The Long-horned Bee in Cornwall

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Photo : Long-horned Bee *Eucera longicornis* P. Saunders

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Summary of the status of the Long-horned Bee

- The population of Cornish Long-horned Bee has declined from 24 to just 6 sites (75% decrease). The key sites have all been assessed as vulnerable.

- The greatest threat is limited foraging resources. Flowering Legumes are rare, either through abandonment of cliff-top grazing, summer grazing or intensive agriculture.

- Further threats are coastal erosion, resulting in nest site destruction and loss of flower-rich coastal edge habitats.

Ecological requirements

- A narrow range of Legume *Fabaceae* species dominated foraging visits and pollen samples. Kidney vetch *Anthyllis vulneraria*, Everlasting pea *Lathyrus sylvestris*, Meadow vetchling *Lathyrus pratensis* and White clover *Trifolium repens*. The study found that the bee does utilise pollen from other plant families, but it is suspected this is caused by lack of preferred Legumes.

- Continuity of flowering Legume species are needed for 3 - 6 weeks. Within the peak foraging period of about 3 weeks, the bee requires both early flowering Legumes and late flowering Legumes. Most sites had one or the other, rather than both.

- Individual pollen samples were usually dominated by one species. This may indicate a preference for mass flowering Legumes.

- A mystery substance was present in pollen samples during the survey, not previously identified in other studies.

- The bee generally uses south facing soft clay or loess cliffs for nesting, although other aspects can be used. The bee creates substantial nests and they may be reluctant to invest in creating new nest networks. This may make the bee less adaptable and more vulnerable to coastal erosion.

- Foraging range is estimated at 0-700m.

Conservation recommendations

- Summer (May to August) grazing or cutting should not take place on flowering Legume habitats within 0m to 700m of nest sites.

- Create or boost areas of mass flowering vetches 'super-peas', to include Common vetch *Vicia sativa* and Meadow vetchling *Lathyrus pratensis*. If possible, also include Everlasting pea *Lathyrus sylvestris* and Bush vetch *Vicia sepium* to extend flowering period.
- White clover *Trifolium repens* is recommended, but should be used in combination with habitats rich in Kidney vetch *Anthyllis vulneraria*.

Contents

"*The males which delight to play the the wildest games of catch race here and there, round and round, close to the ground. Frequently it all ends in two or more of these bees crashing headlong into each other and getting their antennae badly entwined. Then fastened together, the poor things look so miserable and foolish, lifting their legs and moving their heads from side to side, gently scratching and scraping at their antennae, trying to undo the most complicated muddle*."

Ash (1924)

1.1. Introduction

Patrick Saunders (Kernow Ecology) was supported under the "Kernow rare bee project" banner to survey the Long-horned Bee in Cornwall. The study sought to establish the foraging requirements of this threatened bee to enable targeted conservation work. This study builds on previous survey work by the author.

1.2. Acknowledgements

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2. Methodology

A survey list was compiled using data from ERICA, BWARS and hand-written notes by Spooner (Spooner 1984). This was combined with previous data and field observations in Cornwall by the author (Saunders 2014). Sites were visited between May and August.

The bees were counted during the survey as either nest visits or as a listed flower visit. Pollen samples were taken from either bees going in the nest or from bees caught on flowers. The pollen sampling aimed to get a reasonable number from sites throughout the flight period. Pollen balls were posted for identification by Dr. Judy Webb. It was difficult to collect a large quantity of samples as many nests occurred in 20 ft soft cliffs! Some contamination was possible as pollen was removed in the field.

Key sites were visited at least 3 times over the season. Some sites had repeated all day observations. A number of occasional visits were made to new sites which were not repeated if no bees where present. Will Hawkes made visits to two sites. Although complete coverage of Cornwall was not achieved, most significant Cornish soft cliff and flower rich under-cliff habitats were identified and visited. Other potential sites are listed in Appendix 2.

3.1 The status of the Long-horned Bee in Cornwall

Long-horned Bee *Eucera longicornis* is a nationally declining species on the Section 41 list (JNCC 2007) with its main strongholds being on the coast of SW England and Wales. Previously widespread and locally common in Southern England, it has suffered a serious decline, with less than 30 recent sites in the UK (NBN 2017).

The species occurs on 6 active sites in Cornwall with an additional 7 post 2000 sites where the species is no longer present (Fig.1). A further 11 sites have been recorded historically. The recorded sites are mostly coastal. It is a distinctive bee and is likely the records represent a reasonable fit to the true distribution.

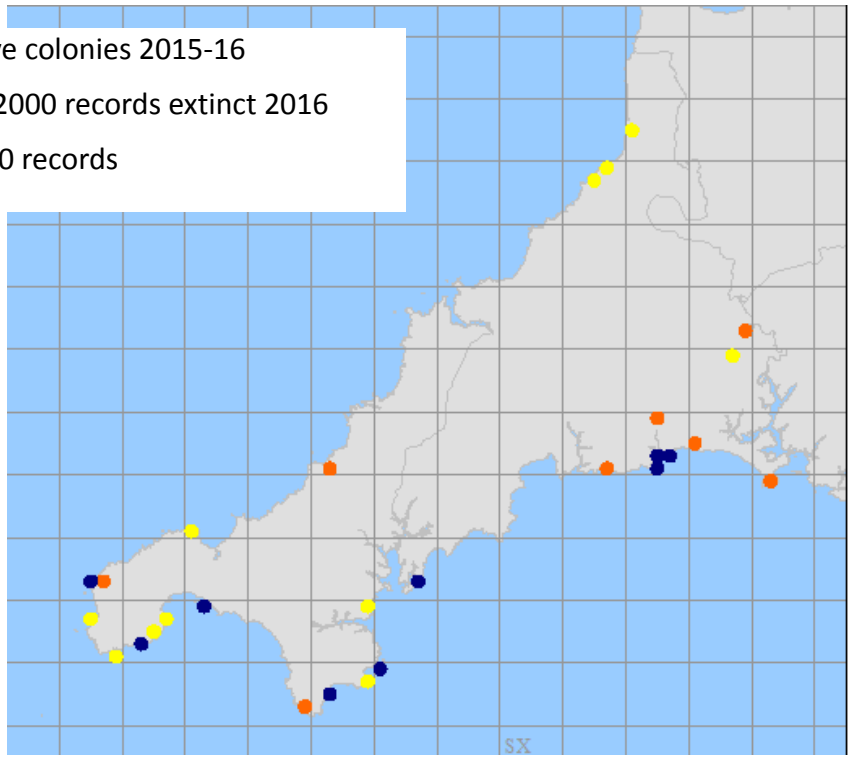
The species is single-brooded usually flying from early-May to mid-July.

Long-horned Bee is considered a pollen specialist, A female provisions a nest cell with Legume pollen in a soup of nectar which her larvae use to develop on until adult-hood. (Peeters 2012) (Falk 2015). (See **Foraging ecology**).

It nests in aggregations generally in vertical sheltered bare-ground. Most of the Cornish sites are coastal soft rock cliffs with a southerly or south-easterly aspect (see **Nest requirements**).

The only UK site for its extremely rare cleptoparasite, The Six-banded Nomad Bee *Nomada sexifaciata*, occurs in South Devon. In the 1900's The Six-banded Nomad Bee was found alongside Long-horned Bee at Mousehole and Newlyn (Clark.J 1906). But this bee should be considered extinct in Cornwall.

Fig. 1 Distribution of the Long-horned Bee in Cornwall



3.2. Key sites

The bee occurs on 6 key sites and 1 additional site which may have a small population. 5 additional sites were identified for future survey (Appendix 2). Although these sites are unlikely to hold large colonies. On 16 locations the bee is assessed to be probably extinct.

Table 1. Key sites

Site Name	First	Last	Top count	Flight period Weeks	Average female count	Status
Kenidjack SW355323	04/Jun	05/Jul	50	6	11.75	Vulnerable - Excellent spring forage, poor later forage. Very restricted nesting habitat
Towan SW868326	09/Jun	04/Jul	30	5	9.4	Vulnerable - Forage restricted to small area. Nesting habitat threatened by coastal erosion.
Lowland Point SW8019	23/May	14/Jul	21	8	27	Vulnerable - Could be one of the strongest sites in UK. But main foraging habitat extremely limited by high grazing levels.
St Loy SW4223	06/Jun	05/Jul	21	6	8.5	Vulnerable - Excellent spring forage, very poor later forage.
Looe (East and West) SX2553	28/May	05/Aug	15	10	4.25	Vulnerable - Early forage limited. East Looe nesting habitat threatened by coastal erosion. Population could become more viable if colony in West Looe becomes established.
Perranuthoe SW534293	25/May	08/Jul	8	7	5.5	Vulnerable - Mid/late forage restricted to small area. Nesting habitat threatened by coastal erosion.

At Poltesco SW727156 one male was recorded in 2015 but not recorded 2016. Site probably unsuitable for large colony, but small occasional colony may be possible.

3.3. Bee phenology

The survey showed the males tend to emerge about a week before the first females. Which is similar to many other solitary bees. The sites did differ in peak abundance with sites either "Early" or "Late". But first emergence of males was broadly similar on most sites (see Fig. 2). This suggests first emergence may be triggered by thermal/climatic factors, but that peak abundance/activity may be synchronised by forage resources.

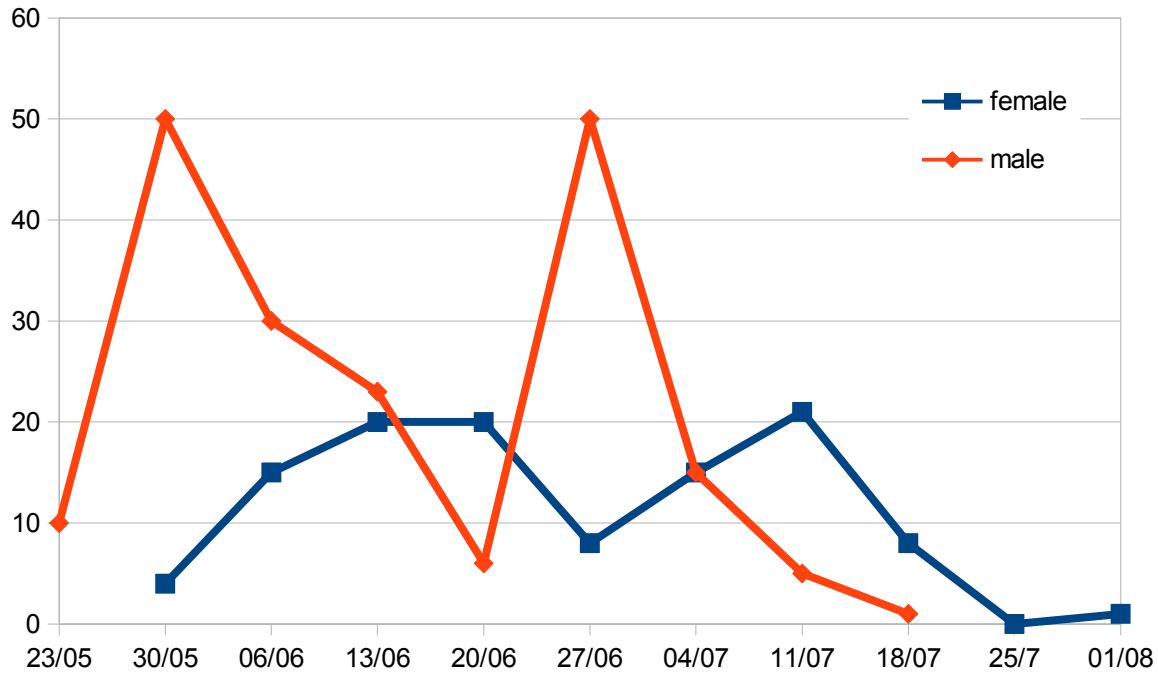
Early sites had abundant Kidney vetch *Anthyllis*. Looe (the latest site) has negligible *Anthyllis* and although females can emerge in May, the main activity occurs in mid July on the late flowering Everlasting pea *Lathyrus sylvestris*. It could be that on early sites females get rapidly worn out by intense nest building/foraging. However on the later sites the females are less active in June, and could even go "back to bed" to wait for flowers to become available. The males also seem to synchronise their peak activity on late sites (see Fig. 2).

The females mate once and there is strong selective pressure for males to mate with the female when she first emerges.

Females are active on most sites for 6 weeks with a peak of foraging activity over 2-3 weeks. This has important implications for site managers ((Fig. 2) and (Fig. 4)).

It was very difficult to make useful observations of nest sites. Only one site wasn't a vertical cliff and much activity probably occurred underground. The bees quickly made an entrance or exit to given nest hole and had long periods before remerging. The paucity of observations of bees entering nests may indicate the bee is on prolonged foraging trips.

Fig. 2. Highest count per week by sex 2015-2016



4. Foraging ecology

4.1. Conclusions

The Long horned bee is generally considered a Legume specialist (Peeters 2012). Within the Legumes there is evidence of narrower preferences. In England, Meadow vetchling *Lathyrus pratensis* (Baldock 2008). In the Netherlands, Clover *Trifolium*, Trefoil *Lotus*, Lucerne *Medicago sativa* and Vetches *Vicia* (Peeters 2012). In Germany, Bush vetch *Vicia sepium*, Tufted vetch *Vicia cracca*, Meadow vetchling *Lathyrus pratensis*, Everlasting pea *Lathyrus sylvestris*, Tuberous pea *Lathyrus tuberoses*, Clovers *Trifolium*, Lucerne *Medicago sativa* (Westrich 2016). The Legume family is important for other large bees including the rare bumblebees (Goulson 2004). This is probably because the family has high quality pollen with high protein content.

- This study confirmed specialism. 90% of samples had Major (>30%) content of Legume family pollen. The results suggest further specialisms particularly on Vetches. Kidney vetch *Anthyllis*, Everlasting pea *Lathyrus sylvestris*, Meadow vetchling *Lathyrus pratensis* and White clover *Trifolium repens* being very important foraging resources (Table 2).

- Surprisingly 12.5% of pollen samples had Major (>30%) content from non-Legume plant families. The samples also contained non Legumes as minor resources. It is thought this represents "desperation" rather than choice. Although mixing of abundant and accessible pollen of sub-optimal nutritional value may be also being practised.

- The samples mostly were dominated by one species. With average content per species 67% in 2016 samples (excluding trace (<2 %) content). This may indicate a preference for mass flowering Legumes.

- The foraging observation suggested phenology of Legume resources on a given site was a important factor, with specific early and later legumes needed over a 3-6 period (Fig. 4).

- Foraging range is estimated at 0-700m. Although the survey suggests dispersal can occur at 8 km. (Foraging range is the maximum distance the bee travels from nest to flower resources. Dispersal distance is the distance females may fly to establish new colonies)

4.2. Methods

The foraging data was compiled by two methods. 1. Counts from 92 field visits between 2009 to 2016. 2. Pollen samples collected from bees between 2014 to 2016 were identified by Dr. J. Webb. Pollen grains are difficult to identify, these were identified to either genus, species or taxon group pragmatically. For example some clover pollen was identified as *Trifolium repens* and *Trifolium pratense* but other pollen could only be assigned as Trifolium/*Medicago*.

Pollen was classed by content within each sample as Major (>30%), Minor (<30%) and Trace (<5%).

4.3.1. Results graphs

Fig. 3. Total foraging observations and pollen samples 2009-2016

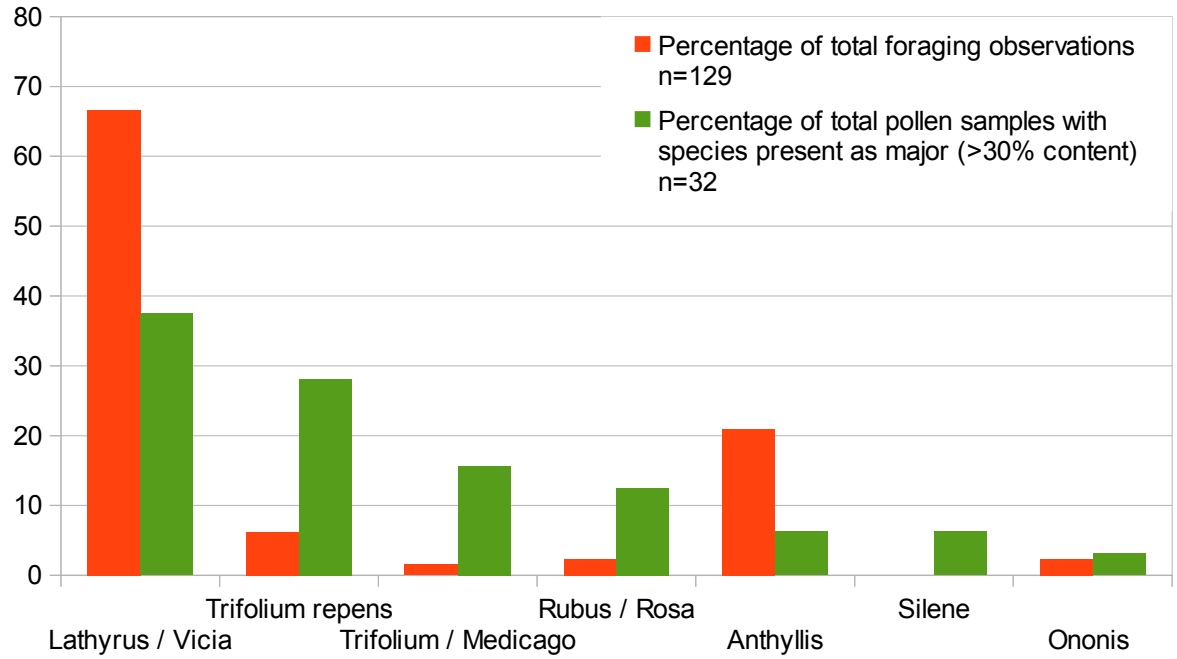
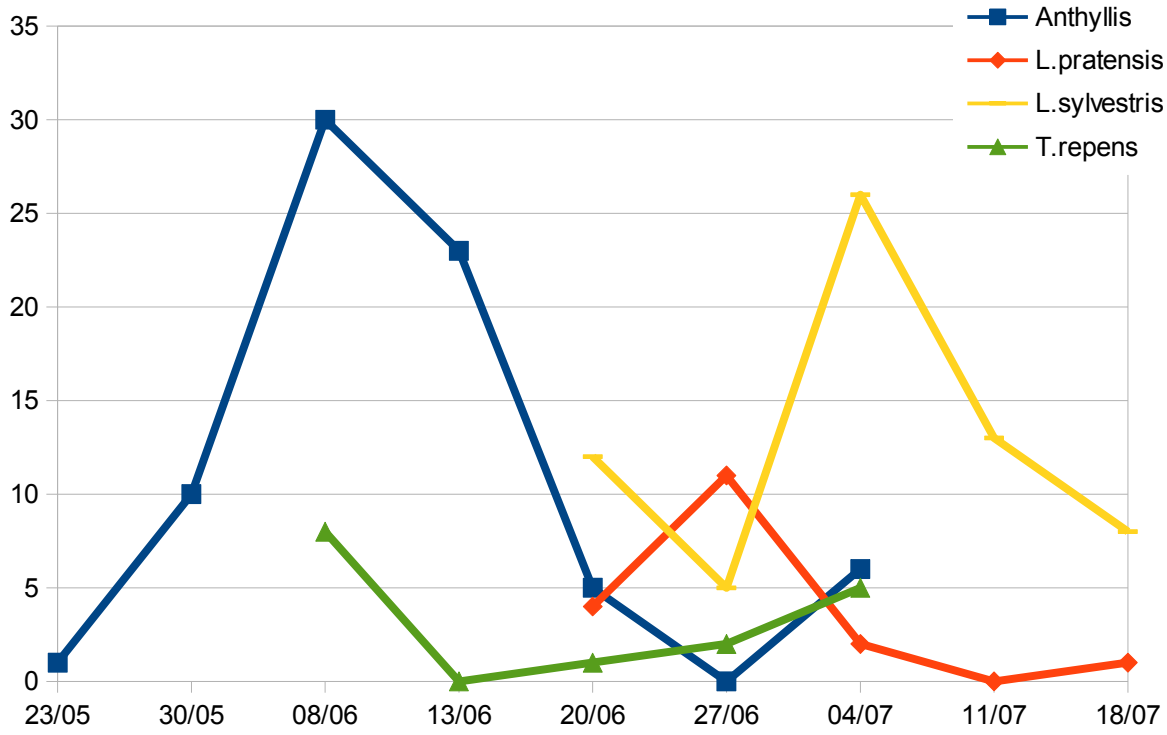


Fig. 4. Total foraging observations per week 2009-2016
Graph excludes species with less than 3 observations. N=192



4.3.2. Results tables

Table 2. Combined foraging data and pollen sample data
The pollen data is a count of total number of samples where a named pollen was recorded with >30% major content. The percentage is taken from this count.

	Foraging observations by plant class		**Pollen samples: Major (>30%) content**		**Foraging observations by species**		
Taxon class	Count	% of total	Count	% of samples with Major (n=32)		Count	% of total
Lathyrus/Vicia	86	66.7	12	37.5	*L.sylvestris*	59	45.7
Trifolium rep	8	6.2	9	28.1	*A.vulneraria*	27	20.9
Trifolium/Medicago	2	1.6	5	15.6	*L.pratensis*	16	12.4
Rubus/Rosa	3	2.3	4	12.5	*T. repens*	8	6.2
Anthyllis	27	20.9	2	6.3	*V.cracca*	5	3.9
Silene	0	0	2	6.3	*O. repens*	3	2.3
Ononis	3	2.3	1	3.1	*R. fructicosus*	3	2.3
Total Result	129		35		*L.linifolius*	2	1.6
					T. pratense	2	1.6
					V. sepium.	2	1.6
					L.latifolius	1	0.8
					V.sativa	1	0.8
					Total Result	**129**	

Table 3. Pollen samples classed as Minor (<30%) 2009-2016

Taxon class	**Minor**	**%**
Trifolium/Medicago	3	9.4
Lathyrus/Vicia	2	6.3
Lotus	2	6.3
Hyacinthoides/Scilla	1	3.1
Ligustrum	1	3.1
Total Result	8	

4.4. Analysis

4.4.1. Major pollen

Vetch *Lathyrus*/*Vicia* was a major constituent of 36% of pollen samples and 66% of field observations. The field observations suggested *Lathyrus sylvestris* and *Lathyrus pratensis* as being the most important forage species, despite *Vicia* and *Lathyrus* occurring less on sites than other Legumes. *Lathyrus* and *Vicia* pollen is structurally very similar (Westrich per comm.) suggesting *Lathyrus* and *Vicia* species may be of similar nutrient value or importance.

Clover *Trifolium* was a major constituent of 42.5% pollen samples. *Trifolium repens* was identified as the most important of the genus. *Trifolium pratense* was surprisingly poorly accounted for in the pollen samples. The smaller *Trifolium*/*Medicago* class is an important resource but not clearly identified to species. It may have been small yellow Legumes such Black Medick *Medicago lupulina* which was common on sites, but could even be smaller *Trifolium repens* varieties.

Kidney vetch *Anthyllis* was a important pollen resource with 27% of observations, but was only a major constituent of 6% of samples. It is suspected if more samples had been collected in the week 1 or 2 of the flight period on "early" sites the percentage would have been higher.

The presence of non Legumes as major resources was unusual as *Trifolium repens* has over twice the mean protein content than *Rubus fructicosus* (Hanley 2008). Praz (2008) suggests some pollen possesses protective properties that hamper digestion and that specialized bees can fail to develop on non-host pollen.

Bramble *Rubus sp.* occurred in 3 observations and in 17% of 2016 pollen. It occurred in samples from 2 sites (mostly Lowland point). This is likely to be because Summer grazing and topping of Lowland point had almost eliminated Legume resources by mid July.

Silene occured as a major in 2 samples from one site (St. Loy). This site had almost no Legume resources after the *Anthyllis* had finished in June. This probably was Red campion *Silene dioica* or Sea campion *Silene uniflora*. Both were very abundant on all sites.

4.4.2. Minor and Rare pollen

In the Minor forage class, Squill or Bluebell *Hyacinthoides* / *Scilla* occured in 3% of total samples and Wild privet *Ligustrum* occurred in one sample at 5% of total content. Both plants were extremely common. This could be examples of the bee collecting small amounts of sub-optimal pollen whilst fuelling up on nectar, as they were very abundant and good nectar sources. Research suggest mixing pollen is a possible strategy to optimize larval food quality. " The larvae can benefit from the nutrient content of unfavourable pollen without being negatively affected by its unfavourable chemical properties if such pollen is mixed with favourable pollen "(Eckhardt 2014).

Birdsfoot trefoil *Lotus* was not a major Legume resource despite being common at many sites. Conclusions are difficult with Restharrow *Ononis* as it is local or rare on all sites.

Trace was the most diverse category with at least 23 species recorded, that total might have been even higher had the 2014/15 samples had more detailed examination. Much of this pollen is likely to represent contamination by windblown or other insects, rather than actual visits by this bee.

4.4.3. Nectar

While nectar is an important requirement to sustain adult activity, the bee also stores nectar for larval development. "The cells are two-fifths filled with a syrupy broth of pollen that might consist of dilute nectar" (Peeters 2012). This is also confirmed in other *Eucerine sp* (Miliczky 1985). The Long horned bee mix pollen with nectar whilst foraging possibly "to make it more sticky allowing larger quantites to be carried" (Falk 2015).

The high diversity of trace pollen in the samples may suggest the bee is utilising a wider variety of nectar plants than pollen plants.

4.4.4. Phenology of flowers

Phenology of Legume resources on a given site was a important factor (Fig.4.). With bees having a narrow window to forage on Early forage resources such as *Anthyllis*. At St. Loy by 11/6/16 at least 90% of *Anthyllis* flowers had finished flowering. The data probably under represents the importance of *Vicia sativa* for forage continuity. At Towan on the 9/6/16, abundant *Vicia sativa* occurred whereas the same patch in July had high abundance of *Lathyrus pratensis*.

4.4.5. Mystery substance

Of 32 pollen samples 8 contained a yellow substance possibly oil (Webb per comm). This could be a important conservation or resource requirement of the bee. This is a hitherto unknown aspect of Long-horned Bee ecology resulting from this survey. A future output of this research is to investigate what this substance is.

Picture 1. Long-horned Bee nectaring on White clover *Trifolium repans*

Picture 2. Long-horned Bee collecting pollen on Meadow vetchling *Lathyrus pratensis.* Note the pollen is in tight "sticky" ball rather than dry grains.

4.4.6. Foraging and dispersal

Foraging range is a maximum distance that a female bee can go from her nest to forage for pollen (or nectar) and then return to her nest. Dispersal Range is a measure of how far individuals can fly from the natal site to establish a new nesting site (Roberts 2017).

Greenleaf (2007) established a link between Inter-Tegular Distance and maximum foraging range. Stuart Roberts has calculated the maximum foraging range based on Greenleaf formulae for the Long-horned Bee at 2.8km (Roberts 2017, in litt). Zurbuchen et al (2010 a) found the maximum foraging distance was 1.4 km for *Hoplitis adunca* (slightly smaller in size than the Long-horned Bee), but found 50% did not forage at distances longer than 300m. Research emphasises the importance of forage resources being close to the nest to optimise larval provisioning (Zurbuchen et al 2010 b).

At the East Looe site, the bee has only been observed within a discrete strip of *Lathyrus sylvestris* about 500m long. They have not been observed at the other nearest potential foraging areas of *Lathyrus* located about 500 -700m away.

A female was observed foraging 300m away from the West Looe nest. At Towan, the nests were found about 700m away from the main foraging patch. At Perrathuoe observed foraging occurred at max of 200m. At Lowland point, several bees were seen foraging about 700m from nest sites.

This suggests 700m may a be a good estimate of optimal or effective forage range. Optimal forage range in this sense refers to the estimated distance they could go and still forage effectively.

Dispersal distance may be suggested from the survey. A colony appeared for a year in sub-optimal habitat in Looe area about 8km North from the only known colony and one individual bee were recorded about 6km East from the colony. Both sites have been monitored over 3 years. This suggests the bee can disperse over quite long distances.

5. Nest requirements

Most nests observed were in long sections of soft vertical cliffs with a prevailing south or south-easterly facing aspect. The bee was found in other situations: at Kenidjack the bee was found nesting at all aspects and in flat compacted ground. The bee was found nesting at a small inland 1.5m high vertical clay bank at Lowland point. The extinct inland colony at Luckett probably utilised a similar low bank.

In one excavated nest soil layering was observed, whereby the upper tunnel occurred within a layer of compacted clay and lower sections were made in more friable material. Bouwman (1907) comments on an excavated nest . "They showed particular fondness for rock-hard, brown black humus sandstone, between 2 layers of sand". There may be subtle soil requirements by this bee, but most of the observed nests looked like typical soft rock cliffs with mixtures of clay and loess and few conclusions were made.

Some nest holes were left open, some sealed by females, with the average hole size about 7mm. The nests appeared to be substantial structures with branched tunnels to one or more chambers. One excavated tunnel was at least 15cm also suggested by (Ash 1924). Many nest tunnels curved away at angles from the entrance hole. Sakagami (1976) comments on a closely related Eucera. "In most nests the main burrow is first vertical, then bends gently or acutely. From this horizontal section several vertical laterals descend, each ending in a vertical cell" (Sakagami 1976).

"The cells are substantially egg-shaped and stand vertically in the ground. They are sealed with a spiral covering of loamy material. The cells are two-fifths filled with a syrupy broth pollen that might consist of dilute nectar." (Peeters 2012). In some nests the remains of old cells were found near or in the extensive burrows, suggesting reuse of the nests, as suggested in (Sakagami 1976). There was little excavated soil near nests, which again may suggest recycling of existing structures.

The nests were entered usually by single females, although on 2 occasions multiple females were found occupying the same nest. Nielsen found a nest in which the main corridor was divided, which may indicate a communal way of life (Peeters 2012). In Japan, similar has been observed (Sakagami 1976).

The bees must invest significant energy and resources in nest building. In West Looe over 2009-2016 despite good foraging resources and significant areas of soft cliff the author has only found the females nesting once, Perhaps the investment in creating new tunnel networks makes the bee reluctant or slow to establish new colonies?

The nests were deep enough to avoid superficial erosion, but the coastal nest sites were at great risk of extreme seas or near cliff seepages creating landslips. The entire colony at Lansallos has probably become extinct as a result of a landslip and one nest aggregation at Towan was probably destroyed by similar landslips.

Picture 3. Probable old nest aggregations exposed by coastal erosion
Note long branched tunnels can be observed. Sometimes old pupal cases were observed and these were often snugly at the end of old tunnels.

Picture 4. Typical nest site coastal soft cliff, clay south to south east facing. Nest in 2016 found high on cliff. In 2015 nest aggregation lower down, this had been destroyed by coastal erosion.

6. Conservation guidance

The Long-horned Bee is threatened by the shortage of Legume rich habitats within 700m of nest sites. The bee is likely to need large quantities of Legumes. Large Legume specialist bee *Megachile parietina* was estimated to need 28,475 flowers or 107 plants to produce 10 brood cells (Muller 2006).

A super food of mass flowering vetches to mainly include Meadow vetchling *Lathyrus pratensis* and Common vetch *Vicia sativa* should be the main priority. If possible, also include Everlasting pea *Lathyrus sylvestris* and Bush vetch *Vicia sepium* to extend flowering period. Standard meadow mixes with a low density of mixed legumes will probably not be as effective as Super food mixes but will provide foraging resources for the bee.

Vetches *Vicia* and *Lathyrus* usually occur in tall grassland, hedgerows or ruderal habitats, with infrequent cutting or grazing regimes. The author has observed *Lathyrus* and *Vicia* is preferentially grazed and in these circumstances produces few flowers. Extensive summer grazing is unlikely to create suitable mass flowering vetch.

Easy and cheap pollen and nectar WM2 mixes (Nowakowski 2016) or even White clover leys are likely to be effective. Although the bee is likely to need additional early and late Legume rich habitat.

Agricultural crops such as Broad beans *Vicia faba* could also be effective. Agricultural forage vetch mixes with Spring Triticale could also be recomended as cover crops with value for this bee. Further agri-environment options are listed in Buglife (2017).

Protect existing Kidney vetch *Anthyllis vulneraria*. This plant is also very vulnerable to summer grazing.

Everlasting pea *Lathyrus sylvestris* is suitable for low input coastal bracken rich scrubby sites with only annual or biannual cutting regimes, where grazing is difficult.

Table 4. Habitat features to conserve ; Aim for a mix of Early, Mid & Late flowers

Type of resource		**Comment**
Nest sites		Difficult to create or conserve. Although inland nest site creation could be attempted on some sites
Vetch-rich ruderal habitats	Mid & Late	Graze or cut between 25/7 at earliest to 15/5 at latest. One annual cut may be enough.
Clover leys or Pollen and nectar margins	Mid only	Graze or cut between 25/7 at earliest to 15/5 at latest
Legume rich meadows	Mid & Late	Graze or cut between 25/7 at earliest to 15/5 at latest
Kidney vetch rich Maritime grassland or under-cliff	Early only	Scrub cut. If possible Graze or cut between 25/7 at earliest to 15/5 at latest
Agricultural crops Broad beans and Forage vetch	Mid ?	Should be promoted as good compromise between farming and conservation

Picture 5. Arable margin rich in White clover *Trifolium repens*. Important late foraging resource for the Long horned bee after Kidney vetch on the under cliff has finished.

Picture 6. Lowland point grazing has reduced the extremely rich coastal meadows to virtually non existent flower resources. Note the only flowering Legumes exist around cow pats where the cattle are reluctant to graze. On this date/site the pollen samples came back as dominated by *Rubus*.

7. Descriptions of key sites

Kenidjack (SW355323)
Small nesting area in sheltered valley on North coast of West Penwith. Close to the nests foraging area consists of maritime grassland with very abundant *Anthyllis* and small amounts of other Legume. Inland, the area is dominated by Bracken and other scrub types with poor other forage resources, although some Legume occurred on the Golf course further away.

Towan (SW868326)
Extensive area of soft cliff. Area of under-cliff with *Anthyllis* is small. Inland habitats very poor either topped and grazed in June/July or intensive arable. One small patch of very good forage occurred in a field margin. restricted to small area. Nesting habitat threatened by coastal erosion.

Lowland Point (SW8019)
Extensive area of soft cliff. Inland excellent areas of Legume occurred in meadows. Should be the best site in Cornwall but meadows topped and grazed in June and had worryingly few resources in the peak foraging period.

St Loy (SW4223)
Large area of suitable south facing soft cliff. Good abundance of *Anthyllis* on under-cliff areas. Inland areas very Legume poor. Dominated by scrub and bracken habitats. Other possible habitats occur in coastal gardens but these are very formally managed with exotic plantings. Further inland intensive arable habitats occur with no field margins.

Looe (East and West) (SX2553)
East Looe side has a small area of high soft cliff. Good abundance of *Lathyrus sylvestris* on cliff margins but little other forage. Suburban gardens and amenity grassland nearby. West Looe has a larger area of soft cliff with good abundance of *Vicia* and *Lathyrus* on the sea wall. Very large area of potential nesting habitat, but females only observed in 2015. Larger areas of Legume rich fields occur. Although in 2015 these had high grazing pressure. In 2016 the grazing started later by request of the author and the site was very rich in flowering Legumes.

Perranuthoe (SW534293)
Large area of suitable soft cliff. Good abundance of *Anthyllis* on under-cliffs. Inland habitats poor dominated by arable habitats or scrub habitats. Field margins rich in *Trifolium* and occasional *Lathyrus* although the areas are small and vulnerable to change in arable planting.

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Appendix 1. Kernow Rare Bee Project 2016 and 2017

The Kernow Rare Bee Project was supported with a small amount of funding considerable achievements were made.

- Survey and report The ecology of the Long-horned Bee in Cornwall.
- Survey of Large Scabious Bee *Andrena hattorfiana* (records submitted to written report by Will Hawkes Buglife).
- The project identified a new large site for Large Scabious Bee in Cornwall.
- Advice to site managers (ongoing).
- Meet and Talk to NT warden team (twice).
- c.a. 1000 plants grown for planting schemes in 2016.
- Large meadow creation with 2kg of yellow rattle seed sown and Long Horn "super bean" areas on East Looe Downs for Long Horned Mining Bee. (Spring 2017 areas doing well).
- Public participation in East Looe Downs planting days in 2015/14.
- Public awareness in pollinators East Looe Downs (reported in Cornish times East Looe town trust website and numerous members of the public meet in person whilst planting the site).
- Planting day and continued boosting of flower resources at Towan NT.
- Scabious planting day at Holywell NT for Large Scabious Bee.
- One practical management day with the public in West Looe.
- Pollinator project development with AONB project team.
- West looe site foraging habitat significantly improved due to meeting and discussions with Landowners/managers in West Looe.
- Awareness raising at Cornwall College, students did various Long-horned Bee activities and will be growing plants for the project.

Appendix 2. Survey list

Possible sites				
Chynhalls Point	SW7817	1977	Possible site for colonization	May be extension of lowland point, small occasional colony may be possible, mostly hard cliff and scrub habitats,
Downderry Seawall	SX3054	2014	Possible site for colonization	Revisited 2014-16, Excellent area of *Lathyrus* and Soft cliff, but not recorded 2015/16
Talland	SX228513	x	Possible site for colonization	Revisited 2014-16. Some soft cliff and *Lathyrus* fairly close to Looe
Maenporth To Swanpool	SW7929	1991	Possible site for colonization,	not visited, small area of soft cliff and poor coastal grassland
Enys Head, Cadgwith	SW7214	2001	Possible site for colonization	small occasional colony may be possible, not visited, no soft cliff present
Poor sites				
Crackington Haven	SX1496	1951	Unknown but Likely to be extinct	Future survey needed, some quality habitats in area, but probably unlikely to have been unrecorded for 60 years
The Dizzard	SX1698	1951	Unknown Likely to be extinct	Future survey needed, some quality habitats in area, but probably unlikely to have been unrecorded for 60 years
Bude	SS2105	1909	Unknown Likely to be extinct	Future survey needed
Callington	SX3669	1917	Likely to be extinct	No habitat
St.Ives	SW5140	1926	Likely to be extinct	
St Levan	SW3821	1973	Likely to be extinct	Possible future survey, Probably unsuitable, no under-cliff on GIS mapping
Kemyel Crease Reserve	SW4524	1975	Likely to be extinct	Possible out lying colony of St Loy
Between Mousehole And Newlyn	SW4626	1882	Likely to be extinct	Possible future survey, Probably unsuitable
Revellers Coombe, St Agnes	SW7251	2007	Extinct	Revisited 2014-16
Whitesand Bay	SW3526	1905	Extinct	Revisited 2014-16

Luckett	SX3972	1971	Extinct	Revisited 2014-16
Deer Park Luckett	SX3873	2009	Extinct	Revisited 2014-16
Penlee Cwt	SX4349	2009	Extinct	Revisited 2014-16
Caerthillian Lizard	SW6912	2010	Extinct	Revisited 2014-16, site now probably unsuitable, only small area of soft cliff and poor areas of *Vicia*/*Lathyrus*, although larger areas of *Anthyllis* occur.
Lansallos, West Combe	SX1651	2013	Extinct	Revisited 2014-16
Cause land Sta.	SX2459	2013	Extinct	Revisited 2014-16
Flushing to Maelor	SW8133		Not present	Will Hawkes 2016
Rosemullion	SW7927		Not present	Will Hawkes 2016