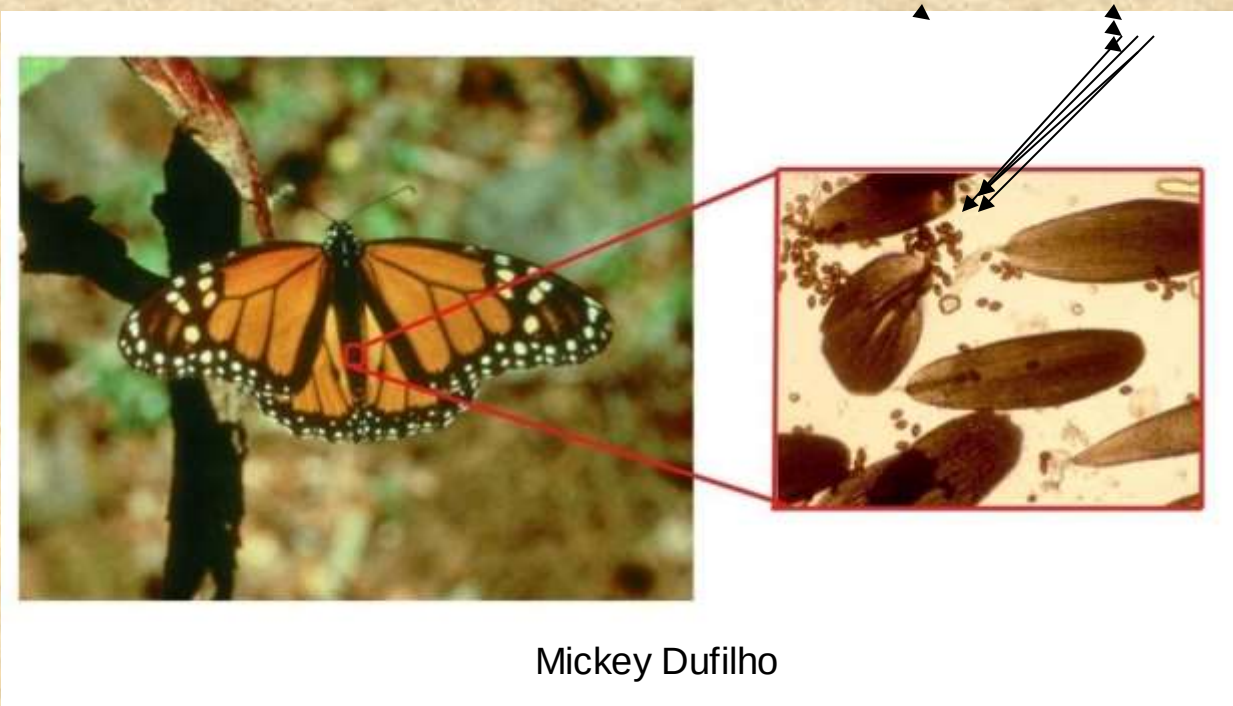
Biology and life cycle of OE

What is OE?

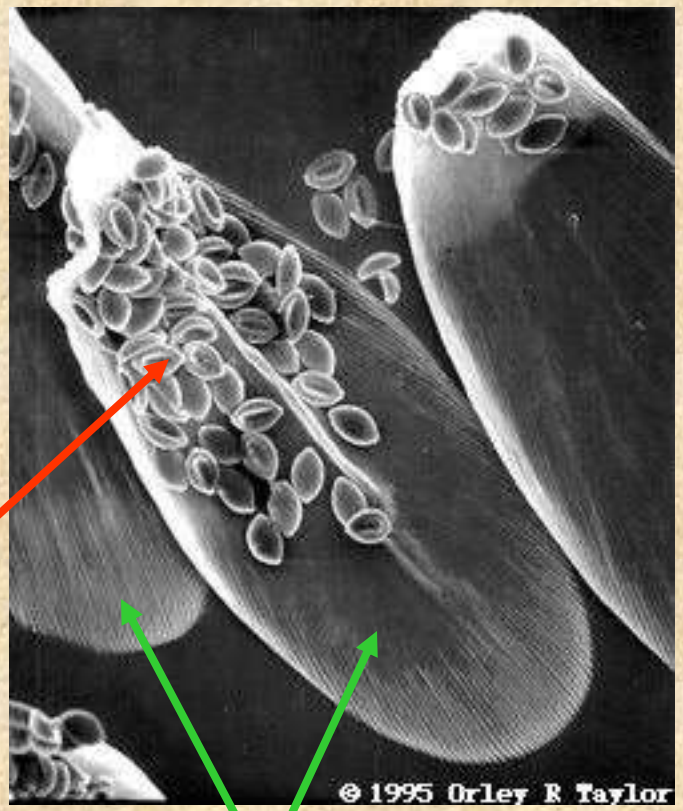
- *Ophryocystis elektroscirrha (*OE) is obligate protozoan.
- Monarch and queen butterflies are the only known hosts of OE



OE spores on the outside of scales

- Spores: dormant cells that can resist harsh environmental conditions
- Found on the outside of infected monarchs

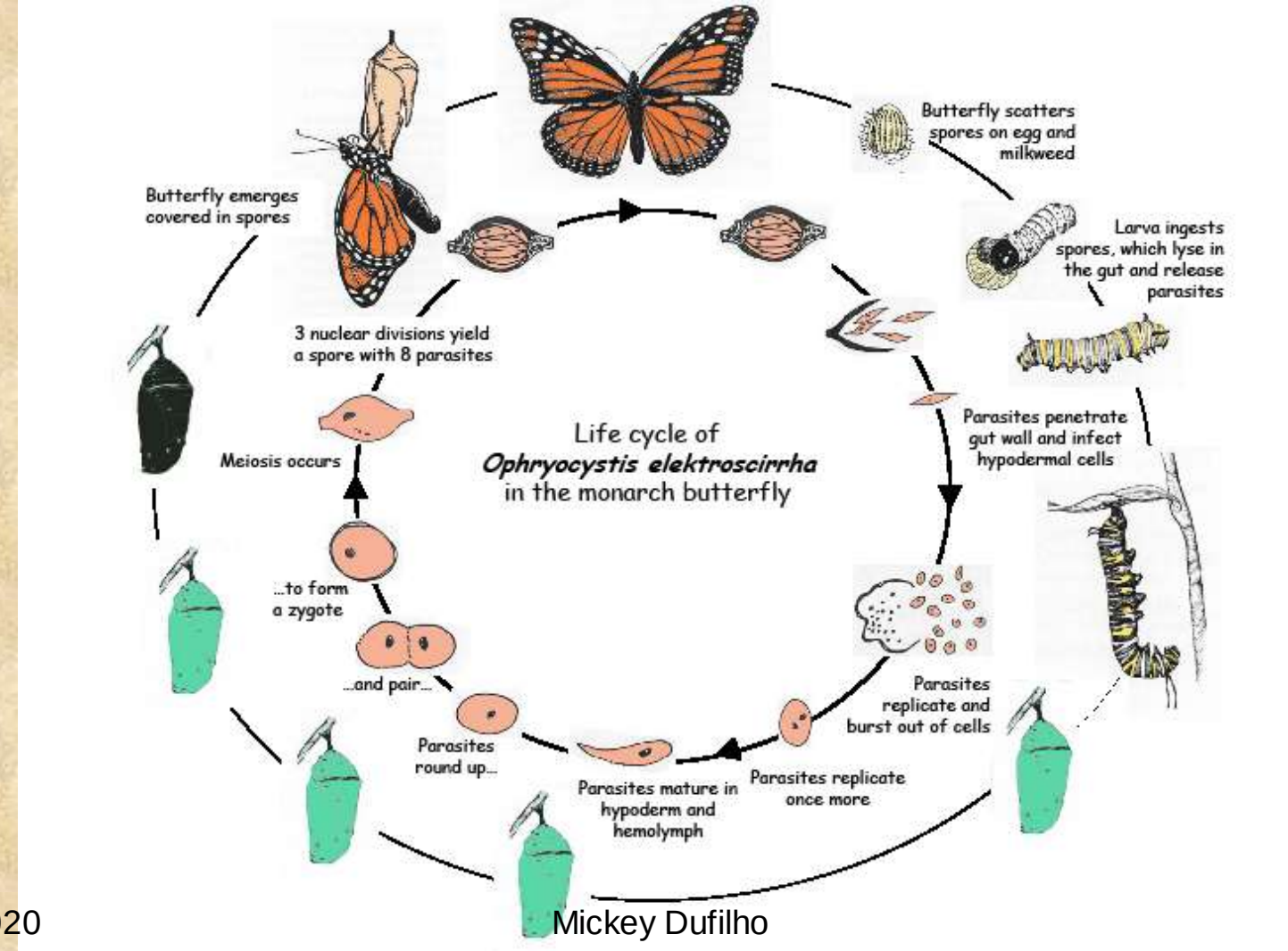
Highly Magnified Image



OE spores

Monarch scales

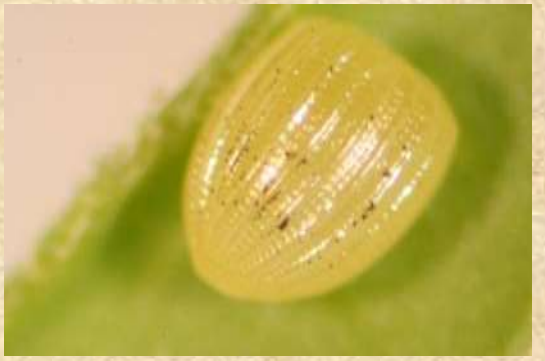
Life cycle of OE is closely related to the life cycle of the monarch butterfly.



OE Life Cycle

- OE can only reproduce inside living monarchs
- Infected females pass the parasite to their offspring when they lay eggs
- Dormant spores on the outside of the female's abdomen are scattered on the eggs and milkweed leaves

Infected females lay eggs and scatter OE spores on eggs and leaves



Dark spots are OE spores

OE Infects the Caterpillar

- When a caterpillar emerges, its first meal is the egg shell
- It ingests OE spores along with the shell and milkweed

Newly emerged caterpillar

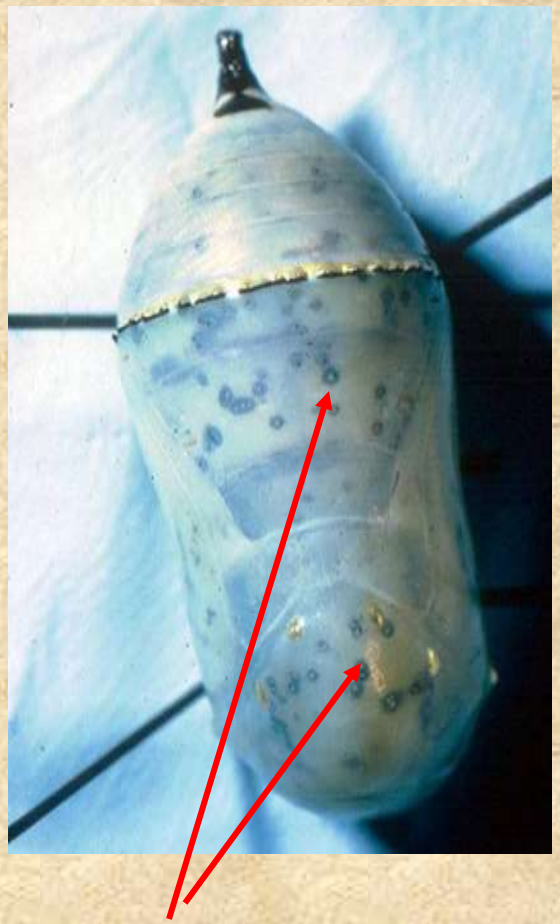
A caterpillar eating the egg shell and any OE spores on the shell's surface

OE Moves to the Midgut

- The dormant spores move through the larva to the midgut
- Digestive chemicals break open the spores releasing the parasites
- The parasites then pass through the intestinal wall to the hypoderm (underneath caterpillar's skin)

Spores Form in the Pupae

- About three days before the adult emerges from the pupa, OE spores begin to form
- Spores allow OE to survive outside of the monarch's body
- The spores can be seen through the integument or outside layer of the pupa



OE Spores

Adult Emerges with Spores

- Infected adults emerge covered with spores
  - *Once butterflies are infected, they do not recover*
  - By the time adults emerge with parasite spores, all physical damage by the OE parasites has been done
  - The parasites do not grow or reproduce on the adults
  - The spores are inactive or dormant until they are eaten by another caterpillar

Parasitized emerging monarchs

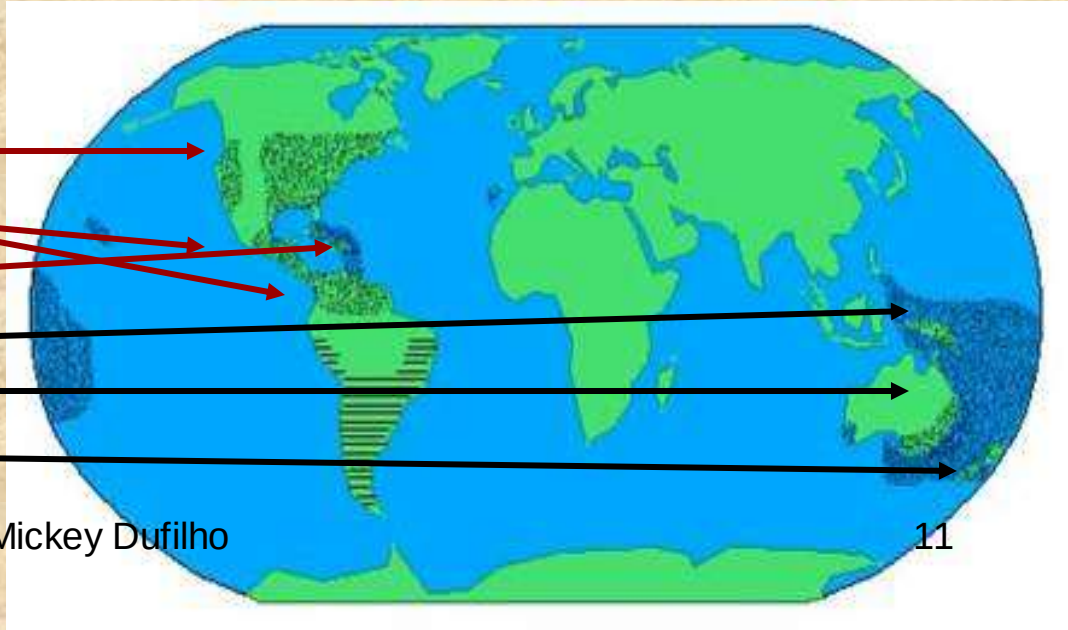
- Monarchs that are heavily infected with OE can have difficulty emerging from their pupal cases

Infected monarchs are covered with millions of tiny OE spores

Where in the World do you Find OE?

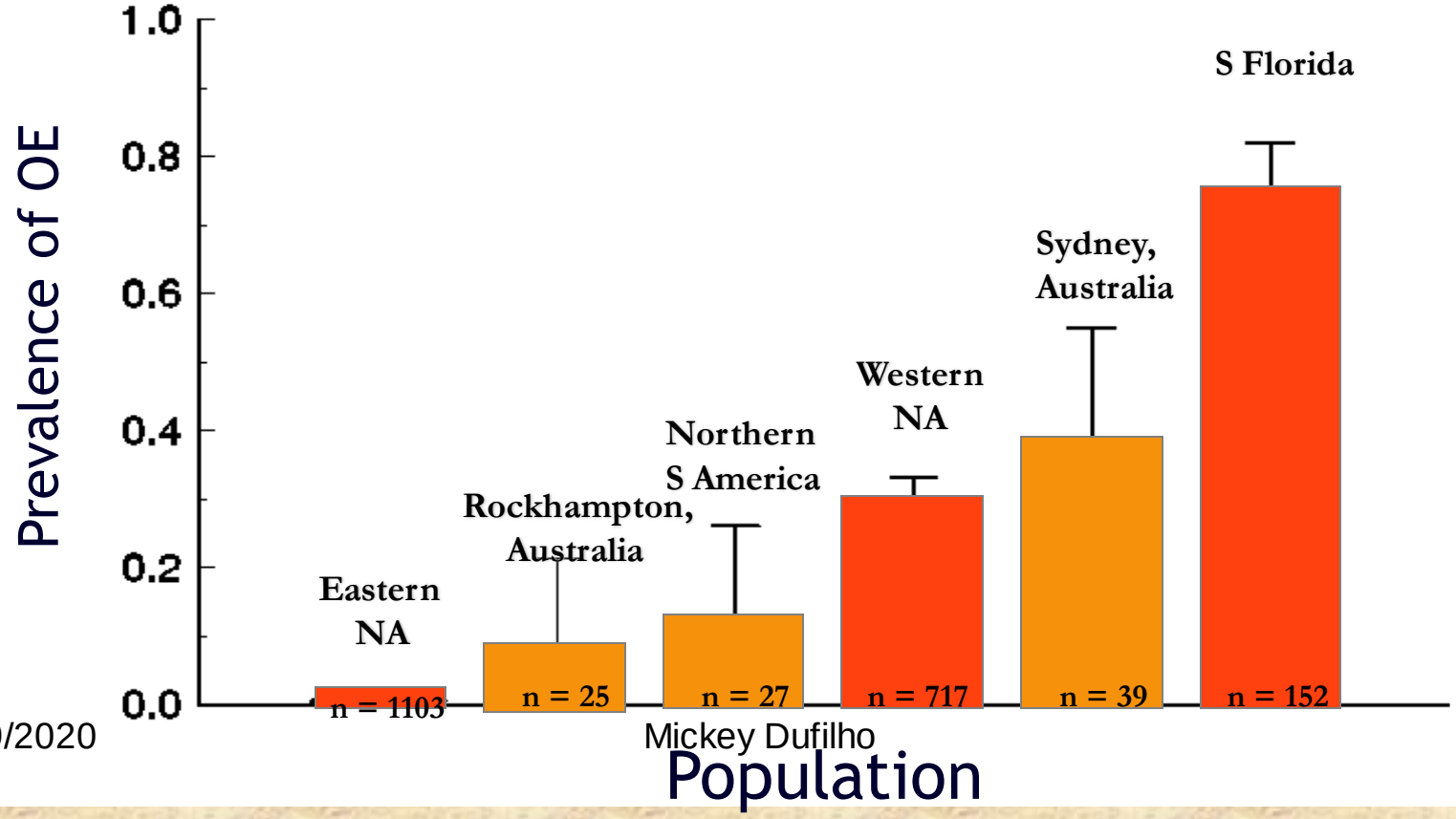
- Monarchs have a wide geographic range
- OE occurs in all monarch populations examined to date

<u>Monarch geographic range</u>:
N. America
Central and S. America
Caribbean Islands
Pacific Islands
Australia
New Zealand

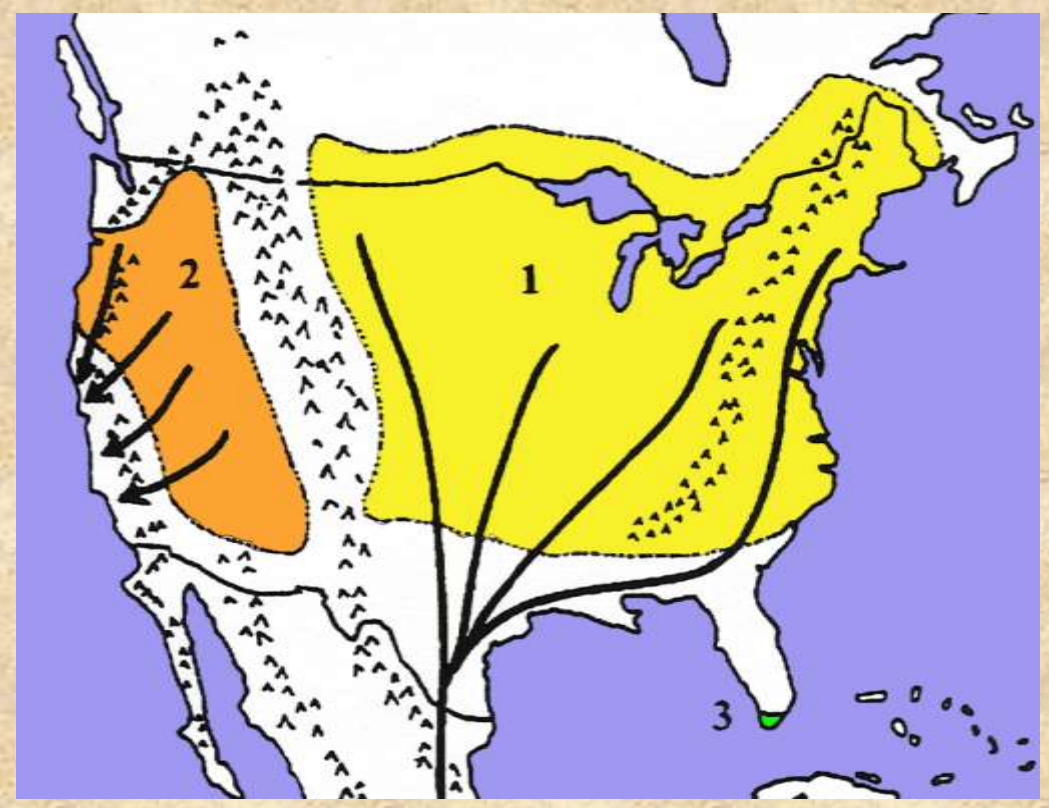


Where in the World do you Find OE?

Prevalence: Measures proportion of monarchs infected with OE
infected / total # sampled (n)



How common is OE in North America?

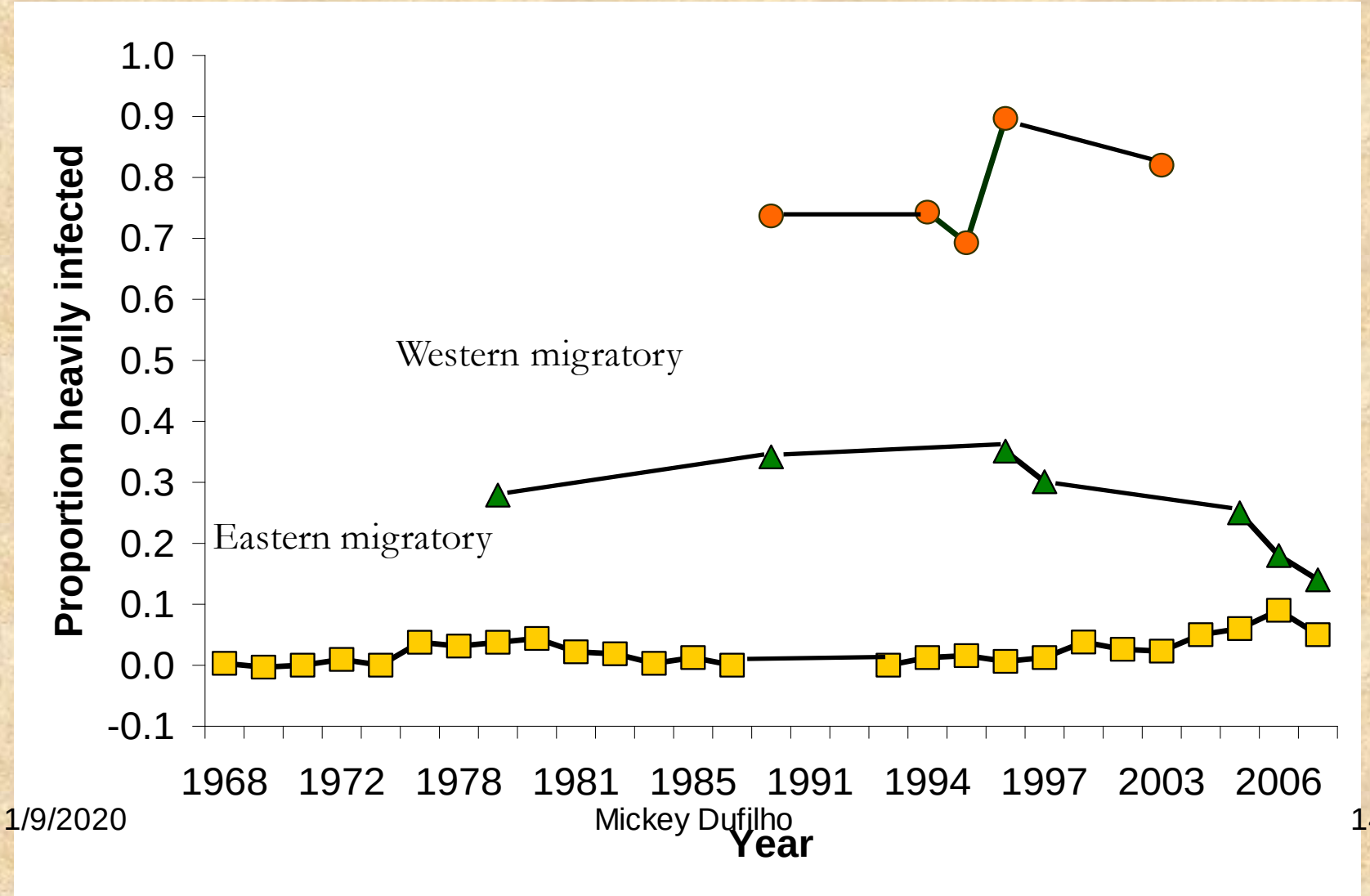


1. Eastern migratory population
   - Less than 10% heavily infected

3. South Florida resident population
   - Over 70% heavily infected

2. Western migratory population
   - 30% heavily infected

Differences between populations have persisted for many decades



Do my Monarchs have OE? What are the Symptoms?

- Butterflies can become sick for many different reasons
- Monarchs infected with OE have a variety of symptoms
  - Caterpillars may have damage to their gut walls
  - Infections may be fatal

Monarch caterpillars often turn brown within a few hours of death.

Damage to the Pupa

- Infected pupae may develop dark spots or blotches 2-3 days before the butterfly emerges
  - These abnormal dark areas are parasite spores
  - Spores form on the eyes, antennae, wing veins, but mostly on the abdomen
  - You can see the spores through the outside layer of the pupa a day or two before pigments that color the butterfly normally darken the pupa

Damaged Adult Monarchs

- Heavily infected adults are weak and often have difficulty emerging from the chrysalis
  - Some monarchs die before emerging
  - Others emerge, but are too weak to cling to the pupal case
    - They fall to the ground before fully expanding their wings
    - These severely deformed monarchs do not survive long

Mild infections also harm butterflies

- Infected adults are often smaller than healthy monarchs
  - They weigh less and have smaller wings and shorter lifespans than normal monarchs
- Parasites also damage the cuticle or outside layer of the monarch's abdomen
  - This causes the butterfly to dry out and lose weight faster than normal.
  - Especially a problem if there is a shortage of nectar or water

Many infected monarchs look the same as healthy butterflies

- These are all symptoms of OE, but many infected monarchs look healthy
  - They emerge normally and are not deformed
  - The only way to really know if your monarch is infected is to check for parasite spores on its body.
- Easy way to test for infections: swabbing

How to test for OE

Can You Tell Which Monarchs are Infected with OE?

The role of Tropical Milkweed and the spread of OE

- Tropical milkweed (*Asclepias curassavica)* is adapted to grow year-round in mild climates
- Allows monarchs to breed in the winter
- This fosters greater transmission of OE and increases the chance that monarchs become infected with OE due to concentration of OE.
- 49% of winter-breeding monarchs were infected with OE vs. 9% of migratory monarchs sampled in Mexico and 15% of migratory monarchs sampled in northern U.S. and Canada
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What can you do?

- Plant native species of milkweed
- If you have tropical milkweed, prune stalks to 6 inches during fall and winter
- Cutting back milkweed will also eliminate OE spores that may be on the plant
- If the milkweed begins to re-sprout – re-cut

References

1. Project Monarch Health www.monarchparasites.org
2. www.monarchjointventure.org
3. Monarch Larva Monitoring Project www.mlmp.org
4. Monarch Watch www.monarchwatch.org
5. Monarch Highway www.monarchhighway.org