# BGU

The Ben-Gurion University of the Negev Magazine

# A Global Perspective

Prof. Yaron Ziv, Head of the Goldman Sonnenfeldt School of Sustainability and Climate Change, is leading BGU's efforts to save planet Earth | A special issue on sustainability and the environment

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# Introducing the Goldman Sonnenfeldt School of Sustainability and Climate Change

BGU's School of Sustainability and Climate Changes recently received a boost in the form of a 20-million-dollar grant from the Goldman-Sonnenfeldt Foundation.

The good news was delivered at the University's 52nd Annual Board of Governors Meeting held in May 2022 when members of the Board assembled at the Sde Boker Campus for the naming ceremony of the Goldman Sonnenfeldt School of Sustainability and Climate Change."This gift is a vote of confidence in Ben-Gurion University's ability to make a difference to our generation's most critical problem," said University President Prof. Daniel Chamovitz during the ceremony. "We have been studying how to thrive in our desert for over 50 years. Now, the world is coming to us to learn from this experience. The Goldman Sonnenfeldt School of Sustainability and Climate Change will enable us to apply innovative approaches to teaching, research and public education, as new environmental needs unfold in the upcoming decades."

The inauguration was attended by the donors and their family members. Michael Sonnenfeldt, co-founder and President of the Goldman-Sonnenfeldt Foundation, expressed his confidence that the school bearing the Sonnenfeldt and Goldman families' names will live up to expectations: "Ben-Gurion University of the Negev is a world leader in the study of adaptation to climate change. BGU researchers have spent decades developing technologies that enable Israel to adapt to the harsh desert climate. Now, with a large part of the world facing similar conditions, this work has global relevance.We are proud to contribute to this global challenge through revolutionary solutions that will allow humanity to not only survive, but thrive as the global climate changes."

The generous donation will go a long way towards realizing the School's strategic objectives, including increasing research capacity in the fields of sustainability and climate change, recruiting world-class faculty, developing trans-disciplinary degree programs to prepare the leaders of tomorrow in key environmental fields, and more.

Katja Goldman and Michael Sonnenfeldt have been among BGU's most generous supporters as far back as 1981. The Joya Claire Sonnenfeldt Auditorium, named after their daughter, has served as the University's main auditorium for the past 30 years; the Forest Goldman-Sonnenfeldt Building for Solar Energy and Environmental Physics, named for their son, has been a Mecca for researchers whose work is shaping our future.


A noble endeavor. Left to right: Prof. Yaron Ziv, Isaac Sonnenfeldt, Michael Sonnenfeldt, Forest Sonnenfeldt, Joya Claire Sonnenfeldt, and President Prof. Daniel Chamovitz



A view from the University's double helix bridge.

Left to right: Prof. Sigal Abramovich, Prof. Gabriel Lemcoff, Prof. Franklin Visciano, and Prof. Diego Quiroga

A memorandum of understanding signed with San Francisco De Quito University will promote joint studies in the fields of sustainability, climate change and oceanography

# A Bridge to Collaboration with Ecuador

Ben-Gurion University of the Negev (BGU) recently signed a collaboration agreement with San Francisco de Quito University (USFQ) in Ecuador, laying the foundation for collaborative endeavors in the fields of sustainability, climate change and oceanography.

The Ecuadorian delegation's visit to BGU's Marcus Family Campus coincided with Ecuadorian President Guillermo Lasso's visit to Israel to promote the common interests of the two countries.

The territory of Ecuador, bordered by the Pacific Ocean, includes the famous Galápagos Islands, home to numerous unique species and fertile ground for scientific research. The memorandum of understanding opens up the possibility of including researchers from BGU's Goldman Sonnenfeldt School of Sustainability and Climate Change in research in the Galápagos Islands.

The agreement is also intended to establish collaborations in additional fields and joint graduate student programs.

Our USFQ guests visited the Department of Earth and Environmental Sciences, headed by Prof. Sigal Abramovich, and were duly impressed by the activity in the new ICPMS-LA laboratory led by Prof. Yaron Katzir, Dr. Itay Haviv and Dr. Bar Elisha, as well as by the work done in the research labs of Prof. Itzik Mizrahi, Prof. Michael Meijler and Dr. Ben Palmer.

The Ecuadorian delegation later visited the Ilse Katz Institute for Nanoscale Science & Technology, where Dr. Palmer demonstrated the new cryo-SEM microscope. The guests were accompanied throughout their visit by Prof. Miki Malul, Dean of the Guilford Glazer Faculty of Business and Management, Prof. Lital Alfonta of the Department of Life Sciences and Prof. Roi Granot of the Department of Earth and Environmental Sciences.

The unprecedented agreement was signed on Friday, May 13, 2022, by BGU Rector Prof. Chaim Hames and the Rector of USFQ, Prof. Diego Quiroga. Also present at the signing were Prof. Gabriel Lemcoff, Dean of the Faculty of Natural Sciences, Prof. Yaron Ziv, Head of the Goldman Sonnenfeldt School for Sustainability and Climate Change, and Prof. Franklin Visciano from USFQ.

Later this year, researchers from both universities will participate in a virtual conference organized by Prof. Abramovich, which will advance collaborative research topics.

# Studying the Invasion by Sea

Prof. Sigal Abramovich, Chair of the Department of Earth and Environmental Sciences, leads a team studying the impact of invasive tropical marine species on life in the Mediterranean

Prof. Sigal Abramovich, Chair of the Department of Earth and Environmental Sciences, is a highly esteemed scientist who leads a research team studying the impact of invasive tropical marine species on life in the Mediterranean Sea.

Social and scientific awareness of global warming has increased significantly in recent decades. The accepted scientific projection foresees an increase of 0.2 degrees Celsius in the oceans' temperature every decade. Climate models and field observations forecast a further increase in the temperature of the Mediterranean, which has already become 1.28 degrees warmer since the 1980s.

One phenomenon closely related to global warming is the mass invasion of foreign species originating in the Indian and the Pacific oceans. These invasive species, called "Lessepsian migrants" (after Ferdinand de Lesseps, the developer and designer of the Suez Canal, inaugurated in 1869), migrate from the Red Sea through the Suez Canal to the Mediterranean Sea. These invaders have had a profound impact on the composition of species and the configuration of 'marine societies' in the Mediterranean. They have successfully challenged indigenous species and have often become the dominant species in the areas they have settled.

More than 500 Lessepsian species have been identified in the Mediterranean Sea so far, and additional invasive species are discovered each year, including algae, mollusks, corals, fish, crabs and jellyfish. "The implications of these invasive species' establishment range from beneficial to extremely harmful," says Prof. Abramovich, adding: "Many of the invading fish species are a valuable contribution to local fishing, while other species cause damages due to their toxicity. For instance, in addition to being a serious nuisance for bathers, the invasion of the *Rhopilema nomadica* (the nomad jellyfish) impacts local fishing and sea-dependent industries financially. For those reasons, the ecological, environmental and financial aspects of Lessepsian migration have been the focus of much scientific work in recent years.

"Another noteworthy Lessepsian invader is the *Foraminifera* – unicellular, mostly skeleton building organisms that are an important component of the calcareous sediment (a mineral deposit composed of calcium carbonate) in the Mediterranean Sea. *Foraminifera* fossils are a key geological dating tool, used to date marine sediments and ancient marine environments (such as the Tethys Sea) in the sub-field called paleoceanography. In recent years, *Foraminifera* have been used as sensitive indicators of ocean conditions and of the impact of climate change and other anthropogenic phenomena. They are useful marine environment indicators for several reasons, including the fact that they are easy to grow in a lab and use in experiments simulating changing climate and environmental conditions, as well as conduct geochemical measurements of their skeletons.

According to Prof. Abramovich, "Invasive species exhibit a different pattern of bio-geographic distribution, associated with temperature constraints. We combine genetic and geo-chemical tools to characterize various species' range of sensitivity to rising temperatures and increasing salinity." The study was conducted by lab members Doron Pinko and Dr. Danna Titelboim (currently a research fellow at Oxford University), and in collaboration with Prof. Uri Abdo from BGU's Department of Life Sciences.

In their most recent studies, Prof. Abramovich and her team used the warm water zone created by the Hadera power station as a field laboratory simulating future warming. "Our findings show that a rise of just one or two degrees Celsius will drive most indigenous species away from the Israeli coastline, limit the presence of Lessepsian species in the Levant basin and even lead to a substantial decrease in their contribution as 'environmental engineers.' On the other hand, certain species have exhibited uniquely high survivability in extreme temperatures, which has not been observed in *Foraminifera* so far.

Other studies in Abramovich's lab use geo-chemical measurements of *Foraminifera* skeletons to identify concentrations of heavy metals. This tool has many advantages over other, more common methods of monitoring marine environments. *Foraminifera* build skeletons that 'record' the presence of metals they absorbed throughout their lifetime, thus serving as a live recording tool of metal pollution. "Through our field and lab experiments we successfully recorded extremely low to high concentrations of metals and, in doing so, raised an early alarm of pollution," reveals Prof. Abramovich. "We also succeeded in demonstrating the effectiveness of this tool by recording a significant increase in heavy metal pollution following the tar pollution disaster along the Israeli coast in February 2021." That research was conducted by graduate student Lynn Hoober, in collaboration with Prof. Adi Torfstein from the Hebrew University, Prof. Barak Herut from the National Institute of Oceanography in Haifa, and Dr. Nadya Teutsch from the Geological Survey of Israel.

In conclusion, Prof. Abramovich says, "We have been able to demonstrate that *Foraminifera* are among the most valuable organisms for monitoring oceanic changes and characterizing the biological effects of global warming. Their unique qualities make them extremely effective marine 'tools' for recording oceanic conditions in the past and in the present."

Ammonia beccarii 1 Foraminifera. Photo by Holger Krisp, CC BY 4.0 via Wikimedia Creative Commons

# A Transformative Journey: From BGU to the Maasai of Tanzania

Students from the Departments of Biotechnology Engineering and Civil & Environmental Engineering traveled to East Africa to offer water, energy, and agricultural solutions to the local population



> It was fascinating to get to know and learn about the life of the Maasai. They welcomed us with open arms, making us feel at home; it was an experience we will never forget

Students from Ben-Gurion University of the Negev joined an international delegation of Engineers Without Borders to the Maasai tribe in Tanzania. Their mission was rooted in principles of environmental preservation and equitable reciprocal relations with disadvantaged populations, principles championed by the Goldman Sonnenfeldt School of Sustainability and Climate Change.

Several months ago, three BGU students joined the Israeli delegation's mission to the village of Socorro in Tanzania. Their goal was to map the needs of the local community and check the feasibility of water, energy, and farming projects. Sewage and waste treatment were also included in the delegation's brief.

The Maasai people were more than happy to collaborate with the mission and brought up their most pressing problems in the hope of finding real solutions. Osher Gueta, a master's student in the Avram and Stella Goldstein-Goren Department of Biotechnology Engineering and chair of the organization's Ben-Gurion University branch, led the delegation to Tanzania. She was joined by Arthur Lagron, also a biotechnology engineering student, and Liran Strauchler, a student in the Department of Civil Engineering.

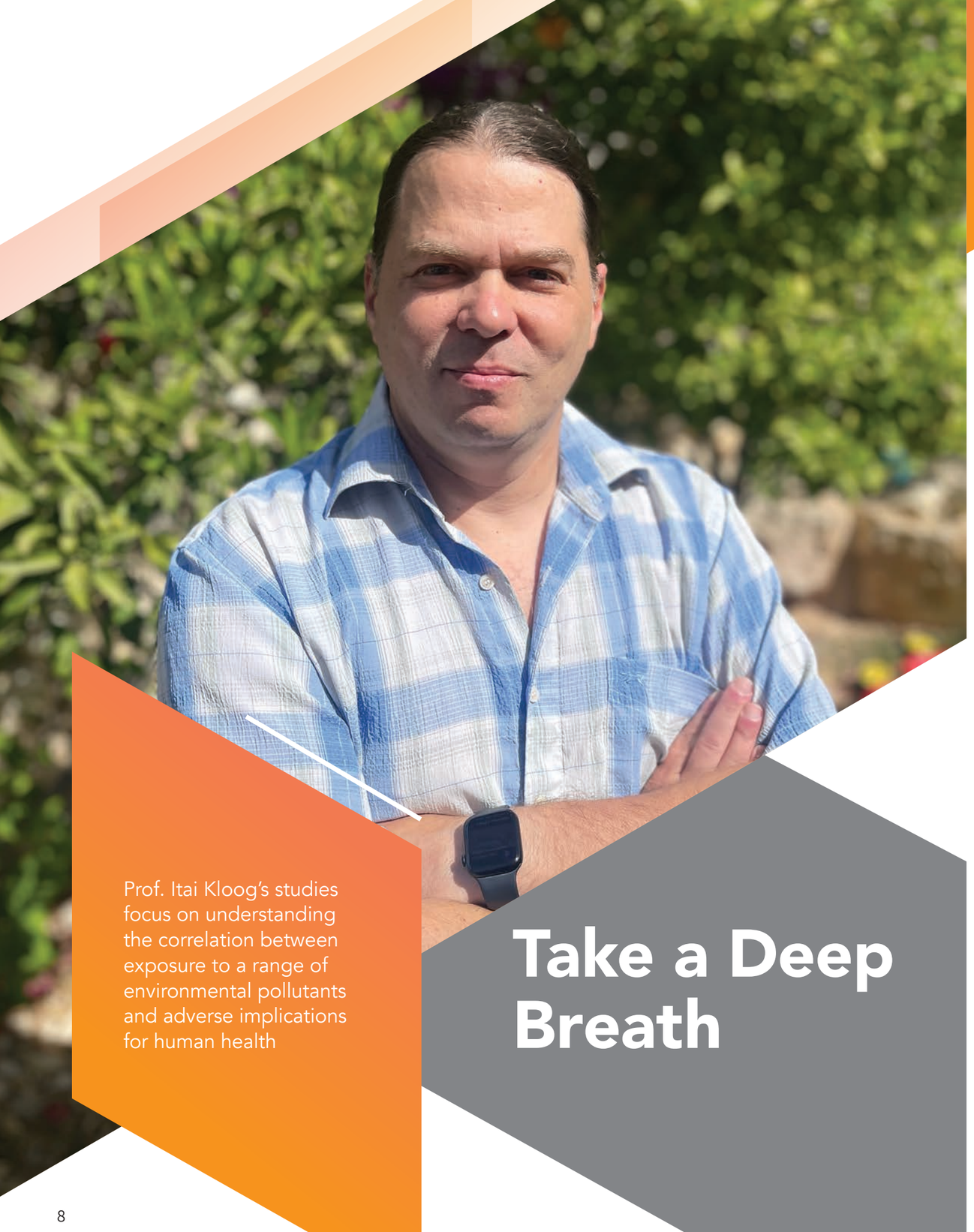
"The trip to Tanzania was thrilling," said Gueta. "Through this project, we got to know the local population, its needs and the ways to integrate into local development."

Arthur and Liran added: "It was fascinating to get to know and learn about the life of the Maasai. They welcomed us with open arms and made us feel at home; they really went out of their way to make sure we'd miss nothing. Staying with them was an experience we will never forget."

The outstanding students in the Beer-Sheva branch of Engineers Without Borders – Israel are acutely conscious of the challenges faced by disadvantaged populations. They work in teams, and each team focuses on its own project, related to the students' fields of study: water, urban agriculture, energy, and recycling. The projects are aligned with the UN's Sustainable Development Goals, as well as objectives related to the climate crisis.

Engineers Without Borders is a non-profit organization striving to improve the quality of life in Israel and for populations in developing nations around the world. Its activities include sustainable engineering initiatives and implementing various sustainable technologies, combined with community training, education and empowerment programs.

Osher Gueta, Arthur Lagron and Liran Strauchler in Tanzania. Photos courtesy of Engineers Without Borders – Israel



# Take a Deep Breath

Prof. Itai Kloog's studies focus on understanding the correlation between exposure to a range of environmental pollutants and adverse implications for human health



Prof. Itai Kloog, a faculty member in the Department of Geography and Environmental Development and head of the Environmental Exposure Assessment Lab, is involved in several fields relevant to our life on this planet: health and environment (the correlation between air pollution and mortality, hospitalizations and other health metrics), developing innovative environmental models (for assessing air pollution, noise, and more) and geographic information systems (GIS). For his achievements, Prof. Kloog will receive the Strage-BGU Award for Excellence in Environmental Sciences from the Goldman Sonnenfeldt School of Sustainability and Climate Change.

Itai Kloog was born in Ramat Gan and grew up in Herzliya. He began his academic studies at Tel-Aviv University, where he obtained a bachelor's degree in geography and archeology. He got his master's and PhD degrees from the Department of Natural Resources and Environmental Management at the University of Haifa.

During his postdoc at Harvard University, Kloog developed innovative satellite-based models to assess air pollution. He joined Ben-Gurion University of the Negev's Department of Geography and Environmental Development in 2013. He is also a visiting researcher at Harvard and an associate researcher at Mount Sinai Hospital in New York.

The team at the Environmental Exposure Assessment lab headed by Prof. Kloog is developing hybrid satellite-based models to assess exposure to air pollution and temperature. They use advanced geo-statistical methodologies, satellite data and new algorithms developed in the lab. The models can help generate accurate forecasts of the acute (short-term) effect of air pollution, as well as of chronic (long-term) impacts.

> The air pollution and temperature observations of meteorological stations are fairly limited and, therefore, ineffective in epidemiological studies. Our models are capable of a precise assessment of daily exposure to air pollution for each individual in their own residential environment

What distinguishes Kloog's methods from predictions generated by meteorological stations? Prof. Kloog answered: "The air pollution and temperature observations of meteorological stations are fairly limited and, therefore, ineffective in epidemiological studies. Our models are capable of a precise assessment of daily exposure to air pollution for each individual in their own residential environment."

Prof. Kloog's models are the basis for numerous public health studies. A good example is a joint study with researchers from the Clinical Research Center at Soroka University Medical Center and Harvard University, which found a correlation between exposure to air pollution and changes in the levels of blood sugar and lipids. The study, which involved analyzing more than 600,000 blood samples from over 70,000 residents of the Negev, showed that exposure to higher levels of air pollution during the three months preceding the test correlated to a decrease of up to 1.13% in the levels of good cholesterol (HDL), and up to a 0.57% increase in the levels of blood glucose, as well as other adverse physiological changes. "The changes in blood sugar and lipid levels associated with an increase in air pollution concentrations were found to be even more significant in diabetics treated with insulin," says Prof. Kloog.

A series of recent studies have also revealed that "the risk of premature delivery in pregnant women exposed to temperatures of 30-35 degrees Celsius is 25-30% higher than that of women exposed to 20 degrees. Our research found that the higher the temperature a pregnant woman is exposed to, the greater the risk of giving birth during that week of gestation or the week after that."

The algorithms and models developed by Prof. Kloog are the basis of over 200 international studies in environmental epidemiology, all of which have been published in scientific journals. According to Prof. Kloog, "The ability to accurately evaluate exposure to environmental pollutants in a specific residential area and create an individual exposure profile, offers new prospects in public health research that were previously not possible."

Prof. Yaron Ziv at the Glasgow Climate Change Conference. "We have reached a critical point." Photo: courtesy

# Lending a Hand to Save the Planet

Prof. Yaron Ziv, head of the Goldman Sonnenfeldt School of Sustainability and Climate Change, shares his impressions from the Glasgow Climate Change Conference

The 26th UN Climate Change Conference, convened in Glasgow in November 2021, forced hundreds of millions of people around the world to acknowledge that we are facing the worst climate crisis humanity has ever known.

Prof. Yaron Ziv, head of the Goldman Sonnenfeldt School of Sustainability and Climate Change, who was a member of the Israeli delegation to the Conference, shared his impressions and insights from the momentous event. "For the sake of our children's future, we must curb the rate of global warming. Otherwise, our planet faces terrible danger," he warns.

**So, what can be done to minimize the danger?**

"We must take urgent action to curb global warming: First and foremost, we must immediately stop using fossil fuels, reduce air pollution, and stop deforestation in the rainforests. At the current rate of warming, we will witness a catastrophe from which there is no way back in our lifetime."

According to Prof. Ziv, giant corporations, nations, and financial entities around the world must make radical changes to their economic models. "The entire story of economic growth is based on the assumption that we can grow indefinitely. But that's not the case. Studies measuring the planet's existing and renewable resources have shown that consumption is more than twice as high as what it must be to maintain equilibrium. We are in a crisis, a catastrophe, yet we continue to consume our planet to oblivion!"

**Can climate change conferences help save the planet?**

"Planet Earth will become 1.5 degrees warmer by 2050. But the new agreement signed by delegates from 197 participating nations does not really offer a solution. That said, it was important to publicize and raise awareness of the climate crisis, and in that respect, some change might be happening."

**And as to the question?**

"Hundreds of millions of people were exposed to the data presented at the Glasgow Climate Change Conference; now they have a better understanding of the gravity of the crisis and the undeniable need for solutions."

**What courses of action are we talking about?**

"Even now, with the existing size of the global population and the continued increase in birth rates – our consumption of natural resources irreconcilably harms our long term and sustainable existence. In this context, India is shaping up to be quite problematic: according to various estimations, it will become the world's most populous country by 2027, dependent on inferior fossil fuel and coal-based technology. In light of such data, it is important to send a clear message regarding the importance of mitigating the growth of the world's population."

**Why is this criticism directed mainly at India?**

"I believe India slapped the world in the face when it objected to the wording of the resolution referring to a complete cessation of coal use."

**On the other hand, some scientists believe that the main cause of global warming is the devastating processes on the surface of the sun, which is slowly disintegrating and moving closer to Earth.**

"I would define such people as 'climate deniers'; we have different perspectives," he said. "Interestingly, dozens of years ago, the world realized that gasses from the CFC (Chlorofluorocarbon) compound family – which contain chlorine, fluorine and carbon and are used as cooling agents in air conditioners and as industrial detergents – deplete the ozone layer. The Montreal Protocol signed in 1987 banned the use of these compounds, and after 2006 their production stopped almost entirely."

**And what has happened since?**

"It is clear that as a result of these actions, the hole in the ozone layer is gradually closing and it is doing better. This proves that if countries come together to introduce enforceable bans, we can be optimistic. We are now at a similarly critical juncture; we are playing with the fate of humanity. Never before could humans change their future, so maybe imposing sanctions will do some good and take us where we need to go."



Prof. Yaron Ziv (fifth from the right) and members of the Israeli delegation with Israel's Ambassador to the UK, Tzipi Hotovely

# An Accommodating Climate for International Cooperation

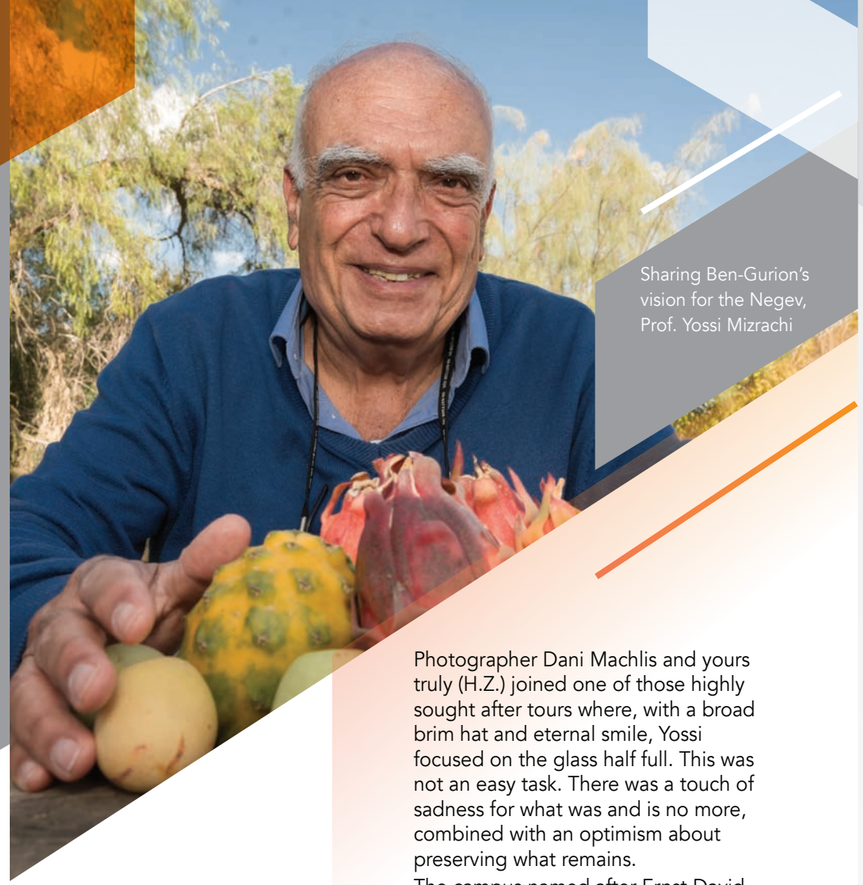
Prof. Yaron Ziv's visit to the UK might pave the way to academic collaborations in the fields of environment and sustainability

Leaders of sustainability centers in Israeli academia, including BGU's Prof. Yaron Ziv, recently returned from a workshop in England. The delegation visited leading institutions of education for sustainability, including Cambridge University, Imperial College London, and Queen Mary University of London. They met with scholars from British research institutions, who presented studies in the fields of the environment and sustainability and expressed their willingness to expand cooperation. The delegates were joined by a representative of the Israeli Council for Higher Education, Gabi Appel, who is responsible for advancing environmental and sustainability fields in Israeli academia.

The visit was a great success, as summed up by Prof. Ziv: "We return with several important insights, mainly regarding academia's potential to be the foundation and mediator for protecting the environment. Also, we brought up options for promoting joint research, pedagogic and community activities with British academia."

The delegation was convened and funded by the British Council, an independent organization associated with the British government focusing on promoting academic cooperation between the UK and other counties. A reciprocal delegation from British academia is expected.

# Enjoying the Fruits of Success



Sharing Ben-Gurion's vision for the Negev, Prof. Yossi Mizrachi

Prof. Yossi Mizrahi is a rare breed | At 82 the eminent botanist continues to share his experience and talents at the Department of Life Sciences

We last visited Prof. Yossi Mizrahi at the turn of the millennium. We tasted the crawling pitaya (dragon fruit) and black sapote and realized that apples were not the only fruit from the Garden of Eden.

Not long ago, after he received the 2022 Ben-Gurion Award, we met with Yossi again. He welcomed us warmly, excited to show us the latest developments in his wonderous world.

On our way from the "gene bank" to the cacti boulevard, the 82-year-old talked to the plants, caressed a white sapote, and felt the pulse of an Argan tree "from whose fruits the healthiest oil in the world is produced" he pronounced, shaking droplets of dew from a sleepy bush.

As far as we know, Prof. Mizrahi is the oldest active researcher in the region; truly a rare breed, Yossi Mizrahi first walked through the gates of the Negev Research Institute in 1961 and put down deep roots. Subsequently, he rose through the ranks to become a senior researcher in the Plant Physiology Unit of the Institutes for Applied Research, the precursor to today's Jacob Blaustein Institutes for Desert Research. The decades of hard work in greenhouses and in open fields proved good for his health. Age, 'touch wood,' has barely left a mark on him.

Yossi still generously shares his experience and talents with the Department of Life Sciences and with residents of Beer-Sheva, and the Negev who participate in his tours greatly enjoy his enthusiasm. So do we.

Photographer Dani Machlis and yours truly (H.Z.) joined one of those highly sought after tours where, with a broad brim hat and eternal smile, Yossi focused on the glass half full. This was not an easy task. There was a touch of sadness for what was and is no more, combined with an optimism about preserving what remains.

The campus named after Ernst David Bergmann, a chemist and nuclear scientist who was a founder of Israel's scientific-defense infrastructure, is different now. The former home of the Negev Research Institute now houses scientists from a range of research fields, including the life sciences, biotechnology, and chemical engineering, as well as professors emeriti from other departments who remain active.

There were several stops on our tour, each with its own unique story. We learned about Mizrahi's research adapting fruit varieties to dry climates, we marveled at the contribution of genetic engineering to crops improvement.

Prof. Mizrahi is responsible for the 'Aliyah' of many exotic fruits to Israel, and he appears to favor them all equally. On our previous visit, Yossi was inspired and, like a magician pulling surprises out of his sleeve, he performed an awe-inspiring trick: he walked up to one of the bushes and with a swift motion plucked a leaf-like stalk and shoved it in his mouth. Before our photographer could raise his camera, the professor began chewing and offered us some. This was not some prank. Indeed, after our first bite we were convinced that this was a benevolent plant with benefits for the digestive system, especially once its thorns were extracted through a complex scientific process. The magical plant, called Nopalitus tastes quite peppery. It contains an antiviral substance and has been found effective against herpes and diabetes.

> There was a guy who couldn't wait for the black sapote to ripen," Mizrachi recalls. "It was so hot his face turned red. Zechug (Yemeni hot sauce) tasted like honey in comparison

This time around though, were spared the pleasure. "It's not in season," Mizrahi apologized for the plump cactus. "Come back in a few months and help yourselves."

Time has not affected Yossi's memory. He had no problem recalling his and his colleagues' shrieks of delight when they discovered the crawling pitaya, a sub-tropical fruit that looks a little like a pineapple, tastes like heaven, and is highly profitable. Pitayas still grow on the Bergmann Campus, with new crossbreeds created in its rambling greenhouses.

Prof. Mizrahi recounts how, together with colleagues and students from the Department of Life Sciences, he conducted an improvement run aimed at extending the fruit's growing season and increase its yield.

The Beer-Sheva pitaya is the offspring of a crossing of two species, imported from Panama and Mexico. "We have never come across a crop that is so profitable with such a small amount of water," pronounced the proud father of the new variety.

Aptly named for the way it grows, the crawling pitaya has really taken off financially. In just three years after it was first marketed in Europe in 1996, its sales soared to 150 tons. It remains a crown jewel that bedazzles its admirers.

The work of Prof. Mizrahi and his colleagues bore fruits of all kinds and flavors over the past decades. Driven and full of energy, these scientists developed countless new fruits and introduced them to local and overseas markets. Dozens of botanical species were brought to the institute's research labs. Some didn't make it; others put down roots. One of the greatest success stories is the marula, an exotic fruit imported from Africa, which is now cultivated throughout the Negev. It is used primarily in the juice, liqueur, and ice cream industries.

Just mentioning the marula lights a spark in Prof. Mizrahi's eyes.

The black sapote and the monkey orange were also successfully adapted to the Negev's soil at the turn of the millennium. Imported from the forests of Guatemala and Mexico, the sapote resembles a green persimmon. When cut open it looks like a pot of black shoe polish, but it tastes wonderful and makes excellent ice cream and cake frosting. "There was a guy who couldn't wait for the black sapote to ripen," Mizrahi recalls. "It was so hot his face turned red. Zechug (Yemeni hot sauce) tasted like honey in comparison."

Our visit with Prof. Mizrahi was a journey back through time, and he concluded with another reminder of the past: "In the early 1960s, Beer-Sheva did not have the resources to support any academic teaching, except for the Negev Research Institute. Beer-Sheva's energetic and highly esteemed mayor, David Tuviyahu, was attuned to residents who wanted academic studies in Beer-Sheva, and in 1964, with the cooperation of other civic leaders, he pushed, encouraged, and founded the Negev Institute for Higher Education. When a green light was finally given in 1969 to establish a university, 20 of the 22 faculty members in the new biology department were also members of the Negev Research Institute!"

A younger Yossi Mizrahi at the Negev Research Institute

# The Insect Whisperer



Prof. Michal Segoli with the Makhtesh Gadol behind her; and with Prof. Yael Lubin in their lab

Prof. Michal Segoli of the Goldman Sonnenfeldt School of Sustainability and Climate Change focuses primarily on factors limiting or promoting insects' evolutionary success and the feasibility of harnessing them for the benefit of humankind

How many of us pause to look at the shape of an insect's body, its motion and behavior? How many of us wonder why there are so many species of insects in the world? What is the secret to their success? What can we learn from them and how can we use them to our benefit?

Prof. Michal Segoli of the Marco and Louise Mitrani Department of Desert Ecology and the Goldman Sonnenfeldt School of Sustainability and Climate Change has dedicated her career to the study of ecology, evolution, and insect behavior. She focuses primarily on factors limiting or promoting insects' evolutionary success and the feasibility of harnessing them for the benefit of humankind.

While studying for her PhD at Ben-Gurion University's Department of Life Sciences, Segoli studied parasite wasps who develop inside larvae of the potato tuber moth *(Phthorimaea operculella)*, an insect that harms potatoes. Since these wasps can be used for biological control of the moth, tens of thousands of them were released during her research in potato fields in the northern Negev to reduce the moth population and the harm to potato crops.

During her postdoc in California, Prof. Segoli expanded the scope of her research to study factors that inhibit the success of parasite wasps that attack and kill leaf cicadas harmful to grapevines. She discovered that these parasite wasps did not have sufficient food sources due to the absence of flowers in and around vineyards. She concluded that adding nectar-producing flowers to vineyards could support the wasp population and reduce the damage to the vines.

Segoli also participated in an international project headquartered in Australia and funded by the Bill & Melinda Gates Foundation, in which she explored innovative methods of controlling mosquito-transmitted diseases. The project tested an innovative protocol for releasing disease-resistant mosquitoes: Mosquitoes in the lab were infected with a bacterium that prevents the Dengue fever virus from developing in their bodies. The mosquitoes carrying the bacterium, now unable to transfer the virus, were released in high numbers in an urban environment, to the extent that they replaced the local mosquito population. The resistant mosquitoes might still be a nuisance, but they prevent the spread of this lethal virus.

Prof. Segoli continues to explore the use of insects to benefit humans in desert environments. One of her projects evaluates the possibility of improving the viability of natural enemies (predators and parasites) of insects that cause damage to crops in Negev fields, with the aim of minimizing the use of chemical pesticides and their environmental effects. In another project, Segoli examines the reasons for the propagation of a venomous spider called the brown widow – an invasive species now commonly found in Israel and around the world.

Prof. Segoli's team discovered that that this invasive species was less susceptible to parasites on her egg sacs than other, local species of widow spiders. One possible reason for this is an additional protection in the form of a thorn-like structure, which the 'spider woman' spins around its egg sac, making it more difficult for parasites to attack. Deciphering the secret of the brown widow spider and other invasive species is a crucial first step in minimizing the environmental harm they cause.

Segoli participated in an international project funded by the Bill & Melinda Gates Foundation, in which she explored innovative methods of controlling mosquito-transmitted diseases

## A Labor of Love

As a child, Michal Segoli was already passionate about the animal world. Her university studies reinforced this passion with a powerful drive to understand what could explain the enormous variety of life forms, behaviors and interactions between animals in nature, alongside the understanding that ecological research tools can help answer these questions.

"Earlier on in the research process, I developed the desire to apply those insights for the benefit of humanity by using biological methods of pest control," she says.

**Why did you choose Ben-Gurion University?**

"What brought me to Ben-Gurion University of the Negev is my love for the south of this country and mainly the Ben-Gurion Campus in Sde Boker, where I live with my family."

**Who are your role models?**

"My master's and PhD advisors, Prof. Yael Lubin, Dr. Eli Harari, and Dr. Tamar Keasar were a limitless source of inspiration and support over the years. All three are outstanding scientists in their respective fields. They taught me to invest myself totally in my research, but more than that, they taught me to invest myself fully in my relations with my colleagues, as well as other aspects of life that enrich the soul, such as family, culture, and hiking."




The late Prof. Sidney Loeb, developer of the reverse osmosis method for water desalination, is considered one of Ben-Gurion University's most eminent scientists. "His contributions take on a unique significance at a time of severe water shortages in many parts of the world and the global need to ensure regular and affordable water supplies," says Prof. Yoram Oren, former Director of the Zuckerberg Institute for Water Research

# The Father of Reverse Osmosis

When Moses struck the rock and drew out fresh water, little did he know that many years later he would have an heir. Prof. Sidney Loeb, one of the most eminent scientists on the faculty of Ben-Gurion University of the Negev, developed a reliable method to desalinate sea and brackish water using reverse osmosis – currently the leading method in quenching the pressing thirst of humanity worldwide. "Prof. Loeb's scientific and technological contributions to water desalination are a great boon not only to the State of Israel but to humanity at large," says Prof. emeritus Yoram Oren, former chair of the Department of Desalination and Water Treatment in the Zuckerberg Institute for Water Research at Sde Boker. "His contributions take on a unique significance at a time of severe water shortages in many parts of the world, and the pressing global need for regular and affordable water supplies."

In 1967, an unassuming man named Sidney Loeb arrived at Beer-Sheva as part of a UNESCO mission. He had been sent to the Negev to help find ways to supply water to the parched Negev and the young State of Israel. His mission was to last three months, during which he worked at the Negev Research Institute (which was incorporated into Ben-Gurion University of the Negev once it was founded). But, when the time came to depart, Loeb announced that he would not return to the US, because "he couldn't leave his homeland."

Loeb began his career at the University of California in Los Angeles, as a graduate student in chemical engineering. In 1959, with his colleague Srinivasa Sourirajan, he developed the prototype for the first reverse osmosis membrane, made of a very thin selective layer supported by a thick, porous layer. High pressure could be applied to the membrane to force clean water through while effectively filtering out salts and producing high volumes of desalinated water.

Their success augured a breakthrough in water desalination technology and led to the establishment of the first commercial desalination facility in Coalinga, California in 1965. The facility produced about 19 cubic meters of desalinated water a day from brackish water.

Israel's first reverse osmosis desalination facility (and the world's second) was inspired by Sidney Loeb and constructed in 1968 in Kibbutz Yotvata, not far from Eilat. The facility produced 200 cubic meters of desalinated water a day, using brackish water pumped from a local well. In the ensuing years, Sidney Loeb and other researchers developed several more generations of reverse osmosis systems.

"The development of the first commercial reverse osmosis membrane is considered the most important breakthrough of the 20th century in the field of water desalination," explains Prof. Oren. "It was the foundation of commercial scale manufacturing of reverse osmosis membranes and generating large volumes of water from desalination facilities. In essence, it ensured the current status of reverse osmosis as the most important modern technology for desalinating sea and brackish water."

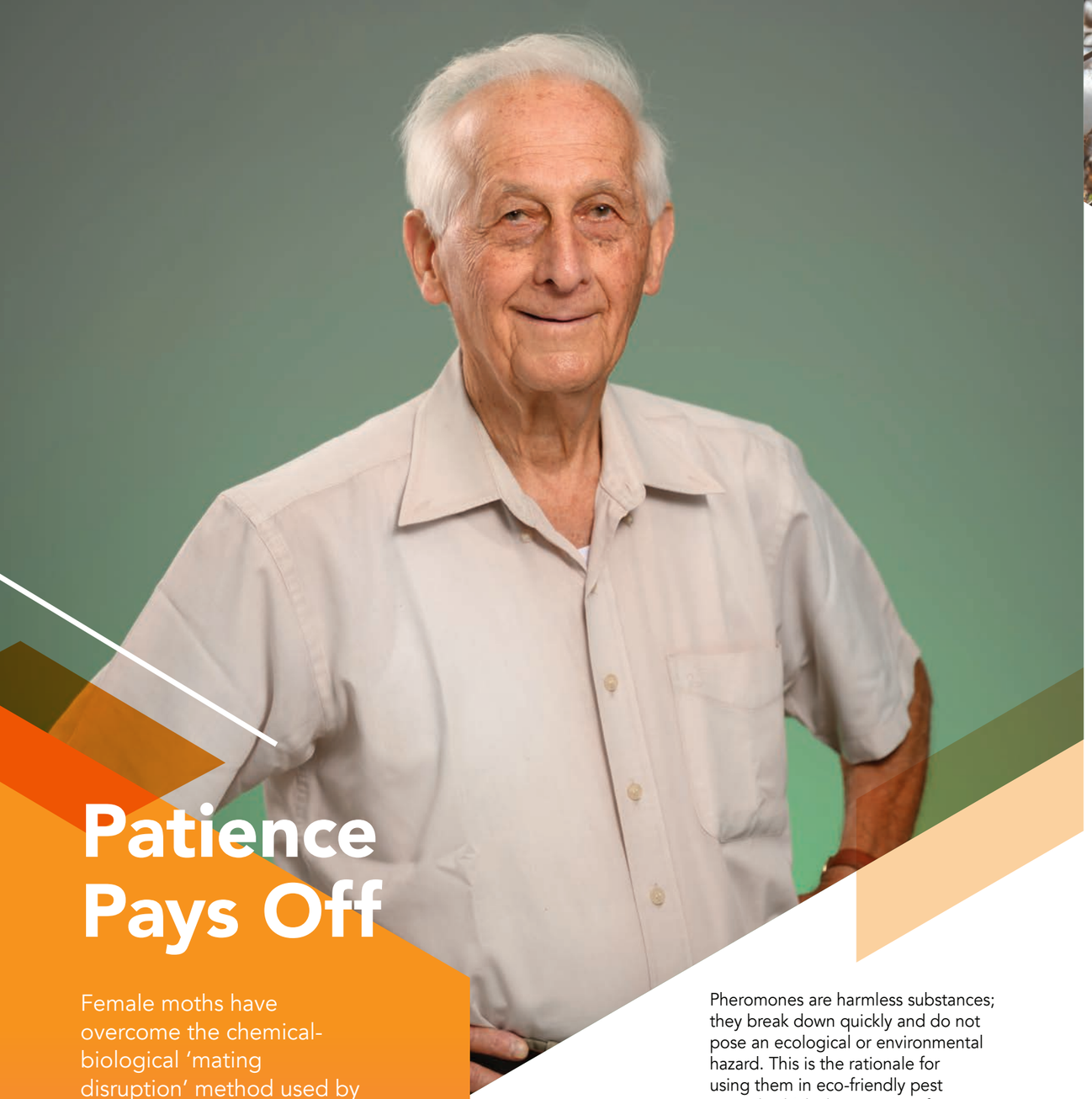
The massive reverse osmosis water desalination facilities being constructed around the world and producing water at low costs will attest to that, says Prof. Oren. In fact, more than 60% of the world's desalinated water is now produced using this technology.

In Israel there are currently five seawater desalination facilities using the reverse osmosis method: in Sorek, Ashkelon, Hadera, Palmachim and Ashdod. They supply drinking quality water and are among the largest desalination facilities in the world. Smaller reverse-osmosis facilities are used to desalinate brackish water.

Prof. Sidney Loeb was a faculty member in BGU's Department of Chemical Engineering until the age of 89. He passed away in 2008 at the age of 92. Two monuments at the Jacob Blaustein Institutes for Desert Research in Sde Boker commemorate Prof. Sidney Loeb's work: The first is the original wooden tower used in casting the membranes for the Yotvata facility. The tower was transferred from the Bergmann campus in Beer-Sheva a few years ago and placed near the Zuckerberg Institute for Water Research.

The second monument is an exhibit located in the lobby of the Zuckerberg Institute for Water Research, in which works by Prof. Sidney Loeb are displayed alongside explanations about reverse-osmosis and its development as a leading desalination process.

Israel's first experimental desalinization plant using reverse osmosis, Yotvata, late 1960s. Photographer unknown. Courtesy of Yoram Oren



# Patience Pays Off

Female moths have overcome the chemical-biological ‘mating disruption’ method used by farmers to control insect pest populations. Prof. Arnon Shani of the Department of Chemistry explains

Pheromones are harmless substances; they break down quickly and do not pose an ecological or environmental hazard. This is the rationale for using them in eco-friendly pest control, which does not interfere with biological balance and avoids poisoning harmless and even beneficial insects (such as bees). The importance of biological pest control and its contribution to minimizing environmental problems have been on the mind of Arnon Shani, a professor emeritus in the Department of Chemistry, for decades. In his research, Shani was surprised to discover that



> Some 40 years ago I hypothesized that should we use the ‘mating disruption’ method over an extended time in continguous areas, it is likely that the main population of the pest, which responds to the composition of the average pheromone, would gradually disappear

his prediction regarding human intervention in the procreation of insects – resulting in a change in their pheromone make-up – has come true after 40 years.

In a nutshell, pheromones are chemical communication agents used to deliver information among same-species individuals for the purpose of reproduction, development, and behavior. Thus, individual ants in a long convoy mark the way with the pheromones on their legs; queen bees disperse a pheromone that regulates the behavior of worker bees; a dog marks its territory with the pheromones in its urine; and female moths, which can do considerable damage to crops, spread their sex pheromone to attract males for the purpose of reproduction. These are but a few examples of the many ways that pheromones play a central role in creatures ranging from algae to the most developed mammals. And each biological species has its own unique pheromones.

The notion that animals communicate using chemicals is quite old, but it was not until the late 1950s that the first pheromone (in the domestic silk moth, or the silkworm’s) was identified, leading to a boom of research on the subject. We currently know of more than 1,000 pheromones in insects alone. The sex pheromones of insects have been studied most extensively thanks to their rapid reproduction in the lab and progress in chemical and analytical research technologies.

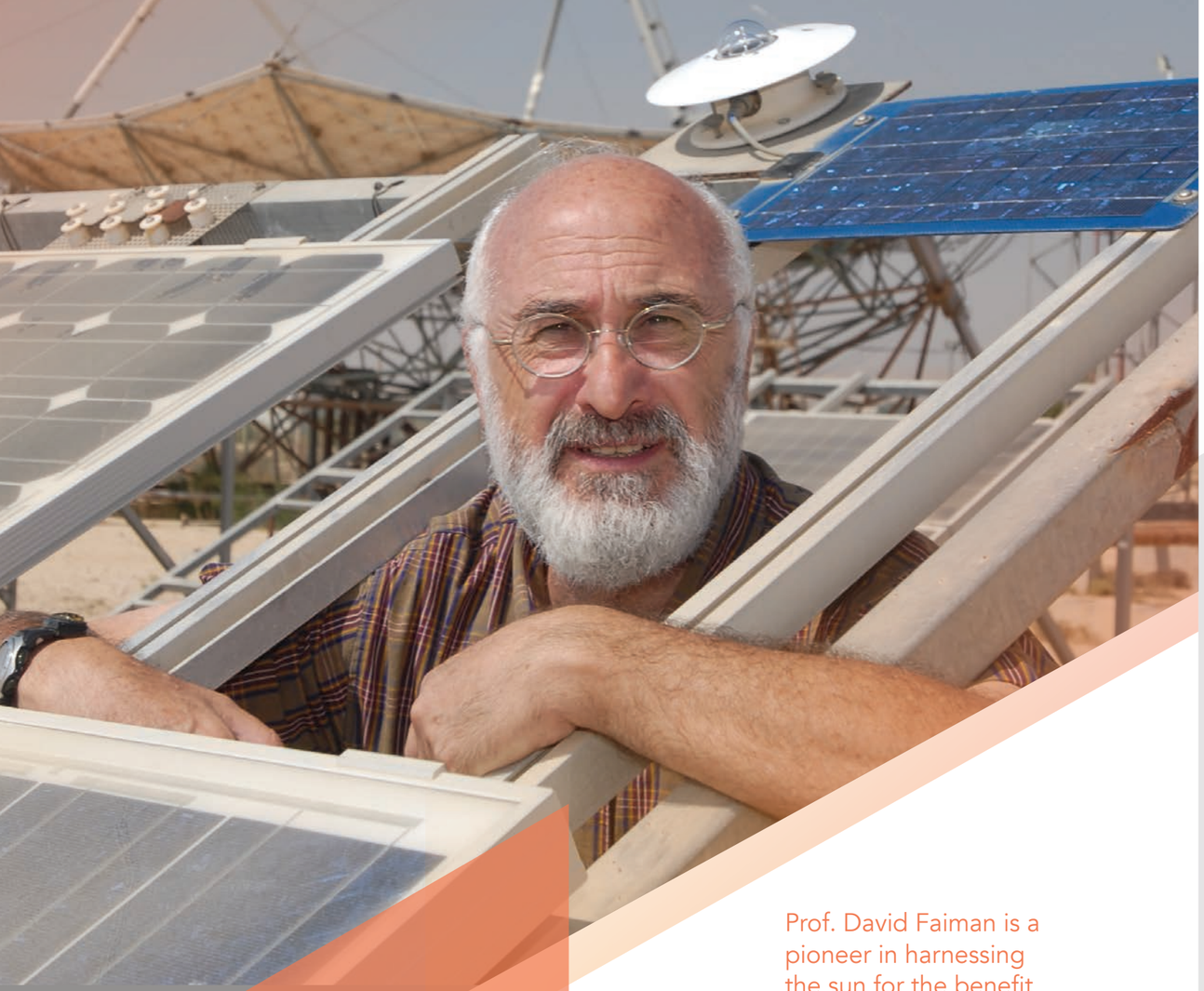
Insects’ sex pheromones are usually secreted by the females and are airborne, so as to reach the flying males of the species, who sense the pheromone with their feelers, react to it, and fly against the wind. Thus, the higher the pheromone concentration in the air, the closer the male is to the female, up until they actually meet. After mating, the female lays fertilized eggs, from which hatches the next generation of larvae.

In other words, an effective way to control pests is by interfering with their communication using ‘mating disruption.’ This entails spreading a synthetic pheromone identical to the natural pheromone using special lures that release the pheromone at a slow and steady rate, to achieve a uniform concentration in the air. When the pheromone concentration throughout a given area is even, but decidedly higher than the natural concentration of pheromones spread by females, the male is unable to find his way to the female, cannot inseminate her, and a new generation of pests cannot be born. Experts in this field have developed several methods and technologies to spread the sex pheromones of various pests and cause communication interference to control the populations of specific pests.

“Some 40 years ago I hypothesized that should we use the ‘mating disruption’ method over an extended time in continguous areas, it is likely that the main population of the pest, which responds to the composition of the average pheromone, would gradually disappear,” says Prof. Shani. “At the same time, I estimated that the outlying population whose pheromone make-up is significantly different from that of the main population, would increase.” This hypothesis was based on Prof. Shani’s lab research, which showed that the quantity and chemical make-up of sex pheromones differs among females and the same goes for its distribution in the population.

It was recently discovered that ‘mating disruption’ of the pink scavenger caterpillar that attacks cotton bolls is ineffective. “The primary reason for this is that all the cotton fields in Israel located in isolated areas have been under a regime of ‘mating disruption’ for 30 consecutive years (with 4-5 generations every year, this means at least 120 generations of pests). According to Prof. Shani, it’s clear that most of the population reacting to the average pheromone make-up was unable to overcome the ‘mating disruption,’ meaning that, no fertilization took place and no offspring who continue the original make-up were produced. They were replaced by individuals who communicate through the same pheromone with a different make-up.

Arnon Shani is a professor emeritus of chemistry, one of the first faculty members in the University and a co-founder of the Department of Chemistry. He served as Deputy Rector between 1984-1986 and later headed the Institute for Applied Research until it was merged with the Jacob Blaustein Institutes for Desert Research in Sde Boker.



# Harnessing the Sun

Prof. David Faiman is a pioneer in harnessing the sun for the benefit of humanity I Although retired, he still teaches and shares his knowledge with colleagues at the Goldman Sonnenfeldt School of Sustainability and Climate Change who follow in his footsteps

"They say: There is a land, a land drenched with sun", wrote the poet Saul Tchernichovski in 1923. And indeed, Israel – especially its south – is blessed with intense sunlight throughout all seasons and there is a significant awareness of the benefits of utilizing solar energy.



> Prof. Amos Richmond once told me that if we could use science to enable people to comfortably live in the Negev and make a good living, we'll be contributing to solving the global problem of urban over-population

Prof. emeritus David Faiman is a world-renowned expert in developing systems to produce electric and thermal energy with concentrated photovoltaic technology – a groundbreaking solar energy system. Through decades of research, Faiman and his colleagues played a major role in Israel's transformation into a global center for the development and dissemination of advanced technologies in solar energy. In 1977, Prof. Faiman founded the Solar Calculation Unit (today's Alexandre Yersin Department of Solar Energy and Environmental Physics) at the Desert Research Institute and served as its head until 1985. He was Director of the Ben-Gurion National Solar Energy Center from 1991 to 2013.

Over the course of a career that began in the mid-1970s, Prof. Faiman's research has dealt with applied aspects of solar energy – heating water for domestic and industrial use, heating buildings (both homes and public facilities) using solar energy, and particularly, using the sun to generate electricity. Faiman pioneered Israeli research and teaching on concentrated photovoltaic technology, a field he believes has the potential to solve Israel's energy crisis.

At first, the tasks and goals matched the spirit of the time. Prof. Faiman recalls: "Prof. Amos Richmond, one of the founders of the University and of the Desert Research Institute in Sde Boker, told me that if we could use science to enable people to comfortably live in the Negev and make a good living, there will be room for the many Jews who will come once the Soviet Union opens its gates. Better yet, we'll be contributing to solving the global problem of urban over-population. These were words to live by!"

"I was won over by Amos' words and so were many other young researchers in different fields. And now, add to Amos' inspiring words the glory of the biblical Zin Valley and the graves of David and Paula Ben-Gurion on the cliff above it – that really is an uplifting sight linking the past of our people with its future."

They say all beginnings are hard. Prof. Faiman and his contemporaries worked hard under difficult conditions in dilapidated shacks. Yet, the constant need to improvise equipment parts and devices to further their research never discouraged them. On the contrary, "it all just added to our enthusiasm and determination," says Faiman as his eyes light up. "Even the bumpy one-lane road from Beer-Sheva to Sde Boker, with just one bus going to Sde Boker in the morning and another returning in the evening, did not undermine the powerful feeling that what we were doing was pioneering and valuable."

These harsh conditions improved after Michael Sonnenfeldt funded the first real building on the Sde Boker campus, and also persuaded his friend Corinne Evens to contribute the funds for an impressive auditorium. Prof. Faiman's memories are still fresh in his sharp mind: "From that moment, the campus in Sde Boker began looking like a serious academic institution. As for us, we always thought of it that way, but you know, an elegant outside appearance has its value, because it encourages other kind-hearted people to build beautiful buildings."

"Michael donated the solar research building at a time when most of our research was theoretical and only a small part of it was applied. We did not expect to have any need for labs," Faiman explains. "That's why those of us working outdoors remained in the shacks and continued to use improvised equipment. We'd still be there today if not for Prof. Rivka Carmi and some very generous donors."

Prof. Faiman takes a deep breath and goes on: "Our dear friend, Gérard Worms of Paris, decided that the best place to hold a fundraiser for this cause would be the Palace of Versailles! And who do you think was the first to respond to Gérard's call to donate? Our dear friend Corinne Evens, again. That was how the dream of this building was realized."

Paradoxically, this support for research on solar energy came at a time when the world seemed to lose interest in renewable energy sources. Large reserves of natural gas had been discovered off the Israeli coastline, and the US had developed technologies to extract gas and oil through fracking. These newly discovered sources of fossil fuel may have contributed to the security of Israel and the US, but they did not solve the problem of carbon dioxide emissions into the atmosphere, the primary cause of global warming.

Academic research spans infinite subjects, but Ben-Gurion University of the Negev has chosen to redouble its efforts and investments in solar energy research, with the aim of finding viable alternatives to the fossil fuel madness. Prof. Faiman urges his colleagues at the Goldman Sonnenfeldt School of Sustainability and Climate Change: "Please remain committed to solar energy research and applications. The journey ahead may still be long, but this not so young professor promises it will be an exciting journey!"

Faiman's own journey continues. Although he officially retired more than six years ago, Prof. Faiman carries on with his research, and at one point was writing five books simultaneously. Over the course of his career, he was awarded numerous research grants from different foundations and organizations in Israel and abroad and published more than 150 articles. His scientific contributions to applied aspects of solar energy have won him the 2016 David Ben-Gurion Prize, and BGU's own Ben-Gurion Award in 2019.

# The Old man and the Sea

Ben-Gurion University of the Negev is planning an oceanic research center

Ben-Gurion University of the Negev is located about 50 kilometers inland from the shores of the Mediterranean Sea and is the only university in the country that also has an academic campus in the city of Eilat. This provides an impetus to establish an oceanic research center. The establishment of such a center is expected to attract additional students to the Goldman Sonnenfeldt School of Sustainability and Climate Change.

Contemporary oceanic research combines an environmental, sustainability and nature preservation focus with science-based applicable goals. Human activity within Israel's territorial waters – such as drilling for natural gas, aquatic farming, marine engineering, the development of marine-based drugs, desalination, and global warming – have had an anthropogenic effect that requires the urgent involvement of Israel's academic community.

This led to a resolution to establish a center for oceanic research at BGU, bringing together some 30 scientists personally and professionally committed to the preservation and rehabilitation of the marine environment. The center will operate under the auspices of the Goldman Sonnenfeldt School of Sustainability and Climate Change and collaborate with government authorities and inter-university institutes such as the Nature and Parks Authority, the Israel Oceanographic and Limnological Research Institute, the Inter-university Institute for Marine Sciences in Eilat, and the Mediterranean Sea Research Center of Israel.

The Eilat campus is home to a unique marine biotechnology BA program, which will focus in the upcoming years on the synergy between sea-tech and marine sciences, with an emphasis on the environment and sustainability. The program is offered in collaboration with the Eilot marine industries park, the Inter-university Institute for Marine Sciences and the Israel Oceanographic and Limnological Research Institute in Eilat. BGU's oceanic research center will support this program by investing in teaching and research programs and promoting the recruitment of outstanding scientists in the fields of sea-tech and the environment to the Eilat campus. At the same time, the BGU center for oceanic research will advance ongoing research activities in the Mediterranean.

Also on the agenda is pushing forward the timetable for establishing an oceanic research station in the city of Ashkelon, in collaboration with the Nature and Parks Authority and the Ashkelon Municipality. The station dovetails with the national strategy for marine environment rehabilitation and the protection of its ecological systems' health.



# Working Magic in the Desert

Dr. Nina Kamennaya, who joined BGU in 2020, works her magic in the labs of the French Associates Institute for Agriculture and Biotechnology of Drylands in Sde Boker

Dr. Nina Kamennaya was born in Siberia and fell in love with the Negev after making Aliyah to Israel. You can find her in Sde Boker, working her magic in the labs of the French Associates Institute for Agriculture and Biotechnology of Drylands within the Jacob Blaustein Institutes for Desert Research.

Dr. Kamennaya obtained all her degrees in the fields of marine ecology and microbiology from the Hebrew University of Jerusalem, under her advisor Prof. Anton Post, and divided her time between the labs in Jerusalem and the Inter-University Institute for Marine Sciences in Eilat. Her first postdoctoral fellowship was at the Lawrence Berkeley National Laboratory at the University of California, "where I engineered cyanobacteria – the only bacteria that use solar energy to produce organic materials – for biotechnological applications." She completed her second postdoc at the National Oceanography Centre in Southampton, England, where she continued researching cyanobacteria physiology and their predators.

At the end of the English chapter in her career, Dr. Kamennaya returned to Israel as a Ministry of Science fellowship winner for an independent project. During her fellowship, she developed a method of modifying cell surface characteristics, "an effective tool to study predatory and other reciprocal relations among microscopic creatures," she explains. She continues to focus primarily on cyanobacteria today as well.

She explains: "The very long evolutionary history of cyanobacteria enables them to thrive in almost any environment with light. I study how cyanobacteria deal with their environment, neighbors and predators and try to translate those research insights into applied uses.

**Why did you choose to join Ben-Gurion University?**

"My story in Israel may have begun in the north, but I feel a stronger connection to Israel's south, to the pathways between fossilized coral reefs, to the waterholes in the desert that fill up in winter, and of course to the Red Sea. The Sde Boker campus is the perfect location for ecological research on sunlight guzzlers in their natural habitat, from deserts to seasonal bodies of water, to oceans."

**Can you share an insight from your research?**

"That there is no single right way to get from point A to point B."

**A Source of inspiration?**

"Stanislav Kurilov, an oceanographer who escaped from the Soviet Union by jumping overboard from a cruise ship and swimming in the ocean for three days, until he reached the Philippines. After coming to Israel, he worked at the Israel Oceanographic and Limnological Research Institute in Haifa."

BGU (Aleph Bet Gimmel) is Ben-Gurion University of the Negev's main Hebrew language magazine.

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