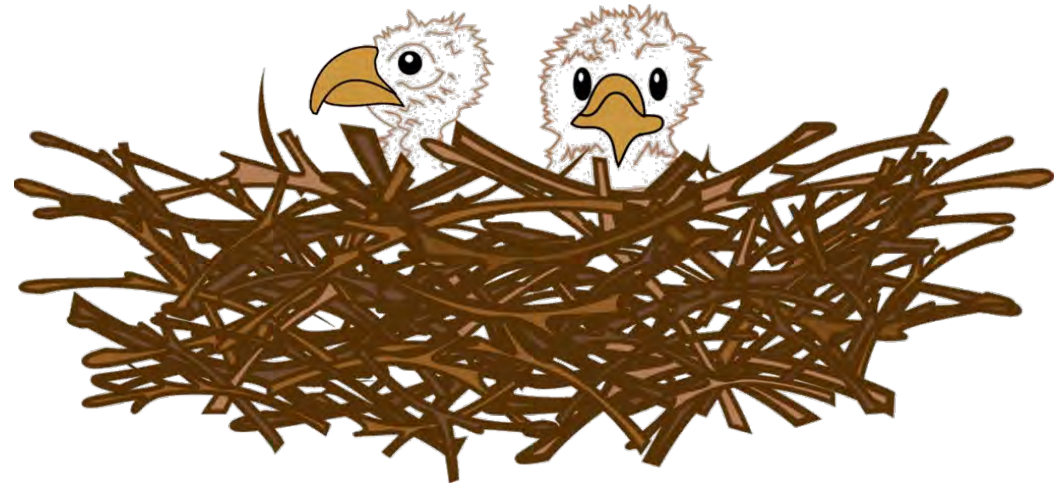


Annual International Conference

2008

Wildlife Disease Association
Edmonton
3-8 August 2008



Avian Filarioid Nematodes of the World

Cheryl M. Bartlett, PhD

Canada Research Chair in Integrative Science
Professor of Biology
Sydney, Nova Scotia

CAPE BRETON
UNIVERSITY

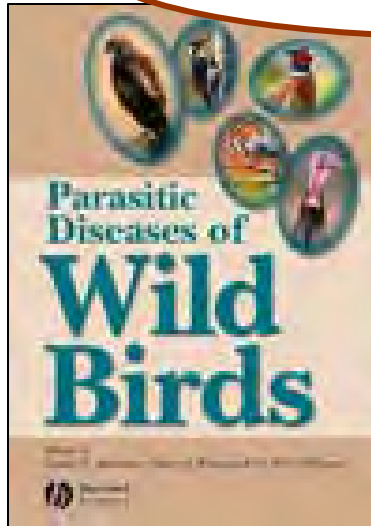


ABSTRACT: Filarioids are highly specialized nematode parasites whose adults live in the tissues and tissue spaces of birds, mammals, amphibians, and reptiles. Females produce microfilariae (MF) that enter the host's blood or skin. Synoptic understandings about filarioids in birds, especially their diversity, distributions, and pathogenicity are now available for the first time with the completion of an extensive literature review. Such reveals about 160 described species and 16 valid genera. Only *Pelecitus* occurs in hosts other than just birds and, while considerable host survey work remains to be done, *Pelecitus* also appears to be the most broadly distributed genus with reports from 17 avian orders. *Chandlerella* is known from 13 and *Paronchocerca*, *Splendidofilaria* and *Cardiofilaria* from 11. With notable exceptions, avian filarioids are not pathogenic, and most cases are associated with adult worms in the heart muscles or lumen, major blood vessels, or brain (e.g. some species of *Sarconema*, *Paronchocerca*, *Chandlerella*, and *Splendidofilaria*) or near joints in the legs and feet (e.g. species of *Pelecitus*). However, the majority of species whose adults live in these sites are not pathogenic. Moreover, a species pathogenic in an individual bird may not be pathogenic in other birds of the same species. And, worms pathogenic in one or more species of birds may not be pathogenic in other species. Pathogenicity is even more rarely reported in association with MF. The normally blood-borne MF of *Splendidofilaria caperata* become trapped and provoke chronic inflammation in tissues near adults in crows. Skin-inhabiting MF of *Eulimdana clava* might be a factor in feather loss in pigeons.

Avian Filarioid Nematodes

SYNOPSIS

6 major topics



*based on
Chapter 26
by C. Bartlett*



Edited by

Carter T. Atkinson
Nancy J. Thomas
D. Bruce Hunter

Parasitic Diseases
of Wild Birds

2008

 **WILEY-BLACKWELL**

Avian Filarioid Nematodes

SYNOPSIS

Biodiversity

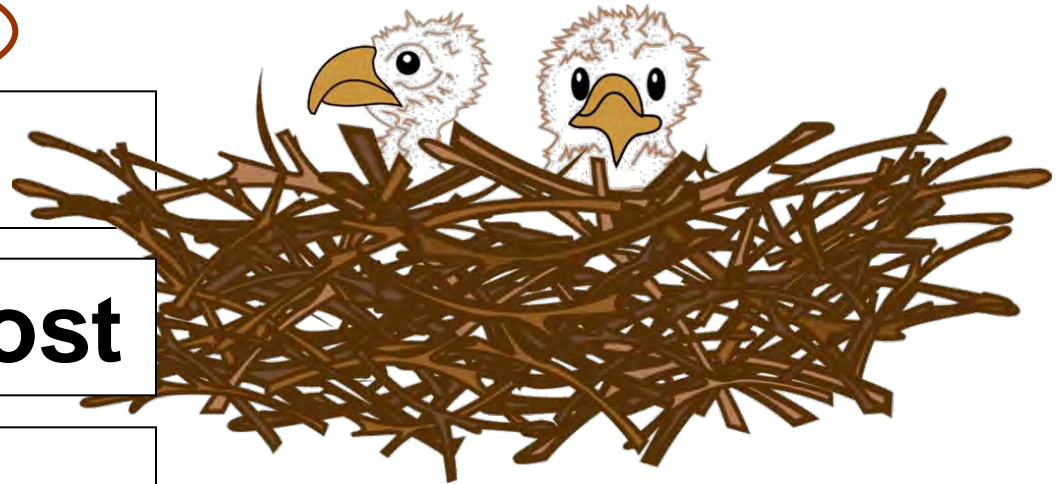
Sites in Bird Host

Life Cycle

Vectors

Host Distributions

Pathogens



*based on Bartlett 2008,
Chapter 26 in:*

**Parasitic Diseases
of Wild Birds**

Carter T. Atkinson } *edited*
Nancy J. Thomas } *by*
D. Bruce Hunter }

 **WILEY-BLACKWELL**

1

Avian Filarioid Nematodes

slender roundworm parasites

Biodiversity

Nematoda

Order Spirurida

Superfamily Filarioidea



parasites of:
birds,
mammals,
reptiles,
amphibians

1

Avian Filarioid Nematodes

Biodiversity

Nematoda

Order Spirurida

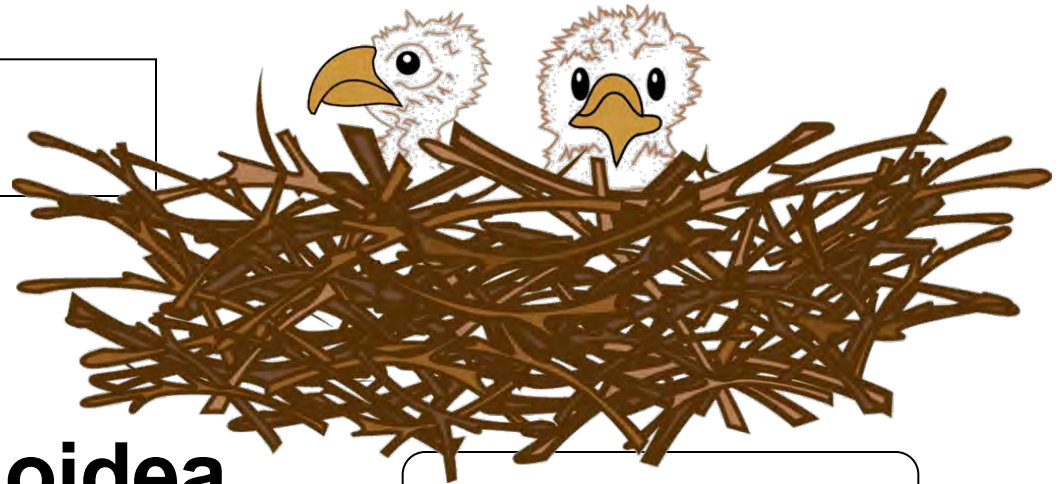
Superfamily Filarioidea

≈ 160 valid species

(numerous synonyms)

16 recognized genera

(31 synonyms)



worldwide

widespread

common

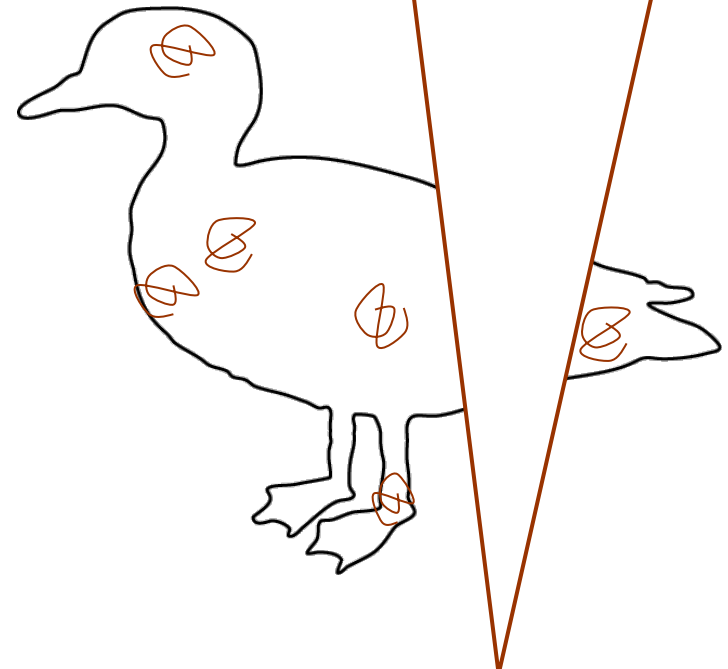
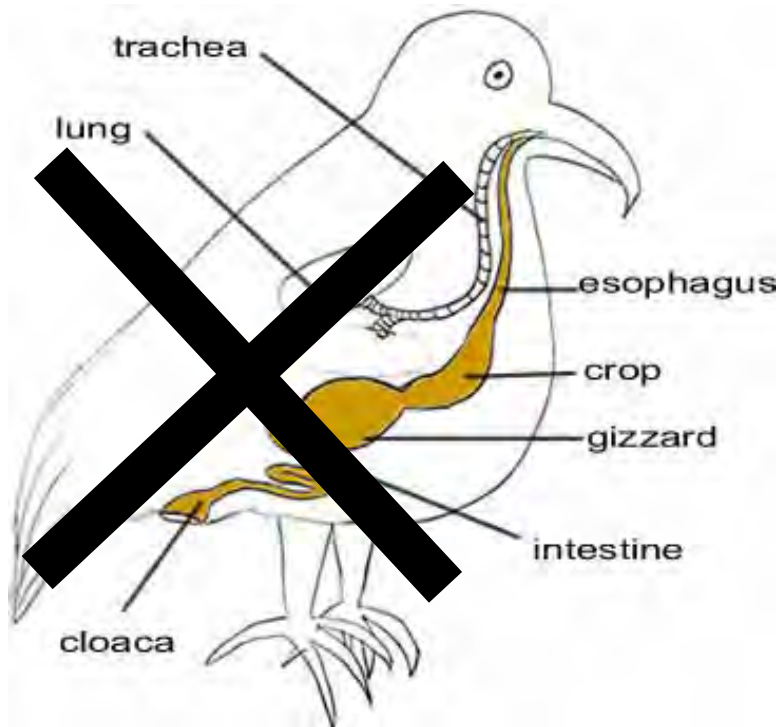
easily overlooked

2a

Avian Filarioid Nematodes

Sites in Bird Host - adult worms

- diverse tissues & tissue spaces
- often very difficult to find



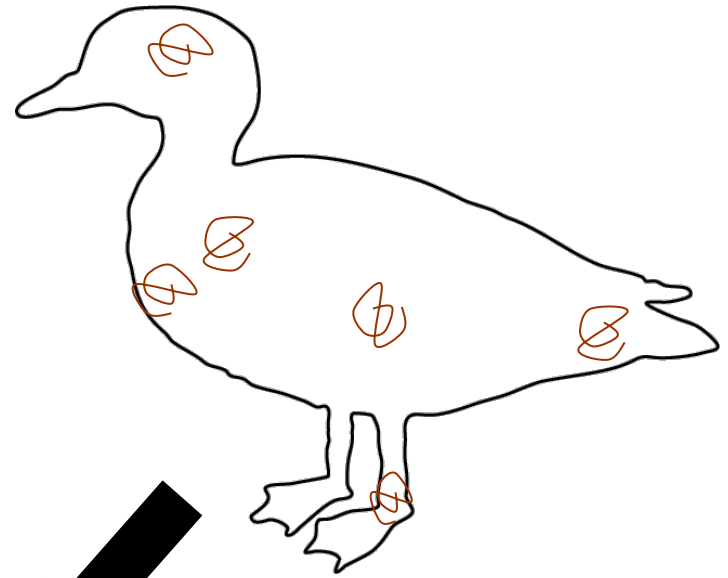
easily overlooked

NEVER: lumen of digestive or respiratory tracts or air sacs

2a

Avian Filarioid Nematodes

**Sites in Bird Host
- adult worms**



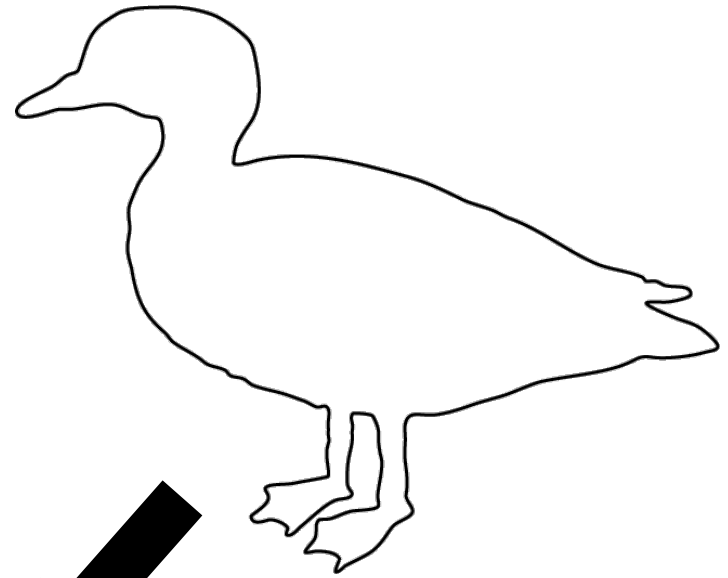
microfilariae (MF)

2b

Avian Filarioid Nematodes

Sites in Bird Host - microfilariae

- **blood**
 - “the rule”
 - species in all genera
- **skin**
 - “little known”
 - some species in 2 genera

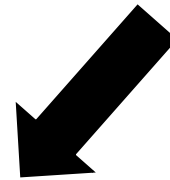
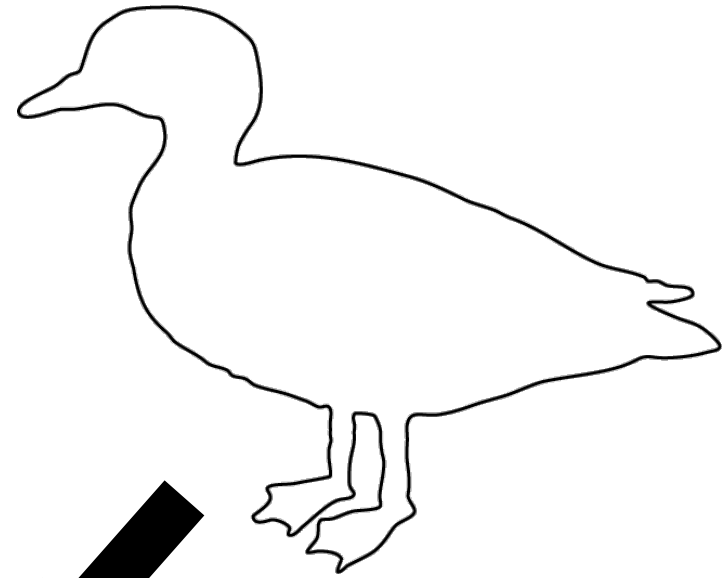
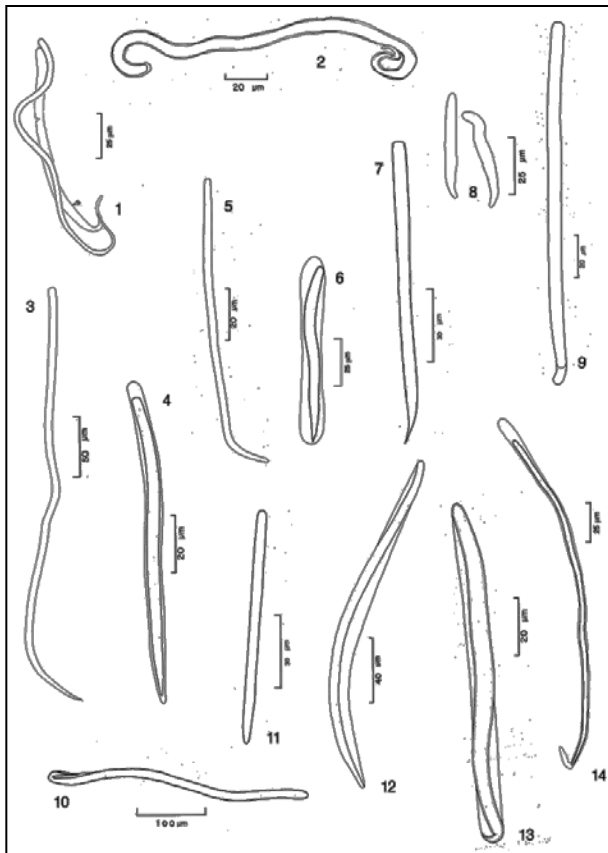


microfilariae (MF)

2b

Avian Filarioid Nematodes

Sites in Bird Host - microfilariae



microfilariae

diverse MF morphology from Bartlett 2008 in *Parasitic Diseases of Wild Birds*

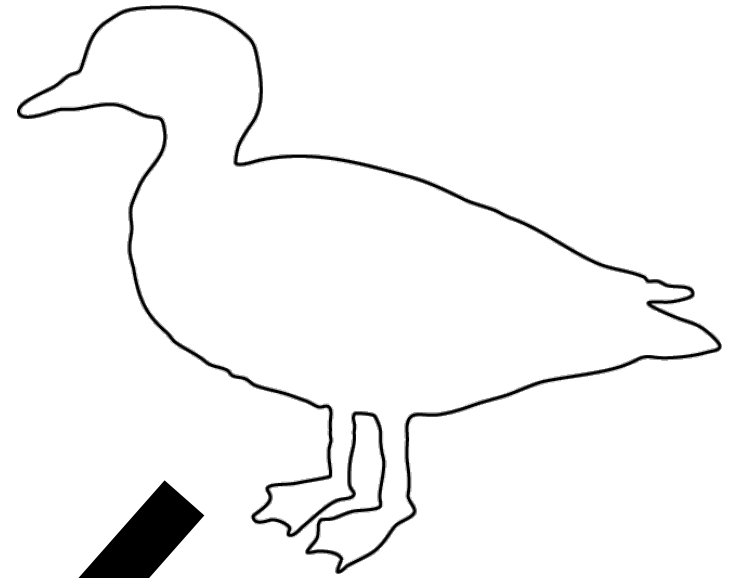
3

Avian Filarioid Nematodes

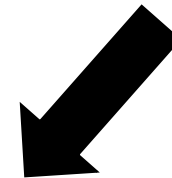
Life Cycle



microfilariae
ingested by
vector



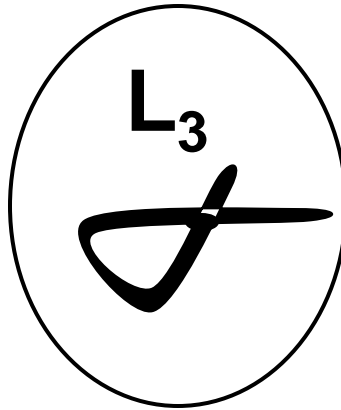
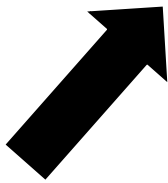
microfilariae (MF)
enter blood or skin



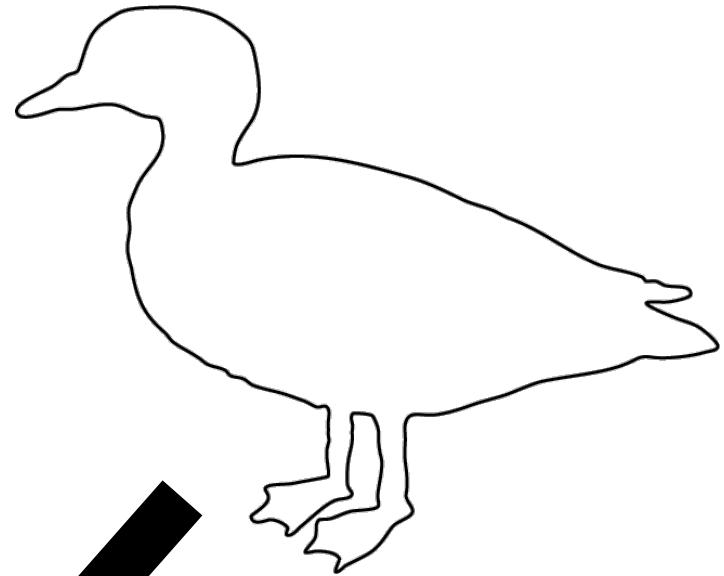
3

Avian Filarioid Nematodes

development to
infective
stage



transmission
to bird



microfilariae
ingested by
vector



microfilariae (MF)
enter blood or skin



4

Avian Filarioid Nematodes

Vectors

19 Filarioids



Lice

5 spp. in 3 genera

MF in skin

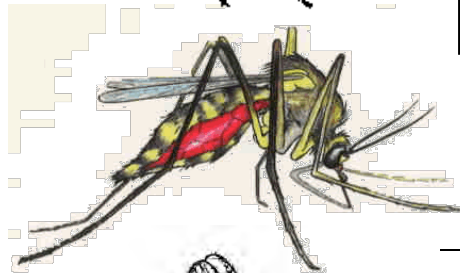
- * *Eulimdana*
- Sarconema*
- * *Pelecitus*



Black Flies

2 spp. in 1 genus

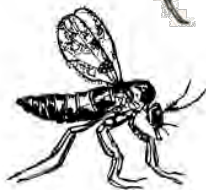
Splendidofilaria



Mosquitoes

3 spp. in 3 genera

Cardiofilaria
Pelecitus
Aproctella



Biting Midges

9 spp. in 3 genera

Chandlerella
Eufilaria
Splendidofilaria

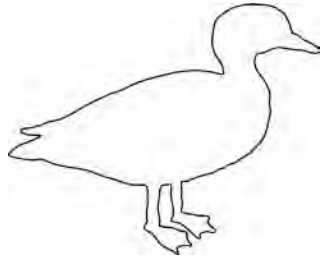
5a

Avian Filarioid Nematodes

Host Distributions

by bird order

27 bird orders



- Struthioniformes
- Rheiformes
- Casuariiformes
- Apterygiformes
- Tinamiformes
- Sphenisciformes
- Gaviiformes
- Podicipediformes
- Procellariiformes
- Pelecaniformes
- Ciconiiformes
- Anseriformes
- Falconiformes
- Galliformes
- Gruiformes
- Charadriiformes
- Columbiformes
- Psittaciformes
- Cuculiformes
- Strigiformes
- Caprimulgiformes
- Apodiformes
- Coliiformes
- Trogoniformes
- Coraciiformes
- Piciformes
- Passeriformes

Host Distributions

by bird order

Pelecitus

Struthioniformes

Paro

Pseu

Stri

Apro

Card

Ande

Chan

Sple

Dess

Lemd

Apro

Sarc

Euli

Eufi

MF

a

ia

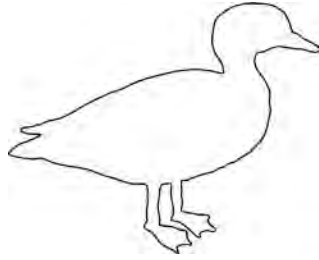
a

ria

aria

a

27 bird orders



Pelecanus

Struthiofilaria

Paronchocera

Pseudomida

Struthiofilaria

Aprocella

Cardiophila

Andesconfilaria

Chandlerei

Spleidofilaria

Dessettila

Lemata

Aproctiana

Sarconema

Eulimdana

Eufilaria

MF

16 parasite genera
(adult parasites)

Struthioniformes

Rheiformes

Casuariiformes

Apterygiformes

Tinamiformes

Sphenisciformes

Gaviiformes

Podicipediformes

Procellariiformes

Pelecaniformes

Ciconiiformes

Anseriformes

Falconiformes

Galliformes

Gruiformes

Charadriiformes

Columbiformes

Psittaciformes

Cuculiformes

Strigiformes

Caprimulgiformes

Apodiformes

Coliiformes

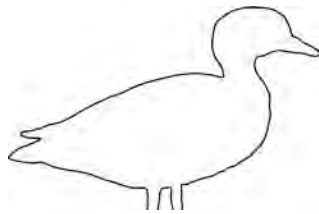
Trogoniformes

Coraciiformes

Piciformes

Passeriformes

27 bird orders



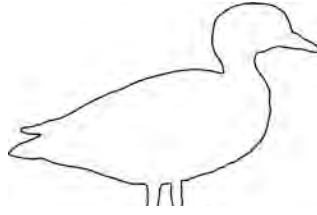
= reported

	<i>Pelecitus</i>	<i>Struthiofilaria</i>	<i>Paronchocera</i>	<i>Pseudomuda</i>	<i>Striofilaria</i>	<i>Aprocella</i>	<i>Cardiilabia</i>	<i>Andesofilaria</i>	<i>Chandlerella</i>	<i>Spleidofilaria</i>	<i>Dessetillara</i>	<i>Lemalia</i>	<i>Apractiana</i>	<i>Sarconema</i>	<i>Eulimdana</i>	<i>Eufilaria</i>
--	------------------	------------------------	---------------------	-------------------	---------------------	------------------	--------------------	----------------------	---------------------	-----------------------	---------------------	----------------	-------------------	------------------	------------------	------------------

16 parasite genera (adult parasites)

Struthioniformes																
Rheiformes																
Casuariiformes																
Apterygiformes																
Tinamiformes																
Sphenisciformes																
Gaviiformes																
Podicipediformes																
Procellariiformes																
Pelecaniformes																
Ciconiiformes																
Anseriformes																
Falconiformes																
Galliformes																
Gruiformes																
Charadriiformes																
Columbiformes																
Psittaciformes																
Cuculiformes																
Strigiformes																
Caprimulgiformes																
Apodiformes																
Coliiformes																
Trogoniformes																
Coraciiformes																
Piciformes																
Passeriformes																

MF



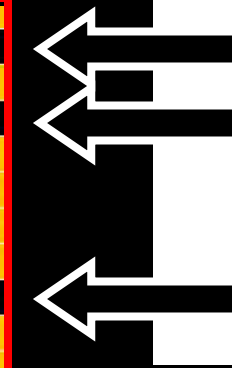
= reported

16 parasite genera (adult parasites)

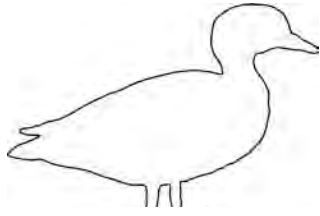


27 bird orders

	<i>Pelecanus</i>	<i>Struthiofilaria</i>	<i>Paronchocera</i>	<i>Psephenoida</i>	<i>Struthiofilaria</i>	<i>Aprocella</i>	<i>Carduifilaria</i>	<i>Andesonfia</i>	<i>Chandlerella</i>	<i>Splendidofilaria</i>	<i>Dessoffilaria</i>	<i>Lemalia</i>	<i>Aproctiana</i>	<i>Sarconema</i>	<i>Eulimdana</i>	<i>Eufilaria</i>
Struthioniformes																
Rheiformes																
Casuariiformes																
Apterygiformes																
Tinamiformes																
Sphenisciformes																
Gaviiformes																
Podicipediformes																
Procellariiformes																
Pelecaniformes																
Ciconiiformes																
Anseriformes																
Falconiformes																
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Gruiformes																
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Strigiformes																
Caprimulgiformes																
Apodiformes																
Coliiformes																
Trogoniformes																
Coraciiformes																
Piciformes																
Passeriformes																



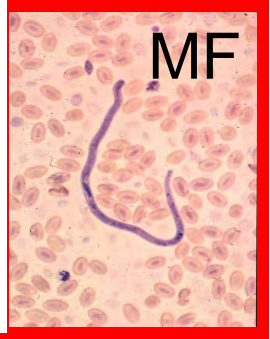
3 orders
... no reports
of adults
or
MF



= reported

<i>Pelecitus</i>
<i>Struthiofilaria</i>
<i>Paronchocera</i>
<i>Psephenoides</i>
<i>Struthiofilaria</i>
<i>Aprocella</i>
<i>Carduillaria</i>
<i>Andesconfaria</i>
<i>Chandlerei</i>
<i>Spleidofilaria</i>
<i>Dessetiella</i>
<i>Lemaria</i>
<i>Aproctiana</i>
<i>Sarconema</i>
<i>Eulimdana</i>
<i>Eufilaria</i>

16 parasite genera
(adult parasites)



27 bird orders

Struthioniformes



jdpics.com

Rheiformes

Pelecaniformes



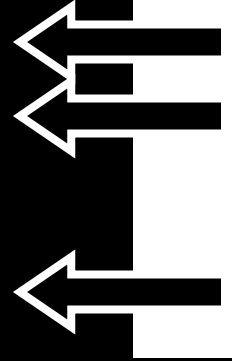
Apterygiformes

Diomedea melanophrys

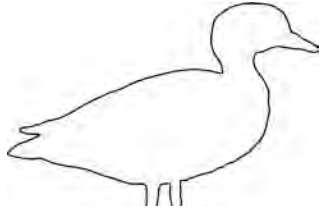


John Gould

Procellariiformes



3 orders
... no reports
of adults
or MF



5 parasite genera broad host distribution

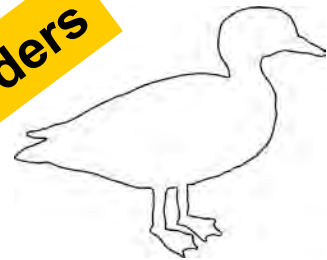
■ = reported

Pelecetus	Struthiofilaria	Arnonchocerca	Pseudoremdana	Struthiofilaria	Aprpetella	ardiofilaria	Andersonfilaria	handerele	pleurodofilaria	Dessfilaria	Lemdana	Aprocciana	Sarcophaga	Eulidana	Eufilaria	Mf
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27 bird orders

	Pelecetus	Struthiofilaria	Arnonchocerca	Pseudoremdana	Struthiofilaria	Aprpetella	ardiofilaria	Andersonfilaria	handerele	pleurodofilaria	Dessfilaria	Lemdana	Aprocciana	Sarcophaga	Eulidana	Eufilaria	Mf
Struthioniformes	■	■	■		■				■	■							
Rheiformes																	
Casuariiformes	■		■				■		■	■							
Apterygiformes																	
Tinamiformes			■														
Sphenisciformes			■														
Gaviiformes										■							
Podicipediformes	■																
Procellariiformes	■																
Pelecaniformes	■		■						■								
Ciconiiformes			■														
Anseriformes										■					■		
Falconiformes							■		■			■					
Galliformes			■			■			■					■			■
Gruiformes	■								■								
Charadriiformes						■	■		■						■		
Columbiformes									■	■							
Psittaciformes													■				
Cuculiformes			■						■								■
Strigiformes						■			■			■					
Caprimulgiformes									■								
Apodiformes	■						■									■	
Coliiformes																	
Trogoniformes	■																
Coraciiformes						■		■	■			■					
Piciformes			■				■		■		■					■	
Passeriformes	■		■	■				■	■		■					■	■

orders



5 parasite genera broad host distribution

Parasite Genus	Order 1	Order 2	Order 3	Order 4	Order 5	Order 6	Order 7	Order 8	Order 9	Order 10	Order 11	Order 12	Order 13	Order 14	Order 15	Order 16	Order 17	
<i>Pelecitus</i>	Yellow	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black
<i>Struthiofilaria</i>	Black	Yellow	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black
<i>Paronchocerca</i>	Black	Black	Yellow	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black
<i>Psephodromas</i>	Black	Black	Black	Yellow	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black
<i>Struthiofilaria</i>	Black	Black	Black	Black	Yellow	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black
<i>Apronchocerca</i>	Black	Black	Black	Black	Black	Yellow	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black
<i>Cardiofilaria</i>	Black	Black	Black	Black	Black	Black	Yellow	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black
<i>Andersonfilaria</i>	Black	Black	Black	Black	Black	Black	Black	Yellow	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black
<i>Chandlerella</i>	Black	Black	Black	Black	Black	Black	Black	Black	Yellow	Black	Black	Black	Black	Black	Black	Black	Black	Black
<i>Splendidofilaria</i>	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Yellow	Black	Black	Black	Black	Black	Black	Black
<i>Dessauella</i>	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Yellow	Black	Black	Black	Black	Black	Black
<i>Lemdaia</i>	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Yellow	Black	Black	Black	Black	Black
<i>Aprocyon</i>	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Yellow	Black	Black	Black	Black
<i>Sarcophaga</i>	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Yellow	Black	Black	Black
<i>Eulimnoria</i>	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Yellow	Black
<i>Eufilaria</i>	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Yellow
MF	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black

17

Pelecitus

13

Chandlerella

11

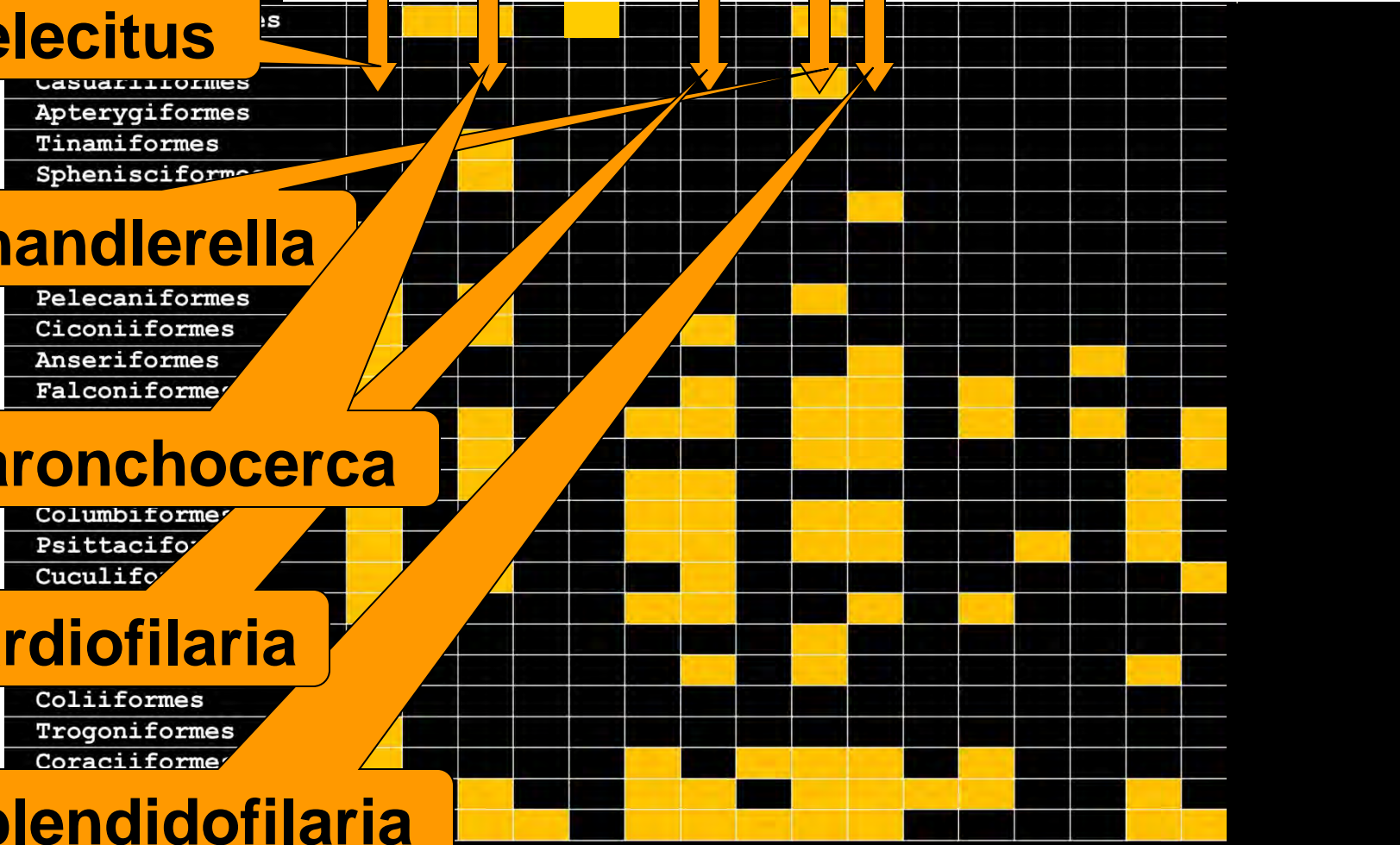
Paronchocerca

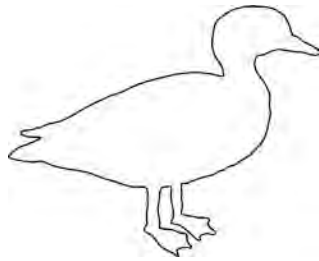
11

Cardiofilaria

11

Splendidofilaria

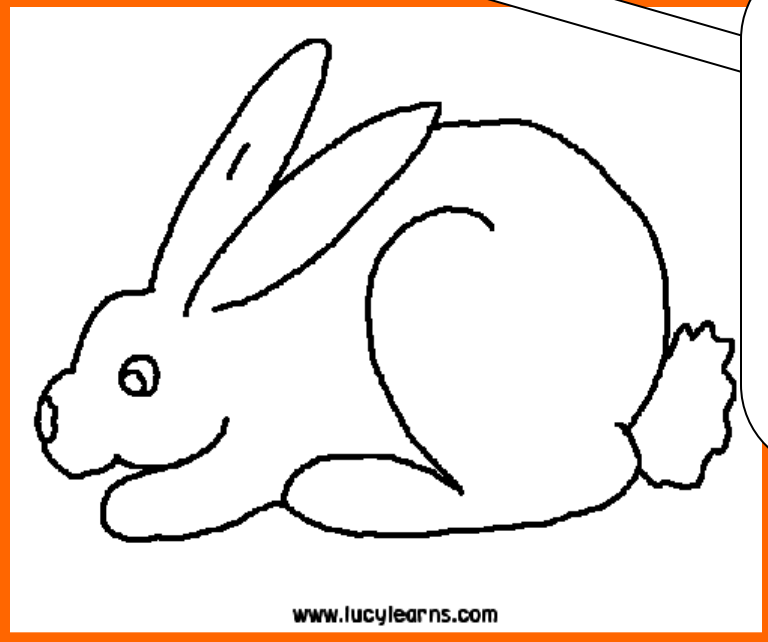
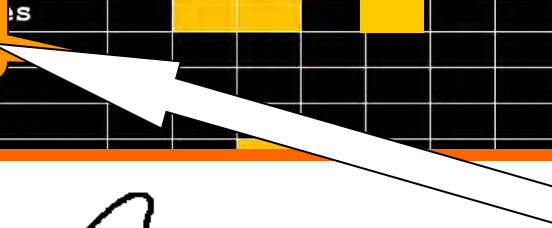




Pelecitus
Struthiofilaria
Paronchocerca
Pseleodana
Struthiofilaria
Apronella
Cardiofilaria
Andersonfilaria
Chanderefilaria
Spleordofilaria
Dessafilaria
Lemda
Aprochiana
Sarcophaga
Eulidana
Eufilaria
Mf

5 parasite genera
broad host distribution

Pelecitus

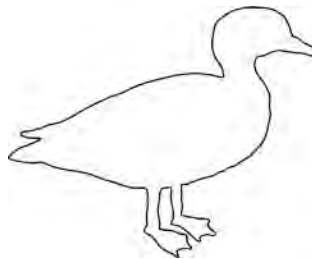


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UNIQUE:
species in birds
AND other
vertebrates
(mammals)

27 bird orders

- Casuariformes
- Apterygiformes
- Tinamiformes
- Sphenisciformes
- Gaviiformes
- Podicipediformes
- Procellariiformes
- Pelecaniformes
- Ciconiiformes
- Anseriformes
- Falconiformes
- Galliformes
- Gruidae
- Charadriiformes
- Coliiformes
- Psittaciformes
- Cuculiformes
- Struthioniformes
- Caprimulgiformes
- Apodiformes
- Coliiformes
- Trogoniformes
- Coraciiformes
- Piciformes
- Passeriformes



<i>Pelecitus</i>	<i>Struthiofilaria</i>	<i>Paronchocerca</i>	<i>Psephenodana</i>	<i>Struthiofilaria</i>	<i>Apronella</i>	<i>Cardiofilaria</i>	<i>Andersonfilaria</i>	<i>Chandereh</i>	<i>Splendordofilia</i>	<i>Dessfilaria</i>	<i>Lemdana</i>	<i>Aprochiana</i>	<i>Sarcophaga</i>	<i>Eulidana</i>	<i>Eufilaria</i>	Mf
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5 parasite genera
broad host distribution

27 bird orders

Struthioniformes		■														
Rheiformes																
Casuariiformes																
Apterygiformes																
Tinamiformes																
Sphenisciformes																
Gaviiformes																
Podicipediformes																
Procellariiformes																
Pelecaniformes																
Ciconiiformes																
Anseriformes																
Falconiformes																
Columbiformes																
Psittaciformes																
Cuculiformes																
Strigiformes																
Caprimulgiformes																
Apodiformes																
Coliiformes																
Trogoniformes																
Coraciiformes																
Piciformes																
Passeriformes																

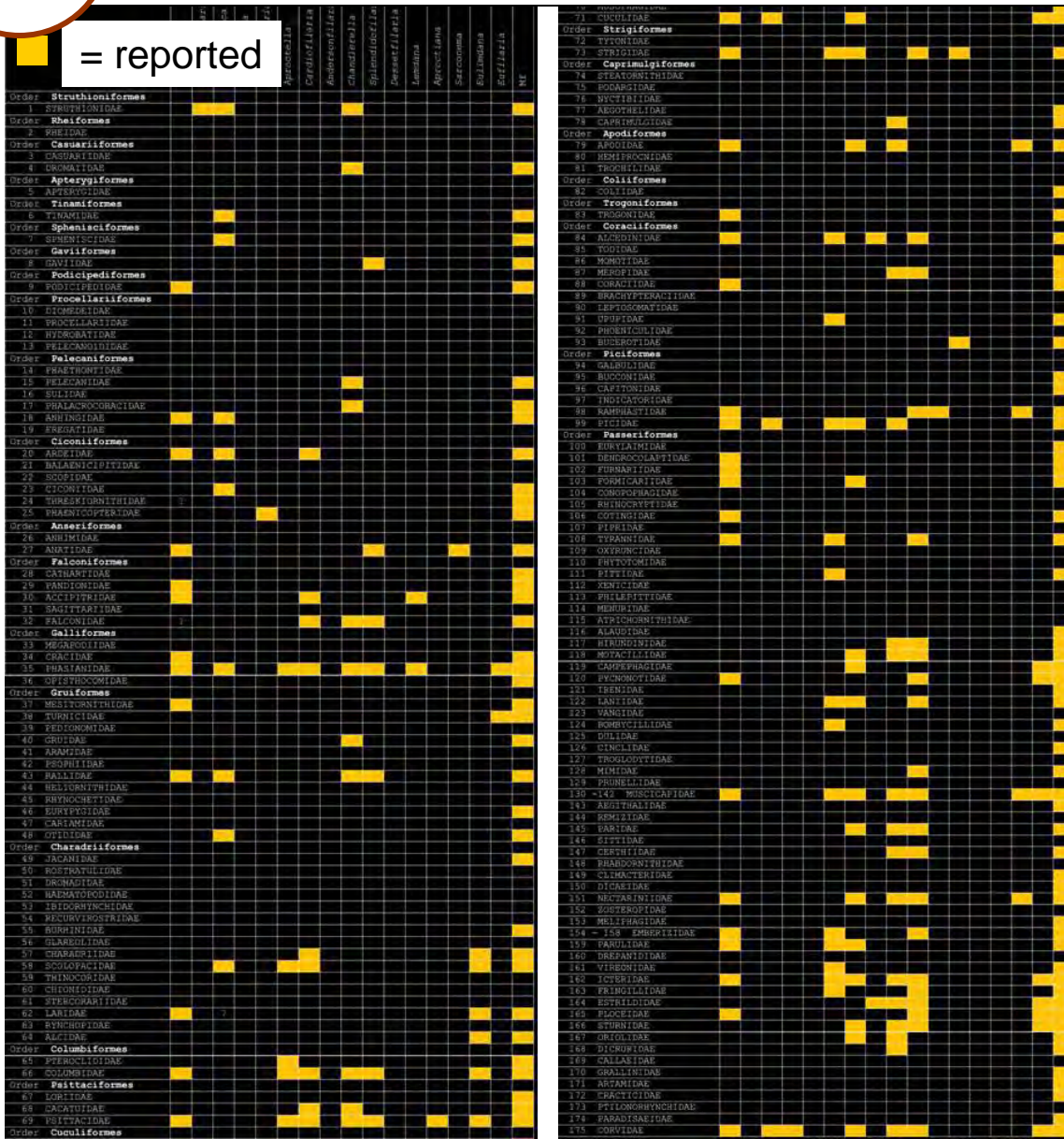
Paronchocerca

UNIQUE:
each species (17)
specific to a
bird family

5b

Host Distributions: by bird family*

 = reported



adult worms



72 of 159
bird families

adult worms
+ MF

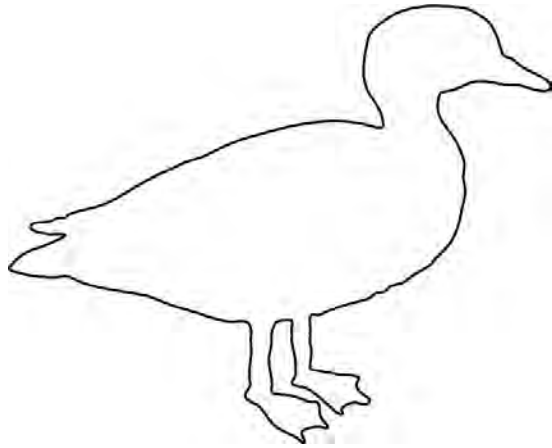


96 of 159
bird families

* families as per Howard & Moore 1984

5c

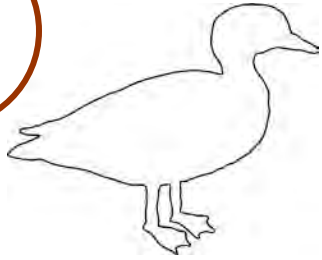
Host Distributions: by bird species



re:
same bird species
OR
individual bird

- multiple infections (≥ 2 genera)
 - 4 genera especially relevant:
Cardiofilaria, Chandlerella, Splendidofilaria, Eufilaria
- concurrent infections (≥ 2 spp. of same genus)
 - 2 genera especially relevant:
Chandlerella, Splendidofilaria

6

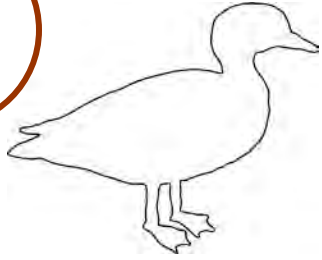


Pathogens

Avian Filarioid Nematodes

GENERAL: very rarely pathogenic

6

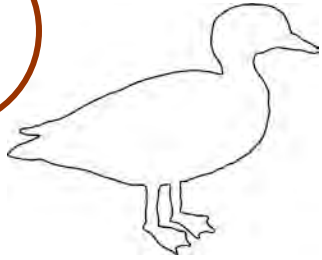


Pathogens

location & host identity important

GENERAL: very rarely pathogenic

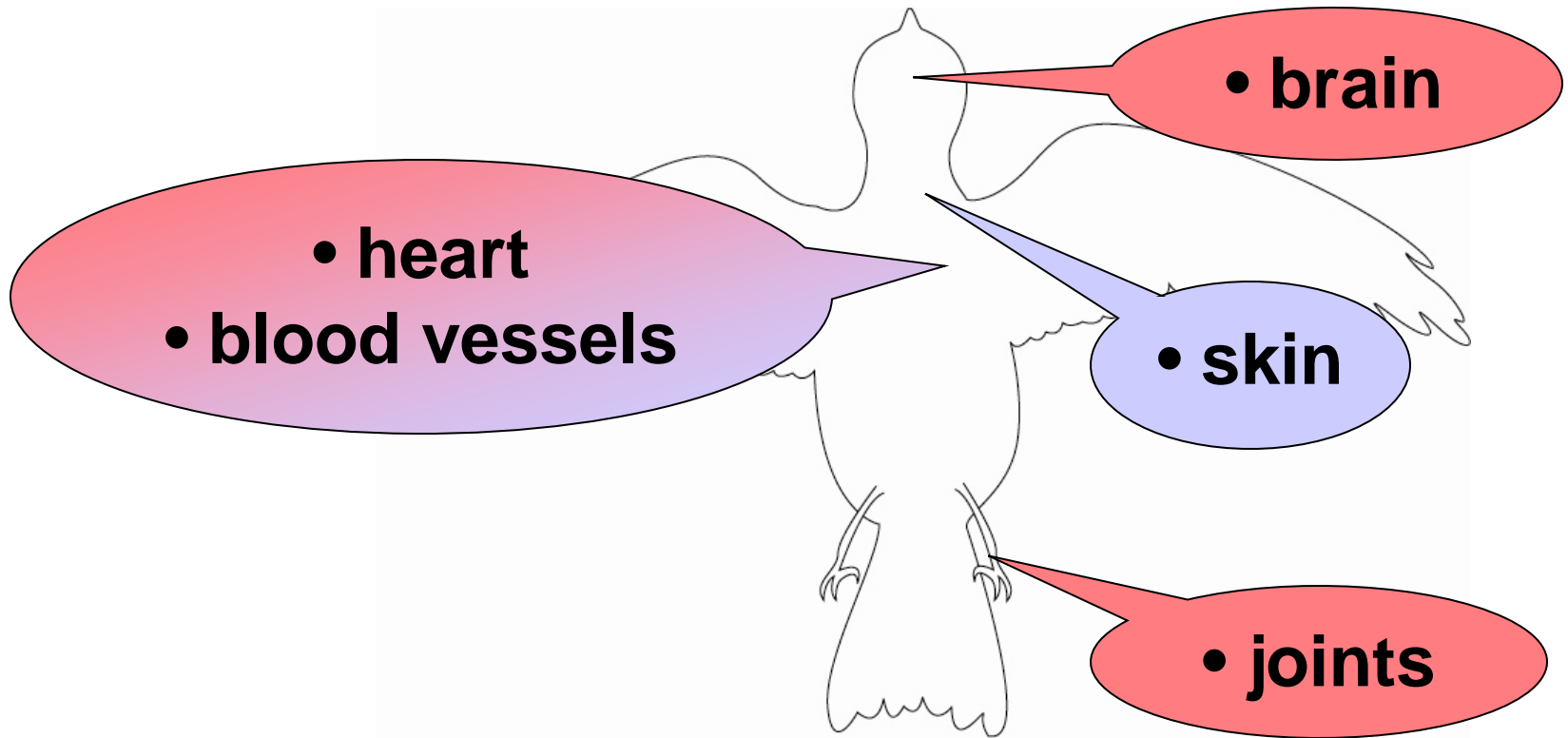
6



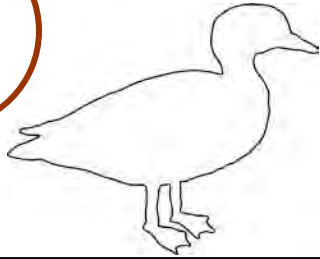
Pathogens

- adult worms
- microfilariae

location & host identity important



6

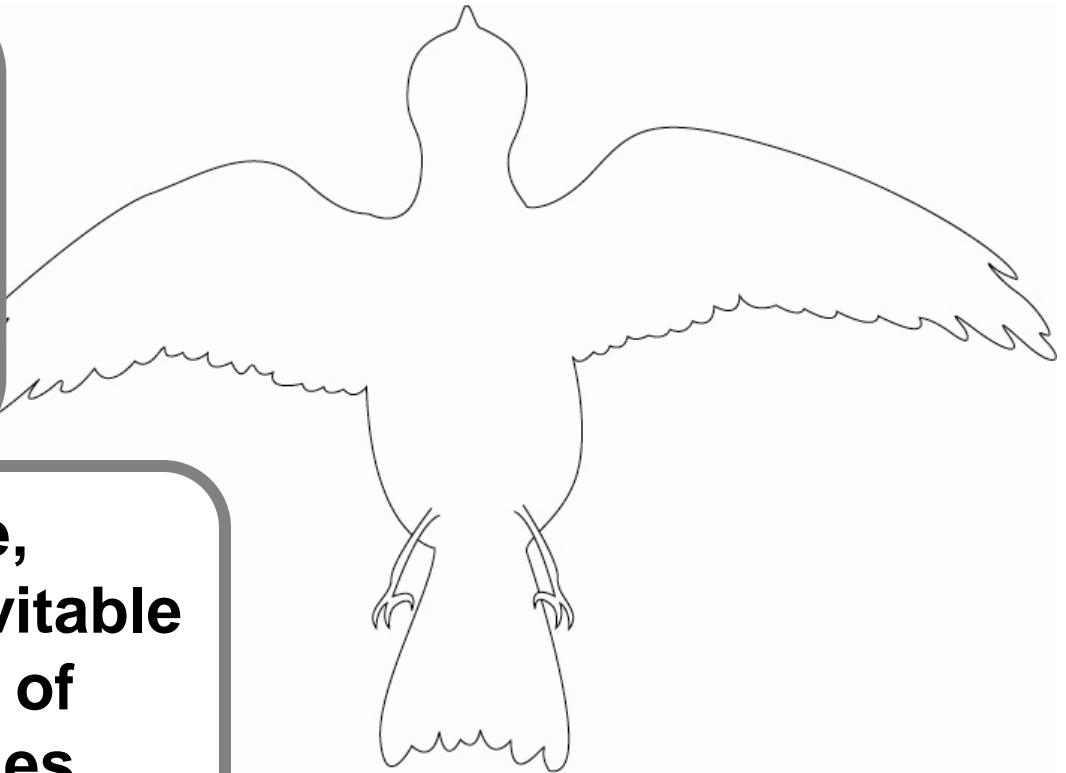


Pathogens

5 examples

**BUT with each:
NO clinical signs
or pathology in
numerous bird
species**

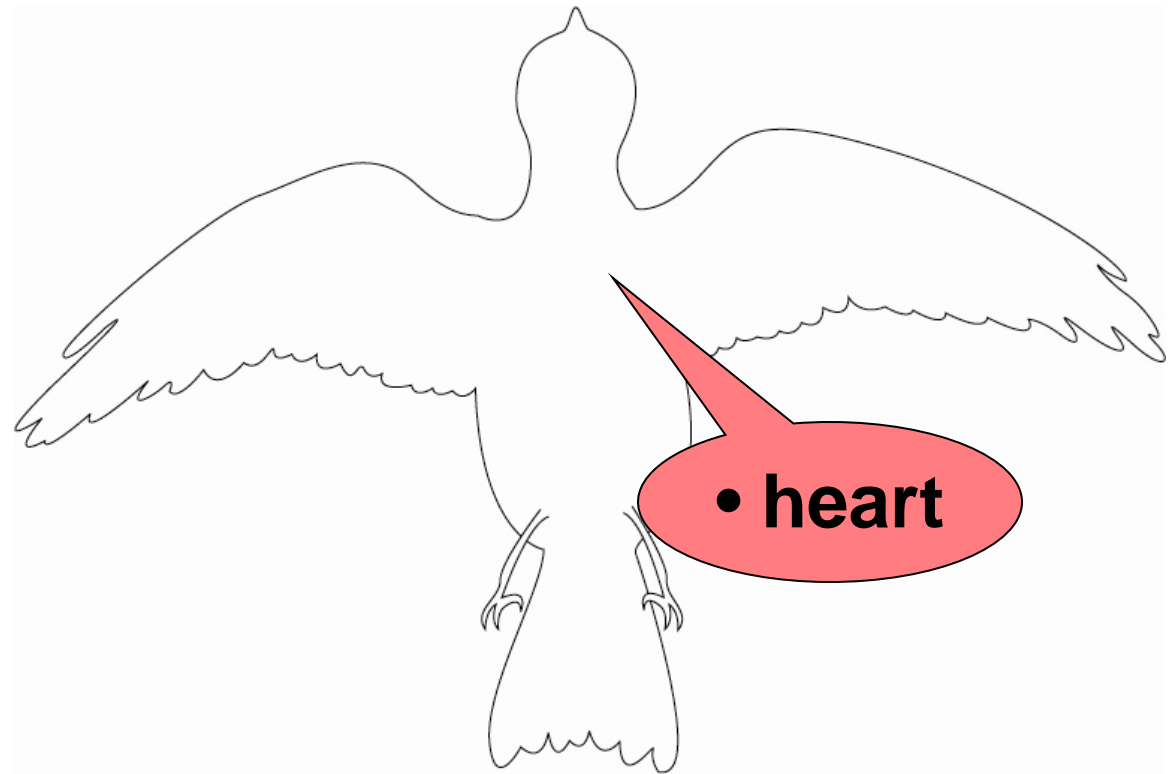
**AND, for some,
pathology NOT inevitable
in all individuals of
same bird species**



6.1

Sarconema eurycerca

- in myocardium (also endocardium)



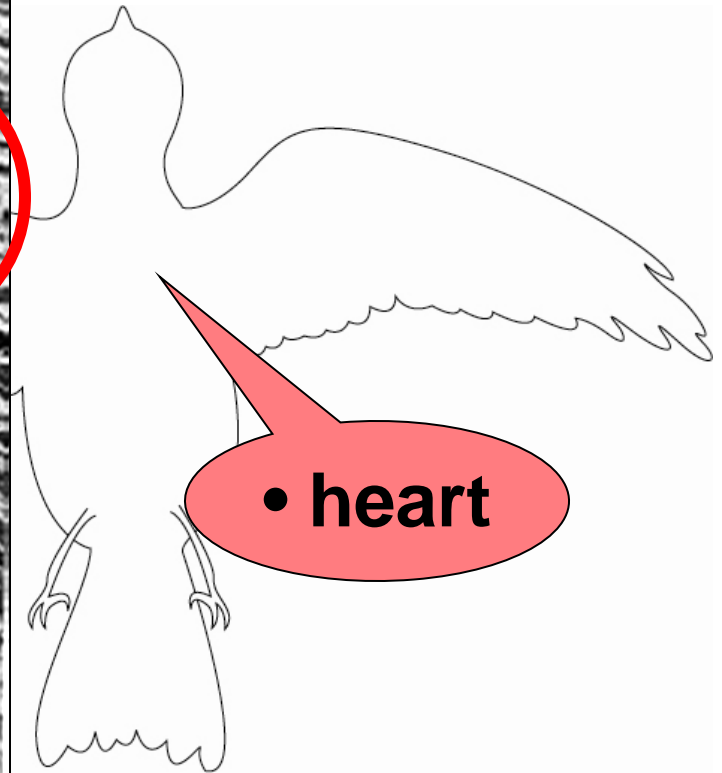
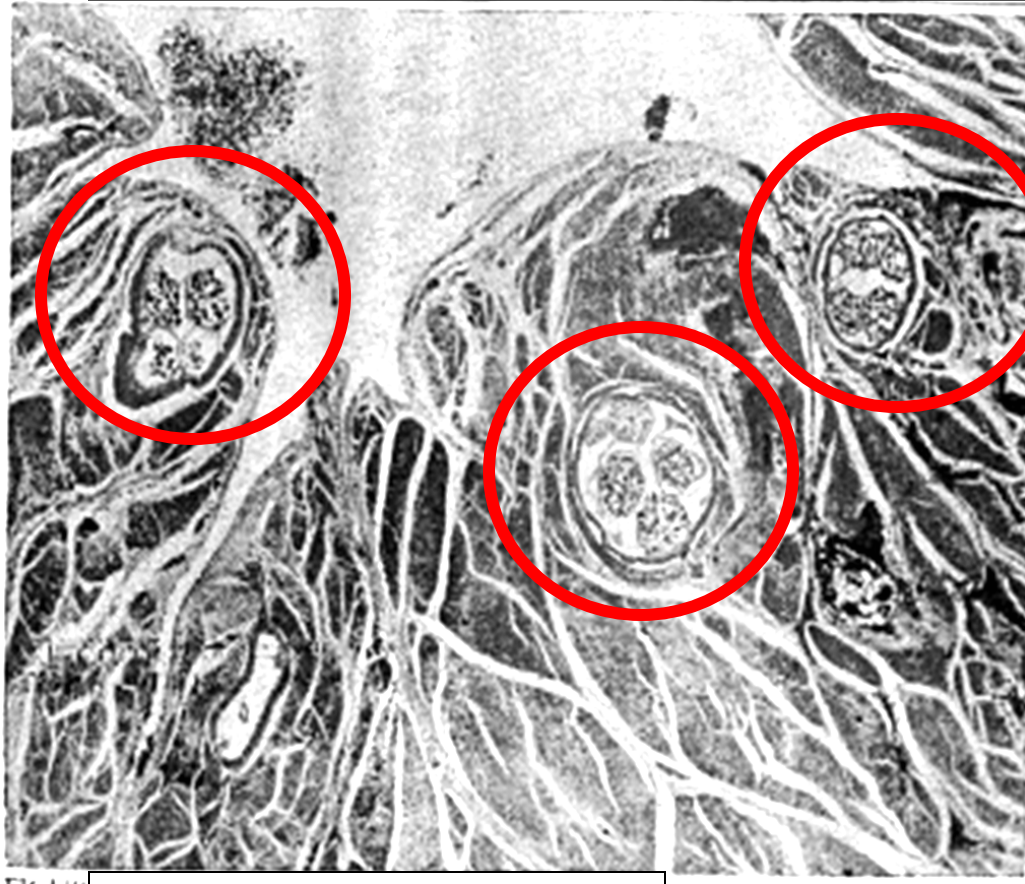
6.1

Pathogen

● adult worms

Sarconema eurycerca

- in myocardium (also endocardium)



from: Kluge 1967, Bull. WDA: 3

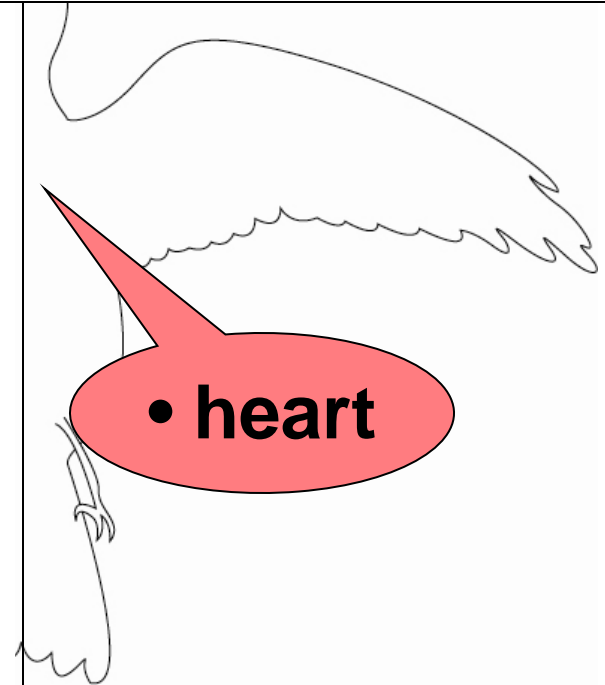
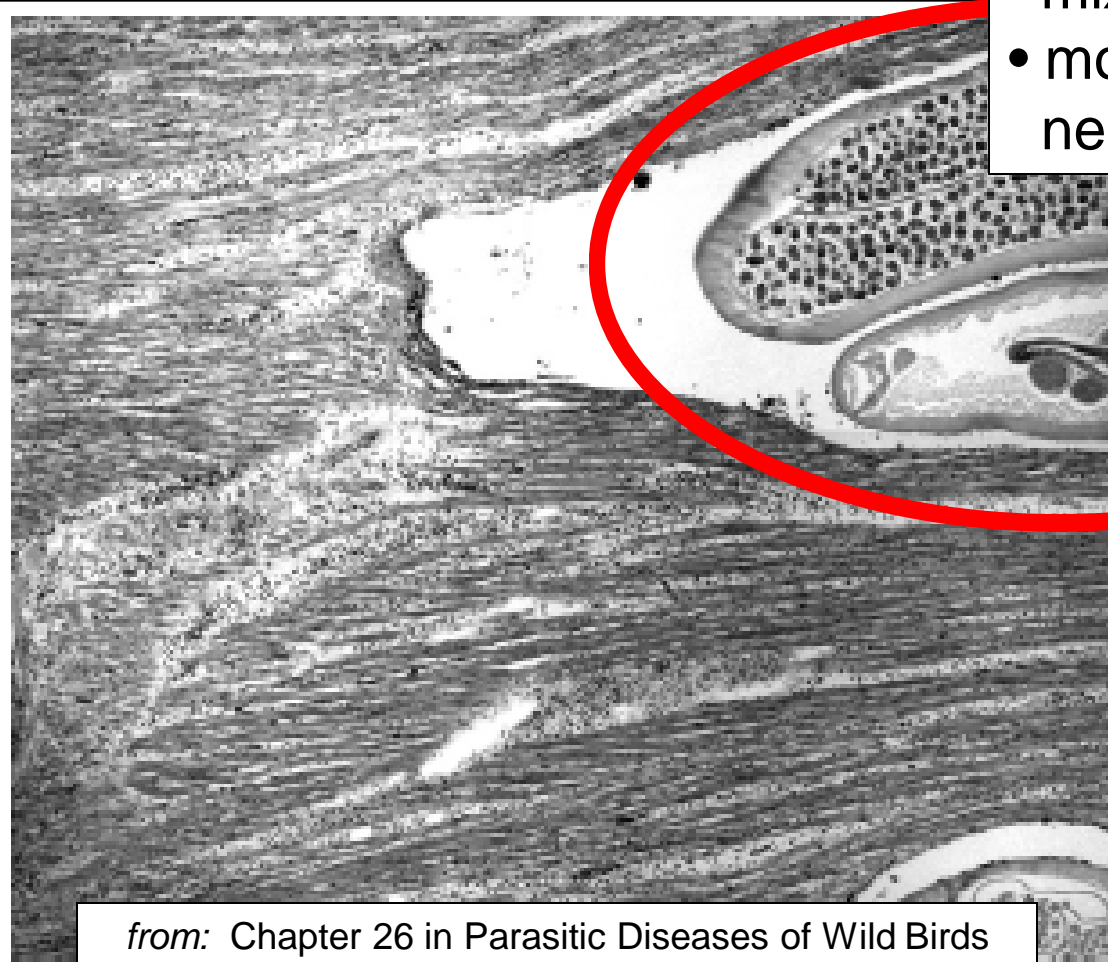
6.1

Pathogen

 adult worms

Sarconema eurycerca - in myocardium

- myofiber separation;
interstitial hemorrhage;
mixed inflammatory infiltrate
- more advanced cases:
necrosis and fibrosis

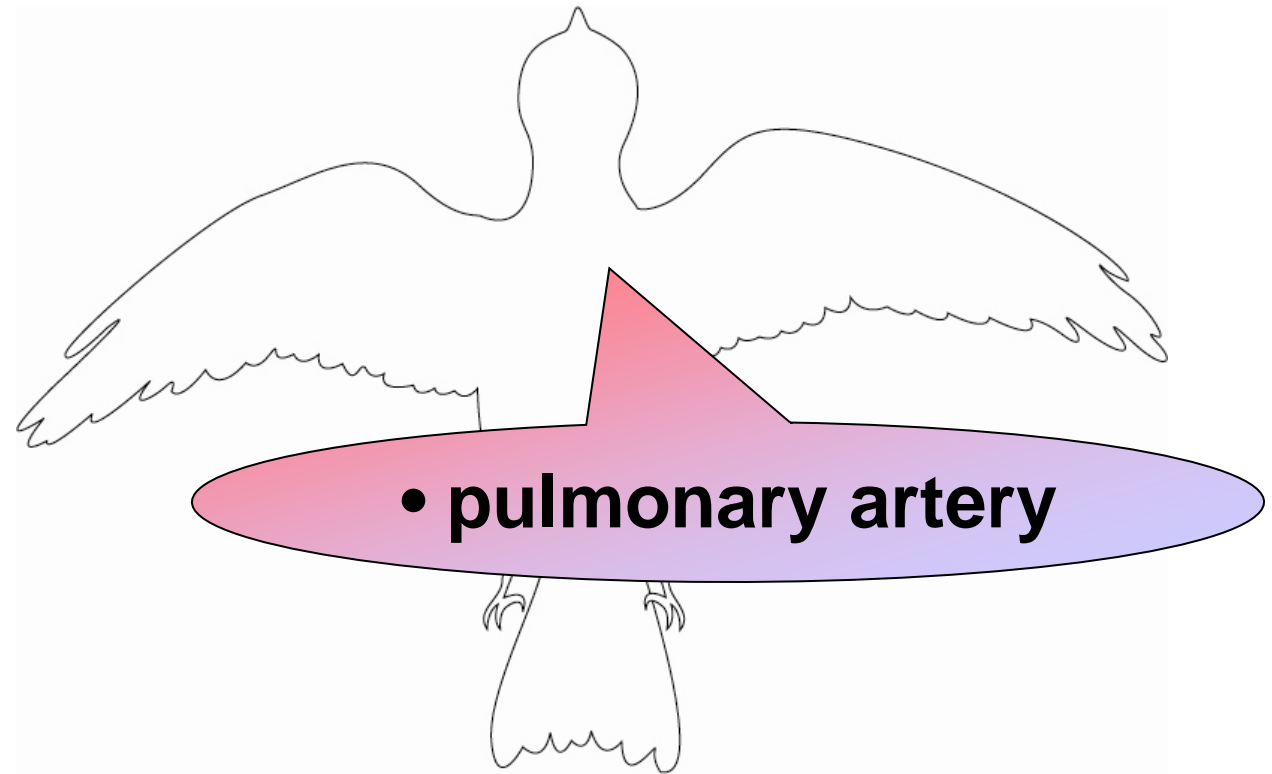


• heart

from: Chapter 26 in Parasitic Diseases of Wild Birds

6.2

Splendidofilaria caperata
- wall of pulmonary artery



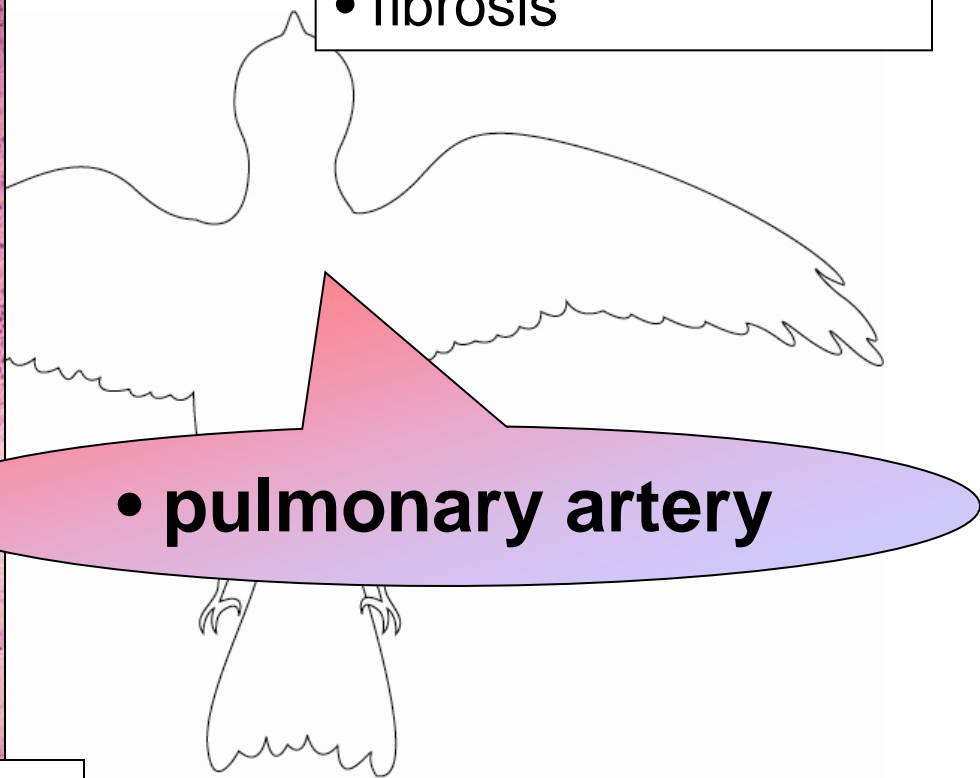
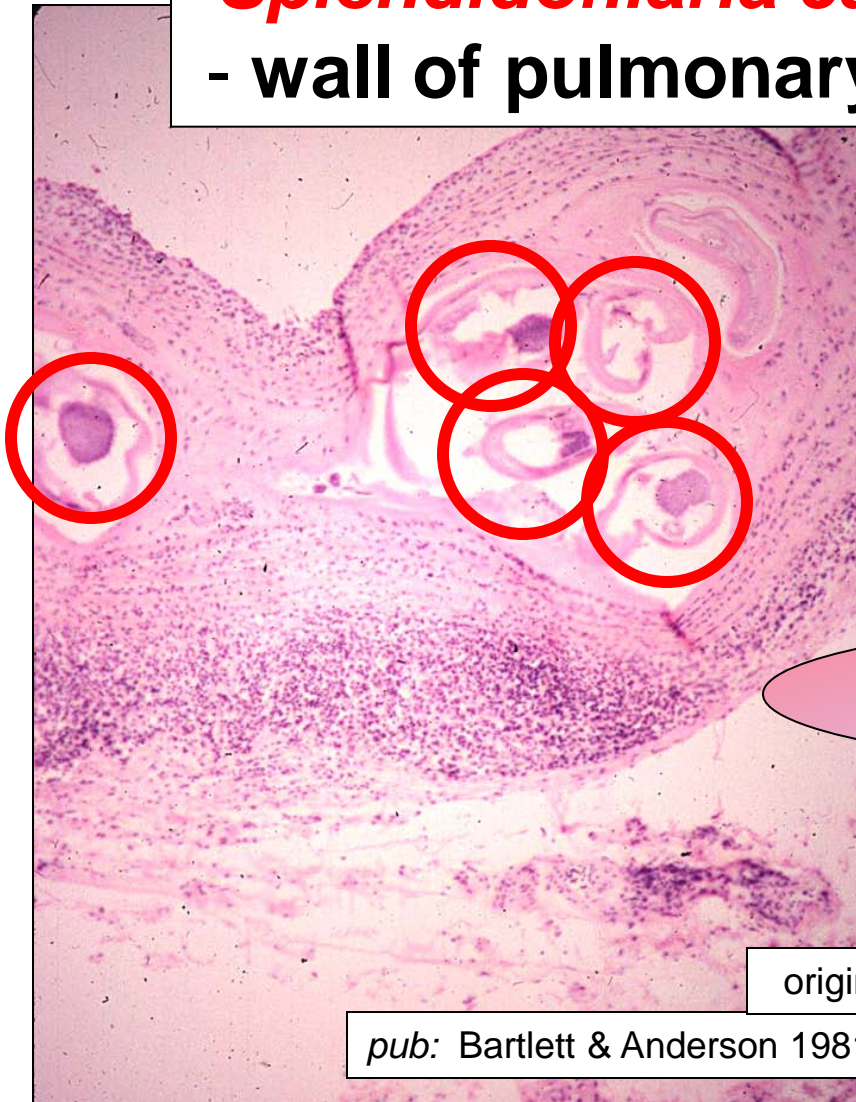
6.2

Pathogen

- adult worms
- microfilariae

Splendidofilaria caperata
- wall of pulmonary artery

- in American crows:
- chronic inflammation
 - fibrosis

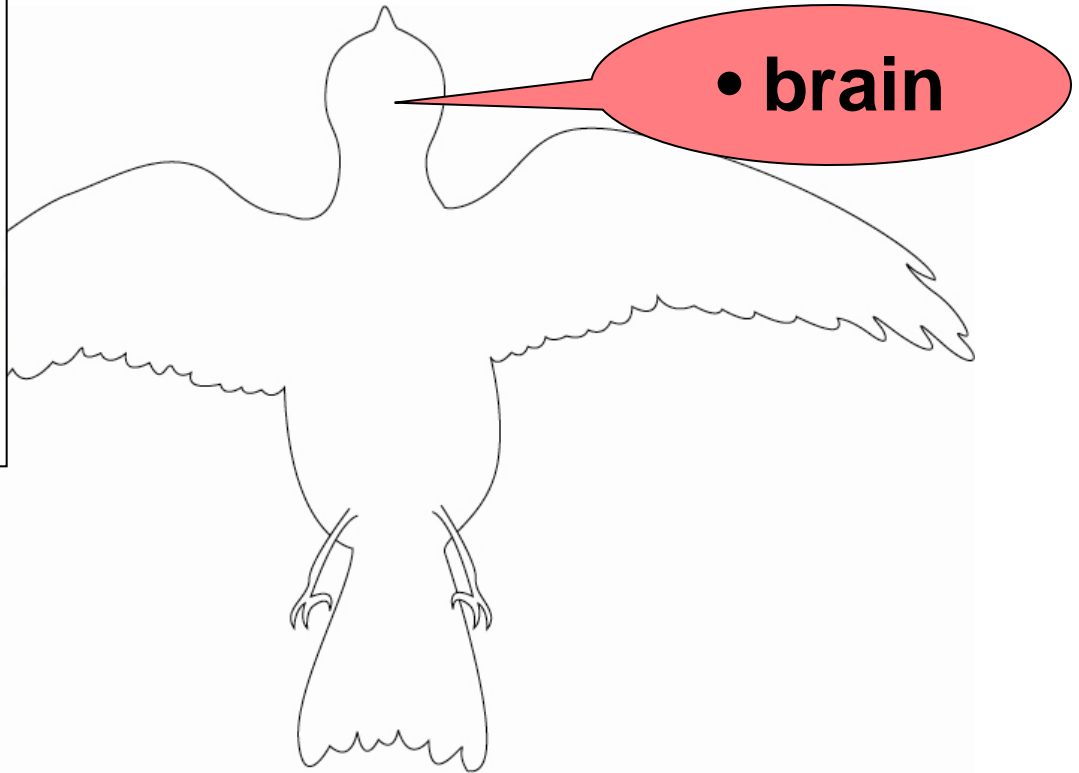
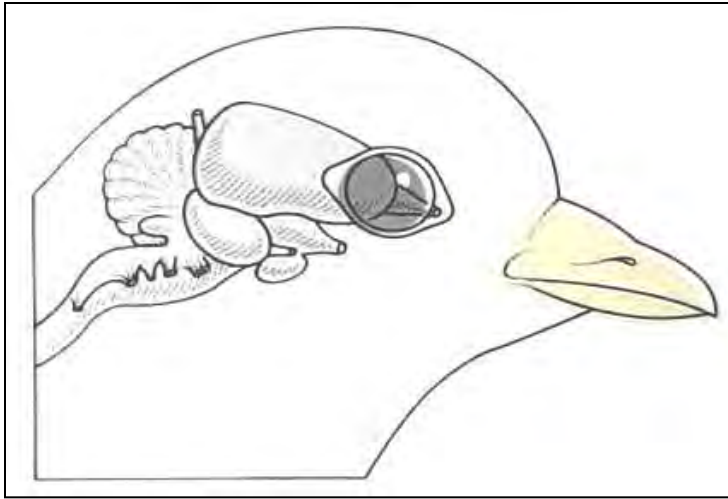


original

pub: Bartlett & Anderson 1981, JWD: 17

6.3

Chandlerella quisicali
- between cerebral hemispheres

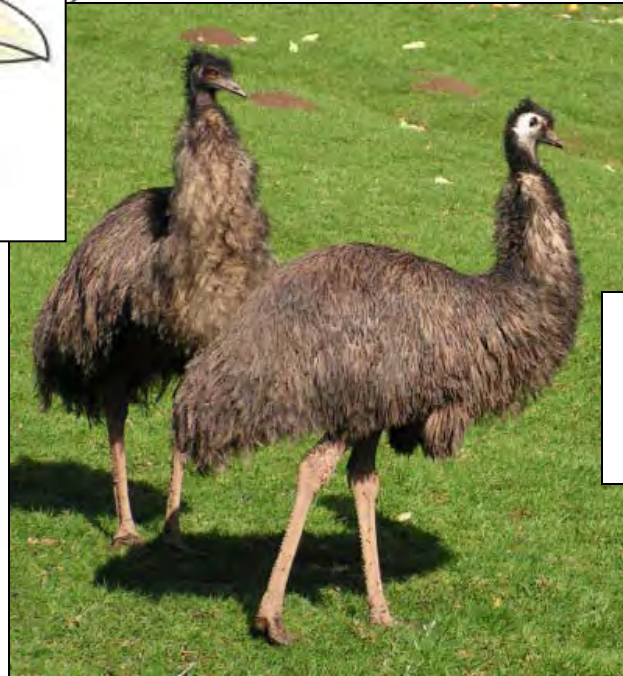
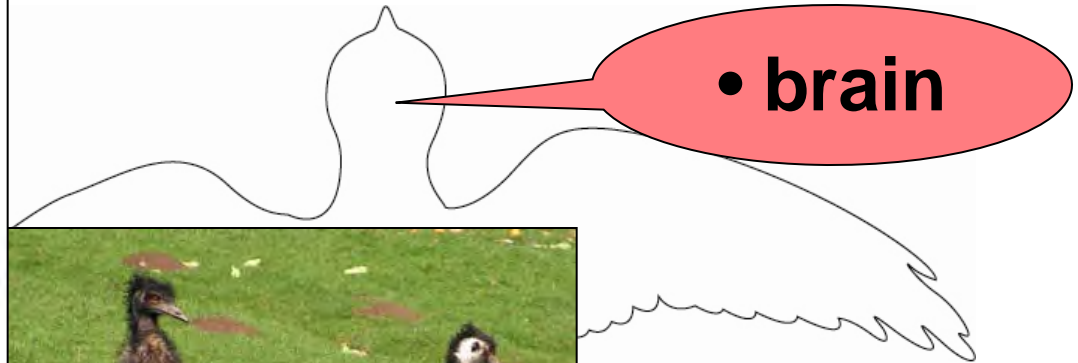
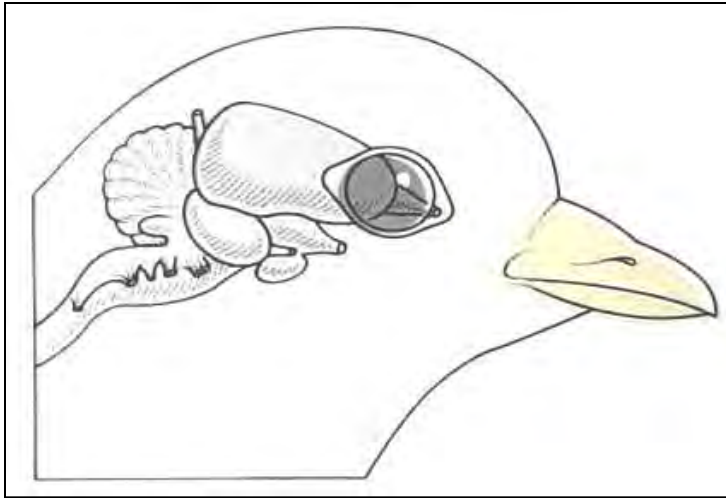


6.3

Pathogen

● adult worms

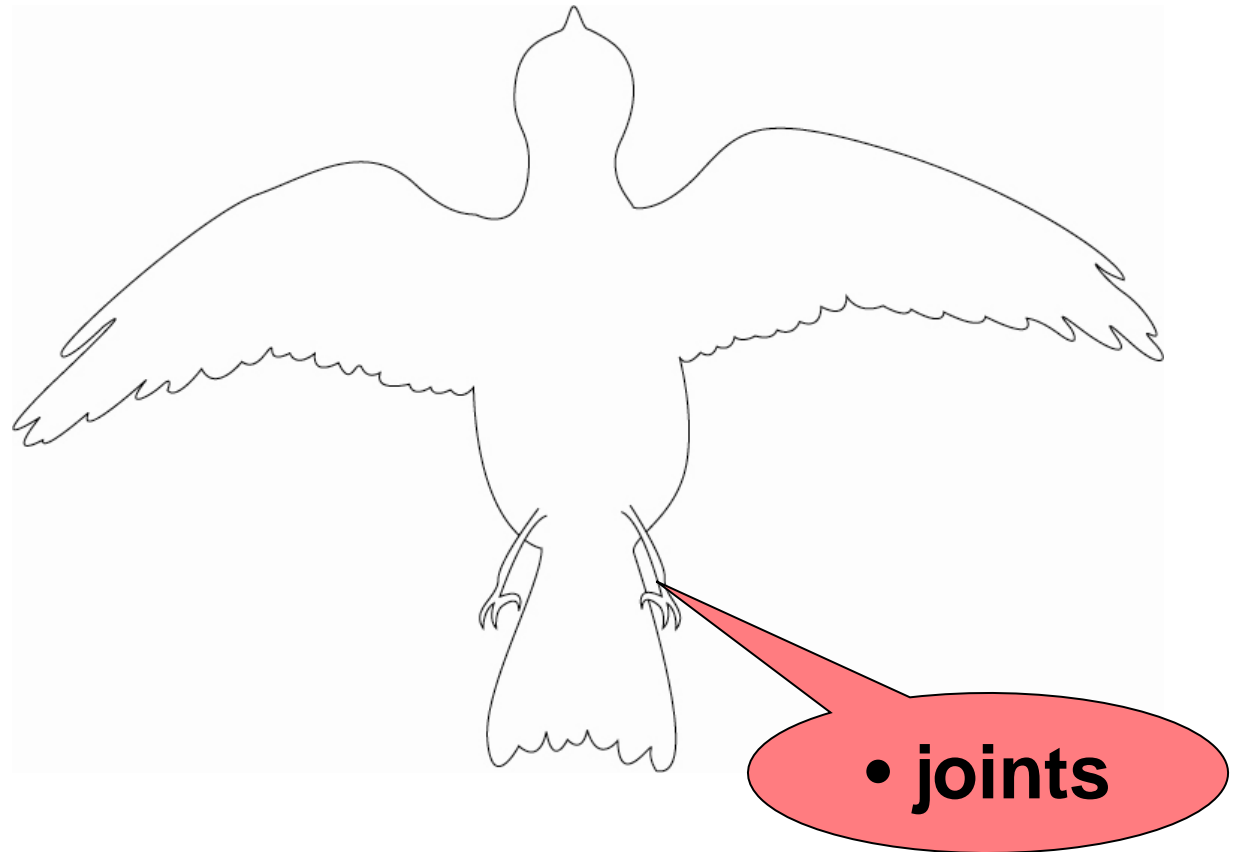
Chandlerella quiscali
- between cerebral hemispheres



in farmed emus
• clinical signs

6.4

***Pelecanus* spp.**
- among tendons



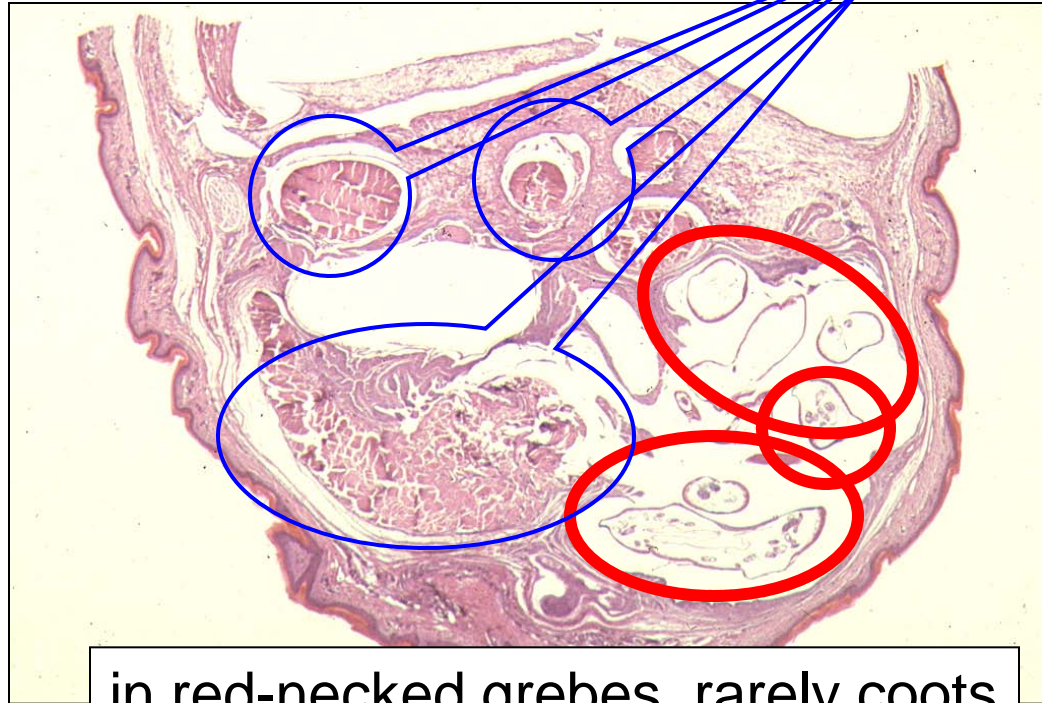
6.4

Pathogens

Pelecitus spp.
- among **tendons**

● adult worms

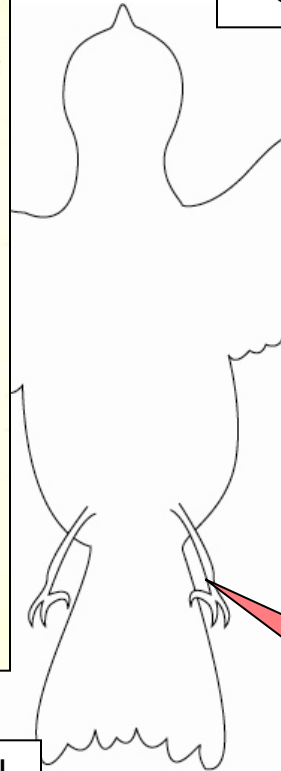
in psittacids (esp. pets)
• tenosynovitis
• swollen feet



in red-necked grebes, rarely coots
• chronic inflammation
• fibrosis

original

pub: Bartlett & Anderson 1989, CJZ: 67



● **joints**

6.5

Pathogen

Eulimdana clava



- **neck**

clinical sign
(isolated report)

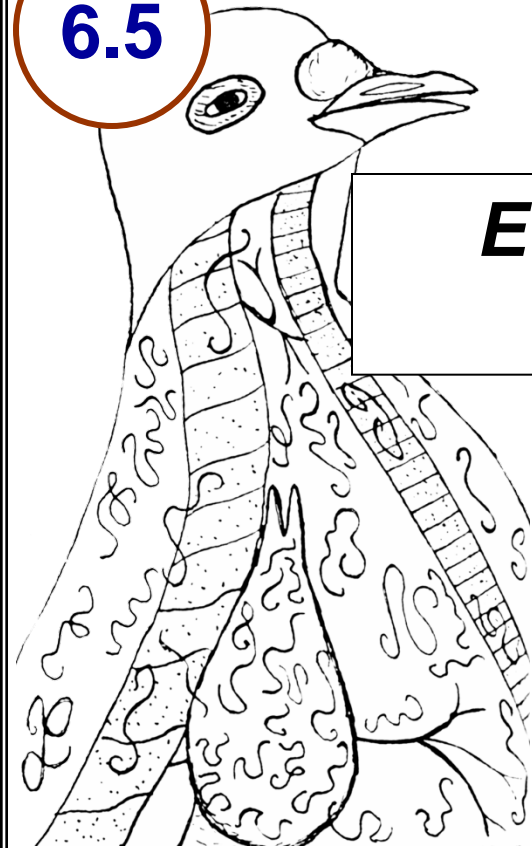
- **extensive feather loss in neck region**



6.5

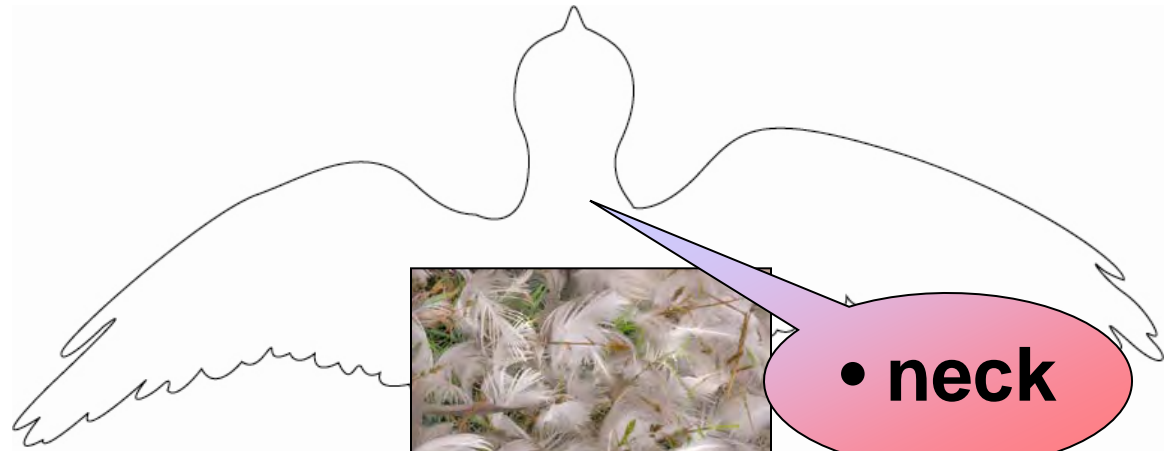
Pathogen

Eulimdana clava



adult worms

from: Guildal & Settnes
1968; Nord. Vet-Med: 20



• **neck**

clinical sign
(isolated report)

• **extensive
feather loss
in neck region**

6.5

Pathogen

Eulimdana clava
- microfilariae in skin*

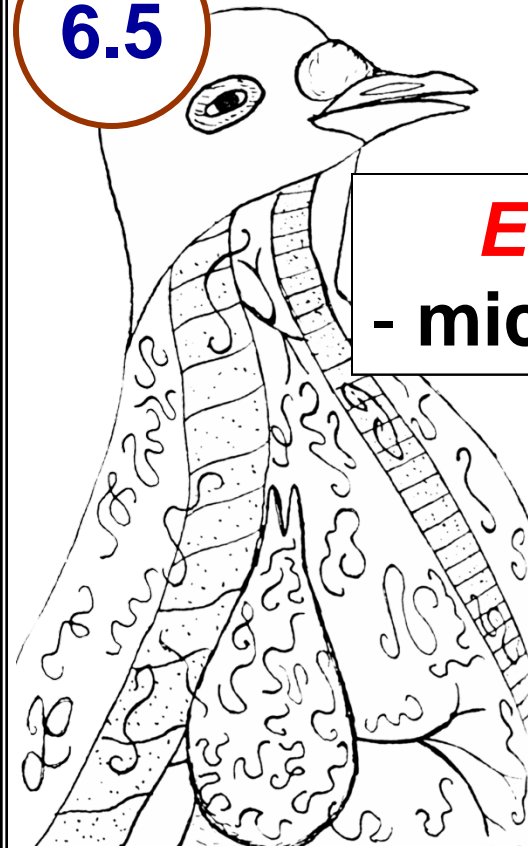
- adult worms
- microfilariae

agent?

louse vector

● neck

clinical sign
(isolated report)
● extensive
feather loss
in neck region



adult worms

from: Guildal & Settnes
1968; Nord. Vet-Med: 20



feather

*

original

(actually = MF of *Pelecitus fulicaeatrae*)



Avian Filarioid Nematodes

SYNOPSIS

Biodiversity

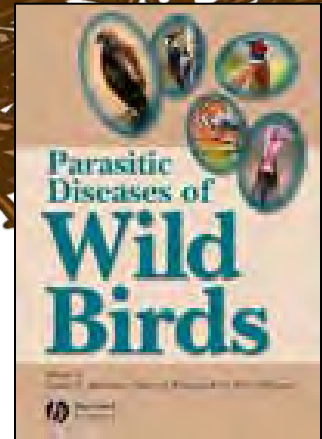
Sites in Bird Host

Life Cycle

Vectors

Host Distributions

Pathogens



*based on
Bartlett 2008,
Chapter 26 in:*

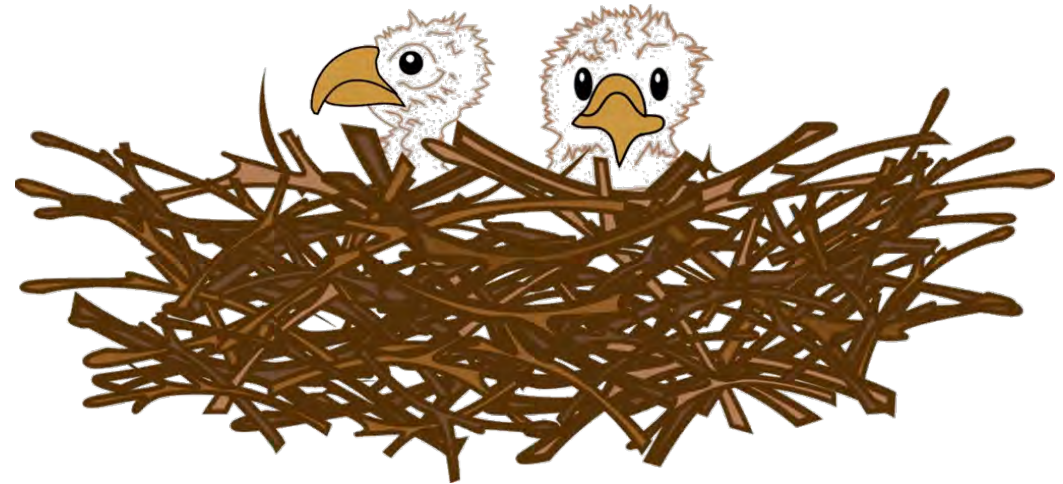
**Parasitic Diseases
of Wild Birds**

Carter T. Atkinson
Nancy J. Thomas
D. Bruce Hunter } *edited
by*

 **WILEY-BLACKWELL**

2008

Wildlife Disease Association
Edmonton



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Conseil de recherches en
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Thank You

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