

## **Wing-Damage Index Used for Characterizing Wing Condition of Bats Affected by White-nose Syndrome**

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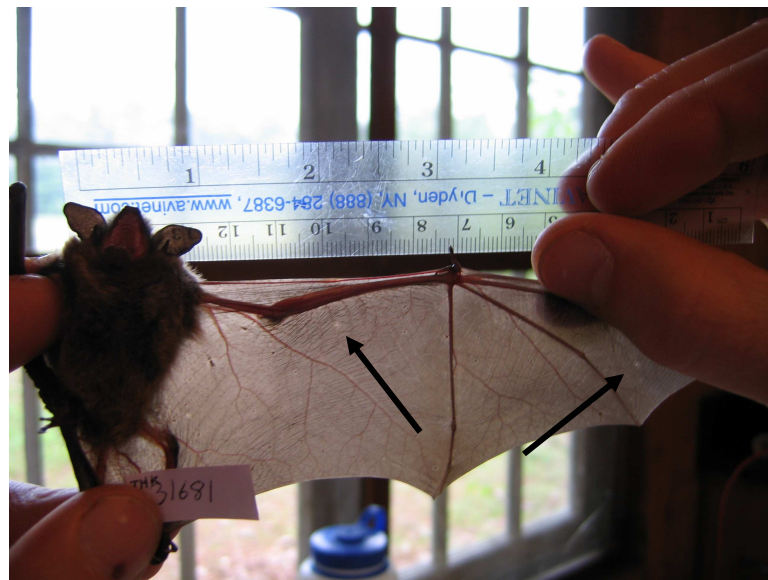
White-nose Syndrome (WNS) is characterized by the growth of one or more species of fungus on the rostrum, ears, and flight membranes of hibernating bats. During the warm months of the year, damage to these membranes may be manifested by the appearance of necrotic tissue, tears, and scars in these membranes. To assess the occurrence and severity of damage to flight membranes, researchers authorized to handle bats should inspect the membranes of both wings and the uropatagium for each bat handled. Each bat is assigned a single score based on the collective condition of these membranes as described below. Affected membrane areas are estimated as the percent of the total membrane area (including both wings and the uropatagium). Translumination of membranes helps to reveal damage that is not otherwise visible. Damage also has been observed on the forearms of some bats and has been included in these scoring criteria. A general diagram of bat anatomy is included in Appendix A for reference.

The damage to membranes and the forearms are scored 0 (none) to 3 (high) according to the criteria listed below and digital photographs are taken to document any damage. Each photograph should include a **reference scale** and the **bat ID number** (specimen number if collected dead or band or ID number if alive and released). Place the **animal on its back on a flat surface with wings and leg extended**. Record images of both wings and the uropatagium either simultaneously or individually. This is best accomplished if one person grasps the tips of the wings and spreads them fully, while a second person extends the bat's legs and uropatagium with one hand and takes the photo with the other. Alternatively, each wing and the uropatagium can be photographed separately, making sure that each photo includes the reference scale and ID number. You may need to experiment with camera settings to achieve quality images; we have had success recording images of flight membranes using a Canon PowerShot A95 (5 MP) digital camera against a white background using the Macro setting, a low intensity, built-in flash, F7.0, shutter speed = 1/800. These settings highlight some of the pspotching and all of the necrosis and holes described below. If possible, translumination may highlight more scarring, but this may be difficult in the field. For translumination, we have used a modified Plano Stowaway tackle box insert (translucent white plastic box) with an LED headlamp inside (see Appendix B). If digital images cannot be recorded, sketches of damaged wings will be helpful.

**Scoring Criteria:**

Each bat is assigned the score for which it exhibits one or a combination of the characteristics designated to that score. Some minor physical damage may be normal. See notes on physical damage not associated with necrosis at the end of this document.

**Score = 0** *No damage.* Fewer than 5 small scar spots are present on the membranes. The membranes are fully intact and pigmentation is normal.

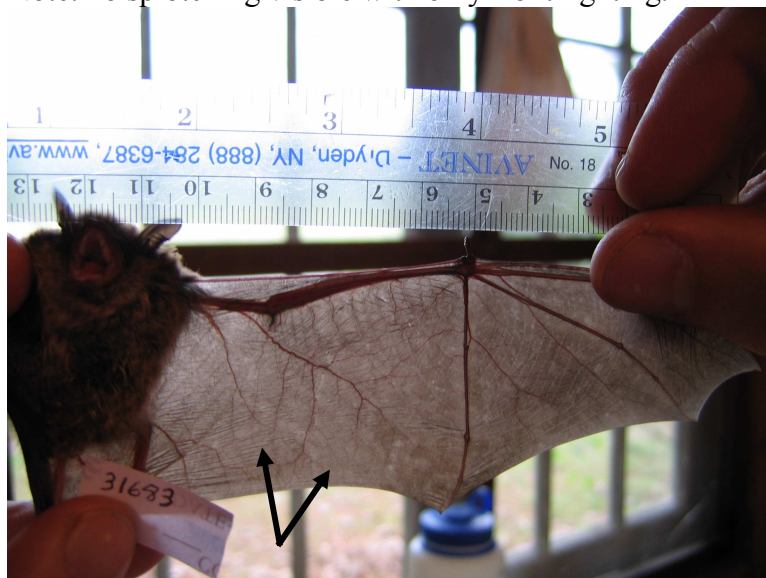


**Score = 1**

*Light damage.* Less than 50% of flight membrane is depigmented (spotching), which is often visible only with translumination. The membranes are entirely intact. Some discoloration or flaking is visible on forearms. Such flaking on the forearm may exist even if the patagium appears unaffected.



Note: no spotching visible with only front lighting.



Translumination reveals the splotchy flight membrane.



Forearms may have flaking skin or discolored areas.





**Score = 2** *Moderate damage.* Greater than 50% of wing membrane covered with scar tissue (splotching). Scarring is visible without translumination. Membrane exhibits some necrotic tissue and possibly few small holes (<0.5 cm diameter). Forearm skin may be flaking and discolored along the majority of the forearm, but this condition alone *does not* earn this score level.

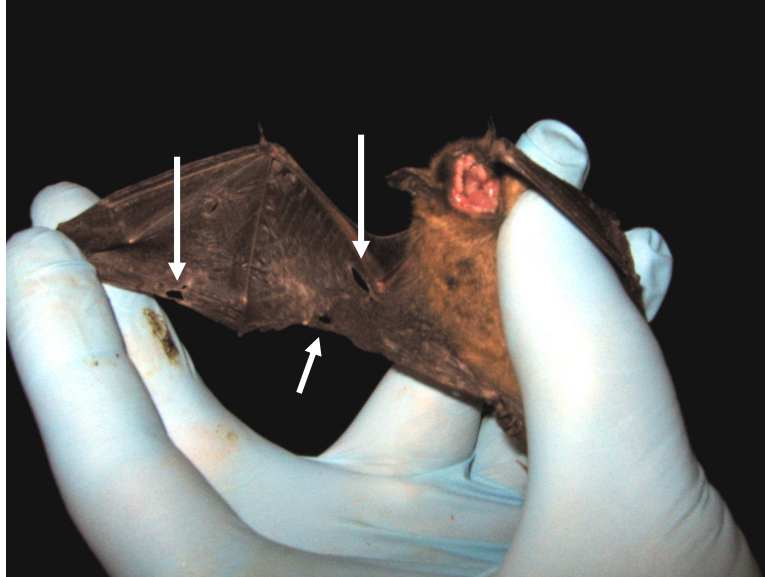


Small holes are surrounded by discolored tissue. Necrotic tissue is sometimes associated with less severe splotching.



**Score = 3**

*Heavy damage.* Deteriorated wing membrane and necrotic tissue. Isolated holes  $\geq 0.5$  cm are present in membranes. Necrotic or **receding plagiopatagium** and/or chiropatagium are evident. This score is characterized by notable loss of membrane area and abundant necrosis.



Flight membranes show damage similar to level 2 damage with additional loss of flight membrane area due to holes and/or receding edges of the wings.





Plagiopatagium loss may be severe.

## Physical Damage

We have encountered bats that have obvious physical damage to wings, but no associated splotching or necrotic tissue. These conditions are important to document as well. We suggest these be recorded in concordance with the above scores followed by a postscript “P” for “physical damage.” For example, an animal which has no noticeable splotching or flaking, but does have a tear in the wing membrane would be scored “0-P.” An animal that has moderate splotching and a tear or puncture would be scored “2-P.” Along with these scores, a description of the physical damage should be included on the data sheet.

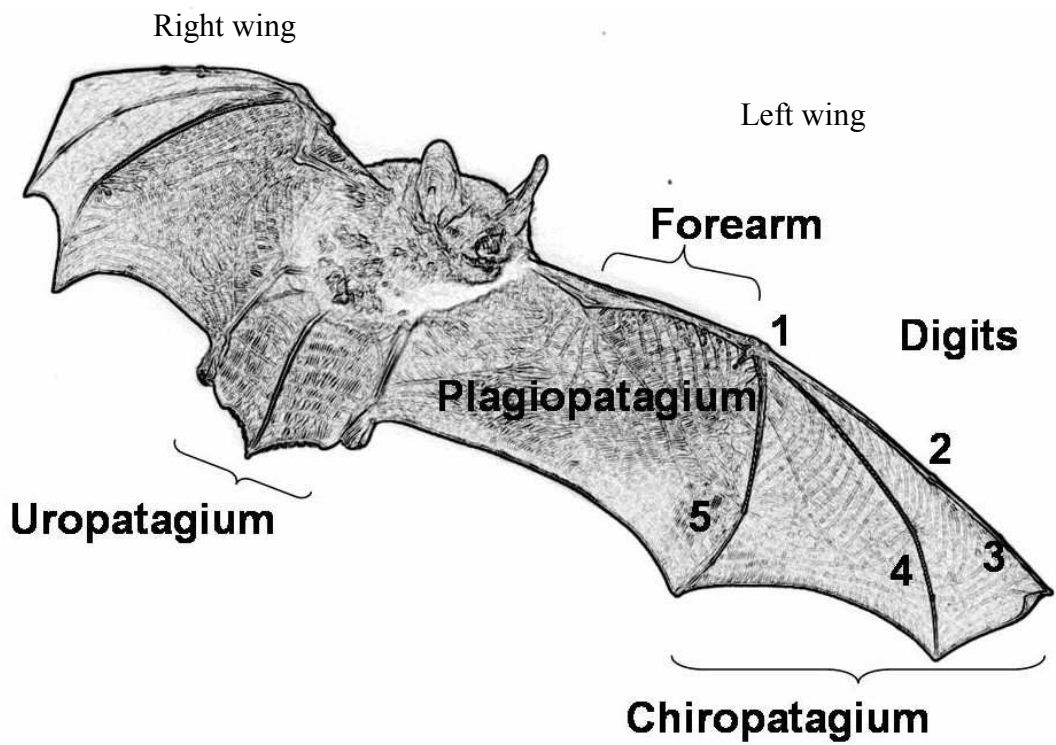


Example: **Score = 1-P** due to light splotching (not shown in photo) and a physical tear in the membrane. **Description:** Right plagiopatagium appears to have torn from trailing edge of the membrane to about 1

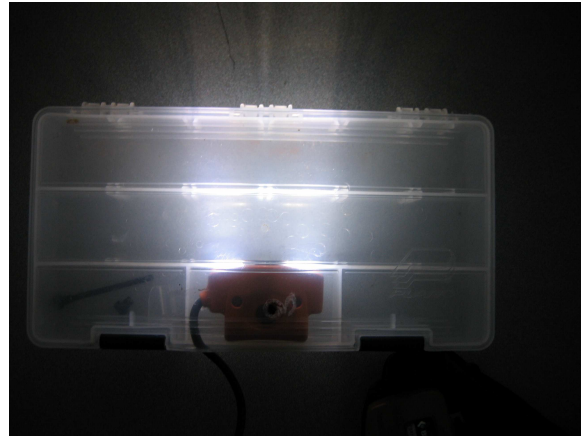
cm proximal to the elbow.



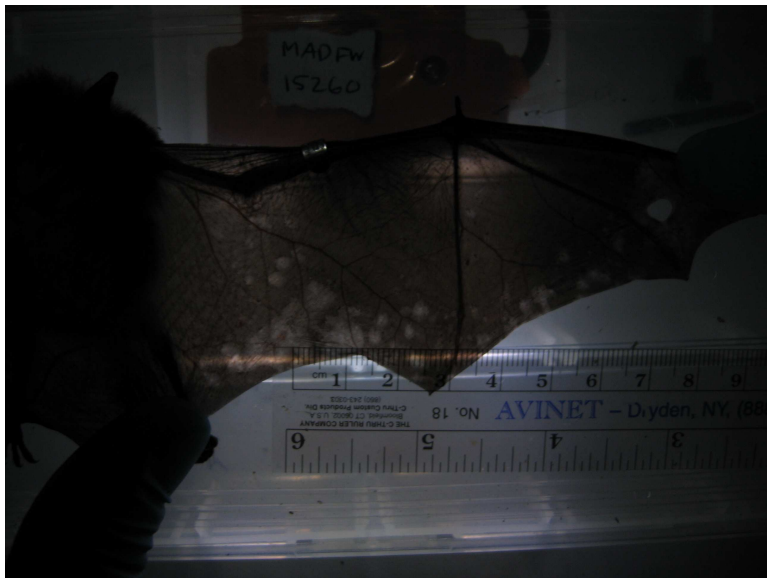
Appendix A: Reference for flight membranes and digits of bats. Image adapted from J. S. Altenbach's photograph of *Myotis thysanodes*.



**Appendix B:** We are working with an inexpensive light box in the field. The following model is an early effort to create an inexpensive, transportable light box for transluminating wings. The Plano Stowaway tacklebox insert (~\$3.00) is a good size and the headlamp in this model may be replaced with small LED keychain lights (~\$3.00 each).



The 23 cm x 12 cm tackle box insert is cut to fit the light of a headlamp, creating a diffuse light source.



In this model, images are a bit underexposed, but splotching is highlighted nicely. Brighter lights or more LEDs may solve this problem and a tripod would allow for slower shutter speed. This image was taken using F2.8, shutter speed = 1/30.