ScienceWatch – Keeping One Eye Open

"The relatively brief but frequent daytime sleep states ('micro-naps') may represent an adaptive balance that enables migratory birds to compensate for extended periods of nocturnal sleep loss during the subsequent day without rendering them entirely vulnerable to environmental challenges like predation …" — T. Fuchs

Its migration time and millions of Neotropical passerines are heading north. Many of these tiny warblers, thrushes and sparrows fly thousands of miles, and they do it at night when the weather is calmer and fewer predators are out. Each night they may fly for 8-10 hours and when they land we see them greedily "refueling". In fact, they move around so much it's often hard to get a good look at them. So when do they sleep?

The answer, presented in two studies by Thomas Fuchs, University of Pittsburg, Johnstown, PA, and colleagues, is that migratory birds compensate for loss of nocturnal sleep with brief episodes of daytime sleep.

The first study, published in the July 31, 2006 issue of *Animal Behavior*, showed that Swainson's thrushes (*Catharus ustulatus*), which fly up to 5,000 km (3,000 mi) from Central and South America to their breeding grounds in Alaska and Canada, take daytime "micro-naps" lasting several seconds during the migration season. The second, published online in *Biology Letters,* November, 2008, reveals a remarkable finding: during micro-naps only half the brain sleeps so one eye can remain open.

In the first study the team observed the behavior of 12 captive thrushes that were kept in an artificial light:dark cycle that mimicked the normal day:night changes they experience throughout the year. Infrared camcorders monitored the birds' activity during "migratory" (spring and autumn), and "non-migratory" (summer and winter) periods.

The scientists found that when the birds were in a migratory state, they reversed their activity cycle, resting during the day and becoming active at night. As a result daytime "drowsiness" (eyes partially closed) increased, but total sleep time dropped by 67% as compared to birds in the non-migratory state. To partially compensate for this sleep loss migratory birds took daytime micro-naps with one or both eyes closed. These episodes occurred during periods of drowsiness and lasted about eight seconds each. The team suspected that unilateral eye closure (UEC) during the micro-naps allowed one brain hemisphere to sleep while the other stayed awake to avoid predation, and they tested this in the next study.

Seven captive Swainson's thrushes were implanted with electrodes in each brain hemisphere to monitor brain activity and eye movements. Video recordings were used to match brain activity with the type of daytime sleep occurring in the "migratory" season.

Micro-nap episodes with UEC lasted an average of 11 seconds and showed differences in brain activity between the two hemispheres. During UEC the brain hemisphere opposite the closed eye showed the slow-wave "delta" pattern typically observed for both hemispheres during nocturnal deep sleep in the "non-migratory" season. Delta brain waves are also seen in mammals during deep sleep. In both birds and mammals, as in other vertebrates, much of the visual information from each eye crosses over in the brain and is recorded in the opposite hemisphere. However, unlike mammals, the separation of brain hemispheres in birds is almost complete so closing one eye blocks most of the visual information to the opposite hemisphere, allowing half the brain to go into deep sleep.

Clearly the thrushes have evolved the ability to cope with nighttime sleep loss during migration by alternately resting one half of the brain during the day while keeping one eye open for danger.

UEC has also been observed in ducks, whales and dolphins, indicating it may be more widespread across the animal kingdom. Perhaps humans exhibit some form of UEC too. I recommend testing college students during exam time and security guards at night.

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