

American Oystercatcher, copyright Bill Baston



**THE AMERICAN OYSTERCATCHER (*Haematopus palliatus*):
A BIOINDICATOR SPECIES FOR ASSESSING ECOSYSTEM
HEALTH ALONG THE GEORGIA AND SOUTH
CAROLINA COASTS AND BARRIER ISLANDS**

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Wildlife Health and Disease Surveillance Program in Georgia



- **Opportunistic and collaborative health assessment projects**
- **Provide veterinary support to conservation organizations and graduate students in our area**
- **Teaching**





Importance of health assessment of wild populations

- Standardized approach to health assessment needed in free-ranging wildlife
- Disease and health often overlooked in management plans for wildlife
- Baseline data is needed to establish “normal” health parameters
- Long-term health monitoring of wildlife populations essential tool especially for threatened and endangered species



Health assessment of wildlife populations



- Additionally determining the infectious and parasitic agents and toxins that are prevalent in these populations is important
- Bioindicator species
- Comprehensive model for investigating shorebird health

Collaborations between biologists, scientists from various disciplines (nutrition, toxicology, parasitology), veterinarians

- Take advantage of having birds in hand by collecting various biomedical samples such as blood, feces, feathers
- Using expertise from a wide range of disciplines provides more quality information





Shore and sea birds in GA and SC



- 11 species of sea and shore birds that nest on the beaches of GA and SC
- All are obligate beach-nesting species
- AMOY rare in both states
 - Specialize on bivalve mollusks living in saltwater
 - Bioindicator species
 - Flagship species for other shorebirds



Threats to shorebird and AMOY Populations

- Threatened by human disturbance
- Habitat loss
- Predation/invasive spp
- Inundation
- Contaminants?
- Natural toxins?
- Infectious disease?
- Often multiple factors





Objectives of this project

- Establish baseline values in clinical pathology, toxicology, reproductive parameters, microbiology, parasitology, morphometric measurements, and gender confirmation with DNA technology
- Evaluate seasonal and age related differences in baseline health, contaminant, and reproductive parameters



Objectives continued

- Establish normal nutritional parameters in the plasma of AMOY (plasma vitamins A, D, and E)
- Perform nutritional and toxicological analysis on commonly consumed prey items at different locations in GA and SC
- Perform toxicological analysis on AMOY eggs (yolk) collected at different locations in GA and SC
- Data comparison between GA and SC (Cape Romain)

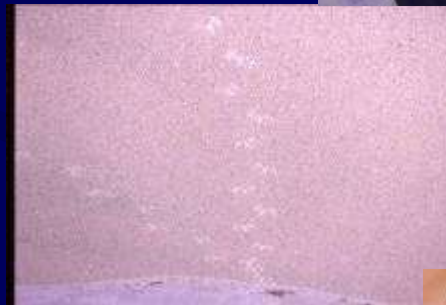


Capture Techniques



Cannon netting: primarily non-breeding season

- Set net at low tide prior to birds arriving
- Cannon netting
 - Oyster rack
 - Beach
- Fire net at high tide
- Predicting where birds will roost
- Low mortality, low morbidity
- Labor intensive and time consuming
- 100 adult AMOY captured by this method (112 with other methods) for health assessment (63:49)



Capturing birds during the breeding and nesting season

Box Trap



Decoy/Mesh



Hand Capturing Chicks



Aging



Physical Examination



- Systematic approach
 - Eyes, beak, nostrils, oral exam
 - Auscultation
 - Coelomic palpation
 - Body condition scoring
 - Feather evaluation
 - Quality
 - External parasites
 - Molt condition
 - Stress lines
 - skin
 - Vent
 - Preen gland
 - Musculo-skeletal
 - Feet



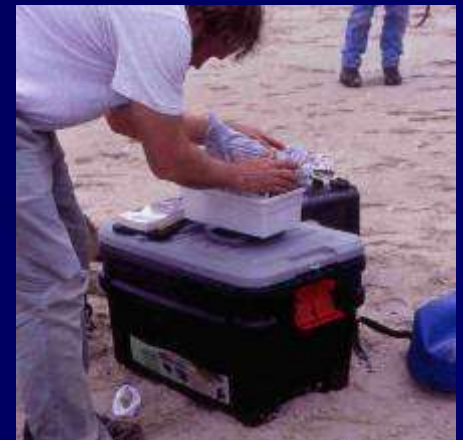
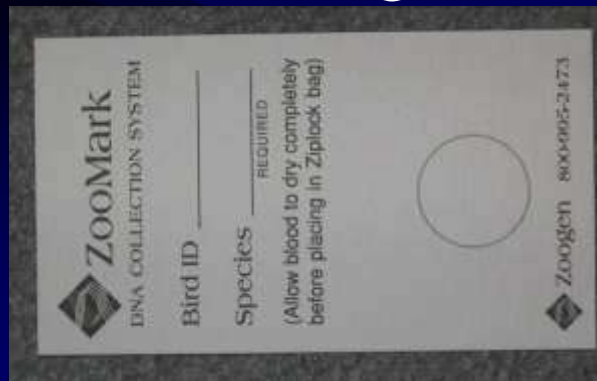
Iris depigmentation

- Unknown cause or significance
- Not age related
- Classified as mild, moderate or severe
- 90% of AMOY evaluated effected



DNA sexing and morphometrics

- DNA sexing results indicate that sexing by morphometrics alone may be inaccurate
- Blood on filter paper
- Commercial lab: zoogen



Clinical Pathology

- Right jugular vein
- CBC
- Plasma chemistry panel
- Plasma protein electrophoresis
- Clinical pathology: similar to other avian species
- Importance of sample processing



What is a Complete Blood Count and what does it tell you?

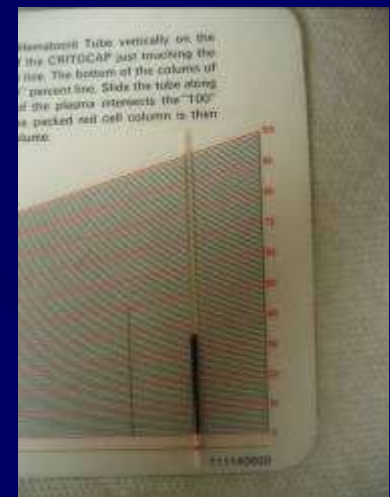
- Packed cell volume (PCV) or hematocrit
- Total Protein
- White blood cell count
- Differential cell count
- Cell morphology



Packed Cell Volume (PCV) or Hematocrit



- Measure of red cell mass
- Elevation/in conjunction with total protein: dehydration
- Decrease: anemia
 - Non-regenerative vs regenerative
- Can be used to assess individuals and populations



Total Solids/Total Protein

- Protein and amino acids: source of energy
- Building blocks for bone, muscle, skin, enzymes and hormones
- Elevation: dehydration, inflammation (globulins)
- Decrease: age related, poor body condition
- Protein electrophoresis

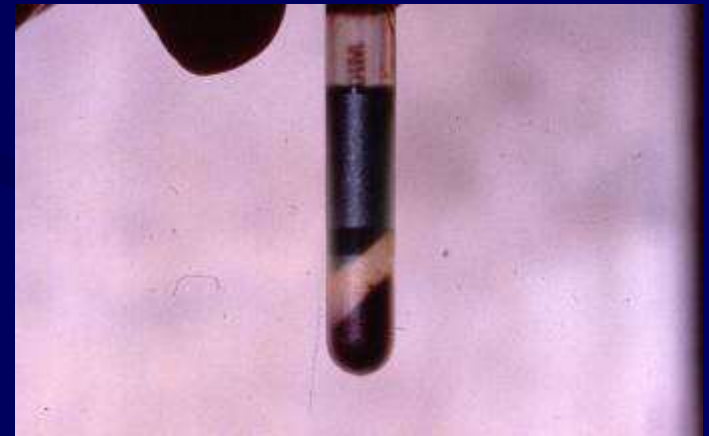


PCV/TP data from 2 sites

- Cape Romain, SC (N=28)
 - PCV=46.6%, Sdev 3.36
 - TP=4.16 g/dl, Sdev 0.53
- Georgia (N=73)
 - PCV=45.14%, Sdev 3.80
 - TP=3.86 g/dl, Sdev 0.63

What is a plasma chemistry panel and what does it tell you?

- Kidney fxn: uric acid, blood urea nitrogen (BUN)
- Liver fxn: AST, ALT, LDH, Bile acid, biliverdin
- Calcium/phosphorus
- Electrolytes
- CPK
- Triglycerides, cholesterol
- glucose



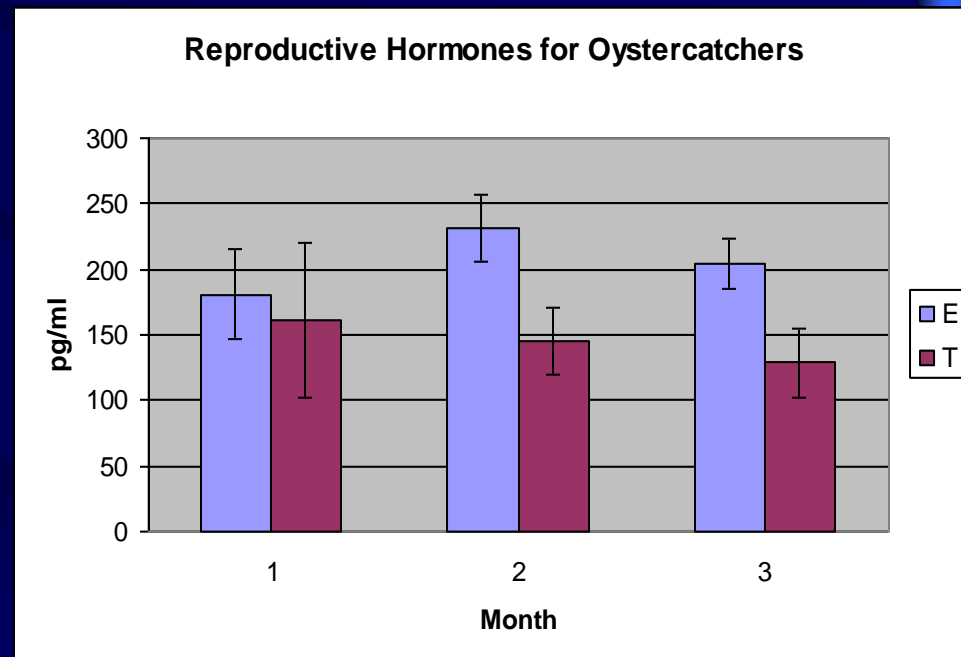
Infectious Disease Diagnostics

- Aspergillosis: most common fungal disease found in birds (34% weak to mod Ab titer, 38% Ag positive-indicative of exposure)
- Chlamydia: common bacterial pathogen of birds, zoonotic (Positive antibody titer in 38%-exposure)
- WNV serology (negative)
- Enteric bacterial pathogen culture: negative on live birds, found to be causing problems in a bird that was found ill at CR and died
- Avian influenza (cloacal swabs/SCWDS/neg)

Reproduction

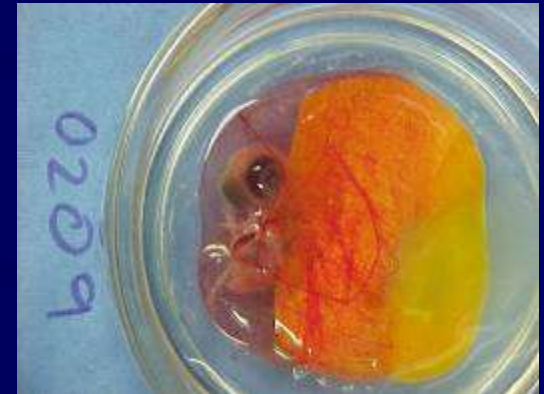


- Territorial nesters
 - Sample collection labor intensive
- Reproductive hormones
 - 17 β estradiol
 - Testosterone



Eggs

- Morphometrics and weight
- Egg shell thickness
- Egg shell porosity
- Contaminants in yolk
- Histopathology of embryos



Plasma vitellogenin levels

- **Protein that is made in the liver**
- **Under estrogen control**
- **Taken up by developing oocytes**
- **Primary function: nutritional source for embryo**
- **Females produce in relatively high concentrations as the egg develops**
- **Developing an ELISA test to measure in plasma**
- **Presence in males would indicate exposure to estrogen-like contaminants**
- **Excellent biomarker for estrogen mimicking pesticides in other species**

Contaminants

- Contaminant levels on blood, feathers, tissue, egg yolk, and prey items
- Measurable levels of DDT/DDE and their metabolites
- Low levels of mercury and toxaphene



Contaminant Panel

- **Mercury***
- **Arsenic***
- **Zinc**
- **Lead***
- **Chromium**
- **Copper**
- **Tin**
- **Strontium**
- **vanadium**
- **PCBs**
- **DDT and metabolites***
- **DDE***
- **Toxaphene***
- **Chlordanes**
- **Benzene hexachloride**

Internal and external parasites

- Fecal exam O/P
- *Eimeria* spp (coccidia)
 - Renal
 - Intestinal
- Acanthocephalans
- Cestodes
- Lice
 - *Saemundssoria haematopi*
 - Mild, moderate to heavy loads

Pathology

Cape Romain/SCWDS

- Elbow injury, anemic, mildly elevated WBC, low body weight, pectoral muscle atrophy
- GI cestodes-heavy load
- Acute severe necrotizing pancreatitis
- Moderate to severe broncointerstitial pneumonia
- Salmonella cultured from lung and GIT-light growth
- Toxicology pending
- Suspect problems secondary to elbow injury and inability to forage adequately

Cape May, Massachusetts, Predation



- Septic pectoral muscle wound
 - Necrosis
 - Hemorrhage
- Pectoral muscle atrophy
- Intestinal coccidiosis
- Suspect predation

Cape Romain, SC

- Injured from cannon net
- Good body condition
- Mild renal coccidiosis
- Focal granulomatous oophoritis with intralesional yolk material



Nutrition

- Vitamin A/E/D
- Identify and collect prey species that AMOY are eating at various locations
- Analyze nutritional content of prey items as indicator of habitat resources
- Undergraduate student senior thesis
- Dr. Ellen Dierenfield



Vitamin A status is a useful parameter from a nutritional perspective and its decline in plasma can be indicative of exposure to environmental contaminants



Ear abscesses

- **Vitamin A def**
- **OC toxicity**

Prey items observed being fed upon and subsequently analyzed

- Eastern Oyster (*Crassostrea virginica*)
- Blood Ark Clam (*Anadara ovalis*)
- False Angel Wing (*Petricola pholadiformis*)
- crabs and polychaete worms.
- Mussels, clams and oysters collected over several months in 2003 from CR as a continuation of this study



Knob Whelks (*Busycon carica*)



Analytical Results

Proximate Composition:

←----- % Dry Matter Basis ----->

Sample	Location	% Water	Crude Protein	Crude Fat	Ash
Blood Ark ± 0.24	SCI	79.86 ± 0.03	59.473 ± 2.76	8.86 ± 0.14	19.16
Eastern Oyster ±4.28	SCI	79.86 ± 0.25	48.87 ± 5.27	9.80 ± 4.81	26.60
Eastern Oyster	CRNWR	83.80 ± 0.46	46.50 ± 3.47	14.65 ± 1.51	36.14 ± 8.96
Knob Whelk	SCI	73.35 ± 1.67	59.95 ± 1.55	10.55 ± 2.84	11.78 ± 2.45
False Angel Wings 77.48 ± 2.45 (with shell)	SCI	62.94 ± 5.82	13.74 ± 0.33	6.52 ± 0.14	
False Angel Wings 79.54 ± 2.02	CRNWR	60.02 ± 2.02	13.10 ± 0.80	7.64 ± 1.19	

Analytical Results

Vitamins A and E:

←----- IU/kg Dry Matter Basis -----→

Sample	Location	Vitamin A	Vitamin E
Blood Ark	SCI	28057.5 ± 29862.3	99.44 ± 34.65
Eastern Oyster	SCI	34327.7 ± 25752.3	191.76 ± 20.62
Eastern Oyster	CRNWR	34921.08 ± 3899.47	285.23 ± 11.26
Knob Whelk	SCI	3365.7*	118.18 ± 15.32
False Angel Wings (with shell)	SCI	10617.33 ± 4285.17	58.86 ± 18.09
False Angel Wings (with shell)	CRNWR	29183.98 ± 551.83	71.61 ± 14.18

Analytical Results

MacroMineral Content:

←----- % Dry Matter Basis ----->

Sample	Location	% Ca	% P	% Na	% Mg
Blood Ark	SCI	1.61	0.63	2.00	0.40
Eastern Oyster	SCI	4.43	0.72	2.20	0.36
Eastern Oyster	CRNWR	6.72	0.61	2.73	0.45
Knob Whelk	SCI	0.65	0.48	0.93	0.67
False Angel Wing (with shell)	SCI	21.2	0.25	0.40	0.21
False Angel Wing (with shell)	CRNWR	19.5	0.20	0.41	0.24

Analytical Results

Trace Mineral Content:

←----- mg/kg Dry Matter Basis ----->

Sample	Location	Cu	Fe	Se	Zn
Blood Ark	SCI	2.7	688	3.0	107
Eastern Oyster	SCI	29.6	458	2.0	453
Eastern Oyster	CRNWR	70.0	959	2.7	625
Knob Whelk	SCI	10.9	118	1.0	172
False Angel Wing (with shell)	SCI	3.9	1670	1.0	13.8
False Angel Wing (with shell)	CRNWR	9.5	3265	1.1	15.8

Plasma Vitamin A, E, D

- (Vit E and A) Extremely elevated especially vitamin A levels, these values would almost appear toxic in other species



Overview of Preliminary Nutrition Results

- Opportunistic feeders
- Prey items
 - high in water content
 - High in protein
 - low in fat content
- *P. pholadiformis* has particularly high ash content because AMOY eat them with the shells on
- Regardless of shell, Ca content higher than expected based on human food comparisons

Discussion (cont.)

- **Minimum Ca:P ratio 1.5:1, but as high as 10:1 (even without shells!!)**
- **Mineral content, particularly trace minerals, may be best indicator of habitat quality**
- **Vitamin A content 11,000 – 35,000 IU/kg DM,**
 - **expected for carnivores**
- **Vitamin E in whole prey ranged from 60 to about 300 IU/kg**
 - **expected for carnivores**
 - **oysters high in E activity**

THE END



