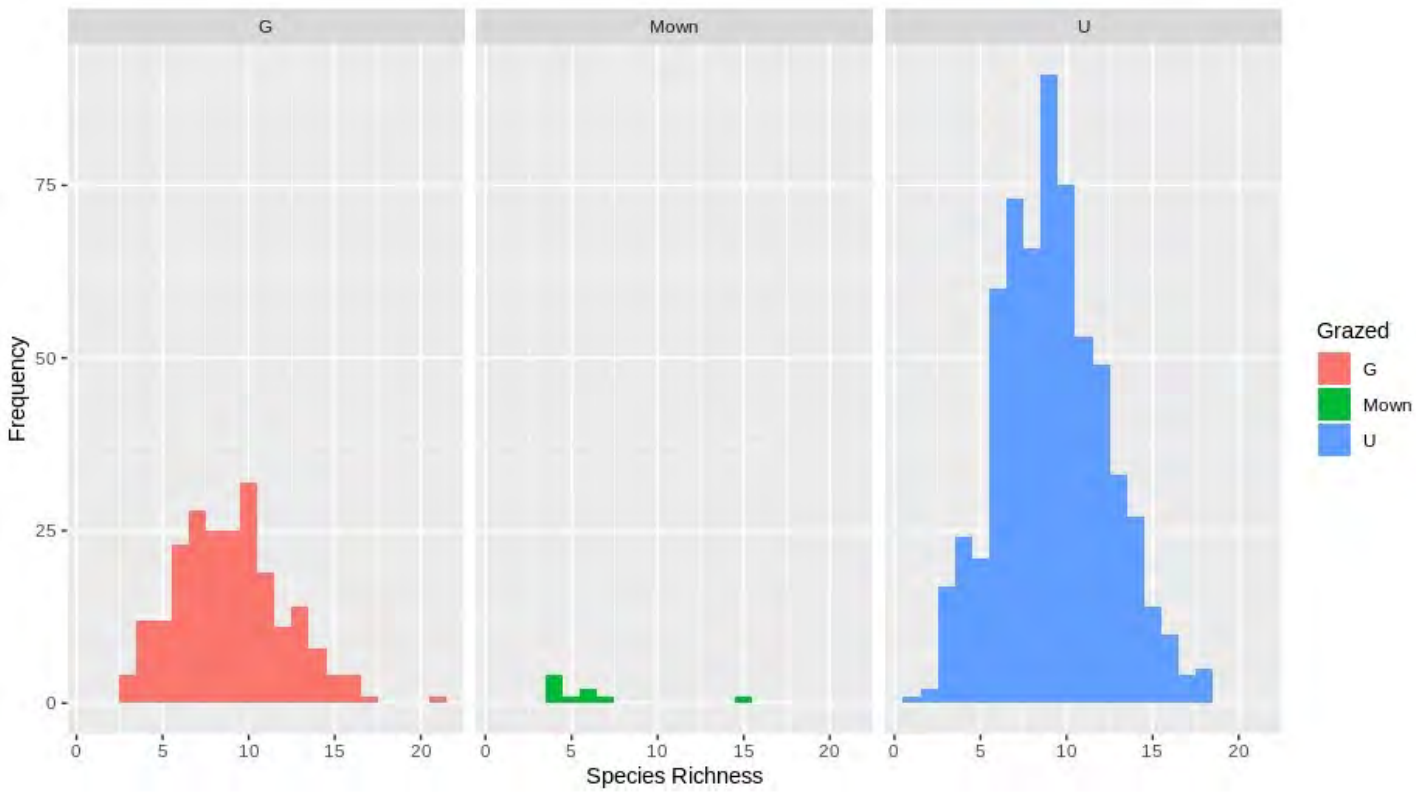


Figure 33: Histogram of quadrat species richness and frequency. Grazing was significant on the species richness. (G = grazed; U = ungrazed)

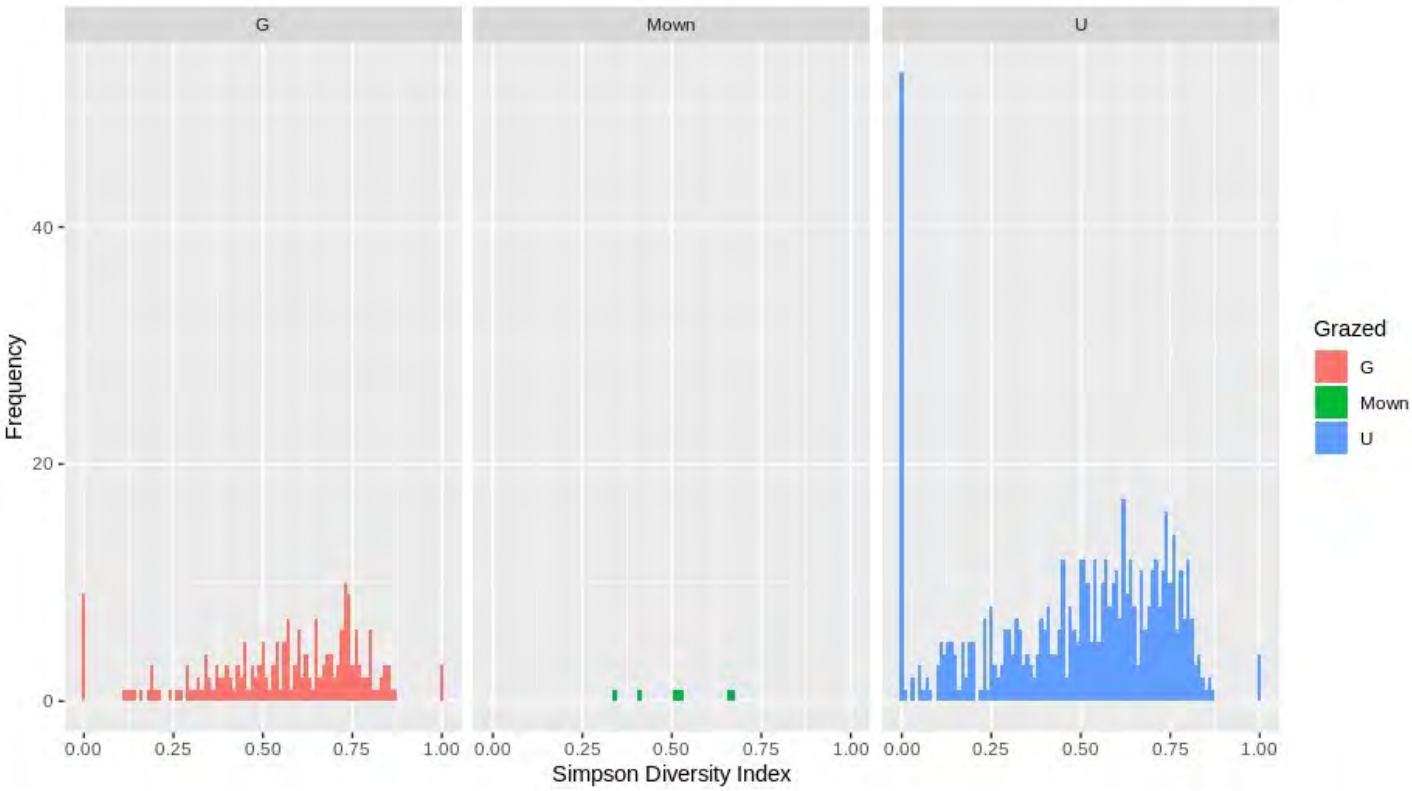


Figure 34: Histogram of quadrat Simpson Diversity and frequency. Grazing had a significant effect on the species richness. Large part of quadrats had little diversity, but the majority are toward higher diversity.

Analysis of Adjacent Management

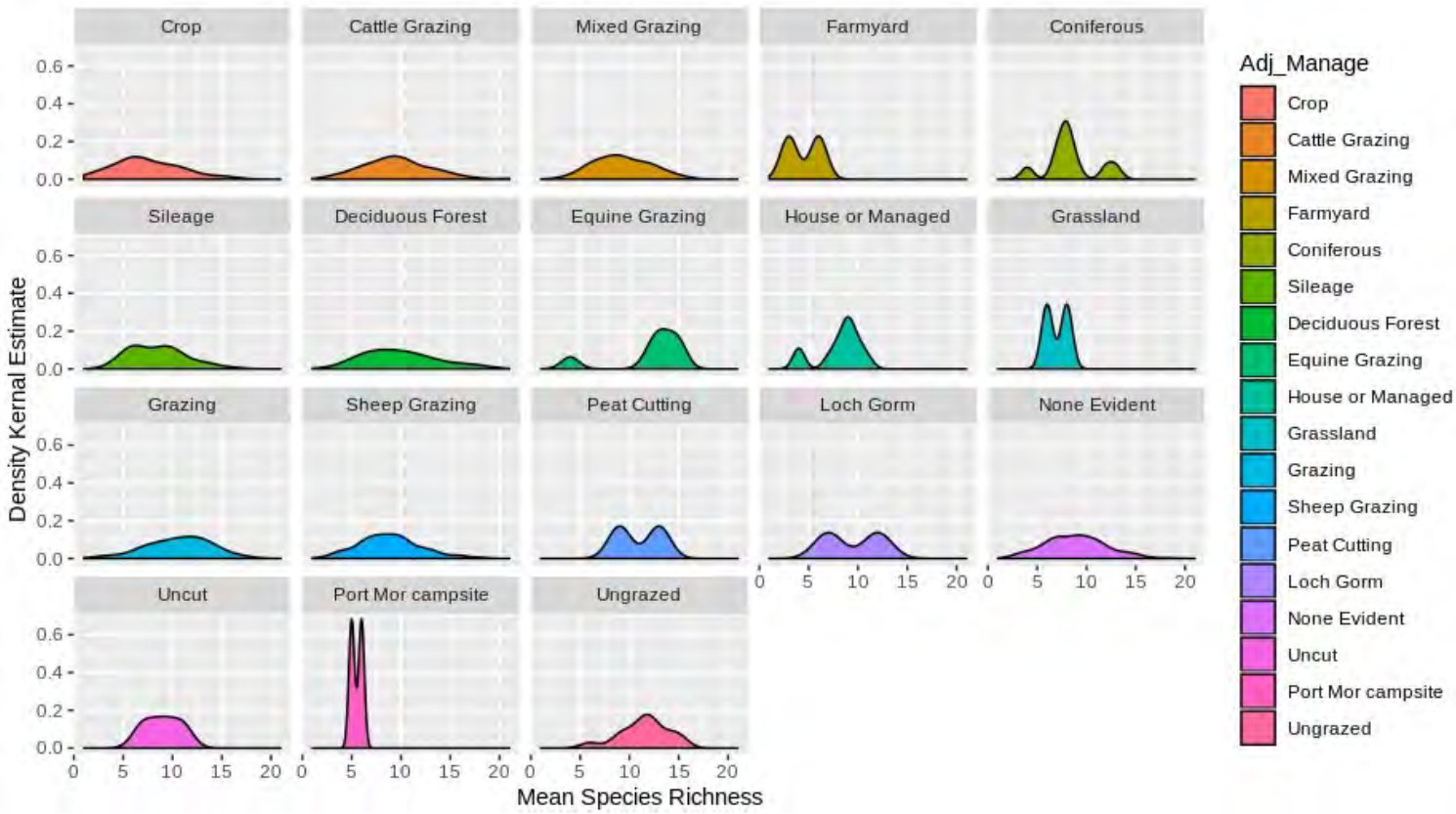


Figure 35: Density graphs of species richness frequencies. Some were removed because they had too few quadrats in and therefore density kernel didn't work.

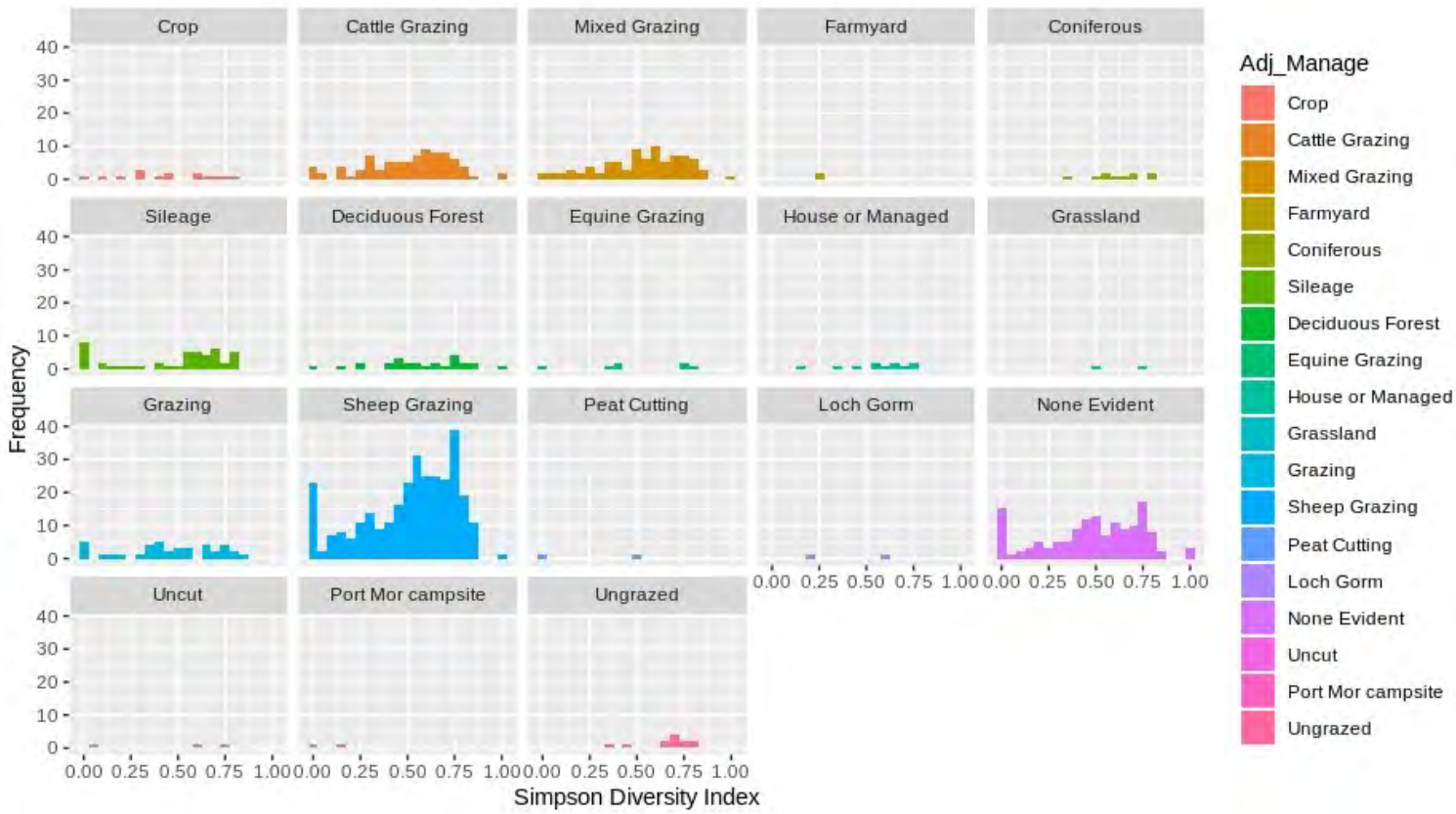


Figure 36: Histogam of Simpson Index frequencies. Some were removed because they had too few quadrats in and therefore density kernel didn't work.

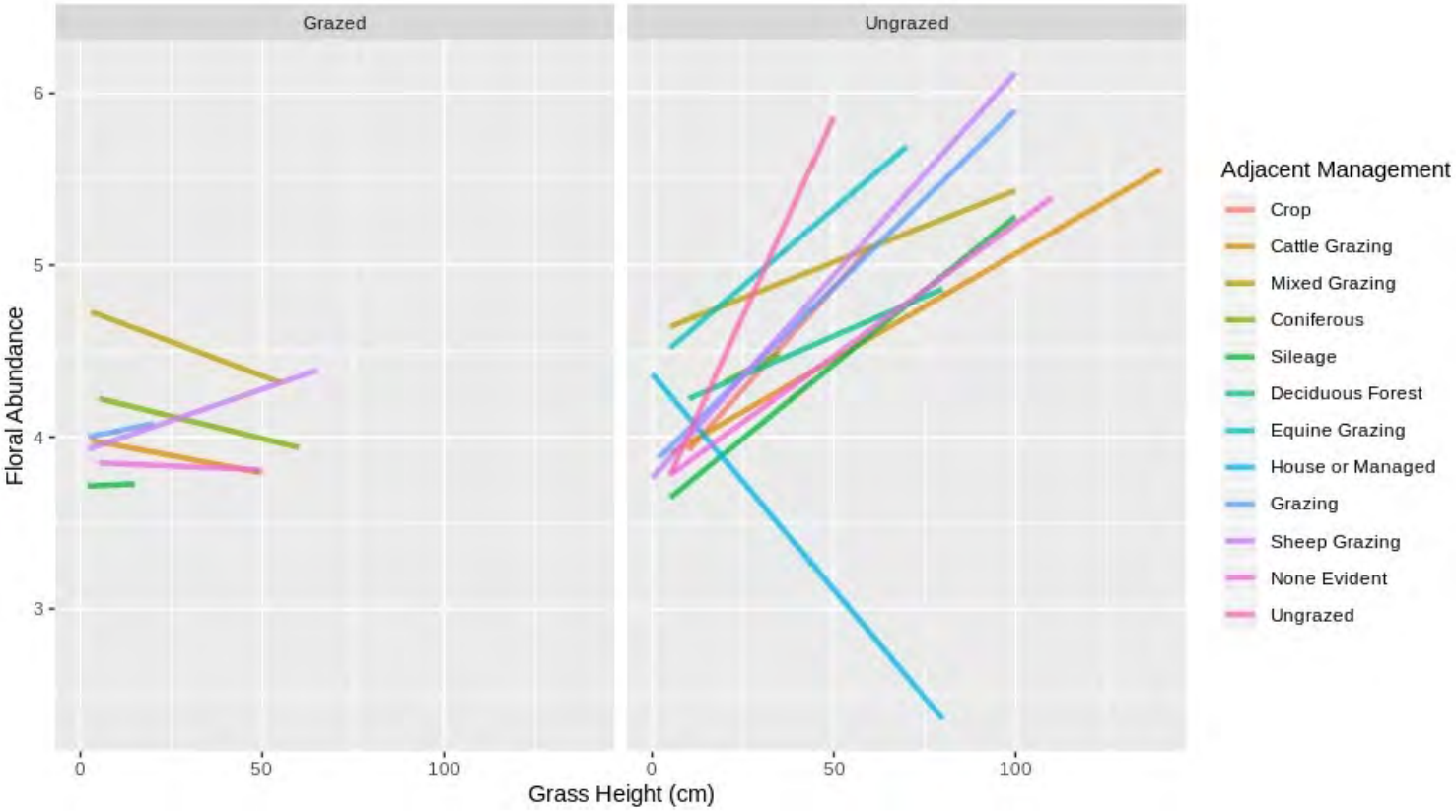


Figure 37: Model showed that Grazing, Grass Height, and Adjacent Management were significant variables in determining Floral Abundance. Hence, a linear model was produced to show the interactions between all these explanatory variables and the response.

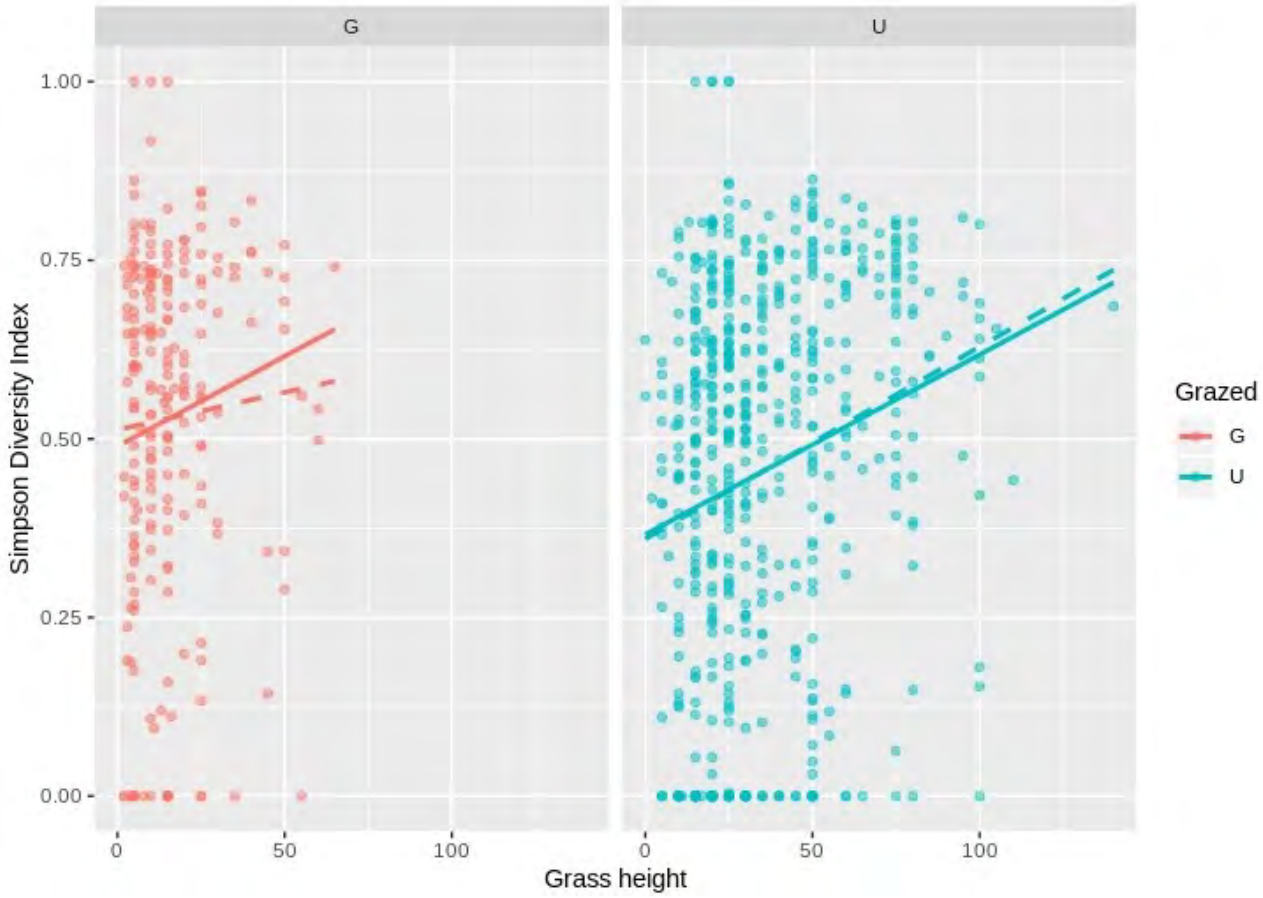


Figure 38: Model showed that Grazing and Grass Height were significant variables in determining diversity. Hence, a linear model was produced to show the interactions between all these explanatory variables and the response. (G = grazed; U = ungrazed)

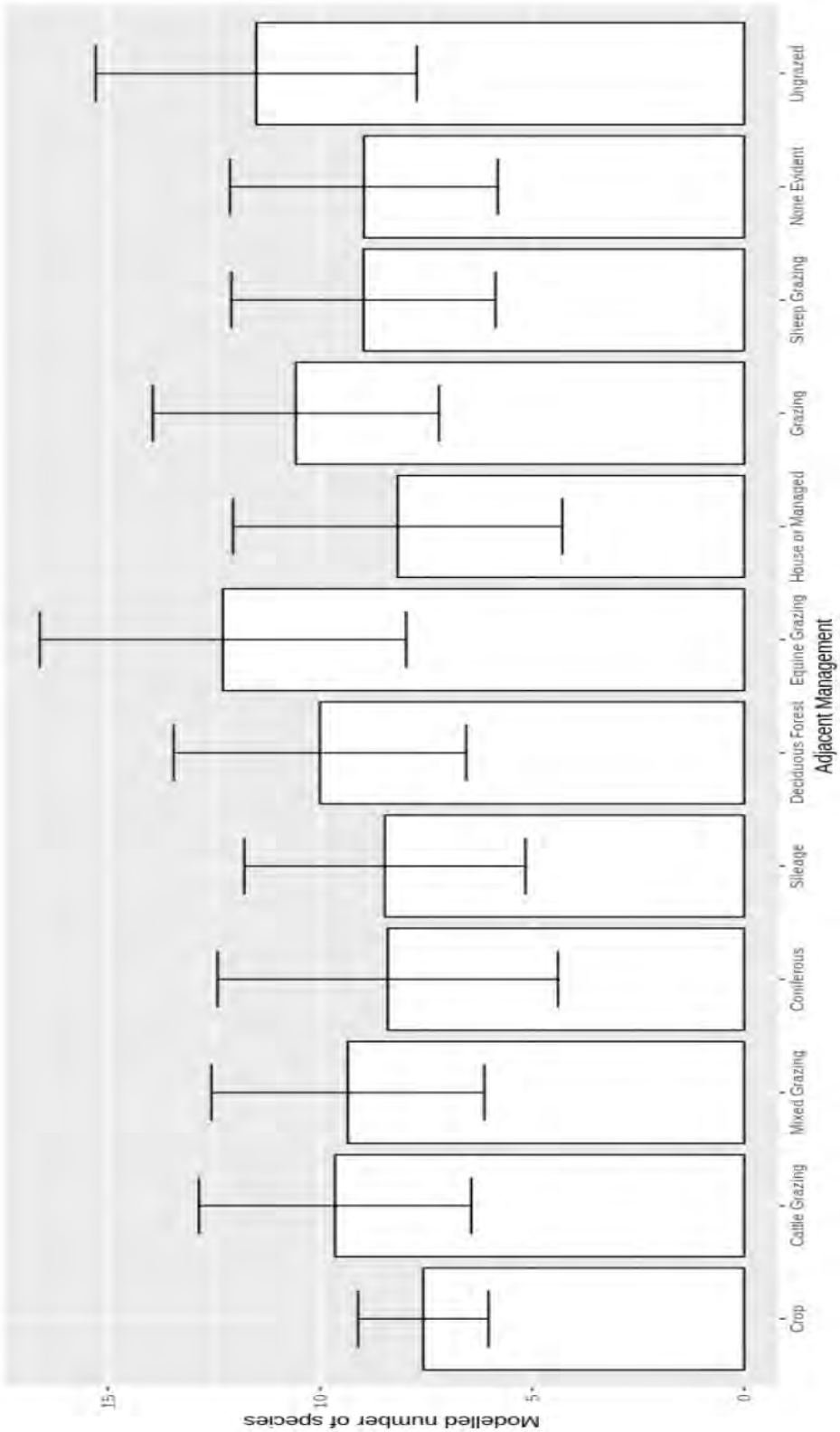


Figure 39: linear models showed that Adjacent Management was the only significant factor which affected species richness. This figure shows the predicted mean richness for quadrats with a specific Adjacent Management. 95% Confidence intervals are also added.

Floral abundance and species richness were analysed against mean grass height comparing across the whole of the route. This showed a positive correlation between grass height and flower abundance but variable correlation between grass height and species richness.

Fig. 30-32: Graphs grass height analysis

Affect of grazing on verge flora

Verges where grazing occurred had a significant positive influence on the distribution of species richness within all quadrats. Mown areas had a negative influence.

Fig. 33-34: Graphs - Grazed data analysis

Adjacent management

Varying types of adjacent management were recorded, the species richness was analysed using kernel density estimation to show the range of richness for adjacent habitat. Areas adjacent to farmyards and crops showed a range of least richness, along with silage fields and some grazed areas. Areas with a skew towards greater richness were in areas of peatland, equine grazing (usually associated with poor pasture) and un-grazed areas, all relating to poor soils.

Fig. 35-36: Graphs - Adjacent Management floral communities analysis

Adjacent management was then related to grass height comparing grazed and un-grazed areas with floral abundance. Un-grazed verges adjacent to all types of managements showed increased floral abundance with grass height increase, apart from areas adjacent to houses or managed areas which dropped significantly.

Grazed verges adjacent to most types of adjacent areas showed a decline in floral abundance apart from sheep grazed areas, where increased grass height indicated increased floral abundance.

Fig. 37-38: Graphs of modeled quadrat data

Pollinators along verges

94.9Km of roadside were surveyed for pollinators, recording all butterflies, bumblebees, solitary bees to species level where possible, honeybees, hoverflies, wasps, beetles, ants and flies to genera. At least three visits through the season were made along all routes, some in 2017 but most in 2018. 1498 200m sections were recorded across routes and months. Species records were condensed into their related 1km O.S. grid square providing identifiable species data for 76 grid squares and inputted to the INHT records database.

Records for all genera:

Butterflies

- 1673 butterflies were recorded over the 95km of verge
- Green-veined White was the most prolific butterfly across all months.

Common name	Scientific name	May	June	July	Aug	Sept	Total	No. 200m	No. grid squares
Green Hairstreak	Callophrys rubi	1					1	1	1
Orange-tip	Anthocharis cardamines	2					2	1	1
Speckled Wood	Pararge aegeria			4			4	2	2
Dark Green Fritillary	Argynnis aglaja		2	10	4		16	10	10
Marsh Fritillary	Euphydryas aurinia		23	1			24	8	7
Small Heath	Coenonympha pamphilus	2	50	49	2		103	44	39
Ringlet	Aphantopus hyperantus		6	168	7		181	30	22
Grayling	Hipparchia semele			1			1	1	1
Meadow Brown	Maniola jurtina		37	196	21		254	54	42
Small Copper	Lycaena phlaeas	2	5	3	4	2	16	15	12
Large White	Pieris brassicae		1	2			3	3	3
Green-Veined White	Pieris napi	212	216	248	161	10	862	152	68
Small White	Pieris rapae	1	3	35	2		41	14	10
Common Blue	Polyommatus icarus		29	49	2		78	25	23
Red Admiral	Vanessa atalanta		11	14	1	1	27	19	19
Painted Lady	Vanessa cardui		11	3			14	9	9
Small Tortoiseshell	Aglais urticae	1	1	18	6		26	16	14
Peacock	Inachis io	1		3	11	4	20	15	13

Fig. 40

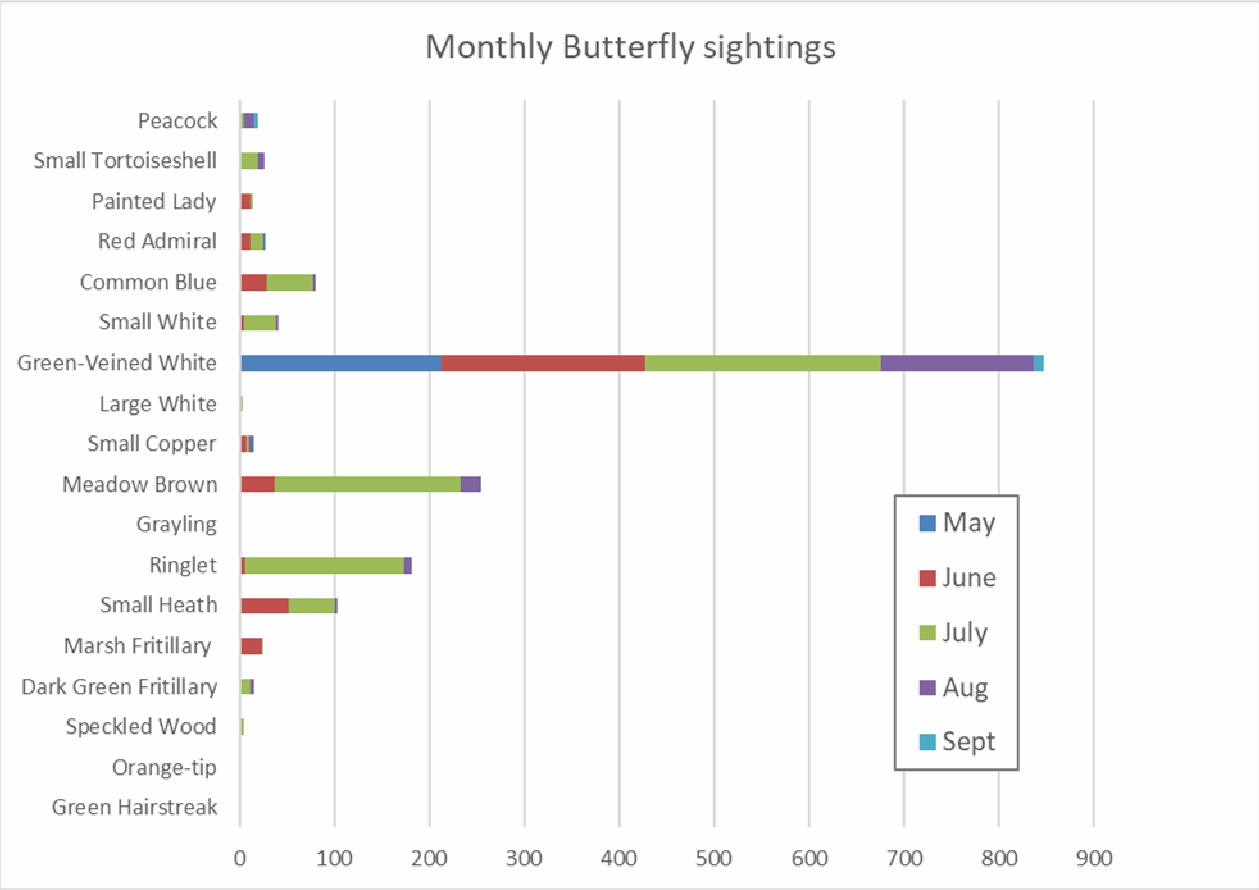

Monthly Butterfly sightings
Peacock
Small Tortoiseshell
Painted Lady
Red Admiral
Common Blue
Small White
Green-Veined White
Large White
Small Copper
Meadow Brown
Grayling
Ringlet
Small Heath
Marsh Fritillary
Dark Green Fritillary
Speckled Wood
Orange-tip
Green Hairstreak
0
100
200
300
400
500
600
700
800
900
May
June
July
Aug
Sept

Fig. 41

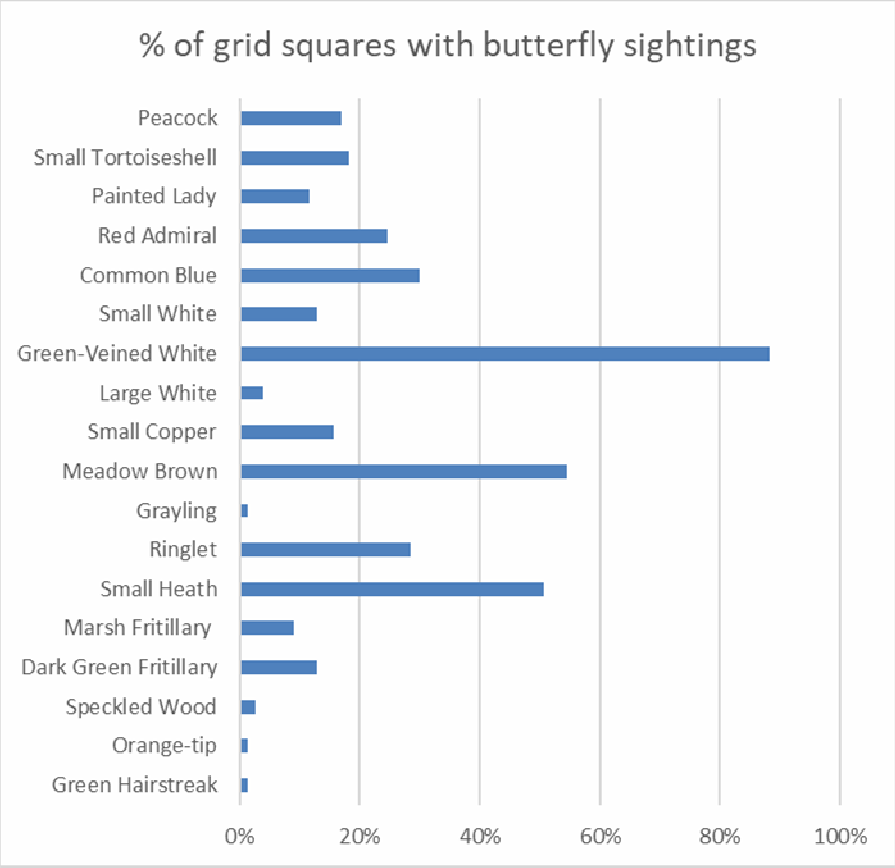

% of grid squares with butterfly sightings
Peacock
Small Tortoiseshell
Painted Lady
Red Admiral
Common Blue
Small White
Green-Veined White
Large White
Small Copper
Meadow Brown
Grayling
Ringlet
Small Heath
Marsh Fritillary
Dark Green Fritillary
Speckled Wood
Orange-tip
Green Hairstreak
0%
20%
40%
60%
80%
100%

Fig. 42

Bumblebees

- 4147 bumblebees were recorded
- Common Carder Bee was the most frequent of nine recorded species

Common name	Scientific name	May	June	July	Aug	Sept	Total	No. 200m	No grid squares present
Common Carder Bee	Bombus pascuorum	32	229	319	879	201	1654	189	62
Common/Moss Carder Bee	Bombus pascuorum/muscorum		21	1	3		25	13	10
Moss Carder Bee	Bombus muscorum	7	16	31	48	1	103	36	21
Heath Bumble Bee	Bombus jonellus			4	2		6	4	3
Small Garden Bumble Bee	Bombus hortorum	1	71	163	421	23	689	114	61
Bombus magnus	Bombus magnus		1	111	63	7	182	26	15
White-tailed Bumble Bee	Bombus lucorum	46	90	253	258	26	678	135	59
White-tailed/Buff-tailed Bumble Bee	Bombus lucorum/terrestris		10	5			15	9	9
Buff-tailed Bumble Bee	Bombus terrestris	3	78	115	128	14	338	83	41
Gypsy Cuckoo Bee	Bombus bohemicus	2	4	8			14	10	10
Early Bumble Bee	Bombus pratorum				1		1	1	1

Early bumblebee ID is questionable and may possibly have been Bombus montana (Mountain bumblebee)

Fig 43

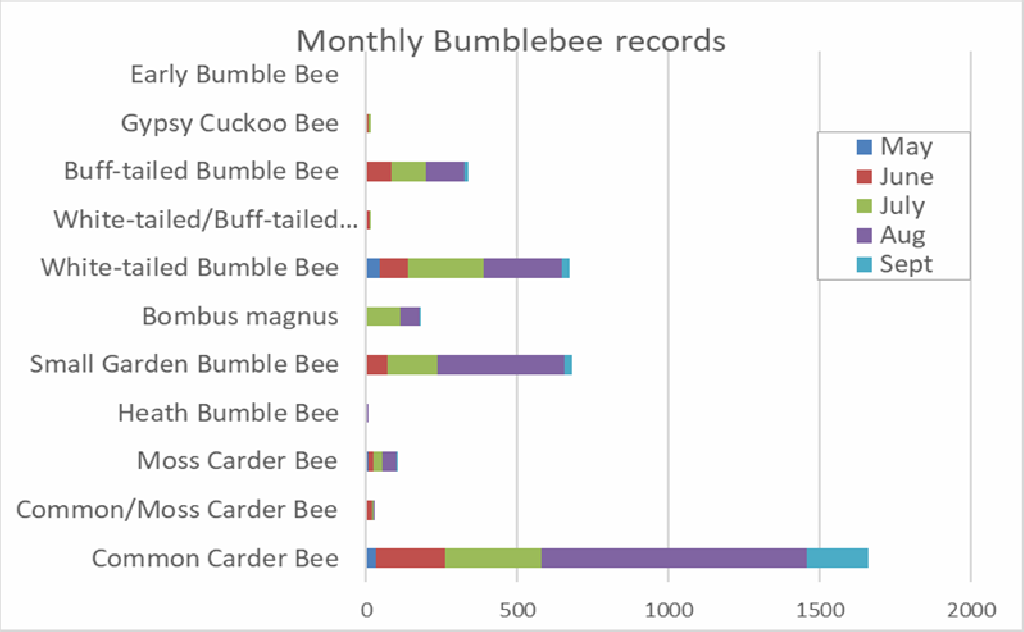


Fig. 44

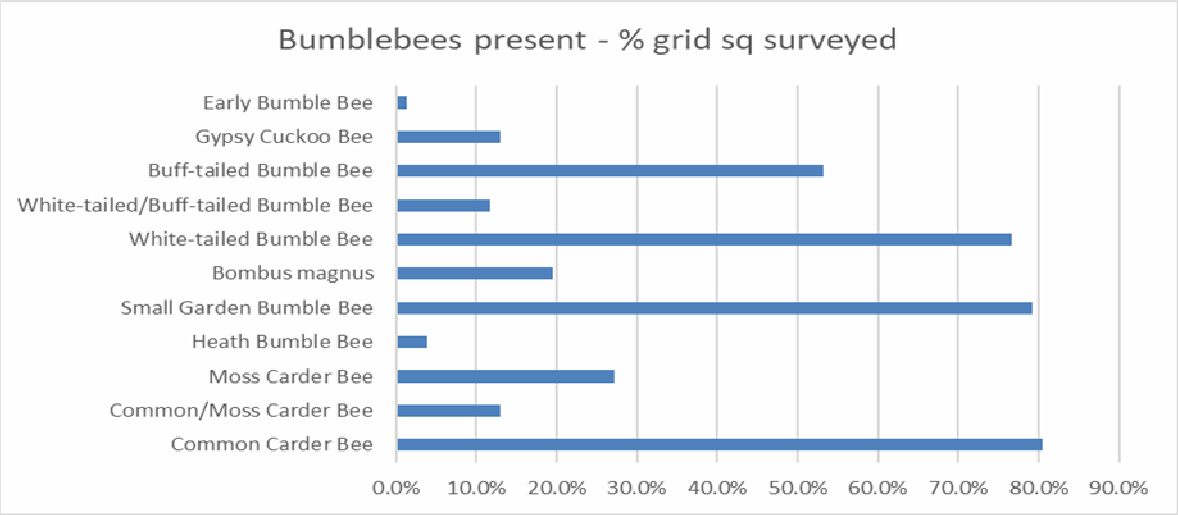


Fig. 45

Solitary bees

Common name	Scientific name)	May	June	July	Aug	Sept	Total	No grid squ	No. 200m
Gwynne's Mining Bee	Andrena bicolor			1			1	1	1
Clarke's Mining Bee	Andrena clarkella	1			1		2	2	2
Orange-tailed Mining Bee	Andrena haemorrhoe	2		1			2	2	2
	Andrena spp	1	3	1			5	4	4
Tormentil Mining Bee	Andrena tarsata			1			1	1	1
	Lasioglossum spp (calceatum, leucozonium?)	1	3				4	3	3
Smooth Faced Furrow Bee	Lasioglossum fratellum	1	1				2	2	2
White Footed Green Furrow Bee	Lasioglossum leucops	1					1	1	1

Fig. 46

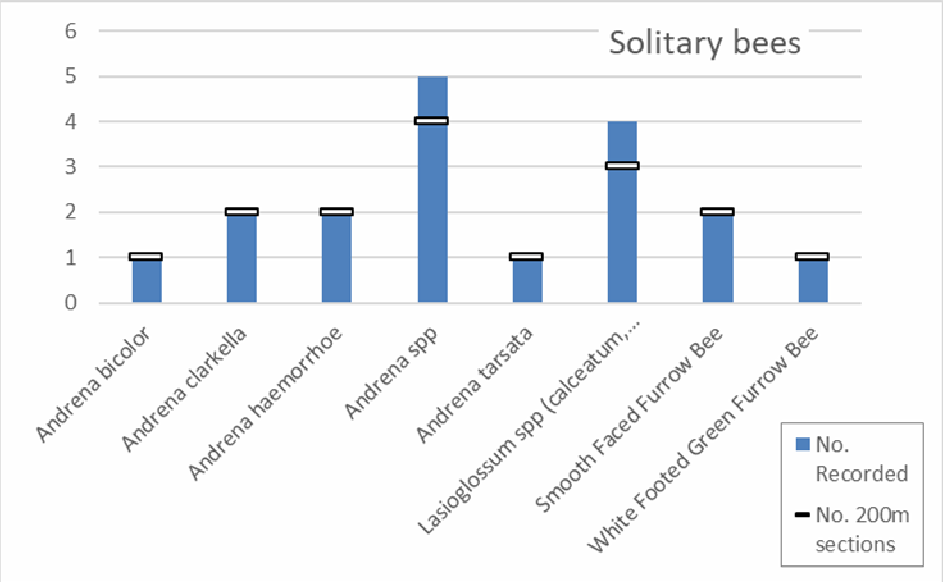


Fig. 47

Other genera

Common name	Scientific name	No grid squ	May	June	July	Aug	Sept	Total	No. 200m	% of 200m
Soldier Beetle	Rhagonycha fulva	7	1		430	11		442	7	0.5
Honeybee	Apis mellifera	25	100	42	80	75	1	298	43	2.9
Moth spp.		57	7	80	55	106	22	270	184	12.3
Hoverfly spp.		64	107	470	523	222	32	1354	404	27
Wasp spp		13	2	0	19	6	3	30	23	1.5
Fly spp.		75	3211	17745	8133	10245	2909	42243	1392	92.9
'The footballer' hoverfly	Helophilus pendulus	1	2					2	1	0.1
Six-spot Burnet	Zygaena filipendulae	1		1				1	1	0.1
Ant spp.		1		1				1	1	0.1
	Tachina grossa	2			3	3		6	2	0.1

Fig. 48

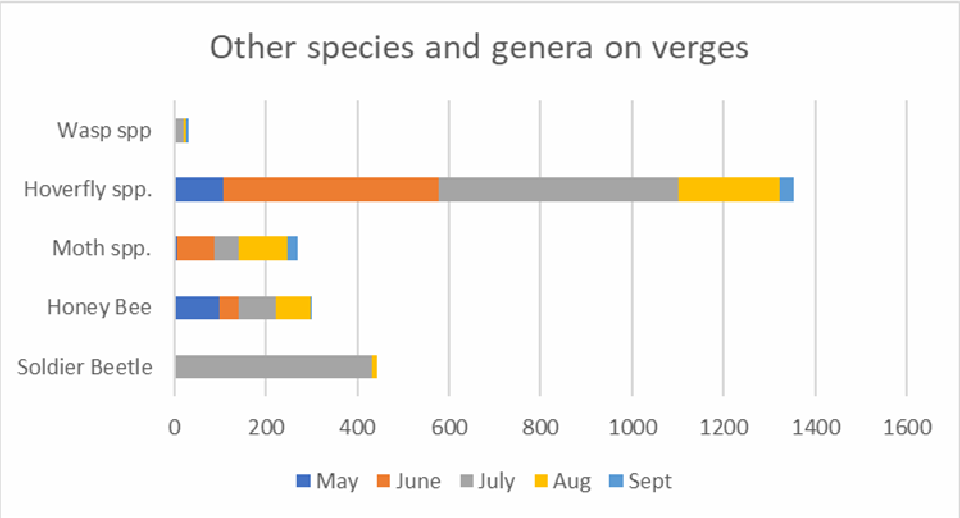


Fig. 49

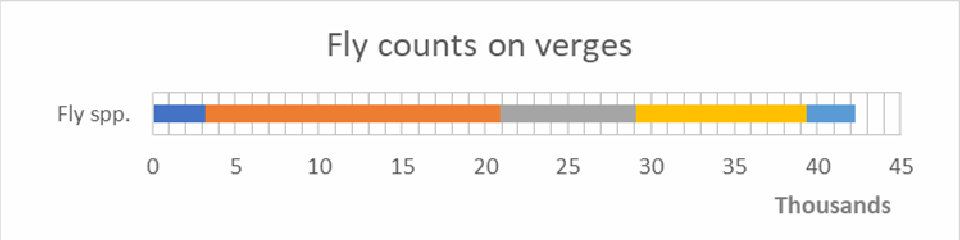


Fig. 50

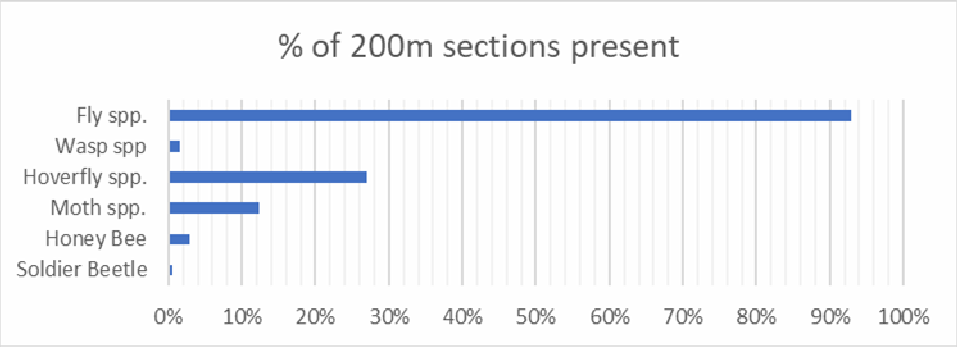


Fig. 51

Comparing the species richness of the flowering species and floral abundance with the pollinators recorded on the survey routes, there was good positive correlation.

Data combined into genus type and data modelling [Appendix…] found that mean species richness, route ID and genus were the best predictors of pollinator abundance, with butterflies (lepidoptera), bumblebees (Bombus), honeybees (Apis), beetles (Coleoptera) and Flies (Diptera) all showing an increase in abundance with increased plant and flower richness.

There was variation between routes, some supporting greater abundance of butterflies, on other routes bumblebees, with flies showing a very different pattern of distribution.

Fig.52: Graphs - Pollinators and ...species richness; Fig. 53 .....flowering richness

Honeybees were found primarily in the localities of known apiaries.

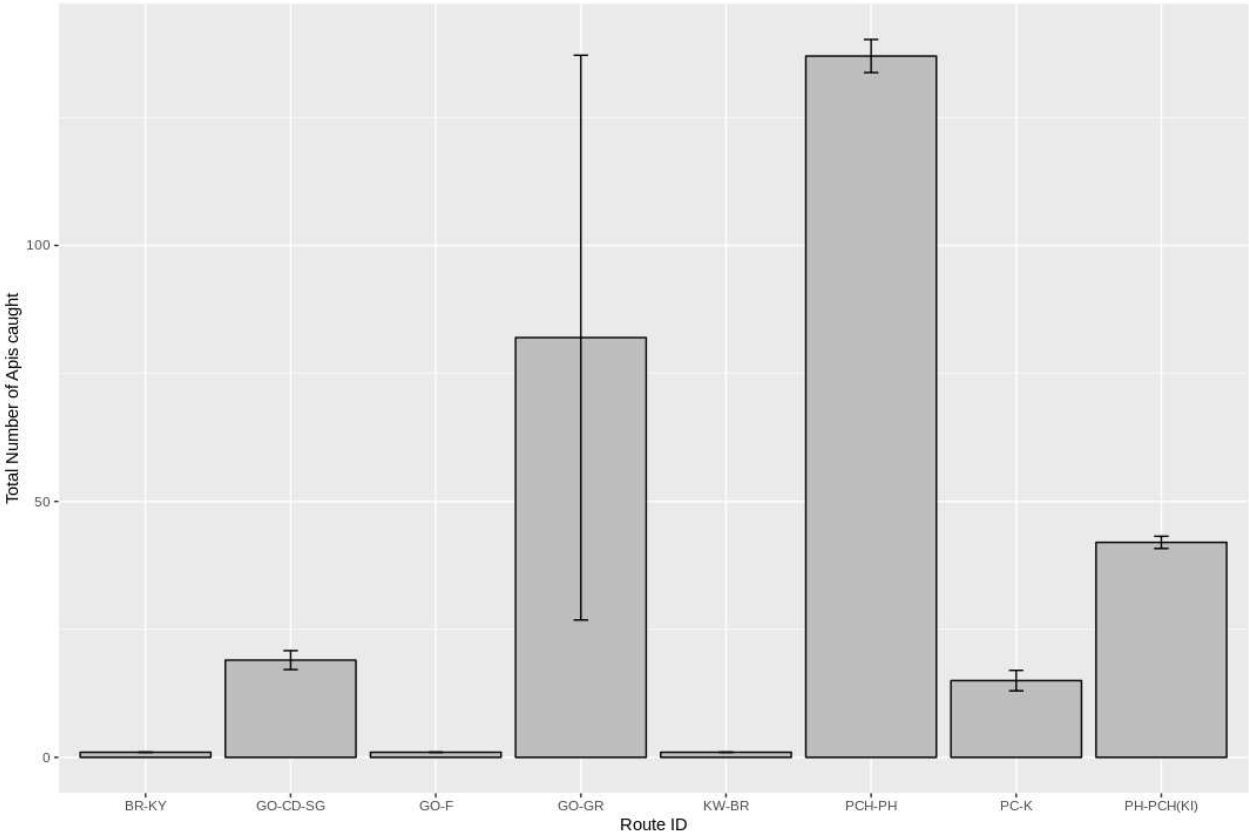


Fig. 54

Pollinator and Transect Data

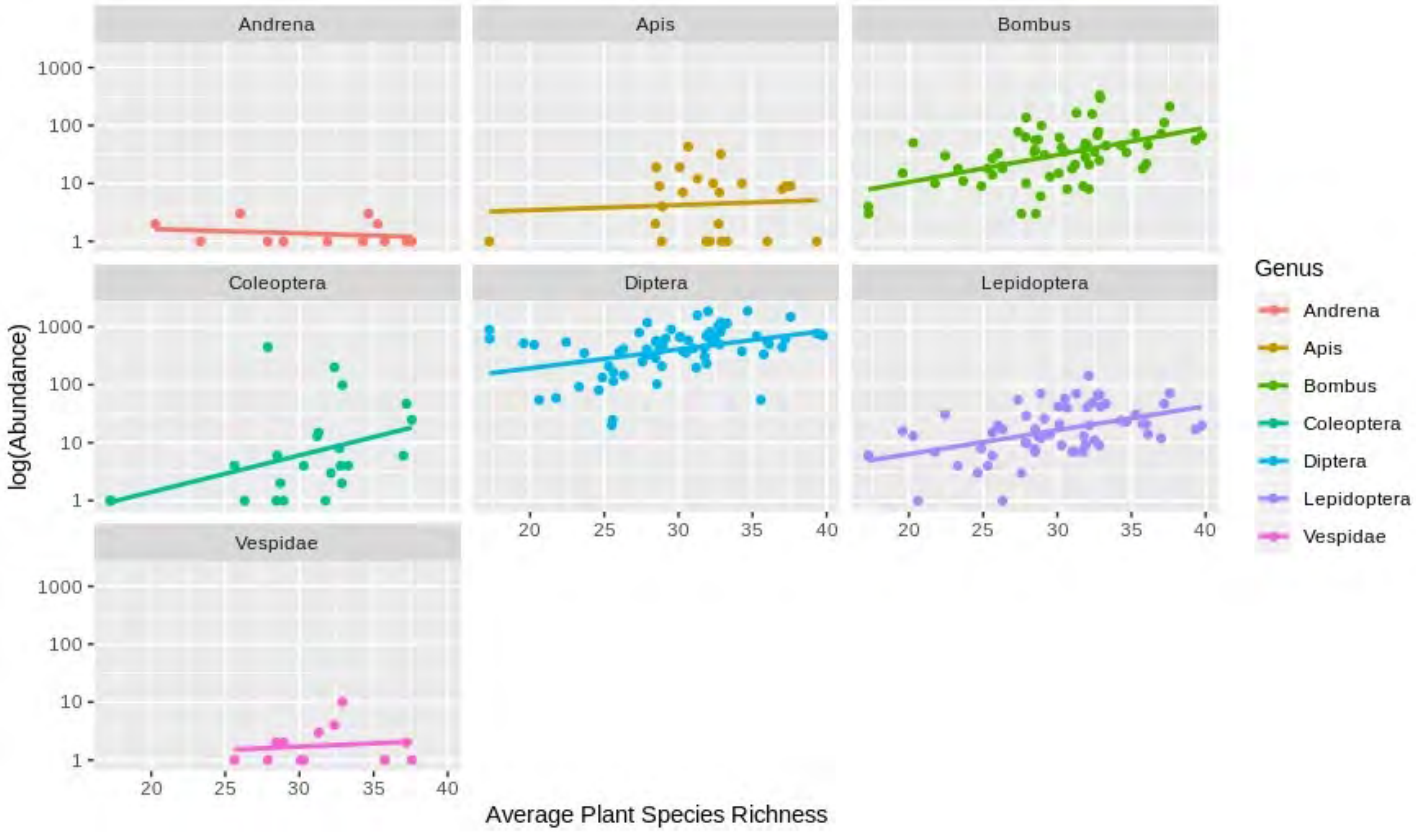


Figure 52: Pollinator abundance in each pollinator genus and mean plant richness. Abundance is a logarithmic scale.

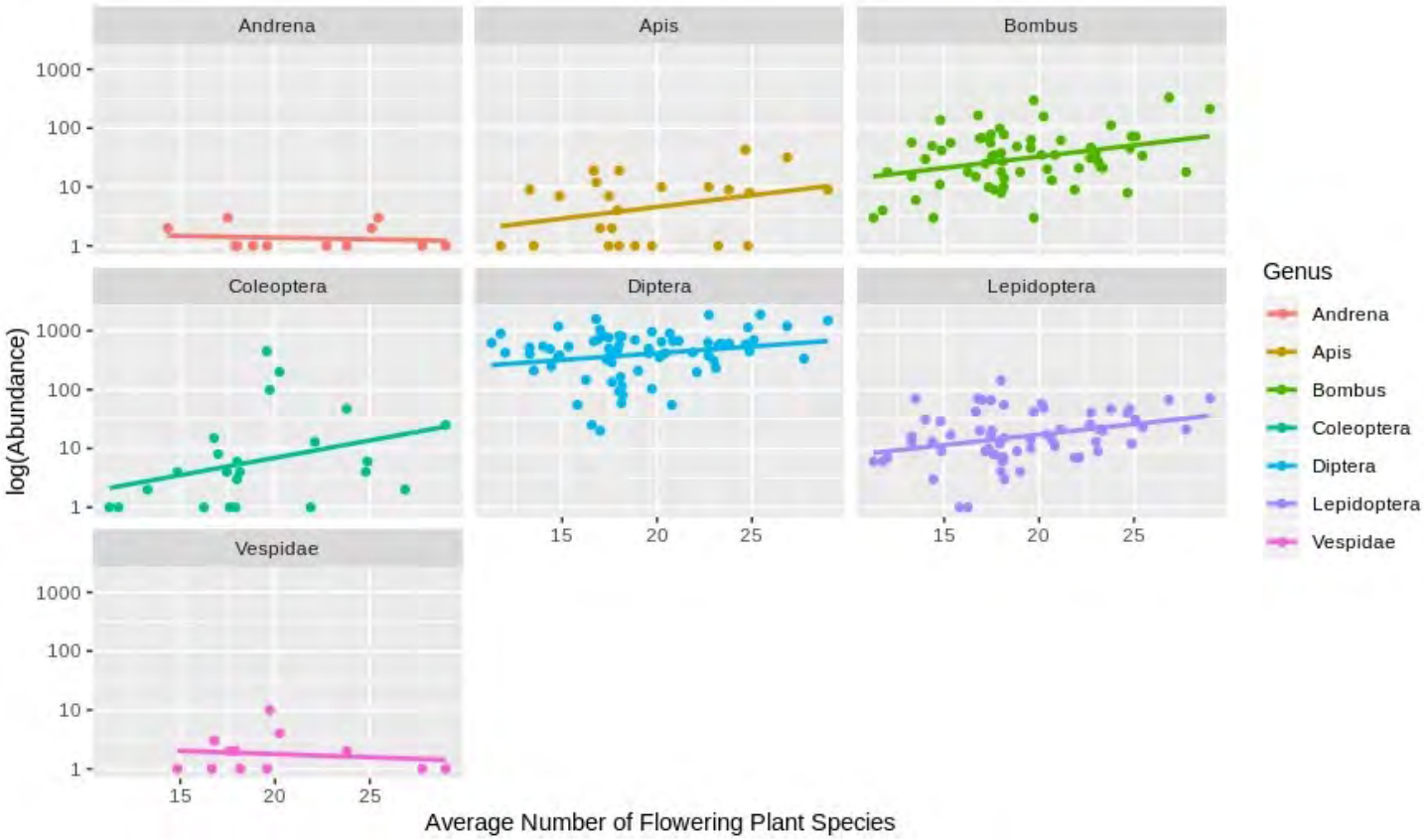


Figure 53: Pollinator abundance in each pollinator genus and mean flowering plant richness. Abundance is a logarithmic scale.

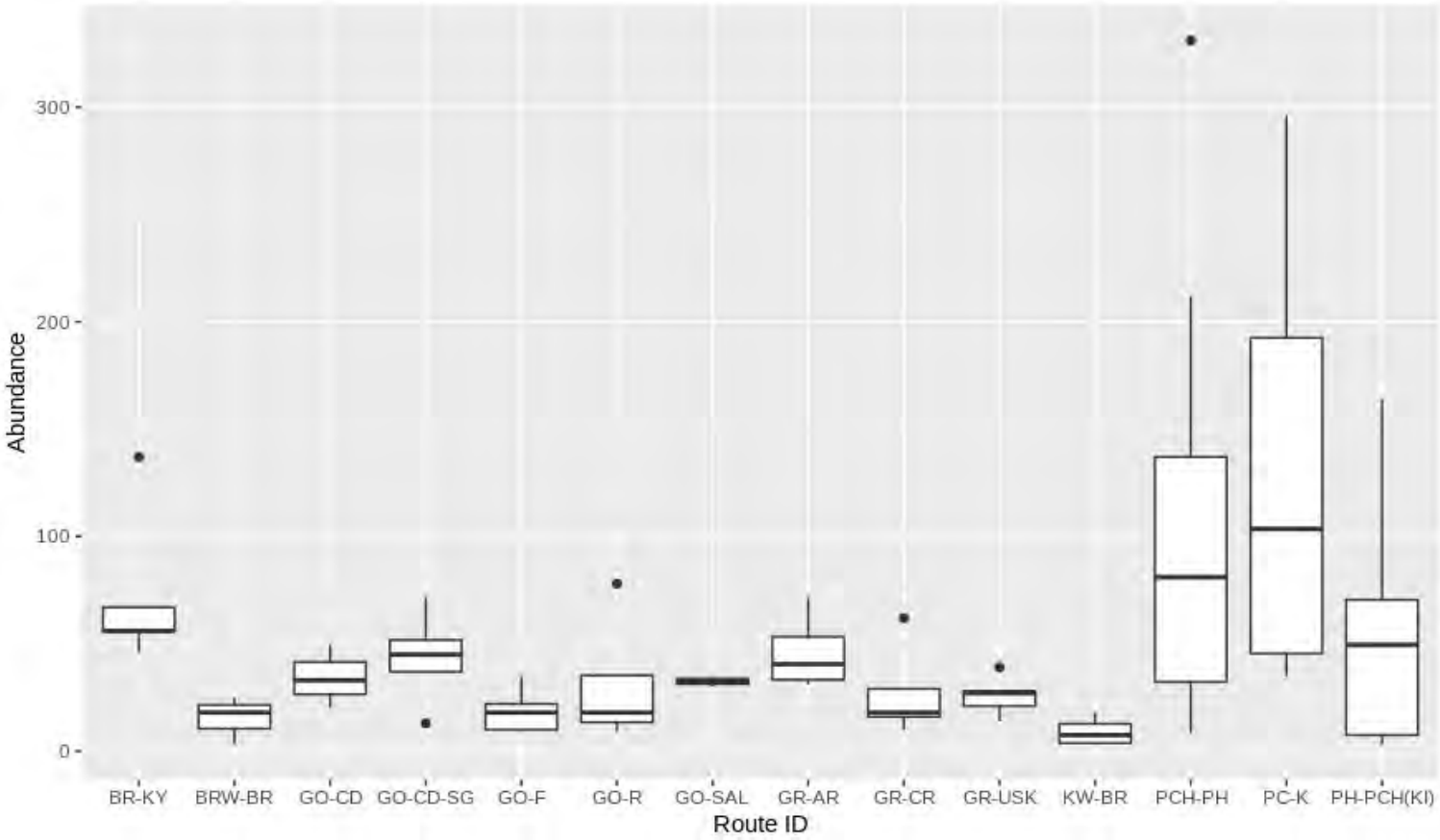


Figure 55: Abundance of Bombus found at each route. Variance of PCH-PH, PC-K and PH-PCH(KI) because of various habitat?

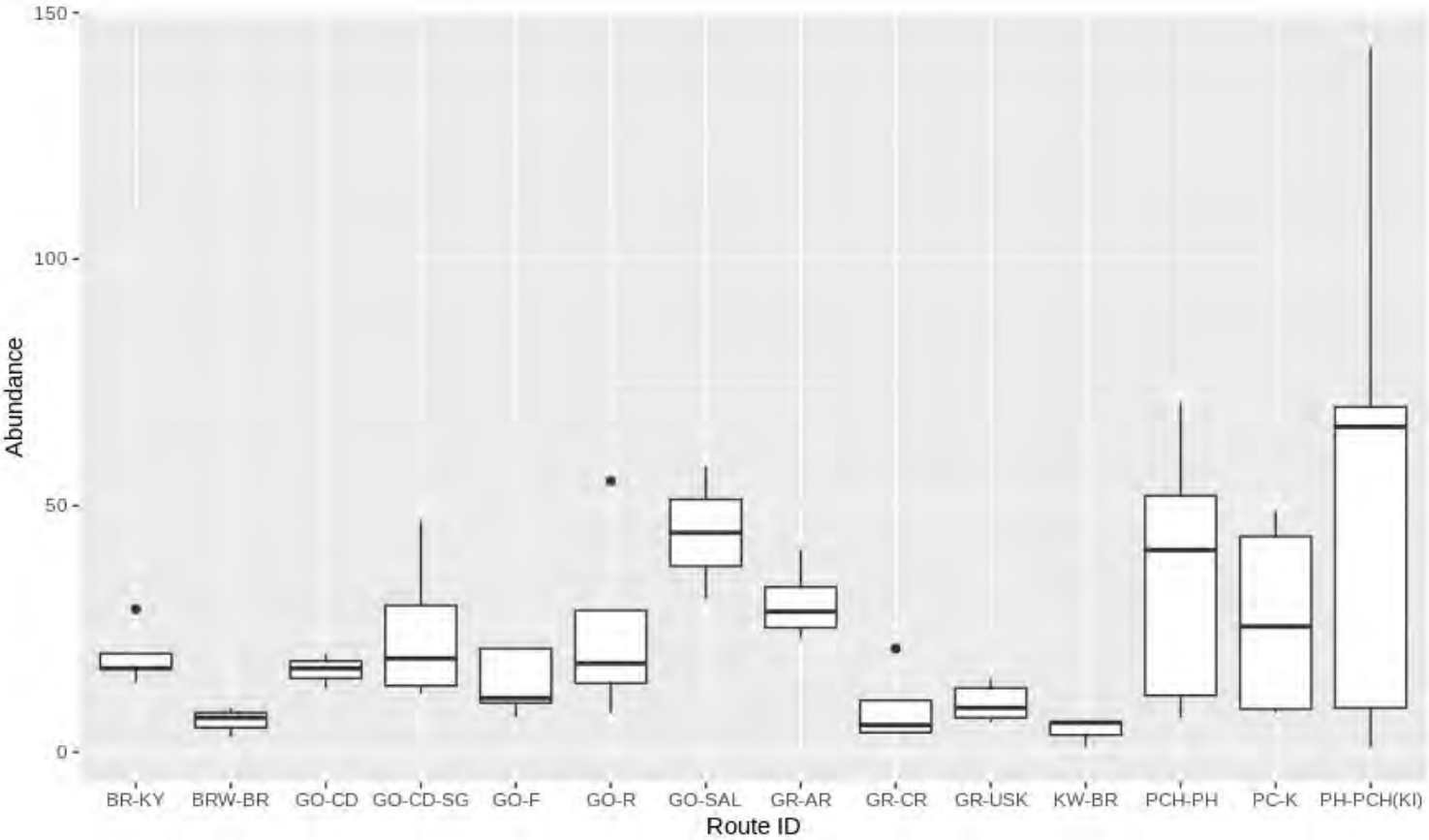


Figure 56: Abundance of Lepidoptera found at each route. Variance of PCH-PH, PC-K and PH-PCH(KI) because of various habitat?

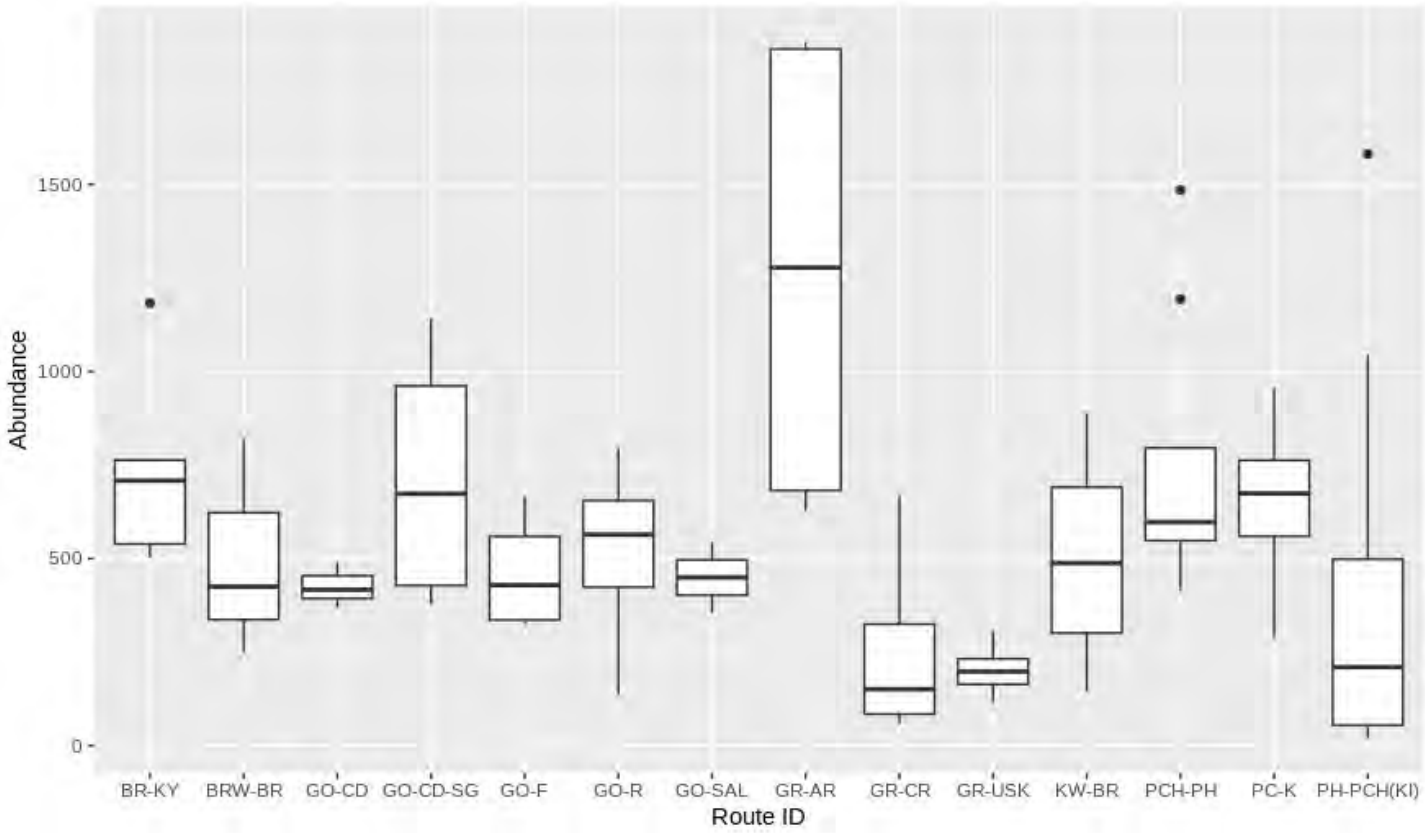


Figure 57: Abundance of Diptera found at each route. Diptera behave very differently in road verges compare to Lepitoptera and Bombus species. They seem to be prevalent in GR-AR and not in PCH-PH, PC-K and PH-PCH(KI).

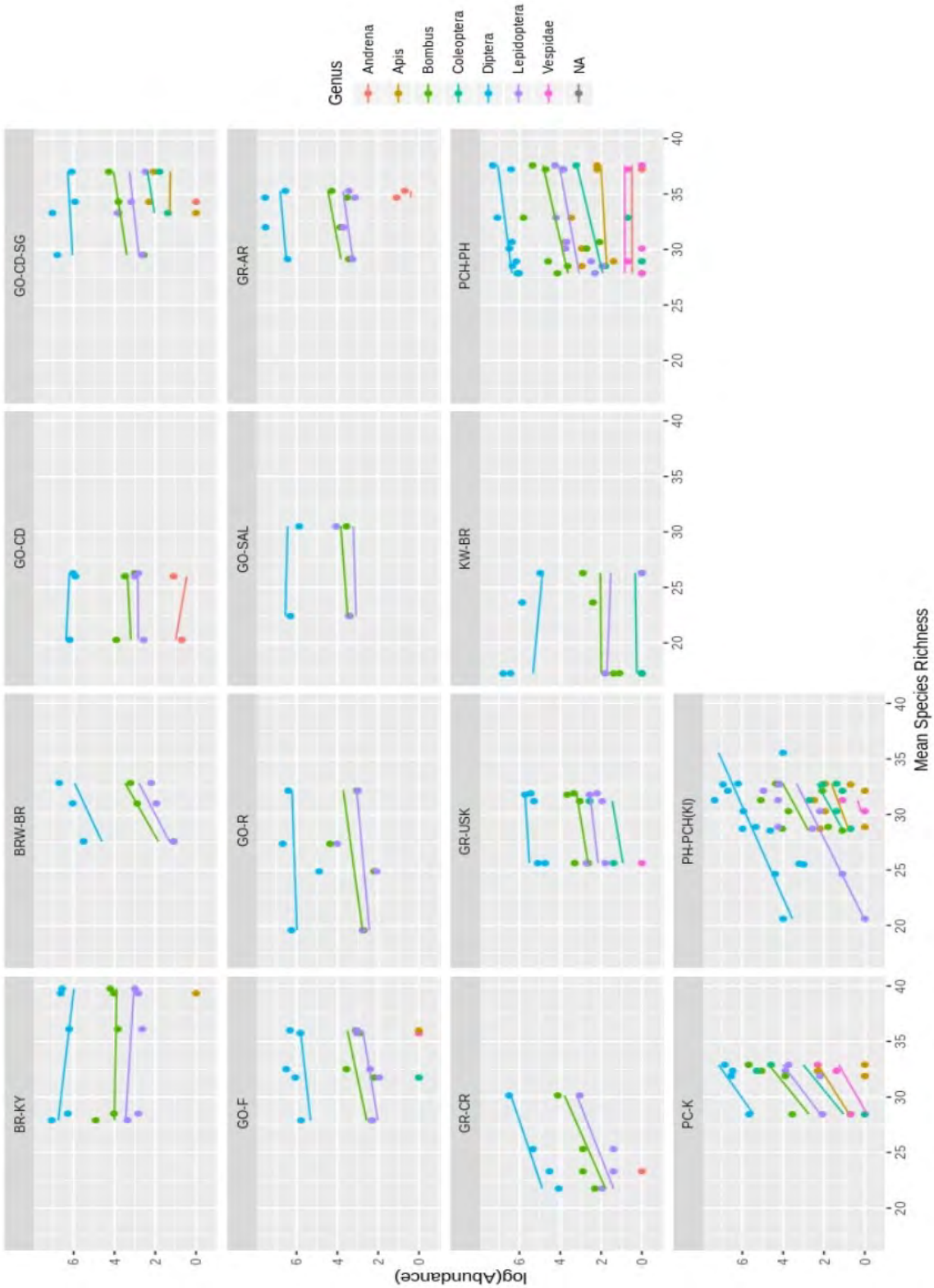


Figure 58: Data plotted using model which stated that Mean Species Richness, Route ID and Genus were the best predictors of pollinator abundance. There is a very high correlation between these variables and the model is very good.

Discussions

Methods and survey outcomes

The methodology proved very effective, providing a large data set. The project employed one full time botanist for four months and supported 2 part time roles and was assisted by four volunteers. Most of the survey data was collected in 2018 which was a very warm and dry summer up until late July/August, but there remained plenty of good survey potential through these later months.

There was some refining of methodology through 2017 with the 200m flower counts adopted for the pollinator walks as well as during the vegetation surveys.

Distribution of flowering plants in Islay's surveyed verges

The spread of Spring flowering flora, summer forage and late flowering species indicates potentially good verges where management is favorable. If Yarrow is allowed to flower and Yellow Rattle is present, this indicates management where cutting is late and potentially increased flowering opportunity for plants and potentially increased attractiveness to pollinators. Assessing current grassland management and its replication in other verges would potentially provide the ideal cutting strategy to support floral richness and availability in other areas where a minor adjustment could manage a verge to its full potential.

The recording of flower abundance along the 200m sections also gives an indication of the potential value of that grassland floristically and a suggested value to pollinators. Since the value of an individual bloom, with regard to pollen and nectar availability and quality varies from species to species, this cannot be a direct indication. Creeping Buttercup, Pignut and Ribwort Plantain all flowered abundantly in many verges but were not viewed with a high level of attractiveness by the major pollinators (butterflies and bees). Buttercup in particular was the main attraction to flies which were found in profusion within the bloom corolla. Further analysis of the data assessing the floral structure and species composition could provide a further level of value to the verge factoring nectar and pollen quality for species (Hicks, et al 2016).

Maps for Yarrow flowering (where flowering occurred) and Yellow Rattle are unsurprisingly similar, both responding favourably to late cutting. The former where Yarrow etc was not able to flower, suggests future potential if progression to flowering is aided. It will not be possible in all areas to aid increased flowering, some sections are in open grazed areas which by their very nature grass will be kept in check by grazers. The perennial flowering species may have been able to secure a niche within the sward but flowering ability may be intermittent year to year. This includes routes KW-BR; GR-CR (2, 3); GO-CN (1, 2); PH-PCH-KI (some sections).

Routes servicing the main villages, (in this survey) Bridgend to Portnahaven, are generally cut through June, with maybe a very late cut after August if required. This means that following a Spring spread of flowers the mid-summer months for flora is poor. Later however Yarrow and particularly Autumn Hawkbit and Catsear were very noticeable, particularly along the sections Foreland road end to Bridgend in late summer. The recovery time following the early cutting regime therefore has favoured late flowering flora which persist as flowering and seeding is possible. Also noticeable is the amount of Dandelion in verges along the PH-K (Port Charlotte to Kentraw) and PCH-PH [1-4] (Port Charlotte to Nerabus) sections where the early flowering and seeding allows for early forage dominance of a very valuable forage species (Hicks, et al 2016).

The single-track secondary routes are generally cut through July. Verges maps (Map 4) shows the distribution of sections where flower abundance exceeded 100 blooms/m. The dual traffic routes show sporadic and intermittent high values but are generally low in flower abundance. Of the single-track routes Foreland, Loch Gorm and Sanaigmore roads (GO-F; GO-R; GO-SAL; GO-CD; GO-CD-SG) indicate good floral abundance in June, verge cutting then occurs in mid-July. The control section GO-R3 shows that flower abundance persist into July where cutting has not occurred. Route: Gruinart to Uiskentuie (GR-USK) and Gruinart to Ardnave (GR-AR) are left until late July for cutting and the Flats section (GR-USK 1 and 2) are left until mid/late August.

The south Rhinns show good flower abundance in the Portnahaven vicinity and in June Port Charlotte to Kilchiaran but perhaps the level of grazing and exposure on the western sections (PH-PCH-KI 5-11) is not favourable.

BR-KY also shows low floral abundance despite it being a minor route and not generally cut until July. The route does however pass through much farmland and perhaps the influence of adjacent management has a significant effect on the value of the verge floristically, as described in our findings on the significance of adjacent habitat.

Overall, each route has a different floral abundance when compared before and after cuts. The interaction of different variables is likely the cause of this (which modelling could show) with other confounding factors also influencing floral abundance. Data does not conclusively say whether cutting verges, as a rule, has an impact on road verge floral communities – other confounding factors will be playing a part. However, we can infer from the data which sections can perhaps be improved by planting species or changing mowing regime.

Floral abundance is not the decisive factor for healthy pollinator populations but plant diversity, plant richness, nectar abundance, plant assemblages, and surrounding habitat will all be playing a part in pollinator attraction. However, floral abundance has been linked to greater pollinator abundance, when compared with areas of lower abundance (Fowler et al. 2016), hence, it is still an important measurement to glance over.

These graphs are important as a visual tool and should be used in conjunction with other data in order to determine how to manage road verges. Low floral abundance does not mean it is not ecologically important and high floral abundance does not mean it is ecologically important. Depending on management requirements this is to represent a guide for each section of the road verge recorded.

<u>Plants of significant note:</u>
From all the vegetation data of 877 quadrats, 9307 individual species records were amalgamated to grid square presence, providing a species list of 167 [Appendix….] and recordings for 86 1km O.S. grid squares.

- Three locations for Northern Marsh Orchid - GO-F4 and GO-R4
- One location for Common Spotted Orchid - GO-CR1
- One location of Yellow Corydalis – BR-KY2. This is only the second record for Islay of this species and was located within the same grid square as the last record.

<u>Species of less favourable note</u>, due to their tendency to spread rapidly and overwhelm other species reducing diversity:

- Rosebay Willowherb (although a good bee plant) 4 locations- BR-KY2; GO-R3 (3,5); PH-PCH-KI4
- American Willowherb 2 locations- GR-CR2; PH-PCH-KI4
- Japanese Knotweed 1 location- GO-F4 (Sunderland Farm)
- Hemlock Water Dropwort 31 locations along 20 sections

What influences floral diversity and availability?
From the analysis, grass height, grazing and adjacent management were found to have the greatest positive correlation on species richness/flowering abundance.

Grazing
Grazing pressure, particularly by sheep prevents grasses establishing dominance in the sward therefore enabling other species to gain a place and hence increase species diversity and sward richness. (Fig. 33)
The Simpsons diversity index of species richness increases in frequency with grass height (Fig.34)

Grass (sward) height
The relationship of grass height to species richness is not that clear (Fig. 31). Only 4 of 14 routes indicated an increase in species richness with increased grass height (route GO-CD; GO-CD-SG; GO-R; PC-K). 4 of the routes showed a negative correlation (BR-KY; BRW-BR; KW-BR; PCH-PH) with 5 indicating no real tendency for change.

There was however greater positive correlation with grass height and mean flower abundance (Fig. 30) with six routes increasing flower availability with increased sward height (GO-CD-SG; GO-F; GO-R; GO-SAL; GR-AR; GR-USK). If a sward remains uncut for much of the season the plants within the sward would gain height and have the opportunity to flower before being eaten by grazers or cut by the mower. If allowed to do this over many years the seed would build up in the sward and potentially, if soils are not enriched too heavily, out compete grasses.

The remaining routes showed no real tendency for change. Three of the routes are primarily grazed and two routes were in the June cutting regime. Sward growth for either would have been interrupted through the season and flowers would be inhibited from flowering. The one route which had reduced species richness and flower abundance with grass height was BR-KY which seems to be different to the trends of the other routes. (Fig. 30/31)

Relationship between pollinator usage and verge richness

Is the value of the floral richness of the verges key to the use by pollinators? This is the key question, as we have the ability to influence floral diversity and abundance, which may in turn favour increased pollinator abundance.

- 76 of 77 1km grid squares gained survey data of identifiable species for input into the INHT records database and fed into the national recording system.
- 1673 butterflies were recorded over 100km of verge
- Green-veined White was the most prolific butterfly across all months.
- 4147 bumblebees were recorded
- Common Carder Bee the most frequent of nine species recorded.
- Flies were recorded in flowers in 93% of the surveyed sections.

Of butterflies, the main species complement of Islay grassland is Meadow brown, Ringlet, Small Heath, Common Blue and Green-veined White. The latter has a very long flight period whilst the other four are primarily June to July. Marsh Fritillary was recorded along 8 200m sections along routes GR-AR 2 and 4; PCH-PH 8; PH-PCH-KI 3, 4, 5 and 6. These were seen flying from 5th to 11th June 2018 (they have a very short flight period spending most of their lives as caterpillars feeding on the leaves of Devil's bit Scabious. The specialist species Green Hairstreak, Orange-tip, Speckled Wood and Grayling were only seen in small numbers, with population size for the island being small or they are more suited to habitat through which the routes pass only in small sections.

Bumblebees are very numerous, and identification can be difficult in bees passing. It is good to have some identified to *Bombus major* (Northern White-tailed bumblebee), however many of the white-tailed bumblebee (*B. lucorum*) sightings could have overlap with *B. terrestris* (Buff-tailed) and *B. major* with workers and male casts being so similar in patterning. There was shown to be a good population of Moss Carder (*B. muscorum*) with 103 individuals recorded on 36 200m sections present in 21 grid squares. The only species with a red tail recorded was Early Bumblebee, however with a good number of Mountain bumblebee observed on the island over the summer 2018 and few Early this may have been a miss-identified record, actually being *B.monticola.*

Solitary bees were a difficult genera to identify, however 8 species were identified fully; although low in number they provide a significant data record.

Hoverflies at 1354 total are a significant genus as pollinators, found in 27% of 200m sections

Using modelling, the pollinator abundance data was compared with species richness and floral abundance. There were positive correlations with each but more marked for floral abundance, more flowers available for more pollinators.

Apis (Honeybee) showed a high tendency where species richness was already high (Pollinator transect data fig. 52). These routes near apiary sites pose a question: are the sections species rich due to the presence of honeybees as the prime pollinators? There is a philosophy that honeybees in an area provide high impact pollination services to the flowers in an area resulting in saturation pollination, the long-term benefit of which is year on year increases in floral and species diversity.

Conclusions

What influences species richness?

Species richness was found to be a factor of grass height, grazing and adjacent management. Adjacent areas of natural habitat favoured more species rich verges, whilst grazed areas were found to be favourably rich in species diversity (grasses not being given the chance to dominate), and on some routes increases in grass height did favour species richness but this was not consistent for all routes. Species richness did not provide a significant guide to the value of a route for floral richness.

What influences flower abundance?

There was however greater positive correlation with sward height and mean flower abundance with six routes increasing flower abundance with increased height (GO-CD-SG; GO-F; GO-R; GO-SAL; GR-AR; GR-USK). A sward remaining uncut for much of the season provides greater opportunity for flowering before being eaten by grazers or mown.

The abundance of pollinators positively reflected increases in flowering across all genera, indicating that verges with more flowers are favoured by more pollinators. This provides a scientific impetus that the goal of more flowers will aid pollinator usage and providing corridors along the road verges would be of positive benefit.

References

Fowler, Robert E, Rotheray, Ellen L and Goulson, Dave (2016) Floral abundance and resource quality influence pollinator choice. Insect Conservation and Diversity, 9 (6). pp. 481-494. ISSN 1752-458X

Hicks DM, Ouvrard P, Baldock KCR, Baude M, Goddard MA, Kunin WE, et al. (2016) Food for Pollinators: Quantifying the Nectar and Pollen Resources of Urban Flower Meadows. PLoS ONE 11(6): e0158117. https://doi.org/10.1371/journal.pone.0158117

Proposal for future management of verges on Islay

There are many of the minor single track routes that are not far from an optimum of species richness and floral abundance. Suppression of grass growth and a boost to species present would bring these areas up to an attractive level for pollinators beyond their current level. Where these pass through grazed pasture and barley production, they would be the ones to target and gain the most benefit.

The main trunk routes however where vehicles pass at speed should perhaps not be targeted as an attractive site for pollinators as there is a high risk that insects would become victims of the road, increasing fatality.

The proposal is to target 37km of roadside verge around the quieter sections of Islay's road network as a trial to see what can be achieved, (see Map 5: Route Sections for Trial Management). Where diversity is potentially good it is proposed to plant Yellow Rattle this year (late summer) which will act as a grass suppressor and reduce the volume of grass in verges next season and allow other flower species to spread in. Some sections would benefit from both Yellow Rattle and other flowering species introduction, as in the long/short term this would reduce grass volume and increase their attractiveness for pollinators and the public. It is aimed that much of the seed will be gained from other verges and simply transposed into suitable locations.

Funding has been agreed by The Botanist Foundation for the first year of trial management, with re-evaluation and potential agreement in 2020, on the proviso that the council are in agreement and that the Conisby road in Bruichladdich be included in the late cutting and management outcomes.

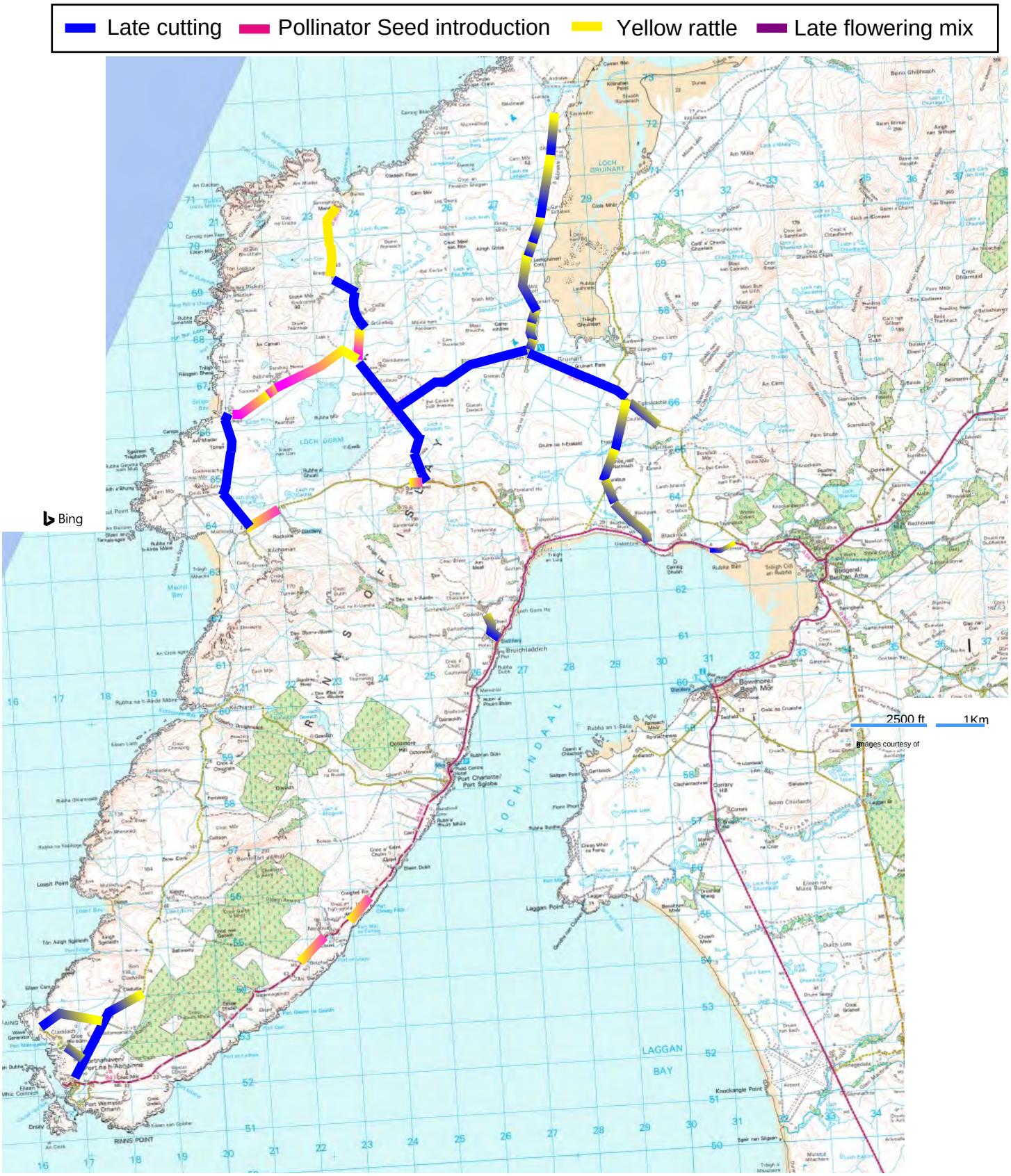
A request has also been received from Portnahaven and Port Wymess to avoid cutting the roadside sections with orchids (Northern Marsh and Heath Spotted) which are prominent through the villages.

Trialling through the winter of 2018/19 with sowing of seed has given an indication of how successful it is for propagation and what seeds are most effective in germinating, this has given influence to the method/practical sowing and nurture and the choice of seed.

Seeds of choice:

Yarrow	Bird's foot Trefoil	Lesser Knapweed	Red Clover
Lady's Bedstraw	White Clover	Sneezewort	Self-heal
Lesser Knapweed	Red Clover	Lady's Bedstraw	White Clover
Meadow Cranesbill	Yellow Rattle	Oxeye Daisy	Meadow vetchling

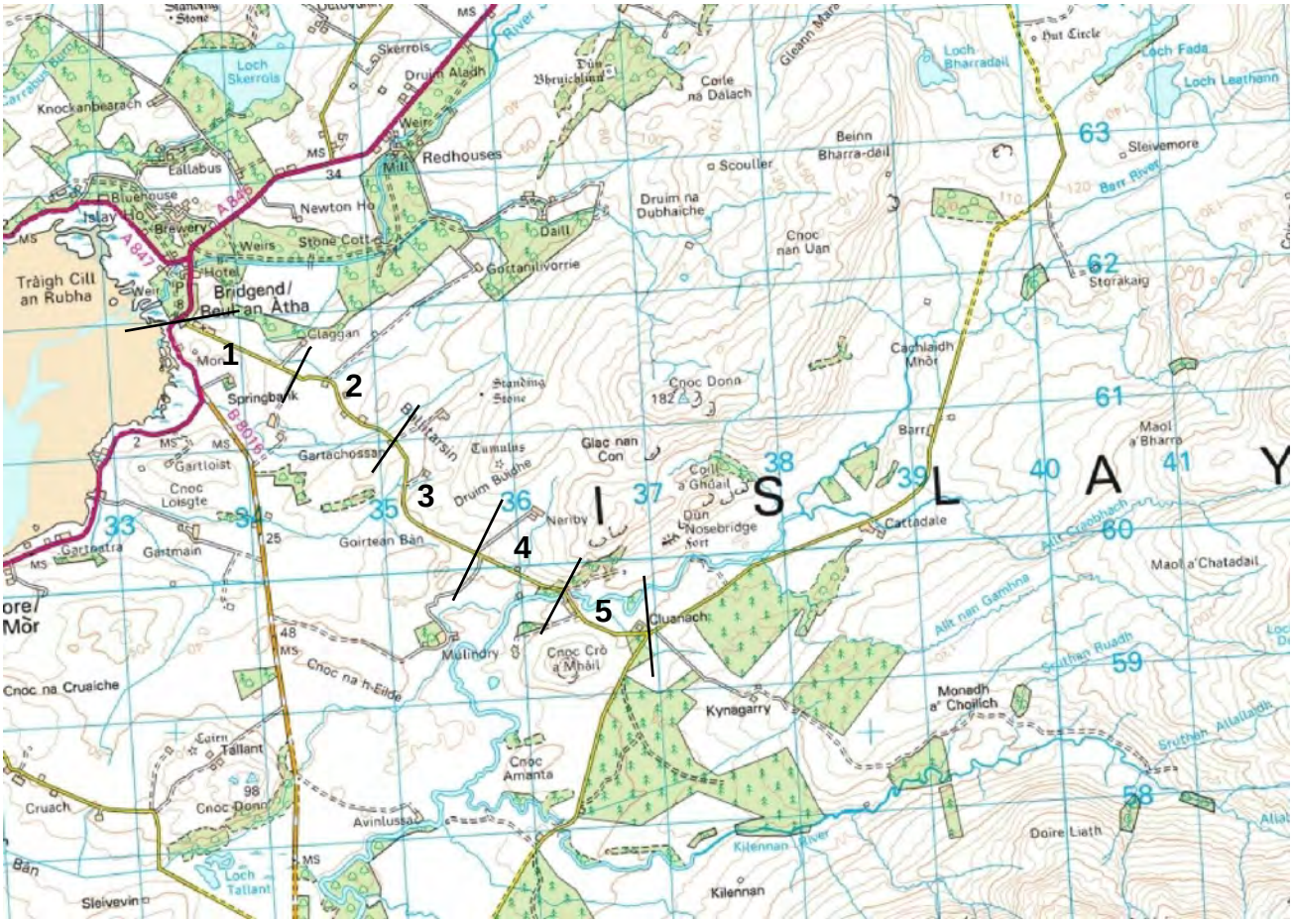
Map Distribution of Route Sections for trial management



Funding proposal:

Area of influence	Detail of activity	No. days	Costs
Practical Management of verges - cutting	Establish a cutting programme for council workers to adopt – cutting after 1st August		A&B Council
Practical Management of verges - seeding	Manual and practical establishment of seeds in 14.5km of verge (looking to utilise a level of volunteer effort to bring the public onboard.	5 days at £120	£600
Seed mixes	14.4km of Islay specific flower seed mix. 3km of just Yellow Rattle flower seed Whole swathes of verge do not need to be seeded but intermittent sections will, with the right cutting management gradually self seed over time.	15.4kg Islay mixed flower species 1.5kg Yellow Rattle seeds	£2113
Vegetation monitoring	37km of verge will require monitoring following management Vegetation sampling by quadrat and linear route counts late season visit 2019 two visits during 2020 season.	186 quadrats c.10 quadrats/ day @£120.....18.5 days per survey cycle	2019.....£2220 2020.....£4440
Pollinator surveys/ monitoring	3 visits during 2020 to survey pollinator usage of these influenced verges	12km surveyed per 5 hour day- 3 sets of 4 days @ £100	2019.....£400 2020.....£800
	Data analysis and report	3 weeks @ £120/day	2020.....£1800
		2019	£5333
		2020	£7040
		Total cost	£12373

Rejig-INHT Roadside verges Pollinator Project - Bridgend to Kynagarry

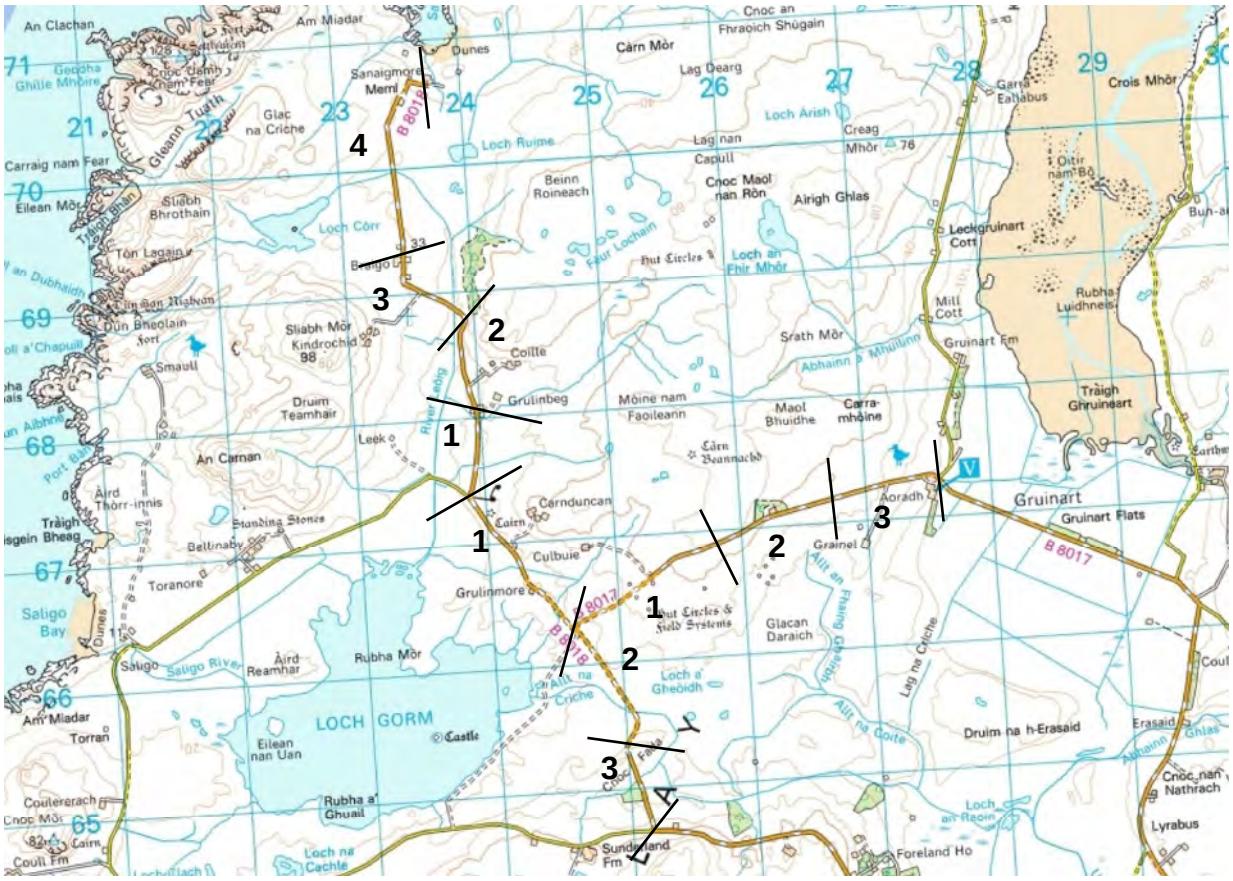


Route code	Sub	Route start	Route finish	Section start	Section finish	End Grid	Dist Km	No. 200m
BR-KY	1L	Bridgend	Kynagarry	Bridgend Est. Off	Starchmill	NR344616	1	5
BR-KY	2L	Bridgend	Kynagarry	Starchmill	Ballitarsin	NR351610	1	5
BR-KY	3L	Bridgend	Kynagarry	Ballitarsin	Neriby	NR356602	1.2	6
BR-KY	4L	Bridgend	Kynagarry	Neriby	Dun Nosebridge	NR364598	0.7	3.5
BR-KY	5L	5 Bridgend R	Kynagarry	Dun Nosebridge	Kynagarry	NR369594	0.8	4

Rejig-INHT Roadside verges Pollinator Project - Foreland to Sanaigmore junction (via. Kilchoman)

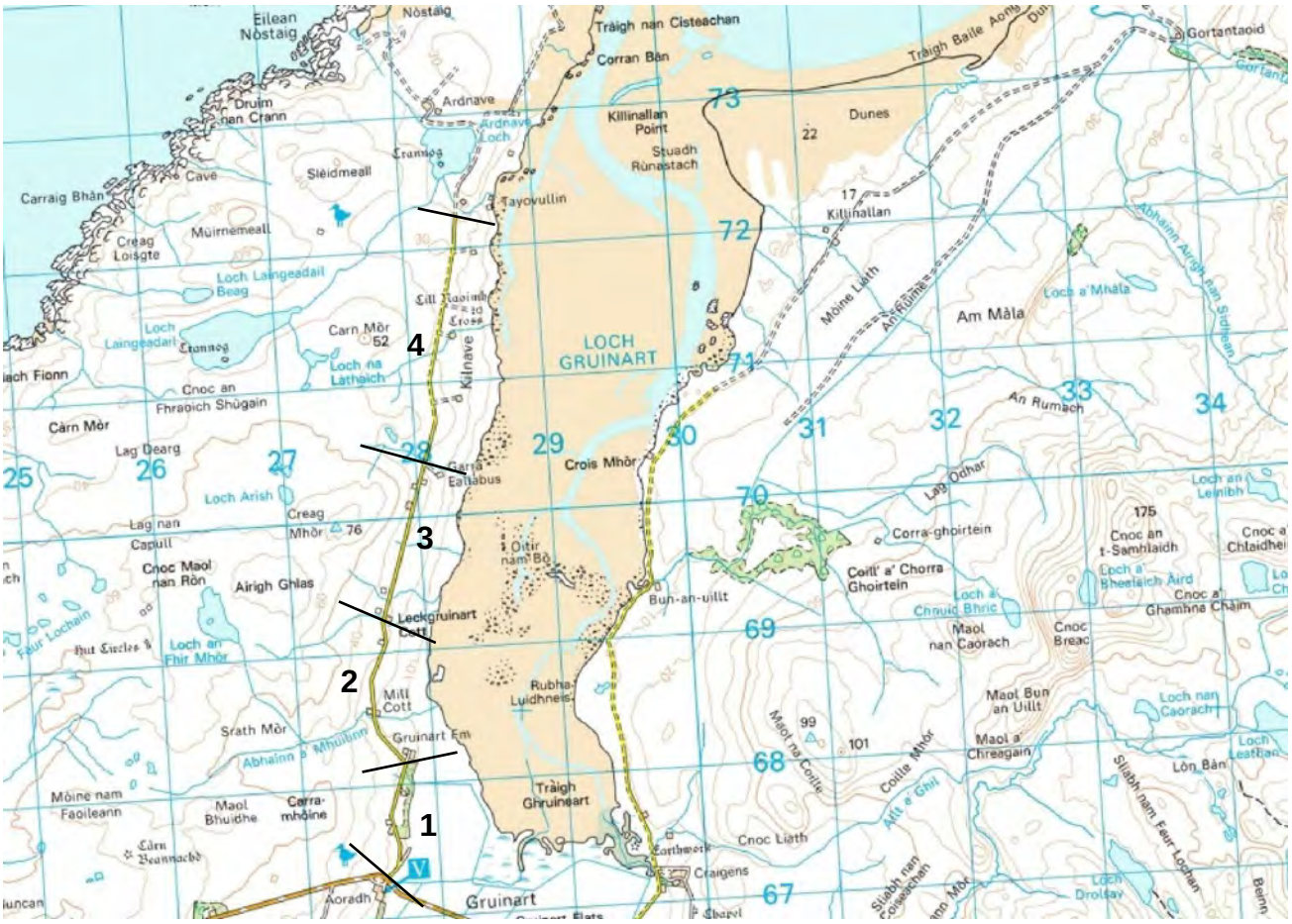
Route code	Sub	Route start	Route finish	Section start	Section finish	End Grid	Dist Km	No. 200m
GO-F	1	Foreland	Gorm	Foreland Road end	Foreland trees	NR270637	0.9	4.5
GO-F	2	Foreland	Gorm	Foreland trees	MacPhearsons Croft bend	NR264645	1	5
GO-F	3	Foreland	Gorm	MacPhearsons Croft bend	Sunderland/Sanaig Junction	NR252647	1.3	6.5
GO-F	4	Foreland	Gorm	Sunderland/Sanaig Junction	Len Powell's house	NR243646	1	5
GO-F	5	Foreland	Gorm	Len Powell's house	Sunderland end field SU01	NR233647	1	5
GO-R	1	Rockside	Gorm	Sunderland end field SU01	Kilchoman Distillery	NR220643	1.4	7
GO-R	2	Rockside	Gorm	Kilchoman Distillery	Machir/Coull turn	NR213639	0.8	4
GO-R	3	Rockside	Gorm	Machir/Coull turn	Coull Farm	NR208647	0.9	4.5
GO-R	4	Rockside	Gorm	Coull Farm	Saligo gate	NR211663	1.9	9.5
GO-Sal	1	Saligo	Gorm	Saligo gate	Ballinaby track	NR224670	1.5	7.5
GO-Sal	2	Saligo	Gorm	Ballinaby track	Sanaig phone box	NR239674	1.6	8

Rejig-INHT Roadside verges Pollinator Project - Sunderland to Sanaigmore: Gorm to Gruinart



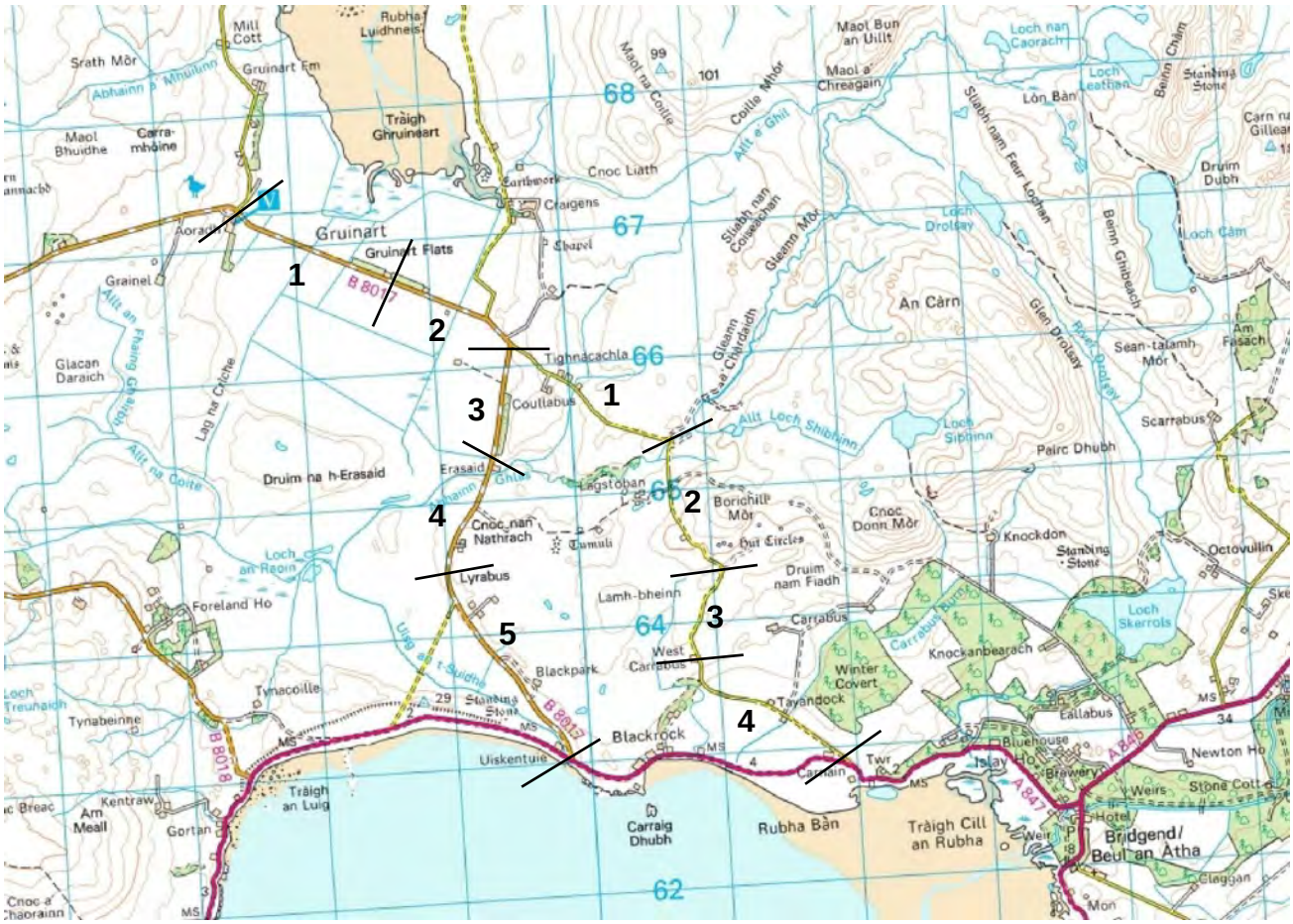
Route code	Sub	Route start	Route finish	Section start	Section finish	End Grid	Dist Km	No. 200m
GO-CD	1	Carnduncan	Gorm	Sanaig phone box	Gruinart Junction	NR246663	1.4	7
GO-CD	2	Carnduncan	Gorm	Gruinart Junction	Sunderland Cnoc Fada	NR250653	1.1	5.5
GO-CD	3	Carnduncan	Gorm	Sunderland Cnoc Fada	Sunderland/ Sanaig Junct	NR252647	0.7	3.5
GO-CD-SG	1	Carnduncan	Sanaig more	Sanaig phone box	Grulinbeg	NR239681	0.7	3.5
GO-CD-SG	2	Carnduncan	Sanaig more	Grulinbeg	Kindrochid bend	NR239688	0.8	4
GO-CD-SG	3	Carnduncan	Sanaig more	Kindrochid bend	Braigo	NR234693	0.8	4
GO-CD-SG	4	Carnduncan	Sanaig more	Braigo	Sanaigmore	NR238707	1.6	8
GO-GR	1	Gorm/ Gruinart road end	RSPB Gruin art	Road end	Hill top by bull field		1.6	8
GO-GR	2	Gorm/ Gruinart road end	RSPB Gruin art	Hill top by bull field	Lay-by schoolhouse to Grainel		0.8	4
GO-GR	3	Gorm/ Gruinart road end	RSPB Gruin art	Lay-by schoolho use to Grainel	RSPB visitor centre		0.9	4.5

Rejig-INHT Roadside verges Pollinator Project - Ardnave Road end to Ardnave



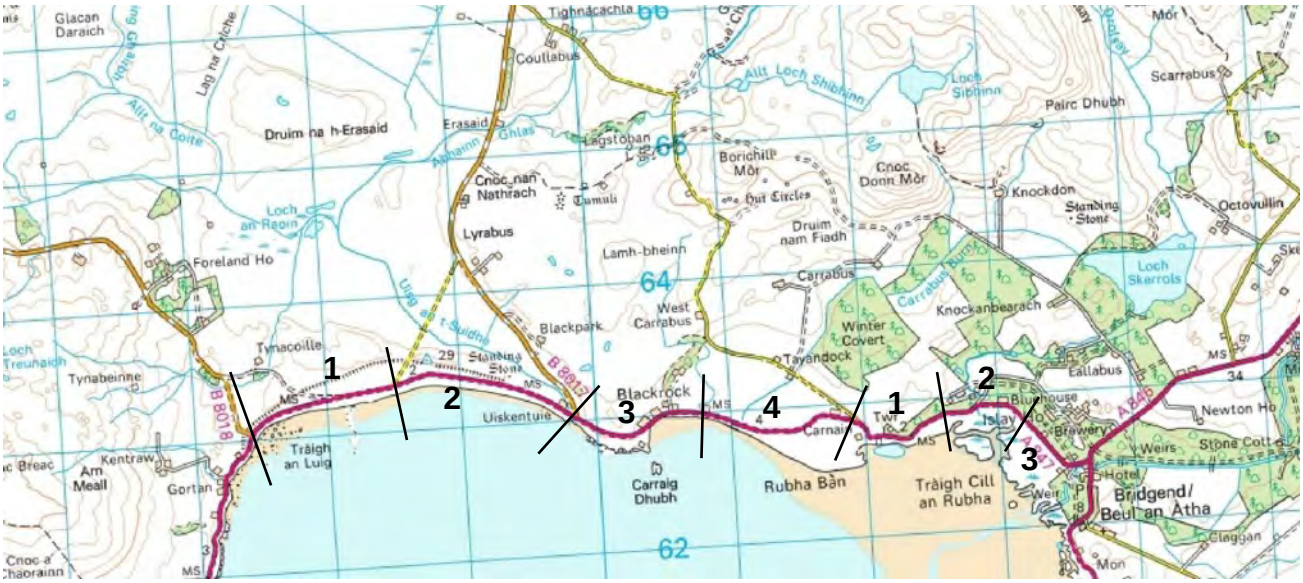
Route code	Sub	Route start	Route finish	Section start	Section finish	End Grid	Dist Km	No. 200m
GR-AR	1	Gruinart	Ardnave	RSPB reserve junct	Gruinart Farm	NR278682	1	5
GR-AR	2	Gruinart	Ardnave	Gruinart Farm	Leck Gruinart Cott	NR277693	1.2	6
GR-AR	3	Gruinart	Ardnave	Leck Gruinart Cott	Garra Eallabus	NR281704	1.4	7
GR-AR	4	Gruinart	Ardnave	Garra Eallabus	Ardnave cattle grid	NR284724	1.7	8.5

Rejig-INHT Roadside verges Pollinator Project - Gruinart RSPB to Uiskentuie and Carrabus



Route code	Sub	Route start	Route finish	Section start	Section finish	End Grid	Dist Km	No. 200m
GR-USK	1	Gruinart	Uiskentuie	RSPB junct	Ruin cottage in trees	NR287667	1.2	6
GR-USK	2	Gruinart	Uiskentuie	Ruin cottage in trees	Coullabus Junction	NR295662	1.1	5.5
GR-USK	3	Gruinart	Uiskentuie	Coulla bus Junct	Erasaid bridge	NR294652	1	5
GR-USK	4	Gruinart	Uiskentuie	Erasaid bridge	Lyrabus sheep fank	NR291643	1	5
GR-USK	5	Gruinart	Uiskentuie	Lyrabus sheep fank	Uiskentuie	NR298630	1.5	7.5
GR-CR	1	Gruinart	Carrabus	Coulla bus Junct	Hump bridge nr. Lagstoban	NR307654	1.5	7.5
GR-CR	2	Gruinart	Carrabus	Hump bridge nr. Lagsto ban	Borichill bend	NR311644	1.2	6
GR-CR	3	Gruinart	Carrabus	Borichill bend	West Carrabus	NR308637	0.7	3.5
GR-CR	4	Gruinart	Carrabus	West Carrabus	Carnain	NR319629	1.5	7.5

Rejig-INHT Roadside verges Pollinator Project - Kentraw to Bridgend



Route code	Sub	Dual	Route start	Route finish	Section start	Section finish	End Grid	Dist Km	No. 200m
KW-BR	1L	1R	Kentraw	Bridgend	Foreland Road end	Track to Lyrabus	NR285634	1.1	5.5
KW-BR	2L	2R	Kentraw	Bridgend	Track to Lyrabus	Uiskentuie	NR298630	1.4	7
KW-BR	3L	3R	Kentraw	Bridgend	Uiskent uie	Black Rock bridge	NR311629	1.3	6.5
KW-BR	4L	4R	Kentraw	Bridgend	Black Rock bridge	Carnain Junction	NR319629	0.9	4.5
BRW-BR	1L	1R	Bridgend woods	Bridgend	Carnain Junction	Whin Park	NR326628	0.8	4
BRW-BR	2L	2R	Bridgend woods	Bridgend	Whin Park	Islay House drive	NR334627	0.8	4
BRW-BR	3L	3R	Bridgend woods	Bridgend	Islay House drive	Bridgend Junct		0.5	2.5

Rejig-INHT Roadside verges Pollinator Project - Port Charlotte to Octofad

Route		Start	Finish	Section	Sect. finish	Grid end	Km	
PCH-PH	1	Port Charlotte	Portnahaven	Port Charlotte	Carn Farm	NR245573	0.7	3.5
PCH-PH	2	Port Charlotte	Portnahaven	Carn Farm	Craigfad	NR235558	1.7	8.5
PCH-PH	3	Port Charlotte	Portnahaven	Craigfad	Nerabus Burn	NR225551	1.3	6.5
PCH-PH	4	Port Charlotte	Portnahaven	Nerabus Burn	Octofad track	NR218545	0.8	4

Rejig-INHT Roadside verges Pollinator Project - Octofad track to Balimony track

Route code	Sub	Route start	Route finish	Section start	Section finish	End Grid	Dist Km	No. 200m
PCH-PH	5	Port Charlotte	Portnahaven	Octofad track	AnGleann	NR208539	1.2	6
PCH-PH	6	Port Charlotte	Portnahaven	AnGleann	End Ellister	NR196529	1.3	6.5
PCH-PH	7	Port Charlotte	Portnahaven	End Ellister	Wester Ellister	NR186524	1.5	7.5
PCH-PH	8	Port Charlotte	Portnahaven	Wester Ellister	Portnahaven Hall	NR171523	1.4	7
PH-PCH (KI)	1	Portnahaven	Kilchiaran	OK Corner	Claddach J. South	NR171528	0.6	3
PH-PCH (KI)	2	Portnahaven	Kilchiaran	Claddach J. South	Ballymeanach Junct	NR174534	0.7	3.5
PH-PCH (KI)	3	Portnahaven	Kilchiaran	Claddach J. South	Currie Sands	NR162534	1.4	7
PH-PCH (KI)	4	Portnahaven	Kilchiaran	Currie Sands	Ballymeanach Junct	NR174534	1.4	7
PH-PCH (KI)	5	Portnahaven	Kilchiaran	Ballymeanach Junct	Cladville cattle grid	NR183539	1	5
PH-PCH (KI)	6	Portnahaven	Kilchiaran	Cladville cattle grid	2nd cattle grid	NR187548	1.1	5.5
PH-PCH (KI)	7	Portnahaven	Kilchiaran	2nd cattle grid	Ballimony track	NR188556	0.7	3.5

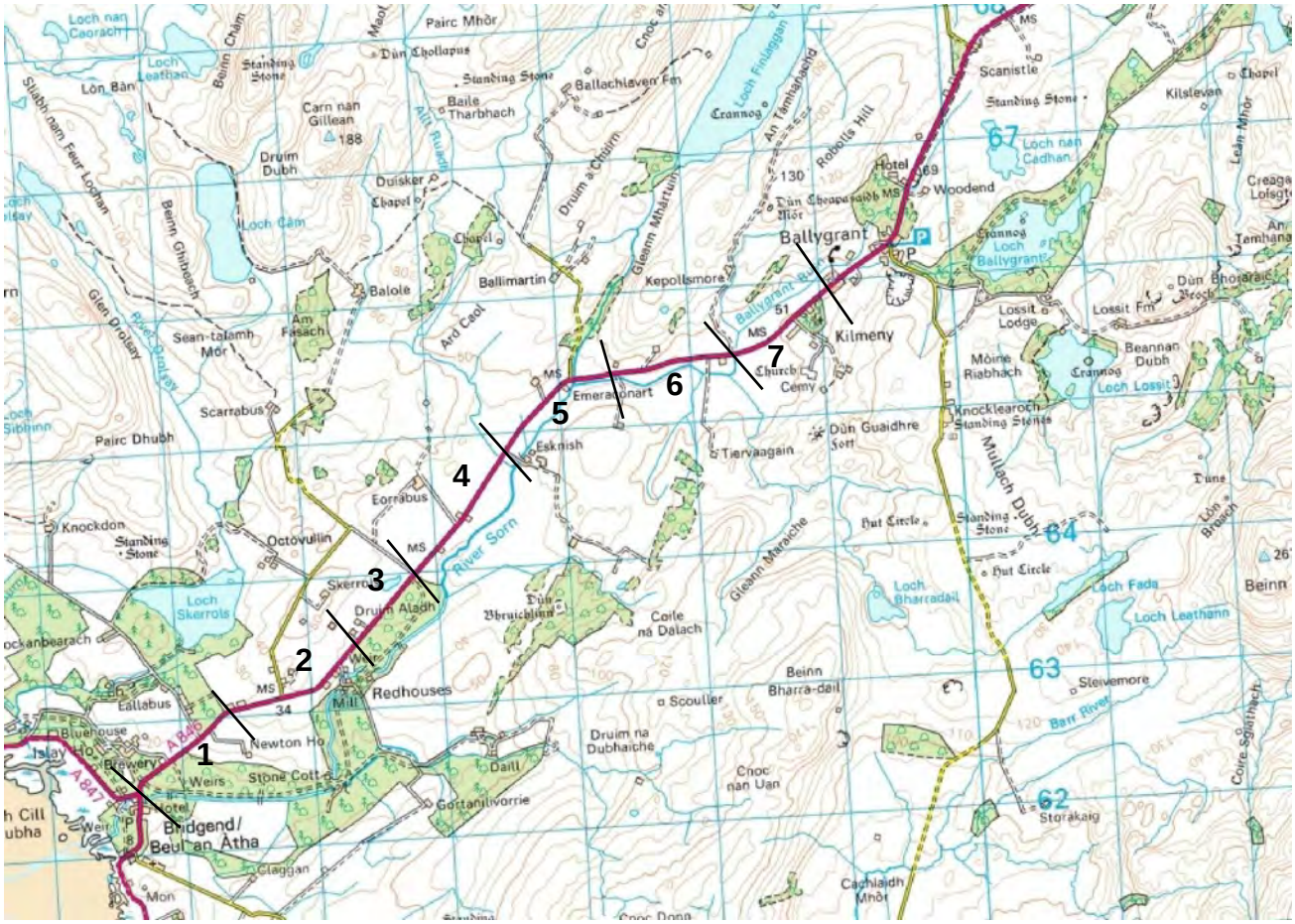
Rejig-INHT Roadside verges Pollinator Project - Balimony track to Port Charlotte

Route code	Sub	Route start	Route finish	Section start	Section finish	End Grid	Dist Km	No. 200m
PH-PCH(KI)	8	Portnahaven	Kilchiaran/ Port Ch	Ballimony track	Lossit Farm track	NR190564	0.8	4
PH-PCH(KI)	9	Portnahaven	Kilchiaran/ Port Ch	Lossit Farm track	Cultoon Farm	NR198573	1.3	6.5
PH-PCH(KI)	10	Portnahaven	Kilchiaran/ Port Ch	Cultoon Farm	Tormisdale	NR199585	1.3	6.5
PH-PCH(KI)	11	Portnahaven	Kilchiaran/ Port Ch	Tormisdale	Kilchiaran Bay	NR202600	1.7	8.5
PH-PCH(KI)	12	Portnahaven	Kilchiaran/ Port Ch	Kilchiaran Bay	Kilchiaran Farm House	NR208603	0.6	3
PH-PCH(KI)	13	Portnahaven	Kilchiaran/ Port Ch	Kilchiaran Farm House	Loch Conailbhe	NR214600	0.9	4.5
PH-PCH(KI)	14	Portnahaven	Kilchiaran/ Port Ch	Loch Conailbhe	Gearach	NR223593	1.1	5.5
PH-PCH(KI)	15	Portnahaven	Kilchiaran/ Port Ch	Gearach	End Gearach Fields	NR232587	0.8	4
PH-PCH(KI)	16	Portnahaven	Kilchiaran/ Port Ch	End Gearach Fields	Bolsay track	NR238582	1.3	6.5
PH-PCH(KI)	17	Portnahaven	Kilchiaran/ Port Ch	Bolsay track	Port Charlotte	NR251583	1.2	6

Rejig-INHT Roadside verges Pollinator Project - Port Charlotte to Kentraw

Route code	Sub route	Dual	Route start	Route finish	Section start	Section finish	End Grid	Dist Km	No.200m
PC-K	1L	1R	Port Charlotte	Kentraw	Port Charlotte	Braibruich	NR258597	1.3	6.5
PC-K	2L	2R	Port Charlotte	Kentraw	Braibruich	Bruichladdich - minimarket	NR267613	1.7	8.5
PC-K	3L	3R	Port Charlotte	Kentraw	Bruichladdich	MacPhearsons track	NR271621	1.1	5.5
PC-K	4L	4R	Port Charlotte	Kentraw	MacPhearsons track	Foreland road end	NR274631	1	5

Rejig-INHT Roadside verges Pollinator Project - Bridgend to Ballygrant



Route code	Sub route	Dual track	Route start	Route finish	Section start	Section finish	End Grid	Dist Km	No.200m
BR-BG	1L	1R	Bridgend	Ballygrant	Bridgend Junct	Newton	NR343631	0.9	4.5
BR-BG	2L	2R	Bridgend	Ballygrant	Newton	End field nr. Druim Aladh	NR354635	1.1	5.5
BR-BG	3L	3R	Bridgend	Ballygrant	End field nr. Druim Aladh	East Lodge	NR358640	1.1	5.5
BR-BG	4L	4R	Bridgend	Ballygrant	East Lodge	Esknish Farm	NR366649	1.2	6
BR-BG	5L	5R	Bridgend	Ballygrant	Esknish Farm	Kepollsmore layby	NR375654	1.2	6
BR-BG	6L	6R	Bridgend	Ballygrant	Kepollsmore layby	Kepolls	NR383655	0.9	4.5
BR-BG	7L	7R	Bridgend	Ballygrant	Kepolls	Ballygrant	NR395662	1.3	6.5

Appendix 2a

Date:	Start time:				Start time:				Start time:				Start time:			
Route ID	Finish time:				Finish time:				Finish time:				Finish time:			
Section ID	Recorder:				Cut- timing				Comments:							
Species \ Quadrats	Quadrat no. Grid ref:	% cover	Flowering y/n	no. flowering units	Quadrat no. Grid ref:	% cover	Flowering y/n	no. flowering units	Quadrat no. Grid ref:	% cover	Flowering y/n	no. flowering units	Quadrat no. Grid ref:	% cover	Flowering y/n	no. flowering units
	Verge depth				Verge depth				Verge depth				Verge depth			
	Boundary type				Boundary type				Boundary type				Boundary type			
	Grazed/ ungrazed				Grazed/ ungrazed				Grazed/ ungrazed				Grazed/ ungrazed			
	Adj. Habitat				Adj. Habitat				Adj. Habitat				Adj. Habitat			
	Adj. Manage				Adj. Manage				Adj. Manage				Adj. Manage			
	Grass Ht. (9 points)				Grass Ht. (9 points)				Grass Ht. (9 points)				Grass Ht. (9 points)			
	Photo taken				Photo taken				Photo taken				Photo taken			

boundary type - fence; wall; ditch; hedge; none

adjoining habitat - farmland (crop type); natural grassland; moorland; woodland..

Appendix 2b

Pollinator recording sheet

Date:	Start time:	Finish time:	Route ID	Section ID	Recorder:	Avg Temp.	Avg wind speed	Wind direction	Weather conditions	Comments:

Species \ 200m sections	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Large White																											
Small White																											
Green-veined White																											
Orange Tip																											
Green Hairstreak																											
Small Copper																											
Common Blue																											
Red Admiral																											
Painted Lady																											
Small Tortoiseshell																											
Peacock																											
Dark Green Fritillary																											
Marsh Fritillary																											
Speckled Wood																											
Grayling																											
Meadow Brown																											
Small Heath																											
Large Heath																											
Ringlet																											
BEES																											
Common Carder																											
Moss Carder Bee																											
Garden Bumb.																											
Buff-tailed Bumb.																											
White-tailed Bumb.																											
Early bumb.																											
Heath Bumblebee																											
Gypsy Cuckoo Bumb.																											
Red-tailed Bumb.																											
Honey Bee																											
HOVERFLIES																											
BEETLES																											
Soldier Beetle																											
Ants																											
OTHER																											

Appendix 3: Flower/Plant species list

Common name	Scientific name	Verge Obs. <=10	Grid Ref.	Observer
Sycamore	Acer pseudoplatanus	2		
Yarrow	Achillea millefolium			
Sneezewort	Achillea ptarmica	6		
Ground Elder	Aegopodium podagraria	10		
Lady's Mantle	Alchemilla vulgaris	1	NR2502265363	Rowan Hookham
Bog Pimpernel	Anagallis tenella	3		
Wild Angelica	Angelica sylvestris			
Lesser Burdock	Arctium minus	1	NR1979658237	Rowan Hookham
Common Mugwort	Artemis vulgaris	1	NR2767267678	Rowan Hookham
Lady-fern	Athyrium filix-femina		NR1771853710	Matt Harding
Daisy	Bellis perennis			
Hard-fern	Blechnum spicant		NR1771853710	Matt Harding
Water-starwort	Callitriche spp	1	NR2197266784	Rowan Hookham
Marsh-marigold	Caltha palustris	4		
Heather	Caluna vulgaris	9		
Hedge Bindweed	Calystegia sepium			
Shepherd's Purse	Capsella bursa-pastoris	1	NR3071765181	Rowan Hookham
Wavy Bitter-cress	Cardamine flexuosa			
Cuckooflower	Cardamine pratensis			
Glaucous Sedge	Carex flacca			
Common Sedge	Carex nigra			
Flea Sedge	Carex pulicaris			
Bottle Sedge	Carex rostrata			
Common Knapweed	Centaurea nigra			
Common Mouse-ear	Cerastium fontanum			
Sticky Mouse-ear	Cerastium glomeratum	10		
Rosebay Willowherb	Chamerion angustifolium	3		
Creeping Thistle	Cirsium arvense			
Marsh Thistle	Cirsium palustre			
Spear Thistle	Cirsium vulgare			
Marsh Cinquefoil	Comarum palustre	3		
Pignut	Conopodium majus			
Yellow Corydalis	Corydalis lutea	1	NR3460761482	Rowan Hookham
Hawthorn	Crataegus monogyna	3		
Montbretia	Crocosmia x crocosmiiflora	4		
Common Spotted Orchid	Dactylorhiza fuchsia	1	NR3033365515	Rowan Hookham
Northern Marsh Orchid	Dactylorhiza purpurella	3		
Wild Carrot	Dacus carota	2		
Foxglove	Digitalis purpurea	10		
Broad Buckler-fern	Dryopteris dilatata	3		
American Willowherb	Epilobium ciliatum	2		
Great Willowherb	Epilobium hiristum	1	NR2208154719	Rowan Hookham
Broad-leaved Willowherb	Epilobium montanum			
Marsh Willowherb	Epilobium palustre			
Hoary Willowherb	Epilobium parviflorum	1	NR2770567471	Rowan Hookham
Field Horsetail	Equisetum arvense			
Water Horsetail	Equisetum fluviatile	2		
Marsh Horsetail	Equisetum palustre			
Bell Heather	Erica cinecea	6		
Cross-leaved Heath	Erica tetralix	3		
Eyebright	Euphrasia nemorosa			
Japanese Knotweed	Fallopia japonica	1	NR2466164572	Rowan Hookham
Lesser Celandine	Ficaria verna			
Meadowsweet	Filipendula ulmaria			
Wild Strawberry	Fragaria vesca	1	NR3625659813	Rowan Hookham
Ash	Fraxinus excelsior	1	NR3188562919	Rowan Hookham
Common Hemp Nettle	Galeopsis tetrahit	1	NR2809370466	Rowan Hookham

Appendix 3: Flower/Plant species list

Cleavers	Galium aparine			
Marsh Bedstraw	Galium palustre			
Common Marsh-bedstraw	Galium palustre subsp. palustr	1	NR1937956674	Matt Harding
Lady’s Bedstraw	Galium verum			
Cut-leaved Crane’s-bill	Geranium dissectum	2		
Meadow Crane’s-bill	Geranium pratense	2		
Wood Crane’s-bill	Geranium sylvatica	1	NR3625659813	Rowan Hookham
Water Avens	Geum rivale	7		
Marsh Cudweed	Gnaphalium uliginosum			
Common Ivy	Hedera helix	17		
Hogweed	Heracleum sphondylium			
Bluebell	Hyacinthoides non-scrpita			
Marsh Pennywort	Hydrocotyle vulgaris	8		
Tutsan	Hypericum androsaemum	1	NR3625659813	Rowan Hookham
Slender St. John's-wort	Hypericum pulchrum			
Square-stalked St. John’s-wort	Hypericum tetrapterum			
Cat's-ear	Hypochaeris radicata			
Yellow Iris	Iris pseudacorus			
Sharp-flowered Rush	Juncus acutiflorus			
Bulbous Rush	Juncus bulbosus	1	NR1650953053	Matt Harding
Soft-rush	Juncus effusus			
Field Scabious	Knautia arvensis	7		
Meadow Vetchling	Lathyrus pratensis			
Rough Hawkbit	Leontodon hispidus			
Oxeye Daisy	Leucanthemum vulgare	2		
Fairy Flax	Linum catharticum	10		
Honeysuckle	Lonicera periclymenum	5		
Common Bird's-foot-trefoil	Lotus corniculatus			
Greater Bird’s-foot-trefoil	Lotus pendunculatus			
Field Wood-rush	Luzula campestris			
Ragged Robin	Lychnis flos-cuculi	3		
Yellow Pimpernel	Lysimachia nemorum	1	NR2132860076	Rowan Hookham
Purple Loosestrife	Lythrum salicaria			
Pineappleweed	Matricaria discoidea	9		
Water Mint	Mentha aquatica	4		
Spearmint	Mentha spicata	1	NR3681359434	Rowan Hookham
Tufted Forget-me-not	Myosotis laxa	3		
Water Forget-me-not	Myosotis scorpiodes	7		
Bog Myrtle	Myrica gale	4		
Daffodil	Narcissus spp.	1		
Red Bartsia	Odontites vernus			
Hemlock Water-dropwort	Oenanthe crocata			
Butterbur	Petasites hybridus	1	NR3362261950	Rowan Hookham
Mouse-ear-hawkweed	Pilosella officinarum	9		
Ribwort Plantain	Plantago lanceolata			
Greater Plantain	Plantago major			
Sea Plantain	Plantago maritima	1	NR1650953053	Matt Harding
Common Milkwort	Polygala vulgaris	1	NR2422556739	Rowan Hookham
Amphibious Bistort	Polygonum amphibium	2		
Knotweed	Polygonum aviculare	8		
Water-pepper	Polygonum hydropiper	2		
Redshank	Polygonum persicaria			
Silverweed	Potentilla anserina			
Tormentil	Potentilla erecta			
Marsh Cinquefoil	Potentilla palustris	1	NR2101765153	Rowan Hookham
Creeping Cinquefoil	Potentilla reptans	2		
Primrose	Primula vulgaris	14		
Selfheal	Prunella vulgaris			
Blackthorn	Prunus spinosa	4		
Bracken	Pteridium aquilinum			

Appendix 3: Flower/Plant species list

Meadow Buttercup	Ranunculus acris			
Lesser Spearwort	Ranunculus flammula			
Rounded-leaved Crowfoot	Ranunculus omiophyllus	1	NR1979757663	Rowan Hookham
Creeping Buttercup	Ranunculus repens			
Yellow Rattle	Rhinanthus minor	19		
Watercress	Rorippa nasturcum-aquaticum	5		
Dog Rose	Rosa canina	1	NR3362261950	Rowan Hookham
Bramble	Rubus fruticosus agg.			
Sheep’s Sorrel	Rumex acetolla	1	NR2560664536	Rowan Hookham
Common Sorrel	Rumex acetosa			
Curled Dock	Rumex crispus			
Broad-leaved Dock	Rumex obtusifolius			
Knotted Pealwort	Sagina nodosa	1	NR1879255592	Rowan Hookham
Procumbent Pearlwort	Sagina procumbens			
Eared Willow	Salix aurita	1	NR2156054216	Matt Harding
Grey Willow	Salix cinerea			
Autumn Hawkbit	Scorzoneroides autumnalis			
Common Figwort	Scrophularia nodosa	1	NR2367656076	Rowan Hookham
Marsh Ragwort	Senecio aquaticus	10		
Common Ragwort	Senecio jacobaea			
Groundsel	Senecio vulgaris	1	NR3460761482	Rowan Hookham
Red Campion	Silene dioica	7		
Bittersweet	Solanum dulcamara	2		
Perennial Sow-thistle	Sonchus arvensis	5		
Prickly Sow-thistle	Sonchus asper	1	NR2700661940	Rowan Hookham
Marsh Woundwort	Stachys palustre	10		
Hedge Woundwort	Stachys sylvatica			
Bog Stitchwort	Stellaria alsine	3		
Lesser Stitchwort	Stellaria graminae	6		
Common Chickweed	Stellaria media			
Devil's-bit Scabious	Succisa pratensis	1	NR1858054720	Matt Harding
Dandelion	Taraxacum agg.			
Wood Sage	Teucrium scorodonia	1	NR2716162470	Rowan Hookham
Wild Thyme	Thymus seripyllum	8		
Lime	Tilla x europaea	1	NR2681163989	Rowan Hookham
Lesser Hop-trefoil	Trifolium dubium	9		
Zigzag Clover	Trifolium medium	6		
Red Clover	Trifolium pratense			
White Clover	Trifolium repens			
Colt's-foot	Tussilago farfara			
Whin	Ulex europaea			
Common Nettle	Urtica dioica			
Common Valerian	Valeriana officinalis			
Corn Speedwell	Veronica arvensis	1	NR2775868073	Rowan Hookham
Germander Speedwell	Veronica chamaedrys			
Thyme-leaved Speedwell	Veronica serpyllifolia	3		
Tufted Vetch	Vicia cracca			
Bush Vetch	Vicia sepium			
Early Dog-violet	Viola reichenbachiana	1	NR1771853710	Matt Harding
Common Dog-violet	Viola riviniana			

Appendix 4

Common name	Scientific name	Poll. Type	No grid squares present	No. of individuals May	June	July	Aug	Sept	Total	% of 200m sections	% of grid. Sq.	200m sections
Soldier Beetle	Rhagonycha fulva	B	7	1		430	11		442	1.43%	9.09%	7
Gypsy Cuckoo Bee	Bombus bohemicus	BB	10	2	4	8			14	2.04%	12.99%	10
Small Garden Bumble Bee	Bombus hortorum	BB	61	1	71	163	421	23	689	23.31%	79.22%	114
Heath Bumble Bee	Bombus jonellus	BB	3			4	2		6	0.82%	3.90%	4
White-tailed Bumble Bee	Bombus lucorum	BB	59	46	90	253	258	26	678	27.61%	76.62%	135
White-tailed/Buff-tailed Bumble Bee	Bombus lucorum/terrestris	BB	9		10	5			15	1.84%	11.69%	9
Bombus magnus	Bombus magnus	BB	15		1	111	63	7	182	5.32%	19.48%	26
Moss Carder Bee	Bombus muscorum	BB	21	7	16	31	48	1	103	7.36%	27.27%	36
Common Carder Bee	Bombus pascuorum	BB	62	32	229	319	879	201	1654	38.65%	80.52%	189
Common/Moss Carder Bee	Bombus pascuorum/muscorum	BB	10		21	1	3		25	2.66%	12.99%	13
Early Bumble Bee	Bombus pratorum	BB	1				1		1	0.20%	1.30%	1
Buff-tailed Bumble Bee	Bombus terrestris	BB	41	3	78	115	128	14	338	16.97%	53.25%	83
Bumblebee species		9		92	520	1440	1814	272	4147			
Small Tortoiseshell	Aglais urticae	BU	14	1	1	18	6		26	3.27%	18.18%	16
Orange-tip	Anthocharis cardamines	BU	1	2					2	0.20%	1.30%	1
Ringlet	Aphantopus hyperantus	BU	22		6	168	7		181	6.13%	28.57%	30
Dark Green Fritillary	Argynnis aglaja	BU	10		2	10	4		16	2.04%	12.99%	10
Green Hairstreak	Callophrys rubi	BU	1	1					1	0.20%	1.30%	1
Small Heath	Coenonympha pamphilus	BU	39	2	50	49	2		103	9.00%	50.65%	44
Marsh Fritillary	Euphydryas aurinia	BU	7		23	1			24	1.64%	9.09%	8
Grayling	Hipparchia semele	BU	1			1			1	0.20%	1.30%	1
Peacock	Inachis io	BU	13	1		3	11	4	20	3.07%	16.88%	15
Small Copper	Lycaena phlaeas	BU	12	2	5	3	4	2	16	3.07%	15.58%	15
Meadow Brown	Maniola jurtina	BU	42		37	196	21		254	11.04%	54.55%	54
Speckled Wood	Pararge aegeria	BU	2			4			4	0.41%	2.60%	2
Large White	Pieris brassicae	BU	3		1	2			3	0.61%	3.90%	3
Green-Veined White	Pieris napi	BU	68	212	216	248	161	10	862	31.08%	88.31%	152
Small White	Pieris rapae	BU	10	1	3	35	2		41	2.86%	12.99%	14
Common Blue	Polyommatus icarus	BU	23		29	49	2		78	5.11%	29.87%	25
Red Admiral	Vanessa atalanta	BU	19		11	14	1	1	27	3.89%	24.68%	19
Painted Lady	Vanessa cardui	BU	9		11	3			14	1.84%	11.69%	9
Butterfly species		18		222	395	804	221	17	1673			
Tachina grossa	Tachina grossa	F	2			3	3		6	0.41%	2.60%	2
Honey Bee	Apis mellifera	HB	25	100	42	80	75	1	298	16.56%	32.47%	81
Six-spot Burnet	Zygaena filipendulae	M	1		1				1	0.20%	1.30%	1
Andrena bicolor	Andrena bicolor	SB	1			1			1	0.20%	1.30%	1
Andrena clarkella	Andrena clarkella	SB	2	1			1		2	0.41%	2.60%	2
Andrena haemorrhoe	Andrena haemorrhoe	SB	2	2		1			2	0.41%	2.60%	2
Andrena spp	Andrena spp	SB	4	1	3	1			5	0.82%	5.19%	4
Andrena tarsata	Andrena tarsata	SB	1			1			1	0.20%	1.30%	1
Smooth Faced Furrow Bee	Lasioglossum fratellum	SB	2	1	1				2	0.41%	2.60%	2
White Footed Green Furrow Bee	Lasioglossum leucops	SB	1	1					1	0.20%	1.30%	1
Lasioglossum spp (calceatum, leucozor	Lasioglossum spp (calceatum, leuc	SB	3	1	3				4	0.61%	3.90%	3
Solitary/mining bee species		7		7	8	4	1		19			
Helophilus pendulus	Helophilus pendulus		1	2					2	0.20%	1.30%	1