TENTATIVE SYLLABUS

TEMPERATE-TROPICAL ECOLOGY & BIOGEOGRAPHY

A joint summer 2020 field course between Highlands Biological Station (Western Carolina University) and Wildsumaco Biological Station, Ecuador (Francis Marion University)

10 July – 28 July 2022

Highlands Biological Station
Sunday 10 July – Saturday 16 July 2022

Quito and Wildsumaco Biological Station, Ecuador
Sunday 17 July – Thursday 28 July 2022

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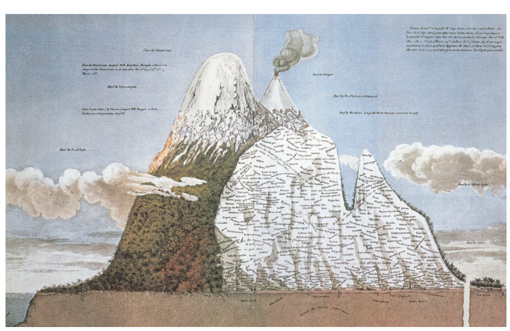
Introduction

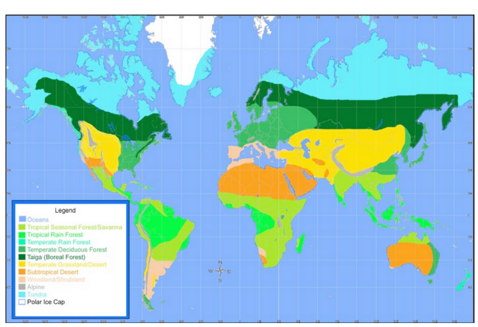
For centuries, naturalists have worked toward an understanding of the structure and function of ecological systems, and the related question of the geographical distribution of species. The historical and ecological processes that shape these form the foundation of modern biogeography and community and ecosystem ecology. Explorer-naturalists of the 18th century, such as Alexander von Humboldt and Aimé Bonpland, pioneered a comparative approach to mapping and understanding global patterns of species diversity and its distribution. In so doing they played a key role in the development of modern ecology and biogeography.



Temperate and tropical communities and ecosystems have interesting commonalities in some of their attributes while also exhibiting striking differences in such characteristics as forest structure and the extent and distribution of biological diversity. This unique field course aims to provide a comparative exploration of the ecology and biogeography of temperate zone and tropical forest ecosystems: the Blue Ridge Escarpment and Great Smoky Mountain region of the southern Appalachian mountains, and the Amazonian slope of the Andes in South America. Our "base camps" for exploration will be **Highlands Biological Station** (HBS, Highlands, North Carolina, USA; 35.0539° N, 83.1894° W) and **Wildsumaco Biological Station** (WBS, Sumaco Biosphere Reserve, Ecuador; 0.6715° S, 77.5987° W).

These field stations are located at comparable elevations (approx. 4,000 feet for HBS, 4,600 feet for WBS) in very different mountain ranges, approximately 35° apart in latitude, one in the temperate zone and the other on the equator. HBS is located on the edge of the Blue Ridge Escarpment, atop a Neoproterozoic- and Paleozoic-aged granite-gneiss plateau in a region that boasts the highest mountains in eastern North America, the second-highest rainfall on the continent at 90+" on average, and biological richness unsurpassed in the earth's temperate zones for many groups of organisms. The region surrounding HBS is remarkably intact mixed-mesophytic, northern hardwood, and spruce-fir forest, including several tracts of Old Growth, with high levels of endemism (notably for plants and amphibians, especially salamanders which exhibit species richness that rivals that of the tropics). WBS is situated on the eastern (Amazonian) slope of the Andes of Ecuador, among the highest and youngest mountains on earth and receiving some 135" of rainfall annually. Volcanic in origin, the Ecuadoran Andes include over two dozen peaks exceeding 10,000 feet in elevation (the highest over 20,000 feet), many volcanically active. Surrounding habitats include primary lower montane rain forest, as well as secondary forest and pasture land. The tropical regions of the world are renowned for their unsurpassed biological diversity, and the Amazonian slope of the Andes is among the very richest.

In this unique field course, we aim to take a field-based comparative approach to exploring southern Appalachian and Amazonian Andean montane ecology and biogeography in the spirit of the explorer-naturalists of the eighteenth and nineteenth centuries. We will consider the geological context of the Appalachians and Andes, comparative biogeography / ecology of these respective regions in terms of the ecological and historical factors that shape their biota, big-picture patterns of latitudinal and elevational diversity gradients, principles of forest community structure and function, and examine comparative species composition and interactions in selected groups as well as soil structure and microbiota.



<u>TENTATIVE</u> COURSE SCHEDULE AND TOPICS

Segment 1 (7 days): Highlands, NC

[Arrival day at HBS: Saturday 9 July 2022, afternoon or evening]

Sun 10 July — -Welcome and Introduction to course; Humboldt and Humboldtian Principles
-Introduction to Blue Ridge Escarpment geology & ecology: Jocassee Gorges, Whiteside Mountain; factors shaping a temperate zone hotspot [lecture & field]
Reading: <u>Humboldt</u>: Bowler 2002; Jackson 2009; Rupke 2010. <u>Regional Geology</u>: Gaddy 2000, Jacobs 2019 (excerpts)

Mon 11 July — Principles of biogeography: ecological and historical factors
Reading: Farrar 1998; Xiang et al. 2000; Quian 2001; Manos & Meireles 2015
(1) Lecture: Climate history of North America: effects on southern Appalachian biota; East Asia-Eastern North American connection;
(2) Field: Exemplars: endemic, Asian, Neotropical, and European-derived southern Appalachian flora, fauna

Tu 12 July — -Transect across ancient coastal & suture zone: Newfound Gap (Great Smoky Mountains National Park) to Waterrock Knob (BRP) [all day field trip]
Reading (excerpts): Davis 2003
(1) Geological: metasedimentary to plutonic/crystalline Appalachians
(2) Elevational effects: temperature, pressure, ecological zonation à la Humboldt
(3) Biological communities: effects of elevation, slope, aspect

Wed 13 July — -AM: A tale of three taxa: Relicts & "ecological anachronisms" [lecture, field]
Reading: Janzen & Martin 1982; Barlow 2000; Kister et al. 2015
-PM: *Synthesis, discussion*

Th 14 July — -Gray Fossil Site and Roan Mountain [all day field trip]
(1) Intersection of historical geology & ecology @ Grassy bald ecosystem
(2) Humboldtian measurements: transect Highlands - Roan Mtn
Reading: Jeffries & Wentworth 2014 (excerpts); Weigl & Knowles 2013

Fri 15 July -AM: E. deciduous forest: structure, evenness, density analysis [lecture & field]
-PM: *Synthesis, discussion*

Sat 16 July -AM: TBD: Chattooga River, Rock outcrop communities, or plethodontid survey (Readings TBD)
-PM: *Synthesis, discussion*; **Exam 1**

Sun 17 July -Depart for Ecuador: HBS van transfer to Atlanta airport.
{Include flight details here}

Segment 2 (12 days): Ecuador

VOLCÁN SUMACO

Sun 17 July -Arrive in Quito ____ PM, transfer to Hotel San Carlos de Tababela.

Mon 18 July -AM: Breakfast & Orientation, then:

Transfer to WBS with stops at Papallacta, Guango, Baeza (approx. 6 h)

(1) Transect: Quito – Papallacta – Guango – Baeza – WBS;
Humboldtian measurements noting biological community change with elevation, slope, aspect; transition to cloud forest (upper montane rainforest): Inter-Andean valley – threatened *Polylepis* forests – páramo ecosystem – montane cloud forest

(2) Intro to montane cloud forest: structure, epiphytes, diversity vs. density

(3) Intro to Hummingbird diversity [Guango]

-PM: Arrive at WBS in time for dinner; Night walk!

Tu 19 July -Andean geology; Humboldt in Ecuador
S. American biogeography; Neotropical species diversity [lecture & field]
Reading: Chown & Gaston 2000; Gaston 2007; Kricher 2011 ch. 5 (excerpts); Kricher 2017 ch. 8, 9 (excerpts); Brown 2014; Wade 2015

(1) Intro to latitudinal & altitudinal biodiv. gradient concept
(2) Tropics as cradle vs. museum
(3) Broad and narrow-scale hypotheses for the gradient
(4) Set up camera traps

Wed 10 July -Tropical rainforest in comparison w/ temperate deciduous forest [lecture & field]
Reading: Kricher 2017, ch. 13
(1) Lower montane rainforest structure, ecology, diversity
(2) Structure, evenness, density analysis

Th 21 July -Discussion: Humboldtian transect data from Quito to WBS
-Janzen mountain pass hypothesis
Reading: Janzen 1967; Ghalambor et al. 2006
-Field exploration {Antpitta?}

Fri 22 July -Forest disturbance dynamics [lecture & field]
Reading: Kricher 2017, ch. 7
(1) Field: gaps, mosaics
-PM: *Synthesis, discussion*

Sat 23 July -Neotropical bird diversity; Neotropical migrants [lecture & field]
Reading: Kricher 2017, ch.15
(1) Diversity, ecology, behavior
(2) Field: bird walk

Sun 24 July -Neotropical mammalian diversity [lecture & field]
Reading: Kricher 2011, ch. 6
(1) Diversity, ecology, behavior
(2) Great American Interchange
(3) Field: download camera trap photographs

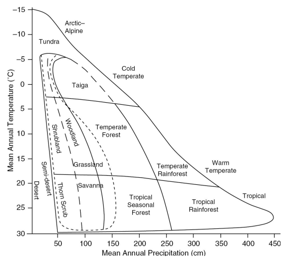
Mon 25 July -Mutualisms and evolutionary arms races: Coevolution [lecture & field]
Reading: Kricher 2017, ch. 11; Kricher 2011, ch. 7
(1) Field: Plant-pollinator relationships (orchids/orchid bees; bats); Leaf-cutter ants.
-Sexual selection: Darwin vs. Wallace; principles and local exemplars.
(1) Tentative: visit to Cock-of-the-Rock lek - Kricher 2017 pp. 164-165

Tu 26 July -AM: Review/discussion; **Exam 2**; Journals due
-PM: Transfer to Quito (Hotel San Carlos de Tababela)
Evening discussion: Páramo ecosystem and global change
Reading: Madriñán et al. 2013

W 27 July Transfer to Antisana Ecological Reserve: full-day excursion to Antisana Volcano! (classic stratovolcano: Páramo ecosystem, condors, vicuñas) [field]
(1) Transect from WBS to Antisana: Elevational effects of temperature, pressure, ecological zonation that Humboldt worked out on Chimborazo. Take Humboldtian measurements.
(2) Exploration of Páramo ecosystem: plants & and their adaptations.
(3) Geological: volcanic / igneous; soils contribution; landslides and *Chusquea* bamboo as pioneer. Alpine glaciation.

Transfer to Quito airport (UIO; Mariscal Sucre International Airport)
for overnight return flight to the US.
{Include flight details here}

Th 28 July Transfer to Highlands [Pickup at ATL by HBS personnel]
TBD: Final essay/reflection due



Course Readings

I. Humboldt

Bowler, P. J. 2002. Climb Chimborazo and see the world. *Science* 298: 63–64

[Editorial] 2019. Humboldt’s legacy. *Nature Ecology & Evolution* 3: 1265–1266.

Humboldt, A. von. 1805. *Essai sur la géographie des plantes*. [excerpt from Lomolino et al. 2004]

Humboldt, A. von and A. Bonpland. 2009. *Essay on the Geography of Plants*. Edited & with an introduction by S. T. Jackson, Translated by S. Romanowski. Chicago: University of Chicago Press. [excerpts: Introduction; cross-sectional ecological diagram of Chimborazo]

Jackson, S. T. 2009. Alexander von Humboldt and the general physics of the earth. *Science* 324: 596–597.

Moreta, P., P. Muriel, R. Jaramillo, and O. Dangles. 2019. Humboldt’s *Tableau Physique* revisited. *Proceedings of the National Academy of Sciences USA* 116(26): 12889–12894.

Rupke, N. A. 2010. Recovering a Humboldtian legacy. *Science* 327: 270–271.

II. Southern Appalachian Segment

<ins>Southern Appalachian physiography, history</ins>:

Davis, D. E. 2003. *Where There Are Mountains: An Environmental History of the Southern Appalachians*. Athens, GA: University of Georgia Press. [excerpts]

Gaddy, L. L. 2000. *A Naturalist's Guide to the Southern Blue Ridge Front*. Columbia, SC: University of South Carolina Press. [excerpts]

Jeffries, S. B. and T. R. Wentworth. 2014. *Exploring Southern Appalachian Forests: An Ecological Guide to 30 Great Hikes in the Carolinas, Georgia, Tennessee, and Virginia*. Chapel Hill, NC: University of North Carolina Press. [excerpts]

Linzey, D. W. 2008. *A Natural History Guide: Great Smoky Mountains National Park*. Knoxville, TN:

University of Tennessee Press. [excerpts]

General geological, ecological, biogeographical principles:

Currie, D. J. and V. Paquin. 1987. Large-scale biogeographical patterns of species richness of trees. *Nature* 329: 326–327.

Hutchinson, G. E. 1959. Homage to Santa Rosalia, or why are there so many kinds of animals? *American Naturalist* 93: 145–159.

Jacobs, W. S. 2019. *Whence These Special Places? — The Geology of Cashiers, Highlands & Panthertown Valley*. Asheville, NC: Great Rock Press.

Whittaker, R. H. 1956. Vegetation of the Great Smoky Mountains. *Ecological Monographs* 26(1): 1–80. [excerpts]

Biogeographic realms:

Sclater, P. L. 1858. On the general geographical distribution of the members of the Class Aves. *Journal of the Proceedings of the Linnean Society (Zoology)* 2 (1858): 130–145.

Wallace, A. R. 1859. Letter from Mr. Wallace concerning the geographical distribution of birds [dated March 1859, Batchian]. *Ibis* 1: 449–454.

e. North America - e. Asia floristic connection:

Gray, A. 1856, 1857. Statistics of the flora of the Northern United States. *American Journal of Science and Arts* 22(2nd ser.): 204–232; 23(2nd ser.): 62–84, 369–403. [excerpts]

Manos, P. & J. E. Meireles. 2015. Biogeographic analysis of the woody plants of the southern Appalachians: Implications for the origins of a regional flora. *American Journal of Botany* 102(5): 1–25.

Quian, H. 2001. A comparison of generic endemism of vascular plants between East Asia and North America. *International Journal of Plant Sciences* 162: 191–199.

Xiang, J. et al. 2000. Timing the Eastern Asian–Eastern North American floristic disjunction: Molecular clock corroborates paleontological estimates. *Molecular Phylogenetics and Evolution* 15: 462–472.

Neotropical relicts:

Farrar, D. R. 1998. The tropical flora of rockhouse cliff formations in the Eastern United States. *Journal of the Torrey Botanical Society* 125: 91–108.

Ecological anachronisms:

Barlow, C. 2000. Anachronistic fruits and the ghosts who haunt them. *Arnoldia* 61(2): 14–21.

Janzen, D. H. and P. S. Martin. 1982. Neotropical anachronisms: The fruits the gomphotheres ate. *Science* 215: 19–27.

Kister, L., L. A. Newsom, T. M. Ryan, A. C. Clarke, B. D. Smith, and G. H. Perry. 2015. Gourds and squashes (*Cucurbita* spp.) adapted to megafaunal extinction and ecological anachronism through domestication. *Proceedings of the National Academy of Sciences USA* 112(49): 15107–15112.

<u>Southern Appalachian Grassy Bald ecosystem:</u>
Jeffries, S. B. and T. R. Wentworth. 2014. *Exploring Southern Appalachian Forests: An Ecological Guide to 30 Great Hikes in the Carolinas, Georgia, Tennessee, and Virginia*. Chapel Hill, NC: University of North Carolina Press. [excerpts]

Weigl, P. D. and T. W. Knowles. 2014. Temperate mountain grasslands: A climate-herbivore hypothesis for origins and persistence. *Biological Reviews* 89(2): 466–476.

III. Ecuador segment

<u>Main texts (tropical ecology, community structure, etc.; selected chapters to be provided):</u>

Kricher, J. 2011. *Tropical Ecology*. Princeton, NJ: Princeton University Press.

Kricher, J. 2017. *The New Neotropical Companion*. Princeton, NJ: Princeton University Press.

<u>Tropical diversity & evolution: latitudinal gradient, museum or cradle:</u>

Brown, J. H. 2014. Why are there so many species in the tropics? *Journal of Biogeography* 41: 8–22.

Chown, S. L. and K. J. Gaston. 2000. Areas, cradles and museums: the latitudinal gradient in species richness. *Trends in Ecology & Evolution* 15: 311–315.

Gaston, K. J. 2007. Latitudinal gradient in species richness. *Current Biology* 17 (15): R574.

Knapp, S. and J. Mallet. 2003. Refuting refugia? *Science* 300: 71–72.

Lutz, D. 2017. Global forest network cracks the case of tropical biodiversity. *The Source*: https://source.wustl.edu/2017/06/global-forest-network-cracks-case-tropical-biodiversity/

Mittelbach et al. 2007. Evolution and the latitudinal diversity gradient: speciation, extinction and biogeography. *Ecology Letters* 10: 315–331.

Wade, L. 2015. Feature: How the Amazon became a crucible of life. *Science* http://www.sciencemag.org/news/2015/10/feature-how-amazon-became-crucible-life

<u>Tropical mountain pass hypothesis:</u>

Ghalambor, C. K., R. B. Huey, P. R. Martin, J. J. Tewksbury, & G. Wang. 2006. Are mountain passes higher in the tropics? Janzen's hypothesis revisited. *Integrative and Comparative Biology* 46: 5–17.

Janzen, D. H. 1967. Why mountain passes are higher in the tropics. *American Naturalist* 101: 233–249.

<u>Páramo ecosystem:</u>

Madriñán S., A. J. Cortés, and J. E. Richardson. 2013. Páramo is the world's fastest evolving and coolest biodiversity hotspot. *Frontiers in Genetics* 4: 1–7

Volcán Antisana

I. OBJECTIVES; COURSE & GLOBAL LEARNING OUTCOMES

Welcome to Comparative Temperate-Tropical Ecology & Biogeography! This course has several objectives. Our primary goals are to learn fundamental principles of ecology and biogeography through comparative immersive study of two biodiversity hotspots: the southern Blue Ridge Escarpment temperate rainforest of western North Carolina, and the lower montane rainforest of the eastern Andean slope, in Ecuador. We will endeavor to study the similarities and differences between temperate and tropical habitats in the context of comparative biogeography, geology, and ecology, using biological field stations in North Carolina and Ecuador as our base of operations: Highlands Biological Station and Wildsumaco Biological Station, respectively.

Through this experiential course we expect that you will come to appreciate the diversity, complexity, and "connectedness" of life, in learning about the geological, evolutionary, and ecological processes that structure biological communities and shape their geographical distribution globally. Along the way, you will learn fundamental principles of temperate and tropical ecology and how to conduct field studies of biodiversity, ecology and/or behavior.

Last but not least, this course provides an immersive experience in Ecuadorian culture. During our travels in Ecuador we will have opportunities to observe and discuss aspects of Ecuadoran history, politics, and cultural practices, as well as elements of social interaction and communication. We expect that you will come away with not only a greater understanding of this foreign culture, but our own society: examining other cultures provides us with a unique frame of reference, allowing us to reflect on the positive and negative attributes of our own culture.

II. SOME NOTES ON ITINERARY & FACILITIES

1. Our first week will be based at Highlands Biological Station, from where we will embark upon several field excursions designed to introduce biogeographical and ecological principles in the context of one of the world's most ancient mountain ranges. From the Great Smoky Mountains to the Blue Ridge Escarpment, we will look at the interplay of geology and physical parameters such as elevation, slope, and aspect, as well as climate history, in explaining observed diversity and its distribution. Most days will begin with a lecture/discussion, followed by field excursions.

2. In Ecuador we will spend our first night in Quito, in a small and comfortable hotel (Hotel San Carlos de Tababela), allowing us to get altitude-adjusted. Humboldtian principles introduced in

Highlands (e.g., climatic effects of elevation, etc.) will be applied here, on a grander scale as we then embark on our journey up and over the Andes Mountains to Wildsumaco Biological Station. We will document our ascent through rare *Polylepis* forest at Papallacta Pass (at over 4,000 meters, 13,000 feet) to the fabulous páramo ecosystem (alpine grasslands and tundra, above timber line but below the permanent snowline), and then descend to montane rainforest on the Amazonian slope.

3. Wildsumaco Biological Station lies in the heart of a protected lower montane rain forest on the eastern (Amazonian) slope of the Andes. The Station sits within one of the world's most biodiverse regions: the Tropical Andes Biodiversity hotspot. We will conduct hikes and group projects here, and go on night walks. This area represents one of the most diverse habitats on the entire planet. Charismatic and fascinating species of note include pumas, margays (a rare and little-studied small tropical cat), jaguarundis, monkeys, toucans, parrots, tropical frogs and reptiles, amazing insects, and towering trees. For many of you, this trip may be the premier ecological experience of your life. Become enthused by reading all you can about tropical habitats and Latin American culture! Make the excitement last far longer than the meager dozen days of our trip!

4. A detailed guide including packing list and other recommendations for HBS and WBS will be provided.

III. COURSE EXPECTATIONS & GRADING

1. Expectations

This immersive course requires long field hours and some hiking in moderate to difficult terrain. Students will be expected to be involved in <u>all</u> field, lab, and classroom activities. In the event that a student declines to participate or does not participate in group activities, their grade in the course may suffer or they may be returned home at their own additional expense without a refund of expenses previously paid.

2. Course grading breakdown is as follows:

40%	Exams 1 & 2
15%	Journal/Notebook
20%	Group Field & Lab Investigations
10%	Identifications
15%	Participation

The +/- grading system will be used as follows for undergraduates:
93-100 = A; 90-92 = A-; 87-89 = B+; 83-86 = B; 80-82 = B-; 77 - 79 = C+; 73 - 76 = C; 70 - 72 = C-; 67 - 69 = D+; 63 - 66 = D; 60 - 62 = D-; Below 60 = F.
As per university policy, graduate students are graded on a straight A-F scale.

A. Exams (40% of course grade)
1. Exam 1 (20%) will cover temperate-zone material, including information from lectures & fieldtrips and their associated readings and handouts, while at Highlands Biological Station.
2. Exam 2 (20%) will focus on the tropical material, including lectures, observational hikes and other fieldtrips, and associated readings and handouts.

B. Journal/Field Notebook (15%)
Each student will keep a field notebook (special water-resistant field notebooks like "Rite-in-the-Rain") for recording notes & observations on the different communities, ecosystems, and habitats encountered, a list of species observed, and any data we collect in our field observations. Notebook entries must be made daily, while the information is fresh in your mind. Notebooks will be collected and evaluated on several occasions during the course. The notebook is an easy component to complete, but time must be allocated for daily entries.

C. Group Field & Lab Investigations (20%)
In both temperate and tropical segments of the course we will conduct some group investigations with easily-observable taxa, groups, or abiotic factors, aimed at encouraging observational skills and further illuminating aspects of the natural history and ecology of these regions. Short quizzes or a brief essay prompt will accompany each investigation.

D. Identifications (10%)
In order to more fully understand the structure and function of ecological systems and biogeographical patterns, it is important to have some knowledge of constituent organisms. Accordingly, in the course of our explorations we will devote some time to learning how to identify a number of species emblematic of the communities and ecosystems we will be experiencing. Species identifications will be assessed with periodic written or oral quizzes.

E. Participation, Attitude (15%)
At both HBS and WBS we will have extensive field explorations intended to highlight principles & processes as well as emblematic communities & organisms. Full participation is expected in every hike and excursion, and an effort made to learn to identify the species encountered and pointed out by the instructor or by guest lecturers.

Graduate Students will be given additional exam questions, held to a higher standard on exams and in field & lab investigations and journals, and will be assigned 2-3 key papers which they will present and lead discussion for the class.

A typical day at HBS begins at 9 AM, either with a lecture followed by field or heading directly to the field (usually in one of the HBS vans). For some of our excursions we will be gone all day, while other sites are close to Highlands. Advanced notice will be given as far as gear, whether to pack lunch, etc. It is a good idea to always pack water, notebook, hat, and rain jacket.

Typical days in the tropics, on the other hand, begin at sunrise, around 6 AM.; sunlight brings the reveille of bird song. AT WBS breakfast will be served at 7:30 AM and we will head out into the field shortly thereafter, weather permitting. During times of adverse weather, we will have lectures and discussions.

Students are each expected to contribute to the success of this trip in their own way, whether it's helping with equipment, keeping our spirits up during rough going or the inevitable delays, or entertaining us with zany antics. We will be living together in close quarters, so team-spiritedness and respect for the rights and feelings of others will be of paramount importance. We expect the vicinity of sleeping quarters to be quiet by 10 PM out of respect for your classmates and others who may be visiting. You must be prepared to rise early and to put in long hours every day.

Well in advance of the start of the course, general/introductory readings on temperate and tropical ecology and biogeography will be provided. All reading assignments should be completed in a timely fashion so that you can hit the ground running! In addition, a "recommended reading" list will be provided. We encourage you to read anything else you can get your hands on about southern Appalachian and tropical biology and Ecuador. Get pumped about the course!

IV. HEALTH AND SAFETY CONSIDERATIONS IN ECUADOR

Vaccinations, antibiotics. See the link below to the CDC website on recommended vaccinations for Ecuador. Make sure you are up to date, and make arrangements for the following: typhoid vaccine & hepatitis A vaccine: http://wwwnc.cdc.gov/travel/destinations/traveler/none/ecuador

Note that two courses of Ciprofloxacin ("Cipro," antibiotic) as well as Imodium, are also recommended in case of traveler's diarrhea. One course of Cipro is a 500 mg dose/day, for 3 days. See your physician for a prescription.

Altitude Sickness. See the CDC webpage on altitude sickness: https://wwwnc.cdc.gov/travel/page/travel-to-high-altitudes. We will spend one day at high elevation (over 13,000 feet), and will take precautions against altitude sickness.

Volcanism and earthquakes. Antisana Volcano has not erupted since 1801-1802, and no major earthquake activity has been recorded from the volcano in many years. Sumaco Volcano has not erupted since 1895. Quito experiences tremblors regularly. For eruption and other information about these volcanoes, see: https://volcano.si.edu/volcano.cfm?vn=352030 [Antisana] and https://volcano.si.edu/volcano.cfm?vn=352040 [Sumaco].

V. CONTACT INFORMATION [FOR EMERGENCIES]

Fernanda Suarez, Wildsumaco Operations Office (Quito)
011 (593) 2 2022488, 011 (593) 987792773
office@wildsumaco.com, info@wildsumaco.com

Jonas Nilsson, Wildsumaco Lodge
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Wildsumaco Wildlife Sanctuary S.A.: www.wildsumaco.com

***Course Description* (*BIOL 493/593: Comparative Temperate-Tropical Ecology & Biogeography*)** An introductory exploration of the ecology and biogeography of temperate-zone and tropical biodiversity hotspots, from the southern Appalachians to Andean Ecuador. Based at two mountain biological field stations (Highlands Biological Station in Highlands, NC and Wildsumaco Biological Station, Sumaco Biosphere Reserve, Ecuador), we will take a field-based comparative approach to exploring southern Appalachian and Amazonian Andean montane ecology and biogeography in the spirit of the explorer-naturalists of the eighteenth and nineteenth centuries. We will consider the geological context of the Appalachians and Andes, comparative biogeography / ecology of these respective regions in terms of the ecological and historical factors that shape their biota, big-picture patterns of latitudinal and elevational diversity gradients, and principles of forest community structure and function. We will also examine comparative functional groups and ecological/evolutionary syndromes (symbioses, parasitism, etc.).

Prerequisites: Introductory Biology, at least one course at the 200 level or above in Biology, Environmental Science, or Geosciences/NRM, or permission of instructor. Spanish-language proficiency is not required. (Summer Session I; 5 semester hours credit).

Formal and informal contact hours: Except for travel days, each day will consist of a mix of lecture, lab, field, and study time/review/discussion. Each full day (13) consists of 5h of formal contact hours (classroom, lab, & field instruction) and 7h of informal contact hours (3 day, 4 evening; study time, meals, group discussion, 'office hours'), and each part day (6) consists of 2h formal and 10h informal contact hours. This yields a total of 77 formal and 151 informal contact hours, commensurate with 5 credit hours.