Rochester Academy of Science

BULLETIN

"An organization of people in the Natural Sciences"

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President's Message

We are a month from our 47th Annual Fall Scientific Paper Session of the Rochester Academy of Science. It will be will be hosted by Nazareth College on Saturday, November 6, 2021, from 8:30 a.m. to 2 p.m. Presentations will be scheduled between 9:30 a.m. and noon. A luncheon follows the presentations and the Larry King Memorial Lecture is featured after lunch. As we discussed last month, our keynote Larry King Memorial Speaker this year will be Howard Lasker, Ph.D. of SUNY Buffalo speaking on his research on the ecology of coral reef organisms.

Friends know that I am an avid historian, so let's look at some of the background for this event. Dr. Lawrence King, then chairman of our long-range planning committee, first suggested having an Academy-sponsored annual session for reading scientific papers in 1973. The idea was enthusiastically received and he and Dr. Melvin Wentland were made co-chairmen of the committee that developed the Academy's first Annual Fall Session for Scientific Papers. It was hosted by the State University College at Geneseo on October 26, 1974, where Dr. King was a faculty member.

It was an outstanding success and was immediately followed by a 1975 Scientific Paper Session at State University College at Brockport, and a 1976 session at St. John Fisher College, where Dr. Wentland was a professor of biology. It has been repeated every autumn since, missing only 2020, the first year of the SARS-CoV-2 (Covid-19) pandemic. Hence, this year's event is the forty-seventh.

Dr. Lawrence King, professor emeritus of biology at the State University College at Geneseo and Fellow of the Rochester Academy of Science, died in July, 1985. He was 70 years old. At the 1987 Paper Session, he was memorialized by naming the keynote address the Dr. L.J. King Memorial lecture. It has been this ever since to honor him for founding the annual Paper Session and for his other note-worthy contributions to the Academy.

The Paper Session had always been an expense borne by the RAS. In 2019, the Board decided to make it self-funding by charging a $10 fee for each abstract submitted. This is trivial compared to fees charged by most conferences and is easily affordable by the students and their professors in starting their scientific research careers. RAS members pay only $5 to submit the abstract for their poster or presentation. Admission to the event is free and the Academy provides morning beverages and snacks.

Do Come!

Michael Grenier, President RAS

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Save the Date!
Saturday, November 6, 2021
RAS Scientific Paper Session
Nazareth College

Featured Article

History of the RAS Herbarium

by Elizabeth Y. Pixley, Curator RAS Herbarium

The RAS Herbarium is a collection of perhaps 30,000 preserved plant specimens, currently housed in a room on the ground floor of the Rochester Museum and Science Center (RMSC). Each plant specimen is pressed and mounted on a large sheet of acid-free paper; a label is attached listing the Latin name, name of the collector, where collected, and description of the area. (Today, collectors also include GPS details.) The entire collection is housed in large metal cabinets; the plants are organized by family, genus and species. The plant specimens were collected by numerous botanists, from areas throughout New York State, other parts of North America and other countries. Most of the plants were collected between 1860 and 1950, though there are also more recent specimens. The RAS Herbarium collection provides a significant record of the Rochester area ecology over the years and is a valuable resource to scientists, especially in this era of climate change. The origins of the Academy Herbarium are interesting. Those early botanists and collectors mentioned above were members of the Botany section, which was the first new section of the Rochester Academy of Science, established in 1881 with eleven members. From the beginning, the Botany section's whole reason for being was to make a collection of the plants of Rochester and western New York and to make known the flora of

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Elizabeth Pixley
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the region. They collected and identified plant specimens; their personal plant collections became the nucleus of the RAS Herbarium and can still be viewed today. In 1896 the Academy published Volume 3 of the Proceedings titled "Plants of Monroe County, New York and Adjacent Territory." Authors were Florence Beckwith, Mary E. Macauley, Joseph B. Fuller and Milton S. Baxter; their names are listed as "collector" on numerous herbarium specimens. Over the years a number of botanists contributed specimens to the Herbarium. Members of the Botany section were responsible for the care of the Herbarium, which has seen many homes over the years. It was for a number of years housed at the University of Rochester, then was moved to the Bausch House at RMSC, followed by a move to the County Parks Department, and it is again housed at RMSC. The Botany section is now known as the Life Science section, and its members are still maintaining the Herbarium.

Several years ago, the RMSC received a grant to upgrade its storage areas, which necessitated the RAS Herbarium to be reduced in area and number of specimens. We decided to eliminate all specimens

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Events for October 2021

For updates to events, check the Academy website http://www.rasny.org and section websites.

5 Tue: Fossil Section Meeting

7:30 p.m. Meeting will be held remotely via ZOOM and is open to all RAS Members and guests.
Speaker: Melanie Hopkins, Ph.D., the American Museum of Natural History Curator-in-Charge for Invertebrate Paleontology.
Topic: Trilobites! Their growth and development.
Note: The Fossil Section will resume its monthly meetings on October 5th. Due to ongoing COVID issues, the October meeting, as well as all other meetings for 2021-2022, will be held via ZOOM. Contact Michael Grenier at paleo@frontier.com for meeting details and logon info.

6 Wed: Astronomy Board Meeting

7:00 p.m. UR Bausch & Lomb Hall, room 203, pending UR approval. Contact: Mark Minarich at mminaric@rochester.rr.com.

8 Fri: Astronomy Section Meeting

7:30 p.m. – 10:00 p.m. RIT Carlson Center for Imaging Science, CAR-1125. Parking Lot F. Meeting will be held in person at RIT as well as virtually via Zoom.
Speaker: Alice Quillen, Ph.D., Professor of Physics and Astronomy, University of Rochester.
Topic: The dynamics of exoplanets.
Contact: Mark Minarich at mminaric@rochester.rr.com.

9 Sat: Astronomy Public Open House and Member Observing

Open House: 12:00 p.m. - 4:00 p.m. Observatory tours and work parties. Indoors at normal capacity for those already vaccinated. If unvaccinated then with masks and social distancing or outdoors only. Bathroom rules are posted. Members may bring guests, but all must sign in at Wolk Building for contact tracing.
Member Observing: Starting from dusk till last person leaves.
Farash Center for Observational Astronomy, 8355 County Road 14 Ionia, NY 14475. For weather related cancellations or changes contact Mark Minarich: (585) 257-6042 or see www.rochesterastronomy.org/calendar-of-events.

16 Sat: Herbarium Workshop

10 a.m. - 2 p.m. The Life Sciences section will hold a workshop at the RAS Herbarium, located in the basement of the Rochester Museum and Science Center (RMSC). At RMSC go to the front desk to meet other participants. You must be fully vaccinated, and masks are required for all visitors at RMSC. We will be working on re-mounting herbarium specimens; no special experience required. You may bring a lunch. If you plan to attend, please send RSVP or send any inquires to Elizabeth Pixley, herbarium curator, at eypixley@gmail.com, or call (585) 334-0977.

20 Wed: RAS Board Meeting

7:00 p.m. Virtual meeting using Zoom. For details, contact Michael Grenier at mgrenier@frontiernet.net.

26 Tue: Mineral Virtual Meeting

7:00 p.m. Zoom meeting. Please note that meetings this academic year are being held on the 4th Tuesday of the month.
Speaker: Rachel Glade, Ph.D., of the University of Rochester.
Topic: her current research on Arctic landscapes, where ice, water, and soil interact to form striking, large-scale patterns.
Members will be emailed a link for this meeting. Contact: J. Dudley at juttasd@aol.com.

28 Thu: Anthropology Virtual Meeting

7:30 p.m. The Rochester branch of the Archaeological Institute of America is presenting a virtual lecture.
Speaker: Nancy Gonlin, Ph.D., Professor of Anthropology at Bellevue College.
Topic: Torches, Fireflies, And Moonlight: The Brilliance Of Classic Maya Lightscapes.
To receive a link to the lecture, send RSVP to archaeologyrochester@gmail.com.
All are welcome.

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Featured Article

Huygens – the little space probe that could . . . and did!

By Dee Sharples, Sky at Night Coordinator for the Astronomy Section of the Rochester Academy of Science

When the Titan IVB/Centaur rocket blasted off from Cape Canaveral on October 15, 1997, it was the beginning of a momentous journey to the planet Saturn and its largest moon Titan. It carried the Cassini spacecraft which would orbit the planet and the Huygens probe destined to land on Titan.

The Cassini-Huygens mission, which began development in 1989, was a joint endeavor by the National Aeronautics and Space Administration (NASA), the European Space Agency (ESA), and the Italian Space Agency (ASI). The spacecraft was built by NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California.

It was going to be a very long journey and the spacecraft needed to acquire as much speed as possible. A unique alignment of planets was going to occur, something that would not happen again for over 600 years. It was planned to use several gravity assists from those planets to create a slingshot effect to increase Cassini's speed each time the maneuver was performed. (See Figure 1 below.)

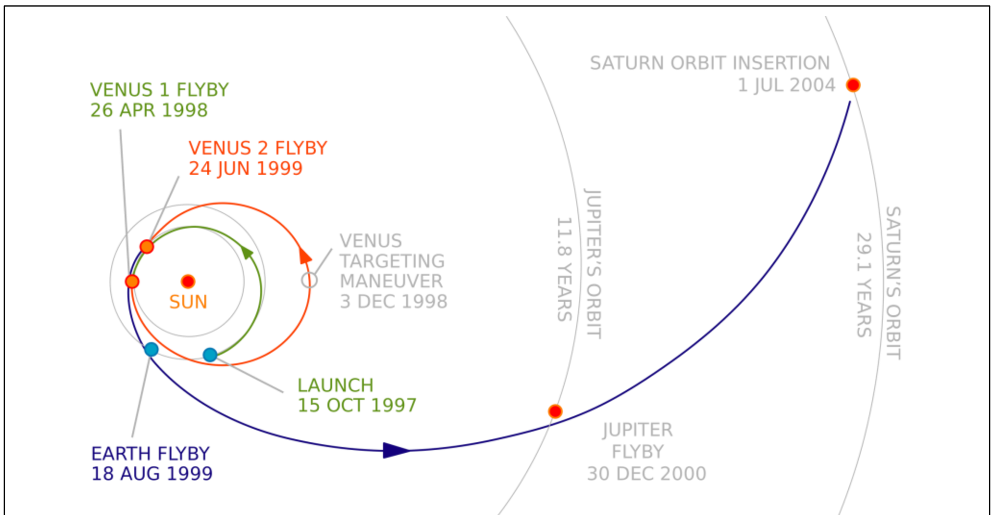

Figure 1: Cassini Trajectory
(Image credit: NASA/Jet Propulsion Laboratory – Caltech)

Cassini was designed to withstand temperatures as high as 266 degrees Fahrenheit when it traveled inside the orbit of Venus and as low as -346 degrees Fahrenheit when it reached Saturn. It received its final gravity assist from Jupiter arriving at Saturn on July 1, 2004. It was the end of a journey which had taken 6.7 years, but the exciting scientific discoveries were about to begin.

***Fast facts**:* Titan is 3,200 miles in diameter, larger than the planet Mercury and almost as large as Mars. It's the second largest moon in the solar system after Ganymede. The atmosphere is comprised of nitrogen, methane, traces of ammonia, argon, and ethane. Its surface temperature is minus 290 Fahrenheit which allows liquid methane to exist, and it has a surface pressure of 1.6 bars, slightly higher than Earth's. Orbiting Saturn in almost 16 Earth-days, Titan is tidally locked, keeping one face positioned toward the planet just as our moon does with Earth. Scientists believe Titan may resemble early Earth, with a complex weather system and a landscape created by flowing liquid and volcanic activity.

The Huygens probe separated from Cassini on December 25, 2004. It would become the first object made by humans to land on a world in the outer solar system. Its Entry Assembly Module was equipped with a heat shield used as a brake and for thermal protection to safeguard the delicate instruments from the high temperature during the descent stage through Titan's thick atmosphere. The Descent Module contained three parachutes released in sequence to control its trip to the surface, as well as the scientific instruments which would do the real work. The entire probe and decelerator shield was approximately nine feet wide and weighed about 700 lbs. (See Figure 2 below.)

Figure 2: Huygens Entry Assembly Module and Descent Module
(Image credit: ESA, NASA, JP, /University of Arizona)

Huygens was released from Cassini and began a solitary 21-day final trek toward its encounter with Titan. On January 14, 2005, after a harrowing 2-hour 27-minute descent through the atmosphere, the Descent Module, only four feet in diameter, successfully landed on the surface of Titan in an area of plains.

The first geologic mapping of Titan completed in 2019 was based on radar and visible light images from the Cassini mission. See Figure 3 on page 4.

It's an active world of lakes, plains, craters, dunes and possible ice volcanos. It is the only planetary body in our solar system besides Earth known to have stable liquid on its surface. But instead of water, the gas methane behaves like a liquid in Titan's extremely cold environment.

The first image taken by Huygens was awe inspiring, revealing an orange-hued landscape covered with surface debris. See Figure 4 on page 4.

Original caption released with this image as reported at [photojournal.jpl.nasa.gov/catalog/PIA07232:](photojournal.jpl.nasa.gov/catalog/PIA07232)

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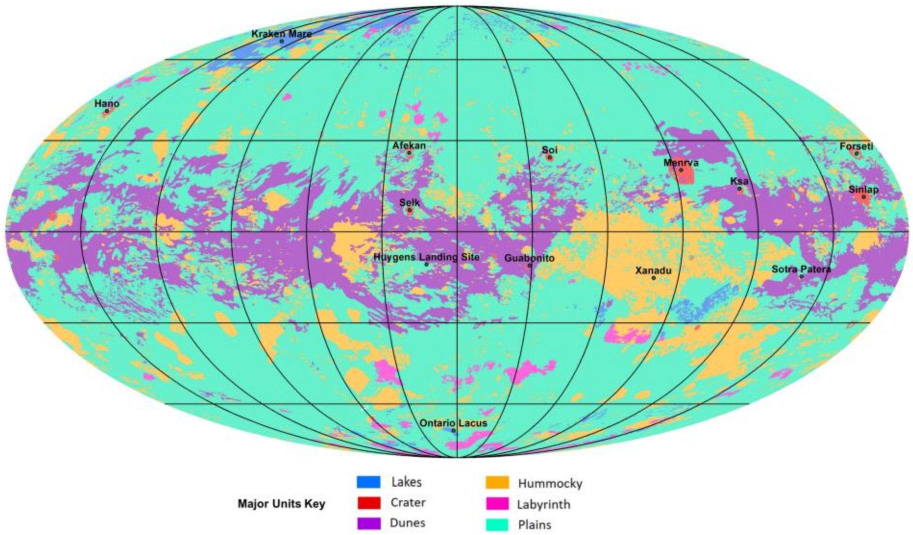

Figure 3: Titan geologic map *(Image credit: NASA, JPL, Caltech, Arizona State University)*

"This image was returned yesterday, January 14, 2005, by the European Space Agency's Huygens probe during its successful descent to land on Titan. This is the colored view, following processing to add reflection spectra data, and gives a better indication of the actual color of the surface."

Figure 4: Titan's surface
(Image credit: ESA, NASA, JPL, University of Arizona)

"Initially thought to be rocks or ice blocks, they are more pebble-sized. The two rock-like objects just below the middle of the image are about 15 centimeters (about 6 inches) (left) and 4 centimeters (about 1.5 inches) (center) across respectively, at a distance of about 85 centimeters (about 33 inches) from Huygens. The surface is darker than originally expected, consisting of a mixture of water and hydrocarbon ice. There is also evidence of erosion at the base of these objects, indicating possible fluvial activity."

"The image was taken with the Descent Imager/Spectral Radiometer, one of two NASA instruments on the probe."

After it touched down on Titan, data continued to be transmitted from Huygens for another 72 minutes before contact was lost with Cassini when it dipped below the horizon.

Huygens was equipped with scientific instruments designed to perform six crucial experiments:

Aerosol Collector and Pyrolyser (ACP) collected aerosols for chemical composition analysis.

Descent Imager/Spectral Radiometer (DISR) took images and performed spectral measurements with sensors. Just before landing, it turned on its lamp to obtain spectra of the surface.

Doppler Wind Experiment (DWE) used radio signals to gather information about the atmosphere.

Winds in Titan's atmosphere caused a measurable Doppler shift in the signal.

Gas Chromatograph and Mass Spectrometer (GCMS) was a gas chemical analyzer designed to identify and measure the various components of the atmosphere.

Huygens Atmosphere Structure Instrument (HASI) measured the physical and electrical properties of the atmosphere and included a microphone which sent back sounds from Titan.

Surface Science Package (SSP) was a group of sensors to determine the physical properties and distinctive composition of the surface at the landing site.

Scientists have produced a list of the "Top 10 Discoveries" found on Titan from the Cassini-Huygens mission. This ESA website has more information about each of them.
https://sci.esa.int/web/cassini-huygens/-/55221-huygens-titan-science-highlights

- Profiling the winds of Titan
- Super-rotating winds
- Methane mystery
- Origin of Titan's nitrogen atmosphere
- Radioactive decay and cryovolcanism
- Hazy Titan
- Titan's tiny aerosols
- Dry riverbeds and lakes
- Schumann-like resonances: hints of subsurface ocean
- Elusive dunes

On September 15, 2017, Cassini ended its mission. It had delivered Huygens to Titan and acquired volumes of data and images that scientists will analyze for years to come. After more than 13 years, Cassini was directed to destroy itself by plunging into Saturn to prevent inadvertently contaminating moons which might harbor signs of life. Enceladus, with a liquid ocean of salty water beneath its icy crust, had become a prime candidate along with intriguing Titan with an atmosphere that's similar to early Earth's. It was time to say goodbye to an old friend, one who had been invaluable in mankind's quest for knowledge.

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Featured 2020-2021 Undergraduate Student Research Grant Award Winner

John Deitsch, Cornell University, *Effects of artificial light at night on caterpillar predation and parasitism pressures*.

Sponsor: Sara Kaiser, Ph.D., Research Ecologist; Director, Hubbard Brook Field Ornithology Program, Cornell Lab of Ornithology.

Abstract

Ecological light pollution from artificial light at night (ALAN) is one of the most widespread and expanding threats to insect biodiversity. Artificial illumination of nocturnal landscapes by streetlights, porchlights, and other light sources affects insects by changing individual behavior, altering species interactions, and changing community and ecosystem structure. Despite considerable work examining impacts of ALAN on adult insects, particularly moths, fewer studies have focused on the impacts of ALAN on earlier life stages. This is an important knowledge gap because the attraction of moths to ALAN may result in increased caterpillar density around ALAN and many caterpillars feed at night to minimize risk of predation and parasitism. I hypothesize that ALAN will affect predation and parasitism pressure on caterpillars from arthropods by altering insect communities and changing predator-prey and parasitoid-host interactions and that these effects will be modulated by the lunar cycle. I propose to experimentally investigate how ALAN affects predation and parasitism pressure on caterpillars from arthropods at the Hubbard Brook Experimental Forest (HBEF), NH; May-Aug 2021. The HBEF is an excellent site to study ALAN because the forest receives essentially no light pollution, maximizing the effectiveness of the experimental design. I will measure the aggregation of arthropod predators and parasitoids around a light source by sampling the insect community with Malaise and pan traps on experimental (illuminated) and control (unilluminated) study plots. I will measure relative predation and parasitism rates on control and experimental plots by conducting a plasticine caterpillar model experiment and a live caterpillar tethering experiment. The results from my study will provide insight into how quickly arthropod communities change in response to ALAN, how low-level illumination affects predation and parasitism pressure on caterpillars, and whether parasitoids congregate around light sources like predatory arthropods.

Background and Rationale for Hypotheses

Ecological light pollution from artificial light at night (ALAN) is one of the most urgent issues threatening insect biodiversity [1]. Recent studies have documented alarming declines in insect biodiversity and abundance due to human-induced environmental change [2]. Insects are essential components of ecosystems and the impact of ALAN on insects can have widespread ecological consequences across all levels of organization [3]. The artificial illumination of nocturnal landscapes from streetlights, porchlights, and other light sources affects insects by modifying individual behavior, altering species interactions, and changing community and ecosystem structure. ALAN also affects insects by obscuring the lunar cycle and natural variation in nighttime brightness levels, an important cue for many species [4].

Despite considerable work examining impacts of ALAN on insects, particularly moths, our understanding of how populations respond to ALAN is incomplete [5]. ALAN has been shown to impact adult insects by disrupting their navigation [6], feeding and pollination [7], reproduction [8], and predator avoidance [9]. However, fewer studies have focused on the impacts of ALAN on earlier life stages. Consequently, the effects of ALAN on caterpillar development, predation and parasitism rates, and behavior remain poorly understood [6]. This is a critical knowledge gap because the attraction of moths to ALAN could result in increased caterpillar density around ALAN [11], many caterpillars feed at night to minimize predation risk [12], and conditions during the larval stage impact adult reproductive fitness. For example, ALAN advanced larval development in *Mythimna separate* (Noctuidae), but reduced larval development and inhibited diapause in *Mamestra brassicae* (Noctuidae) larvae [6], [10] .

ALAN could indirectly affect caterpillar development and survival by affecting the behavior of arthropod predators [13] and parasitoids [14]. Arthropod communities around light sources are often disproportionately composed of predatory species, in part because insects attracted to ALAN are easily exploited by predators [15], [4]. Visual predators benefit from increased visibility provided by ALAN, but predators will cease to forage if light levels are too bright [16], [17]. Thus, it is critical to measure light intensity levels when investigating the impacts of ALAN in predator-prey interactions. In addition to predation, parasitism is a major source of mortality for Lepidopteran larvae, primarily from Hymenopteran (Ichneumonoidea and Chalcidoidea) and Dipteran (Tachinidae) parasitoids. ALAN has been shown to affect parasitoid-host dynamics, but this has not been studied in caterpillar-parasitoid systems. Whether parasitoids

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aggregate around light sources like predatory arthropods has not been extensively studied [17]. Although ALAN has been shown to alter species interactions, impacts on caterpillars and their predators and parasitoids remain poorly understood.

I propose to experimentally investigate how artificial light at night affects Lepidopteran larvae by comparing arthropod predation and parasitism pressures in illuminated (experimental) and unilluminated (control) study plots. I will explore two components of predation and parasitism pressure that might be affected by artificial light. First, I will measure the aggregation of arthropod predators and parasitoids around a light source by sampling arthropod predators and parasitoids with Malaise and pan traps on experimental plots and compare with control plots. Second, I will conduct a plasticine caterpillar model experiment [18] [19] and a caterpillar tethering experiment to measure relative predation and parasitism rates on control and experimental plots. By comparing caterpillar predation and parasitism rates on illuminated and unilluminated plots while monitoring how ALAN impacts abundance of arthropod predators and parasitoids, this study will provide further clarity on how ALAN impacts interactions between caterpillars and their arthropod enemies.

Research Procedures: Hypotheses, Predictions, and Tests

I will conduct my research from May-Aug 2021 at the Hubbard Brook Experimental Forest (HBEF), NH. The HBEF is an excellent site to study the effects of ALAN because it has a Bortle Class 2 rating, meaning the forest receives essentially no light pollution [20]. The absence of existing light pollution will increase differences in illumination levels between experimental and control plots. In mid-May I will establish four 25x25 m study plots (2 control, 2 experimental) with similar understory vegetation composition and structure. Experimental plots will be illuminated from June 1 – July 31 with four unidirectional 6W solar-powered LED floodlights, each producing a maximum of 600 lumens. I will install HOBO Temperature/Light Data Loggers at the center of each plot to log temperature and light intensity readings at 1-hour intervals throughout the study period.

Hypothesis 1: ALAN alters insect communities.
Flying insect biomass will be greater on experimental plots relative to control plots (Prediction 1a**),** arthropod predator and parasitoid abundance will be higher (Prediction 1b) and arthropod predators and parasitoids will be disproportionately represented in insect communities (Prediction 1c). The differences between experimental and control plots will increase over the study period (Prediction 1d).

Test 1**:** I will measure flying insect biomass and quantify the abundance and diversity of arthropod predators and parasitoids using Malaise traps and pan traps [21] [22] from May 15 –July 31. Each week, two 24-hour samples will be collected. All arthropods known to be predators or parasitoids of caterpillars will be sorted to Order. I will measure the dry biomass of predators and parasitoids.

Hypothesis 2: ALAN affects arthropod predation and parasitism pressure on caterpillars. Predation rates (Prediction 2a) and parasitism rates (Prediction 2b) will be higher on experimental plots relative to control plots. Test 2**:** I will estimate caterpillar predation and parasitism rates and identify arthropod predators and parasitoids with two experiments. In the first experiment, I will deploy 50 plasticine caterpillar models during each of 4 sampling periods (June 5, June 21, July 5, July 20) on the leaves of striped maple (*Acer pensylvanicum*) and hobblebush (*Viburnum lantanoides*). After 3 days, I will record all marks left by arthropod predators and parasitoids. This method has been used effectively at the HBEF [23]. In the second experiment, I will tether 80 live caterpillars to vegetation in both control and experimental plots. I will select a species native to the HBEF that is a host of parasitoids and naturally present as mature larvae mid-summer. After 24 hours, I will record the number of caterpillars that died, disappeared, or showed signs of attack/predation. I will rear all caterpillars that survive the tethering experiment to pupation and/or emergence to pupation. I will record and identify any parasitoid specimens that emerge from the caterpillars or pupae. Specimens will be preserved in 80% ethanol.

Hypothesis 3: The effects of artificial light at night on species interactions are modulated by the lunar cycle.

The difference between control and experimental plots will be greatest around the new moon and lowest around the full moon in flying insect biomass (Prediction 3a), in abundance of arthropod predators and parasitoids (Prediction 3b), and in predation and parasitism rates (Prediction 3c).

Test 3**:** Insect sampling will encompass two complete lunar cycles (8 weeks). I will conduct caterpillar predation experiments over four sampling periods during the study period, corresponding to two new moon events (June 5 and July 5) and two full moon events (June 21, July 20). Moon illumination and cloud cover are the primary meteorological factors affecting insect sampling at light traps [24] [25]; fewer insects are attracted to light sources as nighttime brightness levels are increased. I will use the HOBO data to measure how the lunar cycle and variation in cloud cover affect the difference in brightness levels between experimental and control plots. I will then analyze how these factors modulate the impacts of ALAN on insect communities and predation and parasitism rates.

Timetable and Expected Outcomes

During Fall 2020, I worked with long-term data on caterpillar and insect population trends at HBEF,

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which will allow the results of this study to be analyzed within the context of natural population fluctuations. I sorted Malaise trap samples to familiarize myself with the arthropod community at the HBEF, identifying over 500 parasitoid specimens. I will conduct field experiments at the HBEF from May-Aug 2021, sort and identify insect samples in fall 2021, conduct statistical analyses over the winter term (I received data science training via DataCamp over summer 2020) and begin manuscript preparation for my honors thesis that I will present in spring 2022.

References

[1] A. C. S. Owens, P. Cochard, J. Durrant, B. Farnworth, E. K. Perkin, and B. Seymoure, "Light pollution is a driver of insect declines" in *Biological Conservation*, vol. 241:108259, Jan 2020.

[2] F. Sánchez-Bayo, and K. A. G. Wyckhuys, "Worldwide decline of the entomofauna: A review of its drivers", in *Biological Conservation*, vol. 232, pp. 8–27, April 2019.

[3] Manfrin, A., G. Singer, S. Larsen, N. Weiß, R. H. A. van Grunsven, N.-S. Weiß, S. Wohlfahrt, M. T. Monaghan, and F. Hölker, "Artificial light at night affects organism flux across ecosystem boundaries and drives community structure in the recipient ecosystem" in *Frontiers in Environmental Science*, vol. 5:61, Oct 2017.

[4] A. C. S. Owens, and S. M. Lewis, "The impact of artificial light at night on nocturnal insects: A review and synthesis" in *Ecology and Evolution*, vol. 8, pp.11337–11358, Oct 2018.

[5] E. Desouhant, E. Gomes, N. Mondy, and I. Amat, "Mechanistic, ecological, and evolutionary consequences of artificial light at night for insects: review and prospective" in *Entomologia Experimentalis et Applicata*, vol. 167, pp. 37–58, Feb, 2019.

[6] K. G. van Geffen, R. H. A. van Grunsven, J. van Ruijven, F. Berendse, and E. M. Veenendaal, "Artificial light at night causes diapause inhibition and sex-specific life history changes in a moth" in *Ecology and Evolution*, vol. 4(11), pp. 2082–2089, April 2014.

[7] F. van Langevelde, R. H. A. van Grunsven, E. M. Veenendaal, and T. P. M. Fijen, "Artificial night lighting inhibits feeding in moths" in *Biology Letters*, vol.13:20160874, March 2017.

[8] K. G. van Geffen, E. van Eck, R. A. de Boer, R. H. A. van Grunsven, L. Salis, F. Berendse, and E. M. Veenendaal, "Artificial light at night inhibits mating in a Geometrid moth" in *Insect Conservation and Diversity*, vol. 8(3), pp. 282–287, Feb 2015.

[9] C. Minnaar, J. G. Boyles, I. A. Minnaar, C. L. Sole, and A. E. McKechnie, "Stacking the odds: light pollution may shift the balance in an ancient predator-prey arms race" in *Journal of Applied Ecology*, vol. 52(2), pp. 522–531, Nov 2014.

[10] K.-N. Kim, Y.-C. Jo, Z.-J. Huang, H.-S. Song, K.-H. Ryu, Q.-Y. Huang, and C.-L. Lei, "Influence of green light illumination at night on biological characteristics of the oriental armyworm, *Mythimna separata* (Lepidoptera: Noctuidae)" in *Bulletin of Entomological Research*, vol. 110(1), pp.136–143, Feb 2020.

[11] A. A. M. H. Welbers, , N. E. van Dis, A. M. Kolvoort, J. Ouyang, M. E. Visser, K. Spoelstra, and D. M. Dominoni, "Artificial light at night reduces daily energy expenditure in breeding great tits (*Parus major*)" in *Frontiers in Ecology and Evolution*, vol. 5:55, pp. 1–10, May 2017.

[12] C. L. Seifert, C. H. Schulze, T. C. T. Dreschke, H. Frötscher, and K. Fiedler, "Day vs. night predation on artificial caterpillars in primary rainforest habitats - an experimental approach" in *Entomologia Experimentalis et Applicata*, vol. 158(1), pp. 54–59, Jan 2016.

[13] K. Grenis, and S. M. Murphy, "Direct and indirect effects of light pollution on the performance of an herbivorous insect" in *Insect Science*, vol. 26(4), pp. 770–776, Aug 2019.

[14] R. Kehoe, D. Sanders, D. Cruse, M. Silk, K. J. Gaston, J. R. Bridle, and F. Veen, "Longer photoperiods through range shifts and artificial light lead to a destabilizing increase in host–parasitoid interaction strength" in *Journal of Animal Ecology*, vol. 89(11), pp. 2508–2516, Nov 2020.

[15] T. W. Davies, J. Bennie, and K. J. Gaston, "Street lighting changes the composition of invertebrate communities" in *Biology Letters*, vol. 8(5), pp.764–767, May 2012.

[16] C. R. Miller, B. T. Barton, L. Zhu, V. C. Radeloff, K. M. Oliver, J. P. Harmon, and A. R. Ives, "Combined effects of night warming and light pollution on predator–prey interactions" in *Proceedings of the Royal Society B: Biological Sciences*, vol. 28:20171195, Oct 2017.

[17] D. Sanders, R. Kehoe, D. Cruse, F. J. F. van Veen, and K. J. Gaston, "Low levels of artificial light at night strengthen top-down control in insect food web" in *Current Biology*, vol. 28(15), pp2474-2478.e3, Aug 2018.

[18] A. Howe, G. L. Lövei, and G. Nachman, "Dummy caterpillars as a simple method to assess predation rates on invertebrates in a tropical agroecosystem" in *Entomologia Experimentalis et Applicata*, vol. 131(3), pp. 325–329, May 2009.

[19] E. A.Vieira, R. Arruda, K. F. Massuda, P. Cardoso-Gustavson, E. F. Guimarães, and J. R. Trigo, "Volatiles released by damaged leaves of Piper mollicomum (Piperaceae) act as cues for predaceous wasps: evidence using plasticine dummies as herbivore model" in Arthropod-Plant Interactions, vol. 13(4), pp. 593–601, Aug 2019.

[20] F. Falchi, P. Cinzano, D. Duriscoe, C. C. M. Kyba, C. D. Elvidge, K. Baugh, B. A. Portnov, N. A. Rybnikova, and R. Furgoni, "The new world atlas of artificial night sky brightness" in *Science Advances*, vol. 2(6), June 2016.

[21] A. P. Aguiar, and B. F. Santos, "Discovery of potent, unsuspected sampling disparities for Malaise and Möricke traps, as shown for Neotropical Cryptini (Hymenoptera, Ichneumonidae)" in *Journal of Insect Conservation*, vol. 14(2), pp.199–206, April 2010.

[22] A. Rodríguez, J. L. O. Pohjoismäki, and J. Kouki, "Diversity of forest management promotes parasitoid functional diversity in boreal forests" in *Biological Conservation*, vol. 238 (Suppl. 3):108205, April 2019.

[23] W. Leuenberger, E. Larsen, J. Leuenberger, and D. Parry, "Predation on plasticine model caterpillars: engaging high school students using field-based experiential learning & the scientific process" in *The American Biology Teacher*, vol. 81(5), pp. 334–339, March 2019.

[24] J. Bowden, "An analysis of factors affecting catches of insects in light-traps" in Bulletin of Entomological Research, vol. 72(4), pp. 535–556, Dec1982.

[25] J. L. Yela, and M. Holyoak, "Effects of moonlight and meteorological actors on light and bait trap catches of noctuid moths (Lepidoptera: Noctuidae)" in *Environmental Entomology*, vol. 26(6), pp.1283–1290, Dec 1997.

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Elizabeth Pixley
(Continued from page 2)

NOT collected in New York State; Cornell University was happy to accept them. We embarked on an ambitious sorting project with lots of wonderful volunteers who came to help. Now we have a regional plant collection which is much easier to manage.

Digitizing the Herbarium specimens would make this historic collection more easily accessible to researchers throughout the world. Only a small percentage of the plant specimens have been digitized to date. Hopefully, this goal will be achieved in the future.

Individuals are invited to contact, If individuals would like to be involved in the on-going maintenance of the collection, you are invited to contact Elizabeth Pixley, Curator of the RAS Herbarium, by email at eypixley@gmail.com, or phone (585) 334-0977.

Small White Lady's Slipper, (*Cypripedium candidum*) collected in 1864 in Bergen Swamp by George T. Fish a charter member of RAS. Original in the Academy Herbarium

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