New Forest Cicada *Cicadetta montana* Survey Report

Higher Level Stewardship Agreement

The Verderers of the New Forest

AG00300016

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Summary

Buglife- The Invertebrate Conservation Trust was commissioned by the Forestry Commission to undertake a survey of New Forest cicada *Cicadetta montana***.** The last confirmed record of *Cicadetta montana* was in the mid 1990's nearly 20 years ago, this survey reinvigorated the search for this elusive species, using new technology and volunteers we were able to cover a large area of the New Forest, visiting sites that had not been checked for the presence of *C. montana* for many years, if at all. The approach involved collating all existing records, recent potential sightings and survey work carried out to date to inform the survey programme, targeting the most favourable/promising locations. A total of 56 sites were visited over an eleven week period, a rapid assessment was made to establish the sites suitability for *C. montana*. The 19 most suitable sites were surveyed between 18th May and 24th July each site being visited on at least two occasions in favourable conditions. Searches for turrets and casts skins were undertaken alongside beating and sweep netting for adults on Bracken, Hawthorn and Small leaved lime. A directional parabolic dish was used to listen and make sound recordings and the New Forest Cicada Smartphone app developed by Southampton University were used to carry out several samples per site, in addition a bat detector was also used as part of the survey methods. Although suitable habitat was identified and the weather conditions were largely favourable no evidence of *C. montana* was recorded during the 2013 survey. To attempt to better understand the potential influence of climate on *C. montana*, long term meteorological data has been collated (1900-present day). The habitat resource within the New Forest for *C. montana* has been evaluated and broad management recommendations have been compiled. A 2014/15 survey strategy is presented.

Introduction

Background and status

The New Forest Cicada (*Cicadetta montana*) is the only British representative of the family Cicadidae (Hemiptera) and sits at the edge of its northern range. Of the 2000 known species of Cicada most live in warm climates. *Cicadetta montana* has a wide geographical distribution, predominantly northern and Asiatic, and becoming montane in southern Europe (Kudryasheva 1979). It is most closely associated with deciduous woodland of Pedunculate Oak *Quercus robur* with scattered bushes, wide sunny rides and clearings, and with forests with Small leaved lime *Tilia cordata.*

Cicadetta montana was first recorded in Britain at Pennington Common just outside Lymington on the southern edge of the New Forest in 1812 by Daniel Bydder. Since then it has been uncommon and sporadic in occurrence (Ward 1970; Grant & Ward 1992) with almost all sightings coming from/nearby the New Forest; just a few derive from Surrey woodlands in the Haslemere/Cranleigh area between 1864 and 1936. Adult Cicadas, their song, and presence of egg nests were recorded by Lyle (1910, 1911 & 1913) on the outskirts of Brockenhurst. C Morley (1941) reports occasional records between 1812 and 1940. A search of the literature reveals Drs Hobby and Killington made a significant find in 1922 where they recorded an emerging colony of approximately 100 individuals at Brockishill Inclosure 1.5 miles south of Cadnam. After 1941 there was twenty year period that yielded no records, entomologists assumed the insect to be extinct (Pinchen & Ward, 2002). In 1962 a major discovery was made in the northern part of the New Forest between Brook and Fritham. On the edge of a forest Inclosure M Clifton, J A Grant and P S Broomfield located a colony over 100 males singing (Pinchen & Ward, 2002). From its discovery in 1812 to present date *C. montana* has been confirmed from 26 different localities within the New Forest (Pinchen & Ward 2002). Post 1962 confirmed records include Denny Wood, Gibbet Wood/ Brook Common and Kings Garn Gutter. The area around Gibbet Wood and Brook Common became the main study area for the late Jim Grant, who conducted nearly three decades of research and monitoring of C*. montana*. It seems that the peak was in 1962 with 100 singing males, after that a steady decline with occasional peaks- possibly reflecting a periodic (8 year?) cycle, was observed (35 in 1970, only 2 in 1993). Evidence of singing males was recorded in this area until the mid-1990's, no records of adults or nymphal turrets have been made since 1994 (JNCC, 2010). The last definite sighting of a *C. montana* adult was at Denny Wood in 1991, followed by a record of song from an area to the north of Denny wood in 1996 (Pinchen & Ward, 2010), an unconfirmed but likely sighting of two adults was made by Mr Dempsey and his daughter at Whitebridge Hill in 1992. There have been several other possible, but unconfirmed records of the song since then including at Furzey Lawn in 2000 (Pinchen & Wards 2002) Bank, Lady Cross and House in the Woods in 2004 (Brian Harrison pers comm) . Following Grant's death B Pinchen and L Ward continued the search for *C. montana*. They have concentrated searches in and around Gibbet Wood; Denny Wood, Matley Wood, Ferny Crofts, Raven's Nest Inclosure, Pig Bush and Honey Hill, Franchises Wood, Island Thorns and Furzy Lawn Inclosure (Pinchen and Ward 2007 & 2008). Despite their extensive efforts no adults or nymphal turrets have been detected.

Due to its decline *C. montana* was added to Schedule 5 of the Wildlife and Countryside Act, and is classified as endangered (Red Data Book 1). In 1991 it was added to the English Nature Species Recovery Programme. It is also listed as a Priority species on Section 41 of the NERC Act 2006.

Cicadetta montana is an elusive species that has always been hard to find, due to its short adult life and long subterranean nymphal stage (i.e. Grant 1970, Grant & Ward 1992, Pinchen & ward 2002). Some years good numbers of cicadas were recorded (i.e. 1962), however these were often followed by a series of poor years (Grant 1966-9; 1970b). Evidence from continental workers suggests that this species is characterised by transient local populations that track habitat patches as they become suitable, with considerable mobility between sites. Long term persistence at a single site may therefore be the exception rather than the rule. This will almost certainly be applicable to the New Forest, habitat change through succession to woodland, changes in grazing and forestry practices (increased grazing and reduction in traditional coppicing in favour of longer rotations) evident over the last 50 years will have resulted in peaks and troughs of suitable habitat. In addition, changes in weather particularly weather extremes may also play an important role i.e. poor summer temperature and/or heavy prolonged summer rainfall.

With this in mind it is possible that the *C .montana* survives in small vulnerable pockets of suitable habitat. This species is most likely living a very low levels, and quite possibly, in un-surveyed areas of the forest. This makes it important to widen the geographical search for this species beyond the historical sites. The New forest is a large area extending over 57,000ha, utilising volunteers, the public and embracing new survey technology yields an

increased chance of detection. The key to locating such an elusive, mobile species living at very low levels is about being the right place at the right time.

Life cycle and habitat requirements

Like all cicadas *C. montana* spends the majority of its life as a subterranean grub-like nymph. The generation time for this species is between six and ten years when the nymph lives underground feeding on roots (Figure 1). The type of soil and at what depth cicadas inhabit is variable; Grant and Ward (1992) observed chambers depths between 11 and 35cm and they suggest they do not occur in very dry sandy soils, or in soils liable to flooding or waterlogging. They favour clay soils for building tunnel systems possibly because they do not dry out so easily and tunnels are less likely to collapse. The presence of cicada nymphs can only be detected by emergence turrets comprising of funnels of soil moulded by the final instar nymph in the spring before emergence (Kirby *et al* 2003). Turret structure can vary considerably from almost a flat dome of 2cm in height to taller turrets up to about 4cms. The width and diameter also varies, some appearing to be cigar shaped and up to 8cm lying along the ground (Grant and Ward 1992). The function of the turret appears to be related to isolation before emergence, the turret provides shelter and protection allowing the nymph to assess microclimatic conditions (i.e. temperature and humidity) and emerge at the optimum point. Microclimate is clearly important in determining cicada distribution; most turrets are found in areas where vegetation is sparse and the sun the reach and warm the soil i.e. on the edge of a glade or on a dry sunny bank (Lyle 1910; Grant and Ward 1992). Cicadas emerging from turrets in sunny localities emerge more quickly than that in shaded locations, the benefit of this is that they will be less vulnerable to predation. Emergence from the turret usually commences in the early morning, the nymph will climb up vegetation and ecdyse into an adult, usually in a sunny locality a short distance from the turret (Pinchen and Ward 2002) (Figure 1).

Once emerged, the adult will promptly fly high up into the tree canopy. Adults are usually on the wing for 2-4 weeks between late May and mid-July, the earliest emergence has been recorded on the 13th May (1974) and the latest sighting on the 30th July (1907). Only the males sing, they do this to attract females, often singing from high perches on the edge of rides (in Beech *Fagus sylvatica*, Oak or lone Scots pine *Pinus sylvestris* trees 5-15 metres high), occasionally males sing briefly from lower perches on Bracken *Pteridium aquilinum*, Birch *Betula* saplings or young Gorse *Ulex europaeus* (Grant 1970). Males produce a locating song and a courtship song; both are produced by the rapid clicking in and out of a drum membrane by a pair of tymbals inside the thorax (Pinchen and Ward 2002). The courtship song can last several minutes, and it is produced at low amplitude before rising progressively to a higher pitched volume which drops off before stopping (Pinchen & Ward 2002). The song is on the edge of the frequency range of the human ear, young ears may hear a high-pitched ringing buzz produced in the range of 4-16 kc/sec (Figure 2), anyone over the age of 40 will almost certainly not be able to hear the song. Males will only sing on warm still days when the temperature exceeds 20^{o}C, from around late morning, reaching a peak at around 2-2.30pm (Grant 1970, Pinchen & Ward 2002). *C. montana* adults have been recorded feeding on woody plants such as Birch, Beech, Oak and Small leaved lime (Grant and Ward 1992).

Figure 1. Photographs taken by Jim Grant of A) *C. montana* nymph in a burrow B) cast skin and C) female laying eggs on a twig showing egg nests.

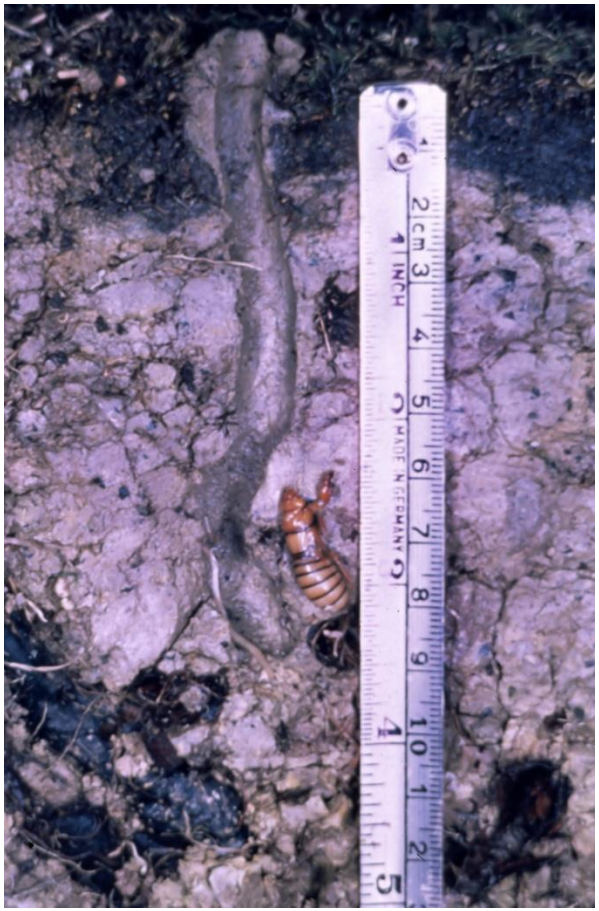
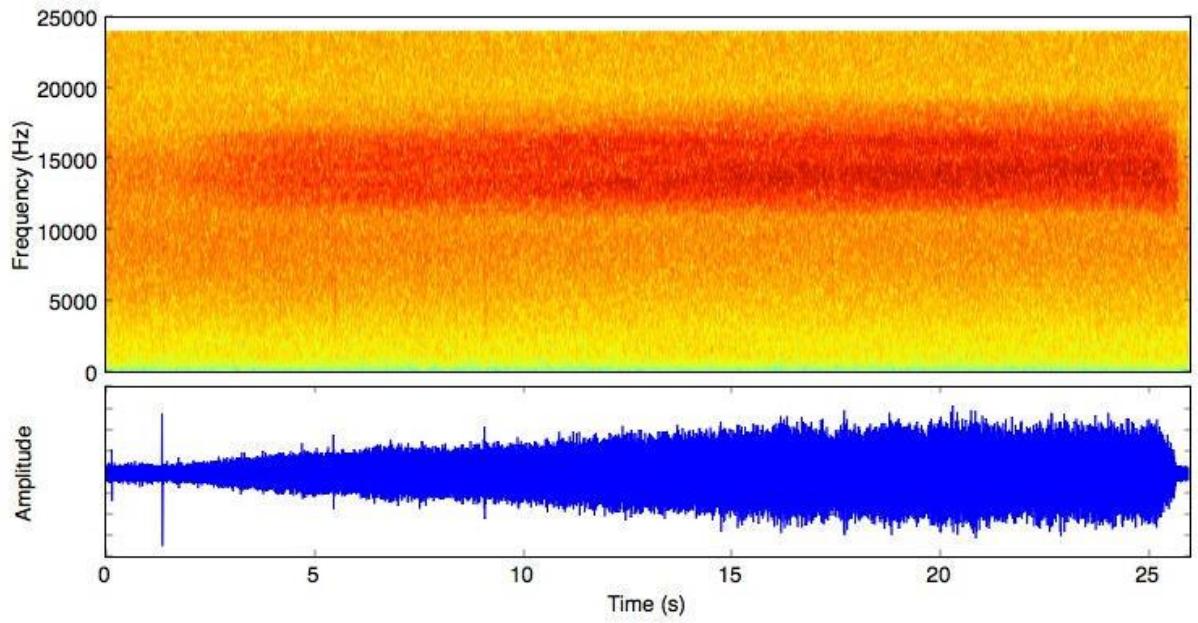
		
C. montana nymph in a burrow ©Jim Grant	*C. montana* cast skin ©Jim Grant	*C. montana* female laying eggs on a twig ©Jim Grant

Figure 2. The waveform and spectrogram of the *C. montana* call.



After mating the female will produce between 200-300 fertile eggs, she will lay her eggs in excavated nests in the stems of herbaceous plants, Bracken and small trees and bushes measuring between 3-8mm in diameter. The eggs are aligned in two rows; distinctive 'W' shaped scars are formed in the stem (Figure 1). Grant and Ward (1992) and Lyle (1913) observed egg laying on Bracken, Beech, Birch and Small leaved lime, and suggest Oak is likely to be used. The eggs hatch in the autumn after 50-125 days depending on temperature, and the tiny red flea like nymphs fall to the ground. The nymphs make their way underground by digging or via cracks in the soil, and begin feeding on the roots of various plants including Purple moor-grass *Molinia caerulea* (Grant & Ward 1992) and Bracken (Morley 1941), they will remain under ground for the next six to ten years.

Cicada are vulnerable to predation at all life stages, Neuroptera larvae (i.e. antlions and lacewings) and Phytocoris (plant bugs) have been observed to prey on cicada eggs, ants will feed on the newly hatched nymphs before they burrow underground (Grant and Ward, 1992) and have been observed attacking emerging adults, final instar nymphs have been destroyed by earwigs and ground beetles (Pinchen and Ward 2020) and adults are likely to be susceptible to bird predation.

Habitat structure is incredibly important for *C. montana,* they require shelter yet need open and unshaded habitat with low bushes and trees (Grant 1970; Grant & Ward 1992). Successional habitat between open heath or grassland and scrubby woodland, alongside open, sunny woodland rides and clearings bordered by scrub or woodland edge provide optimal conditions for *C. montana*. In addition well drained south facing slopes and varied topography are favoured. A good mix of herbaceous plants and scrubs is required to provide food sources and egg laying sites (Pinchen & Ward 2002, 2010). Slope and undulating topography, coupled with varied substrate, will provide the cicada a range of subsurface conditions, nymphs will be able to move vertically to track their favoured microclimate conditions i.e. move vertically to avoid water logging or excess surface water or similarly they could burrow deeper into the ground to avoid cold winter temperatures. Sites that are flat provide little escape and could result in high mortality during periods of unfavourable weather condition i.e. heavy prolonged rainfall or cold temperatures. Heavily grazed sites are wholly unsuitable; as a result all modern records have been made in relatively un-grazed forestry Inclosures (Pinchen & Ward 2010).

Methodology

Desk top exercise

Information was collated and a brief review compiled of all historic records (including Jim Grant's field notes, Grant and Ward 1992), more recent surveys (Pinchen and Ward 2002, 2007, 2008), potential sites (Pinchen & Ward, 2008

and personal communications), and possible recent sightings. Using this information 19 sites were identified for further investigation. These sites were selected based on historical and recent sighting, recommendations contained within Pinchen and Ward 2008, local knowledge gleaned from New Forest naturalists, Forestry Commission and Natural England and sites that had never been searched for *C. montana* in the past.

Rapid site assessment

To narrow down and focus survey effort, each of the 19 potential sites were visited. The habitat was evaluated based on:

1) habitat structure (open woodland, woodland edge, , rides, clearings, scrub matrix, heathland)
2) topographical structure (presence of raised ground, banks and slopes)
3) presence of well drained sunbathed bare ground
4) bracken cover
5) tree species diversity
6) herbaceous plant diversity
7) potential singing trees (tall beech and oak 14-50 feet)

Sites containing/comprising of open sunbathed ground with varied topography, light bracken over, with adjoining woodland edge with large Beech and Oak coupled with the presence of historical/recent/possible records were prioritised for survey.

Field survey

The Cicada season varies a little from year to year but usually falls within the limits of mid-May to July with peak activity in mid-June. However this is heavily dependent on temperature, hot bright sunny days (18-20^{o}C plus) with little wind between 10am-4pm provide optimum conditions for singing and flight. A continuous run of these favourable conditions will greatly improve chance of detection. The 19 priority sites were surveyed using the following methods:

Turret searches and cast skins

Searches for pre-emergent turrets in areas of suitable open habitat with light bracken cover were conducted from mid-May onwards. Greatest attention was paid to the Gibbet Wood area, Denny Wood, Whitebridge Hill and Brockishill Inclosure- these were thought to have greatest potential based on historic records and current habitat quality. Photographs and the grid reference of potential turrets or exits holes were taken. Searches for cast skins were conducted in areas of suitable habitat especially in close proximity to potential turrets/exit holes. Bracken stems, Birch samplings and grass tussocks were searched for casts skins. The Bracken was also swept using a net. A camera was installed at Gibbet Wood to capture images of a potential turret and the insect that emerged.

Detection of singing males

The detection of singing males needs keen hearing, the positioning and movement of the head can influence detection ability (Grant 1970). The male song frequency is 14-16kc/s but almost all sound energy lies in the upper ranges making it difficult to hear. At least two members of the survey team were able to hear the male song in the field (based on a field test using a *C. montana* recording). Using the human ear alone is not a reliable method to detect Cicadas. To complement the human ear a parabolic dish (Figure 3a), smart phone app and bat detector were also used (Figure 3 c & d). The parabolic dish and sound recording equipment was used across all of the survey sites, the dish was directed towards suitable singing perches i.e. often, but not exclusively, Beech and Oak on the edge clearings. When conditions were suitable (hot, sunny and still) several 2-5 minute recordings were made at each site. The sound files were then analysed for presence of *C. montana* song. Southampton University developed a smart phone app. The app. uses a sonogram to detect the song of *C. montana*, if the phone microphone picks up a sound in or around the target range it alerts the operator and prompts a 30 second recording. The built-in software immediately analyses the sonogram and reports whether it is a possible Cicada or something else i.e. Wood cricket or Rosel's bush cricket. The phones GPS records the location the survey was undertaken. There is also the function to take manual surveys. At each survey site between 10-20 recordings were taken on each visit when conditions were suitable. The use of bat detectors to record Orthoptera by picking up their ultrasound emissions is proven very effective (Lee, 2009). A bat detector was used by Grant, Ward and Pinchen and is thought to be effective also at detecting *C.montana*. The Bat detector was set to 15-20 kHz and used at each of the survey sites on at least one occasion when weather conditions were optimal.

Visual searches for adults

Bracken, Hawthorn, Small leaved lime, Gorse and deadwood piles were searched for resting Cicadas. Suitable bushed such as Gorse and Heather were also beaten and swept (Figure 3 b). All other notable invertebrates were recorded (Appendix 4).

Presence of laying females and egg nest

Searches for egg laying females were made on Bracken fronds and stems, Birch saplings, Small leaved lime in suitable habitat. Deadwood piles, fallen trees and fence posts in sunny position were also searched for sun bathing *C. montana*. The surveyors got low to the ground (Bracken stems at eye line) to optimise chance of detection. At Gibbet Wood the Small leaved lime trees were searched for evidence of scars.

Personnel

Site surveys were carried out by Dr Sarah Henshall-Buglife, Paul and Helen Brock -naturalist/entomologists, Brian Harrison- wildlife sound recorder, Davide Zilli- Southampton University and Buglife volunteers John Wilson and Matt O'Callaghan.

Figure 3. Survey methods

a) Directional parabolic dish being used at Gibbet Wood

b) Beating and sweeping vegetation for adults and cast skins

c) Smart phone New Forest Cicada app.

d) Surveyors using the smart phone app at Denny wood. Suitable singing site a large lone Beech

Results

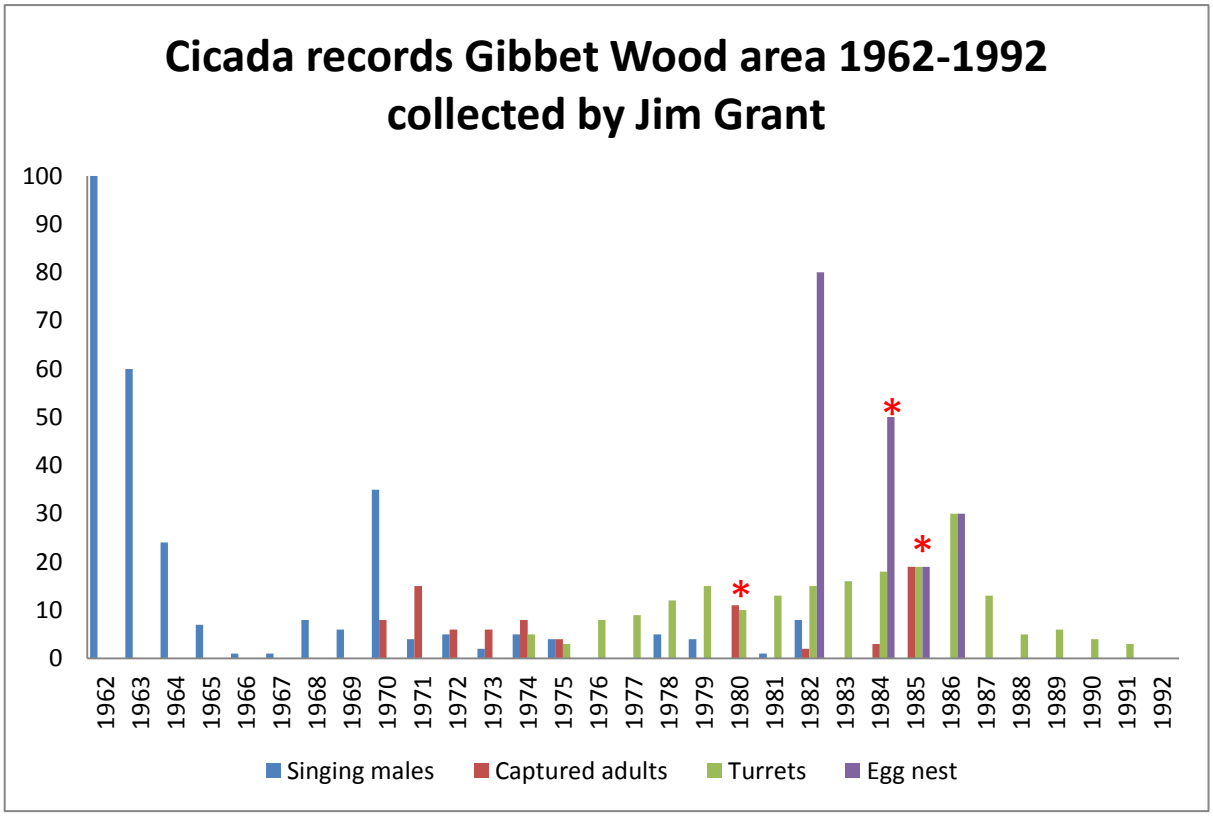
Review of historic records and surveys

Table 1. Summary of recent and historic *C. montana records*, and the areas surveyed by Grant, Ward and Pinchen.

MOST RECENT RECORDS post 1960's	
Whitebridge Hill / Rushpole Wood	1992, Mr Dempsey & daughter observed two adults on bracken. *This is a new record unearthed by this project; the recorder is a credible and experienced naturalist.*
Denny Wood	1996, possible (but likely) song (Pinchen & Ward 2010) 1991, adult on a parked car bonnet Morley heard it here 13/19 June 1907; at nearby Bishops Dyke it was recorded on 28 May 1831
Gibbet Wood / Brook Common, *often said to be 'between Brook and Fritham'* main survey sites: 1) Kings Garn Gutter 2) Gibbet Wood	1962 (rediscovered by Clifton *et al*.) regular monitoring site, singing heard up to 1994 (numbers of males heard singing: 100 in 1962 (peak), 35 in 1970, 2 in 1993) [and a possible oviposition scar seen in 1998]. It is not clear how many records relate to King's Garn Gutter, where Jim Grant ran a transect from King's Garn Gutter to the eastern edge of Brook Wood. The Driftway between King's Garn Gutter and Copse of Linwood was sometimes productive. Gibbet Wood became the locality for prolonged study in 1969 when cicadas were found to be 'plentiful' (numbers were tailing off at King's Garn Gutter). *There has been continuous monitoring for c.50 years at Gibbet Wood, including searching for singing adults, monitoring of 'turrets' (emergence chambers on soil surface) and egg-deposition scars on woody tissue of host plants. Jim Grant 1963-1990, latterly Bryan Pinchen from 1996 – present day.*
King's Garn Gutter	1968 second site monitored by Jim Grant, who ran a Transect from here to the eastern edge of Brook Wood. The driftway between King's Garn Gutter and Copse of Linwood was productive.
Cadnam, Sir John Barleycorn Inn surrounds	Recorded adjacent to Sir John Barleycorn Inn (now a motorway), 30 May 1969, Dr Michael Salmon
OLD RECORDS pre 1960's	
Falling within A337 route between Lyndhurst & Brockenhurst, e.g. Balmer Lawn, Parkhill, Ramnor Inclosurure, Denny Wood, Ladycross Lodge, Bishops Dyke	1812-1941 various recorders, source: Grant (1970)
Brockishill Inclosure southernmost east-to-west side.	1922 [emerging colony of c.100 on 4 June, littered over the grass], Drs Hobby and Killington

Approximately 2.5 km South of Cadnam	
Hollands Wood	1911, W. West
Balmer Lawn	1854 Pickard-Cambridge
Pennington Common	c.1812, Daniel Bydder
RECENT SURVEY WORK	
Post 1992, areas visited by Bryan Pinchen & Lena Ward, bold text denotes most frequently visited sites	**Gibbet Wood , Salisbury Trench, Kings Garn Gutter**, Denny and Matley Woods, Bramshaw Wood, Ferny Crofts, Raven 's Nest Inclosure, Pig Bush, Honey Hill and Culverley, Franchises Wood, **Island Thorns Inclosure**, Furzy Lawn Inclosures and Brockishill, Busketts Wood/ Busketts Lawn Inclosure. Possible cicada song north of Denny Wood (1996) and Furzy Lawn (2000). [source: 2007 report from http://nora.nerc.ac.uk/2484/1/T09056d5Rep.pdf ; 2008 report http://nora.nerc.ac.uk/5616/1/T09056d5Rep.pdf and unpublished information]

Figure 4. A graph showing the numbers of singing males, captured adults, turrets and egg nests recorded by Jim Grant between 1962 and 1992, Grant did not start recording turrets until 1974 and egg nests until 1982. The number of singing males drops off after 1982 this is thought to be due to Jim Grant's age and declining ability to hear the song, however the presence of turrets and egg nest can be used as a measure of abundance. In 1971 Grant introduced Cicada nymphs to several plots in Gibbet Wood, this data included turrets in the seeded plots. Data source Grant and Ward 1992



*Denotes singing males were heard in 1980, 1983 and 1985 but the number was not recorded.

Grant's data clearly shows a large number (100 singing males) in 1962 the year of discovery and a good number the following year (60). Numbers then drop off steeply then rise in the late 1960's reaching a maximum of 35 in 1970. Number never again reach those recorded in the 1960's and 1970 but a small peak is recorded again between 1978 and 1982, turret numbers peak at 30 in 1986 – broadly indicating an approximate 7-8 year cycle. It is useful to note that in 1971 several areas in Gibbet Wood were 'seeded' with first year Cicada nymphs (captive reared), adults emerged from these plots in 1979 (2), 1980 (1), 1981 (2) and 1982 (2). The released Cicada nymphs could have bolstered records.

Grant's data suggests a possible 7-8 year cycle, others sources suggest 6-10 year cycle, with this in mind based on historic sighting it would seem 2013-2015 could be a promising time period to locate *C. montana*.

Figure 5. Mean monthly (maximum daily temperature) for April, May, June and July 1962-1992 Grant's study period. Yellow shading denotes peak periods of Cicada activity.

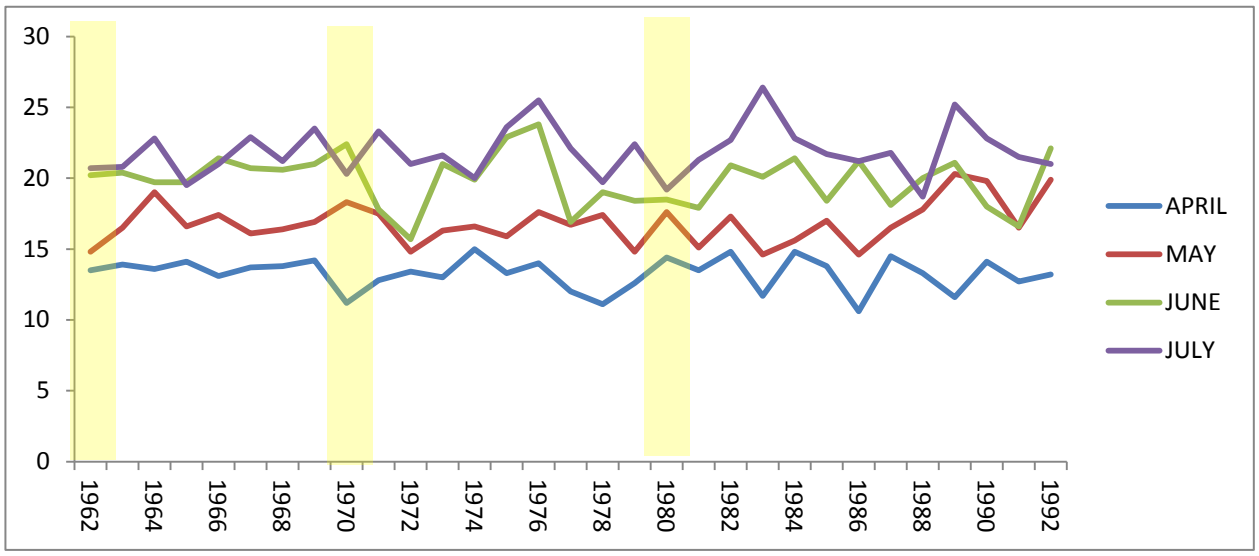


Figure 6. Total rainfall (mm) per month for April, May, June and July 1962-1992 Grant's study period. Yellow shading denotes peak periods of Cicada activity.

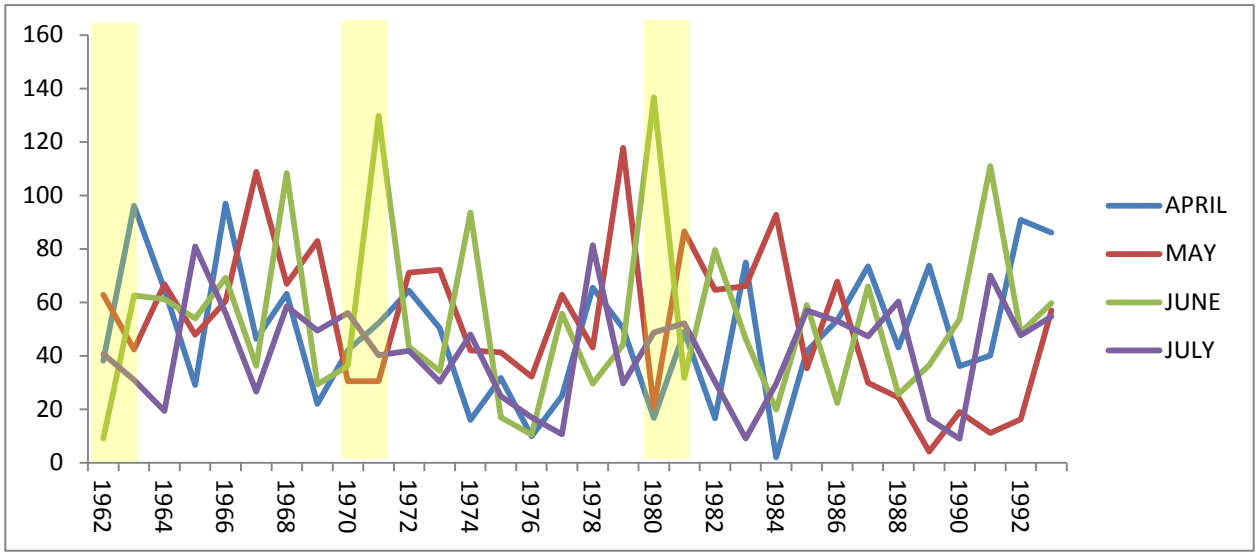


Table 2. Mean monthly (maximum daily temperature) for April, May, June and July during years of peak Cicada activity 1962, 1963, 1970, 1971, 1982 and 1983.

Cicada peak activity	April (°C)	April Rainfall (mm)	May (°C)	May Rainfall (mm)	June (°C)	June Rainfall (mm)	July (°C)	July Rainfall (mm)
1962 (100 singing)	13.5	40.7	14.8	62.8	20.6	9	20.8	40.7
1963 (60 singing)	13.9	96.1	16.5	62.6	20.6	62.9	20.8	19.4
1970 (35 singing)	11.2	39.4	18.3	30.5	22.4	36.2	20.3	56
1971 (15 captured)	12.8	40.3	17.8	30.5	17.8	129.8	23.3	40.2
1982 (80 egg nest)	14.8	16.6	17.3	62.5	20.9	79.6	22.7	30.3
1984 (50 egg nests)	14.8	2	15.6	92.8	21.4	32.4	22.8	29.5

In peak years 1962 and 1963 moderate temperature and rainfall was observed during spring- not hugely higher or lower than in subsequent years. However, the June mean temperature was 20.6°C coupled with very little rainfall. Perhaps providing optimal conditions for emerging and prolonged opportunity for singing.

Survey site details and results

A total of 56 sites were visited between mid-May and the end of July 2013 (Appendix 1 and 2), 19 sites were identified as either having the greatest potential for *C. montana* or sites that had not been looked at by Grant, Ward or Pinchen (Table 3 and Figure 7). Each of the 19 priority sites were surveyed on hot sunny days (minimum temperature 19°C) between 10am-4pm. The six most suitable sites with greatest potential Denny Wood; Whitebridge Hill; Gibbet Wood/Brook Common/Salisbury Trench; Driftway between Kings Garn Gutter and Copse of Linwood; Matley Bog and Denny Lodge Inclosure and surrounds/Denny Lodge were visited on 10; 5; 8; 5; 2 and 2 occasions consecutively (Table 4).

Island Thorns and Raven's Nest Inclosure have been highlighted by Pinchen and Ward as having high potential, these site were not surveyed as part of this survey as the Species Recovery Trust surveyed these sites along with several other sites in 2013. No cicada's or evidence of Cicada's was recorded during this survey.

Table 3. Survey sites, the sites marked in blue denote sites with most suitable habitat that received greatest survey effort. The temperature on all survey days was at least 18-19^{o}C for some part of the day.

Site	Grid Ref	Photo ref' Appendix 1	Date(s) and approx. time of visits	Weather conditions
Denny Wood	SU335059 & surrounds	1, 2, 3 & 4	18/5 (am/pm), 21/5 (am/pm), 26/5 (am/pm), 30 May (am), 1 June (am/pm), 4 June (am), 8 June (am/pm), 8 July (am), 16 July (am/pm), 30 June (am/pm)	Sunny days mainly some cloudy conditions, wind varying speeds
Denny Lodge Inclosure and surrounds/Denny Lodge	SU330054 & surrounds	5 & 6	1 June (pm) whilst at Denny, 8 July (am)	Sunny
Matley Bog	SU335065 & surrounds	7 & 8	1 June (pm), 22 July (pm)	Sunny days mainly, some cloudy conditions, wind varying speeds
Driftway between King's Garn Gutter and Copse of Linwood	SU255138 & surrounds	9, 10, 11 & 12	31 May (am/pm), 5 June (am/pm), 6 June (am/pm), 1 July (am/pm), 18 July (am)	Sunny days mainly, some cloud
Gibbet Wood/Brook Common/Salisbury Trench	SU257141 & surrounds	13, 14, 15, 16 & 17	31 May (am/pm), 5 June (am/pm), 6 June (am/pm), 10 June (am/pm), 27 June (am/pm),1 July (am/pm), 18 July (am) 26 July (am)	Sunny days mainly, some cloud
Whitebridge Hill	SU315095	18, 19 & 20	9 June (pm), 27 June (pm), 8 July (pm) 16 July, (am/pm) 26th July (pm)	Sunny intervals
New Copse Inclosure, near Ladycross/also to Perrywood Haseley	SU335031 & surrounds	21 & 22	25 May (am), 30 May (am), 4 June (pm), 17 July (pm)	Sunny intervals
Brockishill Inclosure/Furzy Lawn	SU301118	23 & 24	31 May (pm), 1 June (pm), 26 June (pm), 5 July (pm), 8 July (am)	Sunny intervals
Cadnam, Bignell Wood	SU287137	25 & 26	1 July (pm)	Sunny intervals
Eyeworth Wood, Iron Wells	SU228148	27	1 July (pm)	Sunny intervals
Bank	SU285073	28	30 May (pm), 1 June (pm)	Sunny
Stubbs Wood, near Tantany	SU365038	29	30 May (pm)	Sunny intervals
Costicles Inclosure/Busketts Lawn	SU328108	30	24 July (pm)	Sunny intervals
Hollands Wood towards Parkhill	SU308051	31	4 July (pm)	Sunny intervals
Mallard Wood	SU320094	32	9 June (am)	Sunny intervals

South Gorley	SU170112	N/A	10 June (pm)	Sunny intervals
Lodgehill Inclosure	SU319097	33	9 June (am), 16 July (am)	Sunny intervals
Mark Ash	SU245075	34	3 June (pm), 24 July (pm)	Sunny intervals
Wootton Coppice Inclose	SZ248996	35	1 June (pm), 24 July (pm)	Mainly cloudy but warm

Figure 7. Map showing all sites visited. Black dote denotes sites visited only once, coloured dots denotes the 19 sites identified as having high potential and selected for further visits. Red denotes high potential for Cicada, orange- moderate/high, yellow- moderate, blue- low/moderate, green- low.

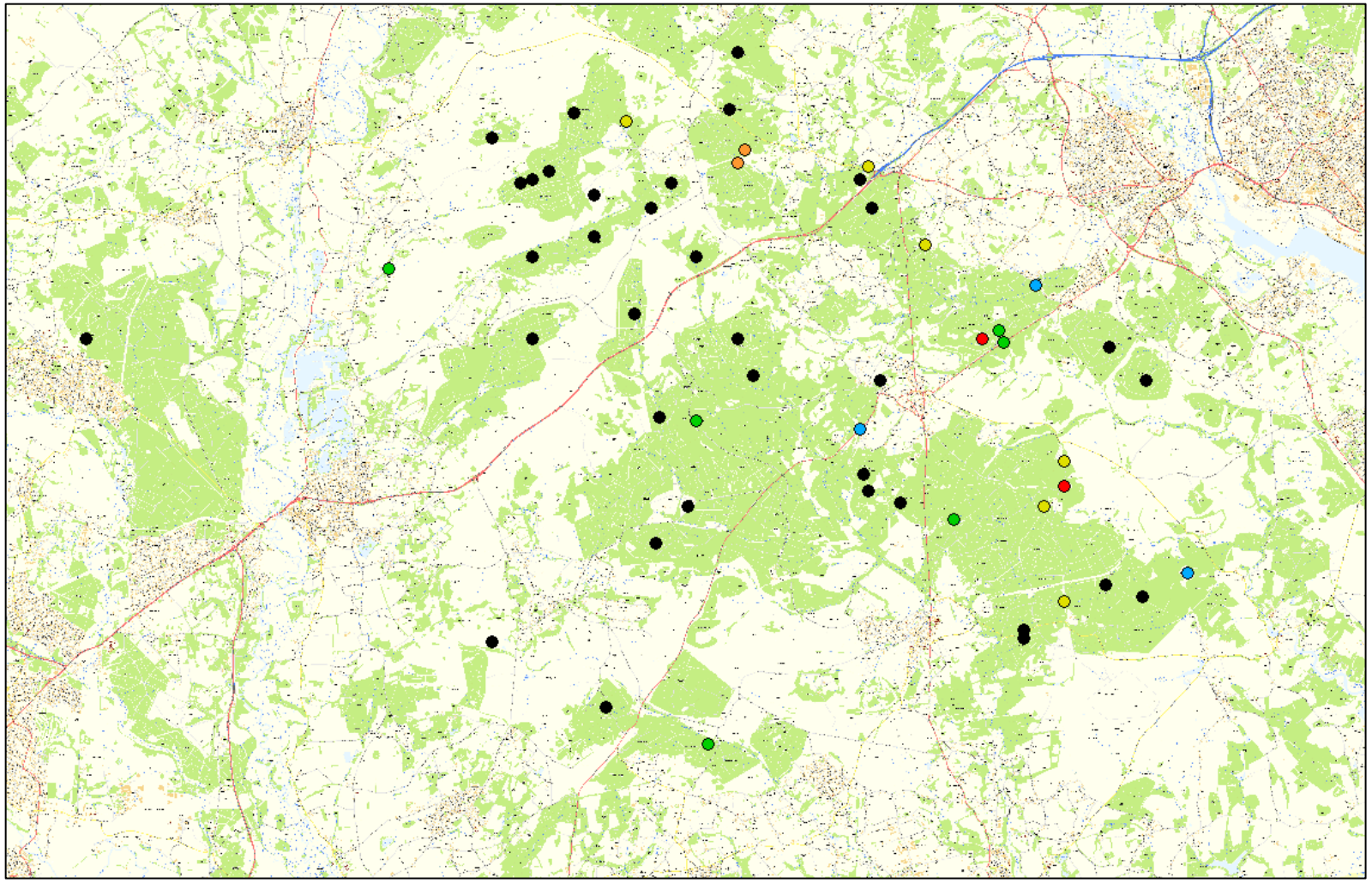


Table 4. Summary of site information and potential habitat for *C. Montana.* (/ denotes suitable habitat; ? possible; X largely unsuitable habitat).

Site	Habitat	Suitable habitat?	Potential for Cicada?	Past records?	Notes
Denny Wood (open woodland)	Open mainly deciduous Ancient & Ornamental (A&O) woodland with large clearings and raised banks, bordered by heathlands to the east. Large stands of Bracken, very occasional Small leaved lime. Good number of large lone trees ideal for singing males. Pony grazing quite heavy in places.	/	High	Yes	Visited numerous areas including past sound recordings SU339058 / SU336055; various suitable habitat in a seldom visited area near key sites such as Denny, fairly recent adult sighting (1991) and song was heard north of Denny in 1996.
Denny Lodge Inclosure and surrounds/Denny Lodge	Inclosed mixed but often coniferous woodland with wide ride, large stands of Bracken; near areas where recorded in Denny in the 1990's.	/	Moderate	Yes	Visited areas where possibly recorded near Denny with some suitable habitat
Matley Bog/Wood	Mainly deciduous woodland (A&O) with clearings, in part bordered by heathlands rather boggy in parts. Small amounts of Small leaved lime. Pony grazing quite heavy in places.	?	Moderate	Yes	Historic records only; various habitat might be suitable but less likely than Denny Wood
Driftway between Kings Garn Gutter and Copse of Linwood	Wide track between Inclosed mixed woodland with small clearings; with small heathland areas, undulating ground, bare ground and Bracken patches.	/	Mod/High	Yes	A vast area, always possible the cicada is hanging on somewhere in the area, popularly known as the 'Driftway' between the Inclosed woodlands. The eastern end of the Driftway looks particularly favourable.
Gibbet Wood/Brook Common/Salisbury Trench	Inclosed deciduous woodland with three main clearings with raised banks (one with a row of Small-leaved lime) scattered Hawthorn *Crataegus monogyna*, light to oderate Bracken cover, undulating ground with bare patches, large beech trees on edge of clearings providing dappled light, . Site is bordered by golf course and	/	Mod/High	Yes	Following conservation work in recent years, this area is now looking more like the site Grant worked on, before it became overgrown following fencing off. Likely the cicada died off here by c. 2000, but if still in the area could now recolonise

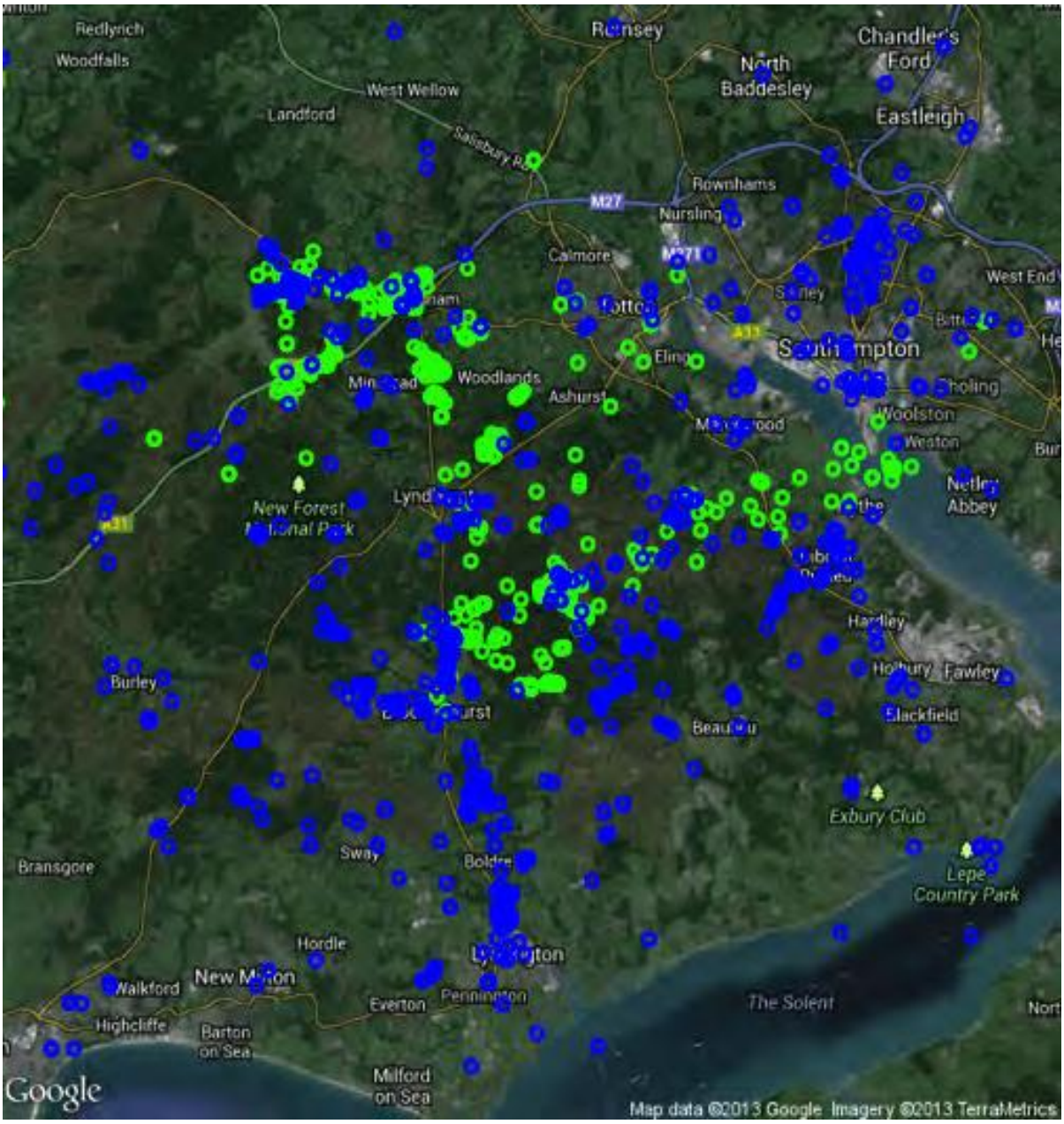
	heathlands				
Whitebridge Hill	Mixed woodland (A&O) with large clearings /areas of heathland, some raised banks	/	High	Yes	Last record of an adult here (1992), suitable habitat available
New Copse Inclosure, near Ladycross/also to Perrywood Haseley	Inclosed deciduous woodland with one main clearings at Ladycross, otherwise mainly woodland rides/railway embankment etc.	/	Moderate	Yes	One main clearing near Ladycross, with a breeding colony of Pearl-bordered Fritillaries on; apparently little suitable habitat in the area but historic records and possible recordings in the past, including 2004 (B Harrison)
Brockishill Inclosure/Furzy Lawn	Inclosed mixed woodland with wide rides and mainly small clearings, except towards Furzey Lawn - little heathland. Suitable banks with bare patches along sections of the rides	/	Moderate/ High	Yes	Old records (site of c.100 on 4 June in 1927), some suitable habitat, particularly in cleared area
Cadnam, Bignell Wood	Mixed woodland (A&O) with clearings /areas of heathland, large stands of bracken, close to busy road	/	Moderate	Yes	Past records in vicinity (not necessarily at this site), some suitable habitat
Eyeworth Wood, Iron Wells	Mixed woodland (A&O) with small clearings surrounded by mostly boggy heathland	/	Moderate	Yes?	Old record from 1968 nearby and possible song in past, some suitable habitat
Bank	Woodland edge, beech trees; small clearing	?	Low/Mod	Yes?	Possible song heard in this area 2004 (B Harrison), but largely unsuitable habitat
Stubbs Wood, near Tantany	Mixed woodland (A&O) with clearings, in part bordered by heathlands rather damp in parts	?	Low/Mod	Yes?	Possible song heard in this area 2004 (B Harrison), limited suitable habitat available
Costicles Inclosure/Busketts Lawn	Inclosed mixed woodland with wide rides but no clearings /areas of heathland	/	Low/Mod	Yes	Old record 1940; limited suitable habitat available
Hollands Wood towards Parkhill	Inclosed mixed woodland with moderately wide rides in part with small junctions/clearings - little heathland	?	Low	Yes	Old records in vicinity e.g. Balmer Lawn (now unsuitable), very limited possible habitat, but worth a look as a few days earlier a longhorn beetle was found here that had not seen for c.100 years!
Mallard Wood	Mixed woodland (A&O) bordered by large areas of heathland, some raised	?	Low	No	Little suitable habitat around this damp woodland, with narrow rides

	banks				
South Gorley	Mixed habitats, gardens, heathlands etc.	X	Low	No	No past records, unlikely habitat
Lodgehill Inclosure	Inclosed mixed woodland with few clearings /areas of heathland	X	Low	No	Very limited suitable habitat available
Mark Ash	Mixed woodland (A&O) with rather small clearings /areas of heathland	X	Low	No	No past records, unlikely habitat
Wootton Coppice Inclosure	Inclosed mixed woodland with wide rides and small clearings - little heathland	/	Low	No	Limited suitable habitat available, although there are some clearings

Smart phone survey coverage

Buglife conducted 577 Cicada app surveys across the forest. The public contributed a further 1200. 10 'possible Cicada' records were generated, however closer examination of the sonogram revealed that they were not Cicada's - most often rustling leaves or Rosel's bush cricket *Metrioptera roeseli* has triggered the alert.

Figure 8. An aerial image of the New Forest region the distribution of Cicada app surveys, green denotes Buglife, blue denotes other surveys (i.e. general public)



Possible turrets

Two possible turrets and several exit holes were recorded at Gibbet Wood (Figure 9 a-d), Denny Wood and Furzy Lawn. The Gibbet Wood images were sent to Mike Webb Hemiptera curator at the Natural History Museum, he said that they looked 'interesting' but could not confirm that they belong to *C. Montana.* A camera was set up to monitor the turret at Gibbet Wood. Unfortunately the camera was knocked by a pony then the batteries failed- hence the emergence was not filmed. The surrounding vegetation around all exit holes was searched for cast skins- none were found. The turret is most likely to belong to a Minotaur beetle *Typhaeus typhoeus*. Images of other potential turrets are shown in Appendix 3.

Figure 9. Possible cicada turrets and exit holes at Gibbet Wood.

a) Possible turret

b) Surveillance camera to monitor potential turret set up between the 6-10 June

c) Exit hole after emergence

d) Surveyors examining bank where potential turret was located

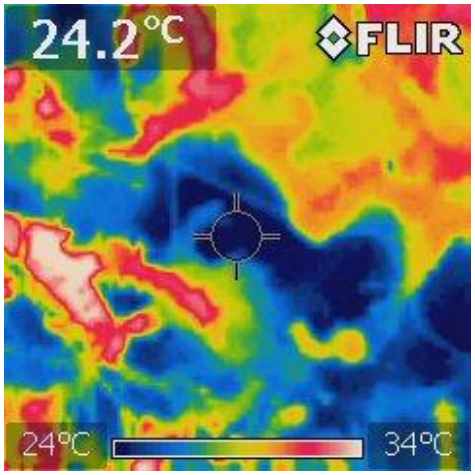
e) Photograph of *C. montana* turrets held at Natural History Museum

Possible leads from the general public

We received several reports from the public regarding potential *C. montana* sighting or song. All leads were followed up but none were fruitful. The most common culprit was the Wood cricket *Nemobius sylvestris* or the Dark giant horsefly *Tabanus sudeticus*.

Thermal images

Figure 10 a-d. Thermal images showing spatial temperature variation of patches of ground in the Driftway. The red to white colours denotes patches of bare ground ranging in temperature from 38-71°C, the blue/ green patches are cooler due to vegetation cover (mostly Bracken) and shading illustrating the significant effect of vegetation cover especially Bracken. The temperature reading in the top left corner is the mean.



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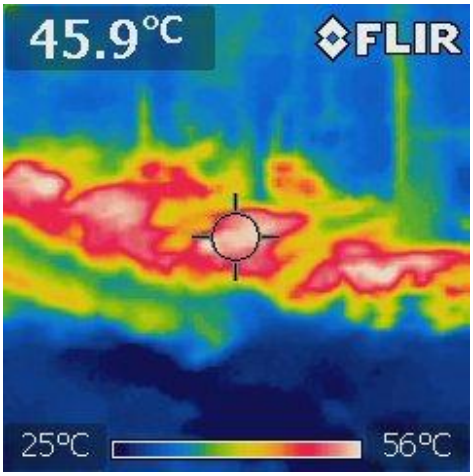

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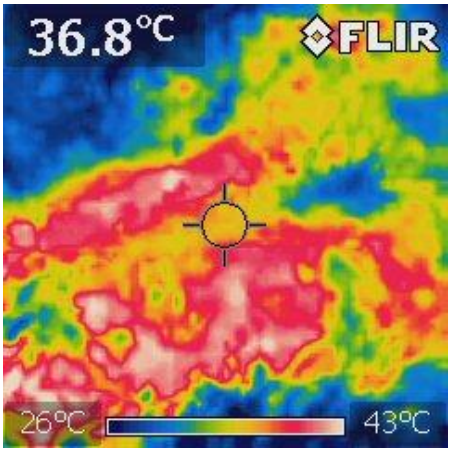

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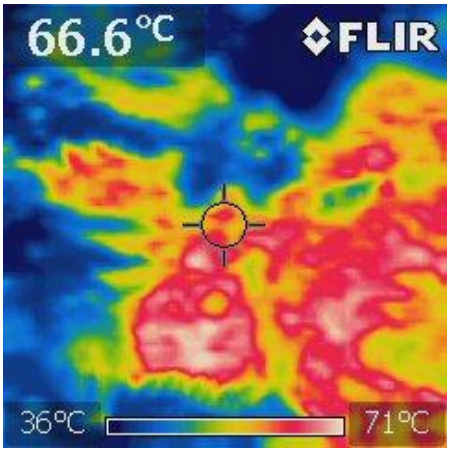


d

Meteorological data

Long term (1900-2013) weather data comprising of monthly mean maximum temperature (°C) (calculated using the daily maximum temperature) and monthly rainfall (mm) was sourced from the Met Office (www.metoffice.gov.uk/public/weather/climate-historic/#?tab=climateHistoric) (Figures 11-15. The nearest Met Office station was Southampton however this station ceased running in 1999, Hurn is the next closest active station (2000-2013). A linear regression was conducted to correlate temperature at Hurn and Southampton. The regression calculation was applied to the Southampton data to fill the period between 2000-2013. It is acknowledge that these stations are not in the New Forest National Park, however they give a useful overview of meteorological variation during the peak Cicada season April-July over a 113 year period. Ideally daily temperature data would have been sourced to establish the number of days per month that provide optimum Cicada conditions (i.e. over 19°C). An attempt was made to secure this data from the British Atmospheric Data Centre as there are several recording stations within the New Forest. However, the majority of these stations only ran for a short period closing in the

1960's, 70's or 80's and the only readily available long term data was rainfall, temperature data was not available. Pinchen and Ward have conducted long term subsurface temperature (5mm) recording at Gibbet Wood and more recently at Island Thorns. This data was not available for this study however it can be gleaned from the literature (Ward 1995; Pinchen & Ward 2002; 2008) that the number of days during the flight season when the ground temperature exceeds 20°Cis very variable year on year ie . 10 days in 1995 and 16 days in 2000. Ground temperature is also directly linked to vegetation cover, at Island Thorns where the site had been clear felled the site provided 92 days exceeding 20°C in 2002. As vegetation cover rapid increased to number of days was reduced to 20 in 2008.

Figure 11.Mean maximum monthly air temperature per month in April, May June and July 1900-2013.

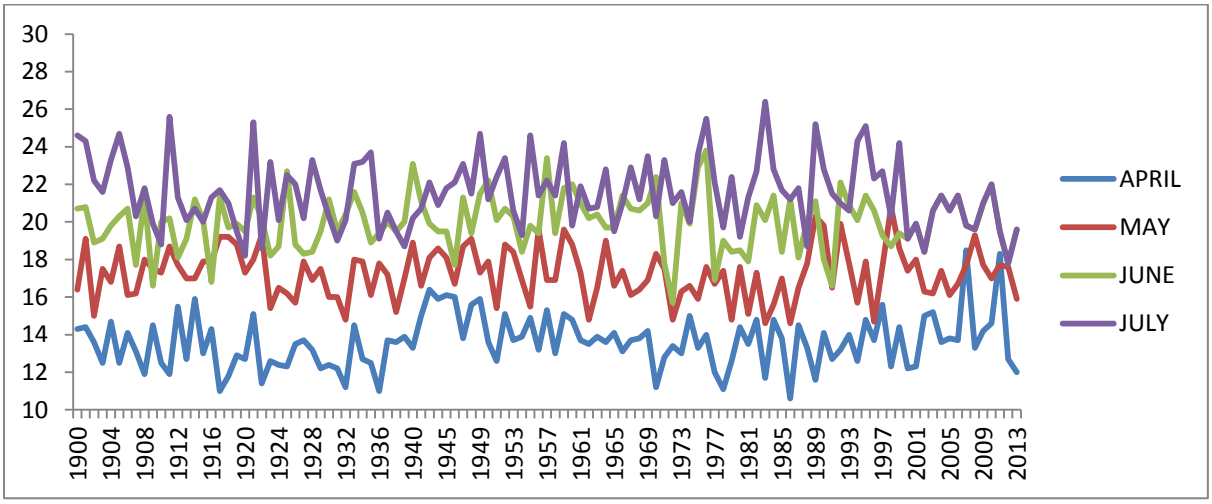


Table 5. summary of mean max temperature (°C) and rainfall (mm) for April-July in years with peak activity (1922, 62, 1963, 1970, 1982 & 1984), confirmed (1991 & 1992) and unconfirmed sightings (2000). Also the earliest emergence (13th May 1974) and latest record (30th July 1907).

Cicada activity	April (°C)	April Rainfall (mm)	May (°C)	May Rainfall (mm)	June (°C)	June Rainfall (mm)	July (°C)	July Rainfall (mm)	Comments
30 July 1907 Latest record	13.1	110.2	16.2	76.8	17.7	12.9	20.3	37.3	Very wet April & May - delay emergence?
1922 (100 emerging) Brockishill	11.4	85.9	15.4	19.7	18.7	50.9	20.1	108.7	-
8 June 1962 (100 singing) Gibbet Wood	13.5	40.7	14.8	62.8	20.6	9	20.8	40.7	Warm dry June
1963 first heard 6 June (60 singing) Gibbet Wood	13.9	96.1	16.5	62.6	20.6	62.9	20.8	19.4	-
1964 first heard on 28 May (24 singing) Gibbet/Drfitway	13.6	64.6	19	66.8	19.7	61.1	22.8	19.4	Warm May – trigger early emergence?
11 June 1970 (35 singing) Gibbet Wood	11.2	39.4	18.3	30.5	22.4	36.2	20.3	56	Cool April
13 May 1974	15	16	16.6	44	20	93.6	20	48	Warm dry

Earliest record									April – trigger for early emergence?
1982 (80 egg nest) emergence noted by 14 May	14.8	16.6	17.3	62.5	20.9	79.6	22.7	30.3	Warm dry April – trigger for early emergence?
1984 (50 egg nests) emergence noted by 24 May	14.8	2	15.6	92.8	21.4	32.4	22.8	29.5	Warm dry April – trigger for early emergence?
1991 (1 adult) Denny Wood	12.7	40.1	16.5	11.1	16.6	111	21.5	70	Cool spring, wet June
1992 (2 adults) Whitebridge Hill	14.1	90.9	19.5	16.2	22.1	47.6	21	47.5	Warm dry May
2000 (unconfirmed song & turret) Furzey Lawn	12.2	150.6	17.4	88.1	19	38.6	19.1	42.8	Cool & very wet April followed by wet May

The meteorological data is not site specific, but it can be effectively used to look for patterns relating to the timing of *C. montana* activity. The earliest record of *C. montana* in the New Forest was the 13 May in 1974 this coincides with a warm dry April. A warm dry spring could trigger earlier emergence, whereas wet and cool April May could result in delayed emergence and potential failure. In 1907 *C. montana* was recorded on 30 July- this coincides with a particularly wet and cool spring (Table 5 & Figures 11-15)

General weather trends

In line with climate change predictions the Met Office UK climate averages indicate we are experiencing increased mean temperatures. However, this is coupled with increased and prolonged rainfall especially in the summer months. Winters are also wetter and milder (www.metoffice.gov.uk/climate/uk/averages/). Wet weather especially in spring could limit/ delay emergence; wet summers will hinders adult activity and may also inhibit nymphal development. Increased mild wet winters may also effect nymphal development- water logged ground could result in nymphs drowning in their burrows. Sites with raised banks and undulating profiles will provide greater protection from water logging, providing opportunities for nymphs to track their favoured habitat moving vertically to avoid water logging. Prolonged winter flooding such as that observed in 2000/01 and the recently 2013/14 could be particularly problematic and result in high nymph mortality (Pinchen & Ward 2002).

It is also worth noting that since 1910 there have been seven significant drought spells 1920-21; 1933-34; 1975-76 and more recently 1990-92; 1995-97, 2004-06 and 2009-12. The 1975-76 drought is considered to be the most significant (www.metoffice.gov.uk/climate/uk/interesting/2012-drought). It is beyond the scope of this report to obtain and analysis this data, however there could potentially be a link between droughts and *C. montana* activity.

On the Continent Cicadas are reported to favour slightly damp soils, if soil is too dry this could potentially cause problems for feeding nymphs and turret building. Grant and Ward (1992) also report *C. montana's* preference for damper soils. In the New Forest *C. montana* could be restricted to clay rich soils that would retain moisture in drought spells? Gibbet Wood is located on Barton clay potentially helping to explain the large population recorded there historically.

Figures 12-15 show total monthly rainfall for April, May, June and July from 1900-2013. Rainfall is hugely variable and fluctuates year on year, these figures provide a useful an overview. April 1993 was the wettest for 26 years

followed by exceptionally high rainfall seven years later in 2000. There does appear to be increased instances of heavy rainfall in April over the last 20 years, similarly there appears increased summer rainfall too- both will impact on *C. montana* emergence, activity and breeding success. Detailed analysis would allow great interrogation of data and identify patterns and significant differences over time.

Figure 12. Total monthly rainfall (mm) in April 1900-2013

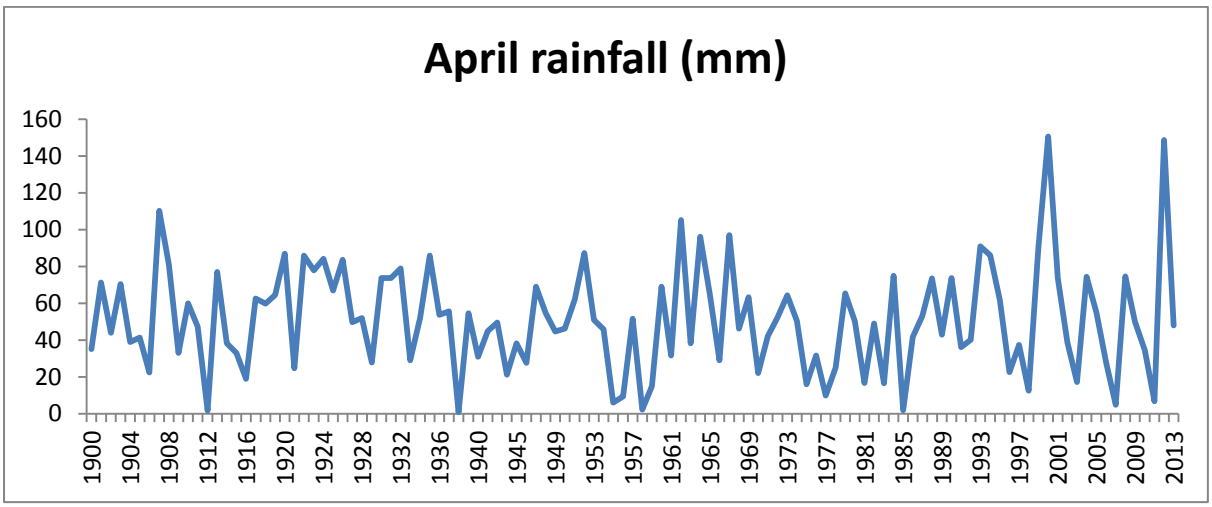


Figure 13. Total monthly rainfall (mm) in May 1900-2013

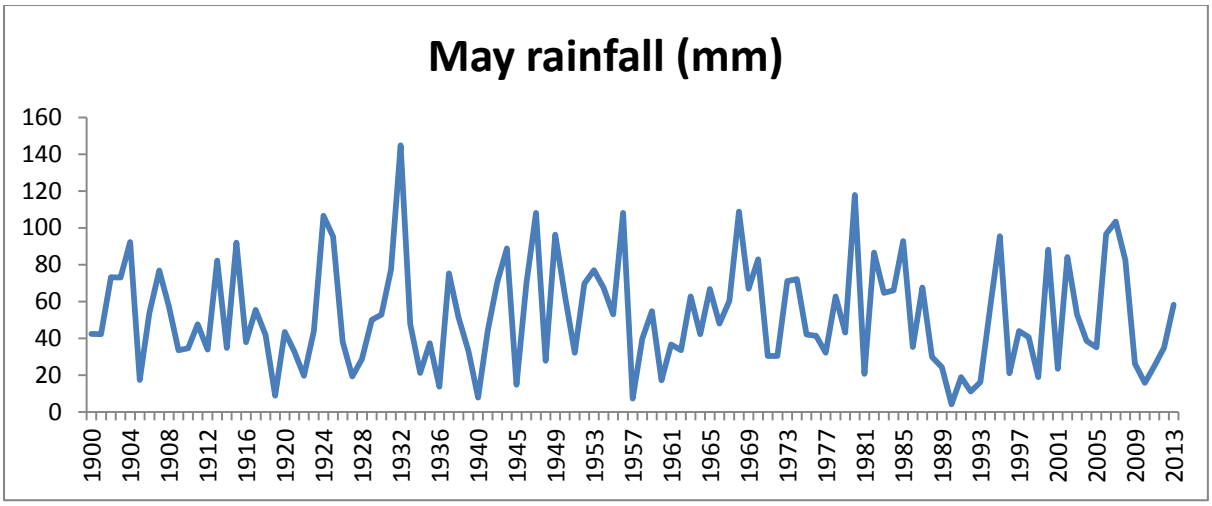


Figure 14. Total monthly rainfall (mm) in June 1900-2013

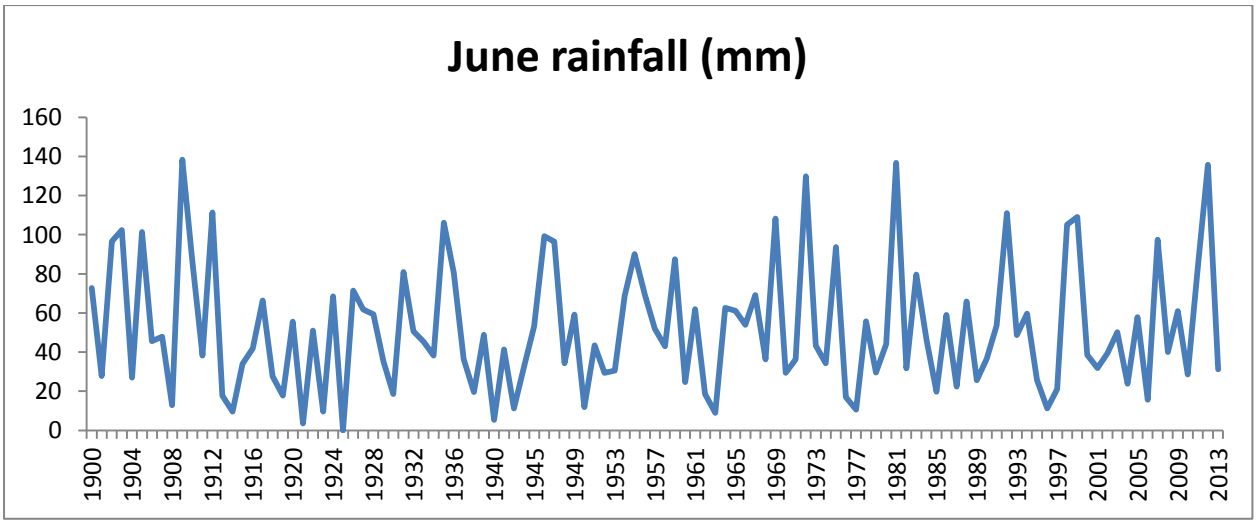
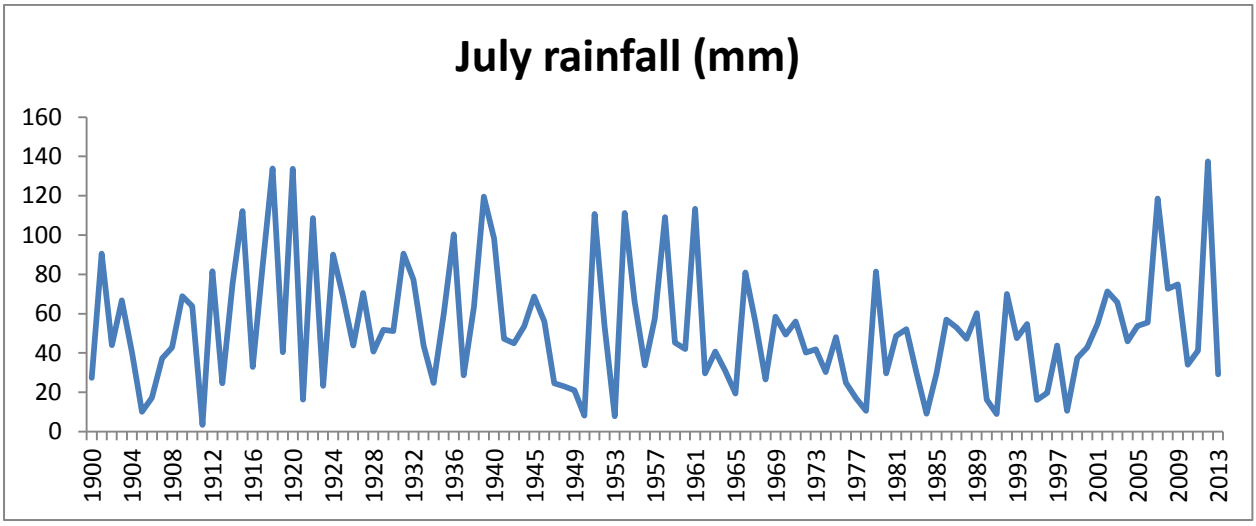


Figure 15. Total monthly rain fall (mm) in July 1900-2013



Discussion

The New Forest

During the last decades of the nineteenth century and for the first few of the next the New Forest was arguably the richest and most popular insect collecting area in the country (Salmon *et al*., 2005). By the 1960's, there were noticeable declines in most insects especially butterflies, grasshoppers and bush crickets. These declines are generally attributed to conifer afforestation, grazing by ponies in some Inclosures, mowing of rides and cutting of ride side scrub such as brambles, coupled with adverse weather i.e.. wet summers, and over collecting. Despite these declines the New Forest is still widely recognised to be one of the most important areas for wildlife in the UK, 63% of British insect fauna is recorded in the New Forest, including over 400 species of conservation concern (Red Data Book, RDB 1, RDB2, Notable, Na and Nb) recorded in the SAC. 80% of Britain's butterflies, 58% of moths (although micro moths are under recorded, so the true figure is probably c .66%), 71% dragonflies and damselflies, and 87% of grasshoppers and crickets (Brock, 2011).

Species may be re-discovered after long periods of time for example the Blister beetle *Sitaris muralis* recorded in Brockenhurst in 2010, the first time in the forest since 1947, and the Longhorn beetle *Pedostrangalia revestita* that was recorded at Hollands Wood in 2013 the first record in nearly 100 years. This certainly gives hope that other rarities still exist in the Forest. Buglife feels this is certainly the case for *C.montana*. The New Forest is a vast area extending over 57,100 hectares, comprising of extensive open and Inclosed woodland and heathland habitats, along with transitional edge habitats. There is continual cycle of clearance and disturbance creating suitable areas of habitat for *C.montana*, many of which are rarely visited.

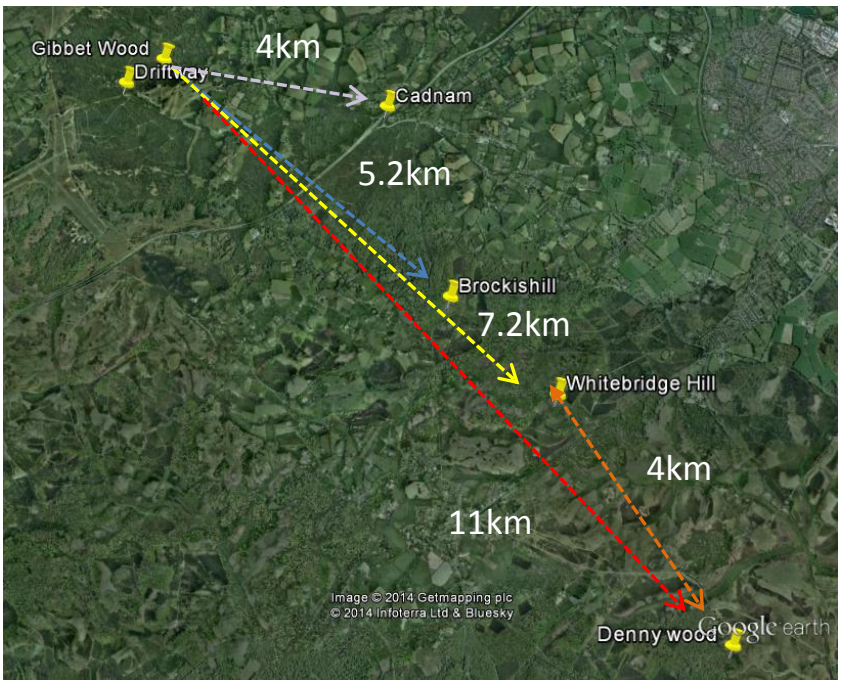
The Open Forest (approximately 22,000ha) is the part of the New Forest where the commoners' livestock are free to roam. The extent of the open Forest changes over time, predominately, but not exclusively, through the erection and removal of fences around Inclosures. Inclosures are areas where the Crown has the legal right to interfere with the commoners rights, in order to grow timber. There are c. 8,500 ha subject to these rights but at any one time there may be far less actually fenced off from livestock and in recent years selected Inclosures have been cleared of plantations with the intention to reverting them to previous habitats such as ancient and ornamental woods, heaths, bogs and lawns (Brock, 2011). The clearing of woodland provides suitable pockets of habitat that *C. montana* can utilise, however with the absence of management these areas can quickly become dominated by Bracken and Birch and become largely unsuitable.

Most modern records of *C. montana* come from 1) un-grazed/ lightly grazed Inclosures that have been cleared and the regenerating vegetation provides a favourable habitat mosaic (i.e. Gibbet Wood and Brockishill) or 2) from Open Forest areas where grazing is suitably low allowing scrub habitat to develop (Whitebridge Hill and some parts of Denny Wood).

Sites with highest potential for C. montana

It is useful to look at the geographical spread of the most recent/ significant *C. montana* sites. Denny Wood lies 11km to the south east of Gibbet Wood, with Cadnam, Brockishill and Whitebridge Hill located in between. This could possibly provide a dispersal corridor with stepping stones of suitable habitat and a continuity of habitat resource. On the Continent cicada's are characterised by transient local populations that track patches of suitable habitat. With the New Forest landscape and cycles of clearance this could certainly be occurring, particularly in the wedge shaped corridor between Lyndhurst, Cadnam and Fritham. Denny Wood has yielded records of *C. montana* in 1831, 1907, 1991 and 1996 indicating the persistence of a long term (but small) population here, possibly the source from which other sites to the north west have been colonised? It is reassuring to note that three sites- Whitebridge Hill, Denny Wood and Gibbet Wood all have records of *C. montana* during the early 1990's indicating that *C. montana* is able to disperse utilising pockets of habitat, and that its fate is not completely resting on the suitability of a single site.

Figure 16. Geographical spread of recent/most significant *C. montana* records.

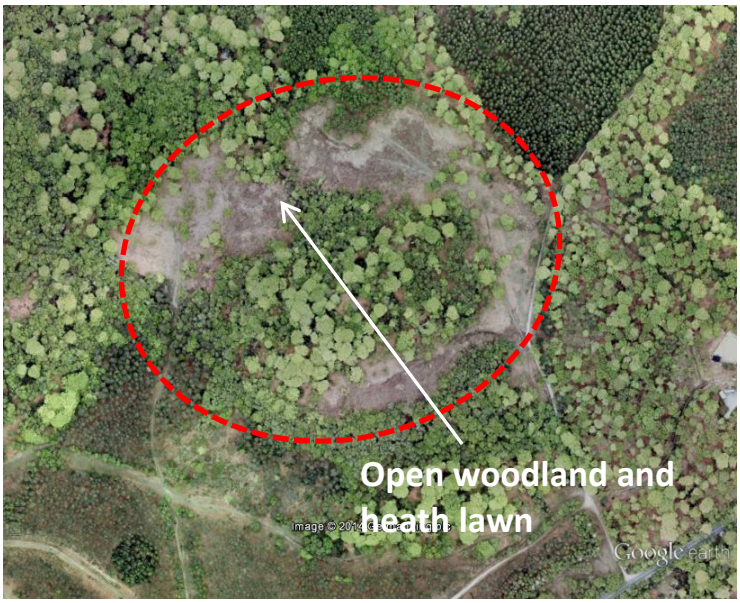


Whitebridge Hill (High potential)

This area is highlighted as having high potential for *C.montana* (Figure 17). Two adults were recorded at Whitebridge Hill in 1992 and the habitat looks very favourable. This area supports Open Forest and heath lawn with a mix of dry and damper ground conditions. The site supports light Bracken and Birch sapling cover, scattered scrub and heathland flora including Ling *Calluna Vulgaris*, Cross leaved heath *Erica tetralix* and Purple moor grass. The open habitat is maintained by Birch removal, occasional Bracken spraying and very occasional patch burning. In addition the grazing at Whitebridge Hill and Rushpole Wood is at a lower level than elsewhere in the forest (Cook pers comm), allow favourable habitat structure ro be created and maintained. There has been a continuous open habitat resource on this site for at least the last 20-30 years, possibly longer (P Cook pers comm) making this site and surrounding area including Rushpole Wood high priority for survey work in 2014/5.

Management recommendations: the site is currently favourable for *C. montana*, retain current grazing levels (prevent any increase), continue Bracken and Birch control to maintain open habitat mosaic and diversity of herbaceous plants. Keep close eye on Bracken to ensure it does not become too dominant, aim for light bracken cover, no more than 25-30% cover and do not allow thatch to build up excessively. Bracken control should comprise of a combination of cutting and spraying. Planting of Small leaved lime could be considered to enhance oviposition opportunities.

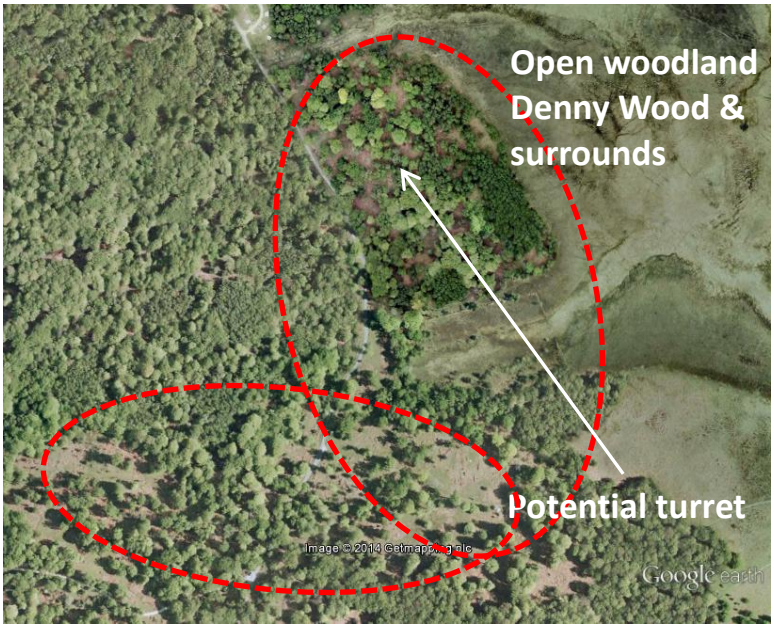
Figure 17. Aerial image of Whitebridge Hill survey site



Denny Wood (High potential)

The open woodland area around Denny Wood provides many pockets of suitable habitat. An adult Cicada was recorded here in 1991 and song was heard in 1996. The habitat in this area comprises of open woodland, with sheltered glades and areas of raised ground bordering open heath. This area certainly provides many pockets of suitable habitat and we believe that *C. montana* could quite well be hanging on in this area. This area is subject to quite heavy grazing especially from ponies.

Figure 18. Aerial image of Denny Wood and surrounds survey area.



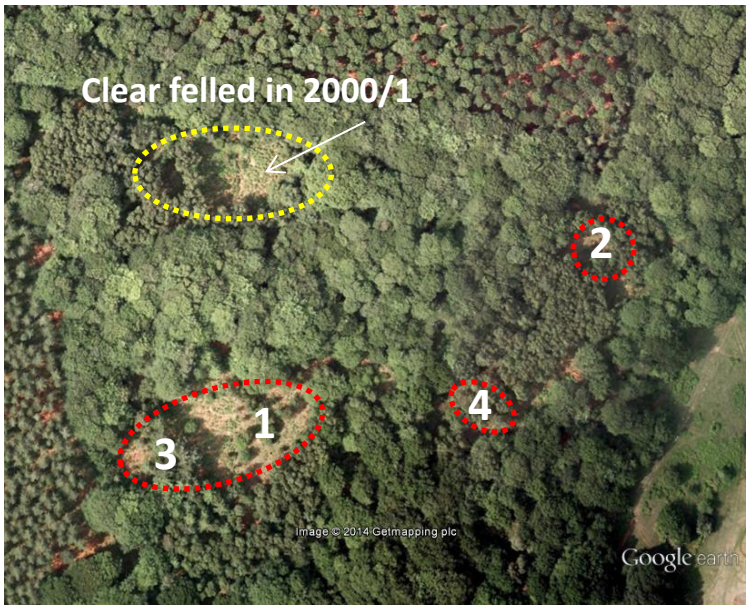
Management recommendations: Denny Wood provides numerous pockets of suitable habitat. The fact that this area has only ever yielded small numbers of *C. montana*, yet there seem to be continuity with occasional records from 1831- 1996 suggests that this areas does support suitable habitat, however there is a limiting factor keeping the population low- that we infer this is grazing. Grazing has reduced the availability of low growing shrub oviposition sites and herbaceous plants required for nymphs to feed on. As with the Driftway Denny Wood is Open Forest, a reduction in grazing would undoubtedly improve this area for *C. montana* promoting short shrubs, herbaceous

plants and early successional scrub habitat to develop. Bracken has become dominant in some areas; control through spraying and cutting would be beneficial.

Gibbet Wood, Brook Common and Salisbury Trench area (moderate/high potential)

One hundred singing *C. montana* were discovered at Gibbet Wood in 1962. Their abundance is thought to relate to the clearance of the woodland around Gibbet Wood approximately 8 years earlier in 1954. The clearance would have provided more open ground habitat, for dispersing females to utilise for oviposition. It is known that woodland clearance has increased Cicada numbers in Russia (Grant & Ward, 1992). Between 1962 and the early 1990's Grant and Ward observed the site becoming overgrown (the site was fenced in the mid 1960's, the exact dates in unknown) and a shift towards the site becoming unsuitable for *C. montana,* due to Birch encroachment and dense Bracken growth resulting in shading and a reduction of herbaceous plants including Ling. Gibbet Wood is fenced, however grazing has certainly not been completely excluded. Deer and ponies have both trampled the site especially when fences are damaged and/or gates left open (in 1985, 6 out of 18 turrets were crushed by ponies and 7 out of 8 planted Small leaved lime trees were fatally damaged by browsing (Grant & Ward 1992) . Between 1994-96 work commenced to open up the four glades removing Birch scrub and Bracken, in 1998 two of these glades were joined up to make one large glade. In 2000 an area to the north of the study site was clear felled (Figure 19). There has been a small amount of ad-hoc scrub clearance works over the last 15 years and Bracken spraying and/or cutting by hand has occurred periodically, most recently in 2008 (T Creed pers comm.). Asulox was used to spray the bracken in late July/early August 2008 and the dead material was collected and removed to promote bare ground. The timing of bracken spraying is important, at sites known to support *C.montana* spraying and removal of bracken before the eggs have hatched and the nymphs moved to the ground could have a negative effect. However, leaving spraying too late can reduce the effectiveness of Asulox.

Figure 19. Aerial image of Gibbet Wood taken in 2005 showing the approximate location of the main glades studied by Grant, Ward and Pinchen 1-4, glades 1 and 2 were cleared in 1994, 3 and 4 cleared in 1996 and glades 1 and 3 were joined up in 1998. The area to the north was clear felled in 2000/01.



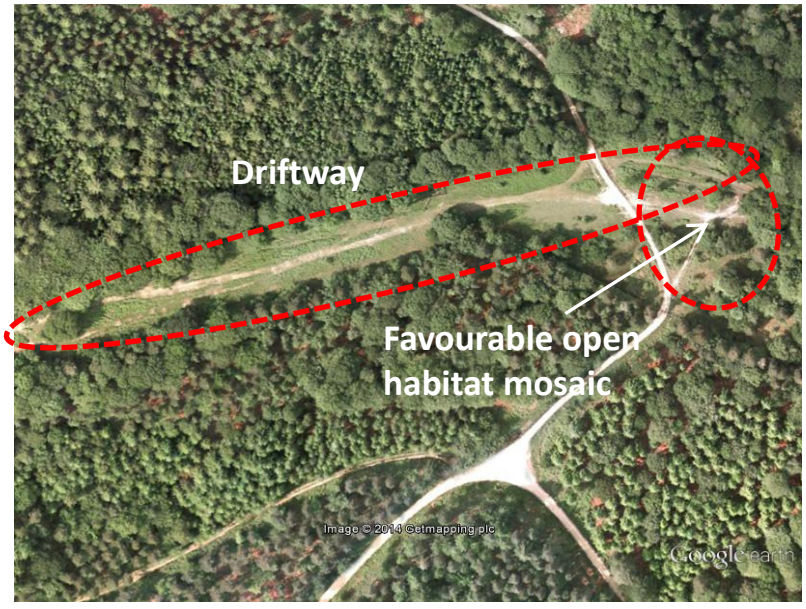
Currently much of the habitat at Gibbet Wood appears reasonably suitable for *C.montana,* however in May 2013 the gate near glade 4 was propped open and ponies were freely accessing the site during the key turret building period. Some parts of the site are starting to becoming dominated by Bracken resulting in increased shading and build-up of thatch- reducing the availability of bare ground, warm microclimate and herbaceous plants (ie. glade 2, northern part of glade 1/3). Overall glade 1/3 provides the most favourable habitat, when visited in May there was a good mosaic of open ground, herbaceous plant cover and light bracken cover. Glade 4 contains suitable raised banks, the substrate at Gibbet Wood (Barton clay) provides favourable conditions (not too dry or too wet) to maintain for nymphal tunnels and turrets. The habitat on the edge of Brook Common adjoining the golf course also appears suitable, providing many suitable perches for singing males .

Although Gibbet currently looks suitable, it is apparent that since the peak records in the 1960's and 1970's the site slowly deteriorated and became unsuitable- through shading of habitat and grazing at inappropriate times of year. The management intervention of the mid 1990's may have come too late and it likely that *C.montana* was lost from this site. *C.montana* is highly mobile therefore emerging adults may have moved away from this site tracking suitable habitat i.e. moving south east through the corridor of stepping stones? (Figure 16). If *C. montana* remained nearby it is possible that it could recolonise this site.

Management recommendations: Management measures such as Bracken and scrub control and exclusion of grazing March- November could further improve Gibbet Wood's suitability for *C. montana*. Bracken control in glades 2 and 1/3 is needed to maintain the open habitat and promote the herbaceous ground flora. A combination of spraying, cutting by hand and removal of thatch to ensure Bracken cover does not exceed 25-30% of each glade. Volunteers could be utilised to assist with this work as well as Birch control. The exclusion of grazing during critical Cicada period is very important. This has previously been recommended by the Cicada working group (grazing only permitted between 1st November and 1st March), winter grazing will also aid scrub control and allow the establishment of good habitat structure. Bracken and Birch control should also be applied to other cleared areas in the vicinity to maintain the open habitat and early successional scrub habitat resource.

Driftway (moderate/high potential)

The Driftway looks promising for *C.montana*. Its runs between Janesmoor and Gibbet Wood, sandwiched between Copse of Linwood and King's Garn Gutter. The Driftway was cleared around 1969 and has been maintained as an open corridor since then (T Creed pers comm). It provides a c.800m linear section of sheltered yet open habitat with favourable woodland edge habitat and scattered patches of bare ground. There are some sizable stands of Brackenin the centre of the Driftway. The eastern section provides a very favourable area of sheltered open habitat comprising of raised banks with a good amount of bare unshaded ground, herbaceous plants, scattered scrub and light bracken cover. This area is grazed therefore limiting its suitability for *C.montana*. The Driftway would have provided suitable habitat for dispersing females from Gibbet Wood during the 1960's-90's, however, grazing density will have influenced cicada's ability to complete its lifecycle here.



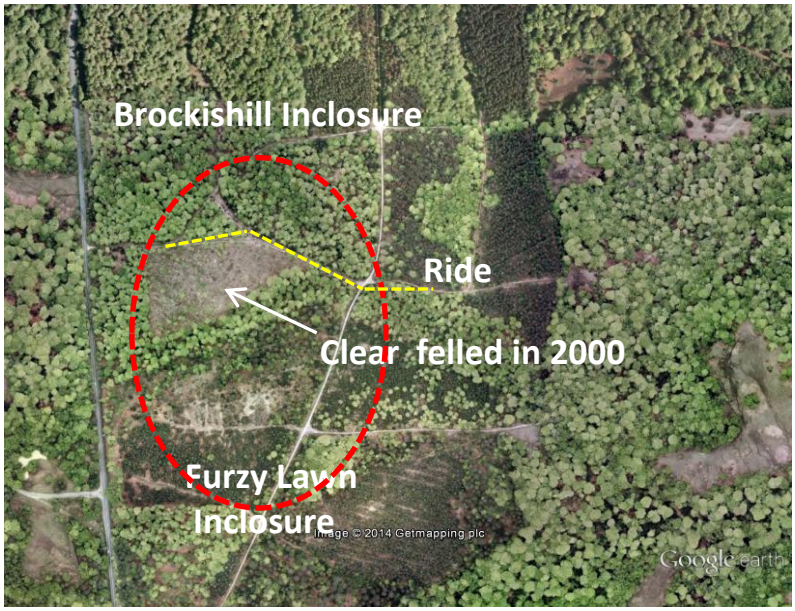
Management recommendations: the habitat structure in the Driftway is favourable, especially in the eastern section, the issue is grazing. Given that this is outside of an Inclosure controlling or altering the grazing level may not be possible in the short term. The current Bracken levels are acceptable overall; keep an eye on the Bracken in the eastern section, if this exceeds 30% cover control with cutting and or spraying.

Brockishill Inclosure and Furzey Lawn (Moderate/high potential)

Brockishill Inclosure is the site of mass Cicada emergence in 1927. Grant visited the site on several occasions between 1966-1970, and noted that the ride in question *'no longer looked suitable but adjoining regrowth on the south side following clearing may have potential'*. Pinchen and Ward report that a possible turret and Cicada song

were recorded from Furzy Lawn in 2000, only a short distance from Brockishill Inclosure. The area comprises of a deer fenced Inclosure that was clear felled in the early 2000's and planted with Oak and Ash *Fraxinus excelsior*. The Ash trees have not taken and the Oak is growing very slowly, therefore this area currently provides raised banks with patches of open ground and heathland , light Bracken and a lot of young Birch. Winter works in 2012/13/14 has been undertaken to remove Birch to give the Oak more space (P Cook pers comm). The ride running next to deer fenced area supports raised banks along much of its length, some are rather shaded but others have dappled light and some are in full sun. The bank vegetation includes of Purple moor grass and Ling. A potential turret (remains of) and an exit hole was located towards the eastern end of the bank, however no cast skins or other evidence of Cicada was recorded. This area (Figure 20, red dotted line encompassing parts of Brockishill and Furzy Lawn)) should be subject to further survey work in 2014/15. This area certainly provides potential habitat for *C.montana.*

Figure 20. Aerial image of Brockishill Inclosure and Furzy Lawn Inclosure.



Management recommendations: maintain open habitat, as the clear felled area re-planted with Oak matures consider creating another area of clear fell in close proximity. Ensure Bracken is controlled to prevent it becoming dominant, ideally no more than 30% cover.

Factors influencing habitat suitability and availability

Bracken & scrub

Historically bracken thatch was harvested for bedding or fodder, it is likely the decline in this practice will have resulted in greater bracken cover and build up of thatch throughout the New Forest. Ideal habitat for *C. montana* comprises of sheltered clearings with early successional scrub, south facing sunny open banks with herbaceous plants and a small amount of scattered Bracken. Too much bracken can have a negative impact through over shading, cooling of microhabitat and reduction of ground flora. Bracken cover can reduce ground temperature by at least 10^{o}C and probably inhabits *C. montana* colonisation and/or nymphal development (Pinchen & Ward, 2000 as cited in Pinchen & Ward 2002) and as shown in Figure 10 a-d. In addition Bracken is not the best oviposition host because it can become weak in the autumn and the stems may break exposing eggs to predation and or desiccation before they are ready to hatch. Sites containing mostly Bracken and few other herbaceous plants provide only limited oviposition opportunities.

Birch encroachment is also issue especially when grazing is excluded. As with Bracken cover uncontrolled Birch encroachment can result in shading and loss of bare open ground. Newly clear felled areas provide suitable habitat for *C. montana* in the short term allowing them to move in and utilise the low growing shrub resource and open habitat. However, in as little as 2-5 years and certainly by the time the nymphs emerge the site can be covered in dense Bracken and Birch sapling making it unsuitable for *C. montana* nymphs to feed and/or emerge.

Traditional coppice rotations would have been more likely to provide suitable conditions than the longer rotations employed by modern forestry.

Grazing

Grazing levels have increased since the fencing and gridding of the Forest perambulation in the early 1960's. Current levels of pony stocking are at an all-time high. In the 1960's there were around 1,700 ponies grazing the Forest, this increased to 3400-4000 in the 1990's, and now sits at around 5,000. With the addition of cattle, pigs and donkeys this figure will easily reach, if not 7,000 grazing animals (http://www.verderers.org.uk/Stock.pdf ; http://www.newforestnpa.gov.uk/info/20089/rich_cultural_heritage/48/commoning#.U7pCYrH-vKd). After the fencing, an estimated 30-40% more livestock were grazing the Open Forest (Tubbs 1986). Increased grazing pressure has resulted in the depletion if low-growing oviposition sites for females (except for Bracken that has increased) and reduced herbaceous plants that the nymphs require for food.

Grazing is a double edged sword; on one hand controlled grazing is an essential management tool on the other it can destroy and decimate habitat especially for insects. Too much grazing at the wrong time of year can compact ground, reduce oviposition sites, destroy turrets or trample vegetation containing eggs nest, however too little grazing can result in Bracken and tree dominated closed shaded habitat.

Slovenian cicada expert Tomi Trilar familiar with *C. montana* visited the New Forest in the mid 2000's noted that "*In two seasons in New Forest I found out that most of the areas are overgrazed or overgrown. Because of overgrazing the Jim Grant's study plot was fenced and then in few years overgrown with forest.*"

Proposals to remove fences from Inclosures is likely to have a negative effect on *C. montana*. We can speculate that opening of Inclosures and increase grazing (with the current stocking density in the New Forest) will have a negative impact on a wide range of insects. There has been no comprehensive survey work or study in the New Forest to look at the impact of grazing and changes in vegetation and insect communities over time. A study of this nature is essential to understand the impact of grazing and develop recommendations for optimum grazing levels.

A balance is required; the ideal would be low level grazing and no fences to promote a transitional zone between open heath and scrub edge and early successional scrub, coupled with the maintenance of a disturbance regime of keeping open ground vegetation by rotational clearance of woodland to make large sunny glades. Light grazing will promote small shrubs and taller herbs to establish. The oviposition resource in the New Forest is largely limited to Bracken, small shrubs are currently limited by grazing, and species such as Blackthorn *Prunus spinosa*, Hawthorn and Small leaved lime are quite rare in the Forest.

Under the current scheme of Inclosures limited seasonal grazing is clearly the best approach accompanied by regular monitoring so that informed decisions can be made as to whether the density/timing needs to be modified. Inclosure gates can be opened and closed at certain times of the year to allow winter grazing but exclude summer grazing.

Undoubtedly some stock (and Deer) will still get into Inclosures, this is not necessarily problematic the overall aim should be to achieve the result of winter grazing and light grazing the rest of the year.

Weather conditions

Cicadetta montana is certainly influenced by micro habitat conditions particularly temperature and humidity. Prolonged cool wet periods especially in spring will influence their ability to complete their life cycle, wet mild winters may influence nymph mortality and the number of days when the temperature exceed 20^{o}C will also the adult cicada's ability to breed and disperse. Prolonged and repeated wet weather at critical periods in *C. montana's* lifecycle is a big problem, especially when habitat is suboptimal and for an insect that is so rare and sporadic in occurrence.

Summary

Cicadetta montana is an elusive and rare insect that has rarely been recorded in significant numbers. There is certainly some suitable habitat with in the New Forest, however continuity and quality of this habitat over the last 45 years since its rediscovery at Gibbet Wood has been significantly influenced by changes in forestry practices and increased grazing. During this time we have also experienced several episodes of extreme weather include droughts and prolonged wet weather- all of which will have reduced to population. In spite of this we believe that it is highly likely that *C. montana* still persists, most likely in very small numbers in unvisited part of the New Forest.

Taking forward the search for the New Forest Cicada

Public engagement

Searching for the New Forest Cicada is not just a job solely for the entomologist, the public, amateur naturalists and Forest workers (i.e. Forest Keepers) can play a vital role too- it about being in the right place at the right time and knowing what to look out for.

'The tracking down of new localities is something in which anyone and everyone has the chance to make a valuable contribution. It would literally take hundreds of keen observes to cover all the potentially suitable sites during the appropriate season' (Grant 1970).

The development of the smart phone Cicada app by Southampton University links technology, social media and biological recording. Engaging a large suite of people who would not have been aware of the New Forest Cicada nor would they ever have searched for this species. The public should continue to be encouraged to help the search for this elusive species.

Survey strategy 2014/15

- Design and distribute poster appealing for records and promoting the Cicada app.
- Produce photo guide and leaflet for Forest Keepers, meet with Keepers covering key areas (i.e. Denny Wood, Gibbet Wood, Driftway and Whitebridge Hill and Brockishill Inclosure).
- Work with Southampton University to re-launch the Cicada app now that it has been refined. Promote via Buglife website, social media, the press and local events.
- Using Buglife volunteer team survey the sites and adjoining suitable habitat highlighted at having High and Moderate/High potential during 2014/15.

HIGH
Denny Wood (and surrounds)
Whitebridge Hill
MODERATE/HIGH
Gibbet Wood (and surrounds)
Driftway between King Garn Gutter & Copse of Linwood
Brockishill Inclosure and Furzy Lawn

- Maintain momentum and further enthusiasm for the 'hunt for the New Forest Cicada' engage the public, naturalists and media.
- Work with Alex Rogers (Southampton University) and Dave Chesmore (York University) to develop technology to create sound recording loggers that can be left in situ to detect *C. montana* song. Loggers to be installed key locations across the New Forest in April 2015.
- Establish the current status of the Cicada working group. If no longer active re-instate the group bringing together current and historic workers on the species (Lena Ward, Bryan Pinchen, Species Recovery Trust and Buglife) as well as Forestry Commission, New Forest National Park and Natural England.
-

Recommendations for further research and activities:

- Further investigation into the sourcing of long term daily meteorological data from Met Office/British Atmospheric Data Centre. Analyse temperature and rainfall data, looking at conditions a year prior to emergence?
- Establish the distribution of Barton clay across the New Forest, as this may provide suitable substrate for nymphal development and turret building. Possibly identify potential sites for survey.

- Obtain tree felling data/ maps Hemiptera
- to try and track where cicada may have dispersed too after Gibbet Wood became unsuitable. Consentrate initially on the area between Lyndhurst, Cadnam and Fritham.
- Establish the outcome of the Bristol Zoo captive rearing studies with a view to possibly re-instating a captive rearing programme.
- Build links with Slovenian worker Tomi Trilar- Slovenian Museum of Natural History, seek his expertise to assist the search fro *C. montana*.

Acknowledgements

Many thanks to Lena Ward and Bryan Pinchen for their valuable papers and reports detailing the ecology of *C.montana* and details of previous studies and surveys. Also thank you to Lena Ward for allowing permission to use Jim Grants photographs. Jay Doyle, Patrick Cook, Tim Creed, Andy Page and Howard Taylor (Forestry Commission) have provided useful background information on the management of the survey sites and facilitated site access. Mike Webb Natural History museum for checking photographs of turrets. Dominic Price (Species Recovery Trust) for sharing results of their 2013 survey.

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Appendix 1- Site photographs showing typical habitat of each of the 19 survey sites

1) Denny Wood

2) Denny Wood

3) Denny Wood

4) Denny Wood

5) Denny Lodge Inclosure and surrounds. NB this was on a scoping visit not taken on a survey day.

6) Denny Lodge Inclosure and surrounds

7) Matley Wood/Bog

8) Matley Wood/Bog

9) Driftway between Kings Garn Gutter and Copse of Linwood

10) Driftway between Kings Garn Gutter and Copse of Linwood

11) Driftway between Kings Garn Gutter and Copse of Linwood

12) Driftway between Kings Garn Gutter and Copse of Linwood

13) Gibbet Wood

14) Gibbet Wood

15) Gibbet Wood

16) Gibbet Wood

17) Brook Common

18) Whitebridge Hill

19) Whitebridge Hill

20) Whitebridge Hill

21) New Copse Inclosure near Ladycross

22) New Copse Inclosure near Ladycross

23) Brockishill Inclosure

24) Brockishill Inclosure

25) Cadnam, Bugnell Wood

26) Cadnam, Bugnell Wood

27) Eyeworth Wood, Iron Wells

28) Bank

29) Stubbs Wood/ near Tantany

30) Costicles Inclosure/ Busketts Lawn

31) Hollands Wood towards Parkhill

32) Mallard Wood

33) Lodgehill Inclosure

34) Mark Ash

35) Wotton Coppice Inclosure

Appendix 2- Complete list of all sites visited by survey team, sites highlighted in blue were priorities for survey and received several visits. This data is also mapped in Figure 7

Site Name	Grid reference	Potential?
Denny Wood	SU335059	HIGH
Denny Lodge Inclosure and surrounds/Denny Lodge	SU330054	Moderate
Matley Bog	SU335065	Moderate
Driftway between Kings Garn Gutter and Copse of Linwood	SU255138	Moderate/High
Gibbet Wood/Brook Common/Salisbury Trench	SU257141	Moderate/High
Whitebridge Hill	SU315095	HIGH
New Copse Inclosure, near Ladycross/also to Perrywood Haseley	SU335031	Moderate
Brockishill Inclosure/Furzy Lawn	SU301118	Moderate
Cadnam, Bignell Wood	SU287137	Moderate
Eyeworth Wood, Iron Wells	SU228148	Moderate
Bank	SU285073	Low/moderate
Stubbs Wood, near Tantany	SU365038	Low/moderate
Costicles Inclosure/Busketts Lawn	SU328108	Low/moderate
Hollands Wood towards Parkhill	SU308051	Low
Mallard Wood	SU320094	Low
South Gorley	SU170112	Low
Lodgehill Inclosure	SU319097	Low
Mark Ash	SU245075	Low
Wootton Coppice Inclose	SZ248996	Low
Alderhill Inclosure,	SU202133	
Amberwood Inclosure	SU209136	
Broomy Inclosure,	SU205115	
Bramshaw Wood	SU255165	
Brown Loaf	SU195021	
Burley New Inclosure	SU235045	
Deerleap Inclosure	SU346093	

Frame Heath Inclosure	SU345035
Frame Wood	SU354032
Gritnam Wood	SU286062
Hawkhill Inclosure	SU660040
Highland Water Inclosure	SU255095
Holmhill Inclosure	SU259086
Holly Hatch Inclosure	SU220120
Holmsley	SU223005
Hursthill Inclosure	SU287058
Islands Thorns Inclosure	SU215150
Latchmore Brook	SU205134
Little Eye Green	SU285134
Longdown Inclosure	SU355085
Milkham Inclosure	SU205095
North Oakley Inclosure	SU236076
Ocknell Inclosure	SU245115
Perrywood Ivy Inclosure	SU325024
Pitts Wood	SU195144
Ravens Nest Inclosure	SU253151
Roe Inclosure	SU290085
Rushpole Wood and surrounds	SU096095
Shave Green Inclosure	SU288127
Sloden Inclosure	SU220130
Slufters Inclosure	SU230101
North Bentley	SU239133
South Bentley	SU234127
South Oakley Inclosure	SU243054
Stockley Inclosure	SU325022
Whiteley Wood	SU295055

Appendix 3- Photographs of potential turrets/ exit holes

Possible turret at Denny Wood	Possible exit hole at Denny Wood	Possible exit hole at Denny Wood
		

Appendix 4 – Additional insect records May-July 2013. All records have been submitted to appropriate recording schemes

RED BOLD = RED DATA BOOK, red normal type = NATIONALLY SCARCE

	Common name	**Site**	**Grid reference**
ODONATA - Dragonflies and Damselflies			
Pyrrhosoma nymphula	Large Red Damselfly	Denny Wood, New Forest	SU335065
Pyrrhosoma nymphula	Large Red Damselfly	Denny Wood, New Forest	SU335065
Ceriagrion tenellum	Small Red Damselfly	Denny Wood, New Forest	SU335065
Ischnura elegans	Blue-tailed Damselfly	Denny Wood, New Forest	SU335065
Ischnura pumilio	**Scarce Blue-tailed Damselfly**	**Latchmore Brook, New Forest**	**SU182125**
Coenagrion puella	Azure Damselfly	Denny Wood, New Forest	SU335065
Libellula depressa	Broad-bodied Chaser	Denny Wood, New Forest	SU335065
Libellula depressa	Broad-bodied Chaser	Copse of Linwood, New Forest	SU254141
Libellula depressa	Broad-bodied Chaser	Denny Wood, New Forest	SU335065
Orthetrum coerulescens	Keeled Skimmer	Denny Wood, New Forest	SU335065
Libellula quadrimaculata	Four-spotted Chaser	Denny Wood, New Forest	SU335065
Libellula quadrimaculata	Four-spotted Chaser	Denny Wood, New Forest	SU335065

ORTHOPTERA - Bush-crickets, Crickets and Grasshoppers

Nemobius sylvestris	Wood Cricket	Denny Wood, New Forest	SU335065

COLEOPTERA - Beetles

Carabus problematicus		Denny Wood, New Forest	SU335065
Cicindela campestris	Green Tiger Beetle	Denny Wood, New Forest	SU335065
Poecilus cupreus		Denny Wood, New Forest	SU335065
Silpha atrata		Denny Wood, New Forest	SU335065
Sinodendron cylindricum	Rhinoceros Beetle	Mark Ash Wood, New Forest	SU245075
Lucanus cervus	Stag Beetle	Denny Wood, New Forest	SU335065
Dorcus parallelipipedus	Lesser Stag Beetle	Mark Ash Wood, New Forest	SU245075
Typhaeus typhoeus	Minotaur Beetle	Denny Wood, New Forest	SU335065
Geotrupes stercorarius	Dor Beetle	Denny Wood, New Forest	SU335065
Cetonia aurata	Rose Beetle	Denny Wood, New Forest	SU335065
Cetonia aurata	Rose Beetle	Denny Wood, New Forest	SU335065
Cetonia aurata	Rose Beetle	Mark Ash Wood, New Forest	SU245075
Ampedus balteatus		Denny Wood, New Forest	SU335065
Ampedus balteatus		Copse of Linwood, New Forest	SU254141
Ampedus cinnabarinus		**Denny Wood, New Forest**	**SU335065**
Ampedus elongantulus		Denny Wood, New Forest	SU335065
Ampedus elongantulus		Copse of Linwood, New Forest	SU254141
Ampedus quercicola		Denny Wood, New Forest	SU335065
Ampedus sanguinolentus		Denny Wood, New Forest	SU335065
Malachius bipustulatus	Malachite Beetle	Gibbet Wood, New Forest	SU257141
Triplax aenea		Denny Wood, New Forest	SU335065
Melandrya caraboides		Gibbet Wood, New Forest	SU257141
Melandrya caraboides		Denny Wood, New Forest	SU335065
Bitoma crenata		Denny Wood, New Forest	SU335065
Ischnomera cyanea		Gibbet Wood, New Forest	SU257141
Ischnomera cyanea		Gibbet Wood, New Forest	SU257141
Ischnomera cyanea		Gibbet Wood, New Forest	SU257141
Ischnomera cyanea		Denny Wood, New Forest	SU335065

Ischnomera cyanea		Denny Wood, New Forest	SU335065
Pyrochroa coccinea	Black-headed Cardinal Beetle	Gibbet Wood, New Forest	SU257141
Pyrochroa coccinea	Black-headed Cardinal Beetle	Denny Wood, New Forest	SU335065
Pyrochroa serraticornis	Common Cardinal Beetle	Gibbet Wood, New Forest	SU257141
Rhagium bifasciatum	Two-banded Longhorn Beetle	Gibbet Wood, New Forest	SU257141
Rhagium bifasciatum	Two-banded Longhorn Beetle	Denny Wood, New Forest	SU335065
Rhagium bifasciatum	Two-banded Longhorn Beetle	Denny Wood, New Forest	SU335065
Rhagium bifasciatum	Two-banded Longhorn Beetle	Denny Wood, New Forest	SU335065
Rhagium mordax	Black-spotted Longhorn Beetle	New Copse Inclosure, near Ladycross	SU335027
Rhagium mordax	Black-spotted Longhorn Beetle	Gibbet Wood, New Forest	SU257141
Rhagium mordax	Black-spotted Longhorn Beetle	Denny Wood, New Forest	SU335065
Rhagium mordax	Black-spotted Longhorn Beetle	Denny Wood, New Forest	SU335065
Rhagium mordax	Black-spotted Longhorn Beetle	Mark Ash Wood, New Forest	SU245075
Grammoptera ruficornis	Common Grammoptera	Gibbet Wood, New Forest	SU257141
Stictoleptura scutellata	Large Black Longhorn Beetle	Denny Wood, New Forest	SU335065
Stictoleptura scutellata	Large Black Longhorn Beetle	Denny Wood, New Forest	SU335065
Stictoleptura scutellata	Large Black Longhorn Beetle	Denny Wood, New Forest	SU335065
Leptura aurulenta	Golden-haired Longhorn Beetle	Gibbet Wood, New Forest	SU257141
Clytus arietis	Wasp Beetle	Gibbet Wood, New Forest	SU257141
Clytus arietis	Wasp Beetle	Denny Wood, New Forest	SU335065
Clytus arietis	Wasp Beetle	Denny Wood, New Forest	SU335065
Anaglyptus mysticus	Rufous-shouldered Longhorn Beetle	Gibbet Wood, New Forest	SU257141
Anaglyptus mysticus	Rufous-shouldered Longhorn Beetle	Gibbet Wood, New Forest	SU257141
Leiopus nebulosus	Black-clouded Longhorn Beetle	Denny Wood, New Forest	SU335065

LEPIDOPTERA - Butterflies and Moths

Thymelicus sylvestris	Small Skipper	Whitebridge Hill, New Forest	SU315095
Thymelicus sylvestris	Small Skipper	Lodgehill Inclosure, New Forest	SU319097
Thymelicus sylvestris	Small Skipper	Denny Wood, New Forest	SU335065
Ochlodes faunus	Large Skipper	Denny Wood, New Forest	SU335065
Gonepteryx rhamni	Brimstone	New Copse Inclosure, near Ladycross	SU335027
Gonepteryx rhamni	Brimstone	Wootton Coppice Inclosure, New Forest	SZ248996

Gonepteryx rhamni	Brimstone	Gibbet Wood, New Forest	SU257141
Gonepteryx rhamni	Brimstone	Gibbet Wood, New Forest	SU257141
Gonepteryx rhamni	Brimstone	Denny Wood, New Forest	SU335065
Gonepteryx rhamni	Brimstone	Denny Wood, New Forest	SU335065
Pieris brassicae	Large White	Denny Wood, New Forest	SU335065
Pieris rapae	Small White	Whitebridge Hill, New Forest	SU315095
Pieris napi	Green-veined White	Denny Wood, New Forest	SU335065
Lycaena phlaeas	Small Copper	New Copse Inclosure, near Ladycross	SU335027
Lycaena phlaeas	Small Copper	Gibbet Wood, New Forest	SU257141
Lycaena phlaeas	Small Copper	Denny Wood, New Forest	SU335065
Plebejus argus	**Silver-studded Blue**	**Whitebridge Hill, New Forest**	**SU315095**
Plebejus argus	**Silver-studded Blue**	**Denny Wood, New Forest**	**SU335065**
Plebejus argus	**Silver-studded Blue**	**Matley Bog, New Forest**	**SU335065**
Plebejus argus	**Silver-studded Blue**	**Brownloaf, New Forest**	**SU195021**
Plebejus argus	**Silver-studded Blue**	**Beaulieu Heath. nr. Hawkhill**	**SU349020**
Plebejus argus	**Silver-studded Blue**	**Rockford Common, New Forest**	**SU165082**
Plebejus argus	**Silver-studded Blue**	**Latchmore Brook**	**SU182125**
Celastrina argiolus	Holly Blue	Gibbet Wood, New Forest	SU257141
Vanessa atalanta	Red Admiral	Whitebridge Hill, New Forest	SU315095
Vanessa atalanta	Red Admiral	Denny Wood, New Forest	SU335065
Inachis io	Peacock	Gibbet Wood, New Forest	SU257141
Inachis io	Peacock	Gibbet Wood, New Forest	SU257141
Limenitis camilla	**White Admiral**	**Lodgehill Inclosure, New Forest**	**SU319097**
Boloria euphrosyne	**Pearl-bordered Fritillary**	**New Copse Inclosure, near Ladycross**	**SU335027**
Boloria euphrosyne	**Pearl-bordered Fritillary**	**New Copse Inclosure, near Ladycross**	**SU335027**
Boloria euphrosyne	**Pearl-bordered Fritillary**	**New Copse Inclosure, near Ladycross**	**SU335027**
Boloria euphrosyne	**Pearl-bordered Fritillary**	**Wootton Coppice Inclosure, New Forest**	**SZ248996**
Argynnis paphia	Silver-washed Fritillary	Whitebridge Hill, New Forest	SU315095
Argynnis paphia	Silver-washed Fritillary	Lodgehill Inclosure, New Forest	SU319097
Argynnis paphia	Silver-washed Fritillary	Denny Wood, New Forest	SU335065
Pararge aegeria	Speckled Wood	New Copse Inclosure, near Ladycross	SU335027
Pararge aegeria	Speckled Wood	Gibbet Wood, New Forest	SU257141

Pararge aegeria	Speckled Wood	Mark Ash Wood, New Forest	SU245075
Pararge aegeria	Speckled Wood	Mallard Wood, New Forest	SU320094
Pararge aegeria	Speckled Wood	Whitebridge Hill, New Forest	SU315095
Pararge aegeria	Speckled Wood	Denny Wood, New Forest	SU335065
Melanargia galathea	Marbled White	Denny Wood, New Forest	SU335065
Maniola jurtina	Meadow Brown	Whitebridge Hill, New Forest	SU315095
Maniola jurtina	Meadow Brown	Lodgehill Inclosure, New Forest	SU319097
Maniola jurtina	Meadow Brown	Denny Wood, New Forest	SU335065
Aphantopus hyperantus	Ringlet	Whitebridge Hill, New Forest	SU315095
Pyronia tithonus	Gatekeeper	Denny Wood, New Forest	SU335065
Hipparchia semele	**Grayling**	**Brownloaf, New Forest**	**SU195021**
Coenonympha pamphilus	**Small Heath**	**Brownloaf, New Forest**	**SU195021**
Coenonympha pamphilus	**Small Heath**	**Beaulieu Heath. nr. Hawkhill**	**SU349020**
Lasiocampa quercus	Oak Eggar	Denny Wood, New Forest	SU335065
Idaea muricata	Purple-bordered Gold	Whitebridge Hill, New Forest	SU315095
Euplexia lucipara	Small Angle Shades	Denny Wood, New Forest	SU335065

DIPTERA - Flies

Ctenophora pectinicornis	a cranefly	Denny Wood, New Forest	SU335065
Tipula maxima	a cranefly	Matley Bog, New Forest	SU335065
Metalimnobia quadrimaculata	**a cranefly**	**Mark Ash Wood, New Forest**	**SU245075**
Tabanus miki	**Plain-eyed Brown Horsefly**	**Matley Bog, New Forest**	**SU335065**
Brachyopa bicolor	**a hoverfly**	**Denny Wood, New Forest**	**SU335065**
Caliprobola speciosa	**a hoverfly**	**Denny Wood, New Forest**	**SU335065**
Caliprobola speciosa	**a hoverfly**	**Denny Wood, New Forest**	**SU335065**
Caliprobola speciosa	**a hoverfly**	**Denny Wood, New Forest**	**SU335065**
Caliprobola speciosa	**a hoverfly**	**Mark Ash Wood, New Forest**	**SU245075**
Criorhina floccosa	a hoverfly	Denny Wood, New Forest	SU335065
Pocota personata	**a hoverfly**	**Mark Ash Wood, New Forest**	**SU245075**
Microdon analis	a hoverfly	Gibbet Wood, New Forest	SU257141
Microdon analis	a hoverfly	Gibbet Wood, New Forest	SU257141
Microdon analis	a hoverfly	Gibbet Wood, New Forest	SU257141
Ferdinandea ruficornis	a hoverfly	Denny Wood, New Forest	SU335065

Hippobosca equina	**Forest Fly**	**Gibbet Wood, New Forest**	**SU257141**
Hippobosca equina	**Forest Fly**	**Denny Wood, New Forest**	**SU335065**
Thyridanthrax fenestratus	**Mottled Bee-fly**	**Denny Wood, New Forest**	**SU335065**
Eumenes coarctatus	Heath Potter Wasp	Denny Wood, New Forest	SU335065

HYMENOPTERA - Bees, Ants and Wasps

Vespa crabro	The Hornet	Gibbet Wood, New Forest	SU257141
Vespa crabro	The Hornet	Denny Wood, New Forest	SU335065
Andrena ferox	**a mining bee**	**Denny Wood, New Forest**	**SU335065**
Andrena ferox	**a mining bee**	**Denny Wood, New Forest**	**SU335065**
Andrena ferox	**a mining bee**	**Denny Wood, New Forest**	**SU335065**
Andrena ferox	**a mining bee**	**Denny Wood, New Forest**	**SU335065**
Andrena haemorrhoa	Early Mining Bee	Denny Wood, New Forest	SU335065
Andrena nitida	a mining bee	Denny Wood, New Forest	SU335065
Macropis europaea	a mining bee	Furzey Gardens, Nr Minstead, New Forest	SU273115