Intelligent Design and Evolution Awareness Center

# Hawkmoth Defense Mechanisms: A Case Study in an Unevolvable Irreducibly Complex System

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Long ago in some forests far far away, evolutionists allege that "ultrastonic hearing has evolved at least twice independently in two distantly related subtribes"[1] of hawkmoths. These two moths, though distantly related, have "hearing organs [which] evolved independently" and "are made up not only of homologous mouthparts but also of homologous sensory structures."[1] Besides being of interest as simply yet another example of 'extreme convergence' of structure in unrelated organisms, this auditory sensory system of hawkmoths is completely unevolvable and bears the marks of intelligent design.

Hawkmoths are predated by bats which use sonar to echolocate their insect prey at night. Lunky flying usually moths provide a quick snack for these bats, however some moths, such as those of the hawkmoth subfamilies Acherontiina and Choerocampina, have the ability to "hear" the high frequency sonar sounds emitted by the bats and respond.

Now before this text begins to read like a script from Animal Planet, we need to know why this is special. The parts are complex specialized to hear and trigger specific flight responses dependent on sonar frequency. The parts include:
1. Specialized hearing cells and "ears".
2. A nerve which returns the audio signal back to the brain.
3. Brain structures which then process the signal and then initiate appropriate and effective evasive flight patterns.

As it turns out, the evasive flight maneuvers are very complex. Hearing the sonar triggers defensive maneuvers to evade the bat which are based upon the frequency of the emitted sonar sound. If the bat emits sonar of a low frequency the moth typically will fly away from the directional source[3] or do an upward spiral to confuse the bat. However, higher frequency sonar, which indicates a bat is closing in close and fast, trigger a "drop dead" response, where the moth simply stops flying and does a nosedive[3, 5].

However, on their own, these parts are of little value. A special "upward spin" or "nosedive" defense maneuver is useless unless the moth knows when to do it. The ears consist special hearing cells and organs which themselves are very complex and finely tuned to react to various sound frequencies. These hearing apparati are found either on the face[1, 2] or on the waste of the moth[5]. They are useless without the nerve to carry the signal back to the brain, and without appropriate flight response. In fact, by some mechanism not yet understood by biologists, this system allows the moth to even localize the spatial location of the incoming bat and react to evade it[5]. The nerve on its own is also useless without the appropriate stimulus organs and brain programming. So, we basically have an irreducibly complex system--the hearing organs, the nerve, and the brain structures, which is unevolvable in a step-by-step manner.

If any of these parts were missing, then the system would not function. The parts on their own would be of no use without the entire system:
1. The hearing organs, which require multiple interacting organs and cells and are quite possible irreducibly complex in-and-of-themselves[2, 4, 5], would be useless without the nerve. The nerve + hearing-organ system would be useless without the appropriate defense flight response. This portion of the system must also be able to spatially identify the bat's location.
2. The defense flight response is useless unless it is properly triggered, which requires the hearing organ and the nerve.
3. The nerve might have pre-existed in the body, but it had to somehow properly route itself from the single

hearing reception cell in the hearing organ[2] back to the right part of the brain to elicit the proper response.

There is no way this system can function unless all the parts are present, and the parts themselves are useless apart from the system. This is truly an unevolvable irreducibly complex system.

**References Cited:**

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