PET REPTILE POPULATION, U.S.A., 2001

<table>
<thead>
<tr>
<th>Animal Group</th>
<th>Total Popul.</th>
<th>Mean No. per household</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turtles</td>
<td>1.07 million</td>
<td>1.7</td>
</tr>
<tr>
<td>Snakes</td>
<td>661,000</td>
<td>2.1</td>
</tr>
<tr>
<td>Lizards</td>
<td>545,000</td>
<td>1.3</td>
</tr>
<tr>
<td>Other reptiles</td>
<td>598,000</td>
<td>1.9</td>
</tr>
</tbody>
</table>

(source: AVMA, 2002)
Bacterial Zoonoses of Reptiles

Salmonella

Mycobacterium (Coxiella)

Campylobacter

Yersinia

Aeromonas

Plesiomonas

Edwardsiella

Zoonotic Bacteria of Reptiles

Salmonella

Gram-negative, rod, usually with flagella
Facultative anaerobe
Over 2000 serotypes

Most recognized zoonoses of reptiles
- Harbored by 83.7%-93.7% of reptiles
- First described in 1946, First proven in 1963.
- Approximately 93,000 cases are attributable to pet reptiles
Reptile-associated Human *Salmonella* History

1944  First Salmonella sp. isolate from snakes.
1946  First Salmonella sp. isolate from turtles and lizards.
1963  Turtle-associated salmonellosis first described.
1972  FDA regulation requiring certification of turtles for sale as "Salmonella-free."
1974  Study shows 300,000 turtle-associated human salmonellosis cases per year in U.S.
1975  FDA bans sale of viable turtle eggs or live turtles with carapace length < 10.2 cm.
1977  CA State regulations ban sale, as above.
**Diagnosis**
- Culture (humans and reptiles)
- Difficult in reptiles
  - Not always passed in feces
  - More common if stressed
  - Persistent in breeding ponds and nests

**Treatment**
- **Humans**
  - Self-limiting (5-7d)
  - Supportive care for dehydration
  - Antibiotics if disseminated
- **Reptiles**
  - Problematic
  - Antibiotics can suppress shed, but not eliminate
Mycobacterium Disease in Reptiles

- Chronic granulomatous and non-granulomatous lesions
  - Lungs
  - Liver
  - Subcutaneous tissue
  - Oral mucosa gonads
  - Bone
  - CNS

Edwardsiella tarda

- Gram negative
- Enterobacteria similar to E.coli
- Reptile Disease
  - Not well documented
- Human Disease
  - Gastroenteritis in a 2 yr old child and a wound infection in an Australian young man.
  - 1 documented case from a turtle
**Plesiomonas shigelloides**

- Gram negative rod
- **Disease in reptiles**
  - Progressive, ulcerative stomatitis
- **Disease in humans**
  - gastroenteritis
  - Diagnosis via fecal culture
  - Exposure to Boa constrictor

- **Treatment**
  - Sulfamethoxazole-Trimethoprim

**Yersinia spp.**

- found in reptiles, serotypes involved usually not found in humans

**Campylobacter fetus**

- Isolated from a pet turtle during a case of Salmonellosis

**Serratia marcescens**

- One case in a child (8 yr old) after a bite by an iguana
Parasitic Zoonoses of Reptiles

Pentostomiasis

Two genera affect man, *Armillifer armillatus* and *Linguatula serrata*. They live mainly in the respiratory passages of snakes but also in birds and nares of mammals where they produce eggs which are released in the environment. Contamination occurs by ingesting the eggs with larvae which spread through various organs forming encysted ninphae which at the surface of the liver form small encapsulated whitish nodules.

Mesocestoides

**Armillifer armillatus** Life Cycle

- Adults in lungs, trachea and nasal passages of snakes and lizards where the female lays her eggs
- Intermediate host consumed by snake or lizard.
- Eggs expelled in nasal mucus or if swallowed in feces. Eggs contain fully formed larvae and are immediately infective.
- Intermediate host consumes the eggs. The larvae hatch and burrow thru the intestinal wall, lodge themselves in an organ, undergo several molts, and then encyst in the abdominal cavity.
Pentostomiasis (*Armillifer armillatus*)

**Clinical Signs**

- **Reptiles**
  - none
- **Humans**
  - Often asymptomatic with parasites in the lungs, liver and mesentary
  - Death is rare
  - Hypersensitivity reactions to toxin release
    - Can cause neurological signs and death
  - Case
    - Congolese man with paresis, seizures & dysarthria
    - All tests normal: CT, MRI, CSF, EMG, EEG

**Diagnosis, Treatment and Prevention**

- **Diagnosis**
  - Often by accident during surgery or via radiographs
- **Treatment**
  - none
- **Prevention**
  - Wash hands after handling reptiles
  - Wash food in endemic areas

- Calcified c-shaped nymphs
**Mesocestoides Infection**

**Clinical Signs**

- **Reptiles**
  - none

- **Humans**
  A few cases (7 in the USA, 27 worldwide)
  - One Case in a child in California in 1990, could have been exposed to reptiles.
  - Diarrhea and “rice grains like stuff” in child stools.
  - Treatment: Niclosamide, Praziquantel

Gravid proglottid of the tapeworm isolated from the case in Louisiana. po = parauterine organ (chlorhydric alcoholic carmine-stained). Bar = 200 µm.

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**Zoonoses of Fish**

- Bacterial
- Parasitic
- Fungal
FISH TANK –SWIMMING POOL GRANULOMA

• Infection caused by inoculation with *M marinum*.
• In the US: Infections are rare. Estimated annual incidence is 0.27 case per 100,000 patients.
• Most case reports of cutaneous infection (about 150). Infection often follows abrasions to an extremity occurring in non-chlorinated water.
• **Individuals at increased risk** for infection are:
  • Fishermen and workers who process saltwater fish
  • Workers who clean saltwater aquariums
  • Home aquarium owners.
  • **Immunocompromised patients** (increased risk of disseminated infection)

FISH TANK –SWIMMING POOL GRANULOMA

• Incubation period: about 2-3 weeks.
• A papule or nodule initially appears at the site of trauma.
• Localized pain and induration are common. Fever, localized lymph adenopathy, and systemic infection rarely are observed (exception for immunosuppressed patients).
• In 25-50% of patients, the nodules proliferate along the path of lymphatic drainage in a sporotrichotic type of distribution. Patients may have deeper involvement, with tenosynovitis, septic arthritis, and osteomyelitis of the underlying bone. Dissemination to the bone marrow and abdominal viscera rarely develops (mainly in immunocompromised).
• Infection responds slowly to appropriate antibiotic therapy (treatment for 2 weeks to as long as 18 months).
**M. Marinum**
Clinical Signs in the Fish

- Anorexia/emaciation
- Exophthalmos
  - Pop eye
- Loss of normal coloration
- Multiple granulomatous nodules affecting multiple organs

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**Fish Tank Granuloma**
*Mycobacterium marinum* Infection – Forearm

**Dorsal hand,**
Sporotrichoid lymphocutaneous Granuloma
**Mycobacterium**
Diagnosis and Treatment

- **Diagnosis**
  - TB skin test (humans)
  - Radiographs

- **Treatment**
  - Not recommended in reptiles
  - Antibiotics for humans
    - Isoniazid, rifampin, pyrazinamide, ethambutol, streptomycin

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**M. Marinum**
Transmission and Prevention

- **Contact with fish or contaminated water.**
  - Organism enters through breaks in the skin or inoculation by stab wound.

- **Major concern for immune comprised persons**

- **Wear protective gloves when cleaning fish aquaria of diving**
**Erysipelothrix rhusiopathiae**

- Saprophytic, gram-positive rod
- Not recognized as a fish pathogen
- Associated most with commercial fishing and fish processing
- Clinical presentation similar to nodular lymphangitis, but lesion is not suppurative.
  - In the disseminated septicemic form may lead to endocarditis.

**Erysipelothrix rhusiopathiae, and E. insidiosa**

- **Diagnosis**: Culture of wound or blood
- **Treatment**: Very responsive to Penicillins and cephalosporin
  - Localized infection may resolve on their own
- **Prevention**: adherence of occupational safety, and wearing gloves when handling fish.
Meliodosis

- Disease caused by *Burkholderia pseudomallei*
  - Gram negative bacillus
- Local abscess at site of inoculation
  - Septicemic shock seen in endemic area – South East Asia
  - Chronic febrile wasting condition
- Not recognized as a disease in fish.
  - Acquisition of infection is most associated with the water

Streptococcus iniae infection

- Four patients admitted to Toronto Hospital (1995-1996)
  - 3 / 4 with upper limb cellulitis originating from puncture or laceration
  - One patient presented with dyspnea, confusion and arthritis of the right knee.
  - All four patients were preparing fish, three were preparing tilapia

*Streptococcus iniae* culture from all patients
Aeromonas

- Gram negative
- Fermentative
- Oxidase positive
- Part of normal Alligator flora
- Can cause disease in fish, frogs and reptiles
- Common in lakes, ponds, and water housing reptiles, amphibians or fish

Aeromonas Disease in Humans and Reptiles

- Reptile disease
  - Ulcerative stomatitis
- Transmission
  - Contact with water on open wounds
  - Bites or scratches
- Human disease
  - Acute gastroenteritis
  - Diagnose with stool culture
  - Treat with Sulfamethoxazole-Trimethoprim
Zygomycetes

- Ubiquitous in the environment
  - Soil, dead plant material, fruits, bread
- Grow rapidly, ferment Carbohydrates, form fuzzy mycelia with asptate hyphae
- Disease is Zygomycosis
  - Orders Mucorales and Entomophthorales
- Isolated from 112/200 garden lizards’ intestinal contents

Zygomycosis

- Transmission
  - inhalation, ingestion or inoculation of spores
- Opportunist infection in reptiles
- Immunocompromised individuals at risk
  - DKA, leukemia, lymphoma, transplants, steroid use, prolonged neutropenia
    - 3rd most common cause of invasive fungal disease
**Zygomycosis**

**Clinical Signs in Reptiles**

- **Upper Respiratory**
  - Nasal discharge
- **Pneumonia**
- **Cutaneous**
  - Necrotizing skin or shell lesions
    - Reported in crocodiles, turtles and lizards
- **Prognosis**
  - Death rate of >50% reported in Florida Softshell outbreak

**Zygomycosis**

**Clinical signs in humans**

- **Rhinocerebral**
  - Acute sinusitis, fever, eye swell
- **Pulmonary**
  - Fever, cough, dyspnea, hemoptysis
- **Cutaneous**
  - Plaque, pustule, ulcer, deep abscess
- **GI**
  - Abdominal pain, vomiting blood
- **Prognosis**
  - 50% overall mortality, 85% for rhinocerebral
Zygomycosis
Diagnosis, Treatment, Prevention

• Diagnosis
  – CT or MRI
  – Staining nasal discharge
  – Culture (not in humans)

• Treatment
  – Surgical removal of dead and infected tissue
  – Antifungals
    • Amphotericin B (humans)
    • Ketoconazole (reptiles)

• Prevention
  – control risk factors for immunosuppression
  – keep environment clean to avoid fungus growth