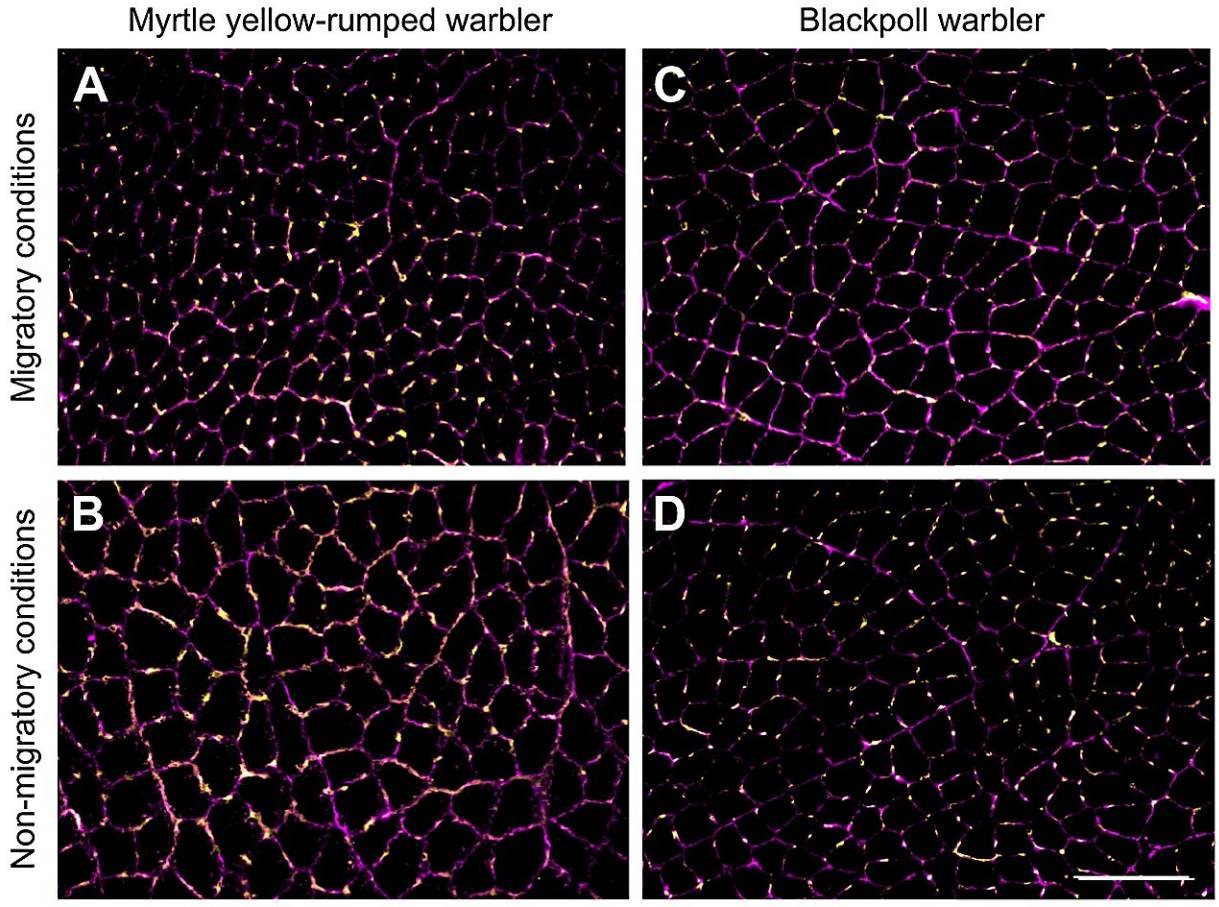
Migratory songbirds found to change breathing patterns to fly at high altitude

September 6 2023, by Jeff Renaud



Representative images of the pectoralis muscle of myrtle yellow-rumped warblers and blackpoll warblers during autumn migration and non-migratory conditions. Fluorescence immunohistochemistry was used to identify muscle boundaries (laminin, in magenta) and capillaries (Griffonia simplicifolia lectin 1, in yellow). Scale bar: 100 μm. Credit: *Journal of Experimental Biology* (2023).

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Climate change has become a climate catastrophe, say researchers. Earth, water, fire and wind are fighting back and everyone and everything is affected. And that includes the world's bird population.

New research from Western University's Advanced Facility for Avian Research (AFAR) is the first to show that birds adjust their physiology during the migratory season to maintain oxygen uptake and movement to flight muscles, with some species exhibiting greater adjustments than others.

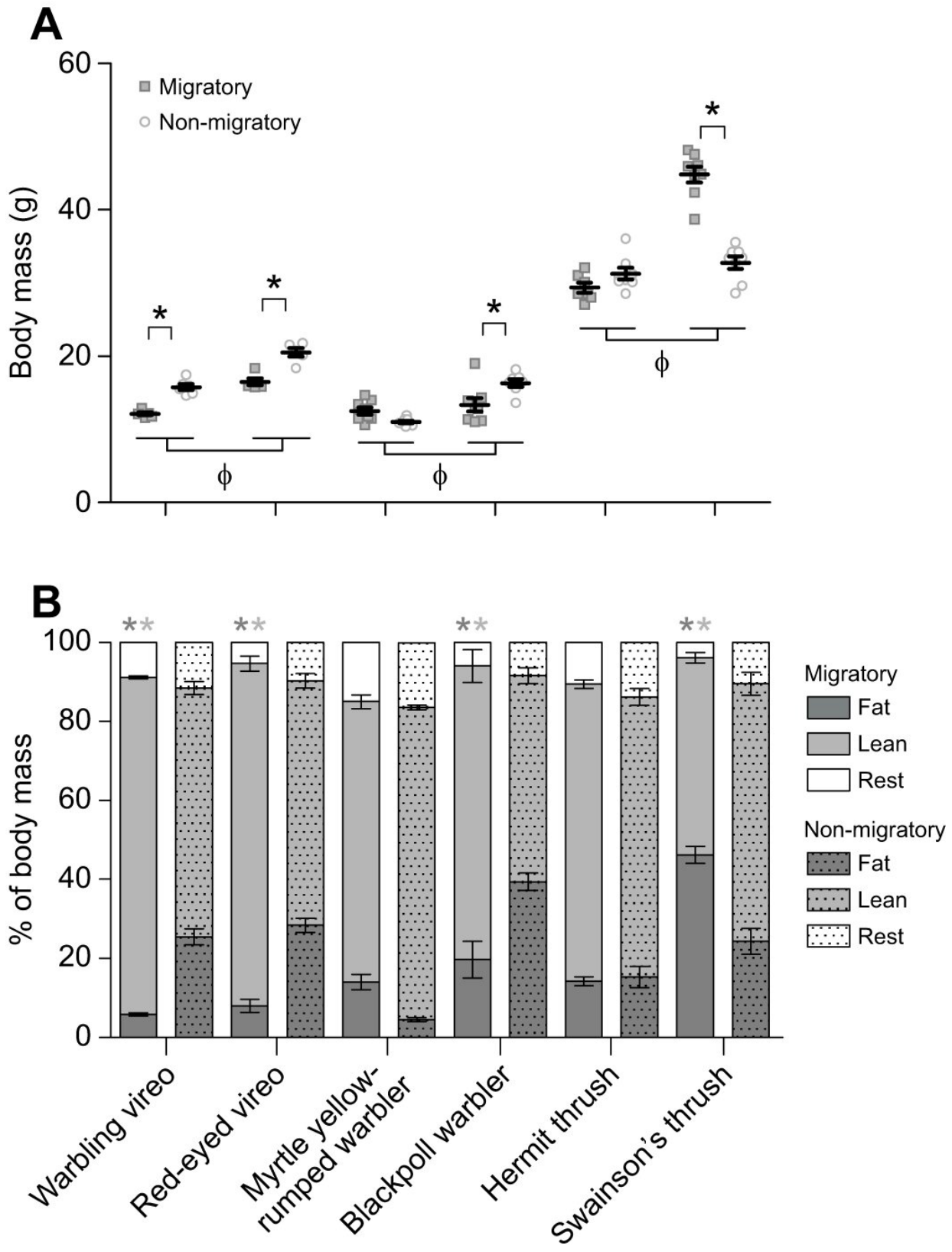
Migration, the regular seasonal movement between breeding and wintering grounds, is greatly affected by climate change (specifically global warming) as birds are forced to encounter and endure changing temperatures, changing humidity, changing altitudes and potentially wildfire smoke to stay cool during flight.

The remarkable modification in breathing pattern, blood-oxygen binding and flight muscle morphology allows the songbirds to fly at much higher altitudes during long distance flights—as much as 4,000 meters (approximately half the cruising altitude of a commercial jet) above sea level—allowing them to avoid major shifts in temperatures and weather patterns caused by climate change.

"Climate change is going to continue heating up the environment and birds need to fly so they can migrate and breed," said AFAR co-director Chris Guglielmo and senior author on the study. "This study shows they need to fly in higher altitudes—and some of them can—to stay in cooler environments or they're not going to survive."

The new study, published in the *Journal of Experimental Biology*, led by Banting postdoctoral fellow Catherine Ivy investigated how some songbirds, like yellow-rumped warblers, adjust their bodies to inhale and distribute oxygen to blood vessels and flight muscles during the migratory seasons compared to non-migratory conditions.

This study allowed for insights into how songbirds can conduct their long-distance flights during migration and whether these birds are able to migrate in high-altitude conditions (where oxygen availability is limited) to avoid major shifts in temperature and weather conditions because of climate change.


A
Migratory
Non-migratory
Body mass (g)
60
40
20
0
*
*
*
*
ϕ
ϕ
ϕ
B
% of body mass
100
80
60
40
20
0
**
**
**
**
Migratory
Fat
Lean
Rest
Non-migratory
Fat
Lean
Rest
Warbling vireo
Red-eyed vireo
Myrtle yellow-rumped warbler
Blackpoll warbler
Hermit thrush
Swainson's thrush

Body mass and fat measurements are influenced by migration state in most species of songbirds. (A) Body mass and (B) % fat and % wet lean mass of body mass. Within family, long-distance migrants (red-eyed vireos, blackpoll warblers and Swainson's thrushes) are all heavier than the short-distance migrants (warbling vireos, myrtle yellow-rumped warblers, hermit thrushes). Reductions in body mass during autumn migration are associated with reduced percentages of fat and increased percentages of wet lean mass. Individual values are plotted in A, in addition to mean±s.e.m. φ represents a significant difference between species within a family; * represents a significant difference between migrating and non-migrating conditions within a species, after a two-factor ANOVA within each family; P