Report on survey work to establish habitat / resource requirements of *Tapinoma ambiguum* and *Tapinoma erraticum*

Final report 2011

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Hymettus

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Report on survey work to establish habitat / resource requirements of *Tapinoma ambiguum* and *Tapinoma erraticum*

To investigate differences in the habitat / resource requirements of *Tapinoma ambiguum* and *Tapinoma erraticum* at Godlingston Heath, Dorset, over two field seasons. The hypothesis that *T. ambiguum* favours vegetation communities on wetter peat and *T. erraticum* favours those on drier sand is to be tested.

Status of *Tapinoma ambiguum* and *Tapinoma erraticum*

Tapinoma ambiguum and *Tapinoma erraticum* are both BAP (2007) species. Loss of known colonies/areas has been reported by several ant workers over most of known range of *Tapinoma erraticum* (jncc 2009). Both the *Tapinoma* have a southerly distribution in the UK. The name *Tapinoma erraticum* has been applied to both species as the two species have only recently been recognised, as they are difficult to separate.

T. ambiguum has been recorded in Purbeck area and an isolated record in Greater London (NBN). Little is known about the habitat requirements of this species although some field workers have suspected it has a preference for wetter sites than *erraticum.*

Contents

1. Summary

1.1 Summary of habitat and soils collected during the survey

- Pearson Chi-Square test on data collected in 2011 quadrats showed there was an significant association between dominant soil type and *Tapinoma* nests (Pearson Chi-Square = 95.139, DF = 3, P-Value = 0.000), with *Tapinoma ambiguum* nests occuring more often in sandy soils than the control. In 58% of nest quadrats the dominant soil type was recorded as Sandy (n=90). In the 2010 survey 9 Tapinoma records occurred on Sandy soil whereas 7 occurred on Peat (n=25)

- There was a significant difference between the recorded soil humidity of the nest sites and the control. Kruskal-Wallis *(H = 99.79 DF = 1 P = 0.000).Tapinoma ambiguum* nests had an average humidity lower than the controls.

- The hypothesis that *T. ambiguum* favours vegetation communities on wetter peat and *T. erraticum* favours those on drier sand is untrue based on this research on Godlingston. References reinforce a link between *T.ambiguum* and sandy sites in Europe: "*T.erraticum* does not occur in sandy sites and *T.ambiguum* does" (Dekoninck et al 2007b)(Seifert B, 2007)

- There was a significant difference between the recorded bare ground of the nest sites and the control. Kruskal-Wallis (H = 73.74 DF = 1 P = 0.000). *Tapinoma* nests occurred on quadrats with a higher average bare ground than the control. (av. 37.7 %). Tapinoma nest sites also occurred over a wider bare ground gradient than the control. (Variance Nest 766.4 Control 60.9)

- There was a significant difference between the soil temperature of the nest sites and the control *Kruskal-Wallis* (H = 74.63 DF = 1 P = 0.000).*Tapinoma* nest sites occurred on sites with higher soil temperatures than the control.

- The 2011 research found some association between soil / hydrology diversity and *Tapinoma ambiguum nest*s. Six soil types where recorded in the nest quadrats and four soil types were recorded in the control. *Tapinoma* nest quadrats also occurred over a wider humidity gradient than the control (variance nest 23.3 variance control 3.3). Field observations during the survey also suggest there was a relationship between greater surface soil diversity and presence of *Tapinoma ambiguum nests*.

- There was a significant difference between the *Molinia* coverage of *Tapinoma* nests and the control (*Kruskal-Wallis* H = 35.74 DF = 1 P = 0.000). *Tapinoma ambiguum* nest quadrats had a lower coverage of *Molinia* than the control. There were no other significant relationships found between vegetation structure and *Tapinoma* nests. It is suspected the presence of bare ground is a more important factor than the absence of *Molinia* although this has not been confirmed.

1.2 Summary of autecology of Tapinoma

- *Tapinoma ambiguum* was found on this survey to be widely scattered over Godlingston Heath. *Tapinoma erraticum* was not recorded on Godlingston. This may be a example of mutual exclusion. Maes studied wet heathland in Belgium (Maes et al. 2003), He found both *Tapinoma sp.* but never both species on the same site (Maes Per. Comm. 2011).*Tapinoma ambiguum* was also recorded at Hartland Moor NNR (SY963852) and Stoborough & Creech Heaths RSPB (SY925843)

- *Tapinoma ambiguum* diet was found on this survey to be relatively unspecific, consisting mostly of arthropods from a variety of groups. (Table 2. lists the observed prey)

- *Tapinoma ambiguum* was found within this survey to forage mainly within 2m from the nest, although was observed to forage 5m.

- *Tapinoma ambiguum* colonies were observed in the survey to move nests readily. This survey suggests *T.ambiguum* move nests in the region of 5m. It probably is finding a temporary niche between other ant species as suggested for *T.erraticum* by Deffernez et al (1990). This niche space must allow for sufficient opportunity to build up a populous nest then *Tapinoma* can become more dominant over other ant species.

- Two thirds of nests found on the survey had a solarium. These appeared to be the more mature established nests. These nests had a greater persistence than the nests without obvious constructions. Most nests used vegetation features such as natural hummocks/tussocks for nest constructions, although in several considerable effort was made to construct the nest with plant / sand material.

- Nest sites found on this survey appeared to occur in areas of higher habitat diversity between dry and wet heath features.*T.ambiguum* was not found associated with large areas of homogenous dry heath in the Godlingston area.

- In various European studies *T. ambiguum* is strongly associated with wet and dry heathland type habitats. Whereas *T.erraticum* occurs in a wider range of habitats.

- Large heaths with greater connectivity such as Godlingston have more diverse niches and are more likely to support a more specialised ant species than small and fragmented heaths (Maes et al. 2003). *Tapinoma erraticum* sites in Devon were small and very fragmented.

2. Methodology

2.1 Methodology 2010
Initially effort was made to relocate previous records. The main survey consisted of surveying Godlingston Heath in its entirety for individual *Tapinoma.* Having located either an individual or colony the soil type, vegetation type and eight figure grid reference was recorded and a voucher/s specimen was taken. Where there was a colony or a number of individuals the location of the find was marked and where possible both at 50m and 100m N,E,S,W, of the initial record a search was made and soil type, vegetation type and eight figure grid reference was recorded.

The survey tried to get a reasonable spread over the heath in its entirety. Random stops were made widely distributed over the large heath. (See map for spread of records). Some stops were made in areas thought to be more suitable for ants.
The Godlingston sites were surveyed on 18/5/10-19/5- 20/5/10 and-26/7-27/7-28/7-29/7-30/7/10 in 2010. A few extra Purbeck sites were searched for *Tapinoma* on the Hartland moor/Stoborough Heath complex.. Two sites for *Tapinoma* in Devon were searched to find sites for future comparison visits (11/8/10 and 11/8/11)

2.2 Habitats and soils around the nest 2011
Soils, environmental variables and vegetation structure were recorded around the nest. Nine 1m quadrats were located around each of the10 nest sites as in the plan below. The 10 controls were located as a random straight line transect across the heath and examined using 9 quadrats and the same methodology.

Table 1. – Quadrat plan (1msq quadrats centre points on nest or 1m away from nest centre)

NW	N	NE
W	Nest	E
SW	S	SE

1.Surface soils assessed using British Bryology Standard (**ADAS 1985)**
2.Assessment of dominant vegetation type (% cover of dominant vegetation type)
3.% Bare ground
4. Average sward height (mm)
5.Soil temperature
6.Soil humidity (measured using a PMS-714 soil moisture meter)
7.GPS reference (8-figure OS grid)

2.3 Nesting ecology 2011

General observations of nests found in previous survey work. Autecological and nesting habitat study work in the immediate vicinity of the nests.

1. Investigation of what the workers are doing, how and where they are foraging.

2. Repeat visits determining phenology of nests and ant activity.

3. Collection of vouchers.

***Tapinoma* prey**

3. Results habitat and soils

3.1 Soil Sampling

Surface soils from controls and *Tapinoma* nests were assessed using British Bryology Standard (**ADAS 1985)** methology Table 2.. Dominant soil types were then extracted from this Table 3..

Table 2. Tabulated statistics: soil, *Tapinoma*

	Control	Nest	All
Clay	0.00	15.56	7.78
Loamy Peat	10.00	0.00	5.00
Loamy Sand	0.00	28.89	14.44
Peaty Clay	0.00	10.00	5.00
Peaty Loam	20.00	0.00	10.00
Peaty Sand	0.00	10.00	5.00
PeatySilt Clay	20.00	0.00	10.00
Sand	0.00	20.00	10.00
Sandy Peat	50.00	15.56	32.78
All	100.00	100.00	100.00

Cell Contents: % of Column

Table 3. Tabulated statistics: Dominant soil, *Tapinoma*

Rows: Dominant soil Columns: Tapinoma

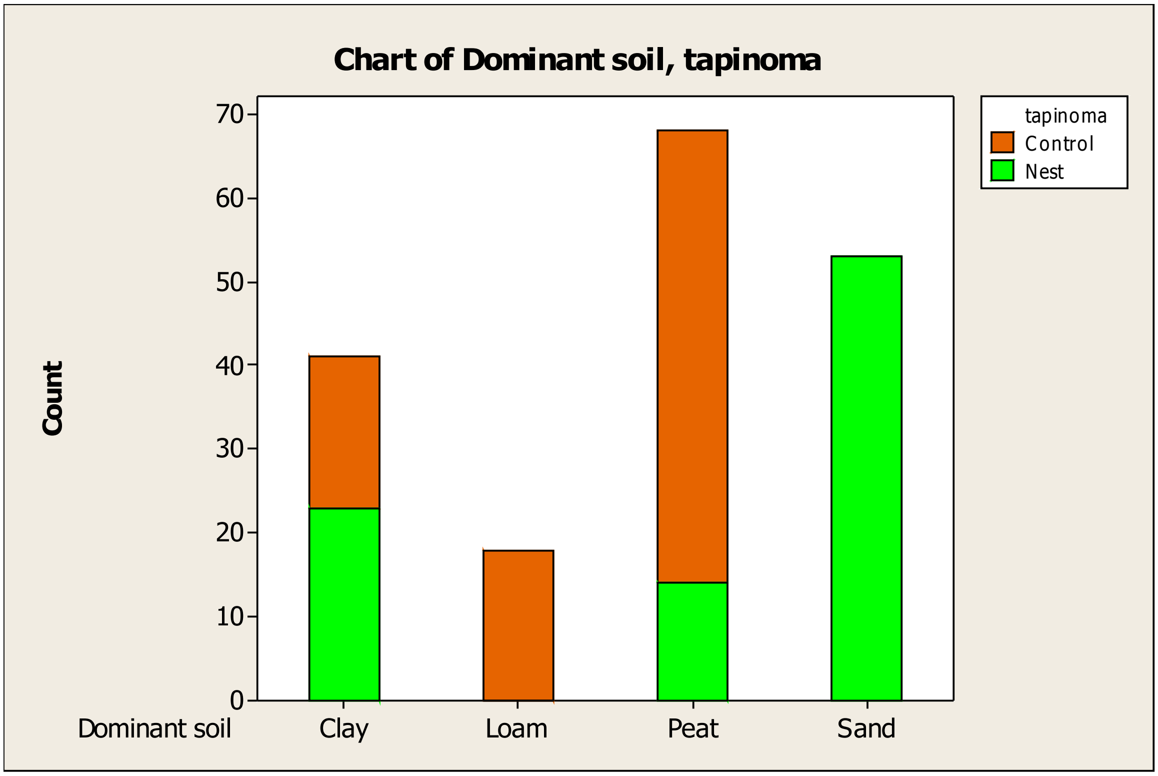
	Control	Nest	All
Clay	18	23	41
	20.50	20.50	41.00
Loam	18	0	18
	9.00	9.00	18.00
Peat	54	14	68
	34.00	34.00	68.00
Sand	0	53	53
	26.50	26.50	53.00
All	90	90	180
	90.00	90.00	180.00

Cell Contents: Count
Expected count

All the Dominant soil data was assessed with a normality test (Anderson Darling) with Mini-tab. The data did not have a normal distribution so a Pearson Chi-Square was calculated.

Pearson Chi-Square = 95.139, DF = 3, P-Value = 0.000
Likelihood Ratio Chi-Square = 124.157, DF = 3, P-Value = 0.000

Figure 1



Conclusion

Pearson Chi-Square test on data collected in 2011 quadrats showed there was a significant association between dominant soil type and *Tapinoma* nests (Pearson Chi-Square = 95.139, DF = 3, P-Value = 0.000), with *Tapinoma ambiguum* nests occuring more frequently in sandy soils than the control. In 58% of nest quadrats the dominant soil type was recorded as Sandy. Six soil types where recorded in the nest quadrats and four soil types were recorded in the control (Table 2.). In the 2010 survey 9 *Tapinoma* records occurred on Sandy soil whereas 7 occurred on Peat (n=25)

3.2 Humidity

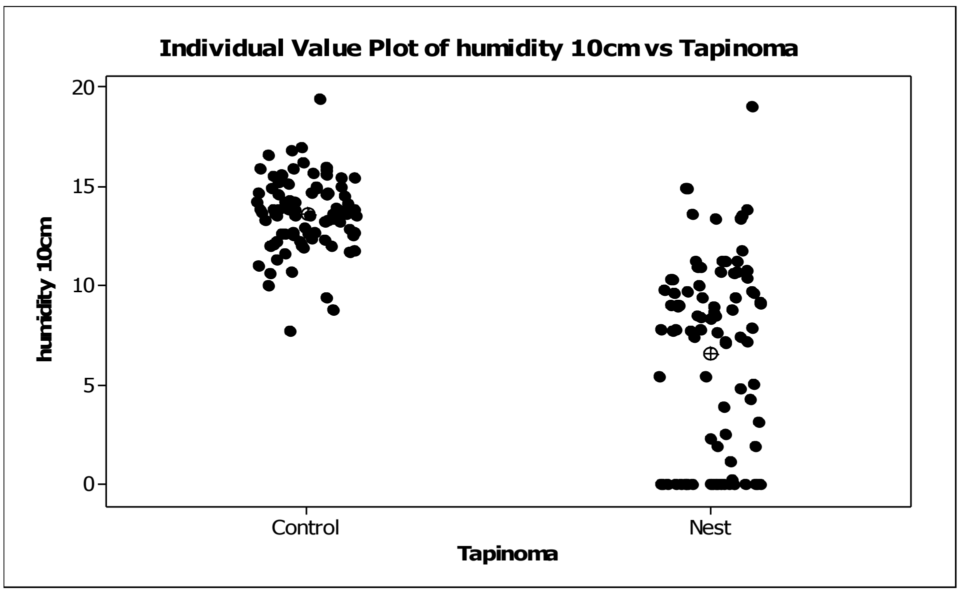
Soil humidity was measured using a PMS-714 soil moisture meter pentretrating to a depth of 5cm both on the nests (n=90) and controls (n=90).

Table 4. Descriptive Statistics: humidity 5cm

Variable	Tapinoma	N	N*	Mean	SE Mean	StDev	Variance	Minimum
humidity 10cm	Control	90	0	13.606	0.194	1.839	3.383	7.700
	Nest	90	0	6.583	0.510	4.837	23.395	0.000000000

Variable	Tapinoma	Q1	Median	Q3	Maximum
humidity 10cm	Control	12.500	13.700	14.750	19.400
	Nest	0.150	7.800	10.075	19.000

Figure.2.



All the humidity data was assessed with a normality test(Anderson Darling) with Mini-tab. The data did not have a normal distribution so a Kruskal-Wallis Test was calculated.

Table 5. Kruskal-Wallis Test: humidity 10cm control versus *Tapinoma*

Kruskal-Wallis Test on humidity 15cm

Tapinoma	N	Median	Ave Rank	Z
Control	90	13.700	129.3	9.98
Nest	90	7.800	51.7	-9.98
Overall	180		90.5	

H = 99.58 DF = 1 P = 0.000
H = 99.79 DF = 1 P = 0.000 (adjusted for ties)

Conclusion

There was a significant difference between the recorded soil humidity of the nest sites (n=90) and the control (n=90). Kruskal-Wallis (H = 99.79 DF = 1 P = 0.000).T*apinoma ambiguum* nests had an average humidity lower than the controls. *Tapinoma* nest quadrats also occurred over a wider humidity gradient than the control (variance nest 23.3 variance control 3.3).

3.3 Bare ground

Bare ground was measured as a percentage cover of nests and controls (n=90).

Figure.3

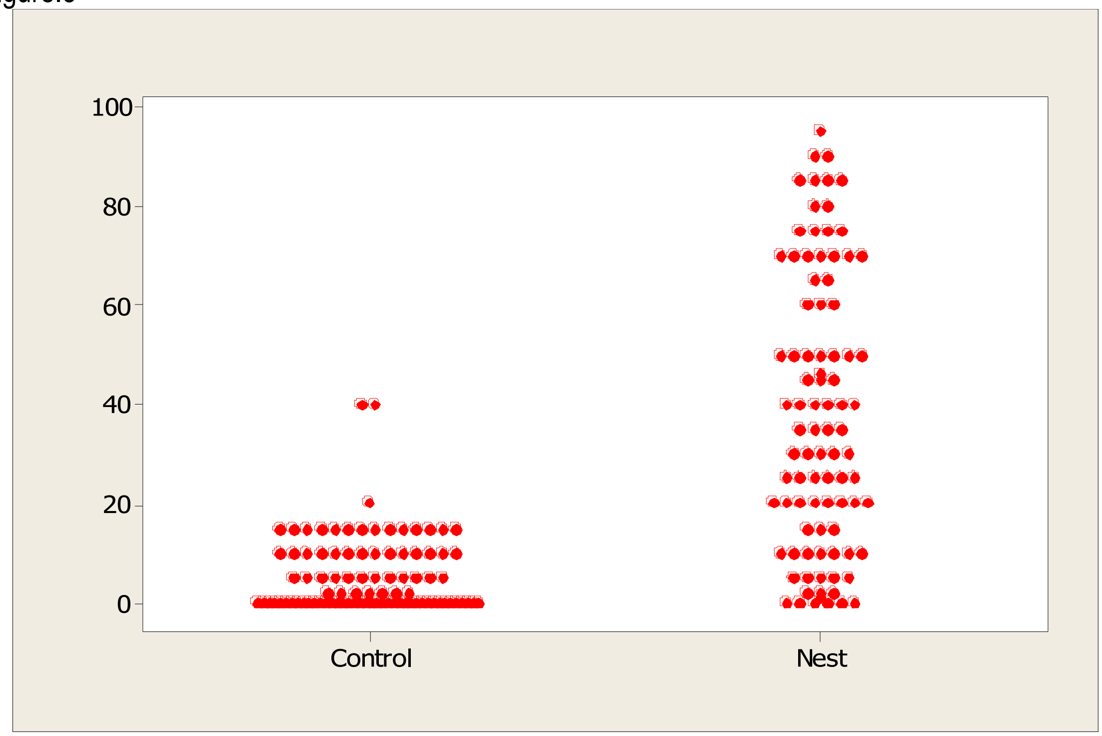


Table 6.

Variable	Tapinoma	N	N*	Mean	SE Mean	StDev	Variance	Minimum
% Bare ground	Control	90	0	5.822	0.823	7.809	60.979	0.000000000
	Nest	90	0	37.70	2.92	27.68	766.44	0.000000000

Variable	Tapinoma	Q1	Median	Q3	Maximum
% Bare ground	Control	0.000000000	2.000	10.000	40.000
	Nest	13.75	35.00	61.25	95.00

All the bare ground data was assessed with a normality test(Anderson Darling) with Mini-tab. The data did not have a normal distribution so a Kruskal-Wallis Test was calculated.

Table 7. Kruskal-Wallis Test: % Bare ground versus Tapinoma

Tapinoma	N	Median	Ave Rank	Z
Control	90	2.000	57.2	-8.59
Nest	90	35.000	123.9	8.59
Overall	180		90.5	

H = 73.74 DF = 1 P = 0.000
H = 75.28 DF = 1 P = 0.000 (adjusted for ties)

Conclusion

There was a significant difference between the recorded bare ground of the nest sites (n=90) and the control (n=90). Kruskal-Wallis (H = 73.74 DF = 1 P = 0.000). *Tapinoma* nests occurred on quadrats with a higher average bare ground cover than the control. (nest av. 37.7 %). *Tapinoma* nest sites also occurred over a wider bare ground gradient than the control. (Variance Nest 766.4 Control 60.9)

3.4 Soil temperature

Soil temperatures at 5cm depth were measured with a soil thermometer of 10 nests and 10 controls.

Figure 4.

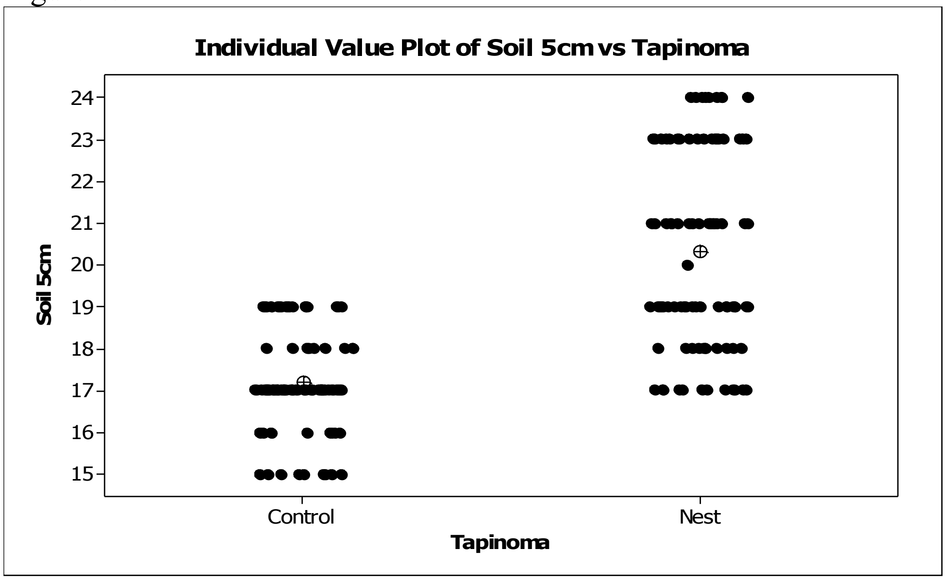


Table 8. Descriptive Statistics: Soil 5cm

Variable	Tapinoma	N	N*	Mean	SE Mean	StDev	Variance	Minimum	Q1
Soil 5cm	Control	90	0	17.200	0.124	1.173	1.375	15.000	17.000
	Nest	90	0	20.322	0.247	2.341	5.479	17.000	18.000

Variable	Tapinoma	Median	Q3	Maximum
Soil 5cm	Control	17.000	18.000	19.000
	Nest	20.500	23.000	24.000

All the soil temperature data was assessed with a normality test(Anderson Darling) with Mini-tab. The data did not have a normal distribution so a Kruskal-Wallis Test was calculated.

Table 9. Kruskal-Wallis Test: Soil 5cm versus Tapinoma

Kruskal-Wallis Test on Soil 5cm

Tapinoma	N	Median	Ave Rank	Z
Control	90	17.00	57.0	-8.64
Nest	90	20.50	124.1	8.64
Overall	180		90.5	

H = 74.63 DF = 1 P = 0.000
H = 78.19 DF = 1 P = 0.000 (adjusted for ties)

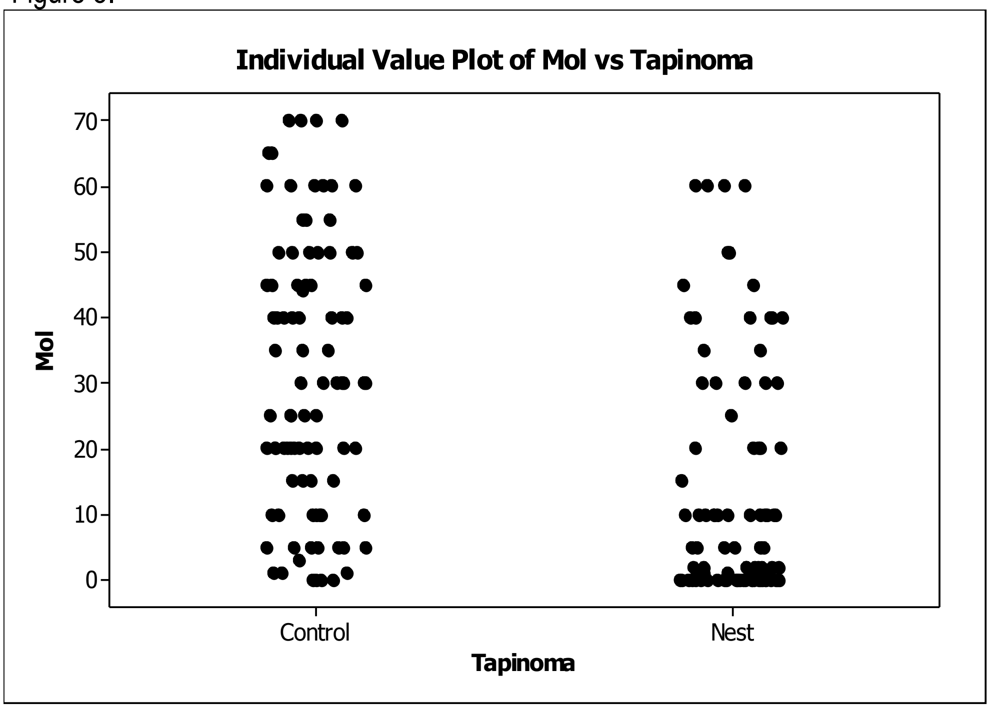
Conclusion

There was a significant difference between the soil temperature of the nest sites and the control *Kruskal-Wallis* (H = 74.63 DF = 1 P = 0.000). *Tapinoma* nest sites occurred on sites with higher soil temperatures than the control. Control and nest temperature were taken on similar days in similar ambient conditions.

3.5 Vegetation cover

Vegetation cover was measured as a percentage cover of nests (n=90) and controls (n=90). Grasses other than *Molinia* were clumped as graminae. *Molinia* was the only vegetation cover to show any difference between nest and control. Vegetation cover was also assesed to National Vegetation Classification using tablefit (Hill, M.O.1996). The Goodness of fit was too poor to include within the report.

Figure 5.



All the *Molinia* coverage data was assessed with a normality test(Anderson Darling) with Mini-tab. The data did not have a normal distribution so a Kruskal-Wallis Test was calculated.

Table 10. Kruskal-Wallis Test: Mol versus Tapinoma

Tapinoma	N	Median	Ave Rank	Z
Control	90	30.000	113.7	5.98
Nest	90	5.000	67.3	-5.98
Overall	180		90.5	

H = 35.74 DF = 1 P = 0.000

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H = 36.08  DF = 1  P = 0.000  (adjusted for ties)
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Conclusion

There was a significant difference between the *Molinia* coverage of *Tapinoma* nests and the control (*Kruskal-Wallis* H = 35.74 DF = 1 P = 0.000). *Tapinoma ambiguum* nest quadrats had a lower coverage of *Molinia* than the control. There were no other significant relationships found between Tapinoma nests and vegetation type or cover . It is suspected the presence of bare ground is a more important factor than the absence of *Molinia* although this has not been confirmed.

2010 Habitat survey

As part of the 2010 survey work vegetation was classified in 98 1m squares randomly scattered over Godlingston heath (see 2.1 methodology 2010). *Tapinoma* was either recorded as present or absent within these quadrats. Three records from other habitats were excluded from chi-square analysis.

Table 11. 2010 Tabulated statistics: Tapinoma ambiguum, Habitat

Rows: Tapinoma ambiguum   Columns: Habitat

	dry heath	wet and dry heath	wet heath	wet heath/mire	All
Not present	31	14	17	6	68
	30.78	13.60	17.89	5.73	68.00
T ambiguum	12	5	8	2	27
	12.22	5.40	7.11	2.27	27.00
All	43	19	25	8	95
	43.00	19.00	25.00	8.00	95.00

Cell Contents: Count
Expected count

Pearson Chi-Square = 0.250, DF = 3, P-Value = 0.969
Likelihood Ratio Chi-Square = 0.249, DF = 3, P-Value = 0.969

- NOTE * 1 cells with expected counts less than 5

Conclusion

No strong relationship between specific heathland habitats or vegetation classes and *Tapinoma* presence was found under this survey using this method.

4. Discussion habitat and soils

The *Tapinoma* nests found on Godlingston all had large amounts of bare ground (this was confirmed in the quadrats). Some of these were natural bare ground features whereas a couple of nest sites had spoil probably from pond creation.

Bare ground occurring near colonies seemed very diverse, including friable types of flinty/sandy, sands, peats and unfriable clays/silts. Another type of bare ground present was in seasonally wet areas where *Molinia* formed a thin black layer of humus as a crust over the soil layer, this being black had a favourable micro-climate. *Tapinoma* utilised these areas. Where these occurred in combination with deer tracks they sometimes were used by *Tapinoma* as tracks.

Both friable types for nest construction and very compacted bare ground pans of clay/peat seem important. The latter either as heat sinks and /or because they arrest successional vegetation.

The micro climate is very important with sites commonly either sheltered by topography or scrub. The quadrats proved this with the average soil temperature recorded being higher than the control

The *Tapinoma ambiguum* nests occurred in more sandy soils than the control. The results also showed slightly more diverse soils within each nest sample than within the control.

References suggest possible niche separation between the two *Tapinoma*. *T ambiguum* has similar habitats to *erraticum* but in contrast to *erraticum* is found in sand and gravel areas (Seifert B, 2007) *(*Dekoninck et al 2007b). Dekoninck found *T.erraticum* commonly on chalk grassland and rocky habitats on one study in Belgium *(*Dekoninck et al 2007a). *Tapinoma erraticum* is considered a xerophytic species of early successional bare-ground short vegetation (Pontin 2005).

The only *Tapinoma erraticum* nest found on the survey was on extremely rocky soils in Devon.

The *Tapinoma nests* found on Godlingston were all within heathland both within the 2010 survey and 2011 quadrats no link was found between specific heathland vegetation classes .

Dekoninck considers *Tapinoma ambiguum* stenotopic on heathland in Flanders (Dekoninck et al 2007a). '*T.ambiguum* is found in both wet (*Molinia*- combined with Gorse and *Erica tetralix*) and dry heathland (heather with *Cladonia* and *Deschampsia flexuosa*' (Dekoninck et al 2007b). '*Tapinoma ambiguum* is found in typical 'bog' habitat' (Maes 2003b)

'Tapinoma ambiguum prefers sunlit, dry and more or less infertile soils in Holland. Two of the strongholds were mosaics bare grassland (Thero-Airion) and buntgrasvegetatie (Spergulo-Corynephoretum) with many (crust) moss'. (Noordijk et al. 2007). (From the photographs in this report these sites appear as very grassy heaths with abundant bare ground possibly similar to 'Breckland' habitats)

Maes (Maes et al. 2003) studied wet heathland in Belgium. The highest overall nest densities of ant species were found on plots with *Molina*. He confirmed that there is indeed an optimal % *Molinia caerulea* cover for nest density of ant species in general (about 40–%); a further increase in the % *Molinia caerulea* however resulted in a lower number of nests.

Maes (Maes et al. 2003) also found higher diversity of ant species on larger sites (these included *T.erraticum and T.ambiguum. The* higher diversity of ant species numbers in large sites may be explained by the greater variation in vegetation structure offering more possible nesting sites for a larger number of species. The correlation between both ant diversity and nest density on the one hand and area on the other, emphasizes the importance of large sites (such as Godlingston-) for the conservation of ants.

The nest sites on the 2011 survey were often contained with areas of high habitat diversity with scrub present as well as both wet and dry heathland. It is suspected that diverse mozaics of heathland vegetation types are needed for *Tapinoma ambiguum*. *Tapinoma ambiguum was* not found on this study associated with large areas of homogeneous dry heathland.

Nest L

5. Autecological research

5.1 Nest Construction

A range of *T.ambiguum* nests were observed during the survey. Many of the nests had a raised structure 'the solarium' constructed out of friable soil/sand and woody material. This structure varied in its naturalness. In some nests this structure was a natural tussock of *Erica* or *Molina* in others a very definite constructed structure of small plant fragments such as *Erica* leaves and sands (photo nest L). When opened the solarium consisted of various chambers and tunnels with some larvae within 1cm of the surface. Some of these chambers where constructed or sometimes natural root/ vegetation structures. There were further more extensive underground chambers present (see photo of T) to which the *Tapinoma* were keen to take the larvae when disturbed. This nest design leaves the ants with lots of microclimatic niches. Some of the nests had further nest entrances some distance away from the solarium these where either obviously connected to the solarium underground or were possibly alternative or reserve nest sites. On one occasion *Tapinoma* dragged the larvae from the solarium over ground to separate nest entrance about 10cm away. One nest when dug up had a 2cm high sand and plant matter solarium (L) with about 6cm by 6cm underground chambers in sand.

Nests encountered during the survey

Simple nest no solarium constructed J H A D F
Constructed solarium L G Q R (and Z 2010)
Possibly mostly natural solarium P T M Z
Multiple nest entrances no obvious central nest H A D G

Where the nests had multiple entrances they occurred 7cm - 20cm away from main site, apart from A and G/H where they were much more likely separate nests and occurred 60-70cm away.

"T.erraticum summer nests with weakly pronounced underground part, very volatile and unstable built under stones, in and under or with a small cushion plant above ground, Material from mineral or organic often sticky in a coarse to 4cm central cavity of plants or rootlets" (Seifert 2007). If *Tapinoma* occurs in more sandy soil it may be easily able to build extensive chambers but may also need to mitigate for the lack of solid material such as rock which will heat up and form an effective heat sink. The *Tapinoma erraticum* in Devon occurred around very dark coloured large blocks of rock the only nest found had a messy less constructed solarium.

5.2 Tapinoma prey collection

During the 2011 survey work possible prey was collected from nest sites. The main prey was arthropods as either complete small arthropods or fragments of arthropods. These came from a range of orders. It seems *Tapinoma ambiguum* is probably not very specific in prey. '*T. erraticum* nutrition is very versatile, but mainly predatory and less nectarivorous' (Seifert B, 2007).

There were few observations of plant material being carried. These were usually from very near the nest when the nest was physically disturbed.. No observations were made of flower visits or honey dew collectionalthough as they are such a small ant it would be easy to miss.

Table 12.

***Tapinoma* prey collected**

Araneae .	complete
Araneae .	
Araneae prob.	palp or tarsus
Araneae prob.	
Arthropod	egg sac ?
Arthropod	palp or tarsus
Arthropod	palp or tarsus
Arthropod	palp or tarsus
Arthropod	palp or tarsus
Arthropod	part
Arthropod	
Arthropod	
Homoptera	
Homoptera	
Homoptera Auchenorrhyncha	
Homoptera Psylloidea	
Hymenoptera	*Cynipidae*
Hymenoptera	*Mymica sp.*
Hymenoptera	*Mymica sp.*
Isopod	
plant material	
Thysanura	complete
Thysanura	part
Unknown	probably plant matter
Unknown	probably plant matter
Unknown	probably plant matter
Unknown	

5.3 Interaction with other Ants
Nest Q was observed attacked by *Formica fusca*. About 4 *Formica* were observed running around seeming to try to get in the nest. The *Tapinoma ambiguum* started to run around manically and appeared to spray Formica. One Formica escaped with a food object from the nest and a few of the *Formica* retreat and climb up high cleaning themselves and after a couple of hours show no interest in the nest. "*T.erraticum* is highly superior by use of a highly toxic immediate paralysis-inducing secretion" (Seifert B, 2007).

"T.erraticum approaches the food in a completely different way" (rather than recruiting workers), "collecting food rapidly and only if no other ant is present on the food source. This species carefully avoids aggressive contacts with other species, and quits immediately the food source when another ant species approaches. Its behaviour is completely different in the close vicinity of its nest. In this case, it chases away other ants even large *Formica* probably using its chemical defences." (Deffernez et al 1990)

Seifert suggests *Tapinoma* does recruit workers *"T.erraticum* quickly locates and mass recruitment to food sources, these ant species may be dominant towards others." (Seifert B, 2007).

Deffernez observations on foraging seemed closer to the field observations, with little co-operation or recruitment between *Tapinoma* observed during the survey.

A nest of *Lasius niger/platythorax* was observed in 1/7/11 this was only about 50cm from *T. ambiguum* nest A and about 70cm from nest D and near to a further *T. ambiguum* nest entrance. Within this area both *Myrmica sabuleti* and *Myrmica scabrinodis* were collected and *Tapinoma* were seen to avoid the *Myrmica*. When the same area was visited on the 24/7/11 there was no *Lasius* nest or Tapinoma nest A although *Tapinoma* nest D had activity. A possibly new *Tapinoma* nest was found about 3m metres away.

5.4 Nest mobility and foraging range
During the survey Tapinoma were commonly observed within 1-2m of nest entrances, although a number were observed at a longer distance, one was observed foraging 5m and another 3m both of which seemed to return to nest area.

'*Tapinoma erraticum* activity centred round the nest within 1 -1.5m. The *Tapinoma* had frequent nest moving within two months 5 'movings' involving 3 nests. The centres of concentrated foraging were limited in time. *Tapinoma erracticum* creeps into available spaces having only access to the food sources in the absence of other ant species and fleeing when another ant approaches. The nest moving habits of *Tapinoma erraticum* probably complete this behaviour, enabling it to exploit the temporarily vacant spaces. '(Deffernez et el 1990).

Many nests had multiple entrance holes and some locations it was difficult to know wether this was two separate nests such A and D also G and H. On several occasions *Tapinoma* were seemed very keen on moving larvae with only minor disturbance. On one occasion another worker stopped a couple of workers leaving the nest with larvae on another occasion several workers took larvae 1.2m away to possible new nest site which disappeared in subsequent visits although the original nest was still populated. This may indicate *Tapinoma* can split to form satellite nests. Nest M moved 40cm to another nest site after disturbance.

6. Discussion of autecological research

During the survey Q nest was found 5m from original Q and 4m from nest found in 2010. Suggesting idea of nests moving within a "home range of suitable habitats" or temporary niche spaces within a favourable landscape. It does also seem likely that a more permanent nest will be founded in a landscape within foraging range of a previous nest.

Also as the nests are polygynous (Seifert 2007) perhaps this results in a lack of social cohesion resulting in conflict and satellite nests being formed. Perhaps this also means there is less collaborative foraging (which was possibly reflected in observations). Their ecology seems based on quickly building up a population in a temporary niche space and then dominating by numbers. They are more vulnerable when the nest is small and this may mean moving round to find gaps in suitable habitat without competition, then given this time window become populous enough to dominant a habitat. Some of the nests were substantial constructions which must mean an investment in staying in on place, it did seem these were better defended from attacks.

Nest with solarium

7. Tapinoma outside Godlingston

Stobourgh and Hartland heath areas were surveyed for Tapinoma on 29/7/10
One *Tapinoma* ambiguum was found at Hartland Moor NNR SY96328529 on dry heath/scrub edge, peaty and sandy dry bare ground. Although near a large wet heath area.

In 2010 areas around Stoborough & Creech Heaths SSSI SY945854 and Hartland Moor NNR SY944862 were searched in some depth with no *Tapinoma* recorded.

One *Tapinoma ambiguum* was found at Stoborough & Creech Heaths RSPB SY9254 8439 30/7/10 on a small patch of bare ground within a small area of wet peaty/ sandy habitat with *Erica tetralix*, *Calluna* and *Molina*.

Tapinoma in South Devon

Bovey Heathfields site was searched for *Tapinoma. Tapinoma erraticum* was found at SX 821766 11/8/10 within dry heath with abundant bare ground,

An area on South Dartmoor was searched. At Newbridge SX703706 a number of *Tapinoma erraticum* were found on South facing dry heath land with gorse scrub both in 2010 and 2011. A nest site was found within this area utilising large solid rock features made black probably by a coating of lichen. These formed very effective heat sinks. Possibly even more important due to the high altitude of the site.

8. Conservation

Some articles have highlighted burning producing suitable bare ground for ants. No *Tapinoma* was found within burnt areas. Burning can encourage a response of lush *Molina* growth. This is probably unsuitable management specifically to create bare ground for *Tapinoma* nesting habitat, Although further survey of different heathland burns are nessescary.

Two nest sites were found on what appeared to be spoil from pond creation. It could be that this is very good way of habitat creation for *Tapinoma* (at the same time as other invertebrates). In the two cases this was observed the result was also a range of compacted and friable bare soil and sub soil types near diverse habitats. This seems to be good way of creating suitable habitat.

9. Future survey work

Visit further possible *Tapinoma ambiguum / erraticum* sites in Purbeck area and New Forest.

Find suitable alternative sites for comparison data about *Tapinoma erraticum* nest and habitat requirements.

Some areas such as Breckland habitats and Surrey heaths may be worth surveying for new *Tapinoma ambiguum* sites.

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Note some of the references were translated using Google, so some caution with translations is required.

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Table 13. Tapinoma hymettus survey records

Taxon	Site	Gridref	Determiner	Date
T. ambiguum	Stoborough Heath	sy92548429	A Jarman	30/07/10
T. ambiguum	Hartland (Slepe)	sy96328529	A Jarman	29/07/10
T. ambiguum	Godlingstone heath	sz00508309	A Jarman	28/07/10
T. ambiguum	Godlingstone heath	sz00888348	A Jarman	19/05/10
T. ambiguum	Godlingstone heath	sz01898284	A Jarman	27/07/10
T. ambiguum	Godlingstone heath	sz02608321	A Jarman	26/07/10
T. ambiguum	Godlingstone heath	sz02658319	A Jarman	18/05/10
T. ambiguum	Godlingstone heath	sz01998305	**B Siefert**	27/07/11
T. ambiguum	Godlingstone heath	sz01998305	**B Siefert**	19/08/11
T. ambiguum	Godlingstone heath	sz02148315	**B Siefert**	19/08/11
T. ambiguum	Godlingstone heath	sz02148315	**B Siefert**	26/711
T. ambiguum	Godlingstone heath	sz00448310	P Saunders	24/07/11
T. ambiguum	Godlingstone heath	Sz00498310	P Saunders	01/07/11
T. ambiguum	Godlingstone heath	sz00508310	P Saunders	31/6/11
T. ambiguum	Godlingstone heath	sz00508311	P Saunders	24/07/11
T. ambiguum	Godlingstone heath	sz00888348	P Saunders	19/05/10
T. ambiguum	Godlingstone heath	sz00888348	P Saunders	19/05/10
T. ambiguum	Godlingstone heath	sz01228296	P Saunders	28/710
T. ambiguum	Godlingstone heath	sz01668361	P Saunders	28/07/10
T. ambiguum	Godlingstone heath	sz01928274	P Saunders	27/07/10
T. ambiguum	Godlingstone heath	sz01948268	P Saunders	27/07/10
T. ambiguum	Godlingstone heath	sz02128311	P Saunders	28/710
T. ambiguum	Godlingstone heath	sz02148315	P Saunders	28/710
T. ambiguum	Godlingstone heath	sz02238407	P Saunders	02/07/11
T. ambiguum	Godlingstone heath	sz02258407	P Saunders	25/711
T. ambiguum	Godlingstone heath	sz02278419	P Saunders	20/05/10
T. ambiguum	Godlingstone heath	sz02298420	P Saunders	30/07/10
T. ambiguum	Godlingstone heath	sz02408452	P Saunders	30/07/10
T. ambiguum	Godlingstone heath	sz02418450	P Saunders	20/05/10
T. ambiguum	Godlingstone heath	sz02418450	P Saunders	20/05/10
T. ambiguum	Godlingstone heath	sz02438450	P Saunders	01/02/11
T. ambiguum	Godlingstone heath	sz02438450	P Saunders	02/07/11
T. ambiguum	Godlingstone heath	sz02438450	P Saunders	25/07/11
T. ambiguum	Godlingstone heath	sz02438450	P Saunders	25/711
T. ambiguum	Godlingstone heath	sz02588324	P Saunders	26/07/10
T. ambiguum	Godlingstone heath	sz02608321	P Saunders	19/08/11
T. ambiguum	Godlingstone heath	sz02608321	P Saunders	31/6/11
T. ambiguum	Godlingstone heath	sz02608329	P Saunders	27/07/11
T. ambiguum	Godlingstone heath	sz0888347	P Saunders	24/07/11
T. erraticum	New bridge	sx702706	**B Siefert**	10/08/11
T. erraticum	New bridge	sx702706	P Saunders	11/08/10
T. erraticum	Bovey heathfield	sx821765	P Saunders	11/08/10