

Seminar in Systematics and Evolution (Biology 770)

Spring 2009 Semester - 2 Units: Graded / CrNC

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Introduction: The Spring 2009 Seminar in Systematics & Evolution (BIOL 770) will focus on “New Developments in our Understanding of the Tree of Life - Phylogenomics, Deep Time, and Large Scale Phylogenetics”.

Phylogenetic progress over the past 5-10 years has been truly remarkable, as systematists use new tools and new data to reconstruct the “Tree of Life”, or history of all lifeforms on the planet. The analytical problems faced in such large scale studies are novel - reconstructed relationships are mostly deep in time, numbers or taxa are often huge (e.g., 1000s of terminals), datasets are typically large (e.g., megabase datasets), and multiple genes (sometimes entire genomes) are always used. Phylogenetics at this level is really quite unique, and differs in many ways from standard (e.g., species-level) phylogenetic research.

Objectives: In this seminar we will read and discuss a sample of the most recent primary literature, with three main objectives in mind:

I) Increasing Organismal Knowledge - Many students know about their own study system, but perhaps know less about the details of the Tree of Life. I believe that all biologists, including all systematists and evolutionary biologists, should have a working knowledge and appreciation for the *primary* branches of the Tree of Life. This seminar will help in this regard.

II) Strengthening Conceptual/Analytical Foundation - We will explore conceptual and analytical issues related to resolving deep, large-scale relationships. Examples of central issues include the following: rooting methods (e.g., using gene duplications, directed indels, etc), phylogenomics, long branch attraction, molecules vs morphology in large scale phylogenetics, unique data classes (e.g., rare genomic changes, etc), paralogy vs orthology, relaxed molecular clocks, horizontal gene transfer, networks, supertrees, supermatrices, covarion shifts, etc.

III) While achieving the above objectives, we will also develop critical thinking skills, and develop/practice skills of oral presentation in an informal setting.

Readings: Primary literature will be made available to students (via Blackboard). A typical workload includes 2-4 papers per week, as detailed in the readings schedule.

Format: Class will last about 2 hours, never more, sometimes less, depending upon how discussion proceeds. This time will be allocated (roughly) to presentation and discussion as follows:

30 -35 minutes (no longer): Summary presentation of primary articles (and relevant background material, if necessary). A single student will be responsible for such summaries each week, presented using PowerPoint.

Remaining Time: Questions, discussion, brainstorming sessions, debates - these activities will vary weekly.

Presentations: All enrolled students will be expected to present at least once (perhaps twice for some students, depending upon enrollment), with topics randomly allocated to students. I expect students to meet with me to discuss papers prior to presentations.

Students will develop a formal PowerPoint presentation. Students without prior PowerPoint experience should either consult with the instructor or fellow students in the class about such presentations. The presenter should not assume that the class members already know everything, and should thus explain any obvious background material to his or her colleagues.

Students presenting will be expected to formulate a set of discussion questions for the week of presentation, providing these to me the Friday before their presentation date.

Students presenting will act as discussion leaders in an informal, roundtable discussion.

Evaluation: Final course grades will be issued based on the following criteria:

Presentation (1/2 of grade) - graded based on the three tasks listed above.

Participation (1/2 of grade) - To receive an A, I'll expect the following:

Each week all students should bring assigned papers to class (preferably electronic, on a laptop), having read and thought critically about these. You will then be expected to participate in discussion (e.g., contribute to discussions, ask questions, etc.).

Each week all students will be required to answer a set of questions pertaining to the readings. I may call on students to present their answers to these questions during class.

Reading Schedule (Subject to Possible Revision)

***for each week, read papers in order listed**

****analytical/conceptual issues highlighted in parentheses**

Jan 22/23 - Scheduling Meeting

Meeting 1- Week of Jan 26 - The TOL: Root and General Structuring

Woese et al 1990 - (review)

Dagan & Martin 2006 - (review)

Ge et al 2005 - (horizontal gene transfer, orthology)

Lake et al 2008 - (deep phylogenetic rooting)

Meeting 2- Week of Feb 2 - Bacteria Diversity & Phylogeny

Rappe & Giovannoni 2003 - (phylogenetic review, rDNA phylogenetics)

Daubin et al 2002 - (supertree analysis)

Sogin et al 2008 - (diversity, metagenomics, barcoding)

Meeting 3 - Week of Feb 9 - Archaea Diversity & Phylogeny

Brochier et al 2005 - (long branch attraction)

Makarova et al 2007 - (COGs, orthology)

Robertson et al 2005 - (diversity, large trees)

Week of Feb 16 - no class

Meeting 4 - Week of Feb 23 - Eukaryotes I

Hedges et al 2004 - (clock analyses)

Embley & Martin 2006 - (phylogenetic review)

Slapeta et al 2005 (species diversity, barcoding)

Meeting 5 - Week of March 2 - Eukaryotes II

Inagaki et al 2004 - (rooting, covarion shifts)

Arisue et al 2005 - (root position)

Burki et al 2007 (phylogenomics)

Meeting 6 - Week of March 9 - Plants

Palmer et al 2004 - (phylogenetic review)

Stefanovic et al 2004 (rooting, long branch attraction)

de la Torre et al 2006 - (ESTs, data partitioning, missing data)

Meeting 7 - Week of March 16 - Animals

Halanych 2004 - (phylogenetic review)
Rokas et al 2005 - (star phylogeny)
Baurain et al 2007 - (taxon sampling, systematic biases)

Meeting 8 - Week of March 23 - Animals II

Phillipe et al 2005 - (long branch attraction, taxon sampling)
Rogozin et al 2007 - (rare genomic changes, hypothesis testing)
Irimia et al - (taxon sampling, long branch attraction)

March 30 - April 3 Spring Break

Meeting 9 - Week of April 6 - Ecdysozoa/Arthropods

Webster et al 2006 (mitogenomics, biased base composition)
Regier et al 2008 (apod gene development, misleading phylogenetic signal)

Meeting 10 - Week of April 13 - Early Vertebrates

Townsend et al 2008 (measuring deep phylogenetic signal)
Kikugawa et al 2004 (hypothesis testing)
Blair & Hedges 2005 (phylogenomics, relaxed clocks)

Meeting 11 - Week of April 20 - Squamate TOL

TBD

Meeting 12 - Week of April 27 - Bird TOL

TBD

Meeting 13 - Week of May 4 - Placental Mammal Phylogeny I

Beck et al 2006 (improved supertree analyses)
Kriegs et al 2006 (rare genomic changes)
Murphy et al 2007 (root position, rare genomic changes, molecular clocks)

Meeting 14 - Week of May 11 - Mammal Phylogeny II

Springer & Murphy 2007 (timescale, KT boundary, applied phylogenetics)
Springer et al 2007 (misleading morphology?)
Asher et al 2008 (response to Springer et al)