Chapter

Moth Species Caught by Ultraviolet and Visible Light Sources in Connection with Their Wingspan

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Abstract

For a long time, researchers have compared light traps operating with different light sources. According to the results, ultraviolet lights often performed better than visible light sources. In the present study, we examine the wingspan of macrolepidoptera species in relation to the catch result of visible (visible) and BL traps in choice and no-choice situations using data from the Hungarian light-trap network. We used the catch data of 19 light-trap stations from 1962 to 1963. Up to 18 stations belonged to the national network and the last one was in Nagytétény. We processed data of 381 species of the 18 light-traps data of the national network and data of 222 species from the light traps of Nagytétény. The data of the wingspan of the different macrolepidoptera species we collected from the websites of UKmoths (http://ukmoths.org.uk/index.php), and Guide to the Butterflies and Moths of Hungary (macrolepidoptera) (http://www.macrolepidoptera.hu). We summarised for each light-trap station and each trap type the number of the macrolepidopteran species and individuals caught from different generations. Then, using the Mann–Whitney test, we checked for species the number of individuals captured by visible and BL traps, and the difference of the level of significance. We summarised the wingspan data of all the 381 species, the more efficient light source for each species in a no-choice situation at multiple sites and for the single site of Nagytétény the more efficient light source for species detected there. The BL trap seems most efficient for operation for plant protecting purposes, despite the fact that their use is far more problematic. Insect species are not only endangered by light trapping but also by the light pollution of urban areas. Our results confirm that the different light sources should incur mortality on different species to differing levels. Such differential mortality from artificial light sources could disturb the balance of life in biological communities.

Keywords: moths, wingspan, light-trap, visible and BL light sources

1. Introduction

For a long time, researchers worldwide have compared light traps operating with different light sources. The results have been diverse although ultraviolet lights often performed better than white light sources. Catching results seem to vary with taxa and with the size of insects; so, it is not easy to assert that one type of light source is best for all occasions. Knowledge of the responses of various insect taxa to artificial light not only has implications for trapping techniques in entomology but also for assessing the impact of artificial light pollution on biological ecosystems.

Researchers have also examined the spectral sensitivity of the insect's eye. Electroretinogram measurements are used to determine the spectral sensitivity of the insect eye. In international literature, several studies are devoted to the results of laboratory measurements carried out on various species. No reports of such experiments are known in Hungary, and data on the most important Hungarian pestilent species are also missing from the international literature on the subject.

Few researchers have examined the relationship of the body or eye size with the selection of light sources.

Different light sources are used in the various types of light traps. The light source determines the running temperature, the colour temperature, and the spectral distribution of the light energy that it emits. Some sources such as black light (BL) emit mainly in the ultraviolet wavelength range (320–400 nm), some such as normal or white light (V) emit in the visible range (400–700 nm), and some such as mercury vapour (Hg) emit across ultraviolet and visible wavelengths (200–600 nm). Some sources emit or are filtered to a narrow range of wavelengths such as particular colours visible to the human eye.

Mikkola [1] established that moths and butterflies (Lepidoptera) and caddis fly species (Trichoptera) have an eye sensitivity that remains practically unchanged in the 350–600 nm spectrum. Its maximum is around 550 nm (green, same as the value of the human eye during daytime). The sensitivity is greatly reduced at about 620 nm (orange-red). McFarlane and Eaton [2] have reported that the responses of Cabbage Looper (*Trichoplusia ni* Hbn.) to monochromatic light stimuli have been investigated by electroretinogram (ERG) and electromyogram (EMG) techniques. The spectral sensitivity curves for male and female Cabbage Loppers show a major peak at 540–550 nm and a minor peak in the ultraviolet range at 360 nm. Agee [3] showed by electroretinogram tests that the sensitivity of eyes of the Bollworm Moth (*Heliothis zea* Boddie) and Tobacco Bollworm (*Heliothis virescens* F.) to 365 nm and 480–575 nm wavelengths light is the highest.

Pappas and Eaton [4] found that the ocelli of the Tobacco Hornworm (*Manduca sexta* L.) are more sensitive to 520 nm light than to 360 nm light stimuli. Similar results are reported by Eguchi et al. [5] about the Sphingid moths. These moths possess the highest peak sensitivity at 540 nm.

Gui et al. [6] reported that the colours on which comparable data are available to arrange themselves in order of least to most attractiveness to insects as red, yellow, white, and blue. From tests of Taylor and Deay [7], it appears that the maximum attractiveness for the European Corn Borer (*Ostrinia nubilalis* Hbn.) is in the near-ultraviolet region between 320 and 380 nm.

Many researchers found that ultraviolet or black light was most effective in catching insects but for some taxa, a combination of ultraviolet and visible light was more effective while a few taxa were best trapped by using visible light alone.

In a comparative experiment, Frost [8] found that black light attracted almost all taxa of insects more than white light. The exceptions were the Miridae and Chrysopidae, which preferred white light. Belton and Kempster [9] (1963) caught more Noctuidae and Geometridae with a BL fluorescent tube than with the normal or cold white light (N). Sifter [10] examined the swarming of the Chestnut Weevil (*Curculio elephas* Gyllenhal, Coleoptera: Curculionidae) by using visible and BL light traps. The body length of this beetle is only 6–9 mm. The normal light trap did not catch a single specimen but the BL one was suitable for investigation of swarming. According to Bürgés et al. [11], those families (Geometridae, Sphingidae, Notodontidae, Arctiidae, and Noctuidae) that are rich in species fly to both normal and BL light traps, but the BL traps catch significantly more species and more specimens of many species [12] studied the efficiency of catching useful or beneficial insects by using different light sources. The Coccinellidae (Coleoptera) species preferred BL, the *Ophion* sp. (Hymenoptera: Ichneumonidae) preferred blue BL while *Chrysopa* spp. (Neuroptera: Chrysopidae) was trapped equally well with white and BL light, while every source of light had the same impact on some broad damsel bugs (Hemiptera: Nabidae) and the lacewings, *Hemerobius* spp. (Neuroptera: Hemerobiidae). Comparative studies [13] found each of several Microlepidoptera species was more effectively collected in BL traps than normal ones. In our earlier study [14], we compared in two light-trap stations, the composition of species of five macrolepidopteran families from the material of normal and BL light traps by applying the Sorensen index. The results are the follows: Geometridae: 0.607 and 0.518; Sphingidae: 0.750 and 0.500; Notodontidae: 0.444 and 0.429; Arctiidae: 0.714 and 0.609; Noctuidae: 0.608 and 0.527.

Some authors found ultraviolet light more effective than particular wavelengths of visible light in trapping insects. In the test of Day and Reid [15], the 15 W fluorescent BL lamps were more efficient for capturing *Conoderus falli* Lane (Coleoptera: Elateridae) than similar yellow sources. Teel et al. [16] perceived the maximum sensitivity of the eye of Hickory Shuckworm (*Laspeyresia caryana* Fitch.) at 365 nm and 515 nm. At these two values, six times as many individuals responded to the near-ultraviolet light than to the green light. Skuhravý et al. [17] found a BL trap much more effective than either yellow, green, or red light in collecting the Saddle Gall Midge (*Haplodiplosis marginata* von Roser) (Diptera: Cecidomydae).

Some authors found a combination of ultraviolet and visible wavelengths to be most effective. Cleve [18] found an ultraviolet fluorescent lamp (BL) that was very attractive to insects if it illuminated a white sheet. Similarly, Belton and Kempster [19] verified the results of their laboratory measurements of eye sensitivity by the test of light-trap collecting. They caught the highest number of insects with lamps emitting both BL and visible light. The catch dwindled when they used BL alone while visible light alone produced an even poorer result. A striking contradiction was found, however, for the six most important insect groups (Coleoptera, Trichoptera, Lepidoptera, Brachycera, and Nematocera Ichneumonoidea) in terms of sensitivity and attractive lighting effect. These insects' eyes were more sensitive to the yellow light but the attractive effect was the opposite.

Some authors found visible light to be more effective than ultraviolet light in trapping certain insects. Jászainé [20] analysed the catching results of Common Meadow Bug (*Exolygus pratensis* Wagner) (Heteroptera: Miridae) in normal (V) and ultraviolet light traps (BL) to find the former caught more individuals. Other taxa showing a greater attraction to regular light include some fruit flies [21] virus vector cicadae (*Laodelphax striatella* (Fallén) and *Javesella pellucida* (Fabr., Homoptera, Areopidae) [22] European Grapevine Moth (*Lobesia botrana* Den. et Schiff.) and Vine Moth (*Eupoecilia ambiguella* Hbn. [23].

Some authors included light sources, such as mercury and sodium in their experiments. For [24] the standard light trap caught only a few specimens of the Eurasian Hemp Moths (*Grapholita delineana* Walker) while a HgLS light source caught many of these moths. The wingspan of the Eurasian Hemp Moths is 10–14 mm.

Blomberg et al. [25] compared two types of light trap catch results. One of them was the so-called blended light trap containing a 160 W Tungsram mercury fluorescent lamp emitting ultraviolet and visible light. The BL was provided with a 125 W Philips HPW lamp. The mercury fluorescent lamp caught twice as many moths of the macrolepidoptera (families Geometridae and Noctuidae), and the microlepidopteran species as the BL trap.

According to Gál et al. and Bürgés [26–28] for light trapping of Chestnut Weevil (*Curculio elephas* Gyllenhal) and Acorn Moth (*Cydia splendana* Hbn.) the most effective light source is the mercury vapour lamp (HgW). Traps with visible or BL lamps achieved comparable catches to each other but less than the mercury source, which produces both ultraviolet and visible light.

Extremely valuable conclusions follow from a series of experiments by Járfás et al., Járfás and Tóth [29, 30] in which catch results yielded by 125 W (HgVE 27) ultraviolet, 125 W (HgLSE27) mercury vapour, 100 W (OHP 220–230 VAO) krypton, 100 W (F_3) 50 cm neon, 250 W (E 279043 IMP) infraruby, and 50 cm germicidal lamps were compared. Silver Y moths (*Autographa gamma* L.), Pine Chafers (*Polyphylla fullo* L.), Vine Chafers (*Anomala vitis* Fabr.), and Scarab Beetles (*Anoxia orientalis* Kryniczky) flew to the mercury vapour lamps in the highest numbers, while infraruby light proved to be practically unsuitable for trapping. Járfás published further results of his experiments on different moth species. Most suitable for catching was the mercury lamp (HgW) ahead of BL which was better than visible or visible light for the Silver Y (*A. gamma* L.) [29], the Codling Moth (*Cydia pomonella* L.) [31], the Pea Podborer (*Etiella zinckenella* Tr.) [32] and the Beet Webworm (*Loxostege sticticalis* L.) [33]. Also, Járfás [34] reported that the Apple Peel Tortrix (*Adoxophyes reticulana* Hbn.), the Pear Moth (*Laspeyresia pyrivora* Pan.), and the Plum Fruit Moth (*Grapholita funebrana* Tr.) can be best caught with the mercury vapour lamp (HgW) but for the Strawberry Tortricid (*Pandemis dumetana* Tr.) and the Dark Fruit-tree Tortrix (*Pandemis heparana* Den. et Schiff.) the visible light bulb was most effective. Similarly, the European Corn Borer (*O. nubilalis* Hbn.) was collected in the HgW traps more successfully than in the visible and the BL traps [35].

Wallner et al. [36] carried out experiments with three lymantriid species in the Russian Far East. They caught significantly more moths of all three species using fluorescent black light than either phosphor mercury or high-pressure sodium lamps. The species were Gipsy Moth (*Lymantria dispar* L.), Nun Moth (*Lymantria monaca* L.), and the Pink Gipsy Moth (*Lymantria matura* Moore).

Fayle et al. [37] compared three types of Robinson light traps equipped with 125 W mercury bulb, which emits visible and ultraviolet light. One of these light sources included materials that absorb visible light; so, this lamp was an ultraviolet or BL type trap. The fewest moths were caught by the BL trap. Barghini [38] tested four light sources. Most insects were caught using the high-pressure mercury lamp (Hg). A further order was as follows—high-pressure sodium (Na) without a BL filter and the same type with BL filter.

In the last decade, most researchers found a connection between the body size of the insects, expressed as body weight, eye size or wingspan, and their light sensitivity. Taxa with larger eyes and wingspan have higher light sensitivity than those with smaller eyes. Over the last decade, published studies supported the finding that the vision of insects with greater body weight is more sensitive than the smaller species. Such a statement was published concerning desert ants (*Cataglyphis*) [39]; pollen foraging bees, (Apoidea) [40] the bumblebees (*Bombus terrestris* L.) [41, 42]; the nymphalid butterflies (Nymphalidae) [43]. Moser et al. [44] found a connection between the size of the eyes of 10 *Atta* species (Hymenoptera: Formicidae) and the time of nuptial flight using the digital photograph method. The diameter of compound eyes of the night flying species was significantly larger. Yack et al. [45] reported similar results in the *Macrosoma eliconiaria* Walker (Lepidoptera: Hedyloidea) species.

Experiments of Kino and Oshima [46] suggest that moth and butterfly emanations could cause allergy-induced bronchial asthma in certain patients. Since moths are attracted readily to artificial lights and often fly into houses, these insects are especially suspect as important factors in extrinsic asthma. Barghini and Medeiros [47] (2010) assumed that in developing countries, the growing light pollution will affect the spread of vector-borne human diseases as well.

van Langevelde et al. [48] established that artificial light with smaller wavelengths attracted more individuals and greater specific diversity of insects than light with larger wavelengths. The attraction was correlated with the body mass, wingspan, and eye size of moths. The size-dependent response to artificial light sources is likely to distort the ecosystems if it generates selective mortality.

In the above-mentioned studies, the catch coming from parallel operated regular and BL light traps offered a unique possibility to answer the following questions.

- Is there a significant difference by species and families between the catch yielded by the two types of traps?
- Which of the two light sources is more suitable for trapping what species?
- Are there any species that can only be collected by one of the two types of light sources?
- Does either of the two types indicate the presence of more species than the other?
- To what extent do the materials yielded by the two types of traps at the same observation site differ in their composition by species?

In the present study, we examined the wingspan of macrolepidopteran species in relation to the catch result of visible and BL traps in choice and no-choice situations using data from the Hungarian light-trap network.

2. Material

To compare the differences in the practical use of visible and BL light traps, from 1962, the Hungarian Plant Protection Research Institute at Keszthely experimented with the parallel operation of two light traps, one running on a visible bulb producing mainly visible light and the other outfitted with BL light-emitting mainly ultraviolet light. Also in 1962, the Plant Protection Service, in its turn, added a BL light trap in Nagytétény to the ones running on visible light, and equipped all its county plant protection stations also with BL traps in 1963. The national network of parallel operated visible and BL light traps opened up the possibility to a wide-scale examination of the results and usefulness of collecting with the two types. Most valuable information was provided by the light traps at Nagytétény where regular and BL traps were placed at a mere 10 metres distance from one another. The proximity of the two traps meant an identity of the microclimate, vegetation, and the distance from the habitats of the various species and so the insects were practically offered the choice of the two different light sources. At other sites, the visible and BL traps were separated by a distance greater than their likely radius of effect and so did not offer a choice situation to insects.

The visible and BL light traps operated in the following cities and villages:

Baj (47°38′N, 18°21′E)
Csopak (45°58′N, 17°55′E)
Fácánkert (46°26′N, 18°44′E)
Gyöngyös (47°46′N, 19°55′E)
Győr-Kismegyer (47°39′N, 17°39′E)
Hódmezővásárhely (46°25′N, 20°19′E)
Kaposvár (46°22′N, 17°46′E)
Kállósemjén (47°51′N, 21°55′E)
Kenderes (47°13′N, 20°45′E)
Keszthely (46°46′N, 17°15′E)
Mikepércs (47°26′N, 21°37′E)
Miskolc (48°51′N, 20°46′E)
Nagytétény (47°38′N, 18°97′E)
Pacsa (46°43′N, 17°09′E)
Szederkény (45°59′N, 18°27′E)
Tanakajd (47°11′N, 16°44′E)
Tarhos (46°48′N, 21°12′E)
Tass (47°12′N, 19°20′E)
Velence (47°14′N, 18°38′E)

The complete macrolepidopteran material of above-listed light traps was processed in our work. We processed data of 381 species of the 18 light-traps data of the national network and data of 222 species from the light traps of Nagytétény.

The data of the wingspan of the different Macrolepidoptera species we collected from the websites of UKmoths (http://ukmoths.org.uk/index.php), and Guide to the Butterflies and Moths of Hungary (macrolepidoptera) (http://www.macrolepidoptera.hu).

3. Methods

We summarise for each light-trap station and each trap type the number of the macrolepidopteran species and individuals caught from different generations but did not separate the individuals into generations. Then, using the Mann–Whitney test, we checked for species the number of individuals captured by visible and BL traps, and the difference of the level of significance. The theoretical bases of the test and its application were shown by Hajtman et al. [49, 50] in detail. We created a common sample in the course of the procedure, which included all of the observation sites. The element number of the sample is twice the number of observation sites (because two traps were in operation at every station), at which one of the traps revealed the presence of a species. We sum it up by segregating the numbers of individuals in the unified sample. We compared these values with the table value to determine the difference and its level of significance.

Particular attention was paid to the comparison of catches at Nagytétény in the visible and BL traps which were in close proximity, with identical micro-climate, vegetation, and habitat, so that the moths could choose between different light sources at one place.

In the taxonomic sequence, we tabulate all species for wingspan and preferred type of light trap. We separate in this table the light traps of the nationwide network (no-choice situations) from the light traps at Nagytétény (choice situation).

For graphical analysis, we arranged in ascending order, regardless of their taxonomic place, all the species collected both by the national light-trap network, as well as the Nagytétény traps according to the wingspan of insects. We calculated the percentages of species caught by BL and visible traps in relation to the sum of data of the network and also Nagytétény. We calculated the approaching functions of the curves.

The approximate curve is the so-called logistic curve:

$$y = \frac{k}{(1 + e^{b_0 + b_1 x})}$$

where "k" is the saturation value [51]. In our case, k = 100, because the elements of samples are in percentage. So, we must not estimate the value of k from the samples. In this way, the values of b_0 and b_1 can be determined by linear regression of transformed data. The estimated values of these constants are: b_0 = 3.19, b_1 = −0.151.

The value of the correlation index can be determined from the relationship:

$$i_{xy} = \sqrt{1 - \frac{s_r^2}{s_y^2}}$$

where s_r^2 is the residual variance, s_y^2 is the variance of the independent variable? In our case: i_{xy} = 0.956.

We depicted their number as the species in the function of the wingspan, that BL and the visible light traps collected it in an equal proportion. We made use of the middle values of the extreme values in all cases. We examined in Ref. to the families Sphingidae, Geometridae, Notodontidae, Erebidae, and Noctuidae whether the number of species collected effectively by the visible or BL traps differed? We also looked for species that cannot be detected in the two results (visible versus BL) in significant differences despite the number of traps being sufficient to determine significant differences.

4. Results and discussion

We summarise in **Table 1** that the wingspan data of all the 378 species, the more efficient light source for each species in a no-choice situation at multiple sites and for the single site of Nagytétény the more efficient light source for species detected there.

We established from the material of the national light-trap network that the BL traps are unquestionably more efficient in collecting several species of the Sphingidae, Notodontidae, and Noctuidae. Several species of the Geometridae and Erebidae families fly to BL and visible traps in equal numbers. However, at Nagytétény, the species of the latter two families clearly flew much more frequently into the BL trap. None of the five families include species that could be captured only by one or the other type of trap.

Figure 1 shows that at no-choice sites, such as the national network traps, 30 mm wingspan is approximately the limit below which some species can be trapped more effectively by using the visible trap rather than the BL type. Above 35 mm wingspan, the catch of the BL approaches 100%. At Nagytétény, however, where the visible and the BL traps were placed so close together that the moths could see both at the same time, even the moths having the smallest wingspan were caught more than 60% by BL trap (**Figure 2**). These results agree broadly with the previous literature although they do not address mercury light sources, which emit light in both BL and V ranges.

Figure 3 shows that the number of the species collected in nearly equal proportions by visible and BL traps significantly declines with increasing wingspan.

No.	Scientific names of species	A	B	C	D
Drepanidae (Average of wingspan is 31.6 mm)					
1	*Watsonalla binaria* Hfn.	24	10	E	—
2	*Drepana falcataria* L.	31	6	E	—
3	*Sabra harpagula* Esp.	30	5	E	—
4	*Cilix glaucata* Scop.	20	20	E	E
5	*Asphalia ruficollis* Den. et Schiff.	36	4	E	—
6	*Habrosyne pyrithoides* Hfn.	37	5	E	—
7	*Tethea ocularis* Hbn.	35	4	BL	—
8	*Tethea or* Den. et Schiff.	40	7	E	—
Lasiocampidae (Average of wingspan is 42.2 mm)					
9	*Poecilocampa populi* L.	37	6	E	—
10	*Trichiura crataegi* L.	27	5	E	—
11	*Malacosoma neustria* L.	30	12	E	—
12	*Lasiocampa trifolii* Den. et Schiff.	47	6	E	BL
13	*Odonestis pruni* L.	40	17	BL	—
14	*Macrothylacia rubi* L.	52	11	E	—
15	*Phyllodesma ilicifolia* L.	35	11	BL	—
16	*Gastropacha quercifolia* L.	70	17	BL	E
Saturniidae (Average of wingspan is 82.5 mm					
17	*Saturnia pyri* Den. et Schiff.	115	7	BL	—
18	*Saturnia pavonia* L.	50	5	BL	—
Sphingidae (Average of wingspan is 82.5 mm					
19	*Mimas tiliae* L.	67	12	BL	BL
20	*Smerinthus ocellata* L.	75	21	BL	BL
21	*Laothoe populi* L.	77	17	BL	V
22	*Marumba quercus* Den. et Schif.	100	5	E	—
23	*Agrius convolvuli* L.	100	14	BL	—
24	*Sphinx ligustri* L.	105	19	BL	E
25	*Sphinx pinastri* L.	77	11	BL	—
26	*Macroglossum stellatarum L.*	45	5	E	—
27	*Deilephila elpenor* L.	53	14	BL	—
28	*Deilephila porcellus* L.	43	14	BL	BL
29	*Hyles euphorbiae* L.	65	21	BL	BL
Geometridae (Average of wingspan is 26.1 mm)					
30	*Rhodostrophia vibicaria* Clerck	27	16	E	BL
31	*Idaea rufaria* Hbn.	13	6	E	V
32	*Idaea serpentata* Hfn.	22	5	E	—
33	*Idaea aureolaria* Den. et Schiff.	11	4	BL	—
34	*Idaea muricata* Hfn.	19	8	E	—
35	*Idaea rusticata* Den & Schiff.	20	17	E	BL

No.	Scientific names of species	A	B	C	D
36	*Idaea obsoletaria* Rambur	22	4	V	—
37	*Idaea fuscovenosa* Goeze.	20	12	E	BL
38	*Idaea humiliata* Hfn.	20	12	V	V
39	*Idaea politaria* Hbn.	16	5	V	—
40	*Idaea seriata* Schrk.	20	5	E	BL
41	*Idaea dimidiata* Hfn.	16	17	V	V
42	*Idaea nitidata* H.-Sch.	20	4	E	BL
43	*Idaea aversata* L.	26	16	E	BL
44	*Idaea degeneraria* Hbn.	28	7	E	BL
45	*Idaea straminata* Brkh.	30	10	E	BL
46	*Scopula immorata* L.	23	17	E	BL
47	*Scopula nigropunctata* Hfn.	31	4	E	—
48	*Scopula virgulata* Den. et Schiff.	20	20	V	E
49	*Scopula ornata* Scop.	22	11	V	V
50	*Scopula rubiginata* Hfn.	18	19	E	E
51	*Scopula marginepunctata* Goeze	26	18	E	E
52	*Scopula immutata* L.	25	17	V	E
53	*Scopula rubiginata* Hfn.	18	19	E	E
54	*Scopula marginepunctata* Goeze	26	18	E	E
55	*Scopula flaccidaria* Zeller	21	14	E	—
56	*Scopula corrivalaria* Kretschm.	20	5	E	—
57	*Scopula incanata* L.	26	7	E	—
58	*Timandra comae* Schmidt	25	22	V	E
59	*Cyclophora annularia* Fabr.	20	15	E	BL
60	*Cyclophora ruficiliaria* H.-Sch.	27	4	E	—
61	*Cyclophora punctaria* L.	22	14	E	—
62	*Cyclophora linearia* Hbn.	29	8	BL	—
63	*Philbalapteryx virgata* Hfn.	23	7	E	BL
64	*Lythria purpuraria* L.	24	15	E	BL
65	*Orthonama vittata* Bkh.	24	7	E	—
66	*Nycterosea obstipata* Fabr.	19	16	E	BL
67	*Xanthorrhoe fluctuata* L.	21	20	E	BL
68	*Xanthorrhoe spadicearia* Den. et Schiff.	25	4	E	—
69	*Xanthorrhoe ferrugata* Clerck	20	16	V	V
70	*Catarhoe cuculata* Hfn.	24	4	E	—
71	*Catarhoe rubidata* Den. et Schiff.	28	6	V	V
72	*Costaconvexa polygrammata* Bkh.	26	7	E	—
73	*Epirrhoe alternata* Müller	22	15	E	BL
74	*Epirrhoe galiata* Den. et Schiff.	30	5	E	—
75	*Pelurga comitata* L.	27	13	E	V

No.	Scientific names of species	A	B	C	D
76	*Gandaritis pyraliata* Den. et Schiff.	30	4	E	—
77	*Operophthera brumata* L.	25	11	V	—
78	*Philereme vetulata* Den. et Schiff.	27	9	E	BL
79	*Perizoma alchemillata* L.	16	10	BL	V
80	*Gymnoscelis rufifasciata* Haw.	17	5	E	BL
81	*Pasiphila rectangulata* L.	17	5	E	—
82	*Eupithecia linariata* Den. et Schiff.	13	14	E	V
83	*Eupithecia simpliciata* Haw.	22	12	E	BL
84	*Eupithecia innotata* Hfn.	21	4	E	BL
85	*Eupithecia centaureata* Den. et Schiff.	18	22	E	BL
86	*Eupithecia vulgata* Haw.	16	7	E	—
87	*Eupithecia millefoliata* Rossler	21	8	V	—
88	*Aplocera plagiata* L.	40	12	E	BL
89	*Lithostege griseata* Den. et Schiff.	29	11	E	BL
90	*Lithostege farinata* Hfn.	31	19	E	E
91	*Abraxas grossulariata* L.	37	5	E	—
92	*Lomaspilis marginata* L.	34	11	E	—
93	*Ligdia adustata* Den. et Schiff.	22	15	E	BL
94	*Stegania dilectaria* Hbn.	21	9	E	—
95	*Macaria alternata* Den. et Schiff.	24	17	E	E
96	*Macaria artesiaria* Den. et Schiff.	26	6	E	—
97	*Narraga tessularia* Metzner	15	6	E	—
98	*Chiasmia clathrata* L.	23	22	E	BL
99	*Epione repandaria* Hfn.	27	7	E	—
100	*Angerona prunaria* L.	40	9	E	—
101	*Ennomos autumnaria* Werneburg	45	16	E	BL
102	*Ennomos fuscantaria* Haw.	37	11	BL	—
103	*Ennomos erosaria* Den. et Schiff.	32	12	BL	—
104	*Selenia lunaria* Den. et Schiff.	39	16	E	V
105	*Artiora evonymaria* Den. et Schiff.	29	4	V	V
106	*Crocallis elinguaria* L.	36	5	E	BL
107	*Colotois pennaria* L.	40	8	E	—
108	*Alsophila aescularia* Den. et Schiff.	30	4	E	—
109	*Ascotis selenaria* Den. et Schiff.	43	21	E	BL
110	*Lycia hirtaria* Clerck	40	9	E	BL
111	*Biston betularia* L.	47	11	BL	BL
112	*Agriopsis bajaria* Den. et Schiff.	29	7	E	—
113	*Therapis flavicaria* Den. et Schiff.	29	5	V	—
114	*Erannis defoliaria* Clerck.	35	7	E	BL
115	*Peribatodes rhomboidaria* Den. et Schiff.	34	13	E	BL

No.	Scientific names of species	A	B	C	D
116	*Cleora cinctaria* Den. et Schiff.	31	6	E	—
117	*Agriopis aurantiaria* Hbn.	31	20	E	BL
118	*Ectropis crepuscularia* L.	35	20	V	BL
119	*Elicrinia trinotata* Metzner	13	6	E	—
120	*Heliomata glarearia* Den. et Schiff.	18	14	E	BL
121	*Synopsia sociaria* Hbn.	36	5	E	—
122	*Aethalura punctulata* Den. et Schiff.	32	5	E	—
123	*Ematurga atomaria* L.	26	17	E	BL
124	*Bupalus piniaria* L.	32	4	BL	—
125	*Cabera pusaria* L.	26	10	E	—
126	*Cabera exanthemata* Scop.	32	15	E	BL
127	*C. exanthemata* Scop.	32	15	E	BL
128	*Lomographa temerata* Den. et Schiff.	24	4	E	—
129	*Tephrina arenacearia* Den. et Schiff.	25	22	E	BL
130	*Tephrina murinaria* Den. et Schiff.	28	11	E	BL
131	*Thetidia smaragdaria* Prout	35	15	E	—
132	*Phaiogramma etruscaria* Zeller	19	9	V	V
133	*Hemistola chrysoprasaria* Esp.	30	10	E	—
134	*Thalera fimbrialis* Scop.	27	16	E	—
135	*Chlorissa cloraria* Hbn.	15	6	E	—
136	*Chlorissa viridata* L.	25	20	V	V
Notodontidae (Average of wingspan is 39.7 mm)					
137	*Thaumetopoea processionea* L.	30	8	E	BL
138	*Cerura vinula* L.	57	7	BL	—
139	*Furcula furcula* Clerk	31	12	BL	BL
140	*Furcula bifida* Brahm	40	16	BL	BL
141	*Drymonia dodonea* Den. et Schiff.	35	6	E	—
142	*Drymonia querna* Fabr.	41	7	E	—
143	*Drymonia ruficornis* Hfn.	37	4	E	—
144	*Notodonta dromedarius* L.	37	5	E	—
145	*Notodonta ziczac* L.	47	17	BL	BL
146	*Notodonta tritophus* Den. et Schiff.	50	6	BL	—
147	*Pheosia tremula* Clerk	50	14	BL	BL
148	*Pterostoma palpina* Clerck	45	20	V	N
149	*Ptilodon capucina* L.	37	5	E	—
150	*Ptilophora plumigera* Den. et Schiff.	38	6	E	BL
151	*Spatalia argentina* Den. et Schiff.	37	11	BL	—
152	*Phalera bucephala* L.	48	17	BL	BL
153	*Gluphisia crenata* Bray	35	13	E	—
154	*Clostera curtula* L.	31	14	V	BL

No.	Scientific names of species	A	B	C	D
155	*Clostera pigra* Hfn.	24	9	E	N
156	*Clostera anastomosis* L.	35	14	E	BL
Erebidae (Average of wingspan is 37,7 mm)					
157	*Scoliopteryx libatrix* L.	42	11	E	V
158	*Rivula sericealis* Scop.	20	21	E	E
159	*Hypena proboscidalis* L.	31	4	E	—
160	*Hypena rostralis* L.	30	12	E	E
161	*Leucoma salicis* L.	43	7	E	—
162	*Lymantria dispar* L.	43	18	BL	BL
163	*Ocneria rubea* Den. et Schiff.	39	6	E	E
164	*Euproctis chrysorrhoea* L.	39	15	E	—
165	*Euproctis similis* Fuessly	31	5	E	—
166	*Calliteara pudibunda* L.	50	7	E	—
167	*Orgya antiqua* L.	27	7	BL	BL
168	*Hyphantria cunea* Drury	38	21	E	BL
169	*Spilosoma lutea* Hfn.	34	18	E	BL
170	*Spilosoma lubricipeda* L.	41	20	E	E
171	*Spilosoma urticae* Esp.	42	18	E	E
172	*Diaphora mendica* Clerck	33	8	E	BL
173	*Diacrisia sannio* L.	42	14	E	—
174	*Phragmatobia fuliginosa* L.	32	22	BL	BL
175	*Phragmatobia lucufer* Den. et Schiff..	37	7	E	BL
176	*Arctia caja* L.	55	21	BL	BL
177	*Arctia villica* L.	52	14	BL	V
178	*Ocnogyna parasita* Hbn.	32	5	E	—
179	*Chelis maculosa* Gerning	33	11	E	BL
180	*Miltochrista miniata* Forster	25	4	E	—
181	*Pelosia muscerda* Hfn.	26	7	E	—
182	*Thumatha senex* Hbn.	17	12	E	—
183	*Pelosia obtusa* H-Sch.	25	8	E	BL
184	*Lithosia quadra* L.	45	12	E	BL
185	*Eilema lurideola* Zincken	31	4	E	—
186	*Eilema complana* L.	31	15	BL	BL
187	*Eilema palliatella* Scop.	34	7	BL	BL
188	*Dysauxes ancilla* L.	23	12	E	—
189	*Eilema pygmaeola* Doubleday	26	14	E	BL
190	*Eilema sororcula* Hfn.	28	5	BL	—
191	*Paracolax tristalis* Fabr.	31	11	E	—
192	*Herminia tarsicrinalis* Knoch.	30	8	E	V
193	*Polypogon tentacularia* L.	25	4	E	—

No.	Scientific names of species	A	B	C	D
194	*Zanclognatha lunalis* Scop.	34	7	V	—
195	*Simplicia rectalis* Ev.	29	6	E	BL
196	*Schrankia costaestrigalis* Steph.	19	5	V	—
197	*Lygephila craccae* Den. et Schiff.	43	7	BL	BL
198	*Phytometra viridaria* Cl.	19	9	E	BL
199	*Colobochyla salicalis* Den. et Schiff.	28	7	E	—
200	*Catocala elocata* Esp.	75	10	BL	BL
201	Euclidia glyphica L.	27	14	E	E
Noctuidae (Average of wingspan is 34,73 mm)					
202	*Eublemma purpurina* Den. et Schiff.	25	18	BL	BL
203	*Abrostola triplasia* L.	30	10	E	—
204	*Abrostola trigemina* Werneburg	37	10	E	BL
205	*Autographa gamma* L.	40	21	BL	BL
206	*Macdunnoughia confusa* Steph.	35	21	E	BL
207	*Diachrysia chrysitis* L.	31	21	BL	E
208	*Plusia festucae* L.	38	12	BL	—
209	*Deltote pygarga* Hfn.	21	9	E	—
210	*Deltote deceptoria* Scop.	24	4	E	—
211	*Deltote uncula* Clerck	21	13	E	—
212	*Deltote bankiana* Fabr.	26	11	E	—
213	*Acontia lucida* Hfn.	28	22	BL	BL
214	*Acontia trabealis* Scop.	19	22	E	BL
215	*Odice arcuinna* Hbn.	27	4	E	BL
216	*Aedia funesta* Esp.	32	20	BL	E
217	*Tyta luctuosa* Den. et Schiff.	23	22	E	BL
218	*Colocasia coryli* L.	34	10	E	—
219	*Diloba caeruleocephala* L.	35	15	E	—
220	*Symira albovenosa* Goeze.	38	10	E	V
221	*Symira nervosa* Den. et Schiff.	32	7	E	—
222	*Acronicta tridens* Den. et Schiff.	40	16	BL	BL
223	*Acronicta psi* L.	40	7	E	BL
224	*Acronicta aceris* L.	45	4	BL	BL
225	*Acronicta rumicis* L.	34	21	BL	BL
226	*Acronicta megacephala* Den. et Schiff.	42	20	BL	BL
227	*Oxycesta geographica* Fabr.	25	4	V	V
228	*Craniophora ligustri* Den. et Schiff.	38	10	BL	—
229	*Cucullia umbratica* L.	47	22	BL	BL
230	*Cucullia chamomillae* Den. et Schiff.	41	4	E	BL
231	*Cucullia lactucae* Den. et Schiff.	48	5	BL	—
232	*Cucullia fraudatrix* Ev.	38	6	E	—

No.	Scientific names of species	A	B	C	D
233	*Lamprosticta culta* Den. et Schiff.	42	4	BL	BL
234	*Ammoconia caecimacula* Den. et Schiff.	42	10	BL	BL
235	*Calophasia lunula* Hfn.	29	18	E	BL
236	*Amphipyra pyramidea* L.	46	5	BL	BL
237	*Amphipyra livida* Den. et Schiff.	42	8	E	BL
238	*Amphipyra tragopoginis* Clerck	35	17	BL	BL
239	*Asteroscopus sphinx* Hfn.	44	11	E	—
240	*Allophyes oxyacanthae* L.	42	7	E	BL
241	*Pyrrhia umbra* Hfn.	31	15	E	BL
242	*Protoschinia scutosa* Den. et Schiff.	33	5	E	—
243	*Heliothis viriplaca* Hfn.	33	21	BL	BL
244	*Heliothis maritima* Graslin	33	22	BL	BL
245	*Periphanes delphinii* L.	36	19	BL	BL
246	*Acosmetia caliginosa* Hbn.	27	10	V	E
247	*Eucarta virgo* Tr.	35	13	E	—
248	*Cryphia algae* Fabr.	27	4	BL	—
249	*Cryphia raptricula* Den. et Schiff.	32	10	BL	—
250	Pseudeustrotia candidula Den. et Schiff.	22	21	E	BL
251	*Spodoptera exigua* Hbn.	29	12	BL	BL
252	*Elaphria venustula* Hbn.	21	7	E	—
253	*Episema glaucina* Esp.	36	9	E	E
254	*Episema tersa* Den. et Schiff.	36	11	BL	BL
255	*Caradrina morpheus* Hfn.	35	17	E	BL
256	*Platyperigea kadenii* Freyer	30	8	BL	BL
257	*Paradrina clavipalpis* Scop.	30	21	BL	BL
258	*Hoplodrina respersa* Hbn.	30	8	BL	V
259	*Hoplodrina alsines* Brahm.	31	17	BL	BL
260	*Hoplodrina respersa* Den. et Schiff.	31	4	E	—
261	*Hoplodrina blanda* Den. et Schiff.	33	14	BL	BL
262	*Hoplodrina ambigua* Den. et Schiff.	33	19	BL	BL
263	*Chilodes maritimus* Tauscher	33	7	E	BL
264	*Charanyca trigrammica* Hfn.	37	16	E	BL
265	*Athetis gluteosa* Tr.	25	19	E	BL
266	*Athetis furvula* Hbn.	20	11	E	—
267	*Dypterygia scabriuscula* L.	34	13	E	BL
268	*Trachea atriplicis* L.	40	12	E	—
269	*Actinotia polyodon* Clerck	33	5	E	—
270	*Phlogophora meticulosa* L.	47	12	BL	BL
271	*Euplexia lucipara* L.	29	7	E	—
272	*Gortyna flavago* Den. et Schiff.	37	9	E	—

No.	Scientific names of species	A	B	C	D
273	*Hydraecia micacea* Esp.	36	5	E	BL
274	*Luperina testacea* Den. et Schiff.	32	22	E	BL
275	*Rhizedra lutosa* Hbn.	46	18	BL	BL
276	*Nonagria typhae* Thnbg.	47	6	E	BL
277	*Archanara geminipuncta* Haw.	29	5	E	BL
278	*Archanara dissoluta* Tr.	30	4	E	—
279	*Denticucullus pygmina* Haw.	26	10	E	BL
280	*Photedes fluxa* Hbn.	28	9	E	BL
281	*Globia sparganii* Esp.	36	8	E	—
282	*Globia algae* Esp.	38	7	E	—
283	*Apamea anceps* Den. et Schiff.	37	15	BL	—
284	*Apamea sordens* Hfn.	38	16	E	E
285	*Apamea monoglypha* Hfn.	50	13	BL	BL
286	*Apamea sublustris* Esp.	42	5	E	V
287	*Mesapamea secalis* L.	28	7	BL	—
288	*Mesoligia furuncula* Den. et Schiff.	25	9	E	BL
289	*Oligia latruncula* Den. et Schiff.	25	19	E	E
290	*Oligia strigilis* L.	23	17	BL	E
291	*Xanthia gilvago* Den. et Schiff.	36	4	BL	—
292	*Xanthia ocellaris* Bkh.	37	8	E	BL
293	*Aegle kaekeritziana* Hbn.	26	9	E	V
294	*Mesogona acetosellae* Den. et Schiff.	42	5	BL	BL
295	*Agrochola lychnidis* Den. et Schiff.	39	19	BL	BL
296	*Agrochola litura* L.	32	15	BL	BL
297	*Agrochola helvola* L.	41	4	E	—
298	*Agrochola lota* Clerck	36	9	E	BL
299	*Agrochola circellaris* Hfn.	37	5	E	—
300	*Agrochola humilis* Den. et Schiff.	38	6	BL	—
301	*Ammoconia caecimacula* Den. et Schiff.	42	10	BL	BL
302	*Conistra vaccinii* L.	32	16	E	BL
303	*Conistra rubiginosa* Scop.	35	6	E	—
304	*Conistra erythrocephala* Den. et Schiff.	38	7	E	—
305	*Eupsilia transversa* Hfn.	37	13	E	—
306	*Cosmia affinis* L.	31	7	BL	—
307	*Cosmia trapezina* L.	29	13	E	BL
308	*Cosmia pyralina* Den. et Schiff.	31	4	E	—
309	*Atethmia centrago* Haw.	34	4	E	BL
310	*Drybotodes tenebrosa* Esp.	35	9	E	—
311	*Aporophyla lutulenta* Den. et Schiff.	40	7	E	—
312	*Orthosia incerta* Hfn.	37	11	BL	BL

No.	Scientific names of species	A	B	C	D
313	*Orthosia miniosa* Den. et Schiff.	33	8	BL	—
314	*Orthosia cerasi* Fabr.	37	9	BL	—
315	*Orthosia cruda* Den. et Schiff.	27	10	BL	—
316	*Orthosia populeti* Fabr.	37	4	E	—
317	*Orthosia gracilis* Den. et Schiff.	37	10	E	BL
318	*Orthosia opima* Hbn.	37	5	E	—
319	*Orthosia gothica* L.	32	11	E	—
320	*Anorthoa munda* Den. et Schiff.	41	9	BL	—
321	*Egira conspicillaris* L.	39	13	BL	BL
322	*Tholera cespitis* Den. et Schiff.	37	15	E	BL
323	*Tholera decimalis* Poda	38	21	E	BL
324	*Anarta trifolii* Hfn.	32	5	BL	BL
325	*Polia nebulosa* Hfn.	50	4	E	—
326	*Proxellus lepigone* Mschl.	28	20	E	BL
327	*Pachetra sagittigera* Hfn.	44	7	E	BL
328	*Lacanobia w-latinum* Hfn.	39	17	BL	BL
329	*Lacanobia thalassina* Hfn.	36	11	BL	BL
330	*Lacanobia suasa* Den. et Schiff.	34	22	E	BL
331	*Lacanobia oleracea* L.	34	22	BL	BL
332	*Sideritis albicolon* Hbn.	42	14	BL	E
333	*Sideritis reticulata* Goeze	34	9	E	E
334	*Melanchra persicariae* L.	38	4	BL	—
335	*Melanchra pisi* L.	34	10	E	BL
336	*Hada plebeja* L.	33	12	E	—
337	*Mamestra brassicae* L.	41	21	BL	BL
338	*Hecatera dysodea* Den. et Schiff.	33	9	BL	BL
339	*Harmodia bicruris* Hfn.	35	18	BL	BL
340	*Conisania luteago* Den. et Schiff.	38	20	E	E
341	*Hadena rivularis* Fabr.	28	11	BL	BL
342	*Hadula dianthi* Wagner	35	8	E	BL
343	*Harmodia perplexa* Den. et Schiff.	31	13	E	—
344	*Hyssia cavernosa* Ev.	31	10	E	—
345	*Mythimna turca* L.	41	8	BL	—
346	*Mythimna pudorina* Den. et Schiff.	36	4	E	—
347	*Mythimna pallens* L.	32	22	BL	BL
348	*Mythimna vitellina* Hbn.	39	10	BL	BL
349	*Mythimna ferrago* Fabr.	37	7	BL	BL
350	*Mythimna l-album* L.	32	21	BL	BL
351	*Leucania obsoleta* Hbn.	38	12	BL	BL
352	*Peridroma saucia* Hbn.	50	11	BL	BL

No.	Scientific names of species	A	B	C	D
353	*Euxoa obelisca* Tutt	37	11	BL	BL
354	*Euxoa temera* Hbn.	32	10	BL	BL
355	*Euxoa aquilina* Den. et Schiff.	35	10	E	—
356	*Agrotis cinerea* Den. et Schiff.	36	7	E	E
357	*Agrotis exclamationis* L.	35	22	BL	BL
358	*Agrotis segetum* Den. et Schiff.	33	22	BL	BL
359	*Agrotis vestigialis* Hfn.	32	4	E	—
360	*Agrotis ipsilon* Hfn.	42	22	BL	BL
361	*Agrotis crassa* Hbn.	44	18	BL	BL
362	*Axylia putris* L.	29	21	BL	BL
363	*Ochropleura plecta* L.	27	21	BL	BL
364	*Parexarnis fugax* Tr.	35	5	E	—
365	*Diarsia rubi* Vieweg	30	6	E	BL
366	*Cerastis rubricosa* Den. et Schiff.	35	9	E	—
367	*Noctua pronuba* L.	50	22	BL	BL
368	*Noctua fimbriata* Schreber	47	14	BL	BL
369	*Noctua comes* Hbn.	41	4	E	—
370	*Noctua janthina* Den. et Schiff.	35	6	BL	BL
371	*Spaelothis ravida* Den. et Schiff.	45	8	E	BL
372	*Xestia xanthographa* Den. et Schiff.	33	11	BL	BL
373	*Xestia c-nigrum* L.	38	22	BL	BL
374	*Xestia triangulum* Hfn.	41	15	BL	—
375	*Eugnorisma depuncta* L.	40	10	BL	—
Nolidae (Average of wingspan is 23.2 mm)					
376	*Meganola albula* Den. et Schiff.	21	5	E	—
377	*Nola aerugula* Hbn.	17	7	E	—
378	*Pseudoips prasinana* L.	36	15	BL	BL
379	*Nycteola asiatica* Kruilkovsky	23	15	BL	BL
380	*Earias clorana* L.	21	14	E	BL
381	*Earias vernana* Fabr.	21	11	E	BL

Notes *Macrolepidoptera species collected successfully by* V *Visible or* BL *black light traps*, E *equal* N *serial number*, A *Wingspan (mm)*, B *Network: Number of trap pairs*, C *Network: More efficient light source*, D *Nagytétény: More efficient light source.*

Table 1.
Macrolepidoptera species collected successfully by Visible or BL light-traps.

It is most remarkable, however, that the number of species for which the results of the national light-trap network could not detect a significant difference between BL and N traps was much smaller at Nagytétény where the BL trap was most frequently chosen by insects (**Figures 4–8**). So provided the moths are free to choose between traps placed extremely close to each other, they will fly to the BL trap. If the visible and BL traps are very close to each other, even the small moths

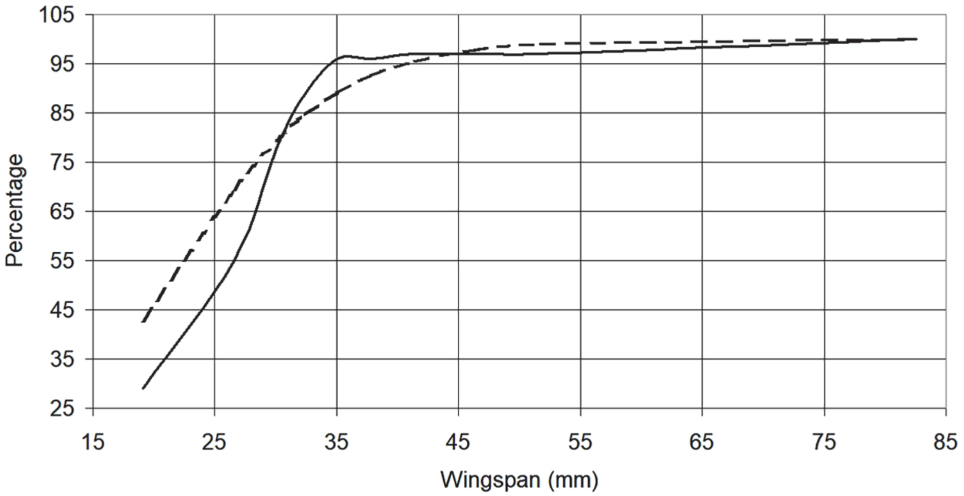

Figure 1.
Percentage of BL traps catch of macrolepidoptera species compared to the visible light ones in connection with the wingspan of moths (solid line = BL, dashed line = visible light).

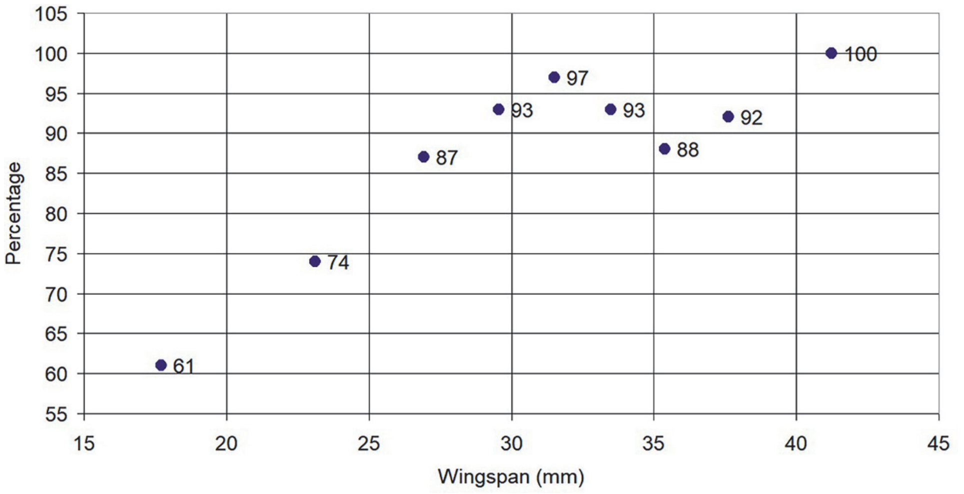

Figure 2.
Percentage of BL traps catch of macrolepidoptera species compared to the visible light ones in connection with the wingspan of moths (Nagytétény).

choose the BL traps en masse. However, such cases would be expected to be a random choice of the moths.

The fact that the highest number of moths with a wingspan greater than 35 mm, is in the BL traps, does not mean that these species cannot be collected with a visible bulb. However, it is clear that the visible or visible light source has low efficiency in collecting moths with wingspans greater than 35 mm. This result is noteworthy and can be used in plant protection and for another entomological research.

The light source of the trap should be chosen to suit our target species while bearing in mind their wingspan size.

The BL trap seems most efficient for operation for plant protecting purposes, despite the fact that their use is far more problematic.

Insect species are not only endangered by light trapping but also by the light pollution of urban areas. Our results confirm that the different light sources should

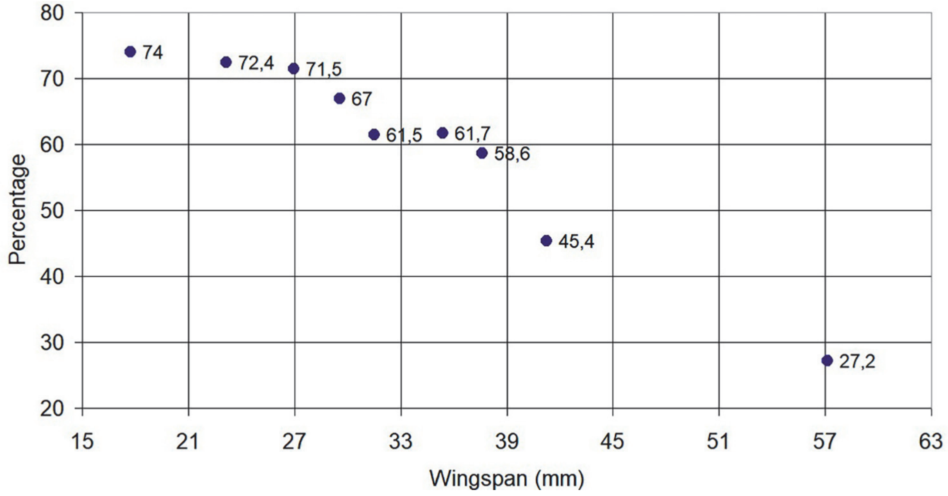

Figure 3.
Percentage of macrolepidoptera species caught by BL traps and visible light ones in connection with the wingspan of moths, if they select in equal proportion the two type light-traps.

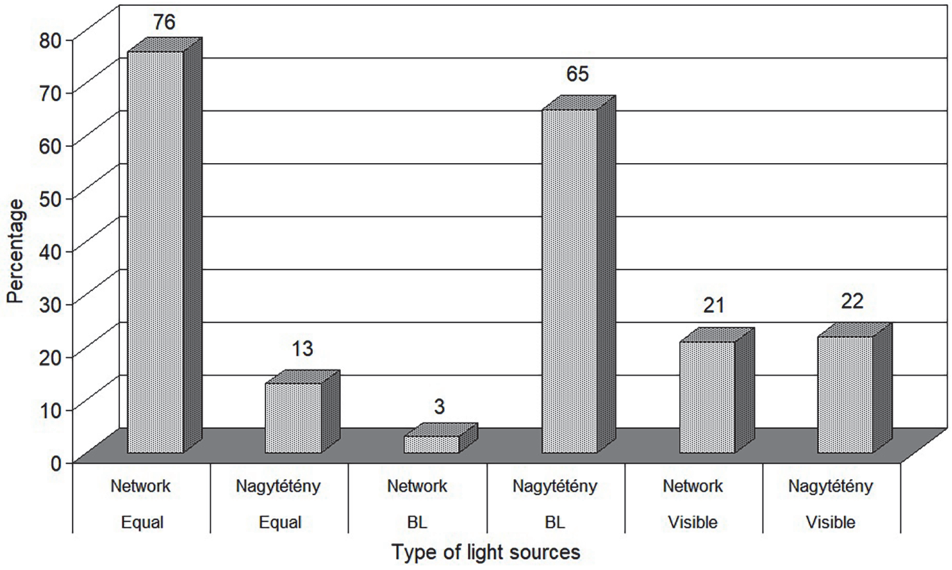

Figure 4.
Percentage of light-trap catch of Geometridae species by BL and visible light sources from data of the Hungarian light-trap network and Nagytétény.

incur mortality on different species to differing levels. Such differential mortality from artificial light sources could disturb the balance of life in biological communities. Kollings [52] established that there was a definite difference in the composition of the catch from two neighbouring street lamps. According to Frank [53], if some moth species are more attracted to light than others, the traits related to this attraction could help us to predict the effects of artificial light on communities of nocturnal species.

Light pollution might, in the future, expand to cover new areas. Some species may have populations more influenced by light pollution than others and some individuals might be more prone to it than others. This may generate a selective pressure to change behaviour. On the other hand, densely lit urban environments

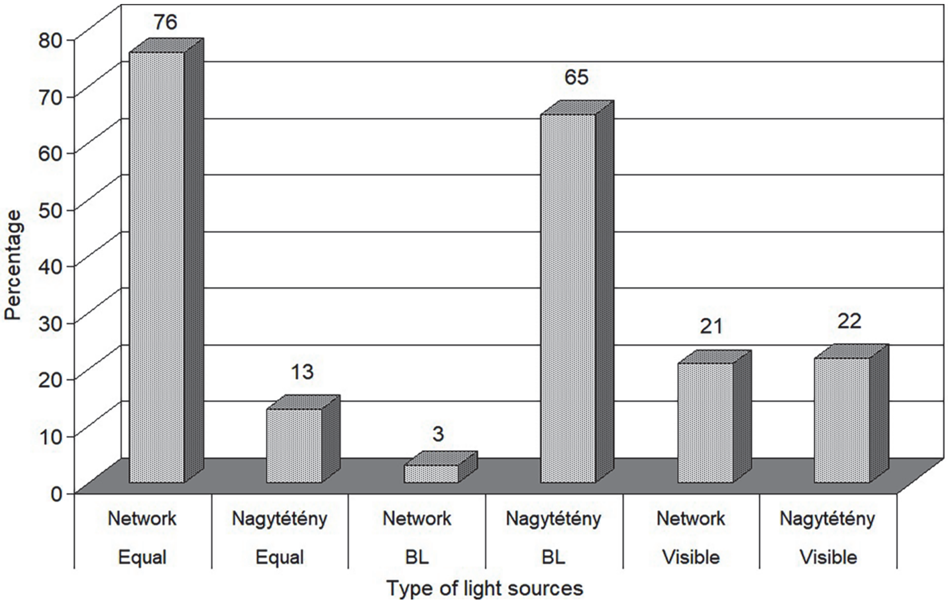

Figure 5.
Percentage of light-trap catch of Geometridae species by BL and visible light sources from data of the Hungarian light-trap network and Nagytétény.

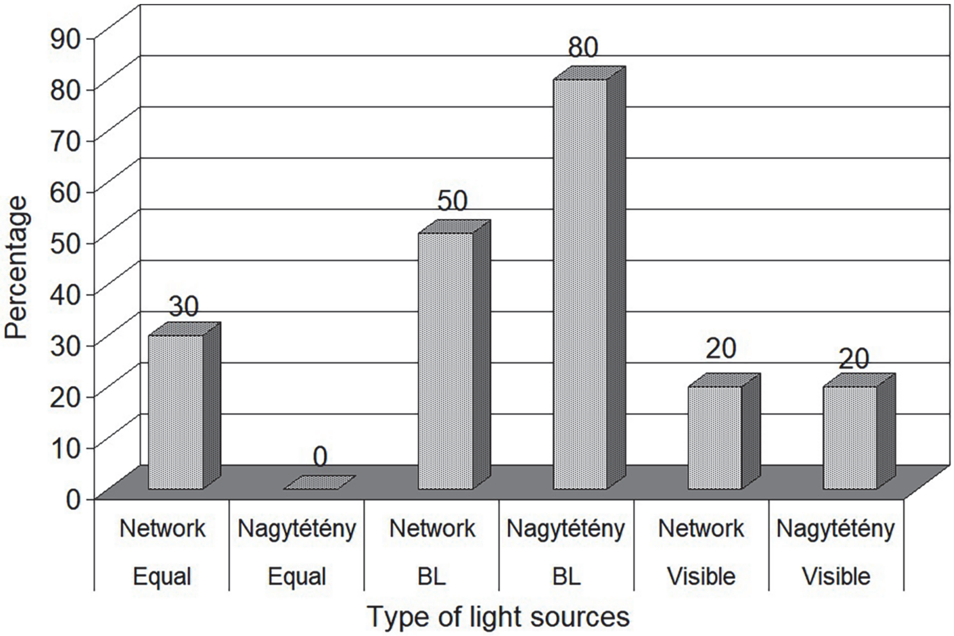

Figure 6.
Percentage of light-trap catch of Notodontidae species by BL and visible light sources from data of Hungarian light-trap network and Nagytétény.

may be advantageous for other species that fly by day or are not attracted to light. And there are also possibilities to solve the problem of light pollution. The use of low-pressure sodium lamps, for instance, may reduce the disturbing effects of illumination. These provoke a reaction of flying to light to a lesser extent than other

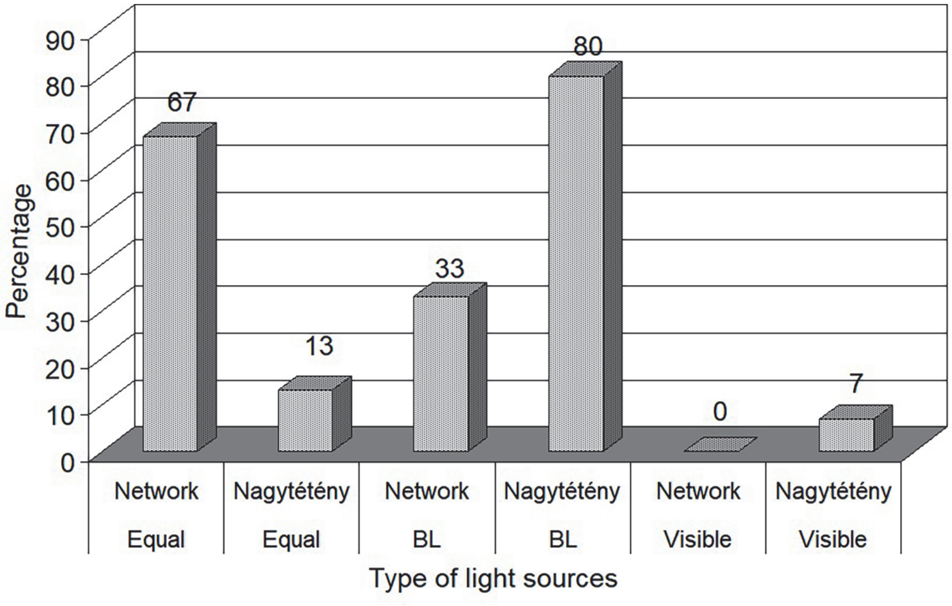

Figure 7.
Percentage of light-trap catch of Erebidae species by BL and visible light sources from the data of the Hungarian light-trap network and Nagytétény.

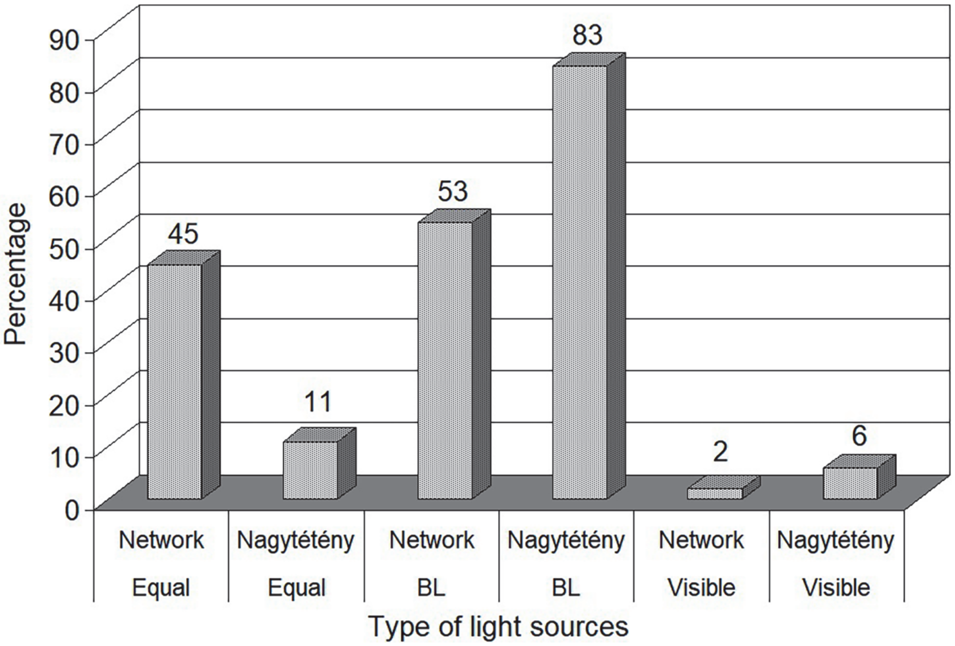

Figure 8.
Percentage of light-trap catch of Noctuidae species by BL and visible light sources from the data of the Hungarian light-trap network and Nagytétény.

lamps do. At the same time, they are also less likely to disturb the circadian rhythm of moths and other insects. These lamps also emit less energy than other lamps providing the same illumination. In an experiment by Eisenbeis and Hassel [54], the use of sodium vapour street lamps reduced the number of insects caught by 50%, including a 75% reduction in the number of moths.

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