Why Moths and Other Insects are Attracted to Artificial Light

(taken from the Lepidoptorist Society)

In studies done on the sensitivity of moth optical neurons to light, they are found to have an extremely low threshold, meaning that even very low levels of light will allow the moths to "see." Not necessarily see sharply, but undoubtedly enough to avoid large (dark) objects. All organisms need to be able to orient themselves/navigate within their environment in relation to other objects (foodplants, mates, finding shelter, etc.).

Finding foodplants and mates for moths flying at night is probably done mostly using chemical cues. However, when just "cruising" moths need cues that will allow them to maintain appropriate orientation to surrounding objects, the ground, etc., and one of the cues that is consistent for moths is that light sources (back before the advent of human-made light sources) were predictably"UP" (in the sky). The moon is not always at a consistent angle upward in the sky, but it *is* always up, as are the stars.

And, by the way, some moths do migrate, needing some cues to direct them. Some noctuid moths migrate using the moon as a primary reference point. To calibrate the location in the sky with actual geographical direction, they periodically use an internal geomagnetic compass. In fact, every hour, they alter their flight path by 16 degrees to correct for travel of the moon across the sky (for purists, rotation of the earth). On moonless nights they navigate solely by the geomagnetic compass. I guess using the moon is 'easier', and therefore they 'prefer' that when it is visible; hence the screwup when artificial bright lights are visible.

The observation that moths *appear to* (see below) fly more strongly on humid, cloudy nights is also well documented, but to say that it doesn't make much sense therefore that they would use lights as a navigational cue doesn't follow. Most animals have *more than one* way to navigate through their environment, and just because they don't necessarily use one all the time doesn't mean they *can't*. (Moths *do* have functional eyes, after all!) The point? Moths undoubtedly can use lights as a navigational cue, and along with gravitational cues, use the light sources from above to maintain appropriate "up-down" orientation in their environment.

So, why do moths come to artificial lights? The use of moon and stars as navigational cues can at least partly explain why moths end up at lights. Since at least some moths attempt to maintain a certain angle between themselves and natural light sources, this would explain the phenomenon of "spiralling in" that is easily observable in many species as they come to artificial lights.

The reason why they stay at the lights after hitting the "moon," an accomplishment they never evolved a decent response to, is likely to be as follows. Now close to the bright light source, the artificial "moon" has become the "sun", and the moths settle down . . . for their daytime "sleep."

Using night-time celestial light sources as navigational cues would also be a convenient explanation as to why it appears that fewer moths come to lights on well moonlit nights. Full moonlight overwhelms the typical artificial electric light sources. On a cloudy night, it therefore may *appear* that there is more activity at artificial light sources, though cloudy nights also tend to be warmer and more humid, which may have more of an effect.

However, this is certainly not the entire story. Many, many moths, if you watch them come to light, fly *directly* at the light source as they come in, with little indication of any spiral. There is a likely explanation

for this as well. If you rear butterflies or moths indoors and the adults escape from confinement, they fly straight to the window, or if no windows, or at night, they go straight to the ceiling lights. To me this means that Lepidoptera use light not only for navigation but as an escape route from confined spaces, or possibly darting though an opening in the forest canopy in escape, or may go into the same escape mode when startled or confused. Certainly, at night, in a dark wooded area, the *lightest* points in the visual background would be those passageways through the branches open to the night sky, and therefore indicating a clear flight path. This probably explains why when at night you walk through surrounding vegetation and stir things up the moths head straight for the light, as does the occasional butterfly. So it is likely that both navigation and an escape reaction are at work in bringing moths to lights.

One last little tidbit. Some have said that moths might hear vibrations from an artificial light source and come to the light based on perceiving that sound. This *might* be a possibility, but there are three things that suggest this is not a likely mechanism. First, it is incredibly unlikely that white light bulbs and white light bulbs painted yellow emit significantly different sound impulses, and so this would not explain why moths come in to different colored lights in significantly different numbers. Second, there are some families of moths that, in essence, have *no* hearing capabilities whatsoever (for instance, the Saturniidae [e.g. *Polyphemus*, *Cecropia*, *Io*, *Imperial*, etc.]). So if sound was the reason, saturniids and some other moths would never come to lights, and this is certainly not the case. Lastly, and perhaps most importantly, there would have to be some reason why the sound is *meaningful* to the moths. Only a small subset of moths actually use any kind of acoustic communication, so for the majority of moths, sounds at night are likely to indicate danger (flee!) as opposed to some sort of attraction.

(The Lepidopterists' Society)