

1. Title Slide

LESS FREQUENTLY USED LABORATORY ANIMALS

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CLASS: MAMMALIA

ORDER: RODENTIA

2. Family: Cricetidae

Calomys callosus – Vesper Mouse (3 other species)

- South America
- weight 30-38 gm
- high fertility rate with gestation 25 days and litter size 3-5
- free from common latent murine viruses
- low water intake
- low-crowned cheek teeth are distinguishing from others in Family

Research Uses

- primary vertebrate reservoir for Machupo Virus (the etio-logical agent of Bolivian Hemorrhagic Fever)

3,4. gross- Dicrostonyx stevensoni - collared lemming- only rodent that changes color

- Alaska and Arctic
- weight 70 gm
- gestation 20-22 days with litter size 3-4
- white coloration in winter, grayish in summer

Research Uses

- high Brucella suis susceptibility
- develop atherosclerosis and high serum cholesterol on atherogenic diet
- spontaneous malignant mammary tumors (D. groenlandicus)

5. **Microtus sp.** – Voles, Meadow Mice (44 species)

Microtus ochrogaster - Prairie Vole (found in Midwest U.S.)

- North America, Central America, and Eurasia
- weight 115 gm
- gestation 21 days with litter size 4-8
- General: Used to study pesticides due to large population density in the field

6. **Microtus pennsylvanicus**- meadow vole- Prospect Hill virus

- Predisposed to tonic-clonic seizures due to handling NOT auditory

Several nutrition models:

- a. hypoglycemia after 6 hours of fast- carbohydrate catabolism
- b. nutrition (anti-quality constituent of forages and bioassays)
- c. increased cholesterol with atherogenic diet

7. **Clethrionomys rutilus** = red backed vole= HFRS (hemorrhagic fever with renal syndrome) model.

8,9. **Mystromys albicaudatus** - white tailed rat or south african hamster

- weight 75-185 gm
- gestation 37 days with litter size 4-5 and young hang on nipples for 2-3 weeks
- susceptible to ringtail
- stomach has 2 distinct portions (forestomach separated from true glandular stomach by annular muscular plica)
- females have **two pair inguinal mammae** and sebaceous gland extending from mammae to vulva (analogous to ventral marking gland in other Cricetidae)
- female with rudimentary prostate
- gall bladder present
- no cheek pouches as with some relatives

Research Uses

- spontaneous diabetes mellitus without obesity (polygenic, possible sex-linked because males at greater risk, clinical signs and pathologic lesions - visceral, vascular, ocular-similar to human)
- **Leishmania donovani** – cutaneous form

- dental lesions - caries and periodontal
- spontaneous tumor development
- high urine protein, ketonuria, and glycosuria common in males without hyperglycemia
- partial albinism without Chediak-Higashi Syndrome
- antibiotic toxicity following topical use of bacitracin-neomycin-polymyxin-B ointment
- poliomyelitis attenuation
- histoplasmosis isolation
- arthropod-borne diseases
- model for Mycobacterium leprae

10. Oryzomys palustris rice rat

- U.S., Mexico, tropics
- weight 40-80 gm

Research Uses

- arboviruses
- congenital erythrocytic porphyria (O. minutis)
- **Dental disorders**
 - **dental development**
 - **periodontitis (dietary factors in laboratory)**

11. Peromyscus maniculatus= common deer mouse= MCV (Muerto canyon virus)

North and South America

- weight 15-50 gm
- gestation 21-27 days with litter size 1-9 (average 4)
- weaning 3-6 weeks
- lifespan may be over 5 years in laboratory (2x mouse age)
- very active and easily adapt to laboratory environment
- inbreeding unsuccessful past 5th generation
- very large ears
- MHV- resistant to MHV; get infected but no disease and don't transmit
- **Natural reservoir for Hantaan virus**

Research Uses

- Trypanosomiasis (T. equiperdum, T. vivax) as a model for sleeping sickness in humans (T. rhodesiense, T. gambiense). Chronic disease produces glomerulo-nephritis as well.
- autosomal recessive senile cataract
- spherocytosis - autosomal recessive hemolytic disease with increased RBC destruction aggravated by splenectomy
- physiologic and genetic studies
- P. leucopus - White-Footed Mouse sometimes mentioned (vaginal cast and estrus cycle)
- Host for tick which transmits Borrelia sp. (Lyme disease)
- P. gossypinus - Cotton Mouse - VEE
- Resistant to Mouse Hepatitis Virus
- Natural reservoir for Hantaan virus
- Cataract model- Type I- early onset by 90 days
 Type II- latter onset- by one year

12. (pic of 5 mice) - Peromyscus leucopus= white footed deer mouse

- Model of Lyme Dz (Borrelia burgdorferi) in east

Q: If working with Hanta virus in these mice, what BSL? BSL4 for permissive hosts and BSL2 for non permissive host

Name three forms of disease syndromes caused by Hantavirus:

1. Hemorrhagic fever with renal syndrome- Hantaan, Seoul, and puumola serotypes
2. Hantavirus pulmonary syndrome- sin nombre virus
3. Tula virus- in European voles

Name three Hantaviruses in USA:

1. Seoul
2. Prospect Hill
3. Sin Nombre virus

13, 14. Cotton rat - Sigmodon hi-spi-dus

This is the most abundant rodent in the southeastern US. What is the common name?

- southern U.S., Central and South America
- weight 70-200 gm
- gestation 27 days with litter size 2-12 (average 5)
- wean at 7 days and mature at 6 weeks
- susceptible to ringtail
- fighting- group before puberty
- Cannibalize young if with parent at puberty
- Precocious (mobile and active early; early maturity)

Research Uses

- *****rodent model of adenovirus:**
 - **causes similar adenovirus pneumonia to that in humans**
 - **only adenovirus model with epidemic keratoconjunctivitis**
 - **due to susceptibility to human adenovirus, used in studies that require use of replicate-defective adenoviruses**
 - **Gene therapy for cystic fibrosis or cancer therapy**
- **Viral respiratory tract disease: caused by paramyxoviruses**
- **Other viruses that replicates well in Cotton rat include:**
 - *****Respiratory syncytial virus (RSV) - leading cause of respiratory disease in infants**
 - **Parainfluenza virus 3: 2nd leading cause of pediatric disease**
 - **Measles virus (CNS research)**
- **Due to Cotton Rat susceptibility to many parasitic and bacterial pathogens:**
 - **Echinococcosis and Leishmania**
 - **Venezualean Equine Encephalomyelitis**
 - **Scrub typhus organism: *Rickettsia tsutsumagushi***
 - **poliomyelitis**
 - **drug testing for anti-microfilarials**

15. (1 slide young cotton rats, precocious)
these rodents are less than three days old...What is the genus ?
Sigmodon

16. give 4th slide if need to see adult....
Sigmodon (hispidus)
young can survive in wild at 5 days of age; born with hair, can scurry around shortly after birth, **eyes open within 36 hours**, incisors erupt by 5-6 days, eat solid food by 1 week

Are males or females dominant?

Males

What breeding scheme is recommended?

breeding monogamous pairs rec, if one dies don't pair the remaining one. Also don't separate the pair after parturition or female will kill male on reintroduction

Can they be group housed?

can group house females, males to group house must be before 7 weeks of age

LAS, Volume 47, no 4, August 1997

Faith et al, The Cotton Rat in Biomedical Research, pp 337-345

What are the two species of cotton rat most commonly used in biomedical research?

Sigmodon hispidus, S. fulviventor

To what family does it belong ? Cricetidae

What was the first rickettsial disease the cotton rat was found to be susceptible to that was studied intensively during world war 2?

Scrub typhus, Rickettsia (orientia) tsutsugamushi

The most frequent use of the cotton rat is for the study of what (parasitic disease)? Filariasis found to naturally harbor the filarial nematode, Litomosoides carinii.

Cotton rats are Infected with this filarial nematode thru the bite of what natural vector?

Ornithonyssus (Lyponyssus) bacoti

Cotton rats are currently used as models for respiratory disease caused by what viral group?

Paramyxoviruses: RSV, Parainfluenza virus 3, and measles virus

Wild caught cotton rats have been demonstrated to harbor what hantavirus?

Black Creek Canal Virus

recent vet path article described exophthalmous in a colony of cotton rats that was associated with what condition?

cardiomyopathy

Why is the cotton rat an important tool in toxicity studies of adenoviral mediated gene therapy?

1. They are semi permissive for human adenoviral replication (even tho the vectors are replication deficient, they carry 70 to 80% of the wild type viral genome that can be expressed and must be evaluated in a permissive environment)
2. They develop lesions similar to those seen in humans after adenoviral infection work showed that it was unlikely that infective vector is shed after systemic in vivo transduction with replication defective adenoviral vectors.

..

Which of the following is NOT associated with gastric carcinomas in cotton rats? :

- A. hypergastrinemia
- B. increased gastric acidity**
- C. higher incidence in females
- D. hereditary factors

Waldron, Rervik et al, Neuroendocrine (ECL Cell) Differentiation of Spontaneous Gastric Carcinomas of Cotton Rats (*Sigmodon hispidus*), LAS, Volume 49, No 3, June 1999, pp 241-247

17. **Ondatra zibethicus** muskrat

- largest cricetid - 1100-1300 gm
 - excellent swimmer and diver; although has been used as dive reflex model, usual model is duck or seal

 - omnivorous and derive sufficient water from vegetation
 - gestation 28 days with litter size 4-7
 - postpartum estrus, wean at 3-4 weeks, mature at 6 months
 - * susceptible to many internal and external parasites; bacterial and fungal diseases
 - house in rabbit cages with water source
 - *Research Uses*

 - * naturally occurring and well-developed diving reflex which is not inhibited by anesthesia
 - brain similar to lab rat
-

18. **FAMILY: MURIDAE**

Mastomys (Praomys) natalensis ---Multimammate rat

- South Africa
- weight 40-80 gm
- gestation 23 days with litter size 6-8
- estrous 7-8 days
- monogamous pairs
- **well-developed prostate in female and os penis in male**
- **female with 8-10 pair of mammae**
- **no gall bladder**
- male lacks preputial gland

- About 66% of multimammate rats have a small solitary ulcer in the middle of the lesser curvature 1 month of age which leads to **spontaneous gastric adenocarcinoma; higher incidence in males**
 - **Serves as a model for gastric ulcer formation and Zollinger-Ellison syndrome (Zollinger-Ellison syndrome is caused by tumors, usually found in the head of the pancreas and the upper small bowel. These tumors produce the hormone gastrin and are called gastrinomas. High levels of gastrin cause too much production of stomach acid.)**

Research Uses

- **Carcinoid tumors**-argyrophilic, histamine producing tumors of the gastric mucosa, distant metastasis, transplantable, and spontaneous
- **Antral adenocarcinoma** - spontaneous in y & z strains, only animal model of human disease
- **induced gastric ulcer** - injections of ovalbumin into mucosa of stomach of previously sensitized animal gives rise to an ulcer in a predictable location so the sequence of events can be followed. Works because of histamine storing entero-chromaffin-like cells that produce carcinoids.
- **Plague (Yersinia pestis) and Toxoplasmosis**
- Schistosomiasis
- **Lassa fever (arenavirus) - is also natural reservoir**
- degenerative joint disease
- chronic renal disease with glomerulonephritis
- thymomas and hematopoietic neoplasms
- polymyositis
- epithelial skin tumors and pancreatic tumors
- **prostatic tumors** - female has a prostate gland
- experimental parasitisms - **Brugia filariasis**, Litosomoides carini
- congenital erythrocytic porphyria
- aging, autoimmune conditions

19. **Thamnomys surdaster** - Tree Rat, African Forest Mouse

- Africa
- weight 55-65 gm
- Tail= one foot long

Research Uses

- Plasmodium berghei (natural host) is used for experimental malaria, circadian rhythm studies

20,21... Acomys cahirinus - Egyptian Spiny Mouse, porcupine mice

- Africa and Middle East
- weight 50-90 gm
- gestation 42 days with litter size 1-5 (average 3) and wean at 14 days
- **only Muridae in which young can eat solid food at birth**
- large hippocampus
- low response to insulin
- Precocious

Research Uses

- congenital erythrocytic porphyria (A. musatus)
- **Type II diabetes** - develop obesity and diabetes in lab due to overeating; corresponding low response to insulin
- Leishmaniasis

22 Pachyuromys duprasi **Fat-Tailed Jird**

- Egypt, Libya, Tunisia and Algeria
- Many physiological similarities to gerbil
- Characteristic club-shaped, sparsely haired tail

Research Uses:

- Thermoregulation
- Audiology
- Infectious Disease

JAALAS January, 2009: Described venipuncture technique and provided normal serum biochemistry parameter

23. Bandicota savilei **What is the common name of this rodent?**

Lesser bandicoot rat

- wild field rat found in Thailand and Vietnam

What are they used to study?

scrub typhus

what is the etiologic agent of scrub typhus?

Orientia tsutsugamushi is the causative organism, which was initially categorised in the genus *Rickettsia* (*tsutsugamuchi*)

Scrub typhus is transmitted by some species of trombiculid mites, which are found in areas of heavy scrub vegetation. The bite of this mite leaves a characteristic black Eschar that is useful to the doctor for making the diagnosis

The lesser bandicoot is the natural host of a parasite that is the most common vector of scrub typhus. What kind of parasite is it?

Trombiculid mite = *Leptotrombidium* sp.

Where is the larvae of this mite found in the bandicoot? in the ear canal

Gettayacamin et al, Vaginal Cytology of the Lesser Bandicoot rat (*Bandicota savilei*), Contemporary Topics, Volume 38 , Number 1 , January 1999, pp. 76-80

24,25 **FAMILY: BATHYERGIDAE**

Heterocephalus glaber --- Naked Mole Rat 2N=60

- Eastern Africa - dry regions of Horn of Africa
- Described as saber-toothed sausages, baby walruses, and simply as ugly!
- 23-33 grams body weight as adults
- May find 40 to 97 moles per burrow
- **No pelage on skin but some scattered hairs**
- **Procumbent incisors - extending well outside the mouth**
 - excavate the soil with large protruding incisors
- **Completely subterranean in system of burrows**

- **Herbivorous** - subterranean plant bulbs and tubers
- Smallest relative brain size of any group of small animals
- Long tail (half the body length with sensory hairs)
- **Reduced eyes - can't see images**
- No sweat glands
- Short limbs, very loose skin
- **Pineal gland is atrophic** -- smallest of any rodent
- Distantly related to the porcupine
- female estrus is suppressed except in the queen
- Social organization like bees
- Nocturnal

Reproduction **

- 4-5 litters per year and 4-15 young (average 10)
- 66-74 day gestation
- Eyes open at 30 days and wean at 21 days
- **So similar genetically, it is as if brother mated with sister for 60 generations**
- **** One reproductive female and one to three reproductive males (all others are functionally sterile)**

Research Uses

- Eusociality -- a remarkable topic in evolutionary biology

Definition:

Species that live in colonies of overlapping generations in which one or a few individuals produce all the offspring and the rest serve as functionally sterile helpers (workers, soldiers) in rearing juveniles and protecting the colony. Wasps, bees, ants, and termites known to live this way had previously been called the "social" insects. The naked mole rat is the only mammal known that practices eusocialism, and are the only mammals to live in colonies ruled by a queen.

- Huddling behavior and effects on homeothermy
- Cholecalciferol (D3) supplementation - effect on gut function and improved digestibility
- Regulation of body temperature and characteristics of poikilotherms

- Pain research as they lack neuropeptides associated with thermoregulation and pain, e.g, substance P

What gene delivery vector was recently shown to be lethal in the naked mole rat but not mice?

- **Herpes simplex virus type 1 (HSV1)**

Comparative Medicine, February 2009

26,27. FAMILY: DASYPROCTIDAE

Dasyprocta sp. - Agouti 2N=64

- Mexico, Central and South America
- **weight 3-5 kg** and life span of 15-20 years
- estrous cycle is 34 days with **gestation 104** days and litter size 2-4
- **4 pairs ventral mammae** and have **vaginal closure membrane**
- young precocious at birth

Diseases

- vesicular stomatitis virus
- TB and Eimeria stiedae
- some helminths and ectoparasites in the wild
- titers to GD VII, Reo 3, and Sendai

Research Uses

- reproductive physiology
- pharmacology and enzymology
- cause allergic-type respiratory conditions in humans

28, 29. **FAMILY: CHINCHILLIDAE**

Chinchilla laniger - Chinchilla 2N=64

- South America, Andes
- weight 500-800 gm
- breeding season November to May and estrous cycle 28-40 days
- gestation 111 days with litter size 1-6 (average 3)
- mature 5-8 months and lifespan is 10-20 years
- separate vaginal opening between rectum and urethra that opens only during estrus
- C-section common for mummified feti
- 3 pair mammae, 1 pair inguinal, 2 pair lateral thoracic

Diseases

- Listeriosis (CNS)
- Trichophyton mentagrophytes and fur-chewing lice
- toxoplasmosis and giardiasis
- **malocclusion**
- Yersinia pseudotuberculosis
- trophoblastic emboli

Research Uses

- **aging**
- **high altitude studies**
- **hearing research** (3 turns of cochlea, absence of presbycusis, and lack of susceptibility to otitis)
- **Chagas Dz (T. Cruzi)**
- **Listeriosis**

30. **FAMILY: CAPROMYIDAE**

Myocastor coypus - Nutria 2N=42

- South America and Gulf Coast of U.S.
- weight 7-10 kg
- gestation **132 days** and may be an induced ovulator
- up to 10 **precocious** young that wean in 5 days
- **No vaginal closure membrane**

Research Uses

- EEG studies
 - Hemorrhagic Shock and Bradycardia
-

31-33 **FAMILY: OCTODONTIDAE**

Octodon degu - Degu, Trumpet-Tailed Rat 2N=58

- South America, Andes
- weight 200-300 gm
- **gestation 90 days** with litter size 1-10 (average 5-6)
- weaning at 3 weeks and mature at 5-14 months
- have a vaginal closure membrane and **4 pairs of mammae**

Research Uses

- developmental patterns and reproductive and play behavior
- thymic immunity and genetic variation of enzymes
- hystricomorph urine composition
- **congenital cataracts in adults**

- **chemotoxic agent on ocular tissue**
- *** Two anatomically separate thymus glands in cervical and mediastinal areas; study role of thymus in immunity

- **Leishmaniasis**

Precocious

gest= 90 days

4 pairs mammae

cheek teeth hypsodont and figure 8

female induced ovulation

tolerant to morphine and has greater ability to metabolize drugs

34. **FAMILY: SCIURIDAE**

Sciurus niger - Fox Squirrel

- Eastern U.S.
- weight 200-900 gm
- * gestation 39 days with litter size 4-10, weaning at 6 weeks of age, mature at 1 year

Research Uses

- **congenital erythrocytic porphyria** is normal,

35. **gray squirrel- Sciurus carolinensis**= No Erythrocytic porphyria (serve as controls for congenital erythrocytic porphyria)

36,37 **Ground squirrel- Spermophilus beecheyi**= susceptible to Ground Squirrel hepatitis virus.

- Spermophilus richardsoni= gallstone, plague
- serve as primary reservoir for plague (Yersinia pestis)
- Hibernate in wild; In lab: may go into a period of torpor
- Females enter torpor more than males
- Even though they don't hibernate they go through a fattening period
increased clotting with hibernation

38. **Beechi Ground squirrel** pinworm eggs- Rauschtineria citelli

39. **13 lined ground squirrel** **Spermophilus tridecemlineatus**

- Similar to Ground squirrel, develop gall stones on High cholesterol diet and serve as reservoir for Plague
- Tularemia
- resistant to hypercholesterolemia and atherosclerosis on high fat diet

Research Uses

- gallstones if fed high cholesterol diet
- * classical diabetes mellitus at 23 months of age with clinical signs and decreased size and number of islets
- estivate
- irradiation and skin grafting

40. **chipmunk** **Tamias striatus**

Research uses:

- develops congenital erythrocytic congenital porphyria
- hibernation

41,42. **Black tailed prairie dog - Cynomys ludovicianus**

- United States
- weight 1 kg
- gestation 28-32 days with litter size 2-10

Research Uses

- gallstones with high cholesterol diets
- plague
- prairie dog hepadna virus

43. **histo pict-- Black tailed prairie dog with a head tilt- histo- baylisascaris**

44,45 **woodchuck** **Marmota monax**

- North America
- weight 3-7.5 kg

- gestation 35-42 days with litter size 2-9 (average 4-5)
- mature 2-3 years and lifespan of 13-15 years
- recommended diet- rabbit chow; If house females together, watch b/c one female may eat all the food

Diseases

- Rocky Mountain Spotted Fever
- * tularemia, leptospirosis, histoplasmosis, and toxoplasmosis
- human encephalitis

Research Uses

- **hibernation**
- * **adult onset obesity (change in size, not number of adipocytes)**
- dietary-induced atherosclerosis
- **aortic rupture**
- cerebrovascular and cardiovascular diseases
- endocrine studies
- * **malignant hepatomas** secondary to chronic hepatitis caused by a virus (Woodchuck Hepatitis Virus - WHV) similar to human hepatitis B
- hypothermia
- thyroid function

Hepa- DNA virus:

1. Woodchuck Hepatitis B
2. Pekin Duck Hepatitis B
3. Ground squirrel Hepatitis B
4. Human Hepatitis B
5. Heron Hepatitis B

6. Prairie Dog Hepatitis B?

46, 47 **Family Gliridae**

Graphiurus Kelleni - African Dormice

- Africa
- Nocturnal

Research Uses:

- Field studies
- Taxonomic characterization
- **Orthopoxviruses: animals shipped from Ghana in 2003 had a viremia with monkeypox**

JAALAS March 2010: Article detailing management and care

- Breeding in pairs (1 male/1 female) to prevent fighting
 - Cyclical Vaginal swelling occur in group-housed females
 - Diet is high fat/high protein rodent diet with supplemental protein sources (e.g., hard boiled eggs)
 - Most clinical problems were traumatic from fighting: myositis
-

48. **Family Soricidae** **Suncus murinus - house musk shrew.**

- Found in Indonesia
- Nocturnal and found to entry homes and runs around wall
- an insectivore which feed on insects as their nutrition sources. It can be considered as a beneficial to human because their diets consist mostly of harmful insects where it can be a biological pesticide
- They breed throughout the year with each female averaging 2 litters per year usually size three.

What are these animals used to study?

Emesis

What is unique about their stomach compared to mice?

Only has glandular stomach

What “pathogen” was recently reported in these animals?

Helicobacter suncus

Pathogenicity of *Helicobacter* Species Isolated from the Stomach of the House Musk Shrew (*Suncus murinus*), *Comparative Medicine*, Vol 50, Number 1, February 2000, pp. 73-77

49. **ORDER: MARSUPIALIA FAMILY: DIDELPHIDAE**

Didelphis virginiana - Opossum 2N=22

- only North American marsupial
- weight 2-5.5 kg
- **gestation 12-13 days; young born in very immature state (compare to 12 day rat embryo) and live in pouch 60-70 days** attached to nipples and then live another month crawling on mother and being weaned.
- litter size 8-18 (7 survive in pouch)
- opposable big toe, **male has forked penis** and female with two lateral canals to uterus
- mature 6-8 months and a lifespan of 2-3 years
- **no lymphocytes at birth allows immunological studies**
- **prehensile tail**
- **only one set of teeth during lifetime (50 teeth)**

Diseases

- resistant to rabies (300 times more resistant than dogs) and *Mycobacterium* sp.
- pseudorabies, equine encephalomyelitis, and Herpes B - experiments
- *Brucella abortus*, *Past. hemolytica* pneumonia and salmonella
- *Franciscella tularensis* and salmonellosis - natural infection
- Leptospirosis - natural infection
- *Borrelia recurrentis* - natural reservoir for relapsing fever
- *Trichophyton* sp. and *Microsporium* sp. - RMSF and typhus
- *Trypanosoma cruzi* - natural reservoir for Chagas disease

- Susceptible to Physaloptera sp.(*Physaloptera turgida*- in stomach can impact and perforate)

Research Uses

- esophageal burn research- musculature resembles man
 - resistant to snake venom
 - short gestation good for toxicology, immunology, and transplants
 - **bacterial vegetative valvular endocarditis - natural occurrence with Strep. viridans and Strep. Pyogenes. Single injection of Strep. viridans IV causes lesions in mitral, aortic, tricuspid, and pulmonary valves.**
 - feined death - catatonia
 - post-natal regeneration of limbs
 - embryology - primitive hemoglobins and circulating cells in pouch
 - glomerulonephritis, amyloidosis, hematology, wound healing, and anatomic research due to lobular neurohypophysis
 - red cell hemoglobin metabolism
 - aging studies
- Model for:
Chagas

50. opossum pouch

51,52 Marmosa mitis - Mouse Opossum, **Pouchless** Opossum - **2N=14**

- South and Central America
- weight 95 gm
- gestation 15-17 days with litter size 6 and weaning at 50-60 days
- **no pouch and circle of mammae on abdomen**
- circle of mammae
- GI ulcers

Research Uses

- bioassay for carcinogenesis in embryonic mammalian systems
- **cytologic studies due to low diploid chromosome number**
- many diseases and parasites

53-54 Monodelphis domestica - Short Gray Bare-Tailed Opossum Or Monodelphis brevicaudata - Northern Red-sided Opossum **INDISTINGUISHABLE** **2N=18**

- South America

- weight 80-155 gm
- litter size 8-14 and **ring of nipples on abdomen instead of pouch (no pouch) and neonates attach**
- **gestation = 15 days**
- **Not dark around eyes**
- **forked penis- male, and 2 vaginas with 1 orifice- female,**
- **flank glands like hamster (male), bicolored**
- prehensile tail
- forked penis caudal to scrotum
- sexually mature at 4-5 months with 3.5-4 year life span

Research Uses

- reproduction
- dietary induced hypercholesterolemia-
- microsurgery
- neuronal development
- **dermatology: only mammal other than man susceptible to UVR induced melanoma**
- corneal opacities/tumors secondary to UVR-
- **cytogenetics**
- xenogenic tumor growth

55. Monodelphus baby;

Why are these animal useful in developmental studies?

-nocturnal pouchless marsupial, at birth pups retain many fetal characteristics providing an excellent model for developmental studies

term that describes marsupial mammals?

-What has been shown to induce estrus in the female ?

presence of unfamiliar male induces estrus in the female within a few days

-What is the gestation period?

14.5 days

-How many pups?

-3-13 pups

LAS Vol 47, No 3, June 1997

Ultrasonographic Pregnancy Detection and Inhalation Anesthesia in the Gray Short-Tailed Opossum (*Monodelphis domestica*), pp. 280-282

56,57. **ORDER: HYRACOIDEA FAMILY: PROCAVIIDAE**

Procavia capensis - Rock Hyrax

- Middle East and Africa
- weight 14-20 kg
- gestation 225 days, mature in 2 years with lifespan of 6 years
- **no tail**
- **related phylogenetically to elephant and sea cow**
- anatomic features –
 - **feet have footpads which can be formed into vacuum cups for clinging,**
 - 4 toes on forefeet and 3 on hindfeet resembling elephant hooves,
 - coelomic cecae,
 - **testicles firmly attached posterior to kidneys and**
 - **ruminant-like stomach**

Research Uses

- nutrition (limited water requirement)
- reproductive physiology, endocrinology (**abdominal testes**)
- immunology
- **naturally-occurring gastric ulcers**

58. **ORDER: EDENTATA (means without teeth)** **FAMILY: DASYPODIDAE**

Dasypus novemcinctus - Nine-Banded Armadillo 2N=64

- only species of Order Edentata in North America
- weight 4-8 kg
- **only has molars: 2(0/0 0/0 0/0 8/8)**
- gestation 260 days, breed in July and August and **delayed implantation (blastocyst 14-16 weeks)** in November with birth 120 days later.
- **low body temperature (32-35 degrees C / 90 degrees F)**
- regular production of 4-8 monozygotic offspring (identical)
- lifespan up to 15 years
- **ability to build up oxygen debt (apnea 5-10 minutes while digging)**
- Double post vena cava
- salivary bladder
- monozygotic quads

Research Uses

- **Lepromatous leprosy - Mycobacterium leprae produces no cellular immunity.** Organisms in macrophages in skin. Lesions in nerves of skin, dermis, and extremities. Systematic dissemination of organism to visceral organs (lung, heart, GI, bladder, CNS, liver, spleen, bone marrow) occurs more frequently than in humans due to low body temperature. Lepromins from armadillo provide skin reaction in humans. Only biological system for producing mass quantities of organism. 40% of wild animals susceptible to experimental disease. Also occurs naturally.
- D. sabanicola from South America is experimentally susceptible
- D. hybridus from Argentina - 50% experimentally susceptible, 8-16 monozygotic young and very aggressive animal
- **spontaneous recovery from ventricular fibrillation**
- organ transplant, immunochemistry, embryology, drug metabolism
- teratology and mutagenesis

59. Armadillo with *M. leprae*

60. ORDER: CARNIVORA FAMILY: MUSTELIDAE

Slide of Mustela erminea

61. Mustela vison - New World Mink

- North America and Canada, Alaska, most of U.S.
- weight 1-1.6 kg
- gestation 50 days (can range from 39-78 days), mate in spring
- litter size 4 with possibility of delayed implantation
- classified by phenotypic hair and eye color
- **induced ovulator**

Diseases

- **Viral Enteritis of Mink (parvo)**
- **Canine distemper**, feline panleukopenia
- Pseudomonas pneumonia is a herd problem; could be due to antibiotics in feed
- coccidiosis (I. laidlani, E. vison)

Research Uses

- **Transmissible mink encephalopathy - scrapie-like disease of mink is model for Kuru, and Creutzfeldt-Jacob disease.** Slow virus spongiform encephalopathy with reactive astrocytosis. TME may be carnivore-passed strain of scrapie. May be

experimentally transmitted to hamster, goat, striped skunk, racoon, rhesus, squirrel monkey and stumpail, but not mice (scrapie is). Kuru and C-J not transmitted to mice but pathologic for NHP.

- **Aleutian Disease of Mink - model for persistent viral infections of man (immunologically-mediated glomerulonephritis and arteritis).** Probably slow viral disease with symptoms due to host response in a/a (gun-metal color, Aleutian). Vertical and horizontal transmission with widespread plasma cell proliferation and hypergammaglobinemia. Other genotypes and ferrets are slightly susceptible. Similar to disease process seen in infectious hepatitis, subacute sclerosing panencephalitis, Kuru, C-J disease, MS, SLE, and progressive multifocal leukoencephalopathy. Immunosuppression prevents disease. Diagnosis by iodine agglutination test.
- Congenital malformations of the brain
- Ehlers-Danlos Syndrome - primary collagen defect in mink and dogs due to autosomal dominant trait (Springer, Dachshund, Blue Doberman)
- Muscular dystrophy - autosomal recessive in mink; flaccid atrophy, choke to death
- **Chediak-Higashi Syndrome - autosomal recessive defect of Aleutian mink, Hereford cattle, beige mice, cats, and a killer whale** manifested by partial oculocutaneous albinism, photophobia fever, recurrent infection. Giant granules in granulocytes in circulation and bone marrow with lysosomal and phagocytic defects. Lysosomal storage disease.
- Hemivertebra - autosomal recessive involving 4th thoracic vertebra. Kyphosis and onset at an early age in mink as opposed to scoliosis and a progressive disease in humans.
- Hereditary deafness - white Hedlund mink with cochleosaccular degeneration. Similar problem in blue-eyed white cats.
- Pseudodistemper of mink - autosomal recessive with increased blood tyrosine due to deficiency of hepatic tyrosine aminotransferase (TAT) similar to human tyrosinemia II (Richner-Hanhart Syndrome). Onset at 6-7 weeks in homozygotes with cloudy cornea, reddened footpads, seropurulent conjunctivitis, necrotizing dermatitis of feet, nose, and ears. Wasting disease fatal in 1 week. Human disease has onset at 3 months and is non-fatal but causes mental retardation. Diet changes control in humans but not successful in mink as yet.
- Metachromatic Leukodystrophy - sulfatide lipidosis of mink and geese. Paralysis and death in newborn dark mink.
- Radial agenesis - absence of digits up to whole forelimbs
- Magnesium Ammonium Phosphate (Styruvite) Urolithiasis - associated with bacterial cystitis (April-June female; August-November male)
- Chasteks paralysis - thiamine deficiency. Like Warnecke's disease in man. May relate to fish diet.
- Urate nephrolithiasis - male 1 year, epistaxis, ulcerations on nose and foot-pads with hemorrhage, bleeding disorder, CNS and URI signs; probably inherited
- defect in uric acid metabolism or excretion

62. Order: Carnivora Family: Mustelidae

Mephitis mephitis - Striped Skunk

- United States
- weight .7 to 2.5 kg
- Gestation 63 days with litter size 4-5 and lifespan of 10 years
- **Increased Gamma globulinemia**
-

Research Uses

- **rabies** and canine distemper
- **Ascaris columnaris** (host skunk and raccoon, CNS migration in rabbits, marmots, ground squirrels, and others)

63. Order: Carnivora FAMILY: VIVERRIDAE

Genetta tigrina - Genet

- Africa, Middle East, Europe
- weight 1-2 kg
- litter size 2-3 with lifespan of 10-34 years
- two pairs of abdominal mammae

Research Uses

- **sickle cell anemia** - naturally occurring sickle-shaped RBCs

64. Order: Carnivora FAMILY: VIVERRIDAE

Herpestes auropunctatus - Mongoose

- Asia and Polynesia
- weight 475-923 gm
- gestation 60 days with litter size 2-4 and lifespan of 7-12 years

Research Uses

- comparative spermatology
 - experimental pulmonary adenomatosis
 - **prone to GI ulcers: digestive tract ulcers**
-

65, 66 **ORDER: ARTIODACTYLA**

FAMILY: CERVIDAE

Odocoileus virginianus - White-Tailed Deer

- North America
- weight 48-145 kg
- mating in November-December with gestation of 196-210 days and lifespan 15 years
- **Paralaphastrongylus tenuis= meningial worm in subdural space** without signs in deer. Causes signs in sheep, goats, mice. Intermediate host= snails or slugs

Research Uses

- **naturally occurring sickle-shaped RBCs**

67, 68 **FAMILY: BOVIDAE**

Cephalophus monticola - Blue Duiker

- miniature South African antelope
- 4-5 kg and 25-30 cm in height
- house in 5' x 8' pens and feed rabbit chow and hay ad libitum
- scent glands ventral to each eye

- gestation 7 months, estrus cycle 20 days
- wean at 3-5 months and puberty at 9-15 months

Research Uses

- forage evaluation
 - ruminant physiology and endocrinology
 - ruminant toxicology
 - ruminant reproduction
-

69 ORDER: LAGOMORPHA FAMILY: OCHOTONIDAE

Ochotona sp. - Afghan Pika

- Asia and North America
- weight 125-400 gm
- gestation 30 days with litter size 3-4
- sexually mature at 65 days (much earlier than rabbit)
- **female with 12 pairs of mammae**
- **no tail**
- can be considered for use as laboratory animal as does well in captivity if given adequate vitamins and minerals

Research Use:

- retinal ganglion studies (**electromyography**)
 - **locomotion**
 - **iron storage disease**
-

70 CLASS: AVES ORDER: GALLIFORMES

FAMILY: PHASIANIDAE

Gallus domesticus - Chicken

- U.S. population is 2-3 billion
- descended from Gallus gallus, the Red Jungle Fowl

- 1 rooster/20 hens
- eggs hatch in 21 days with lifespan of 15 years

Research Uses

- Hereditary muscular dystrophy - autosomal recessive in White Leghorn and New Hampshires (polygenic). Atrophy, phagocytosis, and fatty degeneration of pectoralis muscle. Not exactly like human disease. Mouse and hamster also have a form of this.
- Hashimoto thyroiditis - hereditary autoimmune thyroiditis of obese (os) strain of White Leghorn. Mediated by B-cells. Autosomal polygenetic dominant trait.
- March gangrene - deep pectoral myopathy, Oregon disease, green muscle disease in broilers. Occurs in 40% turkeys and 19% broilers exposed to stress. Prevent by incising fascia of supracoracoid muscle. Analogous to tibial syndrome in military personnel.
- Xanthomatosis - occurs in 1-60% of White Leghorns. Doesn't closely resemble human condition.
- Infantile cortical hyperostosis (Caffey's Disease) – viral avian osteopetrosis in early stages resembles the disease
- Gout - chickens can have hyperuricemia and articular gout
- viral leukemia and tumor research
- spontaneous diabetes insipidus
- eggs are used for virology, cultures, immunology
- hyperlipoproteinemia - White Leghorns associated with non-laying
- atherosclerosis research and hemoglobinopathy studies
- delayed neurotoxicity in White Leghorn

71 FAMILY: MELEAGRIDIDAE

Meleagris gallopavo - Turkey

- U.S. population 100 million
- 1 gobbler/15 hens
- egg incubation 28 days and adults weigh 20-26 lbs

Research Uses

- **cardiomyopathy with endocardial fibroelastosis - Round Heart Disease of turkeys.** 50% incidence in inbred flock of birds with broad breasts. May be viral etiology with IgG mediators. Mortality prior to 6-8 months. 5% incidence in commercial flock. Congestive cardiomyopathy.

- **Alpha 1 - antitrypsin deficiency - turkeys with Round Heart Disease also have A1A deficiency.** Birds have liver degeneration with intracytoplasmic globules and congestive (dilatatory) cardiomyopathy. Man has the liver and blood changes but has panemphysema in the lungs rather than cardiomyopathy.
 - hereditary muscular dystrophy - same as chickens
 - naturally occurring dissecting aortic aneurysms
 - **dietary induced atherosclerosis**
-

72-74 . **Aplysia californica (sea hare) and neuron**

(Sea slug - hermissenda (memory and learning model))

75. Killer Whale - Orcinus orca

Research Use: Chediack-Higashi Disease

- **Chédiak–Higashi syndrome** is a rare autosomal recessive disorder that affects multiple systems of the body, and arises from a mutation in the Lysosomal Trafficking Regulator gene. It occurs in humans, Cattle, White Tiger, Aleutian mink, blue Persian cat, and in a captive Orca.
- There is **dilution of color in the hair and ciliary processes of the eye**, with large granules, believed to be lysosomes, in all cell types and particularly noticeable in circulating neutrophils and eosinophils.
- Anemia, and hepatomegaly
- Leukocytes are defective in chemotaxis and intracellular killing. Affected individuals suffer from an increased susceptibility to infection and bleeding tendencies caused by a platelet storage defect. impaired Bacteriolysis due to failure of Phagolysosome formation.

76. **what genus species is depicted here? picture of zebrafish; normal**

Zebrafish (*Danio rerio*)

77. **(zebrafish with lesion; gross)**

These lesions were observed in several fish in one tank 4 weeks after arrival in a research facility. The nitrite level of the tank was 5 ppm.

78. **(Histo)--histo of mononuclear exudative epidermitis and multifocal myositis and myodegeneration(arrows, H and E 40X)**

-

petechia hemorrhages and ulceration of the surfaces of the skin...gram positive bacteria observed beneath the surface of the skin and around the spinal cord. Both aeromonas hydrophila and A sobria were isolated...diagnosis of motile aeromonad septicemia was made. Water had a nitrite level of 1-5 ppm a toxic concentration that indicated poor water quality. Because the housing system had been seeded with Nitrobacter spp and nitrosomonas spp only 2 weeks prior to the arrival of the fish, a lack of colonizing nitrifying bacteria was deemed to be the cause of the high nitrite level, which along with over crowding stressed the fish and increased their susceptibility to MAS..no further cases of septicemia were observed once the nitrite level and stocking density were reduced.” p 80

what is the differential diagnosis for cutaneous hemorrhages and ulcers , lethargy and abnormal posture in zebrafish?

Aeromonas, pseudomonas fluorescens, vibriosis, TB

what is the most likely diagnosis?

Motile aeromonad septicemia (MAS) also known as ulcer disease / aeromoniasis.

What is the most common genus species of the etiologic agent in tropical fish?

Aeromonas hydrophila

MAS occurs in many freshwater species of fish and is usually associated with stress and overcrowding,

Are these gram positive or gram negative organisms?

Negative

No gram negative organisms were observed in tissues from these fish. Does this argue against aeromonas as the cause of the disease?

No. Lesions due to aeromonas septicemia are the result of bacterial toxins. Therefore bacteria are generally not found in tissues.” p. 82

What control measures can be taken to prevent/control aeromoniasis?

- reduce stress
- improve water quality
- Txt:
 - tetracycline or chloramphenical
 - reduce stocking density
 - decrease water flow rate
 - lower nitrite levels...

What should the nitrite level of a healthy tank be?

- 0

Tanks with a biological filter should be seeded with nitrobacter and nitrosomonas

How long before fish are introduced?

- 1 month

What is the recommended stocking density for laboratory fish?

- 1 inch fish/gallon or 1.0 gm fish/liter.

High Mortality in Zebrafish (danio rerio), Contemporary Topics, vol 38, no 3, May 1999, pp 80-83

**What are zebrafish used for in research?
developmental biology, toxicology**

Are zebrafish warm or cold water fish?

Warm

omnivorous or carnivorous?

Omnivorous

Do zebrafish have a higher requirement for linoleic or linolenic acid in the diet?

- linoleic

A recent article made what recommendation relative to fatty acid content of zebrafish diets to optimize growth and maintenance?

Standardized diet with Decreased linolenic /linoleic ratio low 3/6 ratio
(Meinelt et al, Comparative Medicine, Vol 50, Number 1, February 2000, pp 43-45)

What model of human disease was the zebrafish recently reported to be representative?

Polycystic kidney disease:

Knockdown of what gene caused formation of kidney cysts?

Bicaudal C gene

(Comparative Medicine, April 2010, pp. 96-106)

79. **Female Medaka (Oryzias latipes)**

Pacific Salmon - Salmo onchorhyncus (Cushings)

Amazon Molly - Poecilia formosa

Fish Diseases

Hole in the Head Disease - Edwardsiella ictalurus

Whirling Disease - Myxosoma cerebralis

Ichthyosporidiosis - I. Hoferi -

80-82. **Ich** Gross (white spots) /histo/cyst - Ichthyophthirus multifilis (**white spot disease**)
Sudden Death - flashing (swimming erratically)

Fish Anesthesia used? MS 222

83, 84 Lymphocystis (gross and histo) - Stripped Bass
-Iridovirus

85. Scoliosis- Vit. C deficiency, TB

86. **White Perch** - Morone americana (Wilson's disease)

87. **Bicolor Damsel** - Pomacentrus partitus - neurofibromatosis.

88 **Notophthalmus viridescens** **Eastern Red-Spotted Newt**

- Cover picture from March 2009 JAALAS
- Article compared analgesia compounds following bilateral surgical forelimb amputation
What analgesic agents may be given?
- buprenorphine given intracoelomic injection vs. butorphanol in tank water

Research uses:

- pain research
- developmental biology
- toxicology

89. **Koala** (Phascolarctus cinerus)

Hypothermic when sick

M. ulcerans model; Buruli ulcer in man. Only Mycobacterium that secretes a toxin

90. American Cockroach - Periplaneta americana

Male is bigger

Female has eggs

Why studies in the lab? Source of potent human allergen for asthma

91 German Cockroach - Blatella germanica

Male is smaller

Female has egg

92. For which of the following species, there is a higher incidence of gastric carcinomas in females?

- A. Rattus norvegicus
- B. Sigmodon hispidus
- C. Mastomys natalensis
- D. homo sapiens

Answer: B. Sigmodon hispidus

- Among inbred female cotton rats (**Sigmodon hispidus**) 25-50% of the animals develop spontaneous gastric carcinomas; the corresponding figure for male cotton rats is approximately 1%
- *duodenogastric reflux is implicated in gastric carcinogenesis in the rat*
- **Human Gastric cancer shows a male predominance in its incidence** as up to three males are affected for every female. Estrogen may protect women against the development of this cancer form.
- About 66% of multimammate rats have a small solitary ulcer in the middle of the lesser curvature 1 month of age which leads to **spontaneous gastric adenocarcinoma; higher incidence in males**
 - **Serves as a model for gastric ulcer formation and Zollinger-Ellison syndrome (Zollinger-Ellison syndrome is caused by tumors, usually found in the head of the pancreas and the upper small bowel. These tumors produce the hormone gastrin and are called gastrinomas. High levels of gastrin cause too much production of stomach acid.)**