SYLLABUS FOR 409
Primate Nutritional Ecology
Monday –Thursday 9:15-10:35
RAB 209A

1. | **Course Number:** | **Course Name:** | **Hours:** | **Credits:** |
|---|---|---|---|
| ANTH 409 | Primate Nutritional Ecology | 3.0 | 3.0 |

2. **Instructor Name**: Erin Vogel
3. **Instructor Contact Information**:
   a. Email: erin.vogel@rutgers.edu (out Anth 409 in subject line)
   b. Phone: 848-932-9277
   c. Office: 307 Biology Building, Douglas campus
   d. Office Hours: Monday 2-4 or by appointment
4. **Pre- or Co-Requisites:**
   a. ANTH 102 (Intro. to Human Evolution) *or*
   b. ANTH 212 (Life of Primates) *or*
   c. BIO 103 (Principles of Biology) *or*
   d. BIO 115 – 116 (General Biology)

5. **Exams: Two Midterm exams**

6. **Course Description**: This course will examine how primates meet their nutritional needs through interactions with their environments. From an explicitly evolutionary perspective, the course will address foraging theory, dietary ecology, macronutrient and micronutrient acquisition, and digestive ecology. The course will also provide an overview of methods to analyze primate diets. The course will discuss aspects of primate anatomy, physiology, microbiology, ecology, behavior and life history in relation to their intersection with primate nutrition.

7. **Course-Specific Learning Outcome Goals:**

   a. The basic nutritional components of primate diets and how they are supplied by wild plants and animal material
   b. How primates use their senses to detect edible food items
   c. To use the comparative approach to better understand why primate societies differ
   d. The different theoretical frameworks used in predicting and interpreting primate foraging choices
   e. The variety of digestive anatomy and physiology among the primates
   f. How primate diets compare to early human diets and contemporary human diets
   g. How to critically review scientific articles
   h. To write a critical review paper on a chosen topic
   i. How to give a scientific presentation (undergrads 1 presentation; graduate students 2 presentations)

8. **Writing Requirements:**
   a. Students at the **undergraduate level** will have two writing assignment.

First, they will be required to write a paper synthesizing what is known about the diet and nutrition of a particular primate (8 pages double-spaced). The paper will need to cite at least 10 papers from the primary literature and 10 additional sources.

Second, students will act as a "reviewer" for a paper on primate nutrition (chosen by the instructor), and will have to critique, in detail, the problems of the paper based on information they learned in class, and suggest ways in which the paper can be improved.

b. Students at the **graduate level** will have two writing assignments, two of which are similar to the undergraduate requirement.

First, they will be required to write a paper synthesizing what is known about the diet and nutrition of a particular primate (12 pages double-spaced). The paper will need to cite at least 20 papers from the primary literature and should be a review paper.

Second, students will act as a "reviewer" for a paper on primate nutrition (chosen by the student), and will have to critique, in detail, the problems of the paper based on information they learned in class, and suggest ways in which the paper can be improved.

9. Required Texts and Readings

This course will rely on required journal articles organized by topic, and two required books below. Please see below for additional readings. The required journal articles will be available on Sakai

National Research Council (2003) Nutrient requirements of non-human primates. Second Edition. National Academies.

Barboza, PS, Parker KL, Hume ID (2009) Integrative wildlife nutrition. Berlin: Springer-Verlag

Simpson, S.J., Raubenheimer, D., 2012. The nature of nutrition: a unifying framework from animal adaptation to human obesity. Princeton University Press.

C. Recommended Readings

If students have not taken a course in primatology, the following text is recommended:

Strier, K. (2016) Primate Behavioral Ecology. 5th Edition. Pearson Publishers. ISBN-13: 978-1138954366

10. Anticipated Assignments and Grading Structure (assignments, papers, projects, exams, and other methods of evaluation, with due dates where available).

Students will be assessed via the writing assignments, a final exam, and in-class participation on that week's required readings.

Exam 1	20%
Paper 1	20%
Presentation 1	20%
Exam 2	20%
Review critique	10%
Class Participation	10%

11. ***Academic Integrity***

(http://academicintegrity.rutgers.edu/)

Rutgers has zero tolerance for cheating, plagiarism, etc. Consult the above webpage to learn more about what constitutes a violation of academic integrity and what sanctions are taken against violators.

Course Content and Schedule

National Research Council (2003) Nutrient requirements of non-human primates. Second Edition. National Academies. **(NRC)**

Barboza, PS, Parker KL, Hume ID (2009) Integrative wildlife nutrition. Berlin: Springer-Verlag **(IWN)**

Simpson, SJ, Raubenheimer, D, (2012). The nature of nutrition: a unifying framework from animal adaptation to human obesity. Princeton University Press. **(NON)**

Week 1: *Introduction: Primate Habitats and their Resources*
Jan 23, 26

Required Readings:
IWN, Chapters 1-2
Janson, C. H., & Chapman, C. A. (1999). Resources and primate community structure. In J. G. Fleagle, C. H. Janson & K. E. Reed (Eds.), *Primate Communities* (pp. 237-267). Cambridge: Cambridge University Press.

Week 2: *Primate Digestion: Anatomy and Physiology*
Jan 30, Feb 2

Required Readings:
NRC, Chapters 1-2
IWN, Chapters 3-4

Lambert, J. E. (1998). Primate digestion: interactions among anatomy, physiology, and feeding ecology. *Evolutionary Anthropology, 7*, 8-20.

Milton, K. (1998). Physiological ecology of howlers (Alouatta): Energetic and digestive considerations and comparison with the Colobinae. *International Journal Primatology, 19*, 513-548.

Milton, K. (1981). Food choice and digestive strategies of two sympatric primate species. *American Naturalist 117*, 496-505.

Week 3: *What primates need: the macronutrients*
Feb 6, 9

Required Readings:
NRC: Chapters 3-5, 8, 9
IWN: Chapters 6-8, 10

Week 4: *What primates need: the micronutrients*
Feb 13, 16

Required Readings:
NRC: Chapters 6-7, 9
IWN: Chapter 9

Week 5: *Foraging Theory, Food Selection and Nutritional Frameworks*
Feb 20, 23

Required Readings: Stephens J., Krebs C.. (1987) Chapters 1 & 2 in Foraging Theory. Princeton University Press (will post to Sakai)

Rothman, J. M., Raubenheimer, D., Chapman, C. A. (2011). Nutritional geometry: gorillas prioritize non-protein energy while consuming surplus protein. *Biology Letters*.

Milton, K. (1979). Factors influencing leaf choice by howler monkeys: a test of some hypotheses of food selection by generalist herbivores. *American Naturalist, 114*, 362-378.

Felton, A. M., Felton, A., Lindenmayer, D. B., Foley, W. J. (2009). Nutritional goals of wild primates. *Functional Ecology, 23*, 70-78.

<u>Week 6: *Physical properties of primate foods: Feeding adaptations for food acquisition and processing*</u>

<u>Feb 27, March 2</u>

Required Readings:
Lambert, J. E. (2005). Competition, predation, and the evolutionary significance of the cercopithecine cheek pouch: The case of Cercopithecus and Lophocebus. *American Journal of Physical Anthropology, 126*, 183-192.

Dominy, N. J., Lucas, P. W., Supardi Noor, N (2006). Primate sensory systems and foraging behavior. In: Hohmann G, Robbins M., Boesch C. (eds.) *Feeding Ecology in Apes and other Primates: Ecological, Physiological and Behavioural Aspects*. Cambridge University Press, Cambridge, pp. 489-509.

Milton, K. (1984). The role of food processing factors in primate choice. In: P. Rodman and Cant J, (eds.). *Adaptations for Foraging in Nonhuman Primates*. Columbia University Press. pp. 249-279

Vogel, E.R., van Woerden, J.T., Lucas, P.W., Atmoko, S.S.U., van Schaik, C.P., Dominy, N.J., 2008. Functional ecology and evolution of hominoid molar enamel thickness: *Pan troglodytes schweinfurthii* and *Pongo pygmaeus wurmbii*. Journal of Human Evolution 55, 60-74.

<u>Week 7: *Nutritional composition of primate foods*</u>
<u>March 6, 9</u>

Required Readings:
NRC, Chapter 12
Milton, K. (1999). Nutritional characteristics of wild primate foods: Do the diets of our closest living relatives have lessons for us? *Nutrition, 15*, 488-498.

Raubenheimer, D. and J. M. Rothman (in press). Nutritional ecology of entomophagy in humans and other primates." *Annual Reviews of Entomology.*

Rothman, J. M., P. J. Van Soest, et al. (2006). Decaying wood is a sodium source for mountain gorillas. *Biology Letters,* 2, 321-324.

Vogel, E.R., Harrison, M.E., Zulfa, A., Bransford, T.D., Alavi, S.E., Husson, S., Morrogh-Bernard, H., Santiano, Firtsman, T., Utami-Atmoko, S.S., van Noordwijk, M.A., Farida, W.R., 2015. Nutritional differences between two orangutan habitats: implications for population density. Plos One 10, e0138612.

Week 8: SPRING BREAK

Week 9: ***Analysis of Primate Foods***
March 20, 23

Required Readings:

Rothman JM, Chapman CA, Van Soest PJ (2011) Methods in primate nutritional ecology: a user's guide. International Journal of Primatology

Conklin-Brittain, N. L., Knott, C. D., & Wrangham, R. W. (2006). Energy intake by wild chimpanzees and orangutans: methodological considerations and a preliminary comparison. In G. Hohmann, M. M. Robbins & C. Boesch (Eds.), *Feeding ecology in apes and other primates. Ecological, physical and behavioral aspects* (pp. 445-571): Cambridge University Press.

Chapman, C. A., Chapman, L. J., Rode, K. D., Hauck, E. M., & McDowell, L. R. (2003). Variation in the nutritional value of primate foods: among trees, time periods, and areas. *International Journal of Primatology, 24*, 317-333.

Week 9: ***Putting it all together: how nutritional ecology shapes primate behavior***
March 27, 30

Required Readings:

Ganzhorn, J. U. (1988). Food partitioning among Malagasy primates. *Oecologia, 75*, 436-450.

Conklin-Brittain, N. L., Wrangham, R. W., & Hunt, K. (1998). Dietary response of chimpanzees and cercopithecines to seasonal variation in fruit abundance II Macronutrients. *International Journal of Primatology, 19*, 971-997.

Koenig, A., & Borries, C. (2006). The predictive power of socioecological models: a reconsideration of resource characteristics, agonism and dominance hierarchies. In G. Hohmann, M. M. Robbins & C. Boesch (Eds.), *Feeding ecology in apes and other primates* (pp. 263-284). Cambridge: Cambridge University Press.

Vogel, E. R. (2005). Rank differences in energy intake rates in white-faced capuchin monkeys, *Cebus capucinus*: the effects of contest competition. *Behavioral Ecology and Sociobiology, 58*, 333-344.

Vogel, E.R., Alavi, S.E., Utami Atmoko, S.S., van Noordwijk , M.A., Bransford, T.D., Erb, W.M., Zulfa, A., Sulistyo, F., Farida, W.R., Rothman, J.M., in press. Nutritional ecology of wild Bornean orangutans (Pongo pygmaeus wurmbii) in a peat swamp habitat: effects of age, sex, and season. American Journal of Primatology.

Week 10 ***Putting it all together: primate nutrition and the evolution of human diet***
April 3, 6

Required Readings:

Lambert, J. E. (2007). Seasonality, fallback strategies, and natural selection: a chimpanzee and cercopithecoid model for interpreting the evolution of hominin diet. In P. S. Ungar (Ed.), *Evolution of human diet: the known, the unknown, and the unknowable* (pp. 324-343). Oxford: Oxford University Press.

Milton K (1999) A hypothesis to explain the role of meat-eating in human evolution. *Evolutionary Anthropology 8,* 11-21

Leonard, W. R., Robertson, M. L. (1994) Evolutionary perspectives on human nutrition: the influence of brain and body size on diet and metabolism. *American Journal of Human Biology* 6, 77-88

Week 11: Guest Lecturer: Nutrition, metabolism, health and growth
April 10, 13

Required Readings:
To be announced

Week 13: *Nutrition and health/microbiome*
April 17 (April 20 no class)

Required Readings:

Raubenheimer, D., Simpson, S.J., 2016. Nutritional ccology and human health. *Annual Review of Nutrition* 36, 603-626.

Raubenheimer, D., Machovsky-Capuska, G.E., Gosby, A.K., Simpson, S., 2015. Nutritional ecology of obesity: from humans to companion animals. *British Journal of Nutrition* 113, S26-S39.

To be announced

Week 14: *Vogel lecture on orangutan nutrition/ closing discussions*
April 24 and 27

Required Readings:
To be announced

May 1: Final Paper due