Survey of Butterfly House Lighting: The Results

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Many IABE members have pondered the question of how to effectively use artificial lighting in their butterfly exhibit. What type of lights should I use? How many would we need? Will more light stimulate more butterfly activity? Will extra light increase nectar production in our exhibit plants? Can we make our short winter days longer?

In an effort to find out how many IABE exhibits are using artificial light, how much and what type, we sent out a survey to all members in the October 2005 issue of *International Flutterings*. We received responses from 29 facilities (8 of which do not use artificial light). The following results are based on the 21 facilities that do use artificial lighting.

Of the 21 facilities, 16 are located in North America, 4 in northern Europe and one in Australia. They vary from operating year round, to seasonally for just three months. The flight houses of the facilities range in size from 900 - 10,000 sq. feet (approximately 81-900 sq. meters). To find out why exhibits had gone to the effort and expense of installing lighting, facilities were asked to check all of their reasons for using artificial light.

Reasons for choosing to use/add artificial lighting

Reason	Number of Facilities
We do not have any natural light	3
We host evening events	11
We want to increase day length for the plants and/or stimulate nectar production	8
We use artificial light seasonally	4
We want to stimulate butterfly activity or flight on cloudy days	14
We want to stimulate butterfly activity or flight on short days (Winter)	10
We use lights for maintenance before/after hours	10
We light up the conservatory at night for marketing purposes	6

Magic Wings at the Museum of Life and Science, Durham, North Carolina
Photo: Rick Alexander

The most common reason to add artificial light is stimulating butterfly activity or flight on dull or cloudy days. For the 18 facilities with natural light, 14, or just over 75%, feel the need to add supplemental lighting to boost

activity when it is cloudy. Three of the responding facilities are closed during the winter months, which could explain the lower than expected response to using lights to stimulate activity or flight on short days. Although not on the original survey sheet, 1 facility responded that they use lights to illuminate their 24-hour web cam.

Facilities were asked about the type of lighting they use and the number and wattage of the lights.

Type of artificial/supplemental lights used

Type	Number of Facilities
Metal Halide	15
Fluorescent	6
Grow Lights	0
Halogen Spot or Flood Light	2
High Pressure Sodium	1
Sodium Vapor	1
Incandescent	2

Metal Halide Lighting at the American Museum of Natural History, New York
Photo: Hazel Davies

The most commonly used light is metal halide, either as the sole type of supplemental light, or in conjunction with other types. There are 15 facilities that use only one type of artificial lighting: 9 use metal halide, 2 use halogen spot and/or flood, 1 uses incandescent and 3 use fluorescent. The remaining 6 facilities use a combination of two types of lights; 3 use fluorescent with metal halide, 1 uses sodium vapor with metal halide, 1 uses high pressure sodium with metal halide and 1 uses incandescent with metal halide.

Analyzed below are 17 facilities, 14 of which responded that they supplement artificial light to stimulate butterfly activity levels and 3 facilities that have no natural light, therefore relying entirely on artificial light for butterfly activity. The type and amount of artificial light is compared to the floor area of the flight house to give an indication of the amount of supplemental wattage per square foot/meter.

Metal Halide Lights Only

Facility	Size Sq. Feet / Sq. Meters	Number and Total Wattage of Lights
1*	1,200 / 108	12 x1000W, 3 x 400W, 8 x 100W = 14,000W
2	1,000 / 90	8 x 400W = 3200W
3	6,000 / 540	24 x 400W = 9,600W
4	10,000 / 900	100 x 1000W = 100,000W
5	2,200 / 198	11 x 1000 = 11,000W
6	1,296 / 117	9 x 1000W = 9,000W
7	4,800 / 432	24 x 1000 = 24,000W
8	4000/360	25 x 1000 = 25,000W

* Facility with NO natural light

Fluorescent Lights Only

Facility	Size Sq. Feet / Sq. Meters	Number and Total Wattage of Lights
9	1670 / 150	24 x 33/36W = 828W
10*	1000 / 90	21 x 300W = 6300W
11	6,000 / 540	16 x 100W = 1600W

* Facility with NO natural light

Living Jewels at the Smithsonian, Washington D.C.
Photo: Mark Hardin

Metal Halide Lights at the Pacific Science Center, Seattle
Photo: Hazel Davies

Halogen Lights Only

Facility	Size Sq. Feet / Sq. Meters	Number and Wattage of Lights
12	7,600 / 684	1 x 90W = 90W

Mixed Lighting

Facility	Size Sq. Feet / Sq. Meters	Number, Type and Wattage of Lights
13	8000 / 720	7 metal halide & 7 sodium vapor
14	1,600 / 144	40 metal halide & 18 high pressure sodium
15*	900 / 81	10 x 1000W metal halide & 20 fluorescent
16	2,500 / 225	36 x 100W metal halide & 4 fluorescent
17	3,100 / 280	10 x 400W metal halide & 8 fluorescent

* Facility with NO natural light

Only 5 of the 21 facilities have adjusted their butterfly species list due to lighting conditions. The main species noted as not flying well in low light are Pieridae and some Papilionidae and several facilities have either greatly reduced their numbers, or stopped

flying them at all. Other facilities also noted that they have stopped flying *Anartia*, *Agraulis*, *Consul* and *Historis* since they demand high light levels. However, many facilities noted that *Caligo, Morpho, Idea* and *Heliconius* flew consistently well in lower light.

The response was similar for plant species, with approximately 75% of the facilities not making any adjustments to their plant list due to the amount of available light. Several facilities made suggestions about the plants they observed grew and bloomed successfully in lower light conditions or plants they found did not do well and had to be reduced or removed.

Plants Found To Do Well In Lower Light Conditions	**Plants Found To Do Poorly In Lower Light Conditions**
Bidens pilosa	*Bursera simaruba*
Bougainvillea spp.	*Cereus peruviana*
Calathea warscewiczii	*Cuphea* spp.
Cecropia spp.	*Gliricidia sepium*
Cordia boissieri	*Lantana* spp.
Cordia sebestena	
Dioscorea spp.	
Eupetorium spp.	
Hamelia patens	
Heliotropium steudneri	
Hymanea spp.	
Ixora spp.	
Jatropha spp.	
Pachystachys lutea	
Pentas lanceolata	
Stachytarpheta spp.	
Senecio confusus	
Spathyphylum	
Verbesina virginica	
Yucca spp.	

Nectar plants located directly under light sources at American Museum of Natural History, New York
Photo: Hazel Davies

Some exhibits found that swapping out or replacing nectar plants periodically helped maintain a more consistent nectar supply for the butterflies, while others recommend regular deadheading, pruning and fertilizing to stimulate blooming. Another approach is to adjust the placement of nectar plants to

maximize their exposure to light. Flowering plants can be grouped directly under the best light sources, either natural or artificial, to provide better growth and nectar production, thus producing ‘meadows’ of flowering plants between areas of foliage vegetation where the light levels are lower. Also, staff at one facility suggested that hand watering plants provides a good opportunity to carefully inspect for pests. By doing so it is possible to eliminate some types by directly spraying the pests forcefully with water.

More than half of the facilities, 62%, provide artificial nectar to supplement that available from flowering plants. All 13 did this consistently throughout the year, not just seasonally; interestingly one facility found they needed to top up the artificial feeders twice as often during the winter. Many facilities also provide rotting fruit, such as oranges, bananas and melon.

Caterpillar Flight School at San Antonio Zoo, Texas
Photo: Martin Feather

The staff at several facilities made some additional comments of things to keep in mind when choosing and designing supplemental lighting for a butterfly flight house. A real priority is that the lights should be easily accessible for routine maintenance. It is helpful to have manual control of the fixtures allowing each one to be turned on or off individually for maintenance or special events. However, timers are a good way to allow the lights to dim or turn off in sequence to simulate dawn and dusk for the butterflies. A simulated dusk is especially helpful to allow the butterflies to find time to roost for the night. The light fixtures should be recessed or structured in such a way that the butterflies do not damage themselves and they need to be properly sealed to prevent butterflies getting stuck inside and to avoid infestation.

It is difficult to determine to what extent artificial lighting affects butterfly activity. The staff at one facility suggested that halogen light does not appear to help stimulate flight and that possibly the butterflies can detect cloudy or rainy weather outside, by polarization and barometric pressure. However, it would seem that artificial light could serve to increase activity on dull days or lengthen the flight period on short winter days, since there are exhibits with no natural light, where the butterflies fly and feed very well. The amount of light is a consideration, but the temperature and humidity within the flight house also needs to be carefully monitored. One facility found that increasing the heat on excessively cloudy days encouraged some species to fly and feed. Another noted that high humidity stimulated flight and feeding in *Morpho* and *Idea*.

Coff's Harbour Butterfly House, New South Wales, Australia Photo: Fiona Barden

If butterflies are not very active there are several ways to help visitors get more out of their conservatory experience. Many facilities already employ staff or volunteers to work in the flight house answering visitor questions. In addition to interpreting larvae or pupae displays, the docents can be trained to locate and point out roosting butterflies, perhaps finding species of particular interest to the visitor. Fruit feeding species, especially *Caligo*, are great for staff to hand feed with an orange slice, thus allowing the visitor a chance for a close up photo opportunity or eye to eye viewing with a magnifying glass. Depending on the ceiling height of the flight house, or the height of the trees, a soft ostrich feather on a long lightweight pole is good for 'tickling' roosting butterflies, persuading them to fly and perhaps feed. Another facility always tries to keep a pair of male *Morpho* butterflies in the exhibit at all times, as their aggressive territorial chasing often serves to stir up other roosting butterflies stimulating them to fly as well.

This survey merely scratches the surface on the issue of lighting in butterfly houses and is really just the beginning in trying to address the questions and concerns most exhibitors have when deciding whether or not to add artificial light to their conservatory. Hopefully the results and suggestions here will stimulate discussion between facilities, paving the way for further investigation. There is definitely a lot more to learn and analyze on how butterfly flight levels are related to and affected by lighting conditions.

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