

*Emydomyces testavorans: emerging
fungal pathogen of chelonians*

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Disclosure declaration

- I have no relevant financial relationship that would be considered a conflict of interest for the purposes of this program.
- This program will include a discussion of non-FDA approved medication use.
 - I'm a zoo veterinarian, everything I do is off label



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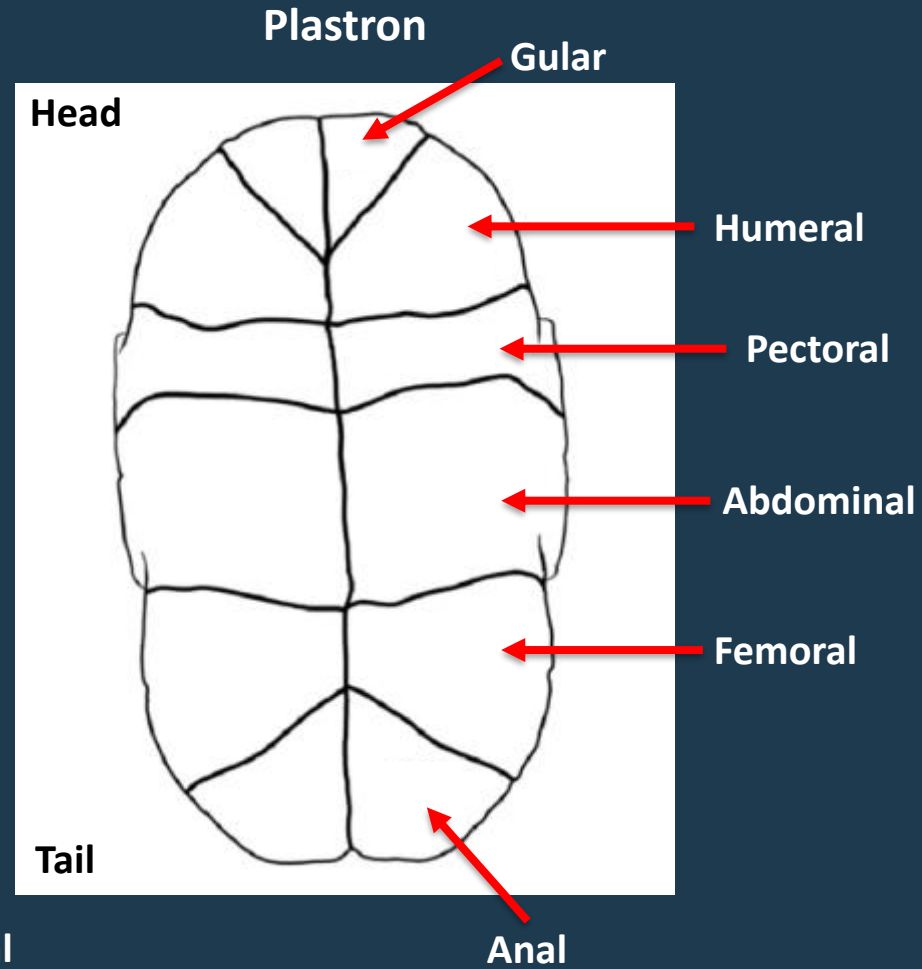
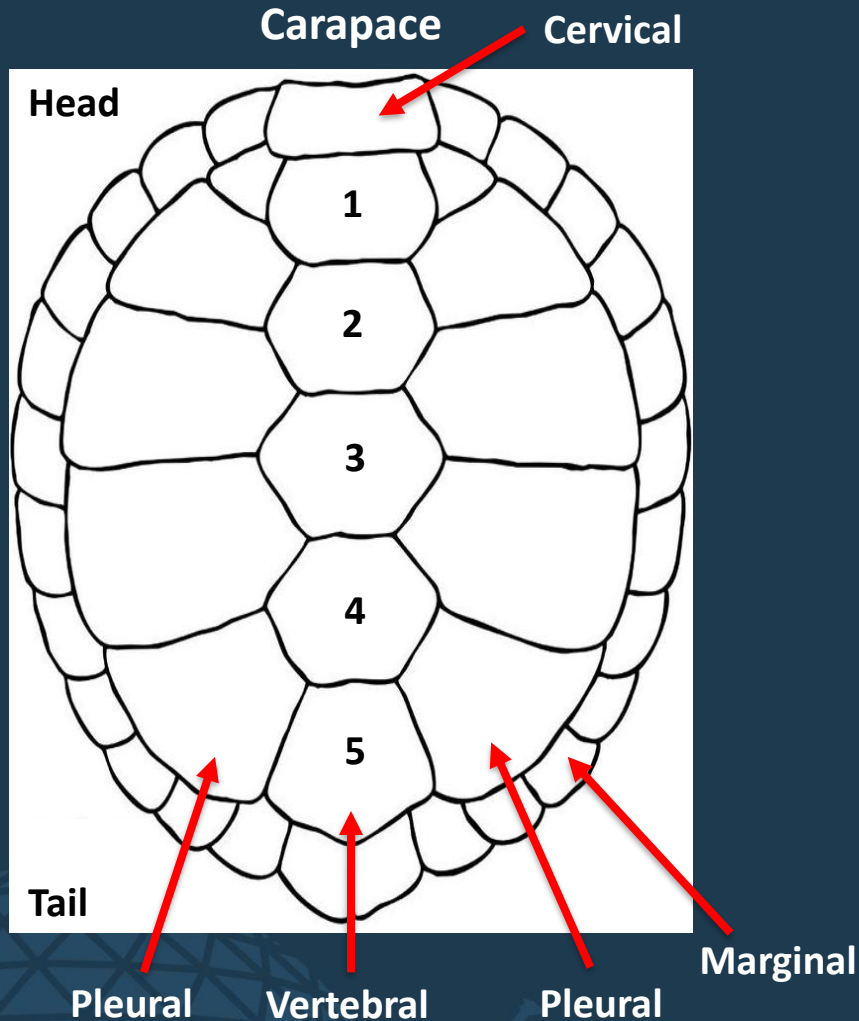


Taxonomy and anatomy

- Chelonian = turtles and tortoises
- Family *Emydidae*
 - Freshwater and terrestrial turtles
- General lifestyle groups
 - Aquatic
 - Semi-aquatic
 - Terrestrial

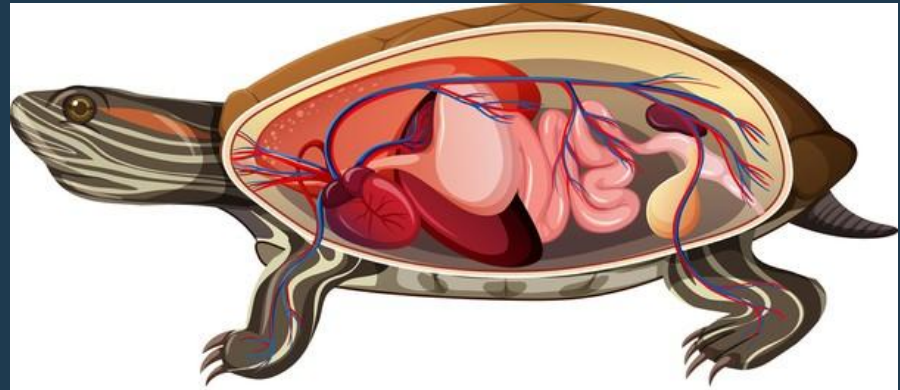


Taxonomy and anatomy



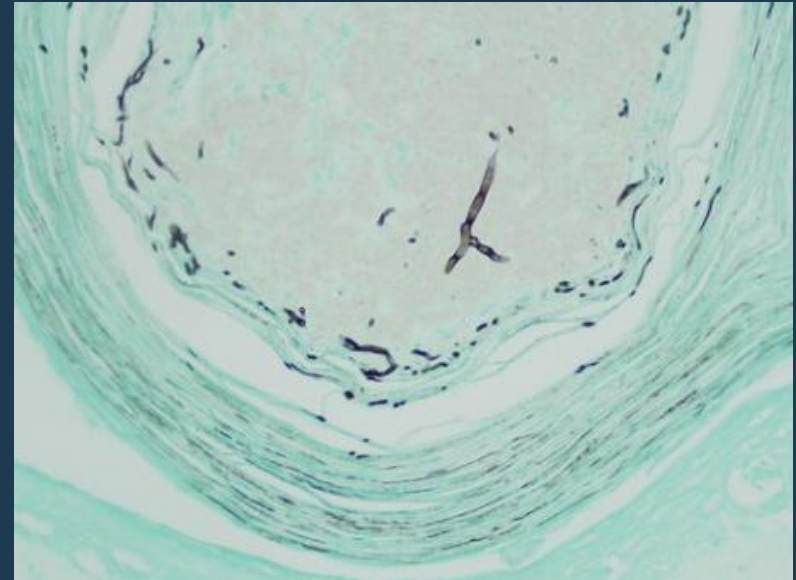
Taxonomy and anatomy

- Thin layer of soft tissue between scutes and underlying bone
- Borders between scutes are offset from suture lines connecting underlying bone
- Coelomic cavity – primary body cavity
 - No distinct thoracic and abdominal spaces



Emydomyces testavorans

- Fungal order *Onygenales*
 - Includes several genera of significant reptile pathogens
- Keratinophilic fungus
- Discovered in 2019
 - Abnormal pattern of fungal associated shell lesions in western pond turtles in Washington
 - Identified from shell lesions across multiple species
- Found in captive and free ranging freshwater aquatic, semi-aquatic, and terrestrial chelonians
- Currently not known to be a zoonosis



Woodburn DB, Miller AN, Allender MC, Maddox CW, Terio KA. 2019. *Emydomyces testavorans*, a New Genus and Species of Onygenalean Fungus Isolated from Shell Lesions of Freshwater Aquatic Turtles. J Clin Microbiol 57:10.1128

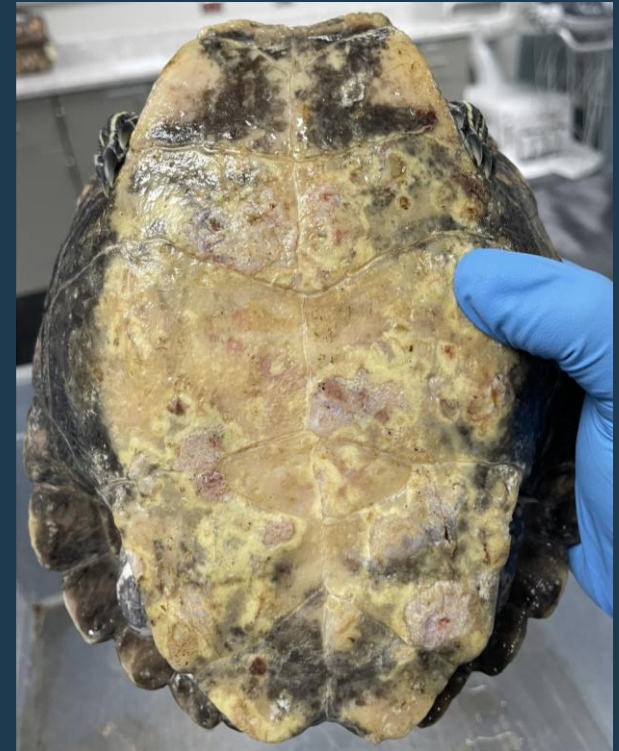
Emydomyces testavorans

- Identified in several free ranging populations
 - Western pond turtles in Washington
 - Western pond turtles in the San Francisco bay area
 - Blanding's turtles and red eared sliders in Illinois
- Found in companion red eared sliders



Clinical presentation

- Ulcerative shell disease
 - Ulcerative defects
 - Excess keratin flaking
 - Pitting lesions
 - Scute discoloration
- Lesions grossly similar to that of septicemic cutaneous ulcerative disease (SCUD), not unique to *Emydomyces*
- Lethargy, anorexia, poor body condition in severe systemic cases



Clinical presentation

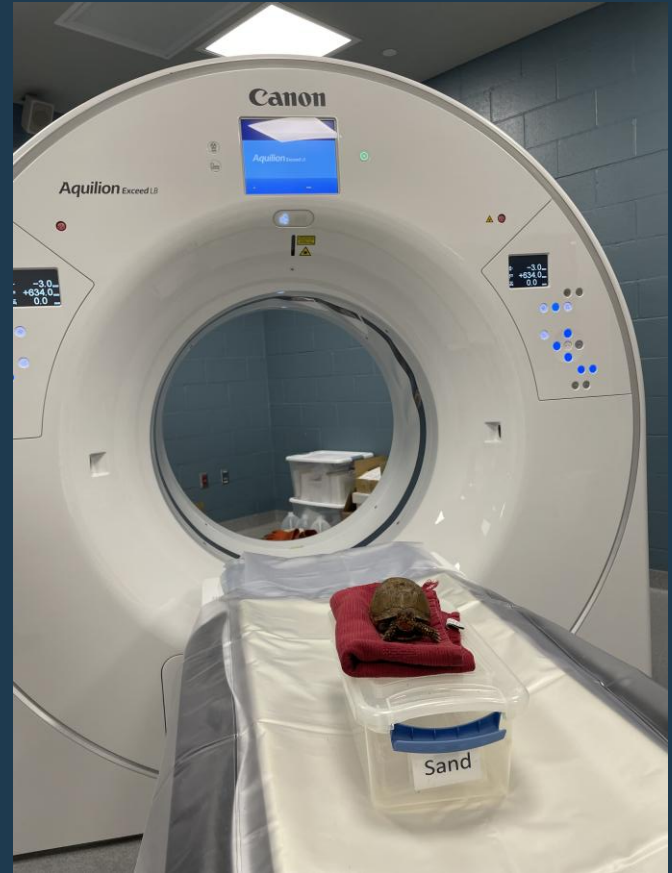
- Epithelial inclusion cysts unique to *Emydomyces*
 - Not seen in all cases
- Identified peri-mortem via CT scan, unable to visualize externally or via radiographs
- Diagnosis
 - PCR of shell sample or cloacal-oral-shell swab



Woodburn DB, Kinsel MJ, Poll CP, et al. Shell Lesions Associated With *Emydomyces testavorans* Infection in Freshwater Aquatic Turtles. *Veterinary Pathology*. 2021;58(3):578-586.

Treatment

- Active area of research
- Clinical trial in 237 Blanding's turtles
 - Terbinafine baths 1 mg/ml for 30 min 3x/week
 - Combination therapy: Terbinafine baths + increased environmental salinity (4 ppt)
- Shell debridement
- Prolonged treatment is necessary
- Other treatment options – questionable efficacy
 - Oral terbinafine
 - Terbinafine nebulization
 - Injectable voriconazole
- Environmental decontamination



Emydomyces testavorans at OHDZA

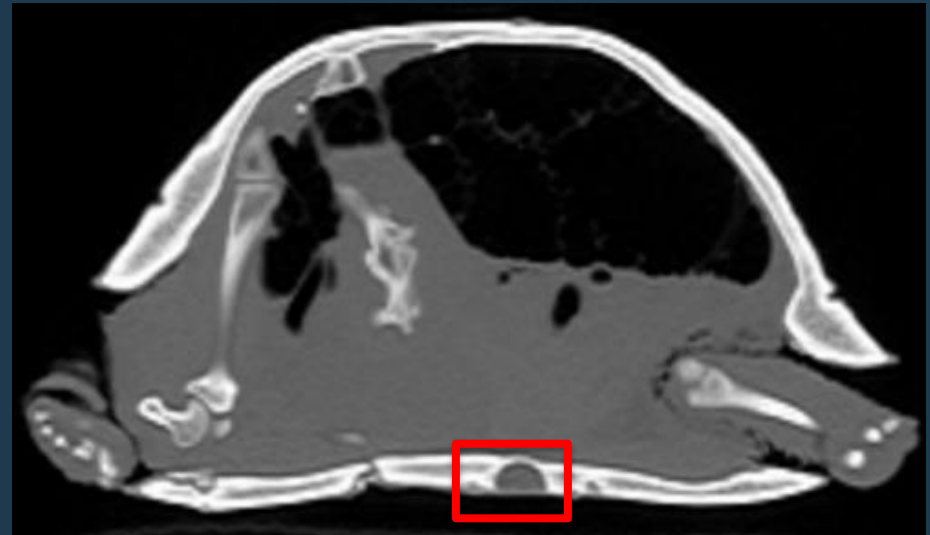
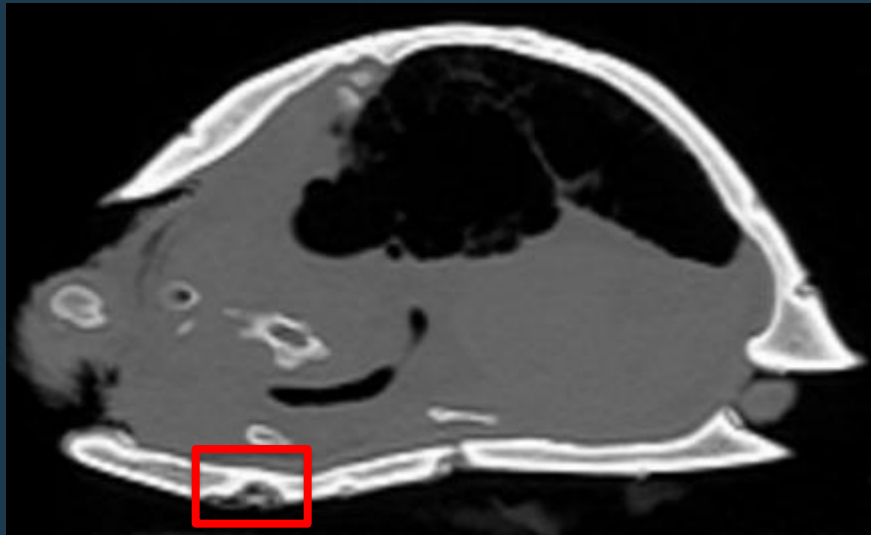


Freckles



Normal box turtle

Emydomyces testavorans at OHDZA



Emydomyces testavorans at OHDZA



Emydomyces testavorans at OHDZA

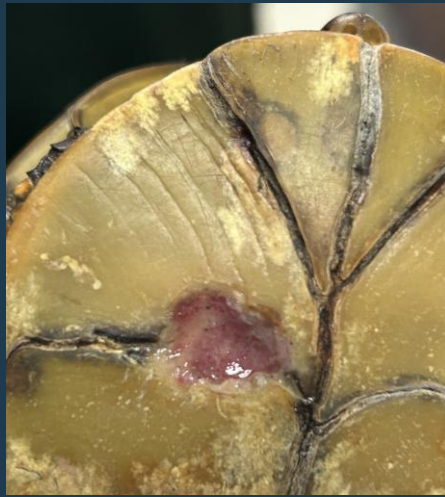
- Sedated shell debridement
- Culture - Light growth multi drug resistant *Brevundimonas* spp, *Achromobacter* spp, and *Pseudomonas* spp
- Biopsy - Ulcerative dermatitis with osteonecrosis and numerous fungal hyphae
- *Emydomyces* PCR – Positive
- Treatment plan
 - Terbinafine baths 1 mg/ml for 30 min 3x/week
 - Bandage changes 3x/week



Emydomyces testavorans at OHDZA



February



March



April



June



Emydomyces testavorans at OHDZA

- Other chelonians in the building
 - 3 box turtles
 - 6 spotted turtles
 - 1 brown mountain tortoise
 - Low risk
- Response
 - All turtles taken off program
 - All turtles screened for *Emydomyces*
 - CT on all turtles
- Review biosecurity protocols

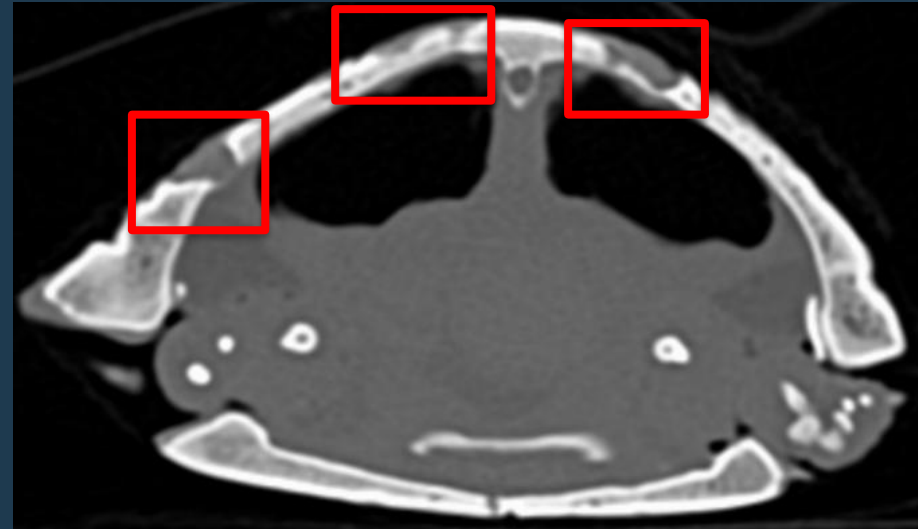
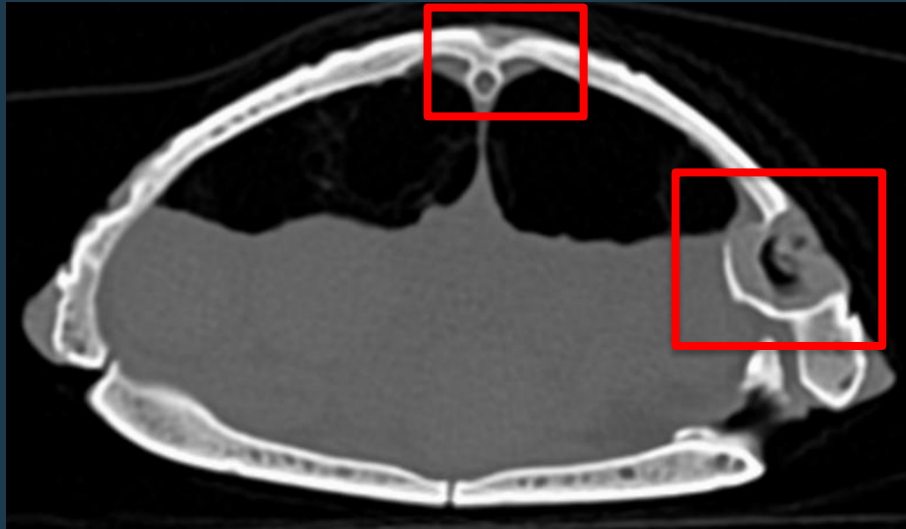


Emydomyces testavorans at OHDZA

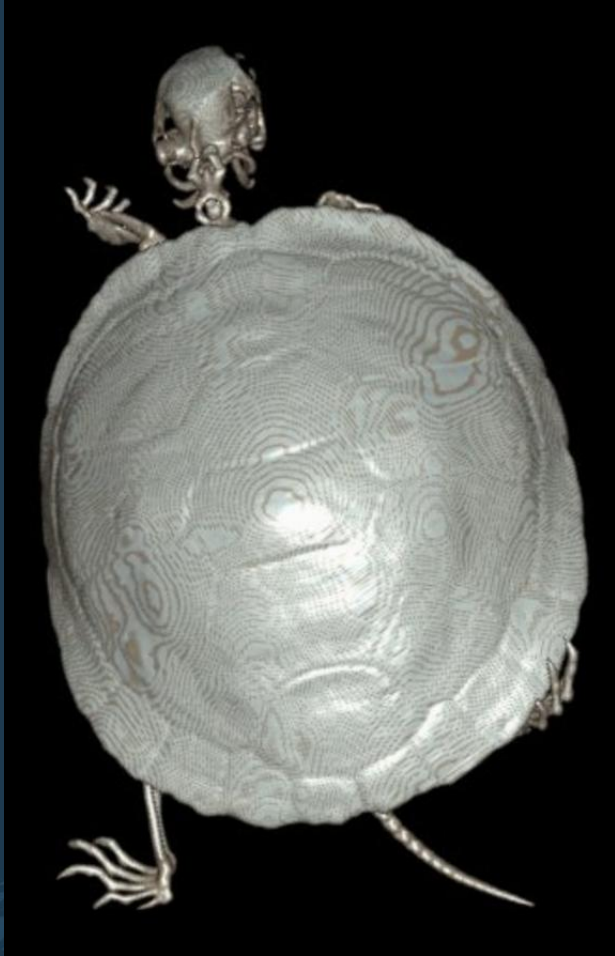
- Initial *Emydomyces* screen
 - 2/3 box turtles positive
 - 2/6 spotted turtles positive
- CT
 - Shell lesions in all box turtles and 3/6 spotted turtles
 - Inclusion cysts in 1 spotted turtle



Emydomyces testavorans at OHDZA



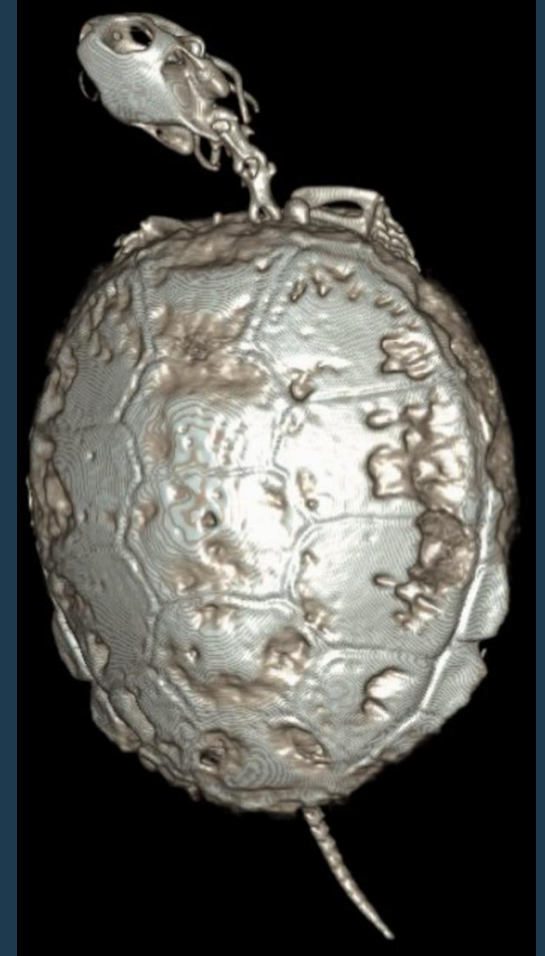
Emydomyces testavorans at OHDZA



Spotted turtle
"Rosa Parks"

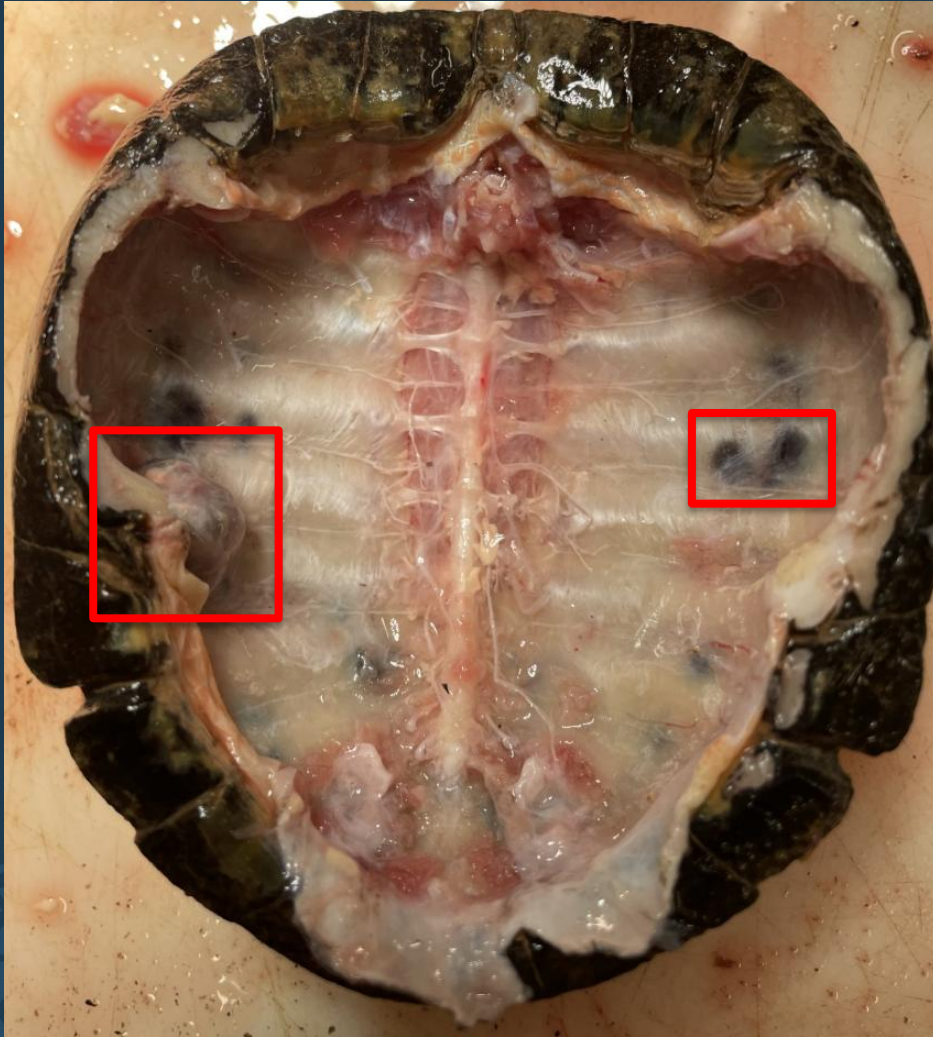


Spotted turtle
"Susan B Anthony"



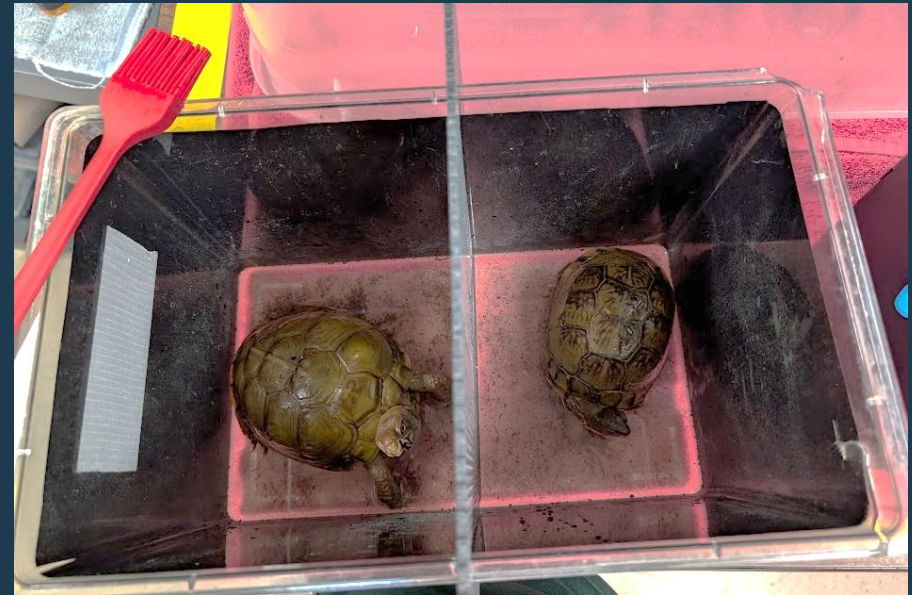
Spotted turtle
"Susan B Anthony"

Emydomyces testavorans at OHDZA



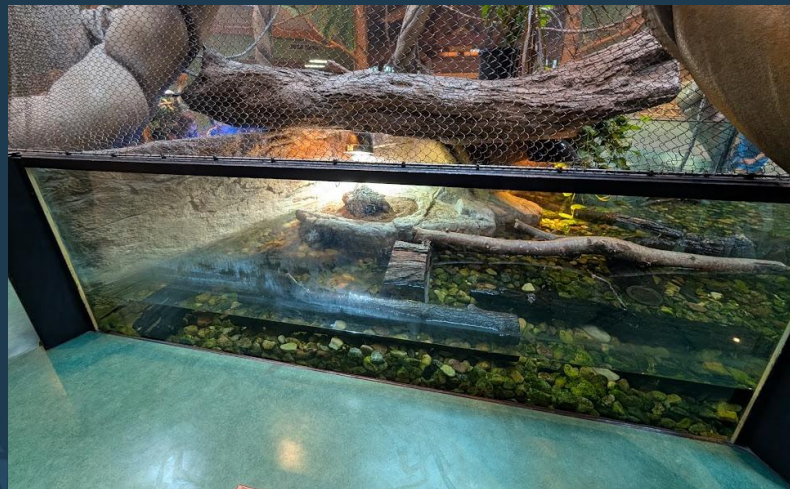
Emydomyces testavorans at OHDZA

- Treatment
 - Shell debridement with bandage management for individuals with lesions
 - Terbinafine baths 1 mg/ml for 30 min 3x/week
- Monitoring
 - Monthly recheck PCR
 - 3 consecutive negatives considered cleared



Emydomyces testavorans at OHDZA

- Environmental decontamination



Emydomyces testavorans at OHDZA

- Current status
 - 4/5 spotted turtles cleared
 - 1/3 box turtles cleared
- Long term surveillance
 - Recheck CT and *Emydomyces* PCR annually
 - *Emydomyces* PCR for any turtle with shell lesions
- Mitigation strategies
 - Closed populations
 - Deep clean with Rescue
 - Screening before animal movement to other areas
 - Different approaches depending on goal: eradication vs management



Emydomyces testavorans at OHDZA

- Box turtle “Freckles”
 - Persistent positive PCR
 - Repeat CT and shell debridement performed



Conservation implications

- Effects on animal movement
 - Species survival program (SSP) breeding recommendations
- Consequences for headstart programs
 - Morbidity/mortality of headstart populations
 - Ethics surrounding release
 - Inadvertent introduction of *Emydomyces*
- Unclear impact in free ranging populations



Ongoing areas of research

- Treatment
- Free ranging population surveillance
- Improved PCR methodology





Questions?



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