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Summary

A countywide survey of the Glow-worm *Lampyrus noctiluca* L. (Coleoptera: Lampyridae) was undertaken in 2001, which aimed to ascertain the current distribution of this species. The survey involved establishing a transect at a potential or known site and walking it three nights during the summer. In addition, casual observations of *L. noctiluca* were accepted so that the Essex distribution could be determined. The survey indicates a widespread but localised distribution for *L. noctiluca*, although this species is not as rare as previously thought, with observations having occurred at 43 sites since 1992.

Numbers of *L. noctiluca* observed on the transect walks were mostly low. The highest count of the survey occurred at One Tree Hill, where 76 individuals were observed. One Tree Hill is part of Langdon Hills Country Park, near Basildon and is of great importance for *L. noctiluca* in Essex, as 37% of individuals recorded during the transect walks were observed at this site. The preferred habitats were meadow and scrub, predominantly in dark, unlit areas. Few *L. noctiluca* individuals were recorded near any form of artificial lighting. The status of this species in Essex appears to be relatively secure in the short-term, although development pressure, pollution and neglect of sites are the main long-term threats.

1.0 Introduction

For many centuries the Glow-worm *Lampyris noctiluca* L. (Coleoptera: Lampyridae) has inspired naturalists and poets due to the pale green glow which is emitted by the adult female on warm summer evenings. Leutscher (1974) fondly recalls his camping days in Epping Forest when specimens were collected and hung in jam-jars inside tents, with the light emitted apparently strong enough to read by. The female's glow is produced via a complex series of chemical reactions and is used to attract the flying adult male. *L. noctiluca* is primarily an insect of unimproved grassland and other habitats such as old woodland (Tyler 1994).

In Essex, *L. noctiluca* has been described as rare (Corke 1984), with the county recorder having records for only 13 sites (Samuels pers.comm.). Many of these records are extremely old and give very imprecise information on the exact location of the observed colony, for example, TM02 Colchester 1903. The apparent rarity combined with the possible under-recording of this species in Essex led the authors to organise a countywide survey of *L. noctiluca* in 2001. The main aims of the survey were to ascertain the current distribution and main strongholds for *L. noctiluca* in Essex.

2.0 Method

Survey participants were required to count glowing females along a chosen transect route on three occasions during July and August 2001. In addition, any casual records of *L. noctiluca* since 1992 were accepted so that the distribution of this species could be more accurately ascertained. The survey was widely publicised in various newspapers throughout the county and on BBC Radio Essex. Leaflets were distributed to nature reserve visitor centres and a press release was posted on the Essex Wildlife Trust website and the British Glow-worm page www.glowworms.org.uk. Although the survey therefore involved participants with limited or no entomological knowledge, the distinctive nature of the adult females minimised the likelihood of identification difficulties.

With appropriate guidance, survey participants were asked to select a suitable site at which to establish a transect route, either within an area where *L. noctiluca* had been observed before or at a new location where habitats such as unimproved grassland were present. Survey participants were initially required to visit their site during daylight hours to determine the

transect route, to produce a sketch map of the area and to note habitat types and management regimes.

A transect of at least 100 metres in length was walked during each of three pre-determined fortnightly periods (Table 1) and any glowing females which were observed along the route were recorded. It was felt that these three periods adequately incorporated the peak glowing season. Survey participants were required to commence each walk between 2200 and 2300 hours, and to terminate by 0000 hours.

Table 1: Two week periods for each of the three transect walks

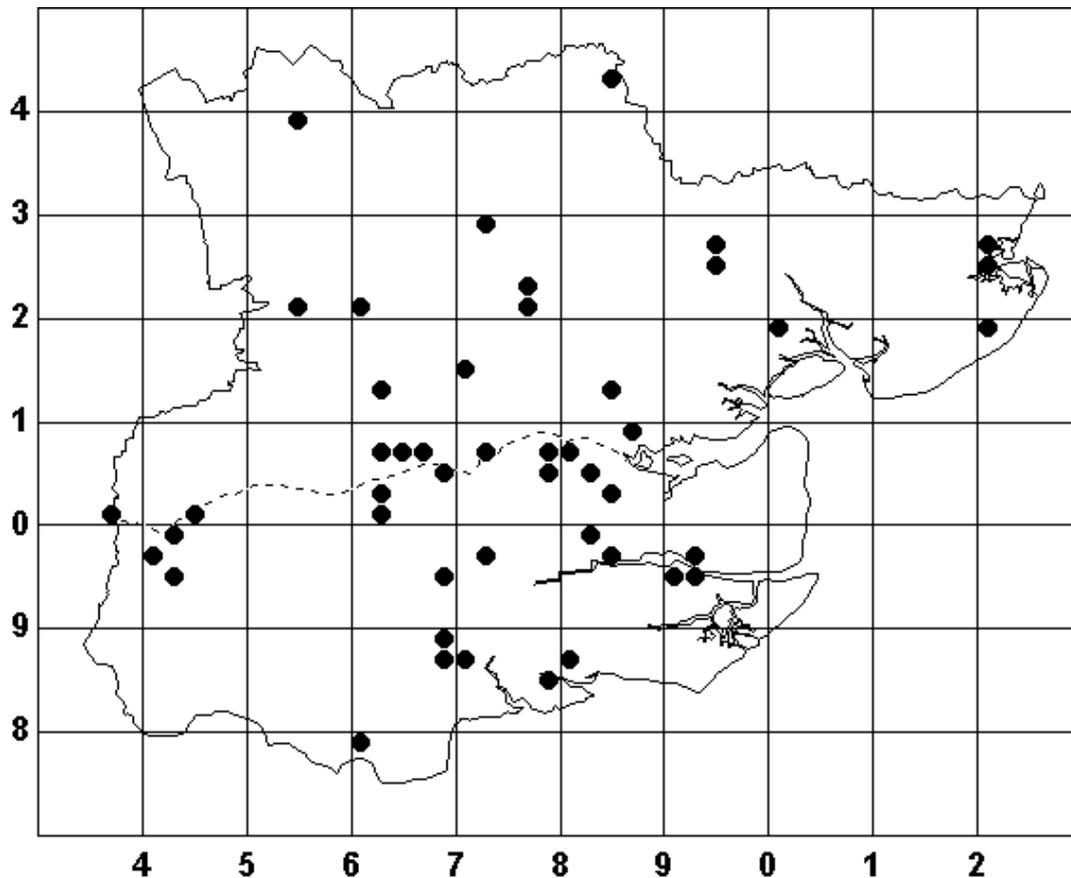
Walk no.	Dates
1	9 th – 22 nd July
2	23 rd July – 5 th August
3	6 th – 19 th August

A slow strolling pace was recommended for the walks to reduce the risk of overlooking glowing females along the route. During the transect walks, survey participants were asked to record the habitat types which were utilised by the glowing females, to detail any artificial lighting at the site and also to mark the approximate position of any *L. noctiluca* individuals on the sketch map. If glowing females were not observed during the first two transect walks, survey participants were advised to abandon the final walk. This transect method was devised to standardise the results obtained and to facilitate site comparison.

3.0 Results

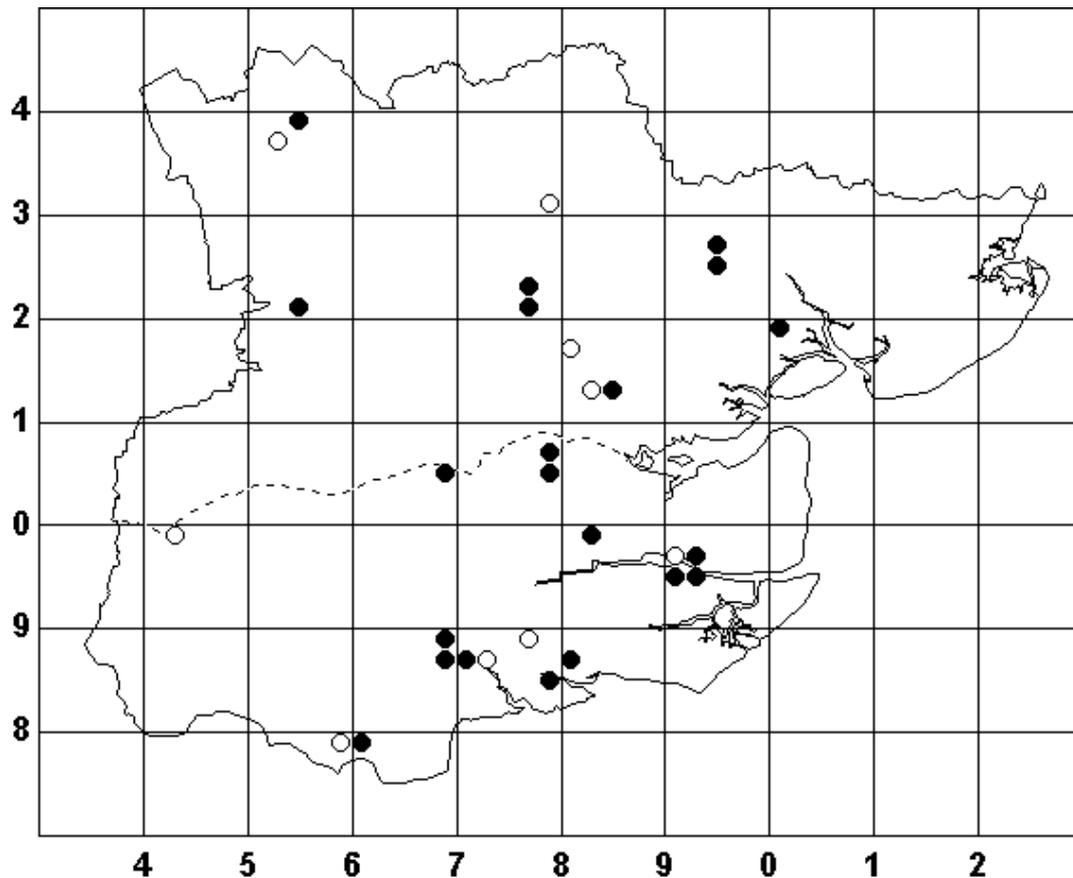
3.1 Recording coverage

Figure 1 displays the distribution of tetrads surveyed in 2001, which includes both the transect monitoring and the casual surveys. The survey attained quite widespread coverage of the county, although there was a slight bias towards the Chelmsford area, where the survey organisers were situated. There were fewer surveyors in the north and west of the county, and also in the extreme south near Grays. A total of 48 people took part, with many surveying more than one site. Overall, 57 locations were visited by survey participants (Appendix 1) and transect walks were completed at 35 of these sites.

Figure 1: Recording coverage in 2001 (map shows 47 tetrads within the survey)

3.2 Distribution of *L. noctiluca* in Essex

The survey illustrates that *L. noctiluca* is widespread but localised in Essex (Figure 2). This species occurs scattered throughout most of Essex, although there are very few records for the north and west of the county. *L. noctiluca* has been recorded at 43 sites since 1992 and was observed at 28 sites in 2001 (Appendices 2 and 3). There have been many colonies recorded on Danbury Ridge (five sites), around Creeksea (six sites) and at Langdon Hills (three sites) since 1992. Although these clusters of sites are quite close together, other colonies are much more isolated. For example, individuals were observed in the grounds of Saffron Walden's hospital during the 2001 survey, which is many kilometres from the nearest extant colony.

Figure 2: Distribution of *L. noctiluca* records since 1992 (30 tetrads occupied)

Key: Black dots indicate 2001 records
White dots indicate records from 1992-2000

3.3 Declines

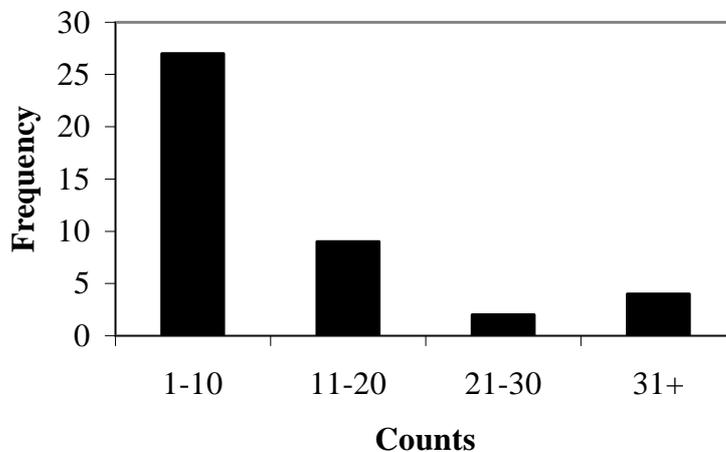
L. noctiluca has declined in areas such as Epping Forest which used to possess scattered colonies in the early 1900s (Leutscher 1974). Although the forest was particularly targeted during the 2001 survey, individuals were not observed at any of the five sites which were visited. Only one colony has been recorded within the forest since 1992, therefore *L. noctiluca* is probably very rare in this area. Searches in 2001 at other sites with old records for *L. noctiluca* were mostly unsuccessful. This species would appear to be extinct at Maldon Wick, Hazeleigh Wood, Chatham Green and the seawall at North Fambridge. Some colonies are also extremely threatened, predominantly by development pressures. For example, although several colonies were recorded in the grounds of the Braintree Freeport complex in 2001, an adjacent housing development has severely reduced grassland habitat availability, and consequently the number of individuals in one of these colonies has rapidly declined since the late 1990s.

3.4 Transect recording

L. noctiluca were observed at 16 of the sites where transect walks were conducted. A total of 507 glowing females were recorded during the transect walks. The majority of these individuals were observed in period one (9th - 22nd July), during which the highest count of the survey also occurred. In the subsequent walk periods, observations gradually declined and only 104 individuals were recorded in period three (6th - 19th August). The highest count during the final period occurred at Hadleigh Castle, which was the only site where more individuals were observed in the final walk period than in the previous two.

Overall, counts of *L. noctiluca* individuals were generally very low (Figure 3). Observations comprising only one glowing female occurred nine times during the survey. Although four counts comprising over 30 individuals did occur during the survey, three of these were recorded at One Tree Hill. The highest count of the survey was 76 glowing females, which were observed at One Tree Hill on July 11th.

Figure 3: Frequency of counts



During three transect walks, 192 glowing females were observed at One Tree Hill, comprising 37% of the total number of individuals which were recorded in the survey (Table 2). Other sites where *L. noctiluca* was observed in relative abundance were Finches Nature Area and Manwood Chase. *L. noctiluca* occurred in very low abundance at Staneway, Dry Street and Hatfield Forest. Glowing females were observed in greatest concentration at One Tree Hill, where 19.20 individuals per 100 metres were recorded (Table 2). *L. noctiluca* individuals were also evident in high concentrations at Hadleigh Castle and Manwood Chase. Glowing

females occurred in particularly low concentrations at Hatfield Forest (0.09 individuals per 100 metres) and Danbury Ridge. Individuals were very widely dispersed throughout a long transect route at the latter site (1,850 metres).

Table 2: Details of *L. noctiluca* monitoring at each site

Site	Total count	(%)	No. per 100m
One Tree Hill, Basildon*	192	37.8	19.20
Finches Nature Area, Canewdon*	54	10.6	11.25
Manwood Chase, Abberton	50	9.8	16.67
Hadleigh Castle, Hadleigh	42	8.3	19.09
Danbury Ridge Complex, Danbury*	40	7.9	2.16
Stow Maries Halt, Stow Maries*	30	5.9	8.57
Hospital Grounds, Saffron Walden	23	4.5	10.95
Hérons Paddock, Little Baddow	16	3.2	3.20
Benfleet Downs, South Benfleet*	16	3.2	3.90
Shut Heath Wood, Little Braxted*	10	2.0	10.00
Iron Latch, Eight Ash Green*	9	1.8	3.60
Bulford Mill Lane, Cressing	7	1.4	2.33
Grays Chalk Quarry, Grays*	6	1.2	6.00
Staneway, Basildon*	5	1.0	5.00
Dry Street, Basildon	5	1.0	5.00
Hatfield Forest, Takeley*	2	0.4	0.09
	507		

* indicates site is a nature reserve

3.5 Nature reserves

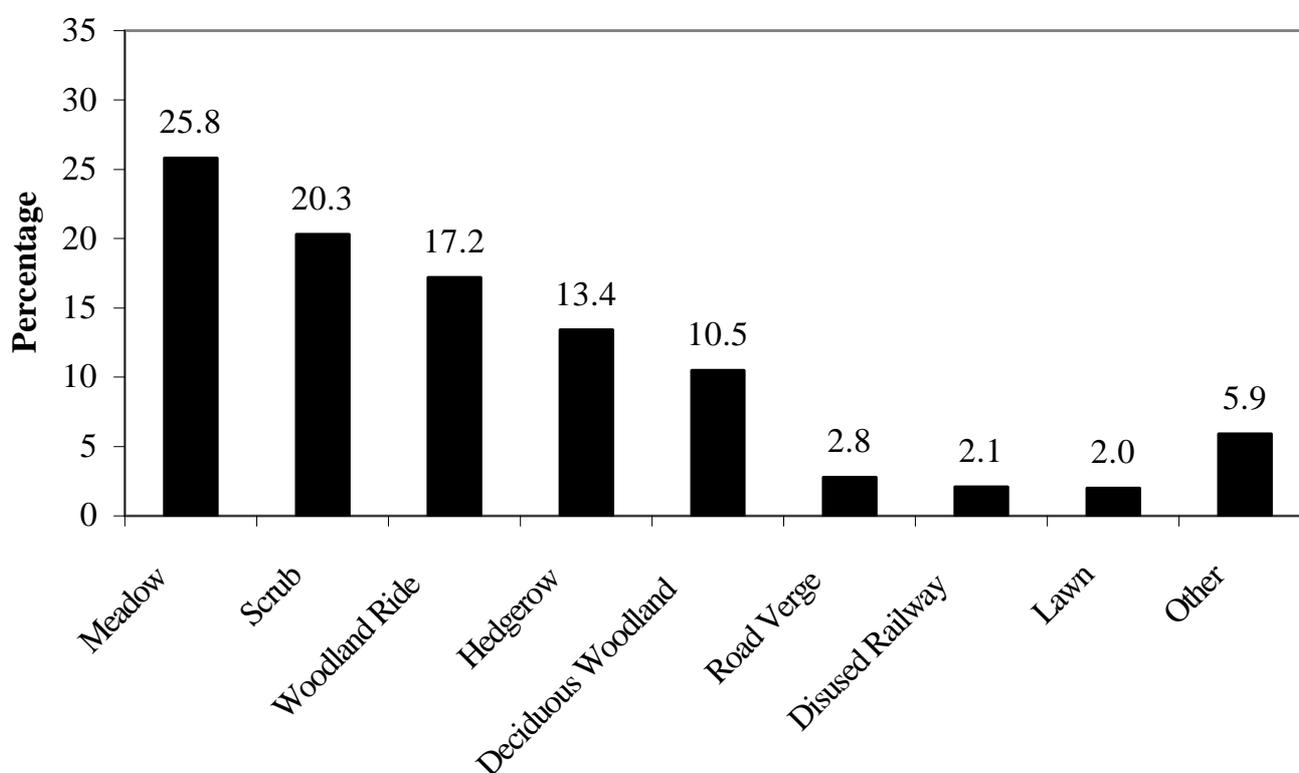
Transect recording was relatively evenly divided between nature reserves and non-nature reserve areas. The total length of the nature reserve transect routes was 12,240 metres, compared with 15,880 metres for those at non-nature reserve sites. During the survey, 364 glowing females were recorded at nature reserves, comprising approximately 72% of the total number of individuals which were observed. The highest count which occurred at a non-nature reserve area was 27, compared with the 76 individuals that were observed at One Tree Hill, which is a nature reserve site. Nature reserves were therefore important areas for *L. noctiluca* in the survey.

3.6 Habitats

The majority of the glowing females which were observed during the survey were utilising grassy meadows and scrub (Figure 4). These meadows were generally botanically diverse and predominantly unimproved. *L. noctiluca* individuals were also recorded on garden lawns, underneath hedgerows and in woodland areas. In the latter areas, glowing females were

observed more frequently in woodland rides than underneath dense tree canopy. Tall overgrown hedgerows, possibly of some antiquity were utilised by glowing females in preference to lower, more managed examples. Individuals were recorded in less abundance on other linear habitats such as roadside verges and disused railway lines. Very few glowing females were observed within the proximity of aquatic habitats or in damp grassland areas. Although some of the sites in the survey comprised arable areas and improved grassland, there were no glowing females detected in these habitat types.

Figure 4: Percentage of *L. noctiluca* females in different habitats



3.7 Lighting

Table 3 illustrates the number of females which were recorded under different lighting conditions. Approximately 78% of females were observed at unlit sites, therefore *L. noctiluca* was most abundant in totally dark conditions. Lower abundance was evident at sites with house and vehicle lights. Only six females were seen displaying at sites with streetlights.

Table 3: *L. noctiluca* females observed under different lighting conditions

Lighting	No. females	%
No lights	398	78.5
House lights only	61	12.0
House and vehicle lights	30	5.9
Vehicle lights only	12	2.4
Street lights only	6	1.2
	507	

3.8 Management of sites

At the majority of the sites where *L. noctiluca* individuals were observed during the survey, the grassland is managed by regular mowing. All of the meadows where glowing females were present are mown at least once a year. However, individuals were also recorded in a variety of less frequently managed tall grassland habitats such as woodland rides, where mowing or scrub clearance is only occasionally conducted. At the only site which is grazed by livestock that was visited during the survey (Hatfield Forest), *L. noctiluca* individuals occurred in very low abundance. Individuals were observed in greater abundance at sites where rabbit grazing was evident, particularly on the heathy grassland of Little Baddow Heath (part of the Danbury Ridge transect).

4.0 Discussion

The widespread but localised distribution of *L. noctiluca* in Essex (Figure 2) is similar to the national distribution of this species. In Essex, it would appear that *L. noctiluca* only occurs where there are suitable habitats such as unimproved meadow or ancient woodland, which are rare habitats in the county (Corke 1984). The dearth of favourable areas in Essex explains the localised distribution of this species. Disturbed habitats such as improved pasture may be unfavourable because of low snail populations, which are the food source of *L. noctiluca* larvae. In areas where there are extensive patches of suitable habitat such as the large ancient woodlands and meadows of Danbury Ridge, there are many colonies evident in close proximity.

The fragmentation of suitable habitats and thus isolation of colonies is compounded by the sedentary nature of this species. The adult females cannot fly to disperse and colonise new areas, whilst the larvae are not thought to move far in search of food (Tyler 2002). The larvae are reported to move approximately five metres an hour, but they may find roads or arable fields a significant barrier to dispersal. Isolated colonies such as the one in the grounds of

Saffron Walden's hospital may therefore lose genetic diversity and ultimately sustain insufficient individuals to remain viable.

Corke (1984) states that *L. noctiluca* appears to be rare in Essex, which was seemingly confirmed by the county recorder having records of only 13 sites. However, with the 2001 survey collating records from 43 sites since 1992, *L. noctiluca* is not as rare as was first thought but is significantly under-recorded. In comparison with other counties, Essex has a relatively high number of *L. noctiluca* colonies. For example, 58 colonies were recorded in a ten year survey of Gloucestershire from 1980 to 1990, which is believed to be one of the most favourable counties for this species in Britain due to the presence of extensive tracts of unimproved limestone grasslands (Alexander 1992).

Despite the relatively high number of Essex colonies, 37% of all of the glowing females which were observed in the transect survey were recorded within one site (One Tree Hill). Counts were generally low outside of this site (Figure 3), so caution must be exercised in declaring *L. noctiluca* as 'safe' in a county context. The important colony at One Tree Hill is afforded some protection because the area is within a nature reserve and is therefore regularly monitored. Consequently, the main threat to this colony is probably from the trampling of non-glowing females by interested naturalists and members of the public partaking in glow-worm walks.

Statistical evidence of declines in *L. noctiluca* abundance is scarce, but many naturalists believe that there has been a steady decline in the British population since the 1950s (Tyler 1994). Throughout the UK, this species has disappeared from many of the sites at which it was once common and this is reflected in the information collected during this study. Cole (1899) states that there were many colonies in Epping Forest in the late 1800s and even in the early 1900s, *L. noctiluca* was noted as having a patchy distribution within this area (Leutscher 1974). However, there has only been one observation of *L. noctiluca* in Epping Forest since 1992 despite extensive searches within this area during the 2001 survey, therefore leading the authors to believe that *L. noctiluca* is currently rare within the forest.

The decline in *L. noctiluca* abundance within Epping Forest may be attributed both to the reversion of many of the favourable open grassy areas to woodland and to the close proximity of the forest to London. Succession has occurred because grazing and traditional woodland

management practices have decreased since the early 1900s. Additionally, air pollution from London may have detrimentally affected colonies within this area because snails can accumulate chemicals deposited onto vegetation and *L. noctiluca* individuals could subsequently become exposed to these pollutants (Tyler 1994).

The majority of *L. noctiluca* colonies that were observed during the 2001 survey were found on nature reserves and in other areas with no artificial lighting (Tables 2 and 3). The intensification of agriculture since the 1950s, coupled with the inappropriate management of rural roadside verges may have resulted in the loss of many colonies in the wider countryside. Development is now the predominant threat to colonies which occur outside of nature reserves. This problem is compounded by the lack of any legal protection for this species. Colonies within the vicinity of Grays and the Braintree Freeport complex are particularly threatened and several favourable sites have been destroyed in these areas during the last few years. Scrub encroachment is probably the main threat to colonies which occur on nature reserves. Although scrub is an important habitat for *L. noctiluca* in Essex, encroachment must be carefully controlled because colonies are infrequently found within mature woodland.

Streetlights were only present at one site where *L. noctiluca* were observed, probably because artificial lighting is known to distract flying males when they are searching for glowing females (Tyler 2002). Any attempt to erect new streetlights near to a known colony must therefore be opposed where pedestrian safety is not a major issue.

4.1 Conservation

L. noctiluca appears to be under no immediate threat from extinction in Essex, although many of the colonies which exist are isolated and most are relatively small. Protection of the remaining populations which occur outside of nature reserves is a priority and where development is planned for a site that currently supports a colony, the planning proposals should be opposed. It is intended that this survey will continue in future years in an effort to detect more new colonies, which are undoubtedly present due to the significant under-recording of this species. There are still many old records to be investigated in areas such as Thorndon Park.

4.2 Transect monitoring

The transect monitoring that occurred during the survey provided valuable data on the abundance of *L. noctiluca* at different sites. It is important that these transect walks are undertaken in future years using exactly the same methodology so that the progress of *L. noctiluca* in Essex can be ascertained. This monitoring will detect the long-term trends in the abundance of *L. noctiluca* and will determine whether future research or conservation measures need to be implemented. These walks will enable the effectiveness of the current conservation management strategies to be ascertained and altered if necessary.

4.3 Site management

Little is known about how to manage sites to encourage *L. noctiluca* (Tyler 2002). Mowing is an important management activity at most of the sites within which glowing females were observed, so this should be continued to prevent scrub encroachment. Alexander (1992) states that the main objective of management for *L. noctiluca* should be to maintain vegetation structure and snail populations. Where possible, the available *L. noctiluca* habitat should be extended in an effort to link it to other favourable areas. The use of chemicals, especially Molluscicides, should be avoided as they have detrimental impacts upon snail fauna. Patches of scrub and dead wood should be retained within open grassland areas to provide cover for larvae and snails (Alexander 1992). It is essential that the collection of glowing females is discouraged because many of the colonies in Essex are very small and particularly vulnerable to extinction.

5.0 Conclusion

The short-term future of *L. noctiluca* in Essex appears to be relatively secure because this species is not as rare as was previously thought. However, with the exception of the population that was recorded at One Tree Hill, most of the colonies which were observed during the survey were small and many were isolated. Development, pollution and the neglect of sites are the major threats to *L. noctiluca* in Essex and monitoring of known colonies should continue in future years to ascertain long-term trends and allow conservation measures to be implemented if necessary.

Acknowledgements

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Appendix 1: Grid references for sites surveyed in 2001

TL379016	Cornmill Meadows, Lee Valley
TL448010	Epping Thicks, Epping Forest
TL545207	Hatfield Forest, on plains
TL548212	On verge near bridge, Takeley
TL552386	Saffron Walden Hospital, near Ambulance Station
TL617216	Dunmow Railway Cutting
TL628134	Hayron's Lane, High Easter
TL630030	Gorrell's Farm, Highwood
TL637064	Colley Bridge Lane, Cooksmill Green
TL639012	Mill Green Common
TL639067	Green lane, Roxwell
TL655069	Newney Green
TL677070	Cow Watering Lane, Writtle
TL682047	Hylands Park, Writtle
TL694047	In garden by railway, Widford
TL714152	Chatham Green
TL728283	Nichols Farm, Shalford
TL739062	Sandford Mill, Chelmsford
TL769221	Behind platform at Braintree Freeport Railway Station
TL771219	On landscaped area, Braintree Freeport
TL775202	Bulford Mill Lane, Cressing
TL7806	Danbury Ridge Complex
TL786059	Garden backing onto Spring Wood, Danbury
TL787075	Hérons Paddock, Little Baddow
TL788049	Hitchcock's Meadows, Danbury
TL793063	Twitty Fee, Danbury
TL809068	St. Michael's Churchyard, Woodham Walter
TL834043	Hazeleigh Wood
TL846030	Maldon Wick
TL853133	Shut Heath Wood, Little Braxted
TL856435	The Valley Walk, Rodbridge
TL872092	Scraley Road, Little Totham
TL952260	Iron Latch Nature Reserve, Eight Ash Green
TL954256	Iron Latch, by railway bridge, Eight Ash Green
TM008199	Manwood Chase, Abberton
TM204190	Great Holland Pits
TM212268	Bramble Island, Great Oakley
TM217243	Skippers Island
TQ407967	Fairmead and Almshouse Plain, Epping Forest
TQ431982	Gregson's Ride, Epping Forest
TQ436955	Roding Valley Nature Reserve, Loughton
TQ607792	Grays Chalk Quarry
TQ683874	Marks Hill, Willow Park
TQ684942	Mill Meadows, Billericay
TQ685882	Staneway, Basildon
TQ695867	Dry Street, Basildon

TQ705865 One Tree Hill, Basildon
TQ736972 Hanningfield Reservoir
TQ781858 Benfleet Downs
TQ800860 Hadleigh Castle Country Park
TQ810860 Hadleigh Castle
TQ835991 Stow Maries Halt
TQ853965 Seawall, North Fambridge
TQ905945 Finches Nature Area, Canewdon
TQ931959 Sailing club car park, Creeksea
TQ932962 Verge of lane, Creeksea
TQ933965 By railway bridge, Creeksea

Appendix 2: Sites at which *L. noctiluca* were observed in 2001

TL694047	In garden by railway, Widford
TL545207	Hatfield Forest, on plains
TL548212	On verge near bridge, Takeley
TL552386	Saffron Walden Hospital, near Ambulance Station
TL769221	Behind platform at Braintree Freeport Railway Station
TL771219	On landscaped area, Braintree Freeport
TL775202	Bulford Mill Lane, Cressing
TL7806	Danbury Ridge Complex
TL786059	Garden backing onto Spring Wood, Danbury
TL787075	Herons Paddock, Little Baddow
TL788049	Hitchcock's Meadows, Danbury
TL793063	Twitty Fee, Danbury
TL853133	Shut Heath Wood, Little Braxted
TL952260	Iron Latch Nature Reserve, Eight Ash Green
TL954256	Iron Latch, by railway bridge, Eight Ash Green
TM008199	Manwood Chase, Abberton
TQ607792	Grays Chalk Quarry
TQ685882	Staneway, Basildon
TQ695867	Dry Street, Basildon
TQ705865	One Tree Hill, Basildon
TQ781858	Benfleet Downs
TQ800860	Hadleigh Castle Country Park
TQ810860	Hadleigh Castle
TQ835991	Stow Maries Halt
TQ905945	Finches Nature Area, Canewdon
TQ931959	Sailing club car park, Creeksea
TQ932962	Verge of lane, Creeksea
TQ933965	By railway bridge, Creeksea

Appendix 3: Sites at which *L. noctiluca* were recorded from 1992 to 2000

TL522366	Disused railway line, Wendens Ambo
TL532187	Hatfield Forest
TL790314	Broakes Wood
TL805175	White Notley railway line (used)
TL837131	Chantry Wood, Wickham Bishops
TL976210	Roman River Valley
TQ431982	Goldings Hill, Loughton
TQ5878	Mill Wood Pit, Grays
TQ598782	Grays
TQ599793	Grays
TQ7386	Wat Tyler Country Park
TQ778891	Wheelers, Rayleigh
TQ918974	Railway line (used), Creeksea
TQ9296	The Cliff, Burnham
TQ934957	Seawall, Creeksea