UNDERSTANDING AND MANAGING AVIAN BUMBLEFOOT

AZA Mid-year Meeting 2014
Avian Welfare Workshop
Avian Scientific Advisory Group

Dr. Ann Duncan
Chief Veterinarian
Detroit Zoo

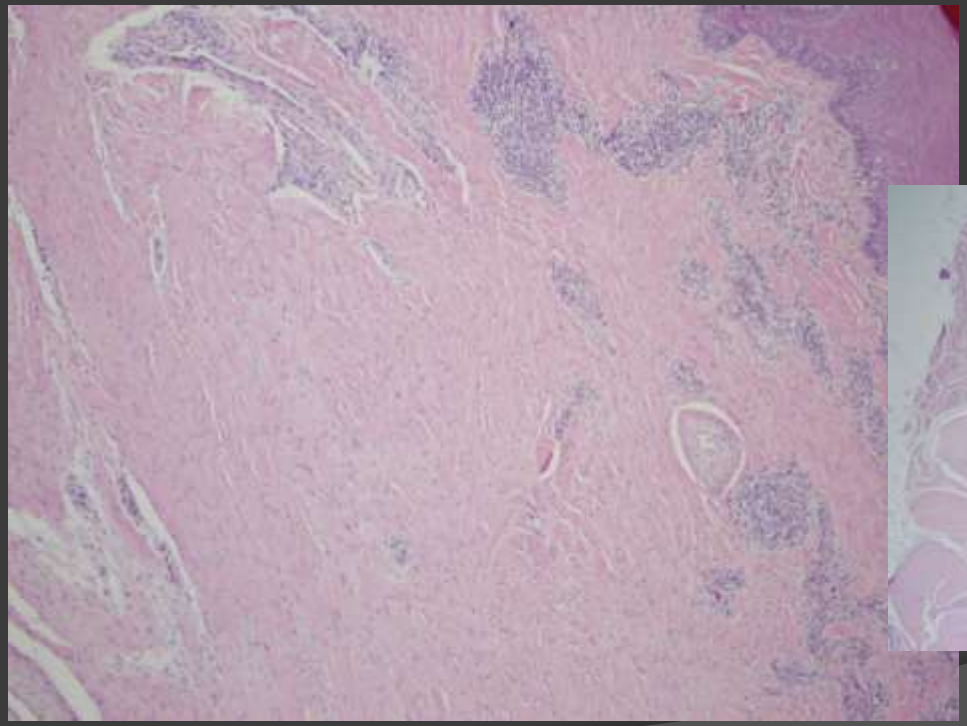
Bumblefoot

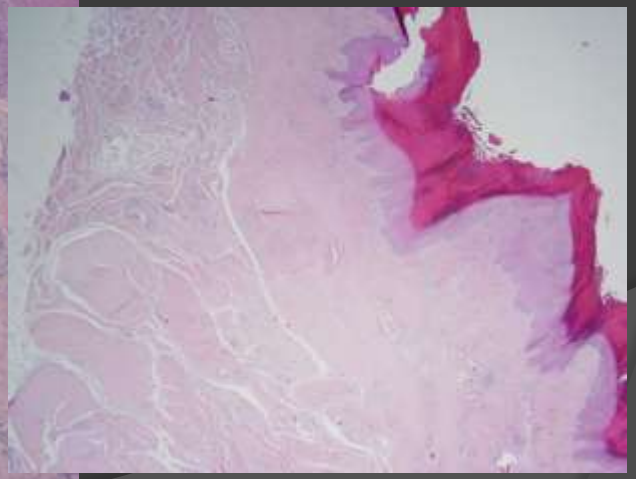
An inflammatory or degenerative condition that arises as a consequence of cellular death due to interruption of blood supply- (pressure or avascular necrosis)

- Bumblefoot =pododermatitis
- On weight-bearing surface of the foot.
- A problem of captivity.
- In some cases, decompensation of the epithelial barrier can allow infection to develop.

Histopathology

- This chronic lesion shows fibrosis and loss of vascularization.
- There is some inflammation present.





Impact on welfare

- Common in captive birds.
- Can lead to prolonged periods of pain, frequent handling for treatment/surgery, and social isolation.
- In severe cases can see infection in the bone and soft tissues, +/- spread along the tendons. Can result in death.

Species

- Most common:
  - raptors/ owls
  - waterfowl
  - penguins
  - flamingos
  - perching birds
- Can be seen in all taxa

Spurwing Lapwing

Spoonbill

Trumpeter swan

Cause/Etiology/Risk factors

- The cause is likely multifactorial, and may vary between species.
- Husbandry factors are important.
  - Raptor and poultry research has shown that suboptimal flooring/ substrate/ perching, trauma (jumping from high perches, puncture wounds), asymmetrical weight distribution and inactivity are important.
  - Nutrition can have an impact: deficiencies in Vit A and E, biotin, pantothenic acid, zinc and riboflavin have been implicated.

Lesion classification

- Using the same language to describe lesions is important. Classification systems have been described for raptors, penguins and flamingos.
- Objective measures are very helpful, especially to track birds with chronic BF.

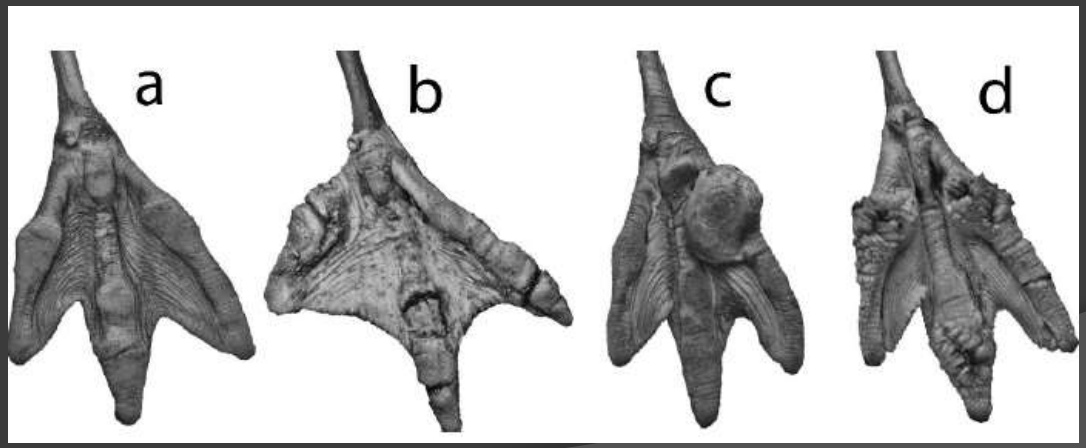
Lesion classification

- In flamingos, 4 lesion types have been described- (Nielson):
  - Hyperkeratosis -HK
  - Nodular lesions -NL
  - Papillomatous growths -PG
  - Fissures -FS

- In penguins, a system was developed- (Erlacher-Reid):
  - Crack, callous, core
  - Active or inactive/chronic

Flamingos- Nielsen 2010

- Four species of flamingo, photos from 845 individuals.
- 100% had at least hyperkeratosis.
- Hyperkeratosis and nodular lesions were most common at the base of the foot and the proximal digit- more weight bearing.
- The 2nd and 4th digits were most affected with fissures and papillomatous lesions, where flexion occurs.



HK FS NL PG

Flamingos

- Nielson 2012- Identified risk factors associated with foot lesions in 337 captive flamingos in 10 of the zoos.

Odds of having lesions were higher:

- North of the 53rd latitude (especially PGs)
- Mean temp <15 °C or less
- Housed indoors >90% of time
- Housed on concrete (especially HK and fissures)

Flamingos

- Bare concrete increases FS and HK
- NL more common in those housed outdoors.
- Lined (coated) concrete did not have the expected advantages. FS just as common, PG more common.
- Grass decreases the odds of NL but increases the odds of FS. Wet or dry soil increases the odds of NLs and decreases the odds of fissures and PGs.

Flamingos

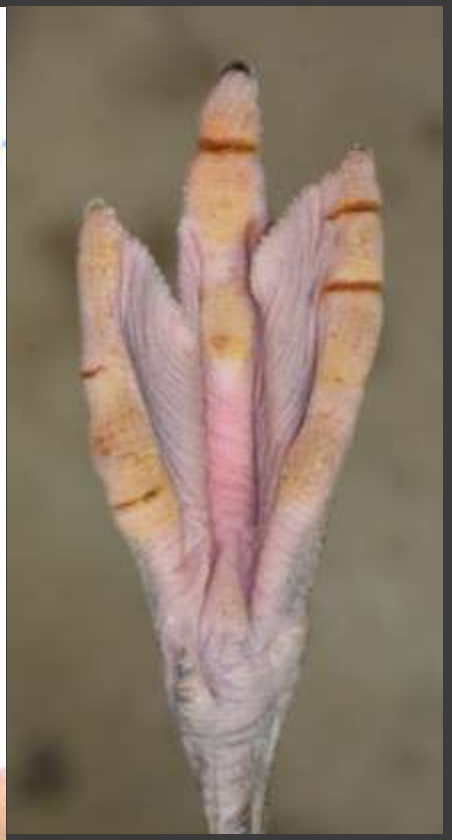
- Wyss et. al housed young greater flamingos on 10 cm of fine granular sand covered with 5 cm of water.
- Repeated study for 3 groups- findings different for each.
- The author's impression was that the feet improved compared to prior years when housed on artificial grass carpet alone.
- Study not strong enough to draw conclusions.

African Greater Flamingos at DZS

Housed on concrete prior to shipment to DZS.

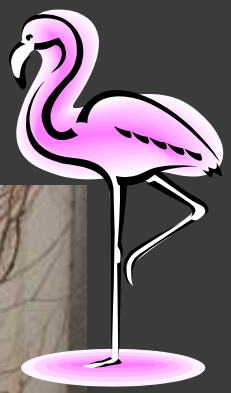
Six weeks later

Housed on concrete prior to shipment to DZS.



Six weeks later

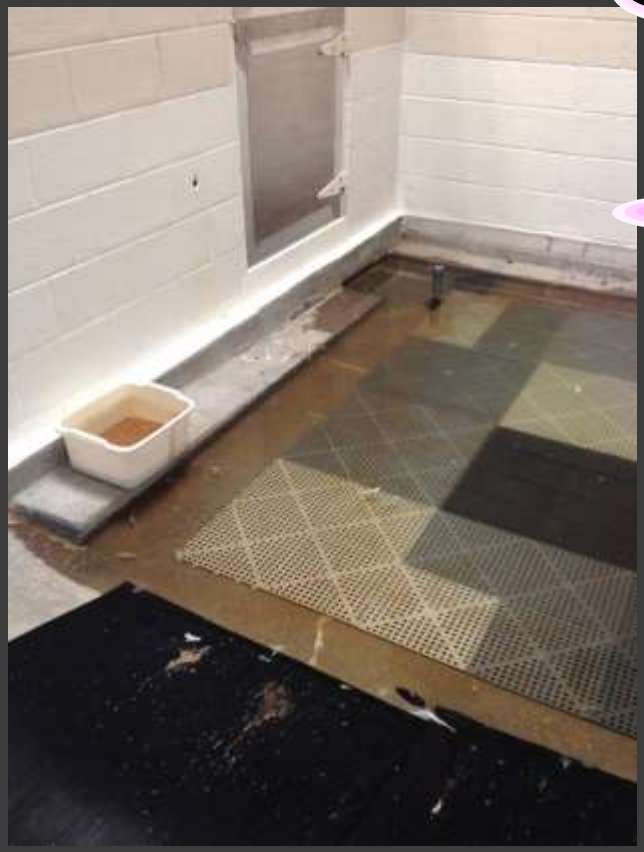
Husbandry prior to arrival



- Housed in a stall with bare concrete flooring.
- This is 1/3 of the floor space.
- Were in this holding for 3 months.
- Had shallow tubs holding food and water.

Husbandry during Q at DZS

Artificial grass carpet.



Dry dek mats in pool.

Six week quarantine

Penguins

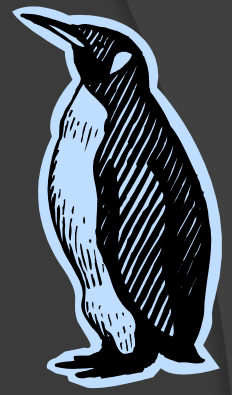
- BF is an important problem in penguins.
- In a colony of Adelie penguins, 64% of had BF. (Reidarson 1999)
- At the Detroit Zoo, 14% of king penguins, 45% of macaroni penguins and 15% of rockhopper penguins are currently under treatment for BF in one or both feet.
- We have lost 1 King penguin and 2 macaroni penguins in 15 years. Currently have 64 birds. (K-14, M-26, RH-24)

African penguins, Erlacher-Reid- 2012

Retrospective study to evaluate risk factors, including sex, weight, age, season, activity and substrate. 31 penguins

- More lesions seen in:
  - Males
  - Penguins weighing >3.51 kg
  - Standing >50% of time, not swimming.
  - Standing on smooth concrete vs. fiberglass reinforced plastic grating.
  - No age predilection found.

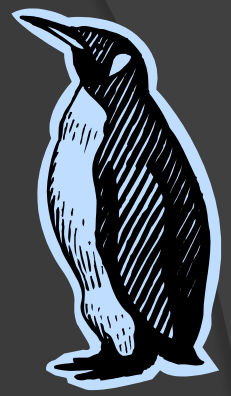
Detroit Penguins



- We used Erlacher-Reid classification system to characterize lesions during a 1 yr period.
- In active lesions the skin is compromised, and infected can occur. Inactive lesions are not open.

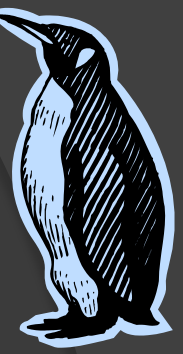
Species	No lesions	Inactive	Active
Kings	9 (65%)	3 (21%)	2 (14%)
Macaroni	2 (7%)	13 (48%)	12 (45%)
Rockhoppers	4 (17%)	12 (50%)	8 (33%)

Additional risk factors



- Increased body weight and decreased activity associated with molting and breeding season.
- Non-swimmers.
- Conformational abnormalities, irregular gait or resting postures.
- Older animals -have less fat in their metatarsal pads, decreased activity d.t. cataracts, arthritis.
- Prior bumblefoot problems.

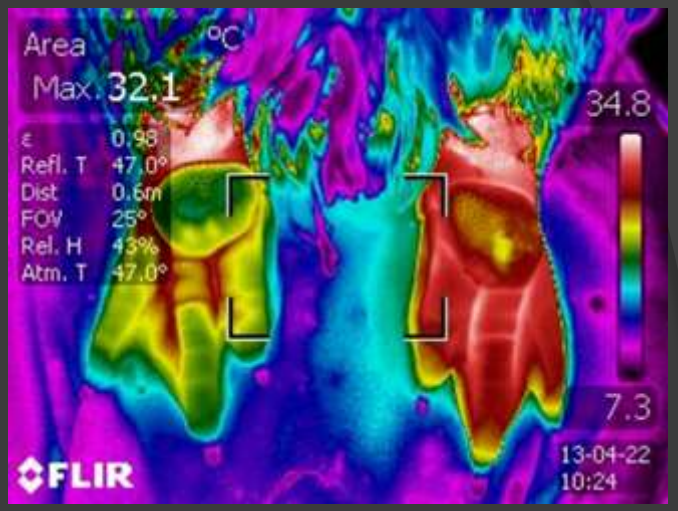
Diagnosis

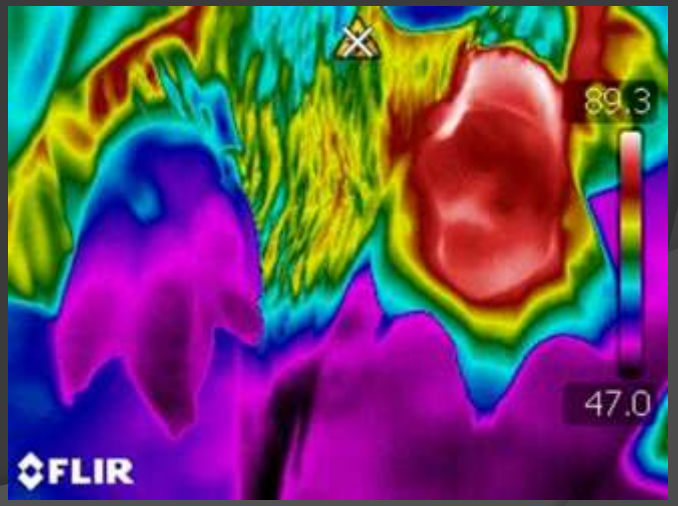


- Continual observations for gait changes.
- Regular exams of the feet important- Q 1-3 mo.
- High quality photos are helpful for tracking lesion appearance over time.
- Radiographs important if chronic lameness. May identify other contributing problems.
- Hawkey et. al 1985 found hemotological changes in captive gentoo penguins with BF.
  - Found elevated heterophils and fibrinogen in birds with severe, untreated BF.

Infrared Thermography- IRT

- We conducted research to see if IRT is a useful diagnostic test for BF in penguins.
- Has been used successfully to find orthopedic injury in horses, mastitis in cows, pregnancy in horses, etc.
- Was used successfully to screen for subclinical BF in chickens.





IRT disadvantage

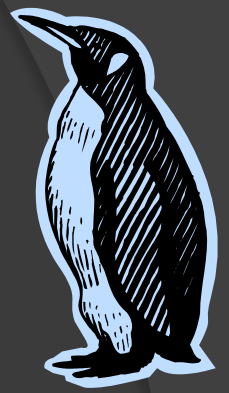
- Expensive
- NOT easy to use. Takes time to become proficient with equipment.
- Must use under controlled circumstances to validate it's efficacy and have data that is comparable.
- In BF cases can see both an increase and a decrease in tissue temperature.

Treatment and Prevention

- Treatment goals are to relieve pressure on weight-bearing lesions and redistribute body weight onto other surfaces.
- Pressure is an obstacle to healing.
- Infection can be an important component:

  We see E. Coli and Pseudomonas, resistant to many antibiotics.

Penguin treatment- Adelies



- Reidarson 1999- Surgical debridement, complete closure, and regular bandage changes. Antibiotics for 1-3 months.
- Neoprene bootie for 2-3 months.
- Not curative in all cases.
- Prevention is the key: improved substrate, colder temperatures, feeding in water, and forced swimming.

Treatment at DZS

- Birds with minor lesions are treated with corona cream once a day.
- Birds with more severe, active lesions are fitted with Pediplast bandages.
- Some require surgical debridement to remove necrotic skin and freshen edges

Pediflex is manufacturer

Pediplast bandages

- Make an insert that is shaped to relieve weight bearing in the area of the lesion.
- Is incorporated into a vetwrap bandage.
- Penguins can remain on exhibit and can swim.
- A silicone impression material was similarly used in raptors. (Remple)



Bandages are changed weekly:

- Foot is cleaned with nolvasan solution.
- Lesion is coated with corona cream.
- Covered with duoderm- hydrocolloid dressing. (FlexiCol)
- Wrap foot once with vetwrap before applying pediplast to avoid slipping.
- Bird left off exhibit for 20 min to 18 hrs to allow duoderm to seal to foot.

Treatment of cores

Surgery 2-10-14

Treatment of crack lesions

- Pediplast treatment has been used in 8 penguins, and all have shown improvement.
- Treatment period is 4-12 weeks, months in some cases.
- Catching lesions early is critical to decrease the length of treatment and improve outcome.
- Preventing BF is the key!

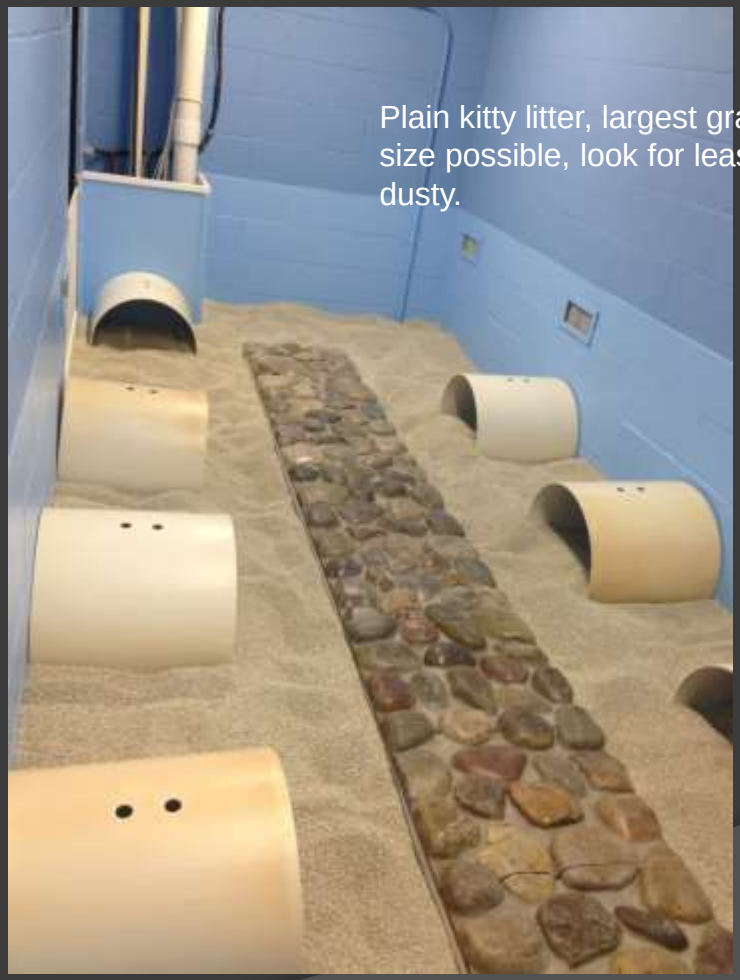
New exhibit at Mystic Aquarium

- Radiant heating to keep feet dry.
- Use surfaces that provide variable degrees of pressure and texture on the feet.

Photos provided by Allison Tuttle and Gayle Sirpenski.

Mystic Aquarium

- Penguins with lesions are housed on cat litter to decrease pressure and keep the feet dry.
- Phase 1 for active lesions:
  - Housed on litter all but 1-2 hrs
  - Twice daily 1) betadine, 2) trypsyme-V spray 1-2 minutes 3) triple Abx ointment.
- Phase 2:
  - Normal access to exhibit
  - Once daily 1) betadine, 2) New Skin



Plain kitty litter, largest grain size possible, look for least dusty.

Increase swimming time

- At the Cincinnati zoo, Kinley used operant conditioning to encourage/ teach their penguins to eat in the pool.
- After 8 weeks of conditioning they jumped into the water for fish.
- Swimming time increased from 20 min to 6 hours/day.
- Incorporated toys as well- hamster ball with fish.

Increase swimming time

- Reisfeld used enrichment to decrease severity of BF in 5 Magellanic penguins.
- Examined feet over a 12 week period, measured lesions.
- Goal was to increase swimming time by 1 hr/day. Used colored balls, bubbles, hula hoops, live fish etc.
- 4 animals improved, (2 were cured). The 1 that did not improve did not respond to aquatic enrichment.

New exhibit design

- New Penguin conservation center being designed with bumblefoot in mind
  - Birds will be encouraged to be active and swim more.
  - It will be easier to feed our penguins in the water.
  - Substrate will include radiant heating, irregular surfaces

Prevention is the key

- Captive bird populations will benefit from continued research to characterize problem, define risk factors and determine treatment methods.
- Coordinate efforts to understand BF.
- Identify other species at risk.
- Keep good records so that trends can be documented. Include husbandry factors.

Thank you to the penguin and veterinary staffs at the Detroit Zoo.

Corners Limited
is the proud sponsor of the
2014 ASAG Workshops!