

Undergraduate Research Symposium May 17, 2013 Mary Gates Hall

Online Proceedings

SESSION 2T

EVOLUTION, GENETICS, AND BIOCHEMISTRY OF PLANTS, ALGAE, AND FUNGI

*Session Moderator: Richard Olmstead, Biology, Burke
Museum
111 JHN*

3:45 PM to 5:15 PM

* Note: Titles in order of presentation.

Primer Development for the Pentatricopeptide Repeat Gene Family for use in the Large Plant Group Lamiales

*Benjamin Paul (Ben) Meersman, Junior, Biology (Ecology,
Evolution & Conservation)*

Mentor: Richard Olmstead, Biology, Burke Museum

Mentor: Patricia Lu-Irving, Biology

Phylogenetics is the study of evolutionary relationships and in order to infer these relationships in plants, various loci that are phylogenetically useful in nuclear as well as chloroplast DNAs should be utilized. Presently, the use of chloroplast loci is widespread in phylogenetic studies whereas the nuclear genome is still somewhat under-utilized. The pentatricopeptide repeat (PPR) gene family is a large group of protein coding nuclear genes that has been shown to be highly informative in the inference of evolutionary relationships among closely related species. There are multiple reasons that make these genes useful to these types of studies. The PPR gene family is very large which offers researchers multiple loci that are available for phylogenetic analyses. This is important because having multiple loci is imperative to answering important phylogenetic questions. A large portion of PPR genes are intronless making it possible to sequence and align data with little or no difficulty. They also have a high rate of evolution, and are single-copy in most plant genomes. 127 of these loci have been identified as phylogenetically useful but of these only 5 have been developed. This research looks to develop 10 more loci that will specifically target the Lamiales. To do this, 10 primer sets were tested using a sampling of species across the Lamiales. The primers were used to amplify these loci in order to ascertain their usefulness for a wide range of species and to obtain sequence data for each species. The sequences obtained were aligned and the alignments were used

to design new primers. These new primer sets will allow for new data to be more easily collected that has been either difficult to obtain or previously unavailable and will increase the number of nuclear loci available for phylogenetic studies.

POSTER SESSION 4

Commons West, Easel 6

4:15 PM to 5:45 PM

Longitudinal Study of Average Spinal Osteoarthritis in Diet Restricted and Non-Diet Restricted Macaques

Lauren Kay (Lauren) Johnson, Senior, Anthropology

Mentor: Patricia Kramer, Anthropology

Osteoarthritis (OA) is a degenerative joint disease present in most older individuals. The macaque, a New World monkey (genus *Macaca*), is an excellent proxy of the human condition in the study of the progression of osteoarthritis in humans, as the disease exhibits similar development in both. The key covariates of OA are age and body mass, but a longitudinal study of the development and severity of osteoarthritis in diet-restricted (n=259) and control monkeys (n=310) is ongoing (total data n=569) to establish whether or not diet plays a role in OA. The average development and severity of osteophytes (OST) and the level of disc space narrowing (DSN) from the thoracic and lumbar vertebrae were scored using previously-established methods. Based on averages of OST and DSN, it appears that diet-restricted monkeys do not show significantly different levels of severity from controls. Age and mass combine to explain 31% of the variation in spinal osteoarthritis ($R^2=0.3091$, $p<0.001$ and $p<0.001$, respectively for OST). Age, mass, and species explain 32% of variation in DSN ($R^2=0.32$, $p<0.001$, $p=0.001$, $p<0.001$, respectively). Diet does not have a significant role in the development of osteophytes ($p=0.16$).

POSTER SESSION 4

Commons West, Easel 7

4:15 PM to 5:45 PM

On Giants and Dwarfs: What Can Kadanuumuu and Lucy Tell Us about Sexual Dimorphism and Variability in *Australopithecus afarensis*?

Boryana Evgenieva Kasabova, Senior, Anthropology

Mentor: Patricia Kramer, Anthropology

AL 288-1, better known as Lucy, is a 3.2 million-year-old *Australopithecus afarensis* partial skeleton. KSD-VP-1/1 is a recently described 3.6 million-year-old hominin partial skeleton that has been assigned to *A. afarensis*. Recent analysis, however, indicates that the estimated lower limb length (eLLL) for KSD-VP-1/1 (0.763 – 0.791m) is substantially longer than that of AL-288-1 (0.525m). The ratio of shorter to longer eLLL for these specimens ranges from 1.44 to 1.51, which raises the question of whether or not these two are likely to belong to the same paleospecies (*Australopithecus afarensis*). In order to determine the probability of randomly selecting two members of the same group with an eLLL ratio ≥ 1.44 , 66 primate groups were examined: 19 non-human primates, 46 modern human populations, and a combined sample that represents species-level human variation. Virtual populations of 10,000 individuals were created using the descriptive statistics of the groups because only 11 out of the 66 groups included two individuals who could generate a ratio ≥ 1.44 . The virtual populations allowed for the existence of individuals that can produce the sought ratio for all groups. 1,000 sets of two individuals were drawn from each virtual population. The probability of two randomly selected individuals generating an eLLL ratio ≥ 1.44 ranges from 0 (*Hylobates*, *Presbytis*, *Trachypithecus*, Andaman Islanders) to 0.0076 (*Macaca mulatta*). If the distribution and variability of early hominin lower limb lengths is adequately represented by extant primates, these results indicate that it is unlikely that two individuals as different in their eLLL's as KSD-VP-1/1 and AL-288-1 could have come from the same paleospecies. More work is needed, however, to understand the morphological variability of paleospecies, particularly that introduced by time.

POSTER SESSION 4

Commons West, Easel 8

4:15 PM to 5:45 PM

Gradient, Burden, Burden/Mass Ratio and Cadence: Correlated With Cost of Transport

Simone Vijgen, Senior, Near Eastern Studies: Lang & Cultures, Anthropology

Mentor: Patricia Kramer, Anthropology

Even though many women engage in subsistence activities that require movement in varied terrains, little is known about the effects of burden and gradient on the energy expenditure of women. Additionally, it remains unclear which anthropometric characteristics predict variability among women in these situations. To begin to understand this better, 10 women walked on a treadmill for 14 randomized trials, divided into 2 or 3 testing sessions. Each trial consisted of different combinations of three variables. The women walked at self-selected slow, medium, and fast velocities; at gradients of 0, 5%, and 10%; and with and without a 10 kg burden carried in a back-

pack. Walking trials lasted 5 minutes, with 4 minutes of resting between each trial. VO_2 and VCO_2 were accessed (using a Sensormedics Vmax 29c metabolic cart) and cadence was determined during each trial. Standard anthropometrics (such as body mass, stature, limb segment lengths) were measured. Cost of transport (CoT) was calculated as the average VO_2 of the last 2 minutes of the 5-minute trial divided by velocity. Gradient ($p < 0.001$), burden ($p = 0.004$), mass ($p < 0.001$), and burden/mass (0.019) were positively correlated with CoT ($r^2 = 0.71$), while cadence ($p < 0.001$) was negatively correlated. Our analysis shows that these variables predict variability within individuals ($r^2 = 0.72$) better than among individuals ($r^2 = 0.64$). Stature ($p = 0.52$) and lower limb length ($p = 0.28$) were not predictive. Future work should investigate how additional anthropometric measurements (such as crural index) interact with gait and terrain characteristics (burden, gradient, etc).

POSTER SESSION 4

Commons West, Easel 5

4:15 PM to 5:45 PM

The Effects of Load-Carrying and Velocity Upon Footprint Formation and Gait in Modern Humans

David Jacob (David) Armo, Senior, Anthropology, Biology (Ecology, Evolution & Conservation)

Mentor: Patricia Kramer, Anthropology

This study attempts to help resolve our lack of knowledge concerning the effects of velocity and load-carrying on footprints and gait. Several archaeological sites worldwide have preserved footprints, and in the case of some sites, such as the Laetoli footprint trails in Kenya, proper analysis of the footprints could yield crucial information about hominids. We will examine how gait and footprints change, if at all, with changes in speed and carried weight. Twelve individuals, six male and six female undergraduate students, moved across 9.2 meters of tiled surface with and without an additional load on their back equal to 20% of their body weight, and at three different speeds – self-selected walking, jogging, and running velocities. As they walked this distance, they stepped across an RSscan mat that dynamically records pressure, generating a digital image of their footprint, while also being filmed in order to record gait. While foot, midfoot, and heel contact length and the contact width of the ball of the foot all varied without any clear pattern over the 216 tests, for almost all volunteers the width of midfoot contact increased significantly with speed. There was a significant increase in midfoot contact width from walking to a higher speed, and also overall from jogging to running. Carrying loads equal to or less than 20% of one's body mass has no significant affect upon mid-foot width or other footprint dimensions. The average angle between the heel and trochanterion (the tip of the greater trochanter, a feature of the femur) changed significantly with

movement speed for most volunteers, but not in response to carried loads of equal to or less than 20% of one's bodymass.

POSTER SESSION 4

Commons West, Easel 41

4:15 PM to 5:45 PM

Unexpected Stories: Nikkei Concerns Oral History Project

Crystal (Crys) Donovan, Sophomore, Anthropology, Edmonds Community College

Mentor: Thomas Murphy, Anthropology, Edmonds Community College

Mentor: Marshall Kramer

The Learn and Serve Environmental Anthropology Field (LEAF) School at Edmonds Community College has partnered with Nikkei Manor and the Wing Luke Museum to develop the Nikkei Concerns Oral History Project. Through this project, students have the opportunity to serve as both mentors and mentees. Eight students have undergone training, interviewed and recorded the experiences of Japanese Americans who were interned during World War II. From these survivors we are learning more than the easy to record factual history, we are learning about experience, about the diversity of coping strategies, adaptive solutions, and emotional struggles these Americans lived. We found unexpected stories relating to aspects of control and freedom within the camps, as well as humor, acceptance, bitterness and forgiveness. The hope in a project such as this is to develop a greater understanding of the experience of these people, to record their stories and create awareness of what they faced. This is a unique opportunity for students to hear firsthand accounts from internment survivors and participating students will continue to learn about the internment era while transcribing the stories shared by Nikkei residents, and mentoring their classmates in the transcription process. While there has been much research elsewhere, the story of internment in the Northwest has received less attention. This project has allowed for student engagement and development as well meeting the needs of the Nikkei residents who wished to share their stories. Recordings will be kept both by the Wing Luke museum and Edmonds community college.