Open Ocean Kelp Biofuel Project Promising

by David Ginsburg

David Ginsburg, SCAS President and USC Associate Professor (Teaching) of Environmental Studies is working with colleagues at USC’s Wrigley Institute for Environmental Studies and Marine BioEnergy, Inc. to develop new approaches for cultivating kelp in the open ocean for biofuel production using funding from the U.S. Department of Energy’s Advanced Research Projects Agency-Energy (ARPA-E) program.

Giant Kelp (Macrocystis pyrifera) grows naturally in the coastal waters of California, and is part of a genus found in temperate waters worldwide. This species is renowned for its rapid growth, with documented rates of up to 1 meter per day with mature individuals that can exceed 50 meters in total length. Giant kelp provides essential habitat and is an important food source for many marine species while sequestering carbon dioxide and producing oxygen as it grows. These characteristics and the fact that it does not require land, freshwater or fertilizer resources have made kelp an attractive source of biofuel since the 1970s.

Growing kelp in the open ocean, as opposed to its native, nearshore habitat, is a challenge. The variables kelp need are not found in one place: sunlight is at the surface, while essential nutrients are found in deeper waters. To successfully enable the large-scale cultivation of kelp in this environment will require the use of autonomous moving structures to ‘depth-cycle’ kelp to the surface for light and to depth for nutrients on a daily basis.

Currently, Ginsburg and colleagues are testing whether this ‘depth-cycling’ is biologically viable for the kelp. Depth-cycling tests are being conducted in waters near USC’s marine facility on Catalina Island (the Wrigley Marine Science Center), using moored structures nicknamed ‘kelp elevators.’ Led by USC faculty and staff, the project offers a unique opportunity for undergraduates to engage with experts in applied marine research.

Upon successful proof-of-concept, Marine BioEnergy hopes to deploy large underwater moving kelp farms that move between depths using autonomous, submersible drones for the optimal balance of sunlight and nutrients, before extracting the kelp for fuel production. By combining decades-old kelp biofuel ideas with today’s technological innovations, large-scale kelp biofuel may finally become a reality.
For 126 years, the Southern California Academy of Sciences has been an important part of southern California’s scientific community. As outlined in our mission statement, we promote fellowship amongst our peers and those interested in science. Additionally, we contribute to the literature through the publication of pertinent manuscripts in The Bulletin, and we encourage and promote scholarship among young scientists.

I’d like to invite each of you to “Save the Date!” for this year’s annual meeting, which will be held on May 4, 2018 as a one-day event on the Cal Poly Pomona campus. Symposia themes for 2018 include Desert Ecology, Marine Science and Policy, and Parasitology. Contributed paper presentations will cover a variety of topics ranging from organismal ecology and physiology to conservation biology and ecosystem change. And, finally, we will cap off the day with an evening poster session, which will include our Junior Academy members enrolled in the Research Training Program.

Special thanks to the following people for their outstanding efforts during our 2017 Annual Meeting at SMC: Lisa Collins as Local Committee Chairperson, Kristy Forsgren, Shelly Moore, Danny Tang, all the symposium organizers, and Gloria Takahashi for leading the Junior Academy. I would also like to thank our plenary speaker, Prof. Sharon Walker from UC Riverside. More than 250 people attended the 2017 meeting, which included 45 oral presentations and nearly 70 posters. Awards were given for best student presentations and posters, and five graduate students were presented grants to support their research.

Congratulations and welcome to our newly elected Board member, Amber Brown from the USC Wrigley Institute of Environmental Studies. The following Board members have agreed to continue to serve as officers; myself as President, Lisa Collins as Vice President, Edith Read as Recording Secretary, Kristy Forsgren as Corresponding Secretary, Karina Johnston as Treasurer, Daniel Pondella and Larry Allen as Editors of The Bulletin, Brad Blood as Editor of The Smilodon, and Shelly Moore as Webmaster. Thank you for your continued support!

If you have scientific papers to publish, please remember that our Academy Bulletin is open to papers in any field of science with relevance to the southern California area, particularly from SCAS members. The Academy publishes papers by members without page charges, so please consider submitting your manuscripts.

I believe the research, scholarship, and professional development opportunities offered by SCAS can greatly enhance the future career choices of students at all levels of their academic career. Your continued participation in and support of SCAS can make all the difference.

Thank you and I look forward to seeing you at the May 4, 2018 Annual Meeting at Cal Poly Pomona!

David W. Ginsburg, Ph.D.
President

MARK YOUR CALENDAR!!
SCAS’ 2018 ANNUAL MEETING
MAY 4, 2018
California State Polytechnic University, Pomona

Astronomers recently scrambled to observe an intriguing asteroid that zipped through the solar system on a steep trajectory from interstellar space—the first confirmed object from another star.

Now, new data reveal the interstellar interloper to be a rocky, cigar-shaped object with a somewhat reddish hue. The asteroid, named ‘Oumuamua by its discoverers, is up to one-quarter mile (400 meters) long and highly-elongated—perhaps 10 times as long as it is wide. That aspect ratio is greater than that of any asteroid or comet observed in our solar system to date. While its elongated shape is quite surprising, and unlike asteroids seen in our solar system, it may provide new clues into how other solar systems formed.

The observations and analyses were funded in part by NASA and appear in the Nov. 20 issue of the journal Nature. They suggest this unusual object had been wandering through the Milky Way, unattached to any star system, for hundreds of millions of years before its chance encounter with our star system.

“For decades we’ve theorized that such interstellar objects are out there, and now— for the first time— we have direct evidence they exist,” said Thomas Zurbuchen, associate administrator for NASA’s Science Mission Directorate in Washington. “This history-making discovery is opening a new window to study formation of solar systems beyond our own.”

Immediately after its discovery, telescopes around the world, including ESO’s Very Large Telescope in Chile and other observatories around the world were called into action to measure the object’s orbit, brightness and color. Urgency for viewing from ground-based telescopes was vital to get the best data.

continued on page 4
Interstellar Visitor Dazzles, cont...

Combining the images from the FORS instrument on the ESO telescope using four different filters with those of other large telescopes, a team of astronomers led by Karen Meech of the Institute for Astronomy in Hawaii found that 'Oumuamua varies in brightness by a factor of ten as it spins on its axis every 7.3 hours. No known asteroid or comet from our solar system varies so widely in brightness, with such a large ratio between length and width. The most elongated objects we have seen to date are no more than three times longer than they are wide.

“This unusually big variation in brightness means that the object is highly elongated: about ten times as long as it is wide, with a complex, convoluted shape,” said Meech. We also found that it had a reddish color, similar to objects in the outer solar system, and confirmed that it is completely inert, without the faintest hint of dust around it.”

These properties suggest that 'Oumuamua is dense, comprised of rock and possibly metals, has no water or ice, and that its surface was reddened due to the effects of irradiation from cosmic rays over hundreds of millions of years.

A few large ground-based telescopes continue to track the asteroid, though it’s rapidly fading as it recedes from our planet. Two of NASA’s space telescopes (Hubble and Spitzer) are tracking the object the week of Nov. 20. As of Nov. 20, 'Oumuamua is travelling about 85,700 miles per hour (38.3 kilometers per second) relative to the Sun. Its location is approximately 124 million miles (200 million kilometers) from Earth — the distance between Mars and Jupiter — though its outbound path is about 20 degrees above the plane of planets that orbit the Sun. The object passed Mars’s orbit around Nov. 1 and will pass Jupiter’s orbit in May of 2018. It will travel beyond Saturn’s orbit in January 2019; as it leaves our solar system, ‘Oumuamua will head for the constellation Pegasus.

Observations from large ground-based telescopes will continue until the object becomes too faint to be detected, sometime after mid-December. NASA’s Center for Near-Earth Object Studies (CNEOS) continues to take all available tracking measurements to refine the trajectory of 1I/2017 U1 as it exits our solar system.

This remarkable object was discovered Oct. 19 by the University of Hawaii’s Pan-STARRS1 telescope, funded by NASA’s Near-Earth Object Observations (NEOO) Program, which finds and tracks asteroids and comets in Earth’s neighborhood. NASA Planetary Defense Officer Lindley Johnson said, “We are fortunate that our sky survey telescope was looking in the right place at the right time to capture this historic moment. This serendipitous discovery is bonus science enabled by NASA’s efforts to find, track and characterize near-Earth objects that could potentially pose a threat to our planet.”

Preliminary orbital calculations suggest that the object came from the approximate direction of the bright star Vega, in the northern constellation of Lyra. However, it took so long for the interstellar object to make the journey — even at the speed of about 59,000 miles per hour (26.4 kilometers per second) — that Vega was not near that position when the asteroid was there about 300,000 years ago.

While originally classified as a comet, observations from ESO and elsewhere revealed no signs of cometary activity after it slingshotted past the Sun on Sept. 9 at a blistering speed of 196,000 miles per hour (87.3 kilometers per second).

The object has since been reclassified as interstellar asteroid 1I/2017 U1 by the International Astronomical Union (IAU), which is responsible for granting official names to bodies in the solar system and beyond. In addition to the technical name, the Pan-STARRS team dubbed it 'Oumuamua (pronounced oh MOO-uh MOO-uh), which is Hawaiian for “a messenger from afar arriving first.”

Astronomers estimate that an interstellar asteroid similar to ‘Oumuamua passes through the inner solar system about once per year, but they are faint and hard to spot and have been missed until now. It is only recently that survey telescopes, such as Pan-STARRS, are powerful enough to have a chance to discover them.

“What a fascinating discovery this is!” said Paul Chodas, manager of the Center for Near-Earth Object Studies at NASA’s Jet Propulsion Laboratory, Pasadena, California. “It’s a strange visitor from a faraway star system, shaped like nothing we’ve ever seen in our own solar system neighborhood.”

For more on NASA’s Planetary Defense Coordination Office:
https://www.nasa.gov/planetarydefense

To watch a NASA Planetary Defense video on International Asteroid Day:
https://www.youtube.com/watch?v=VYO-mpoC8_s

For interstellar asteroid FAQs:
https://www.nasa.gov/planetarydefense/faq/interstellar

Last Updated: Nov. 20, 2017
Edited by NASA’s Tricia Talbert

continued on page 5
The Research Training Program (RTP) provided by the Southern California Academy of Sciences is essentially a timeline and a support group for young high school students looking to sally forth into the world of scientific research. It is largely an individual experience, considering that the job of doing the research itself is the student's, although the meetings provide a much needed opportunity to interact with other students in the program. Personally, I enjoyed this the most because it allowed me to make meaningful friendships with people who are scientifically motivated like myself. The program also provides a schedule complete with milestones to both give the students a sense of progress and also provide deadlines for them to meet. I don't procrastinate as much as I used to, so I am ambivalent toward whether these were necessary for me personally. Sometimes I felt like they were a waste of time, but it served as shelter, garment, and light for people in desperate need. This old man, sitting with his back to a building, holding a pillow, would like for the blades. The radial length of the blades extend behind the assembly, and they would fall apart as I created another blade assembly that contradicted them, and building these precise assemblies without a schedule felt long and discouraging.

For now, Liu's goal is to put TravlerPack in refugees' hands. "He was always looking for ways to make the world a better place," said Matt Linder, an engineer by trade who works as an assistant football coach at Prep, remembered Liu as a thoughtful young man. "We don't want to give them something they can only use three months out of the year."

"You could literally take the blood sample on the spot, and the microscope could take photos and transport them across a village, a country or the world, to a doctor or a laboratory," he explained. Liu's work won praise at school, county, state and international science fairs. As a sophomore, he presented his work at a microfluidics conference in Germany. In 2015 and 2016, the team presented his work at consecutive annual meetings of the American Assn. for the Advancement of Science. Liu's work won recognition at science fairs. "I researched online for a solution to this workflow issue, and discovered the RTP program. I decided to apply, and began to look for a mentor. Within a few emails, I discovered Dr. Marilyn Raphael of the UCLA Department of Geography. Dr. Raphael was very knowledgeable of the behavior of wind, especially on a macro scale. She was able to answer some of my questions concerning the construction of the blade assemblies. This gave me a second wind, and began coming up with new ways to make assemblies, such as 3D printing."

For the Prep science fair, Liu developed an inexpensive, portable blood analyzer that could identify and count blood cells. He later created a 3-D printed cellphone microscope capable of transmitting images of blood sample slides taken in the field. "I found that I would notice new ways to make assemblies, such as 3D printing."

The Research Training Program (RTP) provided by the Southern California Academy of Sciences is essentially a timeline and a support group for young high school students looking to sally forth into the world of scientific research. It is largely an individual experience, considering that the job of doing the research itself is the student's, although the meetings provide a much needed opportunity to interact with other students in the program. Personally, I enjoyed this the most because it allowed me to make meaningful friendships with people who are scientifically motivated like myself. The program also provides a schedule complete with milestones to both give the students a sense of progress and also provide deadlines for them to meet. I don't procrastinate as much as I used to, so I am ambivalent toward whether these were necessary for me personally. Sometimes I felt like they were a waste of time, but it served as shelter, garment, and light for people in desperate need. This old man, sitting with his back to a building, holding a pillow, would like for the blades. The radial length of the blades extend behind the assembly, and they would fall apart as I created another blade assembly that contradicted them, and building these precise assemblies without a schedule felt long and discouraging.

I researched online for a solution to this workflow issue, and discovered the RTP program. I decided to apply, and began to look for a mentor. Within a few emails, I discovered Dr. Marilyn Raphael of the UCLA Department of Geography. Dr. Raphael was very knowledgeable of the behavior of wind, especially on a macro scale. She was able to answer some of my questions concerning the construction of the blade assemblies. This gave me a second wind, and I began coming up with new ways to make assemblies, such as 3D printing. As I went to the RTP meetings, I learned about how to compose an abstract and a scientific paper, and how to present one's findings on a scientific poster. These were valuable lessons, as I am entering the engineering industry, where I imagine it will be expected of me to know these presentation basics. I also enjoyed exploring the venues where the meetings were held, especially the Cabrillo Marine Aquarium. Frankly, I was quite impressed with my experience within RTP. I learned much that I would not have learned elsewhere prior to college, I conducted interesting research with valuable guidance, and I met others who did the same. I am grateful for all the RTP staff and parents, particularly Mrs. Takahashi, considering the number of students and projects to keep track of. I look forward to applying my experience from this program to my future work within the scientific community.

For more information about the RTP program, or if you have (or know) a student who might be interested in participating, please contact RTP Program Coordinator Gloria Takahashi at myopick@aol.com.
FROM THE ARCHIVES...

The following article by Hildegarde Howard announces SCAS’ then-new affiliation with AAAS. The article also provides a snapshot of SCAS in 1953. It is interesting as we move forward to consider how the organization has changed in 65 years, and what things are still familiar.

Public Comment on Ballona Wetlands Ecological Reserve Draft EIR Sought

The California Department of Fish and Wildlife (CDFW), in partnership with the State Coastal Conservancy and The Bay Foundation, has spent years working with the public and envisioning a plan for the revitalization of the Ballona Wetlands Ecological Reserve (BWER). The Ballona Wetlands were once an approximate 2,000-acre expanse of marshes, mud flats, salt pans and sand dunes that stretched from Playa del Rey to Venice and inland to the Baldwin Hills. Today, BWER is less than 600 acres of open space, all that remains of the former wetlands, now owned by the people of California and managed by CDFW. See Ballona Wetlands Restoration Project web site at https://www.wildlife.ca.gov/Regions/5/Ballona-EIR for more information.

CDFW, as the lead agency under the California Environmental Quality Act, is coordinating the preparation of an Environmental Impact Report (EIR) for the proposed Ballona Wetlands Restoration Project. CDFW is soliciting comments on the Draft EIR.

The public comment period for this DEIR has been extended. Written comments will now be received until 5 p.m. PST, February 5, 2018.
THE LAST WORD

In an effort to regularize the publication of this organ, the editorial board of the Smilodon (in consultation with the SCAS Board of Directors) have decided to revise the aforementioned publication's production schedule. The Smilodon will be published twice annually:

April 15 and November 15

To facilitate this schedule, the following deadlines for receipt of articles/input/photographs/etc. will be adhered to.

Deadlines for April 15 (Spring) issue:
- Receipt of articles/input: March 15
- Draft Smilodon to Board for review: April 1
- Board comments on Draft Smilodon to editor: April 8
- Smilodon distributed to membership: April 15

Deadlines for November 15 (Autumn) issue:
- Receipt of articles/input: October 15
- Draft Smilodon to Board for review: November 1
- Board comments on Draft Smilodon to editor: November 8
- Smilodon distributed to membership: November 15

If you have any questions or concerns about this schedule, or better yet, if you have content to provide (this can be an abstract of a paper or presentation you are working on, an idea you want to share or receive feedback on, an essay on a field experience that was singular and noteworthy, a particularly good photo you want to share...), please contact sgraff@psomas.com or bblood@psomas.com. Thank you!