Nonhuman Primates

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New World vs Old World Primates

- Old World
  - Asia and Africa
  - Ischial callosities and cheek pouches
  - Infraorder Catarrhini
    - Narrow nose, nostrils angled down, elongated muzzle
New World vs Old World Primates

Cheek pouches

Ischial callosities
New World vs Old World Primates

- New World
  - South and Central America
  - Prehensile and pseudo-prehensile tails
  - Infraorder Platyrrhine
    - Flattened muzzle with broadly spaced nostrils, nostrils open on the side
New World vs Old World Primates

Prehensile tail with tactile pad

Flat muzzle, broadly spaced nostrils
Rhesus Macaques
Rhesus Macaques

- *Macaca mulatta*
- Old world primate
- Sexually dimorphic
  - Males: 53 cm (1.8 ft) tall, 7.7 kg (17 lb)
  - Females: 47 cm (1.5 ft) tall, 5.3 kg (12 lb)
Rhesus Macaques

- **Range**
  - Mainland Asia

- **Habitat**
  - Tropical and temperate
    - Semidesert
    - Dry deciduous
    - Temperate forests
    - Tropical forests
    - Mangrove swamps
Rhesus Macaques

- Diet
  - Omnivores
    - Up to 93% of their diet can be from human sources!
    - Insects, fruits, flowers, leaves, seeds, gums, eggs, shellfish, fish
Social Structure

- Large multi-male, multi-female groups
  - Female stays in natal group, males disperse
  - Typically 10-80 animals
  - Can be in the 100’s in some areas

- Dominance hierarchy
  - Female ranking remains stable throughout life
    - Female offspring inherit rank
  - Male rank can change
    - Based on social and aggressive skills
Reproduction

- **Estrous cycle**
  - 28 days
  - Anogenital skin reddens during estrus, which lasts 8-12 days

- **Birth seasonality**
  - Majority of mating Oct – Dec
  - Births Mar - Jun
Reproductive Medicine

- Post-partum exams (2-3 weeks)
  - Female
    - Palpate uterus for involution
    - Check milk production
    - Check vulva for tears
  - Baby
    - Check fingers: hair rings frequent
    - Auscultate heart
    - Look for umbilical hernias
    - Tattoo
Housing

- Single housing
- Pair housed
  - Breeding
  - Same-sex groups
- Outdoor housing in corrals or corn cribs
  - Harem groups
  - Large groups of juveniles
Restraint

- Macaques typically chemically restrained
  - What about short procedures?
  - Or frequent procedures?
Common Clinical Problems

- Infectious diarrhea
  - 50-60% of caseload
  - Endemic pathogens + poor hygiene
- Fluid therapy
  - Dehydration and electrolyte loss
    - 30ml/kg/hr for 3hr
- Antibiotic treatment
- Zoonotic
Common Clinical Problems

- Trauma
  - 30-40% of clinical caseload
  - Typically associated with social housing
- Common wounds
  - Lacerations
  - Digit fractures
  - Tail degloving
Macaque Zoonotic Concerns

- **Viral**
  - Cercopithecine Herpesvirus-1
    - AKA Herpes B Virus
- **Bacterial**
  - *Mycobacterium tuberculosis*
  - *Campylobacter spp.*
  - *Shigella*
Herpes B Virus

- Common pathogen in monkeys of the *Macaca* genus
- 1-3% of infected macaques shed the virus at any given time and will typically have no evidence of disease
- Causes a rare but potentially fatal descending rapid ascending paralysis in humans
- Transmission via inoculation with potentially infected body fluids and tissues
  - Bite
  - Scratch
  - Needle stick
  - Eye splash
Working Safely with Macaques

- Personal protective equipment (PPE)
  - Overgarment: scrubs, lab coat, gown
  - Face mask
  - Double gloves
  - Eye protection: face shield or safety goggles
- Animals are typically sedated for treatments and exams
Tuberculosis

- Old world primates are incredibly susceptible to TB infection
- Treatments are not 100% effective at eliminating bacteria from the body
- Vaccines are not 100% effective at providing protection against TB
- TB surveillance and elimination of any positive animals is the primary means for protecting the colony
Tuberculosis Surveillance Programs

- Monkey population
  - Quarterly or biannual testing
- Human personnel
  - Biannual or annual testing
- Quarantine and testing of new animals
  - Every 2 weeks for up to 5 negative tests
Tuberculosis Skin Test

- The test is performed in the middle of the eyelid, just above eyelashes
  - Easy and accurate reading without sedation
- Test agent is Mammalian Old Tuberculin
- A successful intradermal injection will result in a bleb, or a raised blister-like structure, on the eyelid.
Tuberculosis Skin Test

- The test site is to be checked by trained personnel at 24, 48, and 72 hours after injection
- The eyelid is evaluated for redness, bruising, or swelling
- Reactions are graded on a scale of 1-5 depending on severity
Rhesus in Research

- Wide range of research contributions
  - Development of the rabies, smallpox, and polio vaccines
  - Discovery of rhesus factor in blood
  - Development of drugs to manage HIV/AIDS
  - Study of the female reproductive cycle and development of the fetus
Common Marmosets
Common Marmosets

- *Callithrix jacchus*
- New world primate
- 185 mm (7.3 inches) tall
- 250 g
- Average lifespan (wild): 12 yr
Common Marmosets

- Endemic to Brazil
- Variety of forests
  - Coastal
  - Semideciduous
  - Riverine
  - Savanna
Common Marmosets

- Diet
  - Exudativore
    - Incisors same length as canines
  - Insectivore
  - Also seeds, flowers, fungi, nectar, snails, lizards, tree frogs, bird eggs, nestlings, and infant mammals
Common Marmosets

- Claw-like nails
  - Tegulae
  - Compared to flat nails (ungulae) of other primates, including humans
- Aid in squirrel-like locomotion patterns
  - Cling vertically to trees
  - Run quadrupedally on branches
  - Leap between trees
Social Structure

- Revolves around an extended family unit
  - Few dominant breeding individuals
    - One or two breeding females
    - One breeding male
  - Flexible mating behavior
  - Groups range between 3-15 animals
  - Males migrate to other groups, females stay
Reproduction

- Cooperative breeding
  - Breeding adults depend on adult siblings and offspring to care for their new infants
  - Non-dominant females become anovulatory
  - Why would they do this??
    - Dispersal may not be possible due to limited resources
    - May increase non-dominant female inclusive fitness
      - Because they are related to the dominant female, it is in the non-dominant female’s interest to help her nieces and nephews to survive
Reproduction

- Tendency for non-identical twins
  - Uncommon among NHPs
Housing
Housing
Housing
Housing
Restraint

- PVC pipe
- Velcro bands
  - Around abdomen
  - Around hind limbs
Restraint
Blood Collection

- Femoral vein
- Typically use restrainer
Common Clinical Problems

- Diarrhea
  - Multifactorial
    - Change in diet
    - Stress
    - Parasites
    - Bacterial infections
Common Clinical Problems

- Fractures
  - Broken legs and ankles are common
  - Plates, external fixators, casts don’t work
  - Amputation most successful
Marms in Research

- Toxicology
  - Physiological and behavioral effects of drugs
- Immunology
  - Multiple sclerosis model
- Coronary heart disease
  - Determine the effect of diets on atherosclerosis
- Stroke
  - Determination of drugs that protect against cell death
- Parkinson’s Disease
  - Study long-term effects of drug treatments
Squirrel Monkeys
Squirrel Monkeys

- *Saimiri boliviensis boliviensis*
- *Saimiri boliviensis peruviensis*
- New world primate
- 315 mm (12.5 inches) tall
- 850 g
Squirrel Monkeys

- Range
  - Central and South America

- Habitat
  - Tropical lowland rainforest
Squirrel Monkeys

- Diet
  - Insectivores
  - Frugivores
  - Small vertebrates (bats, small birds), eggs, seeds, gums, leaves
Social Structure

- Multi-male multi-female groups
  - 45-75 individuals
  - Both sexes have independent dominance hierarchies
  - All females dominant over all males
  - Females spatially segregate the males to the periphery of the group via aggression
  - Bachelor groups: males emigrate from natal group, form similar-age groups
    - Work together to take over the highest positions in new groups
Reproduction

- Polygamous
  - But only a few males copulate more frequently in a group
- “Fatting”
  - Females prefer the males that gain the most weight during the two months before the breeding season
- Seasonal breeders
  - Gestation 145 days, most births Feb – Apr
  - Highest arthropod availability
Reproduction

- Parental care
  - Females responsible
  - 1\textsuperscript{st} month of life ride on mother’s back
    - Impede movement if carried ventrally
Reproductive Medicine

- Dystocia: 10-12%
  - Large fetal mass in comparison to maternal size
    - Weighs 18% of the non-pregnant weight of the dam
  - Infant head diameter vs female pelvic diameter
- Interesting fact
  - During delivery, when the shoulders of the infant are free, it will reach up to grab the dam and assist in pulling itself out
Squirrel Monkey Housing

- Plastic perches
- Hiding boxes
- Many toys
- Interconnected runs
Common Clinical Problems

- Tooth root abscesses
  - Presents as unilateral facial swelling
  - Extract canine on that side
    - Even if it looks normal!
Squirrel Monkeys in Research

- Neuroscience research
  - CNS studies
  - Behavior / learning
  - Perception
- Infectious disease
- Pharmacology
- Toxicology
- Model for malaria vaccine development
  - Similar clinical signs and lesions as humans
- Pelvic organ prolapse model
  - Similar fetal rotation as humans and similar lesions
Owl Monkeys
Owl Monkeys

- *Aotus nancymaee*
- *Aotus vociferans*
- New world primate
- 780 g
- Only nocturnal monkey
Owl Monkeys

- **Range**
  - Southern Central America and Northern South America

- **Habitat**
  - Primary and secondary tropical forest
  - Subtropical dry forest
  - Gallery forest
Owl Monkeys

- **Diet**
  - Frugivores
  - Flowers, nectar, leaves
  - Insects
    - Moths: active at night
    - Orthopterans: call loudly at night
    - Beetles: active at night
Social Structure

- Small family groups
  - One male, one female, 1-3 offspring of various ages
Reproduction

- Monogamous mating pair in captivity, bond lasts for their lifetime
- Non-seasonal breeders
  - Peak in births Oct – Jan in captivity
- Parental care
  - Male very involved
    - Due to monogamous system?
  - Infant carried by female only for nursing purposes
    - Divorced couples: kids go with dad
Housing

- Plastic cages
  - One family per cage
  - Visual barrier between cages
  - Nest box on outside of cage
- Enrichment
  - Plastic chains, plastic nest boxes
- Natural lighting
  - Lights off at 3:00PM
- Keep separate from squirrel monkeys
  - *Herpesvirus saimiri 1*
Common Clinical Problems

- Cardiomyopathy
  - Dilated cardiomyopathy
  - Hypertrophic cardiomyopathy
  - Reduce stress!
- Diarrhea uncommon
  - Soft stool normal, short colon
    - Less efficient at absorbing water
    - Don’t need to be based on environment
Owl Monkeys in Research

- Malaria studies
  - Susceptible to human and NHP malarias and can transmit these to mosquitoes
- Model for cutaneous and visceral leishmaniasis
- Vision research
Chimpanzees
Chimpanzees

- *Pan troglodytes*
- Great ape
- 82 cm (2.7 ft) tall
- Males 40 – 60 kg (+)
- Females 32 – 47 kg
- Average lifespan (wild) 40 – 45 yrs
Chimpanzees

- **Range**
  - Equatorial Africa

- **Habitat**
  - Savanna
  - Evergreen forests
  - Swamp forests
  - Montane forests
Chimpanzees

- Diet
  - Frugivores
  - Supplement with seeds, blossoms, bark, insects, birds, honey, eggs, small to medium sized mammals
Social Structure

- Fission-fusion social groups
  - All individuals regularly associate with one another
  - Smaller temporary groups
  - Linear dominance hierarch among males
  - All males dominant over females

- Benefits
  - Decreased predation, resource defense, feeding efficiency, higher reproductive success
Reproduction

- **Estrous**
  - 36 d cycle
  - Anogenital swelling characterizes estrus
  - Females mate with multiple males

- **Parental care**
  - Mainly female responsibility
  - Constant ventral – ventral contact for the first 30 days
  - Infancy ends between 4 – 6 yrs of age
Housing

- Things to consider
  - Safety
  - Space
    - Need to brachiate
  - Indoor / outdoor
  - Enrichment
Enrichment

- Training
  - Husbandry and veterinary procedures

- Items

- Companions
  - Mixed sex or single sex groups???
Restraint

- Chemical
  - Telazol
  - Ketamine
- Physical
  - Added safety
Common Clinical Problems

- Trauma
  - Aggression between individuals
- Cardiovascular problems
  - Cardiomyopathy
  - Congestive heart failure
- Obesity
  - Diabetes
More Information

- Primate Info Net
  - [pin.primate.wisc.edu/](http://pin.primate.wisc.edu/)
Practice Questions!
1. What percentage of animals used in research each year are nonhuman primates?

A. 25%
B. 10%
C. 1%
D. 45%
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2. Monkeys of African or Asian origin are referred to as...
   A. Southern Hemisphere monkeys
   B. New World monkeys
   C. Cynomolgus monkeys
   D. Old World monkeys
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3. What is the scientific name of the marmoset genus?
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   B. Saimiri
   C. Callithrix
   D. Pan
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4. Which is a distinguishing feature of an Old World monkey?

A. Prehensile tail
B. Long tail
C. Cheek pouches
D. Nostrils open to the front or side
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B. Long tail
C. **Cheek pouches**
D. Nostrils open to the front or side
5. When is it acceptable to NOT wear a face mask and eye protection around primates?
   A. When they are fully anesthetized
   B. If they are not removed from their cage
   C. If they have passed the health screening
   D. Never
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6. What is a squeeze cage?

A. A cage with a separate compartment to hold food

B. A cage that collapses to compact storage

C. A cage with a mobile side or back that can close in

D. A cage for transporting a primate between cages
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7. What nutrient do primates require in order to prevent scurvy?

A. Vitamin C
B. Fiber
C. Vitamin B6
D. Fatty acids
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8. What type of macaque is pictured?
A. Rhesus macaque
B. Cynomolgus macaque
C. Pig-tailed macaque
D. Stump-tailed macaque
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9. Which is an Old World primate?

A. Owl monkey
B. Rhesus macaque
C. Squirrel monkey
D. Marmoset
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10. Which is an ape?

A. Gorilla
B. Orangutan
C. Chimpanzee
D. Gibbon
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Veterinarians concerned with the care, health and welfare of nonhuman primates.