Concentration and volume of nectar essay

Environment, Ecology

Abstraction

Many old surveies have found that nectar concentration and volume of many angiosperm fluctuates diurnally and bury specifically (Bond and Fyfe 1968: Pham-Delegue et Al. 1991) . It has besides been suggested that this in bend may act upon the forage scheme of many nectivores and possible pollinators. This survey found that the nectar concentration and volume was influenced both dependently and independently by variables 1) works species and 2) clip of twenty-four hours. We found that volume and concentration varies significantly between the two angiosperm species in inquiry Iris pseudocorus L and Rhododendron ponticum L. There is besides important diurnal fluctuation in nectar concentration and volume for both species.

The survey besides tested whether scrounging frequence of 5 Bombus species varied diurnally. We found that the forage frequence was higher for R. ponticum and that diurnal fluctuation in trial frequence was important for both angiosperm species.

Interestingly a tendency between the trial frequences of B. terrestris to both angiosperm species corresponded to the clip of twenty-four hours where nectar was highest for the several flower. There was small noteworthy correlativity between clip of twenty-four hours and trial frequence for the other ascertained Bombus species. Does the sucrose concentration and volume of nectar from the species Iris pseudocorus and Rhododendron ponticum vary diurnally? Does the frequence and diverseness of pollenating Bombus species vary diurnally and inter-specifically?

Introduction

Invasive species Iris pseudocorus L and Rhododendron ponticum L have achieved generative success by set uping mutualistic mutualism with generalist native pollinators such as Bombus species (Arroyo et al. 2004) .

They offer nectar as a wages and a agency of pulling possible pollinators. Bees gage flower attraction in many ways, one being the value of the wages. If a flower does non offer a significant wages its attraction is therefore reduced. It has been suggested that nectar concentration and volume varies inter-specifically and diurnally (Bond and Fyfe 1968: Pham-Delegue et Al. 1991) . Does this impact the trial frequence of Bombus species to the two flowers? This survey will see diurnal fluctuation in nectar concentration and volume of the two species I. pseudocorus and R.

ponticum populating the Isle of Cumbrae. This survey will besides look at whether trial frequence and diverseness of pollinator species from the genus Bombus varies diurnally, and if so whether this is correlated to any prevailing diurnal fluctuation in nectar volume and concentration of the angiosperm species under inquiry. The purpose of this survey is to prove the undermentioned void hypotheses: Ho) – Nectar composing remains the same over the class of the twenty-four hours

1. Secretion rate does non alter
2. Sugar content does non alter

Ho two) – There is no difference between vegetations species

1. volume and rate is the same for both species

2. sugar concentration is the same for both species
3. dinural fluctuation is the same

Ho three) – The trial frequence of Bombus species does non vary inter-specifically or diurnally

Method

Study country

This survey was carried out on The Great Isle of Cumbrae ((55A°45’07? N 4A°55’48? W? / ? 55. 752A°N 4.

930A°W) . Two flower species R. ponticum and I.

pseudocorus were sampled for nectar at several sites over 2 yearss (The location of sites on the Island is described in Figure 1) . Following nectar extraction, each site was observed for 30 proceedingss and the trial frequence of Bombus species, set downing on and imbibing from any I. pseudocorus or R. ponticum flower was recorded. It should be reiterated that the bee had to be observed imbibing from the flower in inquiry. Bees were identified and recorded in a tally. Pseudo-replication may be a possible beginning of mistake in the consequences.

An single bee may hold flown from one site to another or been observed on more than one juncture by different pupils involved in observation. All information was regarded as independent for intents of analysis. R. ponticum nectar was extracted from 5 flowers/inflorescence (bunch) from 5 different workss located on one big site.

Care was taken to sample flowers from different places on the blossoming because upper flowers may incorporate more nectar than lower flowers (Cruden et al. 1983) . Nectar was besides sampled from blossomings at different locations on the works. Different degrees of Sun exposure affect both nectar concentration and volume. Flowers straight exposed to the Sun will probably hold higher concentrations and a lower nectar volume than those in the shadiness (Nepi, M and Pacini, E 2007a) . Iris nectar was collected from 15-20 persons from 3 sites on twenty-four hours 1 and 3 different sites on twenty-four hours 2. Sample sizes from each site were increased from 3 to 5 persons after twenty-four hours 1 to let computation of a more accurate mean.

I. pseudocorus nectar was sampled at six different sites over the 2 yearss because population size at one site was deficient to obtain a big adequate sample size. As a consequence sites were capable to different sun/wind exposure and perchance different dirt types which may impact concentration, and secernment rate. It should be noted that existent sample size may change from pre agreed sample size because some samples were lost or deemed invalid.

Data aggregation

Nectar was collected from both R. ponticum and I. pseudocorus by capillary extraction at 4 different clip points over 2 yearss (10am, 12pm, 14pm, 16pm) .

2 hours prior to nectar extraction, workss were covered with a plastic bag to forestall extraction by pollinators. This presumably allowed sufficient clip for

the several flowers to bring forth and roll up nectar. Plastic bags may bring forth microclimates that addition ambient temperature and humidness and may later impact the rate of station secretory vaporization. It may hold been more appropriate to utilize porous sacking to relieve some of the possible microclimatic influence, but unluckily these were non available.

This is an ineluctable mistake in the consequences but all consequences are every bit biased. Iris nectar was extracted by gently squashing the base of the nectar bank at the vertex of the root. A capillary tubing was used to pipette the nectar from the 6 nectar canals on each flower (2 per petal) . Care was taken non to damage the flower. Once nectar was collected the volume was measured utilizing the dimensions of the capillary tubing (length of nectar x 35Aµl) . It was so expelled onto the home base of a refractometer and the sugar concentration was measured. After measuring, the home base was exhaustively cleaned to avoid taint of subsequent samples.

Datas Analysis

Prior to statistical analysis, the normalcy of informations was tested. Distribution of nectar concentration, for both species was tested for normalcy utilizing the Kolmogorov-Smirnoff trial. The trial produced a p-value & gt ; 0. 05 (p= 0. 15) screening that information does non significantly deviate from normal distribution hence parametric testing can be used.

Kolmogorov-Smirnoff trial was used to prove distribution normalcy of nectar volume. The trial concluded that distribution of informations did significantly

divert from normal. Despite attempts to transform informations (log+1 and Analysis of discrepancy) , normalcy could non be achieved.

2 Way ANOVA (General Linear Model) was performed despite informations for volume being skewed. Consequences for volume should be treated with cautiousness. Pearson ‘ s chi-squared trial was used to prove whether trial frequence of Bombus species varied diurnally.

Consequences

Concentration

A two manner ANOVA indicated that works species had a important consequence on nectar concentration (p= 0. 00) . Time of twenty-four hours besides significantly affected nectar concentration. (p= 0.

013) . Because clip of twenty-four hours and species can consequence concentration dependently every bit good as independently, the significance of clip of day*species was tested. This trial produced a p-value= 0. 000 screening that independent variables clip of twenty-four hours and works species are dependent on one another. The void hypothesis saying that nectar concentration remains the same over the class of the twenty-four hours and that there is no difference between species can be rejected. Speciess type and clip of twenty-four hours significantly act upon nectar concentration both dependently and independently.

Volume

Two manner ANOVA showed that works species significantly affected volume (p= 0. 000) , as did clip of twenty-four hours (p= 0.

004) . Statistical proving besides confirmed that clip of twenty-four hours and species type significantly affect nectar volume dependently every bit good as independently (p= 0. 000) . The void hypothesis can hence be rejected.

Bee species

Pearson ' s chi-squared trial was used to prove whether trial frequence of the 5 observed bee species (unknown bee species excluded) to each of the works species varied diurnally. For I. pseudocorus the difference was important and a P= 0. 001 was produced.

Consequences for R. ponticum were besides statistically important (P= 0. 002) . The void hypothesis can hence be rejected. The frequence of Bombus species does differ significantly diurnally.

Discussion

Previous surveies have found that secernment rate and concentration of nectar varies inter-specifically (Bond and Fyfe 1968: Pham-Delegue et. al 1991) and this is coincident with our findings.

Speciess was a important factor in finding both nectar concentration (p= 0. 000) and volume (p= 0. 000) . R. ponticum has a higher mean concentration than I. pseudocorus for every clip point throughout the twenty-four hours (Figure 4) . I.

pseudocours had a higher mean volume than R. ponticum for every clip point throughout the twenty-four hours (Figure 5) . This information suggests that R. ponticum produces more concentrated nectar in smaller volumes. While

nectar secernment and concentration varies inter-specifically, there are many environmental variables that can act upon secernment and concentration of nectar.

Ambient temperature affects rate of photosynthesis and can lend straight or indirectly to nectar production (Burquez & A ; Corbet 1991 and 1998) . In most species the rate of nectar secernment (quantified by nectar volume) is correlated to temperature (Huber 1956 ; Corbet et Al. 1978) .

Ambient irradiance nevertheless seems to be the most important influential factor (Petanidou & A ; Smets 1996) . Under low light conditions, nectar secernment may diminish well. Both temperature and irradiance fluctuate diurnally which may explicating why in our findings clip of twenty-four hours is a important factor in finding nectar concentration (p & lt ; 0.

013) and volume (p & lt ; 0. 004) . Corolla length and differences in species flower morphology may besides assist explicate some of the differences observed in the consequences. Many flowers have modified corolla length, cut downing surface: volume ratios (Plowright 1987) . Plowright (1987) demonstrated that nectar evaporates more quickly from flowers with a shallow corolla. The flower I. pseudocorus has a comparatively deep corolla. The proboscis of a possible pollinator must be 7mm to make nectar and 15mm to pull out it all (Sutherland 1990) .

The flower of R. ponticum is unfastened, with more open honey glands, increasing its susceptibleness to microclimatic effects. Beament (1979) found that nectar frequently undergoes post-secretory additions in

concentration. This is mostly due to evaporation caused by humidness gradients and high temperatures.

“ A 20 % sucrose solution will lose H2O to all comparative humidness ‘ s below 98 % ” . This accounts for the common negative correlativity between volume and concentration and is likely to be most outstanding at the hottest portion of the twenty-four hours. Figure 2 shows that I. pseudocorus follows this reverse correlativity.

The average volume is highest at 10am (3. 75 Aµl) but the average concentration is lower than at 14pm and 16pm. The average concentration of nectar is highest at 14pm and 16pm when volume is much lower. It is possible that higher volumes in the forenoon could be explained by condensation/due roll uping in the nectar ducts. It is interesting that R. ponticum does non follow this form ; alternatively volume is highest at 2pm (Figure 3) .

Rate of vaporization is besides affected by the presence of waterproofing lipid monolayers on the nectar surfaces and sugar concentration gradients which would change inter-specifically (Corbet, et Al. 1979) . Differences in flower morphology/corolla deepness and their affect on station secretory vaporization in I. pseudocorus and R. ponticum may explicate at least partially the inter-specific differences in nectar volume and concentration observed in the consequences. The consequences are represented diagrammatically in figures 4 and 5. Nectar concentration and volume are likely to act upon the type of pollinator sing the flower.

Bees are more likely to feed and stay at flowers with a big nectar volume than those with a smaller volume (with tantamount concentration) (Harder 1986) . As volume lessenings, nectar becomes harder to make ; this is more noteworthy in species with deep corollas (I. pseudocorus) and for bees with shorter proboscis (tongue) . As a consequence species with deep corollas may counterbalance and bring forth higher volumes of nectar.

Result suggest that this could be true for I. pseudocorus. It has been suggested that humblebees forage so that the net rate of energy consumption is maximised (Waddington 1983) . When given the pick bees will normally choose for nectar that offers the greatest calorific wages (Marden J. H. 1984) . Harder (1986) found that species like Bombus that provender by lapping, show penchant to more concentrated nectars (50-65 %) . Energetic benefit additions with nectar concentration until the cost of a decreased rate of fluid intake ensuing from really syrupy nectar outweighs the wages benefit (Heyneman A.

J 1983) . This is holding with out findings. R. ponticum has a significantly higher entire trial frequence than I. pseudocorus (Entire trial frequence for R. ponticum N= 489, entire trial frequence for I.

pseudocorus N= 195) . This could be explained by the fact that R. ponticum has a higher average nectar concentration and is more attractive in footings of calorific wages. It is besides noteworthy that the flowers are far more abundant and dumbly packed into blossomings, possibly making a more appealing mark. Bees cut down interflower travel in order to conserve energy and be given to travel adjacently from flower to bloom (J. C. Stout) .

R. ponticum may be more attractive in footings of energy saving every bit good as calorific wages. Our consequences show that clip of twenty-four hours and works species are factors that significantly affect the trial frequence of Bombus species. Figures 6 and 7 show the trial frequence of the 5 Bombus species sing the two flower species. The trial frequence of the 5 bee species is non extremely correlated to clip of twenty-four hours. However, in the instance of B. terrestris (the most abundant species) we observed the highest trial frequence to I. pseudocorus at 16pm and to R.

ponticum at 10 and 12pm. Interestingly this increased forage activity coincided with times where nectar concentration was highest for the several flower species. While this could be coinciding, it is plausible that B. terrestris adapts its forage scheme, throughout the twenty-four hours to optimize and forages more at each works species when concentration is highest. This impression is surely coincident with old findings and warrants further survey.

Mentions

- Huber H (1956) ‘ Die abhangigkeit der Nektarsekretion von temperature.

Luft- und Bodendeuchtigkeit. ‘ Planta 48: 47-98

- Chemical bond D. A and Fyfe J. L (1968) ‘ Corolla tubing length and nectar tallness of F1 ruddy trefoil workss (Trifolium pratense) and their seed output following honey bee pollenation. ‘ Journal of Agricultural Science 70: 5-10
- Corbet S.

A (1978) ‘ Bees and nectar of Echium vulgare. ‘ In: Richards J. A erectile dysfunction.

The pollenation of flowers by insects. Newyork: Academic imperativeness.

- Beament J. W. L, Corbet S. A, Prys-Jones O. E, Unwin, D. M, Willmer, P.

G (1979) ‘ Post-secretory determiners of sugar concentration in nectar ‘ . Plant cell & A ; environment, 2: 293-308

- Crunden, R. W, Hermann, S. M, Peterson, S (1983) ‘ Patterns of nectar production and plant-pollinator co-evolution ‘ The biological science of honey glands pg 80-125)
- Heyneman A. J (1983) ‘ Optimal sugar concentrations of flowered nectars- dependance on sugar consumption efficiency and forage costs ‘ Oecologia 60: 198-213
- Waddington K. D (1983) ‘ Foraging behavior of pollinators ‘ Pollination biological science.

Academic imperativeness, New York, 213-239

- Marden J. H (1984) ‘ Remote perceptual experience of flowered nectar by humblebees ‘ Oecologia 64: 232-240
- Harder, L. D (1986) . ‘ Effects of nectar concentration and flower deepness on flower managing efficiency of bumble bees.

‘ Oecologia, 69: 309-315

- Plowright, R. C (1987) ‘ Corolla deepness and nectar concentration: an experimental survey. Canadian Journal of vegetation, 65: 1011-1013

- Sutherland W. J (1990) ‘ Iris pseudocorus (L) ‘ Journal of experimentalaˆ¦aˆ¦
- Le Metayer M, Marilleau R, Mesquida J, Pham-Delegue M. H (1991) ‘ Quantative and qualatitive analysis of rapseed flower nectar (Brassica napus L. var oleifera Metzger) Acta Horticulturae 288: 430-434
- Petanidou T, Smets, E (1996) ‘ Does temperature emphasis induce nectar production in Mediterranean workss? ‘ New Phytologist, 133: 513-518
- Arroyo. J, Crowe T. P, Parnell J. A. N, Stout J. C (2004) ‘ Pollination ecology and seed production of Rhododendron ponticum in native and alien habitiats ‘ Biodiversity and Conservation 15: 755-777
- Nepi, M and Pacini, E (2007a) ‘ Nectar production and presentation ‘ Nepi, M, Nicolson, S. W, Pacini, E, ‘ Nectaries and nectar ‘ Springer pg 200-202
- Google maps (2009) [Internet] Available from: hypertext transfer protocol: //maps. google. co. uk/maps? hl= en & A ; tab= wl (accessed 1st October 2009)