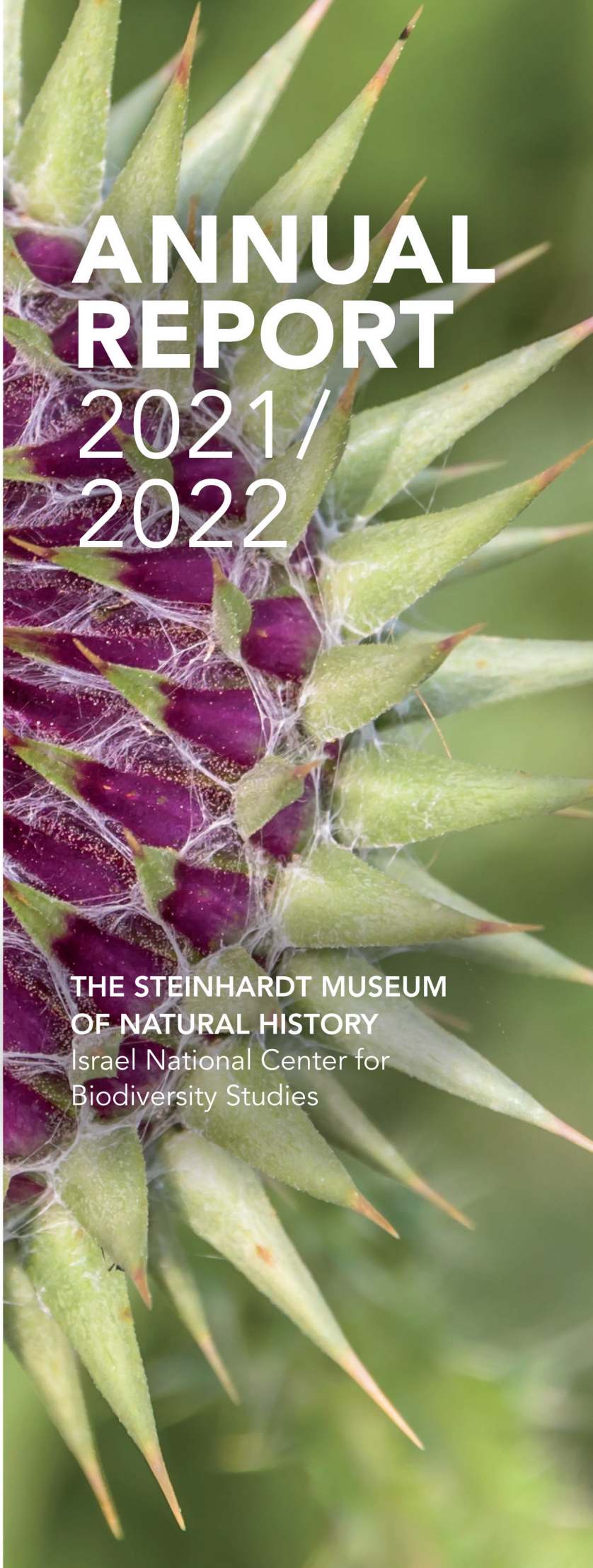
TEL AVIV UNIVERSITY
אוניברסיטת תל אביב

THE STEINHARDT museum of natural history

המוזיאן לתולדות הטבע ע"ש שטיינהרדט

متحف شتاينهارت للتاريخ الطبيعي

ANNUAL REPORT 2021/2022



THE STEINHARDT MUSEUM OF NATURAL HISTORY
Israel National Center for Biodiversity Studies

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החברה הממשלתית לתיירות

ציוני דרך

THE STEINHARDT
museum of natural history
ISRAEL NATIONAL CENTER
FOR BIODIVERSITY STUDIES

Annual Report
Academic year 2021/2022

The George S. Wise Faculty of Life Sciences, Tel Aviv University
- School of Zoology
- School of Plant Sciences and Food Security

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- The Sonia and Marco Nadler Institute of Archaeology
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TABLE OF CONTENTS

The Steinhardt Museum of Natural History Organizational Structure

Public, Education & Operations

Sections

Marketing & strategy

Operations & Exhibitions

Education & Science Communication

Special Projects

Israel Center for Citizen Science

Environmental News

Sustainable Nutrition Project

Kalanit – Israel Plant Magazine

Collections & Research

Sections

Aquatic, including Marine Biodiversity Center

Entomology

Terrestrial Vertebrates

Herbarium

Paleobiology

Dan David Center for Human Evolution & Biohistory Research

Joint Infrastructures

Molecular Systematics Laboratory

Frozen tissue collection

Paleogenomics Laboratory

eDNA Laboratory (under development)

Labs for sorting and absorbing new specimens

Taxidermy Laboratory

Academic Courses & Training

Israel Taxonomy Initiative

Applied Policy-Relevant Research

Centers

Open Landscape Institute

National Center for Aquatic Ecology

HaMaarag – Israel National Ecosystem Assessment Program

Taxonomic Support

The Entomological Laboratory for Applied Ecology

Plant Protection Taxonomic Support

The Feather Laboratory

Biodiversity Monitoring Support

Special Projects

Center for Ecological Restoration & Nature Based Solutions

Compassionate Conservation Middle East

The Steinhardt Museum of Natural History

Israel National Center for Biodiversity Studies

TEL AVIV UNIVERSITY אוניברסיטת תל אביב

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Yonatan Gur — Database Manager.

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- Oz Rittner — Collections Manager (moths and butterflies)
- Ofir Tomer — Collections Manager (moths and butterflies)
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- Dr Elizabeth (Liz) Morgulis — Collections Manager (flies)
- Dr Moshe Guershon — Collections Manager (bees) and Staff Director for Entomology
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- Prof. Zoya Yefremova — Collections Manager (parasitic wasps)
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- Noah Michaeli — Technical Assistant
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- Dr Binyamin Shalmon — Volunteer
- Amir Weinstein — Volunteer
- Tirza Stern — Volunteer
- Nizan Bibas — Volunteer

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- Prof. Noa Shenkar — Curator (ascidians)
- Prof. Micha Ilan — Curator (sponges)
- Prof. Frida Ben-Ami — Curator (molluscs)
- Dr Omri Bronstein — Curator (echinoderms)
- Dr Zafrir Kuplik — Curator (Coelentherata)
- Dr Stanislav Pen-Mouratov — Curator (nematodes)
- Prof. Joseph (Yossi) Loya — Curator Emeritus (stony corals)
- Prof. Yehuda Benayahu — Curator Emeritus (soft corals)
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- Oz Rittner — Collections Manager (molluscs)
- Dr Sigal Shefer — Collections Manager (sponges)
- Dr Liron Goren — Collection Manager (worms and crustaceans)
- Dr Lion Novak — Collections Manager (ascidians)
- Dr Noga Sokolover — Collection Manager (bryozoans and echinoderms)
- Tom Morav — Technical Assistant (sponges)
- Nathan Sharon — Volunteer
- Ronit Vilker Alhadef — Volunteer

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- Prof. Roi Holzman — Curator
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- Assaf Nashiv — Technical Assistant
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- Dr Karin Tamar — Curator (mammals, reptiles and amphibians)
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- Moshe Geizler — Volunteer
- Mira Ideles — Volunteer
- Avraham (Rami) Biran — Volunteer
- David Kobiler — Volunteer
- Matan Hayun — Volunteer
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- Yonatan Gur — Collections Manager (fungi)
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- Dr Irit Zohar — Curator (fish osteology)
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- Yaron Pirody — Technical Assistant
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- Dr Yehezkel Resheff — The Hebrew University of Jerusalem
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- Prof. Assaf Shwartz — Technion–Israel Institute of Technology
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- Dr Menachem Goren — Director
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- Dr Noga Sokolover — Coordinator

Scientific Committee:

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- Dr Menachem Goren — Steinhardt Museum of Natural History
- Prof. Moshe Inbar — University of Haifa
- Dr Netta Dorchin — Steinhardt Museum of Natural History
- Dr Oren Shelef — Volcani Institute, Agricultural Research Organization
- Dr Tamar Guy-Haim — Israel Oceanographic and Limnological Research Institute
- Dr Yael Mandelik — The Hebrew University of Jerusalem
- Dr Jotham Ziffer-Berger — Steinhardt Museum of Natural History & Academic College Levinsky-Wingate

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Applied research institutes/laboratories/programs operating in the Division have each their own steering committees or boards of directors and academic/professional oversight.

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- Amir Erez — Ministry of Environmental Protection
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- Dr Asaf Tsoar — Israel Nature and Parks Authority (starting Feb 2022)
- Dr Yehonathan Bar-Yosef — Keren Kayemeth LeIsrael — Jewish National Fund
- Dr Doron Markel — Keren Kayemeth LeIsrael — Jewish National Fund
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- Prof. Tamar Dayan — Tel Aviv University
- Hanoch Ilssar — The Rothschild Foundation

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- Dr Yaron Hershkovitz — Director
- Tuvia Eshcoly — Lab manager

- Noa Zanzuri — Administrative Manager
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- Avital Katz — Database management
- Etai Kahana — Dipteran taxonomy and GIS
- Adi Weiss — Taxonomy and Reports
- Dafna Luz — Coordinator of the Yarqon watershed bioassessment project and molecular taxonomy
- Almog Hershko-Pnuel — Coordinator of the Western Galilee watershed bioassessment project
- Nili Segman — Coordinator of the wastewater bioassessment project and molecular taxonomy

The Entomological Laboratory for Applied Ecology

Academic Committee:

- Dr Menachem Goren — Tel Aviv University
- Dr Inon Scharf — Tel Aviv University

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- Dr Ittai Renan — Director
- Gilad Ben Zvi — Lab Manager
- Dr Orr Comay — Red List Coordinator
- Dr Udi Segev — Red List Coordinator
- Ariel Aharonberg — Technician
- Ahikam Gera — Technician
- Yael Miara — Technician
- Itai Namir — Technician
- Adi Ramot — Technician
- Ella Fishman — MSc Student
- Carmel Herold-Lozover — MSc Student

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HaMaarag Board of Directors:

- Prof. Tamar Dayan — Tel Aviv University
- Dr Yehoshua Shkedy — Israel Nature and Parks Authority
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- Dr Gilad Ostrovsky — Keren Kayemeth LeIsrael — Jewish National Fund

Steering Committee of the State of Nature Report:

- Prof. Tamar Dayan — Tel Aviv University
- Dr Anna Trajtenbrot — Ministry of Environmental Protection
- Dotan Rotem — Israel Nature and Parks Authority
- Yahel Porat — Keren Kayemeth LeIsrael — Jewish National Fund

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The Open Landscape Institute

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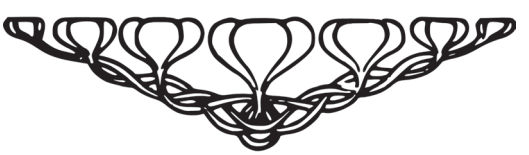

PROGRESS AT THE STEINHARDT MUSEUM OF NATURAL HISTORY

Tamar Dayan and Alon Sapan

This is the 20th Annual Report, of what started out as the National Collections of Natural History and has evolved into the Steinhardt Museum of Natural History, Israel National Center for Biodiversity Studies.

During this year we continued to work hard to develop the museum with all its sections and capacities. The most pivotal event of this year was Tel Aviv University's decision to grant academic status to the museum. To date, our Curators all belonged to other Faculties—Humanities, Life Sciences, and Medicine—but as the museum evolved to fulfill its designated role of Israel's National Museum of Natural History, its scientific development became increasingly crucial. The importance of this step cannot be overemphasized.

In this academic year, we hired our first joint faculty member with the Faculty of Social Sciences and three Curators on Tel Aviv University's academic researcher track, and set out for a search for two joint appointments with the School of Zoology. This is the first of a five-year scientific development plan that will set the museum on track to become a proper national research infrastructure.

During this year, we established the Steinhardt Museum's Marine Biodiversity Center, to leverage the museum's unique assets in this field—world class museum collections, an excellent team of marine biologists, many of whom are taxonomists, and the museum's abilities in communicating science to the public using diverse tools.

We also established a precursor for the Israel Center for Citizen Science to promote the development of this field in Israel, as a link between science and society. Citizen science involves engaging the public in scientific exploration, thus empowering it and contributing to scientific education, and concurrently to the production of big biodiversity data for research and monitoring.

This year museum visitation and educational activities were still partly under restrictions related to the Covid pandemic, but a temporary exhibition on the climate crisis drew many visitors, and things were looking up compared with the previous year. We hope that the next year heralds even better news.

COLLECTIONS NEWS

The staff members of the Steinhardt Museum of Natural History (SMNH) continued curation and promotion of our collections. Routine curatorial activities continued to be adversely affected to some extent by the Covid-19 pandemic during the 2021—2022. Nevertheless, much effort was dedicated to curation of the collections and to compliance with best curatorial practices. We continued to collect and preserve new scientific material, rescue and incorporate important private and institutional collections, maintain the existing holdings, send scientific material and data nationwide and abroad, and assist graduate students, academic courses and educational activities.

Since December 2021, the SMNH staff were involved in a joint Pest Risk Assessment project with the Plant Protection and Inspection Services, coordinated by Dr Zohar Yanai.

During the 2021—2022 academic year, we added over 19,000 new specimens of various taxonomic groups through collecting by our curators and research staff, students and the Israel Nature and Parks Authority, or through donation from private collectors.

During 2021—2022, we completed data migration for most of our active collections, including the insect collection that presently holds roughly two-thirds of the records in our database, to a new system based on the SQL Server solution. Over 40,000 new records were added to the database during this year. The SMNH database has been made available to the public on the Museum Website (https://smnh.tau.ac.il/en/research/collections-database) and is to be updated annually.

THE ENTOMOLOGY SECTION (INCLUDING ARACHNIDS)

Netta Dorchin, Inon Scharf, Gal Ribak, Sergei Zonstein, Tania Novoselsky, Malkie Spodek, Vladimir Chikatunov, David Furth, Arieh-Leib-Leonid Friedman, Oz Rittner, Ofir Tomer, Elizabeth (Liz) Morgulis, Mike Mostovski, Moshe Guershon, Zoya Yefremova, Wolf Kuslitzky, Gideon Pisanty, Armin Ionescu, Dany Simon, Tirza Stern, Avi Keysary, Binyamin Shalmon, Amir Weinstein, David Saar, Noah Michaeli, Nizan Bibas

Research and curation

The entomological collections was fully functional in the new facilities, with constant optimization as an ongoing process co-ordinated by Moshe Guershon assisted by the collections managers. The staff continued expansion of the collection through field work, their collection-based research and provision of services to government agencies, academia and general public. The Museum received US$20,000 as a private donation from Dr D. Furth to purchase 400 new entomological drawers. The Furth Systematic Entomology Fund covered Ella Fishman's attendance at the International Firefly Symposium 2022 in Portugal and Laibale Friedman's fieldwork in Uzbekistan. Our entomologists participated (online) in the Entomological Collections Management Workshop at Arizona State University, facilitated by Dr D. Furth.

Arachnida

S. Zonstein continued day-to-day curation of the arachnid collection and his active research into mygalomorph spiders. Many arachnid groups beside spiders remain to be unsplitted to the genus/species level. The collection of spiders (Araneae) was completely reordered, as planned, and can be summarized as follows:

- The total number of jars, 800 (newly added 120);
- The number of spider species in the SMNH collection (without loans), ca. 1100;
- The number of spider species from Israel — 630 (80% of spider diversity in the country);
- The number of spider species from other regions, mostly Western Europe, Central Asia, South-East Asia, sub-Saharan Africa — 480.

Sergei continued his research into Palaearctic and Afrotropical spiders. A new species *Brachythele rhodopensis* Dimitrov & Zonstein, 2022 was described from Rhodope Mountains, Bulgaria. The spider genus *Sahastata* Benoit was recorded in Israel for the first time, and a new species

Sahastata aravaensis Ganem, Magalhaes, Zonstein & Gavish-Regev, 2022 was described from Arava Valley. A new genus *Sceliraptor* Zonstein & Marusik, 2022 (representing the subfamily Chediminae) and two new species, *Sceliraptor jaegeri* and *Sceliraptor murphyorum*, were described from Kenya. An African genus *Ikuma* Lawrence, 1938 and its type species were redescribed, and a new species *Ikuma larseni* Zonstein & Marusik, 2022 was described from Namibia.

Orthoptera

M. Guershon continued identification of unsorted material of the Caelifera using the keys edited in the previous year and reorganized the Caelifera collection at the genus level.

Mantodea

D. Simon and A. Weinstein continued routine curation of the Mantodea collection and devoted much of their effort toward completion of their monographic study of praying mantises of Israel and neighbouring regions.

Hemiptera

T. Novoselsky received 16 unit trays of newly collected material, most of which she identified to the genus level and proceeded to the species-level identification and incorporation of the specimens into the collection. She also continued to sort alcohol-preserved samples; the material included some species new to science and/or to the Israeli fauna. She sorted and databased 7889 specimens of the family Pentatomidae (stink bugs), compiled a full list of the stink bug species represented in our collection, and updated the Pentatomidae collection. Tania continued working on final drafts and proofs of her manuscript on the Scutelleridae and Acanthosomatidae. During the project coordinated by Dr Zohar Yanai, as a service to the Ministry of Agriculture, Tania summarized and provided information on 59 hemipteran pests affecting 15 different crops. During the reporting period, 19 people used the Hemiptera collection through visits, loans, data requests etc. Tania continued collaborative research with Dr Jing-Fu Tsai, Hokkaido University, Japan, on the taxonomy of the *Elasmucha grisea* complex (Acanthosomatidae); Dr Pavel V. Putshkov, I.I. Schmalhausen Institute of Zoology, Ukrainian Academy of Sciences, on the classification and biology of Assassin bugs in Israel; and with Dr Nico Nieser and Dr P. (Ping-ping) Chen, Naturalis Biodiversity Centre, Leiden, The Netherlands, on a very important project of revising the collection of the Israeli Museum of the Waterbug. Tania was also interviewed by the Israel media about the Brown marmorated stink bug in Israel.

Coleoptera

Gal Ribak and his group focused their research on flight of Coleoptera, Lepidoptera and Thysanoptera, including collaborations with Prof. Roi Gurka (Carolina University, SC, USA) and Dr Bat-El Pinchasik (Mechanical Engineering, Tel Aviv University) on the aerodynamic and mechanical properties of various beetle wings.

L. Friedman continued routine curation of the Coleoptera collection. About 5,000 insects from Israel, Europe, Africa, America and Central Asia were mounted, databased and labelled. Numerous field trips and excursions yielded interesting findings. The rare and enigmatic weevil *Trichocaulus longipilis* was found after 25 years of collecting efforts and its host plant was finally determined; around twenty specimens of this beetle were procured in addition to the four collected since 1946. A series of the rare afrotropical *Acacia*-dwelling weevil *Camptorrhinus erectisquamis* was collected in the Northern Arava. A second species of the water leaf-beetle *Donacia*, that had been last found more than 120 years ago, was occasionally discovered in the Dora Pool, a small pond inside a municipal park in the southern part of Netanya. A field trip to Southern Uzbekistan brought some 2,000 specimens of insects, predominantly weevils and leaf-beetles, most of them new to the SMNH collection. Among the highlights are Apionidae, Nanophyidae and Entiminae from *Tamarix*, *Alcidodes karelinii* from *Convolvulus arvensis*, several species of *Metapion* (Apionidae) from *Haplophyllum*, *Curculio* sp. from *Salix*, probably not recorded previously from Uzbekistan.

V. Chikatunov assisted with identification of beetles, mainly darkling beetles (Tenebrionidae), and with curation of the SMNH beetle collection, and continued updating his catalogue of Israeli Coleoptera.

Lepidoptera

Ofir Tomer and Oz Rittner continued routine curation of the Rhopalocera (butterflies) and Heterocera (moths) collections, respectively. Ofir Tomer works once a week and concentrates mainly on computerizing the collection and identification of butterflies. Until recently, the Rhopalocera collection was fairly heterogenous and composed of several collections. These are now going through the process of integration, specimens are being identified and databased, and the main goal is to create a single systematically ordered collection.

Diptera

N. Dorchin concentrated her ongoing studies on the taxonomy and systematics of gall-midges from Israel, South Africa and Europe; these projects include descriptions of new species, morphological and molecular analyses of specific genera and phylogenetic analyses. She also closely supervised several other projects: Continuous monitoring of the establishment of the seed-feeding beetle *Melanterius castaneus* as a biological control agent against *Acacia saligna* in Israel, following its release in Israel in the spring of 2021; The effect of photosynthetic pathways in host plants on diet breadth of gall midges (supported by a 4-year grant from the ISF; MSc students, Yael Kenigsberg and Oriel Fischer); The taxonomy and life history of fireflies in Israel (Lampyridae) and the possible effect of light pollution on their populations (MSc student, Ella Fishman); The taxonomy and ecology of the Hydropsychidae (Trichoptera) of Israel (MSc student, Almog Hershko-Pnuel; in collaboration with Yaron Hershcovitz, the Israeli Center for Aquatic Ecology); The ecology and behavior of the little fire ant, *Wasmannia auropunctata* in Israel (supported by a 3-year grant from the Ministry of Science, in collaboration with Prof. Abraham Hefetz; PhD student, Carmel Herold-Lozover). As a result of the ongoing projects, the collections grew by hundreds of microscope slides of gall midges from Israel, Europe and South Africa, hundreds of ethanol-preserved and pinned gall-midge specimens, and hundreds of Trichoptera specimens, mostly from the northern part of Israel. Netta actively collaborated with researches from Israel and overseas: Zvi Mendel, Agricultural Research Organization, Bet Dagan, Israel; Jonathan Colville, SANBI, Cape Town, South Africa; Cornelia Klak, University of Cape Town, South Africa; Rauri Bowie, University of Berkeley, CA, USA; Yaron Hershkovitz, Israel National Center of Aquatic Ecology, SMNH, Tel Aviv University; Abraham Hefetz, School of Zoology, Tel Aviv University; Omri Bronstein, School of Zoology, Tel Aviv University; Tommi Nieman, Norwegian Institute of Bioeconomy Research, Svanhovd Research Station, Norway; and Hans-Henrik Bruun, University of Copenhagen, Denmark. Netta taught the following courses for students of the Faculty of Life Sciences, Tel Aviv University: *World of Insects* (graduate and undergraduate) and *Research Skills* (graduate). She was also a member of the Flora and Fauna Committee of the National Academy of Sciences (Israel), Advisory Board of the Leibniz-Institute for the Analysis of Biodiversity, Bonn and Hamburg, Germany, the Council of the International Congresses of Dipterology, and served as President for the Entomological Society of Israel.

Asiodiplosis largifica, a new species of gall midges developing in saltworts in Israel. (From Dorchin, Shachar *et al*. 2021)

E. Morgulis continued rearranging the Acalyptratae collection, both alphabetically and phylogenetically, and added data (taxonomy, type status, etc.) on several thousands of specimens at the database. She also started working with the Calyptratae and Schizophora groups, mostly by adding the material to the database. Liz received hundreds of specimens, which had been sent as a loan for identification, and handled this material, including proper placement and listing of types, and updating the database. She also sent Diptera material on loan to specialists abroad. Liz traced

the type series (including the holotype) of *Dziriblatta galilaeana* (Bei-Beienko) (Blattodea), which belongs to the SMNH, but was left at the Zoological Institute of Russian Academy of Sciences, and arrange for it to be brought back to the museum. During this year, Liz also participated in a project of the Plant Protection and Inspection Services, where she summarized data on agricultural pests of several crops.

Hymenoptera

Hymenoptera Apocrita (G. Pisanty): Gidi continued his work on Levantine bees of the genus *Andrena*. Based on new material that he collected throughout Israel, generous specimen barcoding and comparison with reference material, he co-authored a monograph describing 25 species new to science and listing another 15 species as new to Israel. All unsorted bees (1 cabinet) were sorted to the family level and moved to their respective cabinets. About 1040 specimens were databased (3109 specimens collected during the reporting year excluded): 420 bees (mostly *Andrena*) and 620 parasitoid wasps of the family Braconidae. Gidi continued the collaboration with his colleagues from the Canadian National Collection, Ottawa, Canada, in an effort to barcode the Israeli fauna of the solitary bee genus *Andrena* (Dr Sophie Cardinal) and the parasitoid wasp subfamily Microgastrinae (Dr Jose Fernandez-Triana); and with Thomas J. Wood from Mons University, Belgium, to identify *Andrena* specimens from Israel and neighbouring countries, and to describe new species and subgenera. Gidi presented an invited talk *The mining bee family (Andrenidae): Phylogeny, taxonomy, diversification and biogeography* at the monthly webinar series *BeeBST — Bee Biogeography and Systematics Talks*, York University, Canada, on 29 June 2022.

Parasitic Hymenoptera (W. Kuslitzky): During the reporting period, collections were carried out mainly by breeding under laboratory conditions: (1) from phytophagous insects of some species of Poaceae to identify their parasitoid complex; (2) from the seeds of *Acacia saligna* to reveal the role of *Stator limbatus* (Coleoptera: Chrysomelidae: Bruchinae) in the destruction of seeds under natural conditions. The material was placed in cages, which maintained a higher humidity than indoors. Taking into account the presence of summer diapause in the inhabitants of Poaceae, the plant material was preserved for one year or more. A large number of insects hatched from plant material collected in the previous year. An attempt was made to bring insects out of diapause, so some stems were placed in a household refrigerator for one month but no changes were observed in the dynamics of the insect emergence. About 1500 insect specimens were collected from nature and bred from various hosts, labelled and entered into the SMNH database; in addition, about 300 specimens of Ichneumonidae were received from colleagues. A new species of Ichneumonidae (Tryphoninae) was identified and described in collaboration with Dr D. Kasparyan (Zoological Institute, Russian Academy of Sciences).

Parasitic Hymenoptera (Z. Yefremova): New material of the Eulophidae, Encyrtidae, Pteromalidae collected in Mali was sorted and put away for storage in the wet collection. Oak parasitoids and material reared from the Cecidomyiidae (Diptera) were being identified. Zoya's research focused on the thelytokous strain of the parasitoid *Neochrysocharis formosa*, which was shown to be outperforming the arrhenotokous strain in its reproductive capacity and biological control of agromyzid leafminers. Kenyan representatives of the genera *Euplectrus*, *Euplectromorpha* and *Platyplectrus* (Hymenoptera: Eulophidae) were revised and descriptions of new species were prepared as a draft manuscript. The genus *Kolopterna* (Hymenoptera: Eulophidae) associated with the Cecidomyiidae (Diptera) was reviewed and new species were identified and described. Zoya continued her collaboration with Dr Robert Copeland (International Centre of Insect Physiology and Ecology, Nairobi, Kenya); US National Museum of Natural History, Smithsonian Institution, Washington, USA; Prof. George Japoshvili (Institute of Entomology, Agricultural University of Georgia, Tbilisi, Georgia); Natalie Dale-Skey (Natural History Museum, London, UK); and Museum für Naturkunde, Berlin, Germany.

An euplectrine parasitoid wasp with a greatly swollen scape.

Other insect orders

Avi Keysary curated and databased some 3000 specimens of Isoptera, Embioptera, Psocoptera, Thysanura, Mallophaga, Hemiptera Lygaeidae, Coleoptera, Lepidoptera, Hymenoptera Formicidae and Orthoptera. Most of these specimens had been collected during 1930—1950.

Identification Services

Over 1,400 specimens were identified by the Entomology staff for government, academic and private organizations. Full details of identifications done for the Plant Protection and Inspection Services, Ministry of Agriculture, Israel, were entered into the Museum database and voucher specimens were retained in the collection for future reference.

- Arachnida: S. Zonstein identified 4 specimens for the Plant Protection and Inspection Services, Ministry of Agriculture, Israel.
- Coleoptera: L. Friedman provided ca. 50 identifications, mainly of beetles, for Plant Protection and Inspection Services, Ministry of Agriculture, Israel, Ministry of Agriculture, and ca. 50 for private persons in Israel and throughout the world (part of them via social media and part on the direct request), for his colleagues from the Ben Gurion University of the Negev (Dr E. Groner, Dr Yaron Ziv) and for the museum staff from the Entomology Lab for Applied Ecology, Israel National Center for Aquatic Ecology, etc. Ca. 1,000 beetles of different families collected on the top of Mt Meron in 2021—2022 by Meir Finkel and his students, under the supervision of Gilad Ben-Zvi (the Entomology Lab for Applied Ecology), were sorted and identified, at least half of them to the species level.
- Diptera: E. Morgulis assisted Yehonatan Halevi (Dr Yael Mandelik's Lab, The Robert H Smith Faculty of Agriculture, Food and Environment, Hebrew University of Jerusalem) in the identification of Diptera collected during his project.
- Hymenoptera (Parasitica): Z. Yefremova identified about 300 specimens for Plant Protection and Inspection Services, Ministry of Agriculture, Israel.
- Hymenoptera (Parasitica): W. Kuslitzky identified 3 species for Prof. M. Segoli (Ben Gurion University of the Negev) and 1 species for Plant Protection and Inspection Services, Ministry of Agriculture, Israel.

Collecting trips and expeditions

Our Natural History Collections actively grow through donations, research projects, and collecting trips and expeditions. Many research projects added numerous specimens to our collections, while other collections benefited from focused collecting trips. Our scientists often go on joint field trips. The entomology staff added about 10,000 specimens to the collection during the reporting period, excluding those in Malaise trap bulk samples that still need to be processed.

N. Dorchin went on multiple field trips to the Jordan Valley, Negev and 'Arava, mostly during winter and spring together with students and SMNH collection managers. In June 2022, she collected gall midges on various plants in Denmark; in August 2022 she collected gall midges on Chenopodiaceae and Aizoaceae in South Africa and *Salix* spp. in northern Norway.

S. Zonstein went on a trip to the mountains of Southern Uzbekistan on 9—18.05.2022, together with L. Friedman. The following ranges were surveyed: Babatag Mts, Kugitang (Kouhitang, Köýtendag) Mts and Zeravshan Mts (Kitab Nature Reserve and Aman-Kutan Pass), and collecting was also made in the valleys of Syr Darya and Sherabad Darya rivers.

T. Novoselsky conducted extensive fieldwork, which yielded 503 specimens from 'Arava Valley, Central Coastal Plain, Central Negev, Dead Sea Area, Golan Heights, Hula and Korazim Block, Judean Desert, Judean Foothills, Judean Hills, Karmel Ridge, Mt Hermon, Northern Coastal Plain, Kinneret area, Southern Coastal Plain, Southern Negev, Upper Galilee Hills and Yizre'el (Jezreel) Valley.

L. Friedman undertook 27 collecting trips throughout Israel, which yielded approximately 3,000 insect specimens, predominantly beetles (mostly weevils). Five trips were carried out jointly: five trips to the Arava Valley, Central and Southern Negev, two or tree days each, together with N. Dorchin, her students and S. Zonstein; two one-day trips with S. Zonstein to the Judean Mountains and Northern Negev; the one-day ecological camp by INPA in the Hadom Shomeron Nature Reserve, with M. Gershon and G. Pisanty. Nine trips were private family travels, on the private

Hundreds of insects collected in Uzbekistan in 2022 entered the Entomology Collection of the Museum. (Photo: L. Friedman)

expenses, while part of the time was dedicated to the entomological investigations. The rest were half-day or day trips, mainly to the wetlands of the Coastal Plain and the Galilee. Five trips were dedicated to the Jordan Valley, particularly to its central part (Nahal Tirza spill and Wadi Ahmar saline). L. Friedman joined S. Zonstein on a trip to Southern Uzbekistan on 9—18.05.2022, surveying the mountain ranges of Babatag, Kugitang (Kouhitang, Köýtendag) and Zeravshan (Kitab Nature Reserve and Aman-Kutan Pass), and the valleys of the Syr Darya and Sherabad Darya rivers, resulting in 2,000 specimens of insects, mainly weevils and leaf-beetles, most of them new to the SMNH collection.

D. Furth continued in March 2022 his fieldwork associated with a long-standing project at Kibbutz Dan (Bet Ussishkin) about the rediscovery of *Donacia simplex* (Coleoptera: Chrysomelidae: Donaciinae). In April 2022, David collected, together with L. Friedman, a species of semi-aquatic leaf-beetle *Donacia* (Chrysomelidae) in a small pond in a municipal park in the southern part of Netanya; this species had not been recorded in Israel since 1918.

W. Kuslitzky collected infested *Acacia saligna* seeds and Poaceae at Palmahim (19.06, 15.07, 27.08, 26.09.2022; each collection event brought at least 4,000 seeds); in the vicinity of Rehovot, Rishon LeZion and Akko, and on the slopes of the Ayalon River (irregular visits with 300—1,000 seeds on each collection event); Nahshon Junction (Zelafon) (31.01, 21.04, 9.05, 15.06.2022) and the vicinity of Rehovot (6 samples of Poaceae: *Hordeum bulbosum* (L.), *H.* sp. (? *spontaneum* (Koch)), *Avena* sp. (? *sterilis* L.). General collecting was done with a net at Mishmar Dawid. Overall, ca. 1,500 insect specimens were collected from nature and bred from various hosts, labelled and entered into the SMNH database.

G. Pisanty collected 3109 specimens (mostly Hymenoptera) during his 14 field trips to Republic of Georgia (17—30.08.2021), HaSharon (28.03.2022), Judean Foothills (3.04.2022), Mount Hermon (16 & 29.04.2022, 19.05.2022), Golan Heights (28.02 & 1.03.2022), Negev and Arava Valley (13—15.02.2022), Northern Negev (18.02, 2.03 & 19.03.2022), Lower Galilee (6.04.2022), Upper Galilee (14.10.2021).

Outreach

The Hebrew version of the popular science book *Insects Did It First* by G.S. Paulson and E.R. Eaton was published in 2022 as a joint project of Carmel Publishing and SMNH. The book showcases various 'inventions and technologies' in the insect world and compares them to commonly known features in the human world. The book contributes to public education and familiarity with entomology, thus popularizing empathy for insects. This project was assisted by the following SMNH experts: Dr Gilad Ben-Zvi, Dr Achik Dorchin, Prof. Netta Dorchin, Leonid Friedman, Almog Hershko-Pnuel, Ella Fishman, Dr Yonatan Mersman, Dr Liz Morgulis, Oz Rittner, Dr Yuval Sapir and Dr Dany Simon. Scientific editing of the Hebrew version was done by Dr Zohar Yanai, who verified the accuracy of the translation and suggested some additions based on the Israeli entomofauna.

The book is available from the publisher: www.carmelph.co.il/product/insects-did-it-first.

THE INSECTARIUM

Elizabeth (Liz) Morgulis

At the insectarium, we continued to rear the species listed in the Annual Report of 2017—2018 (p. 24; http://doi.org/10.5281/zenodo.2589132) and maintain the live insect display at the SMNH.

THE MARINE & FRESHWATER SECTION

THE PORIFERA COLLECTION

Sigal Shefer

Collection and field survey of Porifera communities along the Mediterranean coast of Israel, and other locations

This year 191 samples were collected. Of them, 73 specimens were collected during excursions to the mesophotic sponge grounds located at depth of 80—100 m off the Mediterranean coast of Israel and all of them were added to the collection. These specimens were collected as part of studies conducted at Prof. Ilan's Lab. From depth down to 30 m, 68 specimens were collected, most of them as part of studies conducted at Prof. Ilan's Lab in the Mediterranean Sea and one from Eilat. The rest of the specimens were received from Dr Stern Nir of the Israel Oceanographic and Limnological Research Institute (8 samples), and from Dr Ido Sella of the SeArc Company (1 specimen).

Taxonomic identification

One sponge sample was identified for EcoConcrete and SeArc Company (Dr Ido Sella): Po 26794 — *Tethya* sp.

Curatorial

- The following loans were issued: three subsamples were sent to Prof. Paco Cardenas (Uppsala University, Sweden; PO 25633 *Ciocalypta* sp. 1, PO 26461 *Ciocalypta* sp. 1, PO 26464 *Ciocalypta carbaloi*); two subsamples were sent to Dr Amy Fraley (Institute of Microbiology, Zurich, Switzerland; 26714 *Negombata magnifica*, 26232 *Negombata rotundata* sp. nov.); and two subsamples were sent to Prof. David A. Gold (University of California, Davis, USA; PO25633 *Ciocalypta* sp. 1, PO26464 *Ciocalypta carballoi*).
- The sponge database includes 1,811 specimens, of which 338 samples were entered in 2021—2022, thanks to the valuable help of Tom Morav.

THE COELENTERATA COLLECTION

Zafrir Kuplik

Curatorial

The Coelenterata collection rose to 13,926 samples. In 2022, data pertaining to the collection were successfully transferred to the new museum online collection database and became accessible to the public.

The collection continued to be very actively used, mostly its Octocorallia part, with most of the research done by Prof. Yehuda Benayahu and his students. Hundreds of samples were sent from the collection for molecular identification, as part of a taxonomy verification process done by Prof. Y. Benayahu and Prof. C.S. McFadden of the Harvey Mudd College, Claremont, CA, USA.

During the reporting year, Prof. Y. Benayahu visited several European natural history museums, from which he brought to SMNH hundreds of samples, many of them types, to be deposited in the collection and used for comparative taxonomy work: 110 samples from the Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands; 255 samples from the Muséum national d'Histoire naturelle, Paris, France; and 50 samples from the Zoologisches Museum, Berlin, Germany.

The collection was used routinely for taxonomic research by Íris Sampaio, a postdoctoral fellow, who was working on *Lenalia* spp. and *Paralemnalia* spp., and Ms Einav Lazar, MSc student, working on *Cladiella* spp.

As part of a re-established collaboration with the Israel Oceanographic and Limnological Research Institute, dozens of cnidarians, collected during their monitoring programme of the coastal shelf of the Israeli Mediterranean, were transferred to the collection. Most of these were sea pens of the order Scleralcyonacea.

A vast revision of Octocorallia, as well as some Scyphozoa and Hexacorallia (McFadden et al. 2022) prompted some major changes to our database and to the taxonomic data of many samples in the collection. The work on introducing the changes was expected to last several months.

Reference

McFadden, C.S., van Ofwegen, L.P. & Quattrini, A.M. 2022. Revisionary systematics of Octocorallia (Cnidaria: Anthozoa) guided by phylogenomics. *Bulletin of the Society of Systematic Biologists*, 1(3), Art. 8735.

Research

As the coelenterates collection manager and an experienced jellyfish researcher, I participated in a plankton course at the the Interuniversity Institute for Marine Sciences (Eilat, Israel), presenting a lecture and conducting field sampling and laboratory work on gelatinous zooplankton.

FRESHWATER MYXOZOA

Aditya Gupta and Dorothée Huchon

The Myxozoa is a class of parasitic cnidarians, which, with over 2,300 described species, exert a substantial negative economic impact on fisheries and aquaculture. Some myxozoans are agents of emerging fish diseases and myxozoan infections have been linked to environmental changes. No treatment exists against myxozoan infections at the moment and relatively little is known about myxozoan biology. Several myxozoan species have been described from Israel; however, there is no accurate checklist of the Israeli species.

Research

Most myxozoan species have been described only morphologically, although it has been shown that the myxozoan classification based on spore structure is artificial and does not reflect the true evolutionary relationships. Consequently, it is important to revise the number of species present in Israel using a combination of morphological and molecular approaches.

During the reporting period, we published our observation on myxozoan infection in mullets fish (Mugilidae) based on the samples we collected in 2020—2021. This publication is the first report of myxozoan infections in mullets from the Lake Kinneret (The Sea of Galilee).

Mullets hold a significant economic value in Israel. In order to increase fishermen's income two species of mullets *Chelon ramada* (the thinlip mullet) and *Mugil cephalus* (the flathead grey mullet) have been introduced to the Lake Kinneret. These alien species do not reproduce within the lake and thus require a human-mediated introduction of fingerlings every year. This practice started in 1958 with the introduction of fingerlings from the coastal plain estuaries of Israel. Alongside these two species, few additional mullet species, including *C. labrosus*, were unintentionally introduced. Since 2018, only fingerlings from aquaculture facilities have been introduced.

Our 2020—2021 survey of myxozoan infections led us to describe *Myxobolus pupkoi* infecting the gill arches of *C. labrosus*, and to report the presence of *Myxobolus exiguus* from the visceral peritoneum and the gall bladder of *C. ramada*. Our molecular analyses of these samples demonstrate that the parasites identified in the Lake Kinneret are closely related to myxozoan lineages infecting mugilids. This suggests that the infection likely occurred in the Mediterranean Sea, where the fingerlings were captured, prior to their introduction into the Sea of Galilee. Consequently, we recommend to closely monitor the presence of these parasites in the future to determine whether the introduction of farm-raised fingerlings leads to the elimination of these parasites.

Curatorial

Slides with stained myxospores of *M. exiguus* and the newly described *M. pupkoi* Gupta et al. 2022 have been deposited in the parasite collection of the Steinhardt Museum of Natural History as collection lots SMNHTAU-AP-50-53 and SMNHTAU-AP-48-49 respectively.

Conferences

Our findings on myxozoan infections in mullets of the Lake Kinneret were presented at the 3rd meeting of the Israeli Society for Evolutionary Biology (Rehovot, 9—10 March 2022), where Dr A. Gupta received the first prize for his poster presentation, and at the 58th meeting of the Zoological Society of Israel (Tel-Aviv, 13 March 2022).

THE MOLLUSCA COLLECTION

Henk K. Mienis and Oz Rittner

During the 2021—2022 academic year, the activities in the Mollusc Collection focused mainly on the revision and incorporation of two new collections that had been donated to the Steinhardt Museum: the worldwide collection of especially Cypraeidae, Volutidae and Conidae of Lieutenant-Colonel David Bahral and the local collection of Yechezkel Nagy (see notes on new acquisitions further down in this report on pp. 27—30).

Yet we continued of course our research in the fields of taxonomy, systematics, nomenclature, Lessepsian migration, exotic and invasive species in the mollusc fauna of Israel and various aspects of archaeomalacology.

New interesting faunistic records from Israel

Marine Molluscs

The American bivalve *Anadara transversa* known already from off Turkey and the Adriatic Sea seems to have also established a population off Ashdod.

Terrestrial Molluscs

Lissachatina iredalei discovered near a walking stretch of the Eretz Boulevard in Harish on 24 November 2020 turned out to be *Lissachatina allisi*.

Freshwater Molluscs

The invasive *Mieniplotia scabra* is becoming one of the commonest freshwater snail species in Israel and is turning up in numerous isolated waters throughout Israel. Most probably waterbirds play an important role in the distribution of that tropical species.

The connection between terrestrial snails and other animal groups

New data on land snails preyed upon skinks in Israel were published by Mienis & Mienis-Israeli (2022) and Mienis (2022a, 2022b).

Cases of predation on land and freshwater molluscs by European Rollers *Coracias garrulus* were summarized by Mienis (2021).

Support with identifications

Various ecologically and malacological studies on the presence of molluscs in Israel were being carried out by a number of colleagues at various institutes and by private investigators. They received our expertise through identification of their material. A major part of the identified material was retained for permanent storage in the Steinhardt Museum of Natural History malacological collection.

Cooperation with the Plant Protection & Inspection Services (PPIS), Ministry of Agriculture

This academic year Mrs S. Vaisman brought us for verification or identification 88 samples of land and freshwater snails intercepted by inspectors from the PPIS from either agricultural merchandise arriving from abroad or found on local material grown in nurseries.

New or interesting records turned out to be:

Cernuella virgata on squash from Portuigal;

Afropunctum seminium on an orchid from Germany;

Pallifera dorsalis on *Dieffenbachia* cuttings from The Netherlands;

Oxychilus alliarius on potted *Azalea* from The Netherlands;

Oxychilus navaricus helveticus on potted *Nertera* from The Netherlands.

The discovery of *Pallifera dorsalis* is especially noteworthy. So far, this slug species was known from the USA and Canada only (Hubricht 1951; Brady & Pearce 2007; Grimm et al. 2009). Its discovery on horticultural material arriving from The Netherlands in Israel means therefore an unexpected event (Mienis 2022), and highlights the utmost importance of work of the PPIS inspectors in the harbours and other ports of entrance in Israel.

Cooperation with the Israel Nature and National Parks Protection Authority

Like in previous years, we received some mollusc material that had been collected during the BioBlitz project carried out in several Marine Nature Reserves along the Mediterranean coast of

Israel. The results turned to be again rather disappointing from both a quantitative and qualitative points of view.

Cooperation with local and foreign archeologists

Studies of archaeomalacological material from sites in the Jewish Quarter of the Old City of Jerusalem excavated by the late Nahman Avigad and more recently by Hillel Geva, Horbat Bet Loya excavated by Oren Gutfeld, Tell es-Safi/Gath fields D and E excavated by Aren M. Maeir, Tell Erani field P excavated by Iair Milevski, Ashdod Yam excavated by Alexander Fantalkin and the Assyrian fortress in Rishon leZiyyon taken care of by Oren Tal, were still in various stages of publication.

New acquisitions of the Mollusc Collection 2021—2022

New material, from colleagues at various institutes and especially from private collectors, was coming in regularly during the reporting year. The identifications of the newly acquired material were immediately checked and the specimens were prepared for permanent storage in the collection.

The major acquisition event was donation of the world-wide collection of especially Cypraeidae, Volutidae and Conidae of Lieutenant-Colonel David Bahral and the local collection of Yechezkel Nagy. Further elaboration on these collections follows below (pp. 27—30).

Name	Brief description of the material
D. Bahral	Marine molluscs world-wide, mainly of the families Cypraeidae, Volutidae and Conidae
D.E. Bar-Yosef Mayer	Marine shells eastcoast of USA
R. Ben-David Zaslow	Marine molluscs from the Mediterranean coast of Israel
A. Brand	Euchondrus from Israel and Egypt
T. Feldstein	Land- and freshwater snails
B.S. Galil	Marine molluscs from the Mediterranean coast
U. Israeli	Marine molluscs from Israel
Sh. Matalon	Worldwide collection of marine shells
M. Mendelson	Marine molluscs from the Mediterranean coast
D. Mienis	Land snails from Israel
H.K. Mienis	Land- and freshwater molluscs from Israel and The Netherlands
Y. Nagy	Marine molluscs Mediterranean coast of Israel and Gulf of Aqaba
J. Numhauser	Collection of marine molluscs from Chile
PPIS	Intercepted material arriving from abroad
O. Rittner	Land snails from Israel
S. Vaisman	Land snails from Israel
T. Yarkoni	Ornamental shell items

Computerization of the collection

The computerization of the Mollusca collection continued by Oz Rittner and Mrs Ronit Vilker-Alhadef (a volunteer).

The Malacological library

The library is an extremely important tool for taxonomic and systematic studies in the Mollusc Collection.

We continued receiving many reprints and numerous journals from zoological institutes and malacological societies in exchange for *Triton*, the independent malacological journal published in Israel (no issue was published in the 2021—2022 academic year), and the quarterly journal *Natuurhistorische en Andere Notities — Natural History and Other Notes*, of which four issues were published.

With the mollusk collection of Lieutenant-Colonel David Bahral, we also received some books dealing with the family Cypraeidae. Most of them we had received already during the previous academic year from the Heiman library.

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For references to works authored or co-authored by Henk K. Mienis and Oz Rittner please refer to the Publications section in this Annual Report (p. 73).

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Notes on new mollusc acquisitions

Henk K. Mienis & Oz Rittner

The shell collection of Lieutenant-Colonel David Bahral (1922—2021)

David Bahral was born on 19 December 1922 in Rovno, which was at that time part of Poland and today it is known as Rivne in western Ukraine. At the age of three years his parents moved to Palestine and settled in Jerusalem, where his father became the manager of a local Palestinian bank. His mother worked as a dentist, a profession she had learned in Odessa. Later on, the family moved from Jerusalem to Tel Aviv.

His father died in 1940, and David started to work as a clerk in his father's bank and commenced a study in order to become a professional accountant.

He became a member of the Palmach, the underground army of the Jewish community during the British Mandate. With the independence of Israel in 1948 he established the Financial Department of ZAHAL, the Israeli Army, and became head of its Budgetary Department. At some time he resigned from ZAHAL and started to work at his friend's office: the Almagor Law Firm and Notary. However, at the urgent request of Yigal Yadin he returned to his former position in the army from which he retired with the rank of Lieutenant-Colonel in 1975. That military rank seemed to be of very importance to him because he even used it in his correspondence with all his connections in the field of shell collecting.

David Bahral died on 23 December 2021 in Tel Aviv at the advanced age of 99.

David Bahral as a shell collector

We lacking any information when David Bahral became interested in collecting shells in general and when he started to specialize in Cowry shells (Cypraeidae). In his specialization in the beautiful Cowries he got a boost by two local fishermen in Eilat, Michael Kurz and Yizchaq Roges. They presented him with some 100 specimens of *Luria pulchra*, at that time a rare species confined in its distribution to the Red Sea and Persian Gulf. With this exchange material he managed to acquire many of the rarer Cowry species. In the 1960s, his Cowry collection was the third largest in private hands.

Bahral was mentioned as a collector of marine molluscs in the various editions of Richard E. Petit's *Directory of Conchologists*, with a note that he was especially interested in the Cypraeidae.

He was a longtime member of the now defunct Israel Malacological Collection, but never showed any activity to play a role in it.

Publications about the Bahral collection

Bahral never published anything about his mollusc collection, yet various information about his activities in the field of cowries and material in his collection was reported by others.

Franz and Maria Schilder (1968) published a statistical study about 998 shells of *Naria spurca* found by Bahral on the beach of Herzliyya in 1955.

Pat Burgess (1970, 1985) published some personal information given to him by Bahral, on various aspects of biology, habitat and range of *Luria pulchra*, *Naria macandrewi*, *Naria nebrites*, *Naria turdus*, *Cypraea pantherina*, *Mauritia grayana* and *Bistolida erythraeensis*, all known to live in the Gulf of Aqaba.

Type specimens in the Bahral collection

At least three samples of cowries in the Bahral collection consist of paratypes:

Purpuradusta raysummersi F.A. Schilder, 1960

Philippines, Siassi Islands, leg. Local fisherman, 1959 (SMNH MO 101202/1 paratype) (ex col. Ray Summers);

Philippines, Siassi Islands, Laminusa Island, leg. Local fisherman, February 1960 (SMNH MO 101201/1 paratype) (ex col. Ray Summers).

Lyncina titan F.A. Schilder & M. Schilder, 1962

Kenya, Shimoni Channel, leg. R.S. Benton, 6 February 1962 (SMNH MO 101099/1 female paratype) (ex coll. Schilder).

The shell had been broken intentionally by the Schilders in order to establish the gender of the specimen just in the same way as they did with the paratype of it in the collection of Aryeh Hadar (SMNH MO 42904) (Mienis 2010).

Partial list of collectors or former owners of the Cypraeidae in the Bahral collection

David Bahral maintained contact with well-known specialists of Cypraeidae like Franz and Maria Schilder in Germany and Clarence Milton (Pat) Burgess on Hawaii, with Zoological Museums in Europe, Australia and the USA, and numerous collectors of Cowries all over the world.

A donation of molluscs to the Smithsonian Museum in Washington was listed in the Annual Report of the United States National Museum for the year ended June 30, 1964 (Anonymous 1964: 134). His contact over there was Dr Harald A. Rehder.

Bahral's collection comprises material accumulated by at least 82 collectors and former owners. The names are listed below in the alphabetical order, with some information on the provenance of the material in parenthesses:

Robert Tucker Abbott (worldwide); Brian Bailey; Paz L. Bautista; M. Benray (Palau Is.); Ronald Stewart Benton (East Africa, especially Kenya); Anna McLean Bidder (Venezuela); Dr Biddu (India); Hope Black-Macpherson (Australia); Helen Boswell (South Africa and various worldwide localities); Neil M. Bouray (Palau Is.); R.F. Browne (Fiji Is.); Clarence Milton (Pat) Burgess (Hawaii and other Pacific localities); Esteban Calderon (Equatorial Guinea); Crawford N. Cate (Philippines & Cabo Verde); Mrs Chatuff (Kwajalein Atoll); P. Clover (worldwide); James Arnold Constable (West Africa via American Museum); Cedric Coucom (Australia: Queensland); Victor Dan (Philippines); James Denis; Val Davies (Australia: New South Wales); Fernando G. Dayrit (Philippines and other Pacific areas); John E. DuPont (Philippines); H. Eastwood (West Australia); Misha Fainzilber (East Africa, especially Kenya); John Ferguson (Hawaii); Lev Fishelson, Israel South Red Sea Expedition (Eritrea: Dahlak Is.); Kurt Geisel (Mediterranean coast of Israel); Charles Joseph Gravier (Gulf of Aden: Somalia); Roland Gray (Hawaii and other Pacific localities); F. Hakye/Hukye (Bahrain); Diana & Gerosa Harman (Australia: Queensland); A. Hoffman (Mozambique); Nan Fan Hong (Taiwan); C.M. Huang (Taiwan); V. Jamrachi; Harold Jewell; Rodney S.L. Jonklaas (India); Félix Pierre Jousseaume (Gulf of Aden: Somalia); B. Kaspiew (South Australia); Leila Kerr; Mrs D. Klease (Australia: Queensland); Carl F. Kurtze (South Australia); Kathleen Matcott (South and West Australia); L. Martin (Australia: Victoria); Adrianus Dirk Jacob Meeuse (Indonesia); W. Murray (Ascension Is.); Arthur Nash; T. Nielsen; William E. (Bill) Old Jr. (worldwide); Ambrogio Orlando (Mediterranean area of Italy); Malcolm F. Parker (West Australia); Dov Peled (Eritrea, Dahlak Is.); Eduardo Quisumbing (Philippines); Harald A. Rehder (Puritan Expedition, Mexico, and St Helena); Thomas C. Rice (Brazil); Damioner Ribeiro del Mandouca (Brazil); C. Leonard Richardson (South Australia & Philippines); P.J. van der Riet (Solomon Is.: Malaita); Roberts (Hawaii); P.J. le Roux (South Africa); Juan Rutllant y Bassets (Spanish Morocco); Mary Saul (Indo-Pacific); John G. Saxby (South Australia, Fiji Is. & Philippines); Alex Scheleshoff (Australia: Queensland); Franz & Maria Schilder (worldwide); Josef Schneider (New Britain Is.); A. Scott (Japan: Ryukyu Is., Okinawa); Virginia Siewertsen; Avraham Singer (Eritraea); John L. Staid-Staadt (Andaman Is.); Paul Haines Steele; Ray Summers (Hawaii); W. Paul Trenberth (Australia: Queensland & South Australia; Solomon Is.); William H. Turton (St Helena); Albert Jean-Baptiste Marie Vayssière (Gulf of Aden: Somalia); Clifton Stokes Weaver (Singapore); Dave Wellington (Hawaii); D. Wilson (Galapagos); R.A. Witthaus (St Vincent, later part of 19th century); Rodney C. Wood (Seychelles); Kim Yap (Thailand & Singapore).

Additional material in Bahral shell collection

Besides cowries, in Bahral mollusc collection two other families of gastropods are well represented: Conidae and Volutidae. He received that material from the same shell collectors who provided him with worldwide Cypraeidae. Notable absents are general collections of marine molluscs from the Israel Mediterranean coast and from the Gulf of Aqaba.

Donation of the Bahral collection to the Steinhardt Museum of Natural History

Some eight years ago David Bahral invited us to visit him at his home to talk about a possible transfer of his shell collection to the Mollusc Collection of the Tel Aviv Unversity. Being aware of the reputation of his Cowry collection, we of course accepted his offer with both hands. Conditions of the transfer of the collection were discussed but no final decision waw reached. After his death the bulk of his collection was donated to the Mollusc Collection of the Steinhardt Museum of Natural History, Tel Aviv University, and arrived on 18 April 2022.

His extensive correspondence with fellow shell collectors turned out to be in a very bad state of conservation (eaten by insects and rodents) and was unfortunately destroyed prior to the transfer of the collection to the Steinhardt Museum.

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The shell collection of Yechezkel Ernő Nagy (1933—2014)

At the end of January 2022, the shell collection of Yechezkel Nagy was quite unexpectedly donated by his niece Mrs Ruth Rotenberg of Herzliya to the Steinhardt Museum of Natural History.

Yechezkel Ernő Nagy was born on 6 November 1933 in Budapest, Hungary, to László Nagy and Malka Maria Nagy-Foldes. He had an older sister Rachel Edith (born 1928 in Budapest). During the Second World War the family was hiding in the Budapest ghetto. However, only his mother, sister and Yechezkel survived the war. His father and other members of his family were murdered.

At the age of only 16 he emigrated alone to the newly established State of Israel. Here he finished his study at the secondary school, after which he enrolled at the Technion in Haifa, where he received a second degree in engineering. Yechezkel was always interested in nature and started shell collecting in 1956. He was a member of the Israel Malacological Society (IMS) at least since 1972. Although he never played an active role in that society, he attended most of its meetings. He was a perfectionist in keeping and curating his collection. Each sample was supplied with the basic information of where, when and by whom the material had been collected. He kept his growing collection up to date by continuously applying the numerous changes of the scientific names.

At meetings of the so-called working groups in the IMS which were often held in the premises of other members he was always a background figure, never involved in the often loud discussions. Yet he maintained personal contacts with many of the other members, which is attested by labels in his collection. Material not collected by himself always carried the information: “Don[ated]” followed by the name of the collector or the former owner of that sample. Due to this we know that

he maintained contacts and received material from Uri J. Bar-Zeev, Sagie Cohen, Kalman Hertz, Eli Holzer, Daniel Korkos, Henk K. Mienis, Moshe Erlunder Okon, Zvi Orlin, Fruma Salzman, Avraham Singer, Benjamin S. (Solly) Singer, Vital (Haim) Treves and Israel Yeruslavski. Isaac (Jitzchaq) Yaron identified some of problematic material in Nagy's collection.

Yechezkel also participated several times in fieldtrips, organized by members of the IMS, along the East coast of Sinai, Gulf of Aqaba (Singer 1992a, 1992b).

Nagy's collection is important being almost entirely local, from Eastern Mediterranean coast of Israel and the entire eastern coastline of the Sinai Peninsula in the Gulf of Aqaba, and moreover because of the reliable information accompanying each sample.

Yechezkel remained a bachelor and lived for most of his life in Givatayim. He died on 20 November 2014, almost exactly one year after his sister Rachel Edith Deutsch-Nagy, and was buried in Petah Tiqwa.

References

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THE BRYOZOA COLLECTION

Noga Sokolover

Bryozoa is a phylum of small aquatic filter-feeding colonial invertebrates. The majority of about 4,000 species are marine and live in tropical seas, with some dwelling in temperate or cold waters, and some in brackish or freshwater basins. The bryozoan fauna of the Mediterranean Sea is among the best studied of all bryozoan faunas, but the main focus of research has been on the Western Mediterranean, leaving the Levant area, including Israel, poorly investigated. The impact of global warming on the composition of marine biotas also affect the Levantine bryozoan communities, which were shown to gradually change from a temperate to a more tropical state.

Collection management and research

The Bryozoa collection hosted Dr Kamil Zágoršek from the Technical University of Liberec, Czech Republic, who travelled to Israel on a SYNTHESYS grant. Dr Kamil Zágoršek's research focused on Cyclostomes and examined some palaeobryozoans.

I presented a talk on Bryozoa at the Interuniversity Institute for Marine Sciences (Eilat, Israel), as part of the *Invertebrates of the Red Sea* course.

As part of the Museum's involvement in the Consortium of European Taxonomic Facilities, a network of biological collections, I joined a workshop in Viena (Austria) with Dr Omri Bronstein and went to a meeting in Frankfurt (Germany) together with Dr Tamar Feldstein-Farkash. I also participate in monthly lectures and discussions of the collections working group.

TERRESTRIAL, FRESHWATER AND MARINE FREE-LIVING NEMATODES

Stanislav Pen-Mouratov

Nematodes play crucial roles in the ecosystem processes. Many are free living and abound in soils and sediments in terrestrial, freshwater and marine habitats. As parasites they occur in every multicellular group. They are found in all, including extreme and disturbed ecosystems. The free-living nematodes are useful as biological indicators of soil health, because their numbers and types reflect changes in the microbes they consume, and in the soil physical and chemical conditions. Nematodes contribute to essential functions in soil, including biodiversity maintenance, nutrient cycling, soil formation and aggregation, decomposition, carbon sequestration and pest control.

Research goals

- To study the species diversity, abundance and distribution of free-living nematodes inhabiting the Israeli ecosystems.
- To determine impact of different natural and anthropogenic disturbances on the free-living nematode communities.
- To study the influence of vertebrates on the free-living nematodes and their habitats.

Research projects

- During the reporting period we continued study of the impact of bird nesting and roosting activity on soil biota in Israel (Pen-Mouratov & Dayan 2019). The soil biota, including soil microorganisms and free-living nematodes along with soil properties (soil moisture, conductivity, pH, ammonium, nitrate and phosphorus), was seasonally investigated in the nesting and roosting habitats of the colonial birds *Milvus migrans*, *Phalacrocorax carbo*, *Nycticorax nycticorax* and *Egretta garzetta* in the Israeli Mediterranean region. The main aim of this investigation was to determine the seasonal effect of bird nesting and roosting activity on soil habitat, soil biota abundance, trophic structure, sex ratio and generic diversity of soil free-living nematode communities. As a result of several years work, necessary data were obtained to complete the following research: "Seasonal fluctuations attenuate stimulatory or inhibitory impacts of colonial birds on abundance, structure and diversity of soil biota". All my efforts during the reporting period were aimed at preparation of the obtained data for publication in a journal with an appropriately high impact factor.
- During the reporting period, I continued to collect, treat and analyze soil and free-living soil nematode samples for a publications on the influence of different wild animals' activity on the free-living nematodes and their habitats.

Nematode collection

The soil free-living nematodes were extracted and counted from the above-mentioned study sites. The collected nematode samples were prepared for the long-term storage in the Museum collection. For ecological research, the nematodes were mounted on the temporary collection slides and identified to the order, family, genus and sex using a compound microscope. The best nematode specimens were remounted on permanent slides for the museum collection.

Field trips

We continued our study of effect of animals activities on the soil ecosystems and collected samples of soil, which was exposed to animals impact, on the monthly basis. Along with direct observation of wild animals, e.g. through binoculars, we used digital trail cameras to monitor their activity to obtain additional information about the impact of the wild animals on the soil ecosystem in general, and on communities free-living nematodes in particular.

International collaborations

During the reporting period, I continued active collaboration with colleagues of different scientific organizations from different countries, including including Swedish Museum of Natural History, Russian Academy of Sciences, Institute of Geology and Geophysics (Academy of Sciences of Uzbekistan), Geosciences Institute, Johannes Gutenberg University (Germany), etc.

I also reviewed and commented on

- Kalinkina, D.S. 2021. *Communities of soil nematodes during the introduction of plants in the north-west of Russia*. PhD thesis. The Institute of Plant and Animal Ecology, Urals Branch of the Russian Academy of Sciences, Yekaterinburg, Russia. 195 pp.
- Holovachov, O. 2022. *Identification key to the genera of European marine nematodes* [draft version]. Swedish Museum of Natural History, Stockholm. 78 pp.

THE CRUSTACEA COLLECTION

Bella Galil

The Crustacea constitute a large, primarily aquatic, subphylum of Arthropoda. There are over 50,000 known crustacean species and it is suggested that 200,000 more are yet to be discovered. Most crustaceans occupy marine and freshwater environments, but also terrestrial habitats all over the world. Familiar crustaceans include shrimps, lobsters, crabs and woodlice, but there are other, less known but still diverse groups such as the barnacles, sand fleas, pillbugs and mantis shrimps. Some crustaceans live under extreme—in terms of temperature, pressure, and salinity—environmental conditions. Crustaceans are ecologically and economically important, and they are an essential food source for many marine animals and humans.

The Crustacean collection of the SMNH comprises over 50,000 specimens of marine, freshwater and terrestrial species. Most of the specimens have been collected along the Mediterranean coast

of Israel and in the Red Sea; of special interest is a growing collection of Red Sea species introduced into the Mediterranean through the Suez Canal.

Research

Prof. Bella Galil focused her main research efforts on marine indigenous and non-indigenous species in the Mediterranean Sea, as well as on taxonomy of Indo-Pacific decapod crustaceans.

Prof. Galil continued her studies on the outbreak of the widely invasive mytilid mussel *Perna perna* along the Israeli coast. The newly established population was surveyed at four sites in June 2021. The main objectives were documentation and comparison of its population status, comprising basic data on the population density (averaged between 2155 and 8022 specimens/m^2), size structure, growth rate and epibiota within one year of their initial detection. The study plan was upended by successive heatwaves culminating in a prolonged period of hot weather in August (ambient temperatures 36—38 °C, sea surface temperature 32 °C), with diurnal low tides occurring midday. The population suffered catastrophic mortality at the sampled sites and throughout the coast.

Prof. Bella Galil sampling invasive *Perna perna* fouling infrastructures in Haifa Bay. (Photo: M. Mendelson)

Prof. Galil continued her collaboration with Dr G. Innocenti (Museo di Storia Naturale dell'Università di Firenze, Italy) on the lesser swimming crab *Charybdis (Archias) longicollis* parasitized by the barnacle *Heterosaccus dollfusi*, both introduced through the Suez Canal. A total of 3966 specimens collected off Ashdod, Israel, between November 2021—November 2022, were examined as to the host size, sex ratio, prevalence of ovigerous females, parasitization and multiple parasitization, as part of a unique long-term (>30 years) study of the host—parasite population variation.

The ghost crab *Ocypode cursor*, a key component of the sandy beach ecosystems is listed among the threatened and endangered species in Annex II of the Barcelona Convention. In October 2021, Prof. Galil concluded a two-year survey of its population structure in the supralittoral zone of nature reserves and adjacent public beaches. Three transects, each 50×5 m, parallel to the high water mark were sampled at each location. All burrow openings were counted and measured for a total of over 7000 burrows. The dataset was analyzed in 2022.

In May 2022, Prof. Galil visited the Muséum National d'Histoire Naturelle, Paris, France, to continue her studies on the deep-sea leucosiid crabs collected off New Caledonia.

Within the framework of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, Prof. Galil compiled and analyzed a global database, supported by quantitative and experimental data, and co-authored a chapter *Impacts of invasive alien species on nature, nature's contributions to people, and good quality of life*.

Prof. Galil also prepared the datasheet on *Callinectes sapidus* for the Invasive Species Compendium CABI.

The International Association for Open Knowledge on Invasive Alien Species (INVASIVESNET) awarded Prof. Bella Galil the Life Honorary Membership of the Association in 2022 for her contribution "to a number of renowned international organizations such as the International Council for the Exploration of the Sea (ICES) and the United Nations' Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)". Prof. B. Galil became the second Honorary Member of INVASIVESNET and joined Prof. James Carlton of Williams College (Williamstown, Massachusetts, USA), who received this honorary title in 2018. Prof. Galil described her own life's work as "rooted in the intense wonder best expressed by the poet of the Psalms — *the sea, vast and spacious, teeming with creatures beyond number — living things both large and small*".

Conferences

- *ICAIS International Conference on Aquatic Invasive Species*; 18—22 April 2022, co-hosted by the Netherland's Office for Risk Assessment & Research (NVWA/BuRO) and Belgium's Research

Institute for Nature and Forest (INBO), Oostende, Belgium.
Keynote speaker: *Some like it hot — Erythraean bioinvasions into the Mediterranean Sea*.

- *NEOBIOTA 12th International Conference on Biological Invasions: Biological Invasions in a Changing World*; 13—16 September 2022, University of Tartu, Tartu, Estonia.
  Keynote speaker: *A canal, A sea, A disaster — The Suez Canal and the transformation of the Mediterranean biota*.
- *81° Congresso Unione Zoologica Italiana*; 20—23 September 2022, University of Trieste, Italy.
  Keynote speaker: *The Suez Canal and the transformation of the Mediterranean biota*.
- *Mediterranean Symposia on Marine Vegetation, Coralligenous, Dark Habitats and Non-Indigenous Species*; 19—23 September 2022, co-hosted by the SPA/RAC, the Specially Protected Areas Regional Activity Centre of UNEP/MAP — Barcelona Convention, the Italian Institute for Environmental Protection and Research, the University of Genoa and its Department of Earth, the Environment and Life Sciences, and the association Società Italiana di Biologia Marina, Genoa, Italy.
  Presentations: *The Levant — a hotspot, a beachhead and a dispersal hub of Erythraean alien species*. (with M. Goren and H. Mienis)
  Inadequate: monitoring surveys' failure to assess alien biota along the Israeli coast. (with M. Goren)
  Here today, gone tomorrow — the Levantine population of the Brown mussel Perna perna *obliterated by unprecedented heatwave*. (with M. Goren)

Collection management and databasing

During 2021—2022, 168 records were added to the Crustacea database, 136 were identified by Dr Y. Levitt-Barmatz, 31 by Prof. B. Galil. The specimens were collected and donated to the SMNH by Drs N. Stern and H. Lubinevsky, both from the Israel Oceanographic and Limnological Research Institute.

Field work

Within the framework of the *Integrated program for establishing biological baselines and monitoring protocols for marine reserves in the Israeli Mediterranean* (PI Dr Omri Bronstein), burrow openings of *Ocypode cursor* were counted and measured in October 2021, in nature reserves and adjacent beaches in Betzet, Dor and Evtach.

THE ANNELIDA COLLECTION

Liron Goren

The annelids, or the segmented worms, are a phylum of invertebrates, with over 22,000 extant species including ragworms and other polychaetes, earthworms and leeches. The annelids live in and have adapted to marine (as distinct as tidal zones and hydrothermal vents), fresh water and moist terrestrial environments. In their size, the annelid worms are ranging from microscopic filter feeding marine polychaetes to the Australian and African giant earthworms, which can grow up to 3 m and almost 7 m, respectively. Both terrestrial and aquatic annelids play a very significant role in ecosystems. Earthworms contribute to soil fertility by loosening the soil so that oxygen and water can penetrate it, by mixing organic and mineral matter and by accelerating the decomposition of organic matter and thus making it more quickly available to other organisms, and by concentrating minerals and converting them to forms that plants can use more easily. In marine ecosystems, polychaetes may constitute over one-third of benthic animals around coral reefs and in tidal zones. Burrowing polychaetes increase the penetration of water and oxygen into the sea-floor sediment, which facilitates the growth of populations of aerobic bacteria and minute animals alongside their burrows.

Collection management and field survey of the Polychaeta

I went on five mesophotic ROV (remotely operated vehicle) expeditions with Prof. Micha Ilan's research group. Although these were focused on the sponge fauna, all samples with polychaetes were added to the collection. I also went on several SCUBA diving expedition with Prof. Micha Ilan's research group, for collection of sponges along with polychaetes.

A few hundreds of specimens from field work, as well as a few dozen specimens from Dr Orit Barnea's private consulting work, were added to the collection.

A slow but steady progress was made with databasing newly acquired material.

Collaborations

- Collaborated with the Society for the Protection of Nature in Israel and Prof. Yizhak Makovsky's research group (Haifa University) in the preparation of the ecological section of the *Master Plan for Marine Nature Reserves in Israel's Exclusive Economic Zone in the Mediterranean Sea*.
- Collaborated with Dr Omri Bronstein (Tel Aviv University and SMNH) in *An Integrated Program for Establishing Biological Baselines and Monitoring Protocols for Marine Reserves in the Israeli Mediterranean Sea*. This work included SCUBA diving sampling of polychaetes in the rocky substrate and identification of the collected polychaetes. The analysis of results was on-going.
- Collaborated with Dr Omri Bronstein in identification of polychaetes specimens collected in his Autonomous Reef Monitoring Structures project. The analysis of results was on-going.

Taxonomic identification services

- More than 250 samples of Hirudinea and Polychaeta, as well as 31 samples of freshwater amphipod crustaceans, were identified for the Aquatic Ecology Center (SMNH).
- Freshwater invertebrates were identified for the HaMaarag's 'swan lake' survey.
- Risk assessment of nematodes in imported agricultural produce was done for Israel Ministry of Agriculture.
- On several occasions, I participated in Israel Oceanographic and Limnological Research Institute efforts for identification of invertebrate fauna collected during their trawling expeditions.

Future plans

- Complete and publish the identification of the new invasive leech species, *Barbronia* sp.;
- Publish a paper on three new polychaete records (*Branchiomma luctuosum*, *B. bombyx*, *Timarete punctata*) in Israel, found during fieldwork conducted last year;
- Publish results of the Crete study;
- Complete computerizing the catalog of the Polychaete collection;
- Create a Polychaete taxonomic course in the museum;
- Analyze results of ARMS polychaetes;
- Analyze results of monitoring program;
- Publish a manuscript on sponges, in collaboration with Prof. Micha Ilan's research group.

THE ECHINODERMATA COLLECTION

Omri Bronstein and Noga Sokolover

Echinoderms constitute one of the most prominent and wide-spread groups of marine invertebrates. Distributed across all oceans, from the poles to the equator and from the abyssal to intertidal depths, they are among the most ecologically significant components of diverse marine environments. With about 7,000 living species, echinoderms are the second-largest group of deuterostomes, strategically situated at the base of the evolutionary split leading to vertebrates. This unique evolutionary setup coupled with their fundamental ecological role, turns echinoderms into a primary research model taxon.

Collection management

The identified material was entered into the SMNH database, which was increased by 35 echinoderm records during the reporting period. The material originated mainly from the Mediterranean expeditions with contributions of the older material (2011) that was collected during a fish study and came up as bycatch.

In addition, the echinoid collection of Dr Jacob Dafni (Eilat), focusing on the Red Sea fauna, was handed over to the echinoderm collection at the SMNH. This material consisted of several dozens of specimens, mostly dry, that were being processed and examined.

Student supervision

Undergraduate students supervised by Omri Bronstein were regularly using samples from both the Mediterranean and Red Sea echinoderm collections—echinoids and holothuroids—for their research projects.

Taxonomic identification services

We provided species identifications to the Israel Oceanographic and Limnological Research Institute as part of their Mediterranean BOLD (Barcode of Life Data System) project. Additional species identifications based on photographed specimens were occasionally provided to both academics and recreational divers upon request.

Ongoing projects

Work on the illustrated guide for the Israeli echinoderms still continued with the part on the Red Sea echinoids nearing its completion.

Outreach and lectures

Noga Sokolover presented a talk about the current state and issues of the collection in the frame of the SMNH seminars.

THE ASCIDIACEA COLLECTION

Noa Shenkar and Lion Novak

Ascidians, or sea squirts, are the largest and most diverse class of the Tunicata, which is thought to be the sister group to the vertebrates according to recent phylogenomic studies. With about 3,000 described species, ascidians are found in all marine habitats from shallow water to the deep sea. The exceptional filtering capability of adult sea squirts makes them important bio-indicators for monitoring anthropogenic pollution in marine environments.

Collection management

Curatorial activities during the reporting period were aimed at the regular maintenance of the material and resulted in the addition of 50 new records to the museum database.

Collecting solitary Ascidians in Israeli waters.

Research

During 2021—2022, we conducted periodical surveys and sampling, by both snorkeling and scuba diving, as part of our effort to characterize the ascidian biodiversity along the Mediterranean and Red Sea coasts of Israel. These surveys were done by Noa, Lion and all members of the Shenkar Lab, to monitor our region, discover new invasive species and describe new species. Ascidians, being successful marine invaders, were collected also from fishing ports and marinas, which are hot spots for the spread of newly introduced taxa. Part of our monitoring effort was carried out during Bio-Blitz marine surveys, organized by the Israel Nature and Parks Authority.

Apart from the collections, the Shenkar Lab continued studies of ascidians as sentinel animals for biomonitoring the marine environment, by focusing on drugs and pharmaceuticals, heavy metals, plastics, and changes in the ascidian proteomic profile as a response to changing conditions.

Active grants

2020—2023 ISF—NNSC (co-PI Prof. Aibin Zhan, Chinese Academy of Sciences). *Mechanisms of rapid local adaptation in marine invaders: ascidians as a case study.* (360,000 NIS per year)

Conferences

Lion Novak presented a seminar on Ascidians for researchers and students at the School of Zoology, Tel Aviv University. Noa Shenkar was on the Organising Committee and made an oral presentation at the Second International Symposium *Galapagos—Israel, Sustainability in the Galapagos Islands: 21st Century and Beyond* (7—8 February 2022). She led the Israeli delegation that comprised experts and scientists from Tel Aviv University, Hebrew University of Jerusalem, University of Haifa, Bar-Ilan University, Ben Gurion University of the Neguev, Geological Survey of Israel, Technion — Israel Institute of Technology, and the Weizmann Institute of Science.

Public outreach

During the 2021—2022 academic year, Noa Shenkar and members of her lab appeared on the following public media:

- *How do 'hitchhiking' marine species survive the ride? - study*. Jerusalem Post, 19 June 2022. https://www.jpost.com/science/article-709831
- *Galapagos Syndrome — what happens to scientists that come to visit the enchanted islands?* YNET, 17 February 2022. https://www.ynet.co.il/environment-science/article/hkfceus1q
- *Nature's laboratory*. NEWS 13, 19 February 2022. https://13tv.co.il/item/news/abroad/galapagos-islanda-902881728
- *The animal that fails to die*. Globes, 21 October 2021. https://www.globes.co.il/news/article.aspx?did=1001388788

MEDITERRANEAN AND RED SEA FISHES

Bat-Sheva (Shevy) Rothman

Personnel

A few months prior to the reporting period, Shevy Rothman finished her postdoc fellowship in the museum and was appointed as the Manager of the fish collection.

Avery Deveto started working in the collection as a technical assistant and advanced the data entering. Moti Ginter volunteered in the collection and helped with maintenance projects, and Elina Babay, a high school graduate who came for a short internship in the collection through Aardvark project, reorganized and relabelled large preserved specimens.

The native fish fauna of the Eastern Mediterranean is facing changes, which are more rapid than anywhere else. The ongoing influx of invasive Red Sea species, rising water temperature, overfishing and pollution transform fish diversity in this part of the basin. The Mediterranean fish collection at the Museum provides a globally unique resource, which is being used to monitor how these immense changes influence fish diversity, biogeography and, more generally, marine ecosystem services and function. Such understanding is vital to identify consequences of these major changes to the integrity of the marine ecosystem and, more importantly, to mitigate adverse influences of human activity.

Collections management and databasing

During the reported period, we collected many fish specimens from various sources and added 277 new records to our database (excluding many that are waiting in the freezers or in jars and temporary containers). As of January 2022, the fish collection database was transferred to the new platform. Fish records predominantly originated from soft bottom trawl catch as a part of our ongoing collaboration with Dr Nir Stern from the Israel Oceanographic and Limnological Research Institute. In addition, we expanded and strengthened our collaboration with the marine enforcement unit of the Israel Nature and Parks Authority, and therefore received their confiscated catch from the Mediterranean and Red Sea, including vulnerable and unique reef species.

To improve our storage capacity, we added a large custom-made container that can hold up to 2 m^3 of fixative liquid, where we put large species, including a 187-cm long specimen of *Rachycentron canadum* (cobia), confiscated from a fisher in Eilat, the first and only specimen of this species in the collection, as well as some other large-sized species, particularly rays and sharks.

Research

During the reported period, Shevy Rothman participated in a multi-institutional project funded by a Yad-Hanadiv grant and led by Dr Omri Bronstein. The scope of this project was to create a biological baseline and integrative monitoring protocols inside marine reserves in the Mediterranean Sea. She used three methods to survey fish diversity: (1) using Baited Remote Underwater Video Systems in four marine reserves/suggested marine reserves; (2) conducting a professional Underwater Visual Census (UVC); (3) training volunteering citizen scientists to survey fish underwater with an adapted protocol and the supervision of the Israeli Diving Federation.

In collaboration with Dr Simona Georgieva from the National Research Foundation of South Korea, we continued a parasitological study of the invasive lionfish in the Mediterranean and sampled the lionfish in its native origin place in the Red Sea.

Avery Deveto started her PhD research under the supervision of Prof. Jonathan Belmaker and Prof. Roi Holtzman. She was using the fish collections to measure fish morphometrics and to calculate functional metrics of invasive species versus native Mediterranean species.

Public outreach

During the reported period, Shevy Rothman organized a seminar for the Israel Nature and Parks Authority rangers, exposing them to the activities and research conducted in the fish collection to further enhance our collaboration and standardize collection protocols and requirements.

THE TERRESTRIAL VERTEBRATES SECTION

Shai Meiri, Tamar Dayan, Yossi Yovel, Amos Belmaker, Karin Tamar, Avigail Ben-Dov Segal, Igor Gavrilov, Stanislav (Stas) Volynchik, Yulia Gordover, Arieh Landsman, David Kobiler

Overview

The tetrapod collections kept growing albeit at a slower pace than before the COVID pandemic. We further made great strides in arranging the collections, as well as caring better for, and organizing better, what we already have. Our main challenge was manpower of collection managers; effectively we were down to one and a half positions (full for Amos, 50% for Karin), down 40% from our recent peak of 2.5. This was reflected in the lower rate of specimen addition and a backlog of specimens awaiting processing in our freezers. Other major challenges included computing (i.e. adjusting to an inflexible new system) and a diminishing space for storing specimens in the dry collections. So far, there were no forthcoming solutions for any of these issues. An outside the box thinking is thus clearly needed but miracles cannot be worked. Slowing the rate of specimen addition would be the easiest, but probably not the best, solution. On a positive note, what we had in the collection was probably better kept, organized and curated than ever.

Personnel

The academic year of 2021—2022 saw many personnel changes. Erez, our long-time collection manager of reptiles and amphibians left for a position in the School of Zoology, Tel Aviv University. Karin took on the management of those collections, and she was in charge of the mammal, reptile and amphibian collections. Later Karin was appointed in a partial scope as an associate researcher, a blessing for her, less so for the collections under her care

Yulia Gordover, a Masters student with Prof. Lidar Sapir-Hen and Prof. Tamar Dayan, was working part time helping Karin organize the collections.

Daniel Berkowic, the manager of the egg and nest collection, finished his PhD and started working in the Ministry of Defense, as part of the Mimshak programme. Aviagail will take up his responsibilities.

Hamutal Friedman, left to pursue her PhD in the Technion and was briefly replaced by Sirin Falah, a BSc student from the School of Zoology, Tel Aviv University, who also then left. Every now and then another undergraduate joined for a short stint of work in the collections, then moved on.

Moshe Geizler and Mira Ideles stopped volunteering in the collections due to medical problems. We wish both of them good health and a speedy recovery. David Kobiler started volunteering in the bird collection to help with inventory and organization. Arieh Landsman shifted to work mainly on the long-neglected pellet collection; he is now helping better protect and organize the pellets.

Collection management: equipment, infrastructure, storage and curation

While fully situated in the new building, we were still working on the basic arrangement of the collections. This included taxonomic organization in the cabinets, better protecting specimens using plastic boxes and plastic sleeves, and inventorying the collections. The last is necessary as in past decades insufficient attention was given to logging where specimens went to. As a consequence, we did not know whereabouts of many specimens. This process is time consuming and we do not expect it to be completed any time soon.

The nest and egg collection was being moved to new plastic boxes for their protection. The nests found a new permanent home and were ordered taxonomically unlike before. The eggs were also being organized and that process was expected to be completed within the next few months.

We were still assimilating the A.D. Gordon Museum and Beit Shturman holdings of birds, reptiles, amphibians and mammals into our collections. The work was progressing very slowly due to shortage of manpower. The newest addition was the bird collection of the late Haim Hovel, which also included some reptiles and mammals. This collection includes hundreds of skins that need to be cataloged and bagged. This proceeds in conjunction with the progress David is making in the inventory of the Aves collection to ensure we maintain the correct order of the specimens in the cabinets.

While we were gradually progressing with the organization of the collections, the future is unclear. Currently we have space for only ten more storage cabinets (4 for mammals and 6 for birds) in the main hall. These cabinets, when purchased, will quickly fill up, as we need room just to space out specimens to prevent damage. We have little room for the growth of the collection. We are trying to purge the collection of unimportant specimens (specimens from captivity or with no collection information). We currently give them to the museum's education department and to educational courses of the School of Zoology. However, this will only buy us a little more space rather than solve the problem in the long run. The main conclusion is that the current collection rate cannot continue for much longer unless we can 'colonize' a different space.

A serious issue emerging lately, but one that was already partially solved, was the lighting used in the collection halls. Lights were on 24/7 and could not be turned off. Apart from inflating the electricity bills and the obvious carbon footprint, this had a direct effect on both specimens containers (mainly jars) that were being worn out at a fast rate, and more importantly, on the specimens themselves. In short, specimen colours were fading, with important implications for the ability to study them (including taxonomy) in the not too distant future. The museum has undertaken a prompt fix for this issue.

Research and Curation

The amphibian collection

The down trend in collecting amphibians continued also this year. From October 2021 through September 2022, the amphibian collection grew by 107 specimens to the total of 3,068 items. Most specimens (80) entered were of the species *Pelobates syriacus*, Eastern Spadefoot; they were collected between 2013—2015 and came from the lab of Prof. Eli Gefen, from which we also received 11 specimens of *Latonia nigriventer*, the Hula painted frog. Other specimens were of *Bufotes sitibundus* (7), *Salamandra infraimmaculata* (6), *Hyla savignyi* (2) and *Pelophylax bedriagae* (1). We continued preparing skeletons from all the Israeli amphibians and we were missing only a skeleton of the Arabian treefrog (*Hyla felixarabica*) and the Hula painted frog (*Latonia nigriventer*). The amphibian collection remained the smallest and least active among the other tetrapod collections.

The mammal collection

During the reporting period, 168 specimens were added to the mammal collection, which now

amounts to 17,451 databased specimens. The newly added specimens include small-sized mammals (i.e., rodents, bats, hedgehogs), tissue samples without vouchers and medium to large-sized mammals from the Israeli Wildlife Hospital (Safari), Israel Nature and Parks Authority stations, and Ramat HaNadiv. The mammalian specimens received this year belong to 52 species, the most common of which were Tristram's jird (*Meriones tristrami*, 25 specimens) followed by Mountain gazella (*Gazella gazella*, 12 specimens) and wolf (*Canis lupus*, 8 specimens).

The reptile collection

Between September 2021 — October 2022, the collection grew by 539 specimens, to 20,386 specimens. Most of the added specimens are well known from the Israeli fauna, and are dominated by the Mediterranean chameleon (*Chamaeleo chamaeleon*, 37 specimens), wedge-snouted skink (*Chalcides sepsoides*, 28 specimens), coin-marked snake (*Hemorrhois nummifer*, 25 specimens) and the Mediterranean house gecko (*Hemidactylus turcicus*, 22 specimens). Among the new entries are 10 specimens of Brown anole (*Anolis sagrei*), a new invasive species to Israel, and one specimen of the oriental garden lizard (*Calotes versicolor*) brought by the INPA confiscated from a shipment from India.

This year we continued to enter into the collection specimens from the A.D. Gordon Museum and the Beit Shturman collections. We continued preparing skulls and skeletons and we added to the collection 13 specimens from 11 species. We intend to continue with this project until we have representatives of all the species in Israel.

The bird collection

Between September 2021 — October 2022, the bird collection grew by 378 specimens, to 23,720 databased specimens. This number represents only specimens that were entered into the collection with at least a tissue sample. There are hundreds of specimens in the freezers that were collected during this period and before that, and have yet to be prepared. It is hard to estimate how many specimens were entered during that period but had been collected prior to it, as we have an issue with the timestamp in the new database. We toot several steps to try and control the high volume of specimens coming in. First, we were much stricter than before about only collecting specimens with full information attached. Unless the specimen is of a rare species, we do not accept any material without at least the date and place of collection. Second, we only accept specimens in good condition (unless a skeleton is required). Third, we only accept a few of each species a year. For this last point, we aim to develop a more robust way to know quickly what is needed but currently have not been able to do so. During said period, specimens from 113 species were entered in the collection, an impressive number no doubt. This number included some exotic species from the collection of Haim Hovel and from other collections.

Research collaboration

During 2021—2022, researchers of the terrestrial vertebrates section actively collaborated with numerous academics in Israel and abroad, through their involvement in both scientific projects and student supervision. Especially relevant collaborators were Prof. Uri Roll (Ben Gurion University of the Negev) and our mutual postgraduate and postdoctoral students, Dorothée Huchon (SMNH), David Chapple (Monash University, Australia), Roberta Graboski Mendes and Marco Antonio Ribeiro-Junior (our foreign postdocs), Paolo Faraone (University of Palermo, Italy), Sunandan Das (University of Helsinki, Finland), Claudia Koch (Museum Koenig Bonn, Germany), Tali Magory-Cohen (University of California, USA & University of Copenhagen, Denmark) and Daniel Jablonski (Comenius University in Bratislava, Slovakia).

Conferences

Shai Meiri was on organising committees of the following scientific meetings:

- 2022 — The 5th GARD (Global Assessment of Reptile Distributions) meeting, *Viewing the world through different lenses changes our perception of it — exploring influences of mapping methods on macroecological patterns and biodiversity conservation*. (SMNH; with Prof. Uri Roll, BGU)
- 2022 — A Bat-Sheva de Rothschild symposium, *Reptiles in space and time — using prehistoric & historic knowledge to gauge current and future global trends of reptilian diversity and conser-*

vation. (Ben Gurion University of the Negev, Sde Boker Campus; with Prof. Uri Roll, BGU, and Reuven Yeshurun, University of Haifa)

- 2022 — Chaired the organizing committee of the *58th Annual Meeting of the Zoological Society of Israel*. (SMNH)

Visits, teaching and loans

During 2021—2022, 24 people visited the collections for a total of 51 times. The visitors were affiliated to mainly Israeli academic institutions (Tel Aviv University, 12; Haifa University, 4; Hebrew University, 1; Technion, 1), but also from the Israel Nature and Parks Authority (1), Israeli Binding Center (2), or unaffiliated (3). Two visitors were from the USA (San Diego University and University of Connecticut).

The total of 34 loans were sent out. Five of these were for educational purposes and the rest for research and art exhibits. Most of the loans were to Israeli recipients (23), but 11 went to overseas researchers from the USA (9), France (1) and Italy (1). Three teaching courses used our collection materials.

In the 2021—2022 academic year, we gave cadavers to the *Vertebrate Biology* course at the School of Zoology, Tel Aviv University. The purpose was to allow the students to dissect the animals, learn about them and about the collection. The cadavers were then returned to us to prepare their skeletons. This experiment turned to be very successful, and the students (and their teachers!) really enjoyed seeing a diverse set of species rather than just one as per normal.

THE FEATHER IDENTIFICATION LAB

Avigail Ben-Dov Segal, Amos Belmaker and Tamar Feldstein-Farkash

Military and civilian air traffic has increased dramatically over the years. This heavy traffic shares air space with half a billion migratory birds that pass through Israel twice a year, in addition to resident birds. This combination poses a tremendous risk of bird strikes that often lead to substantial material damage and even loss of human lives. Identifying the risks is an important step for preventing collisions and improving flight safety. Therefore, it is essential to identify bird species responsible for accidents, whether high in the sky or around airfields.

Since 2011, the Steinhardt Museum of Natural History Feather Identification Lab works closely with the Israeli Air Force, the Israel Airports Authority and the Civil Aviation Authority. In 2013, an official contract between the parties was signed and the Lab provides around 150 identifications annually.

In addition, the Lab assists the Israel Nature and Parks Authority to identify bird species collected in various surveys on the effects of infrastructures on wildlife. The surveys include wind turbines, electric lines (electrocution and collision), trains, acoustic walls alongside roads and the solar power station at Ashalim. This cooperation has greatly expanded over the years, starting with a few illegal poaching cases to several hundred identifications a year.

The Lab's work is forensic by nature. We receive various animal remains to identify, whether a partial body, several feathers, just a crumb of a feather or a smear of blood. Our main goal is to identify the animal to the lowest possible taxonomic level, utilizing various techniques.

As part of the Steinhardt Museum of Natural History, we can consult the largest regional collection of birds (almost 24,000 specimens), which is an invaluable resource for comparing the remains and identifying the different bird species.

When only few feathers or feather shreds are found, their fine details are inspected under the microscope. The feather microstructures have both systematic and diagnostic importance and are an effective tool for identifying the bird species. We have a comprehensive comparative collection of feather microscopic slides of many Palaearctic species.

The Molecular Systematics Laboratory at the Museum (headed by Dr T. Feldstein-Farkash) routinely provides genetic identifications of the bird remains and compliments our microscopic and morphological work. This is particularly important when the remains do not allow species-level morphological identification in cases such as bird collision with aircrafts, illegal poaching and ecological surveys based on environmental samples. During 2021—2022, the Molecular Lab examined 59 bird strike cases for the Israel Airports Authority and 36 cases for the Israeli Airforce.

During the reporting period of 2021—2022, the Feather Identification Lab examined 110 bird strike cases and 280 cases for the Israel Nature and Parks Authority.

THE HERBARIUM

THE WATER PLANTS, CYANOBACTERIA AND WATER FUNGI COLLECTIONS

Razy Hoffman

Research and curation (2021—2022)

Surveys and collecting trips continued and the herbarium was upgraded with the addition of nearly 900 new herbarium specimens of seaweeds, cyanobacteria, marine fungi and seagrasses from the Mediterranean and the Red Sea. Freshwater Bryophytes and Charophyta were collected from inland waters. Surveys of 2021—2022 revealed some new aliens seaweeds that had never been reported from the Levantine shore of Israel before. Some of them are first records from the Mediterranean Sea.

Taxonomical and molecular studies also revealed several species new to science from the Red Sea and from the Mediterranean shore of Israel.

Maintenance and cataloging of both Lipkin's and Hoffman's dry collections continued in 2022.

Collaborative studies

- Collaboration with Dr Frederik Leliaert and Prof. Olivier De Clerck from Gent University, Belgium, resulted in publishing a paper including molecular study reports of two new green non-native seaweed invaders.
- A collaborative study with Dror Melamed (citizen scientist) from Tel Aviv continued, regarding the genus *Riella* and other liverwort found in freshwater reservoirs in Israel. The collection of sediments revealed some new strains of the genus.
- A new collaborative study supervised by Prof. Maria Alba Vergés Guirado (University of Girona, Spain) of the origin of the invasive strain of *Lophocladia lallemandii* in the Mediterranean, including the Mediterranean shore of Israel, was initiated.

LAND PLANTS COLLECTION

Yuval Sapir and Jotham Ziffer-Berger

Research

During the 2021—2022 academic year, we focused our research efforts on:

- The natural populations of *Vitis* (Vitaceae) in Israel and their reproduction;
- Evolution and systematics of Brassicaceae.

Collection management

- We received ca. 1100 new specimens from Israel Gene Bank, Avi Shmida, Yuval Sapir, Dar Ben David, Bar Shemesh and Yair Ur.
- We organized the Israeli lichen collection and stored it in the main herbarium hall.
- We started organizing the foreign lichen collection and preparing it for storage.

Databasing

During the reporting period, we databased 1173 land plant specimens and about 486 lichen specimens.

Scientific collaboration

The vascular plant herbarium maintained research links with several institutions:

- Oz Barazani, Volcani Institute;
- Einav Mayzlish-Gati, Volcani Institute;

- Thameen Hijawi, Al Quds University (Abu Dis, Palestinian Authority);
- Klaus Mummenhoff, Osnabrueck University (Germany);
- Ilana Shtein, Ariel University;
- Daniela Cafri, Minisrty of Agriculture;
- Avigail Heller, Ministry of Agriculture;
- Agostinho Chicaia, African Union (Addis Ababa, Ethiopia);
- Avi Shmida, the Hebrew University of Jerusalem;
- Shivi Drori, Ariel University;
- Udi Weiss, Bar Ilan University.

Field trips

The Herbarium staff went on collecting trips to Bet Shean Valley (3 days) and Samaria (1 day).

Conferences

We held a Hebrew botanical conference celebrating the inauguration of the new herbarium hall, and dedicated the conference to Prof. Avi Shmida, who donated his collection to our museum.

Visitors

During the 2021—2022, we accommodated five researchers from Ariel University, Research and Development Instuitute—East, Volcani Institute and the Israel Plant Gene Bank.

Teaching

The following academic courses were offered:

- Introduction to plant sciences (Dr J. Ziffer-Berger, Levinsky Wingate College of Education);
- General Botany (Dr J. Ziffer-Berger, Levinsky Wingate College of Education);
- Unique phenomena in plants (Dr J. Ziffer-Berger, Levinsky Wingate College of Education).

THE PALAEOSCIENCES SECTION

THE PALAEONTOLOGICAL COLLECTION

Daniella E. Bar-Yosef Mayer

During the reporting period, the collections manager, Daniella Bar-Yosef Mayer, was on sabbatical leave, therefore there were no major activities in the collection. A graduate student, Jacob Dambitzer continued cataloguing the collection on a part time basis.

Dr Yuri Katz continued collaboration with his colleagues from the Institute of Geology and Geophysics, National Academy of Sciences of Azerbaijan; Institute of the Physics of the Earth, Russian Academy of Sciences; and Tel Aviv University. His research efforts focused on the quantitative analysis of magnetic anomalies in northern Israel and resulted in producing palinspastic tectonic-palaeomagnetic maps that contributed to understanding the palaeogeodynamic evolution of the easternmost Mediterranean during the period of 3.6—2.0 Mya. Yuri also continued to analyse tectono-geodynamical peculiarities of the African-Levantine-Caucasian region in relation to dispersal of ancient hominins from Africa to Eurasia.

Dr Olga Orlov-Labkovsky continued curation of the Palaeozoic Foraminifera collection, focusing on the preparation of thin-sections or slides of the material from the Carboniferous (Upper Palaeozoic) of the Central and South Tien Shan (Central Asia: Uzbekistan, Kyrgyzstan, Tajikistan and Kazakhstan). She continued to work on the project *A mass extinction on the transition (boundary) of the Permian–Triassic (P/T) in the Coastal Plain of Israel on the example of foraminifera* in cooperation with Dr Dorit Korngreen of the Geological Survey of Israel (Jerusalem). Olga also continued her research collaboration with the Subcommission on the Carboniferous Stratigraphy, particularly with Prof. Markus Aretz, Geosciences Environnement Toulouse Université Paul Sabatier, Toulouse, France, and with the Institute of Geology and Geophysics, National Academy of Sciences of Uzbekistan, Tashkent, Uzbekistan.

THE ARCHAEOBOTANICAL COLLECTION

Dafna Langgut

All research done in the Laboratory of Archaeobotany and Ancient Environments is based on our botanical collections. The reference collections available in the Lab focus mainly on the Israeli flora and include the following:

- Pollen and Spores Collection (a reference collection)
- Wood Collection (a reference collection)
- Thin sections wood anatomical structure (a reference collection)
- Charcoal Collection (a reference collection)
- Archaeobotanical Collection (discoveries from archaeological excavations)

Activities related to the Botanical collection

- We collected new samples for all our references collections (pollen, wood and charcoals), mainly from Tel Aviv Botanical Gardens (with cooperation of Dr Y. Sapir).
- Ancient waterlogged wood preservation project. We preserved for future studies the waterlogged wood assemblage of the ca. 600,000-year-old site of GBY NBA (Gesher Bnot Ya'akov, North Bridge Acheulian).
- The First Annual Meeting of the Israeli Botanical Forum, Tel Aviv University (organized together with Dr J. Ziffer-Berger) (May 2022).

Active grants

2022—2023 Gerda Henkel Foundation. *Early* Homo *dispersals Out-of-Africa: human adaptability to environmental changes?* (P.I., €30,000).

2022—2026 Israel Science Foundation. *The pollen evidence of Early-Pleistocene Milestones in the Out-of-Africa Corridor: A paleoenvironmental study of south Levantine paleo-waterbodies* (P.I., NIS 420,000, equivalent to US$125,000).

2022—2023 Tel-Hai College Research Grants. *Reconstructing the paleo-vegetation and climate of the upper Jordan Valley — new palynology of the 750,000-year-old Benot Ya'aqov Formation* (P.I., together with G. Sharon, NIS20,000, equivalent to US$6,000).

2022—2023 Irene Levi-Sala CARE Archaeological Foundation, Hebrew University of Jerusalem. *Paleoenvironmental conditions during early* Homo *dispersals Out-of-Africa: The pollen evidence from the Levantine Corridor* (P.I., US$6,000).

Research projects and collaborations

<u>The reconstruction of gardens in Pompeii</u>

I was invited by an American expedition that conducts excavations in Pompeii, to apply the pollen-plaster technique that I developed several years ago. I successfully applied this cutting-edge method to the garden of Villa Arianna (Langgut 2022) and am currently applying it to Casa Del Regina Carolina (CRC). We published some preliminary pollen results regarding the CRC project. I participated in the CRC excavation at Pompeii and collected additional plaster samples aiming to provide a more detailed botanical reconstruction of the plant composition of the CRC garden. The pollen-plaster technique has great potential, specifically in Pompeii, since most of these ancient gardens were already long-exposed or even destroyed. Furthermore, some of the Pompeiian gardens were 'contaminated' by pollen from recent flora that was planted by the Archaeological Park of Pompeii. To fund this ongoing research beyond a small grant I received, I intend to submit a grant proposal together with my colleagues from Cornell University, Prof. Kathryn Gleason (a world-leading scholar in Roman gardens) and Dr Caitlín Barrett (Director of the CRC project). Through these projects, I also studied horticulture trends (e.g., dwarfism of trees and importation of exotic plants) in elite Roman gardens.

<u>The beginning of fruit tree cultivation</u>

My recent studies showed that the earliest evidence worldwide of fruit tree horticulture derived from the southern Levant. This groundbreaking discovery was achieved based on identification of fig and olive wood remains from 7,000-year-old strata of Chalcolithic Tel Tsaf, which is located

outside the realm of natural olive distribution. In archaeobotany, this is considered indisputable proof of domestication (Langgut & Garfinkel 2022). This project was featured in *Science News*: https://www.sci.news/archaeology/olive-fig-tel-tsaf-cultivation-10910.html.

Reconstruction of natural and cultural landscapes in ancient Israel

This task involves identification of wood-charcoal assemblages from excavations in order to reveal the natural vegetation near the sites, timber types that were used for construction and fuel, fruit tree horticulture, tree importation, etc. The remains were collected from the following sites: Shivta, Elusha, Nitsana, Azekah, Timna, City of David (Jerusalem), Herodium, Tel Goren and Tel Beit-Yerah. Through these projects, two MA theses were submitted, two dissertations were being written and several papers were published.

Paleoenvironment of the Levantine Corridor during early *Homo* dispersals Out-of-Africa

Though climate instability and environmental variability are a catalyst for human evolution, only limited evidence is available to assess hominin adaptations to environmental changes during key evolutionary stages such as the Early-Pleistocene, when hominins first dispersed Out-of-Africa. In this proposed study, sediment samples that were recovered from two Early-Pleistocene Levantine paleo-waterbodies, Zihor and 'Ubeidiya, would be used to reconstruct the paleoenvironment based on the identification of fossil pollen grains. Both paleo-waterbodies encompass Lower Paleolithic human artifacts ascribed to the Early Acheulian culture ('Ubeidiya-type techno-complex). Although the Levantine Corridor was one of the main routes of northward migration of hominins, the vegetation and climate conditions of this gateway area were not studied in detail. To execute this project, an MA and a PhD students were recruited, and two grants were received from the Gerda Henkel Foundation and the Israel Science Foundation.

Supervision of students

In 2021—2022, I supervised four PhD students (Mark Cavanagh, Nitsan Ben Melech, Yael Hockema, Minji Jin) and two MA students (Inbar Friedman, Elizabeth Ahola).

Scientific meetings and lectures

Local Conferences

- The 14th Annual Conference on New Studies in the Archaeology of Jerusalem and its Region, October 2021, paper: *Exposing the royal gardens of ancient Jerusalem*.
- The Annual Conference of the Sonia and Marco Nadler Institute of Archaeology, Tel Aviv University — New Discoveries from the Excavations and Research of the Institute of Archaeology, November 2021, paper: *Between royal gardens and ancient diseases, a case study from Armon Hanatziv, Jerusalem*.
- The Annual Conference of the Israel Prehistoric Society, Ben-Gurion University, December 2021, paper: *Paleoclimate reconstruction of the Epipaleolithic Mediterranean Levant based on pollen and wood remains recovered from the JRD site*.
- The Reality of 'The Garden': Art, Poetics and Archaeology, TAU Art Gallery, December 2021, paper: *A botanical-archaeological perspective on Herod's royal gardens*.
- The 47th Archaeological Congress of Israel, Tel Aviv University, March 2022, paper: *Wood economy of Tel Beit Yeraha* (together with E. Mor [presenter] and R. Greenberg).
- The 47th Archaeological Congress of Israel, Tel Aviv University, March 2022, paper: *Visiting the royal gardens of King Herod the Great at Herodium* (together with R.S Evyasaf [presenter], K. Gleason, A. Ben-Haim and Y. Korman).
- The 47th Archaeological Congress of Israel, Tel Aviv University, March 2022, paper: *Environment and climatological background of the Neolithic Revolution and the beginnings of fruit tree cultivation (Chalcolithic)*.
- The Israeli Botanical Forum, The Steinhardt Museum of Natural History, Tel Aviv University, May 2022, paper: *The history of olive (*Olea*) and citron (*Citrus medica*) in the Mediterranean Basin*.
- Meeting in Honor of the Retirement of Professor Simcha Lev-Yadun, Oranim-Haifa University, September 2022, invited lecture: *Between east to west — the reconstruction of prestigious gardens in the archaeological record*.

International Conferences

- Cultural Plants and their Wild Ancestors. International Symposium organized by the Israel Gene Bank, Botanical Gardens, Jerusalem, March 2022, invited lecture: *When and where olive was brought under domestication?*
- The 19th Conference of the International Workgroup for Palaeoethnobotany, České Budějovice, Czech Republic, June 2022, paper: *Environmental roots of the transition to agriculture: integration of on-site and off-site data*.
- EU Operational Program Research, Development and Education: International Seminar Course, Charles University, Prague, invited seminar: *The natural and cultural landscape of Judea: between climate crises and royal gardens*.

ARCHAEOMALACOLOGY

Daniella E. Bar-Yosef Mayer

During the reporting year I was a visiting scholar at the Department of Anthropology and Peabody Museum of Archaeology and Ethnology at Harvard University and was mostly busy writing a book about shell artifacts (as yet in progress), therefore there were no major activities in the collection.

Scientific collaborations

- I collaborated with a research group from Cyprus on the project *Delineating probably sea routes between Cyprus and its surrounding coastal areas at the start of the Holocene: A simulation approach*.
- I was a Scientific Advisor to the exhibition *Adornment: Jewelry and Body Decoration in Prehistoric Times* at the Israel Museum, Jerusalem.

Conferences

- 2021 — American Society of Overseas Research, Chicago, USA. Paper presented: *Making ties: widening circles of affiliation at Neolithic Kfar HaHoresh as expressed through the molluscan assemblage*.
- 2022 — Society for American Archaeology, Chicago, USA. Paper presented: *The earliest strung beads of the Middle Palaeolithic*.

Student supervision

- Heeli Schechter, PhD, Hebrew University of Jerusalem: *The use of shells as adornments among PPNB communities in the Mediterranean zone of the Southern Levant*. (Co-adviser: Prof. Nigel Goring-Morris)
- Daria Leibin-Graiver, MA, Tel Aviv University: *Mollusc shells as material culture in the Iron Age II of the Southern Levant*. (Co-advisors: Ido Koch, Oded Lipschits)
- Yaara Shafrir, MA, University of Haifa: *The Plaster beads of Nahal Hemar Cave, a Neolithic site in the Judean Desert*.

Public outreach

- Harvard Archaeology Seminar (10 March 2022): *The earliest strung beads*.
- UConn/Stony Brook University archaeology lecture series (4 November 2021): *The earliest strung beads: What they tell us and why it matters*.
- Onlineolithic webinar series (1 December 2021): *Personal ornaments in the Neolithic southern Levant*.

ARCHAEOZOOLOGY

Lidar Sapir-Hen

The research at the Laboratory of Archaeozoology is based on the Archaeozoological collections. Since 2020, the Laboratory conducts sampling of bones for stable isotopes analysis.

Active grants

2019—2021 The Porter Foundation "Life Under Extreme Conditions at the Dead Sea". *Food for thought: Exploring identity and survivorship mechanism through food refuse from a refugee camp on the fringe of the Judaean Desert* (P.I., US$ 50,000).

2020—2023 Israel Antiquities Authority. *Hunting and herding at the dawn of animal domestication* (P.I., NIS 120,000).

Ongoing research projects

- Hunting and herding at the dawn of animal domestication;
- The development of animal husbandry in the Neolithic period;
- The emergence of complex societies in the southern Levant;
- The role of animals in past populations;
- Urban—rural relationships under the Islamic rule.

Field projects

I actively participated in archeological excavations at Masada, Timna, Azekah and Tel Hadid. My participation included advising site directors on retrieval methods of findings, and lectures to students at the field school using comparative collections.

Conferences

- The American Schools of Oriental Research Annual Meeting, November 2021, Chicago, USA, paper presented: *The role of animals in the mobility of biblical era societies*.
- 9th meeting of the ICAZ Animal Palaeopathology Working Group, March 2022, Wrocław, Poland, paper presented: *A survey of animal paleopathology cases, from the Neolithic to Early Modern Period in the Southern Levant*.

Student supervision

I advised four MA, one MSc and one PhD students, and one postdoctoral fellow. In addition, one lab technicians worked on archeozoological projects. The students' work was based on faunal assemblages from archeological sites (archeozoological collection) and relied on the Museum mammal and bird comparative collections.

Teaching

Teaching at Tel Aviv University: *Introduction to archaeozoology*, *Using the archaeozoological collection from various excavation sites and the land vertebrates collection*.

Visiting scholars to the Archeozoological collection

- Prof. Cheryl Makarewicz, Kiel University, Germany;
- Prof. Haskel Greenfield (University of Manitoba, Winnipeg, Canada);
- Prof. Deirdre Fulton (Baylor University, Waco, TX, USA);
- Prof. Elizabeth Arnold (Grand Valley State University, Allendale, MI, USA).

FISH OSTEOLOGICAL COLLECTION

Irit Zohar

The fish osteological collection includes over 700 fish skeletons from the Mediterranean and Red Sea, the Nile (Egypt) and other freshwater habitats. This collection is used to identify fish remains recovered from lacustrine sediments, animal gut contents and archaeological sites in the southern Levant. The fish osteological collection is vitally important for characterization of environmental changes in aquatic habitats, reconstruction of fish economic and dietary value to past populations, and for detection of past fishing technologies and processing methods.

Collections management and databasing

For better curation of the fish skeletal and archaeological collection, new boxes were purchased and new labels were printed. The reference collection was expanded by purchasing new fish from the Levant, the western part of the Mediterranean Sea, and from the Atlantic Ocean. Digitizing the modern osteological reference collection and the archaeological material continued.

Research

During the reporting period, the following research projects were active:

- The use of fish remains in reconstructing the palaeoenvironment and understanding their significance in the diet and evolution of hominids.
- Fishing for isotopes: The contribution of icthyoarchaeology and isotopic analyses in the study of the Iberian Medieval and Modern Age fisheries (6th/17th CE).
- New insights on human-fish interactions, selection, and trade during the Iron Age period, along the Levantine coast.

Collaboration with local and overseas researchers

- Dr Nimrod Marom — University of Haifa, Israel;
- Prof. Ayelet Gilboa — University of Haifa, Israel;
- Dr Ofra Barkai — University of Haifa, Israel;
- Dr Guy Sisma-Ventrura — Israel Oceanographic & Limnological Research Institute, Haifa, Israel;
- Prof. Israel Hershkovitz — Tel Aviv University, Israel;
- Prof. Arturo Morales Muñiz — Universidad Autónoma de Madrid, Spain;
- Prof. Eufrasia Rosello — Universidad Autónoma de Madrid, Spain;
- Dr Luis Angel Ortega Cuesta — University of the Basque Country, Bilbao, Spain;
- Dr Yolanda Fernández Jalvo — Museo Nacional de Ciencias Naturales, Madrid, Spain;
- Dr Jens Najorka — Natural History Museum, London, UK;
- Prof. Thomas Tütken — Johannes Gutenberg-University of Mainz, Mainz, Germany;
- Dr Romina Frontini — Universidad Nacional del Sur Bahia Blanca, Argentina;
- Dr Laura Llorente Rodriguez — University of Leiden, The Netherlands.

Conferences

- July 2022 — I. Zohar organised, together with Lidar Sapir-Hen, a one-day meeting of local and international zooarchaeologists, with some 20 participants.
- August 2022 — NHM Vienna Austria: ICAZ Fish remains working group 21st meeting. Presentations: (1) *Masters of the Levantine Sea: Patterns in fish exploitation during the Iron Age period.* (2) *On the track of the elusive gilthead (*Sparus aurata*): a preliminary survey of finds in the Mediterranean and Iberian Peninsula.*
- October 2021 — La maison méditerranéenne des Sciences de l'homme est une maison des Sciences de l'homme implantée à Aix-en-Provence, France, Sea, Fish, and Sun "Archaeological and isotopic approach of aquatic resource acquisition". Presentation: *Sparus aurata role in the Blue Revolution.*

PALAEOGENOMICS LABORATORY

Meirav Meiri

Since May 2021, the Palaeogenomics Laboratory has been fully operational in its new spacious location in the Museum. During the reporting period, the Lab continued to work on museum and palaeobiological specimens.

On-going research projects

- *Revealing the lost Byzantine viticulture of the Negev Highlands*. The aim of this project is to identify the origin and diversity of the Negev grapevine varieties, and to determine the closest living relatives of the Negev Byzantine heirloom cultivars.
- *Modelling Anthropocene trophic cascades of the Judean Desert ecosystem: A hidden dimension in the history of human-environment interactions*. In this project we explore the effects of human settlement intensity on desert ecological community structure, focusing on the hitherto unstudied phenomenon of trophic cascades in antiquity.
- *Taxonomic and ecological characterization of the extinct Hartebeest (*Alcelaphus *sp.) population in Israel*. The aim of the project is to identify the exact taxonomy of the Hartebeest and explore whether habitat availability or human impact led to its extinction.

Active grants

2020—2024 The Israel Science Foundation research grant (No. 915/20) with Prof. Guy Bar-Oz, Department of Archaeology, University of Haifa.
Project: *Revealing the lost Byzantine viticulture of the Negev Highlands*.

2020—2024 Tel Aviv University — University of Manchester Research Fund (21,000 NIS).
Project: *Using multiomic approaches to understanding ancient biomolecule preservation*.

Conferences

April 2022 The Israeli Archaeological Congress, Tel Aviv University, Tel Aviv, Israel.
Talk: *Crested rat in the Judaean Desert: Taxonomy, genetics and paleoclimate reconstruction*.

Visitors from abroad

In May 2022, we accommodated Catalina Haidau, a PhD student from Institute of Speleology, Romania, working on ancient wolves.

Student supervision

- Uri Wolkowski, project title: *Taxonomic and ecological characterization of the extinct Hartebeest (*Alcelaphus *sp.) population in Israel* (joint supervision with Dr Nimrod Maron, University of Haifa).

DAN DAVID CENTER FOR HUMAN EVOLUTION AND BIO-HISTORY RESEARCH

Rachel Sarig, Hila May, Viviane Slon and Israel Hershkovitz

The Dan David Center for Human Evolution and Bio-History Research occupies over 1200 square meters at the Steinhardt Museum of Natural History. The Center includes technical and research laboratories, as well as an exhibition on the origins and evolution of humankind.

The goals of the Dan David Center concentrate on:

- Searching for the origin of modern humans — development and migration.
- Studying the origin of diseases, their development and evolutionary history as well as the development of medical knowledge.
- Understanding the dynamics of human demography and its association with cultural, economic and scientific changes through time.
- Biohistory: reconstructing historical events from human fossils remains.
- Creating a digital database that will be accessible to researchers worldwide.
- Initiating scientific collaboration with other leading institutes.
- Preserving and restoring important fossils.
- Initiating excavations in important prehistoric sites.
- Delivering knowledge on human origin and development to the public.
- Fostering scientific and cultural ties with non-Israeli scientists and students.

Running research projects (2021—2022)

Dr Hila May

- Violence in the Neolithic.
- The earliest evidence of failed hunting from Nesher-Ramla site.
- Bone rings from Motza PPNB site.
- The murder reconstruction at the Byzantine church in Ashdod Yam.
- Paleopathology in domesticated animals at the advent of agriculture.
- The people from Timna Valley.
- An evolutionary perspective on rare genetic diseases: Klippel Feil Syndrome of a Nabatean nobleman from Yotvata.

Prof. Israel Hershkovitz
- Homo VI from Tinshemet Cave.
- The frontal bone from Nesher Ramla.

Dr Rachel Sarig
- The teeth from Geulla and Misliya Caves.

Dr Viviane Slon
- Preservation of morphological features prior to DNA sampling.
- What was the genetic makeup of the people of the Levant during the Paleolithic?
- Who were the inhabitants of the southern Levant during the Neolithic revolution?
- An ancient DNA view of the Chalcolithic.

Running field projects 2021—2022
- Manot Cave excavation (Early Upper Palaeolithic);
- Tinshemet Cave project (Middle Palaeolithic);
- Skhul Cave project (Middle Palaeolithic);
- Tabun Cave project (Middle Palaeolithic);
- Geulla Cave project (Middle Palaeolithic);
- Timna valley project (Early Bronze Age — Iron Age);
- Emireh Cave project (Upper Palaeolithic);
- Horashim East (Middle Palaeolithic) (2021 only);
- Revadim;
- Qadim Cave Project (Late—Early Neolithic).

Active collaboration projects with foreign researchers (2021—2022):
- Prof. Gerhard Weber — University of Vienna, Austria;
- Prof. Anne-Marie Tillier — Université Bordeaux, France;
- Prof. Dominique Grimaud-Hervé — Muséum national d'Histoire naturelle, Paris, France;
- Prof. David Reich — Harvard University, USA;
- Prof. Svante Pääbo — Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany;
- Prof. Johannes Krause — Max Planck Institute for the Science of Human History, Jena, Germany;
- Prof. Rolf Quam — Binghamton University, US;
- Prof. Bruce Latimer — Case Western Reserve University, Ohio, USA;
- Prof. Luca Fiorenza — Monash University, Australia;
- Prof. Paul O'Higgins — The University of York, UK;
- Prof. Stefano Benazzi — University of Bologna, Italy;
- Prof. Frank Ruhli — University of Zurich, Switzerland;
- Prof. Antoine Balzeau — Histoire Naturelle de l'Homme Préhistorique, CNRS;
- Dr Matthias Meyer — Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany;
- Dr Priya Moorjani — University of Berkeley, California, USA;
- Dr Marine Frouin — University of Stony Brook, NY, USA;
- Dr Andrew Kandel — University of Tuebingen, Germany;
- Dr Maria Spyrou — University of Tuebingen, Germany;
- Dr Matasha Mazis — Technical University of Darmstadt, Germany.

Active collaboration projects (incl. joint research grants) with Israeli archaeologists (2021—2022):
- Dr Yossi Zaidner — Hebrew University;
- Dr Uri Davidovich — Hebrew University;
- Dr Dina Shalem — Kinneret College;
- Prof. Ofer Marder — Ben Gurion University;
- Prof. Mina Weinstein Evron — Haifa University;

- Dr Reuven Yeshurun — Haifa University;
- Dr Dani Nadel — Haifa University;
- Dr Ron Shimelmitz — Haifa University;
- Dr Omri Barzilay — Israel Antiquities Authority;
- Prof. Udi Weiss — Bar Ilan University;
- Dr Guy Stibel — Tel Aviv University;
- Prof. Erez Ben-Yosef — Tel Aviv University;
- Prof. Avi Gopher — Tel Aviv University;
- Dr Ido Koch — Tel Aviv University;
- Dr Hamudi Khalaily — Israel Antiquities Authority;
- Dr Kobi Vardi — Israel Antiquities Authority;
- Dr Gonen Sharon — Tel Hai College;
- Prof. Yuval Gadot — Tel Aviv University;
- Prof. Oded Lipschits — Tel Aviv University;
- Dr Ella Assaf — Tel Aviv University;
- Dr Ianir Milevski — Israel Antiquities Authority;
- Prof. Leore Grossman — Hebrew University;
- Dr Michal Birkenfeld — Ben Gurion University;
- Prof. Dani Rosenberg — Haifa University;
- Dr Pablo Bezer — Israel Antiquity Authority.

MOLECULAR SYSTEMATICS LABORATORY AND TISSUE COLLECTION

Dorothée Huchon and Tamar Feldstein-Farkash

The molecular systematics laboratory of the Steinhardt Museum of Natural History at Tel Aviv University (SMNH) offers identification of museum samples when morphological identification is uncertain.

Operational

During the reporting period, tissues from 350 animal specimens, including mammals, birds, reptiles, fish, echinoderms, polycheates, mollusks, crustaceans, insects, sponges and fungi were processed for molecular identification. The molecular work, in collaboration with the morphological identification by collection managers, or researchers working in the different collections, proved to be highly important for the curation of the samples, and for promoting the zoological and ecological research.

The Laboratory also provides genetic identifications of birds involved in collision with aircrafts, illegal poaching and ecological surveys by the Israel Nature and Parks Authority, which is particularly important when remains do not allow species-level identification based on morphology. During 2021—2022, the Lab examined 59 bird strike cases for the Israel Airports Authority and 36 cases for the Israeli Airforce. Altogether, the molecular identifications included 190 genetic analyses of 55 bird species and two bat species.

Collections management and databasing

The Molecular Systematics Collection of the SMNH consists of frozen or alcohol-preserved tissues of vertebrates and invertebrates. We encourage its use by the international non-profit research community.

During the reporting year, 710 tissue samples were added to the Museum tissue collection, including 84 mammal specimens (25 species), 71 (60) birds, 299 (67) reptiles and 53 (5) amphibians. The DNA or tissue samples from the mammal collection were loaned to Barbara Boljte from the University of Ljubljana, Slovenia, to Elena Fabbri and Romolo Caniglia from the Istituto Superiore per la Protezione e la Ricerca Ambientale, Bologna, Italy, to Yaron Tikochinski from the Ruppin

Academic Center, Israel, and to Ayelet Barash from the Shamir Research Institute, Israel. A bird tissue sample was loaned to Alexander Kirschel from the University of Cyprus.

Student training

The molecular lab provides training in the molecular techniques for students and personnel of the SMNH and School of Zoology, Tel Aviv University. In 2021—2022, 17 students took the course *Applied molecular species identification* (#0431-3896-01, 2 academic credits) and acquired basic technics in the DNA extraction and PCR. The course offered both wet-lab practices and computer analysis of results. The course focused on the practical aspects (rather than theory) of molecular barcoding and provided hands-on experience and guidance in utilizing genetic sequence data.

THE MUSEUM DATABASE

From inception to the public domain

Menachem Goren

The digitization of the Steinhardt Museum of Natural History (SMNH) collections commenced in 1978, when we were among the world pioneers in computerizing biological collections. The data were stored on magnetic tapes, fed by punched cards to a mammoth CDC computer and organized using FORTRAN package. Since then, the database went through frequent upgrading until 2021—2022, when we completely moved it to a new, advanced system based on the SQL Server solution.

The SMNH collections comprise over 5.5 million items, of which a few thousands are in the public wing of the museum in exhibitions such as *The Father Schmitz collection* and *Treasures of Biodiversity*. New items are being added to the collections by our scientists on a daily basis. These days, many specimens are being deposited by the Israel Nature and Parks Authority and by zoos.

The Museum's natural history collections form a dynamic and vital archive of the biodiversity of Israel and many other countries around the world. This archive is at service to Israeli and overseas scientists as a tool for environmental, evolution and nature conservation research.

Continuous documentation of the biota is indispensable for understanding changes in ecosystems around us. Using collections data, scientists can trace phenomena such as temporal and spatial spread of parasites, changes in concentration of pollutants in ecological systems, assess the impact of urbanization on the environment, *etc*. About 500 scientists from Israel and abroad use the SMNH collections every year.

The SMNH database contains over 600,000 records, with about 30,000 added annually. Most of the vertebrate and invertebrate (terrestrial and aquatic) collections, except for the insects, are completely digitized. It has become a standard routine that newly acquired specimens are preserved, identified to the lowest possible level by the museum taxonomists, registered in the database and only then enter a corresponding collection for safekeeping. A collection item can be either a single animal or plant, or a whole jar with dozens of specimens such as fish or crustaceans. If a species is identified as new to science, it is named, described and published in a reputable scientific journals.

All previously used databases have been standardized and merged into a single database on the new platform. This makes data mining more efficient and enables running complex queries for extraction of taxonomic, spatial, temporal and other pertinent information. Each record provides scientific names of the organism and particulars of the collecting event (date, the collector's name, *etc*.).

The new database system improves the management of loans to comply with the best international practices. The system enables printing all kinds of labels for the specimens, producing shipment lists of the material, address stickers for the packages, declarations for the customs, tracking the shipments, etc.

The SMNH database has been made available to the public on the Museum Website and is to be updated annually (https://smnh.tau.ac.il/en/research/collections-database).

The museum database: 2021—2022 update

Yonatan Gur and Tirza Stern

During 2021—2022, we completed data migration for most of our active collections, including the insect collection that holds roughly two-thirds of the records presently in our database. Collection data were migrated from our legacy systems to a new centralized database with an improved user interface, performance and features. This upgrade greatly improves our ability to extract information and share it with our colleagues. During the year, the new system underwent tweaking of the user interface and general functions as per feedback from our end users. We also registered and trained 29 additional users.

In 2021—2022, 40,036 new records were added to the SMNH database, to a total of 597,229 entries. At present, the SMNH database contains the following numbers of entries in the following groups, with the number of new records in parentheses:

- Amphibia — 2890 (99)
- Aquatic parasites — 65 (18)
- Archaeobotany — 1012
- Arthropoda (other than insects) — 6724 (178)
- Ascidiacea — 1184 (50)
- Aves — 23720 (378)
- Brachiopoda — 47
- Bryozoa — 480
- Coelenterata — 13926 (40)
- Echinodermata — 2436 (35)
- Feather Identification Lab — 2332 (264)
- Foraminifera — 786
- Fossils — 3579 (35)
- Insecta — 403221 (35081)
- Lichens — 1831 (486)
- Mammalia — 17451 (168)
- Molecular Laboratory — 1830 (255)
- Mollusca — 66275 (1420)
- Pisces — 15716 (277)
- Porifera — 1684 (338)
- Reptilia — 20386 (539)
- Vascular plants — 3486 (1173)
- Vermes — 260 (20)
- Water plants — 5908

PEST RISK ASSESSMENT PROJECT

Zohar Yanai

Since December 2021, the SMNH staff were involved in a joint Pest Risk Assessment (PRA) project with the Plant Protection and Inspection Services (PPIS) at the Ministry of Agriculture. Due to changes in import regulations, initiated by the Israel Government, the PPIS was tasked to prepare a scholarly-based file for each agricultural product that may potentially be imported to Israel. This file, aligned with the international standards of PRAs, included various details regarding potential pests that may infect, and transfer with, produce. Upon the PPIS' request, the SMNH staff obtained relevant pest lists, each being evaluated by the in-house experts who provided information regarding their biology, distribution, economic impact, etc. Based on this information the PPIS officials could formulate product-specific regulations and measures. This joint project was of the highest importance for protecting Israel's agriculture and nature from invasive pests.

During the period of concern (2021—2022), the project involved the following members: Prof. Netta Dorchin, Leonid Friedman, Dr Liron Goren, Dr Moshe Guershon, Dr Armin Ionescu-Hirsch, Dr Liz Morgulis, Dr Tatyana Novoselsky, Dr Gideon Pisanty, Oz Rittner, Dr Dany Simon, Dr Malkie Spodek, Ofir Tomer and Dr Jotham Ziffer-Berger. The staff contributed a total of 735 labour hours and assessed eleven products.

THE ISRAEL TAXONOMY INITIATIVE

Noga Sokolover

Preservation of biodiversity—the variety of life forms on the planet—depends on scientific knowledge and expertise. Government agencies, research institutes and nature conservation organizations around the world have identified an alarming gap between the existing taxonomic knowledge of biodiversity and the need for this information to guide the best conservation practices. Taxonomic research is crucial for identification of the great majority of living organisms, to understand the evolution of life and to slow down the loss of species; however, the state of the discipline is still inadequate. Many sophisticated tools and models—morphological, biochemical and genetic—as well as advanced software, are available for taxonomists; still, basic research lags seriously behind needs. The Millennium Ecosystem Assessment—a United Nations endeavour to review trends and implications of changes in global ecosystems—identifies insufficient knowledge of species and their geographic distributions as one of the impediments to sustainable development; the international treaty of the Convention on Biological Diversity initiated the Global Taxonomy Initiative in an effort to improve this situation.

In Israel, where geographic, topographic and climatic conditions have contributed to amazing and unique biodiversity, the basic taxonomic research is in despair. A recent report submitted to the Israel Academy of Sciences and Humanities demonstrated that within 10 years—the average period for training a young taxonomist—Israel would have no scientists in research or teaching positions, who can pass the knowledge to the next generation of taxonomists. Therefore, a major and urgent effort is required to salvage this field and to ensure the existence of this critical discipline.

In addition to nature and environmental conservation, taxonomic research has direct implications for the agriculture, economy, human welfare and health; it is, therefore, essential that it remains viable in face of fleeting fashions in scientific research.

The Israel Taxonomy Initiative is a consortium of government ministries and agencies, research universities and higher education institutions that aims to promote training of taxonomists and to support fundamental knowledge of Israel's biodiversity by

- Providing doctoral and post-doctoral fellowships;
- Providing funding for overseas training for graduate students;
- Providing funding for biodiversity surveys;
- Inviting taxonomists from the international scientific community to teach short academic courses on local species groups.

Our goal is to revitalize Israeli taxonomy and deepen our knowledge of biodiversity, thus promoting the contribution of science to conservation of Israel's ecosystems and developing the sustainable use of the country's natural assets.

The Israel Taxonomy Initiative was launched in 2009, and its first stage was funded by Yad Hanadiv (The Rothschild Foundation) as a 5-year programme with the aim to support (through matching) postdoctoral studies abroad, PhD students, travel grants and monitoring surveys focusing on certain phyla, and to host foreign scientists to run short taxonomic courses and workshops in Israel. A second stage of the programme was also funded by Yad Hanadiv but on a smaller scale, and, therefore, it supported only PhD and Msc students (also with matching funds), as well as taxonomic courses presented by overseas experts. During these two rounds, the programme funded 4 postdoctoral and 12 PhD students, provided 29 travel grants, financially supported 33 biodiversity surveys and hosted over 30 foreign scientists.

The current stage of the Israel Taxonomy Initiative is funded by the SMNH only, focusing on taxonomic and biodiversity courses and workshops offered by local and foreign scientists. The courses are open to participants from all academic intuitions, governmental authorities and professionals. A classroom has been renovated and optical equipment purchased to facilitate these courses.

Due to Covid-19 restrictions and their repercussions, taxonomic courses and international research visits planned for the 2020—2021 academic year had to be generally cancelled.

ITI-sponsored courses in 2021—2022

- *Pseudoscorpions of Israel (Arachnida): creating in-country expertise for biodiversity research and applied science*, by Dr Efrat Regev-Gavish (The Hebrew University, Jerusalem) and Dr Danilo Harms (Leibniz Institute for the Analysis of Biodiversity Change, Hamburg, Germany).
  This course had been planned for the previous year but was postponed due to the COVID pandemic. It took place at the Hebrew University, Jerusalem.
- *Soil organisms in an ecological context from sampling to data integration*, by Dr Oren Shelf (Volcani Institute, Agricultural Research Organization) with Prof. Maria J.I. Briones (University of Vigo, Spain) and Dr Andrey Zaytsev (Justus Liebig University, Germany).
  The course was run at the Steinhardt Natural History Museum in collaboration with a COST action, with 15 Israeli and 6 foreign students.

EDUCATION AND SCIENCE COMMUNICATION DEPARTMENT

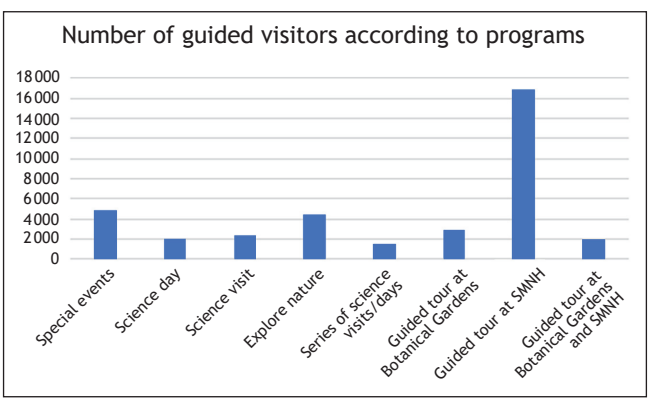
Ilil Pratt

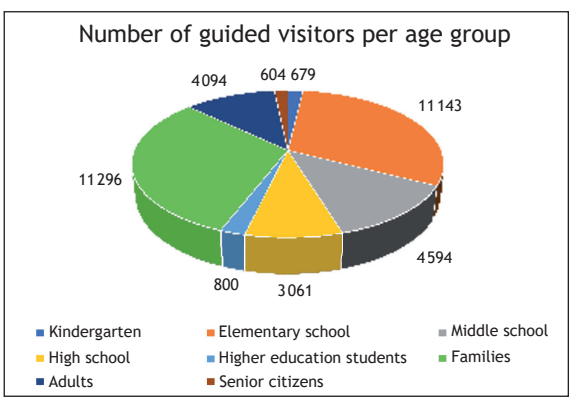
The academic year of 2021—2022 was marked by the return to routine after two years of the COVID-19 pandemic. And indeed, our guided visitor numbers rose three-folded to the highest figure than ever, with 36,271 guided visitors in a variety of programs.

This year, we launched a temporary exhibition *Global Warming: The Climate, the Crisis and Us* and initiated special guided tours at this exhibition, which attracted 3,511 visitors, including 1,872 school and kindergarten students.

With the re-opening of the Botanical Gardens, 5,894 people visited the gardens this year, either exclusively the gardens (2,826), or as part of a visit to the museum (1,868) or participating in other programs.

We assessed the visitor's experience at the museum in collaboration with Tel Aviv University's Social Involvement department in an observational study about the museum as an educational and social environment.





Left: Almost half (46%) of the guided visits during 2021—2022 were guided tours around the museum exhibitions.
Right: Over half (54%) of the guided visitors during 2021—2022 came from the education system, mostly from elementary schools. Additionally, we guided many families this year.

Visitors according to program

Program	Number of visitors
Guided tour at SMNH	16,794
Guided tour (incl. the Botanical Gardens)	1,868
Guided tour at the Botanical Gardens	2,826
Science day	1,892
Science visit	2,320
Series of science visits/days	1,446
Explore nature	4,306
Special events	4,819
Total	**36,271**

Visitors divided by age group

Age group	Number of visitors
Kindergarten	679
Elementary school	11,143
Middle school	4,594
High school	3,061
Higher education students	800
Families	11,296
Adults	4,094
Senior citizens	604
Total	**36,271**

ISRAEL CENTER FOR CITIZEN SCIENCE

Tomer Gueta

Scientific advisory committee: Prof. Ofer Arazy (Haifa University; Committee Chair), Dr Yehoshua Shkedy (INPA), Dr Ofer Steinitz (INPA), Dr Neta Lipman (IMEP), Dr Anna Trajtenbrot (IMEP), Dr Doron Markel (KKL-JNF), Dr Gilad Ostrovsky (KKL-JNF), Dr Yoav Perlman (SPNI), Dr Liat Hadar (Ramat Hanadiv), Dr Uri Roll (BGU), Dr Ori Sharon (BIU), Prof. Dan Malkinson (Haifa University), Prof. Jonathan Belmaker (TAU), Dr Shay Rotics (TAU), Dr Yael Mandelik (HUJI), Dr Yehezkel Resheff (HUJI), Prof. Tali Tal (Technion), Prof. Assaf Shwartz (Technion), Prof. Gil Rilov (IOLR), Prof. Ron Milo (Weizmann Institute), Prof. Ayelet Shavit (Tel-Hai College).

What is citizen science?

Citizen science (also known as participatory/community science) is the active involvement of the public in scientific research. It involves scientists and non-scientists—activists, volunteer groups, students, youth, and others—working together to gain new scientific knowledge through collaborative projects.

As a relatively new field of research and practice, citizen science has grown rapidly, primarily as a result of technological advancements that facilitate easy participation and direct communication with research teams. The significant contribution of citizen science and the importance of public participation in research are expressed through its many contributions to science, society and individual participants. There are thousands of active citizen science projects worldwide spanning a variety of fields, including astronomy, medicine, climate change, humanities, biodiversity, and the environment. Volunteers in these projects participate in various stages of the research, from selecting potential topics and formulating research questions, through collecting data and analyzing the results, to publishing and presenting the findings.

In early 2022, the Steinhardt Museum of Natural History began to develop the Israel Center for Citizen Science, to facilitate public participation in environmental monitoring and research in order to promote biodiversity science and conservation in Israel. The center will foster sustainable technological, scientific and social development to forge a stronger foundation for citizen science in Israel. It will be a hub—a source of knowledge and support—for existing citizen science programs and future initiatives, aiming to establish a national network of citizen science.

The center is guided by a scientific advisory committee with the following objectives:

- To provide professional academic guidance to the center's activities;
- To promote the field of citizen science within academia in Israel;
- To provide leadership and guidance for an annual citizen science conference;
- To enhance multi-organizational and multi-institutional collaborations in citizen science.

The Center's vision

The Israel Center for Citizen Science at the Steinhardt Museum of Natural History will facilitate general public participation in environmental research to promote biodiversity science and conservation in Israel.

The Center's goals

- To provide technical, scientific, and methodological support to existing and new citizen science initiatives in Israel.
- To ensure that research data and results are accessible to the public, stakeholders, and decision makers.
- To establish globally shared FAIR (Findability, Accessibility, Interoperability, Reusability) data.

The Center's team

The staff of the Center includes experts from academic and applied backgrounds with experience in citizen science both in Israel and abroad. Their fields of expertise include project design, recruitment and retention of volunteers, science communication, education and training, big data, open code development, information system management, user interfaces and data science.

Establishment of infrastructure

The center is currently developing a central technological platform, based on Living Atlas technology, to collate, manage and display biodiversity data collected through citizen science projects in Israel. A data collection application (BioCollect) is being adapted to support the management and collection of data from a wide variety of citizen science initiatives. This will provide flexibility in the development of new projects and enable data collection protocols to be tailored to each project's unique needs. Additionally, the iNaturalist platform and its accompanying applications (iNaturalist, Seek) are being adapted and localized for use in Israel. The central platform will serve as a gateway (central portal) for citizen science in Israel, displaying a catalog of projects as well as training materials, guides and other supporting resources. Following the establishment of the core infrastructure, the center intends to provide support to initiatives interested in receiving assistance, within its capabilities and resources. A scientific advisory committee accompanies the work of the center, and working groups will be established as needed.

The center's network of citizen science initiatives

The center's network of citizen science projects will include initiatives in the fields of biodiversity and the environment that meet citizen science standards, have expressed interest in joining the network, and are aligned with the mission and goals of the center. The network will provide a space for all initiatives to be displayed under one roof and offer its members support in creating and implementing their initiatives, as well as use of the resources developed by the center. The assistance may be methodological, scientific or technological in nature, and is subject to the center's capacity.

Conferences

- *Public participation in biodiversity monitoring*. Annual Science and Environment conference, Expo Tel Aviv. July 6—7, 2022. (Poster; Gueta T., Arazi O., Malkinson D., Shamir A., Lavie-Alon N., Priess-Bloom S., Arkin N., Golumbic Y.N., Sapan A., Dayan T.)
- *Israel Citizen Science Center — Establishment Perspectives*. Citizen Science for Planetary Health. 4th International European Citizen Science Association Conference, October 5—8, 2022, Berlin, Germany. (Talk; Gueta T., Lavie-Alon N., Golumbic Y.N., Sapan A., Dayan T.)
- *Between Exoplanets and Planetary Health: Viewing Citizen Science through the SDG Lens*. Citizen Science for Planetary Health. 4th International European Citizen Science Association Conference, October 5—8, 2022, Berlin, Germany. (Talk; Hoppe U., Schulten C., Santos P., Calvera M., De Groot R., Golumbic Y.N.)
- *Investigating the potential of citizen science to respond to emerging health challenges — The case of COVID-19*. Citizen Science for Planetary Health. 4th International European Citizen Science Association Conference, October 5—8, 2022, Berlin, Germany. (Poster; De Groot R., Golumbic Y.N., Turbe A.)

THE ISRAEL NATIONAL CENTER FOR AQUATIC ECOLOGY

National project for aquatic taxonomy, ecological assessment, and river management and restoration.

Yaron Hershkovitz

Steering Committee: Prof. Tamar Dayan (TAU), Dr Menachem Goren (TAU), Nissim Keshet (INPA), Assaf Tzhoar (INPA), Dr Dana Milstein (INPA), Neta Lipman (IMEP), Dr Amir Erez (IMEP), Hanoch Ilssar (Yad Hanadiv), Dr Doron Markel (KKL-JNF), Yehonatan Bar-Yosef (KKL-JNF).
Members: Dr Yaron Hershkovitz, Tuvia Eshcoli, Etai Kahana, Avital Katz, Adi Weiss, Nili Segman, Sasha Pekarsky.
MSc students: Almog Hershko-Pnuel, Dafna Luz.

The Israel Center for Aquatic Ecology (ICAE) was established in 2015 as part of the Steinhardt Museum of Natural History. Our main goal is to adapt and implement the EU-WFD bioassessment protocols for streams in Israel. It is supported jointly by the Israel Nature and Parks Authority (INPA), The Ministry of Environmental Protection, the Jewish National Found (HaKeren HaKayemet LeIsrael, KKL-JNF) and Yad Hanadiv Foundation.

Objectives

- The primary objective of the ICAE activity within the context of monitoring and assessment of the state of streams in Israel is the development and implementation of a national stream monitoring program.
- Creation of tools to monitor actions related to stream restoration, involving the monitoring of restoration activities and the overall management of streams.
- Conducting fundamental ecological research to expand our understanding of biological diversity, species distribution and ecological traits.
- Managing ecological databases, storing data and assimilating information to generate a comprehensive understanding of factors influencing stream conditions and deriving practical conclusions.
- Initiating efforts to make knowledge accessible by disseminating information to decision makers and the public.
- Strengthening international collaborations with organizations engaged in river restoration and monitoring, both in Israel and globally.

Main activities in 2021—2022

- *Development and implementation of a national biomonitoring scheme for streams in Israel.*
  In 2021—2022, we conducted the 2-year of biological monitoring for the Shikma—Besor catchment. The project was supported by the Shikma—Besor Drainage Authority and the Ministry of Environmental Protection. In 2022, we initiated a 2-year project of biological monitoring for the Hadera catchment.
- *Biological monitoring of restoration projects.*
  (1) Cattle management in the Meshushim Nature Reserve. The project was supported by INPA.
  (2) Leading the ecological assessment and accompanying the ecological restoration plan of the Tzipori watershed restoration project. The project was supported by The Kishon Drainage and River Authority.
  (3) Monitoring the planed restoration of the Kefar Baruch reservoir. The project was supported by The Kishon Drainage and River Authority.
  (4) Biological monitoring of the Dishon nature reserve. The project was supported by INPA.
  (5) Biological assessment of the Ashalim stream industrial wastewater spill (5th year). A 5-year monitoring to assess the impact of highly acidic wastewater spill on the aquatic ecosystem of Ashalim Wadi (Judea desert).

(6) Biological assessment of the Dishon stream as part of the management of JKL. The project was supported by Open Landscape Institute.
(7) Routine seasonal monitoring of the Kishon stream. The project was supported by the Kishon Stream Authority.
(8) Monitoring the effect of pollution in the Prat stream. The project was supported by INPA.
(9) Biological monitoring downstream of Dalia as part of the restoration effort in the Diffle area. The project was supported by INPA.

Scientific collaborations

- Ongoing collaboration with the Aquatic Ecology Department at the University of Duisburg-Essen and the Emschergenossenschaft und Lippeverband (EGLV), the oldest and biggest public German water board located in Essen, Germany.
- EU-Horizon 2020: Research and Innovations Actions project MERLIN — Mainstreaming ecological restoration of freshwater-related ecosystems in a landscape context: innovation, upscaling and transformation. Preparing of a research proposal.
- Collaboration with the Open Landscape Institute on the topic of examining the effects of climate change on streams and springs in Israel.

Teaching

- *Pollution and Rehabilitation of Aquatic Systems*. Porter school of environmental studies, Tel Aviv University.
- *The Integrative-organismal lab: biomonitoring using aquatic invertebrates*. School of Zoology, Tel Aviv University.
- *Monitoring the ecological value of streams*. Ramat HaNadiv and the Steinhardt Museum of Natural History. Guest lecture.
- *Stream ecology in the light of climate change: new challenges — new solutions?* School of Zoology, Tel Aviv University. Guest lecture.
- *Ecological value of aquatic systems in Israel — characteristics and distribution*. Training course for pest control: the little fire ant, mosquitoes and the pest control scheme. Pest Control Division, Ministry of Environmental Protection. The course was held at the Steinhardt Museum of Natural History (24.05.2021).

Graduate students

Almog Hershko-Pnuel (MSc, Tel-Aviv University): *Taxonomy and ecology of Hydropsychidae larvae as bioindicator species in freshwater ecosystems in Israel*.
Dafna (Dafi) Luz (MSc, Tel-Aviv University): *Taxonomy and ecology of Elmidae as bioindicator species in freshwater ecosystems in Israel*.

Talks and presentations

- *Streams in the upper Kinneret — Uniqueness, pressures and challenges*. Connecting the Upper Kinneret — Challenges and Opportunities, Tel Hai (21.10.2021).
- *The impact of climate change on streams in Israel*. The Annual Conference for Streams in Israel, Ness Ziona (30.03.2022).
- *Stream restoration: the ecosystem as a compass*. The 50th Annual Conference for Science and the Environment (ISEES), Tel Aviv (6.07.2022).

THE ENTOMOLOGY LABORATORY FOR APPLIED ECOLOGY

Gilad Ben Zvi

Arthropods are the most diverse group in terrestrial ecosystems, accounting for over 85% of all known organisms. Arthropods inhabit a tremendous variety of niches across wide spatial scales and exhibit a variety of feeding habits and life forms that constitute, after the plants, the basis for most terrestrial food webs. Because of their high and fast reproduction rate, arthropod communities are sensitive to short- and long-term environmental changes. Large numbers of arthropod species and specimens can be efficiently collected. For these reasons the group is utilized as a rich data source for ecological monitoring and ecosystem management.

The Entomology Laboratory for Applied Ecology aims to provide a high-resolution tool for understanding ecological systems in order to conserve the Israel's biodiversity. Current research in the Lab focuses on conservation and ecological management, utilizing arthropods as a sensitive tool for the assessment of ecological quality and ecosystem response to anthropogenic activities. The assessment includes the multivariate analysis of the community structure and composition, integrating various ecological indices and experimental approaches. The taxonomic identification is the basis of the analysis in each study. The identification relies on the insect collections in the Steinhardt Museum of Natural History and the Museum's scientists, as well as worldwide experts on different insect groups. The large-scale arthropod sampling from different sites, seasons and methods, supplements the collection with valuable specimens: rare, new to Israel fauna and even species new to science.

The Lab's activity spans geographically from Mount Hermon in the north to Wadi Ashalim near the southern Dead Sea and Halutza sands in the northwestern Negev. The current Lab research deals with monitoring of arthropod communities along borders between agricultural and natural landscapes and ecological corridors; providing operational recommendations for restoration management following ecological disasters in nature reserves; monitoring and eradicating invasive insect species; assessing anthropogenic pressure on sensitive ecological systems; coordinating the compilation of the Israeli endangered invertebrate species 'red list' and compiling the Israeli invasive invertebrate species 'black list'.

The projects run in collaboration with the Ministry of Environmental Protection, Ministry of Agriculture & Rural Development, Israel Nature and Parks Authority (INPA), the Society for the Protection of Nature in Israel, Israel's National Ecosystem Management Assessment Program, Ramat Hanadiv and the Jewish National Fund (KKL-JNF).

This year we ran 17 research projects, published 13 reports and presented our studies at five conferences in Israel. The Lab employs four full-time and three part-time workers.

Reports

- *The effect of the 2016 wildfire on the arthropod community of Hakfira nature reserve — a summary of 2020—2021 sampling data*. For INPA.
- *The effect of the 2017 pollution event on the arthropod community of Wadi Ashalim — a summary of 2020—2021 sampling data*. For HaMaarag and INPA.
- *The arthropod community along an altitude gradient in the Upper Galilee*. Prepared with Meir Finkel for INPA.
- *Effective protocols for the eradication of the Little Fire Ant in gardens — results of the 2021—2022 season*. For the Ministry of Environmental Protection and INPA.
- *Effective protocols and insecticides for the eradication of the Little Fire Ant from plant pots, nurseries and various habitats — final report*. For KKL-JNF, INPA and the Ministry of Environmental Protection.
- *Assessing the effects of agri-voltaic land use on the agro-ecosystem as manifested in arthropod community composition — summary of spring 2022 sampling season*. For the Ministry of Energy and Infrastructure, and the Ministry of Environmental Protection.

- *Negev Highlands isopod sampling in summer 2022*. For HaMaarag.
- *Negev Highlands snails sampling in winter 2021—2022*. For HaMaarag.
- *Arthropod and snail survey in Mount Hermon — summer 2022*. For INPA.
- *Butterfly survey in Mount Hermonit — spring 2022*. For INPA.
- *Butterfly survey in Elot Ada, Batot Menashe and Ahu Binyamina nature reserves — spring 2022*. For INPA.
- *Arthropod survey in jujuba plantations — spring 2022*. For Deshe Institute.
- *Bio-acoustic survey of the Dead Sea Mole Cricket (*Gryllotalpa marismortui*) — summer 2022*. For INPA.

Invited lectures

- *A fair-play war: Is it possible to eradicate the Little Fire Ant using environment-friendly methods?* Zoology Conference, December 2021.
- *Polluted status quo — the 4th year of arthropod sampling in Wadi Ashalim*. Wadi Ashalim Project Conference, January 2022.
- *The effect of the 2016 wildfire on the arthropod community of scrubland and thicket habitats in Hakfira nature reserve — a summary of 5 years of monitoring*. Hakfira Nature Reserve Wildfire Project Conference, May 2022.
- *The effect of the 2016 wildfire on the arthropod community of scrubland and thicket habitats in Hakfira nature reserve — a summary of 5 years of monitoring*. The Israeli Environmental Conference, July 2022.
- *A survey of dominant bioindicators as a substitute for arthropod long-term monitoring: the case study of* Liometopum microcephalum. The 40th Conference of the Entomological Society of Israel, October 2022.

HAMAARAG — ISRAEL'S NATIONAL NATURE ASSESSMENT PROGRAM

Ittai Renan

Overview

HaMaarag—Israel's National Nature Assessment Program—is a consortium of organisations that are responsible for natural resource management in Israel, operating from the Steinhardt Museum of Natural History. Our partners include the Ministry of Environmental Protection, the Israel Nature and Parks Authority, the Jewish National Fund (KKL-JNF), with additional financial support from a private fund.

HaMaarag's primary mission is to assess the state of nature in Israel. We strive to advance management of open spaces and natural resources through continuous production of scientific knowledge on the state of ecosystems and biodiversity in country. This knowledge is accessible to decision makers as well as to the general public.

Main achievements in 2021—2022

State of Nature Report

The *State of Nature in Israel Report 2022* was published in June 2022. The report focused on ecological threats and included seven chapters with updated, high-resolution maps and an analysis.

Ashalim Stream Ecosystem Montoring Program

A large-scale leakage of acidic affluent with high concentrations of heavy metals from a local fertilizer plant affected 20 kilometers of the Ashalim stream in Judean Desert in summer 2017. The Israel Nature and Parks Authority appointed HaMaarag to develop, coordinate, monitor and analyse

a five-year assessment of the ecological consequences of the leakage and the naturally occurring rehabilitation processes within the ecosystem. We designed and developed the monitoring program and completed the third monitoring year. Reports of the findings of the monitoring program were submitted by HaMaarag to the State Attorney's Office as part of the mediation process conducted against the polluters. Representatives of HaMaarag and researchers from the monitoring program presented the findings at a meeting of the parties as part of the mediation mechanism.

Israel National Ecosystem Assessment — Final report

The final report of the Israel National Ecosystem Assessment, including key findings of a five-year assessment and amounting to 1,000 pages, was completed and published in October 2021. The project aimed to increase the awareness of Israel's dependence on functioning ecosystems and their multidimensional value. In addition, it would produce a knowledge base to assist managers and policy-makers in assimilating the value of biodiversity and ecosystem services in the planning and management of Israel's landscapes. Furthermore, the report includes a summary of all project results and a trends table of the main Nature's goods and services.

The National Program for Terrestrial Biodiversity Monitoring

We finished the fifth cycle of the National Program for Terrestrial Biodiversity Monitoring. The program aims to assess the state of Israel's biodiversity and nature, as well as significant changes taking place within them. The program monitors the flora and fauna throughout Israel on a regular basis through field surveys, surveillance cameras and sensors. A pilot for vegetation remote sensing ended in November 2021.

Evrona Nature Reserve Ecosystem Monitoring Program

The last year of the five-year monitoring program was finished. The program assessed the effects of the oil spill in the Evrona Nature Reserve, and submitted an interim report to the Israel Nature and Parks Authority. Considering the rehabilitation that was conducted in the reserve during the last year, HaMaarag was in the process of building a follow-up plan for monitoring, with an emphasis on examining the impact of the rehabilitation on the ecosystem.

Arthropods Red Book

A national monitoring system was built with the aim of identifying long-term trends in the composition of the arthropod community, and of using insects as bio-indicators of changes of sensitive ecosystems in Israel. A pilot of two sampling systems (Malaise traps and Insect mobile) was successfully carried out during the autumn. Threat level assessments were so far been carried out for 20 different species of arthropods, and a similar assessment was completed for all 147 species of Israel's butterflies.

National Biodiversity Index

As part of the development of the quality of life metrics by the Central Bureau of Statistics, HaMaarag was tasked by the Ministry of the Environmental Protection to develop an index that would assess the biodiversity in Israel. The index was accepted and published by the Ministry of the Environmental Protection and the Central Bureau of Statistics.

Conferences

- September 2021 — *Evrona Nature Reserve Ecosystem Monitoring Program*. A full-day seminar conducted by the HaMaarag at the Steinhardt Museum of Natural History.

Publications

Ben-Moshe, N. & Renan, I. (Eds). 2022. *State of Nature Report Israel 2022 — Trends and Threats*. HaMaarag — Israel's National Ecosystem Assessment Program, Steinhardt Museum of Natural History, Tel Aviv University. 120 pp. [in Hebrew, with executive abstracts in English and Arabic] https://hamaarag.org.il/wp-content/uploads/2022/11/State-of-Nature-Report-2022-Trends-and-Threats-English-summary-1.pdf

THE OPEN LANDSCAPE INSTITUTE

Uri Ramon, Amir Perelberg, Aviv Avisar

This was the seventh year of the Institute's operation under the Steinhardt Museum of Natural History. Our ties with the Museum staff and our colleagues in the applied science wing strengthened, and a few projects were conducted in collaboration with the Israel National Center for Aquatic Ecology. The work with the Forestation department in the Keren Kayemet LeIsrael — Jewish National Fund (KKL-JNF)expanded significantly, and the OLI staff conduct core surveys for forest management. The Society for the Protection of Nature in Israel (SPNI) resumed its annual support together with the Nature and Parks Authority and the Ministry of Environmental Protection.

Overview of activities during 2021—2022

Streams restoration is an extensive project of tools development for eco-hydrological restoration of streams, developed over the last two years in cooperation with drainage and streams authorities.

Nature and Landscape surveys were carried out in the following regions: Misgav regional council, Mate Asher regional council, Volcanic mounds in the Golan Heights, Wild olive trees on Atlit ridge, Yarkon basin streams. Nationwide surveys were conducted: *KKL-JNF upgrade of the forests survey system*; *Protected nature assets in KKL-JNF forests*; *Integration of remote sensing methods in KKL-JNF forests survey system*; *Long-term monitoring plan of endangered & rare plant species in KKL-JNF forests*; *Endangered plant species — INPA*; *Four national monitoring units: Mediterranean-desert transition zone, Loess plains of the northern Negev, Negev highlands and hyper-arid desert (Arava valley)*; and *Crops wild relatives* survey.

The Open Landscape Institute (OLI) is a partner in development and implementation of methodology in the following fields: Nature-based solutions for streams restoration; Analyzing regulatory barriers to reducing light pollution in Israel; Agro-ecology — Incorporating biodiversity friendly management practices in avocado orchards (including an ecological restoration pilot project at orchard margins and endangered plants species reintroduction); Implementation of ecological principles in vineyards management at Barkan Winery, removal of obstacles that hinder passage along national ecological corridors was planned as part of this project; Visitor management program for the eastern channel of the Jordan (the program integrated the ecological, touristic and agricultural needs of the stakeholders in the region); Improving the assessment of ecological valence of natural, forested and agricultural landscapes; Developing monitoring programs with professionals from HaMaarag and the Israel Nature and Parks Authority (INPA); Planning a model of Bedouin rural settlement, which is environmentally and economically sustainable; Number of studies and projects concerning environment and agriculture were carried out. Additional studies in progress in this field are detailed below.

The main challenges that the Institute faced in 2021—2022 included:

1. Strengthening and expanding activity in fields defined within the Institute's core practices:
   - 1.1. Ecological and landscape background for planning — conducting and developing methodology for nature, landscape and human heritage surveys.
   - 1.2. Agriculture and environment — developing knowledge, expanding dialog circles, supporting professional and public processes.
   - 1.3. Botanical surveys — developing methods and tools like field guides for practitioners from different sectors and organizations.
   - 1.4. Restoration Ecology — developing the knowledge of the field and implementing it in agriculture, water management, planning, and development practices. The focus this year was streams' restoration.
2. Expanding and assimilating of our products among various target audiences:
   - 2.1. Developing tools for disseminating knowledge: workshops, lectures for planners and university students in relevant fields, instructors, and more.

3. Strengthening connections and expanding collaboration with the partner organizations in the Steinhardt Museum of Natural History and other colleagues.
4. Professional and budget strengthening: determining the budgetary basis for the coming years, preserving current professional staff, absorbing new employees and training them to carry out the intended tasks.

Detailed Report for 2021—2022 — Nature and Landscape Surveys

Misgav regional council

About 90% of the area of the Misgav regional council, located in the northern part of the lower Galilee and the southern part of the upper Galilee, are open areas — mostly natural landscapes and planted forests. The survey was meant to provide a detailed background to support future and existing planning processes and an improved database for policymakers. The first year of this survey was completed and an intermediate report was submitted. The survey is to be completed in 2023.

Mate Asher Regional Council

The regional council Mate Asher in the upper western Galilee is characterized by the Mediterranean climate and patched with broad areas of natural Chaparral landscapes, planted and natural forests, and an open agricultural landscape. Part of its range was already surveyed, or being under survey by other OLI projects. The current survey meant to cover the yet unsurveyed open areas of the council and to provide a detailed background to support various current and future planning processes, and an improved database for policymakers. The first year of this survey was completed and an intermediate report was submitted. The survey is to be completed in 2023.

Volcanic mounds in the Golan Heights (in collaboration with Shamir Research Institute)

The area of the volcanic mounds in the Golan Heights is the largest volcanic area in Israel, with distinct and prominent landscapes at the national level. In this unique region, there are various aquatic habitats: springs, winter ponds, shallow wetlands and steep canyons with flowing streams. These support a nationally exceptional biodiversity that should be carefully planned and protected. The survey was meant to provide a detailed background to support future and current planning processes and an improved database for policymakers. The first year of the survey was completed and an intermediate report was submitted. The survey is to be completed in 2023.

Wild olive trees on Atlit ridge (in collaboration with Volcani Institute)

The Kurkar ridge around Atlit is full of natural, landscape and cultural assets. Among these, is probably also a wild-type variant of the European Olive (*Olea europaea* var. *sylvestris*), a dominant tree species along this quickly diminishing habitat, but still prominent in the relatively undisturbed parts of the ridge. This unique population might be the last genetic remnant from which modern olive trees were domesticated. The survey is meant to map and characterize these plants, to provide a scientific basis for planning, conservation, management and maintenance of this important population. The survey was completed, and a final draft of the report was submitted to Volcani Institute, which continued with the project based on the survey results.

Yarkon basin streams

The Yarkon drainage authority is the last in the Mediterranean Israeli region, where ecological survey of its streams is yet to be done. The aim of the survey is to provide a detailed background to support future and current planning processes and an improved database for policymakers. We completed the first out of three years of this survey and an annual report was submitted. The survey is planned to continue for the next two years.

Vegetation monitoring as part of the National Assessment of the State of Nature in Israel (HaMaarag)

A survey of four monitoring units was conducted: The Mediterranean-desert transition zone, loess plains of the northern Negev, Negev highlands and hyper-arid desert (Arava valley). The final report and data were submitted.

Protected nature assets in KKL-JNF forests

Thinning of the forest and renewal of degraded forest stands are the most important and significant maintenance activities in the Israeli planted forests, and essential for the health and proper development of the trees, for the natural regeneration of the forest undergrowth and for increasing its plant diversity. A three-year study was completed, aiming to develop protocols for ecological surveys in JNF forests designated for thinning or renewal, in order to locate, map and mark protected natural assets before thinning/renewal, and to develop a suitable GIS database to mitigate the damage to these assets as much as possible. The project was completed, a final report was submitted, and the project passed from the development phase to a routine process, as part of the survey's unit annual plan.

KKL-JNF upgrade of the forests survey system

KKL-JNF began a process of unifying and standardizing its national forest surveys, based on the recently approved forest management policy. The basic development phase was completed, survey manuals and protocols were prepared, and the project was moved into the routine survey phase, aiming to cover the survey of all KKL-JNF forests in Israel within 5—6 years.

Integration of remote sensing methods in KKL-JNF forests survey system (in collaboration with Prof. Noam Levin, HUJI)

KKL-JNF manages more than 10,000 ha of forests, and the forest survey is one of its major tools for planning and management. The forest database accepts zoning the forests into polygons, characterized by many attributes using traditional field methods. The limitations of this database include the high cost of time and work force required to map the forests, and thus surveying all forests takes at least 10 years. In the past decade, there were great advances in remote sensing of forests from space, thanks to the access to sensors with improved spatial, temporal and spectral resolutions, and the Google Earth Platform, enabling to run global analyses. Recent studies in Israel demonstrated a potential to map natural vegetation in high details, but some of those studies were based on drones or on aerial hyperspectral sensors with high abilities; however, they are costly and cover small areas. In this three-year study (2022—2024), we intend to develop operational tools to collect quantitative metrics for forest surveys using freely available imagery, automatic segmentation and machine learning tools. We use time series of spectral indices calculated from these sensors to quantify the following variables: percent cover of perennial vegetation, annual vegetation, non-photosynthetic vegetation and bare soil; trends in vegetation cover; canopy height; burnt areas and fire severity; segmentation of tree canopies (in sparse forests) and of forest stands. The remote sensing analysis is to be accompanied by field surveys of the same variables for calibration and validation of the models, in selected forests in three districts of KKL-JNF, representing different climate conditions and forest types. This study will enable KKL-JNF to advance the operational use of remote sensing for monitoring and managing its forests, reducing costs and shortening field work, better directing field surveys, and providing annual products of the state of the forest benefiting the public. The first year of this research was completed according to the plan, an annual report was submitted, and the study would continue for the next two years.

Long-term monitoring of endangered & rare plant species in KKL-JNF forests

KKL-JNF-managed open landscapes are of primary ecological importance in habitats that have been widely affected by anthropogenic development and under-represented in nature reserves and national parks: deep, heavy soils in valleys (mostly cultivated) and light soils in the coastal plain (mostly covered by asphalt and concrete). The predicted further development, according to Israeli population growth forecasts, is expected to exacerbate this trend. Thus, KKL-JNF forests constitute a potential refuge for rare and endangered plant species, as well as to flag species that are not endangered but represent cultural values and attract visitors. Protection of these species serves multiple purposes: preventing harm to protected natural values (state law), preserving biodiversity, maintaining proper function of ecosystems, fulfilling international treaties requirements for the protection of biodiversity, and protecting flag-species that bear cultural values. All coincide with the protocol for the management of sustainable forests adopted

by KKL-JNF. Optimal protection of target species requires long-term monitoring, as well as the characterization of environmental factors and management actions that influence the fitness of the populations. This study sets a long-term plan composed of two aspects, i.e. monitoring and research. In the monitoring part, annual surveys are performed to map the distribution and size of the target species populations and assess their habitat quality. In the research aspect, an observational study is carried out to examine the effect of selected environmental, management and use variables on the spatiotemporal population dynamics, to optimize forest management for the benefit of the focal species and the forest as a whole. The first year of this research was completed (there was one-year delay in the planned schedule due to administrative problems), an annual report was submitted, and the study would continue for the next two years.

North Akko valley

The area of the Na'aman basin in the north of Akko Valley is comprised of some of the most vulnerable and sensitive habitats in Israel: salinas, wetlands, ephemeral and perennial streams, and heavy soils. Most of the area is currently used for open-field agriculture, but these habitats are further threatened by various development plans, including photovoltaic farms, expansion of settlements, and construction of new roads and railroads. The Ministry of Environmental Protection intends to confront these plans with evidence-based data, and the survey is meant to provide the missing information. The survey was completed and a final draft of the report was in preparation.

Crops Wild Relatives (CWR)

Israel intends to submit an application to the UNESCO to declare selected regions as world heritage, due to the fact that Israel is a hotspot of crops wild relatives, recognized by the UN Food & Agriculture Organization as crucial for the worlds food security. The survey was meant to complete gaps in the distribution of CWR and to serve as a database for validation and calibration of computerized distribution models. The survey was completed and a final report was submitted.

Endangered plant species survey — INPA

As part of Israel's global commitment to protect endangered species, the INPA prepared a multi-annual plan to survey the endangered plants of Israel. The survey of the endemic species was completed in 2018, and since 2019 the survey has been focusing on: (1) sub-endemic species; (2) very rare species; (3) rare species in strong decline; (4) newly added species to the endangered list with insufficient data; and (5) species with taxonomic uncertainty/complexity. In 2022, the survey focused also on four hot-spot habitats of endangered plants, viz. Ein Geddi Oasis (springs and palm plantations), heavy soils (Yizreel valley), Mediterranean shores salinas (Kishon estuary), and wetlands (Hula valley), in addition to 10 particular endangered species. An annual report was submitted to the INPA, and the survey would continue in 2023.

Advanced field course for botanists

This year, we continued the development of the botanic skills of field workers, by providing an advanced course in botany. During the reporting period, 15 botanists participated in four workshop days, covering various regions in Israel.

Surveys and projects not yet approved

Shmaria stream basin survey (submitted to the Open Landscape Protection Fund), Hula valley & Upper Galilee regional council survey (submitted to the Open Landscape Protection Fund), Golan regional council (awaits bidding), Shafir regional council (awaits bidding).

Plans for 2022—2023 — Nature and Landscape Surveys

Misgav regional council

About 90% of the area of the Misgav regional council, located at the northern part of the Lower Galilee and the southern part of the Upper Galilee, are mostly natural landscapes and planted forests. The survey is meant to provide a detailed background to support future and current planning processes, and an improved database for policymakers. The survey is planned to be completed in 2023.

Mate Asher Regional Council

The regional council Mate Asher in the Upper Western Galilee is characterized by the Mediterranean climate and is patched with broad areas of natural Chaparral, planted and natural forests and open agricultural landscapes. Part of its range had been already surveyed or was under survey by other OLI projects. The current survey was meant to cover yet unsurveyed open areas of the council and to provide a detailed background to support various current and future planning processes and an improved database for policymakers. The survey is to be completed in 2023.

Volcanic mounds in the Golan Heights (in collaboration with Shamir Research Institute)

The area of the volcanic mounds in the Golan Heights is the largest volcanic area in Israel, with distinct landscapes at the national level. There are various aquatic habitats in this unique region—springs, winter ponds, shallow wetlands and steep canyons with flowing streams—that harbour a nationally exceptional biodiversity, which should be carefully planned and protected. The survey was launched to provide a detailed background to support future and current planning processes, and an improved database for policymakers. The survey is to be completed in 2023.

Dead Sea & fault cliff survey

The Dead Sea coast is a unique ecosystem in Israel, characterized by a long narrow strip of an open landscape in the hyper-arid desert, between the Dead Sea and the He'etekim Cliff, along the Syrian—African rift valley. This area has geological and scenic views existing in no other place in the world. The ecosystems under these extreme conditions include wide alluvial fans at the pass of large streams from the mountains to the coastal plain, perennial and ephemeral streams, the clefts of the Lisan formation, the receded beaches of the Dead Sea, as well as a variety of salt-marshes. The Dead Sea coast is also an important part of migratory birds' route. The uniqueness of this area is threatened by an accelerated rate of landscape change processes, including active geological faults, the retreat of the Dead Sea and the resulting development of sinkholes and structural topographical changes in the streams, as well as the conversion of the southern Dead Sea basin into large-scale industrial saltwater ponds, the diversion of streams, the construction of water reservoirs, changes in the regional groundwater levels, quarrying and other land disruptions, the development of touristic facilities and increased agricultural areas. The purpose of this survey is to create an ecological and landscape database for this region and define valence levels for each area, in order to prepare a background for sustainable planning (including the promotion of proposed reserves), management and maintenance of this unique landscape. The survey is planned to be completed in 2023.

North-Western Galilee forests survey

The northern part of the Western Galilee, from the Israel—Lebanon border to the Nahariya—Ma'alot road, contains a unique mosaic of natural areas, planted forests and agricultural fields. Three main streams—Betset, Kziv and Shaal—are the northernmost streams in Israel that drain the Western Galilee Mountains to the Mediterranean Sea. The perennial parts of Betset and Kziv attract hundreds of thousands of hikers every year. This area has many natural, landscape and heritage values in a uniquely large and relatively uninterrupted region of open landscape. KKL-JNF intends to prepare a master plan for the forests of this region. The aim of the survey is to prepare a comprehensive environmental (ecology, landscape, human heritage, and leisure and recreation) background, which will serve as the basis for planning, management and maintenance of the open landscape in general and KKL-JNF forests in particular. The survey is to be completed in 2023.

West Galilee streams survey

The survey is planned to be conducted along eight stream basins under the responsibility of the Western Galilee Drainage and Streams Authority. The survey has two main goals: (1) a partial update of the ecological valence survey of the streams that was carried out about 15 years ago, for the purpose of recommending a sustainable maintenance plan of these streams, conserving biodiversity without compromising drainage requirements; (2) map and characterize the presence and extent of invasive plant species along the streams, in order to propose an action plan for the treatment of these species. The survey is planned to be completed in 2023.

Yarkon basin streams

The Yarkon drainage authority is the last in the Mediterranean region of Israel, where an ecological survey of its streams is yet to be done. The aim of the survey is to provide a detailed background to support future and current planning, and an improved database for policymakers. The survey is planned to continue for the next two years (2023—2024).

Endangered plant species survey — INPA

As part of Israel's commitment to protect endangered species, the INPA prepared a multiannual plan to survey the endangered plants of Israel. The survey of the endemic species was completed in 2018, and since 2019 the survey has been focusing on: (1) sub-endemic species, (2) very rare species, (3) rare species in strong decline, (4) newly added species to the endangered list with insufficient data, and (5) species with taxonomic uncertainty/complexity. In 2023, the survey will focus on two endangered plants' habitats: heavy soils (Upper Galilee) and salinas (Jordan and Beit Shean valleys), in addition to 13 particular endangered species.

Vegetation monitoring in Ashalim basin as part of the National Assessment of the State of Nature in Israel (HaMaarag)

Following the Ashalim basin ecological disaster in 2017, a monitoring program was established by HaMaarag (Israel's National Ecosystem Assessment Program). In 2023, we plan to conduct the botanical monitoring of this project for HaMaarag.

Protected nature assets in KKL-JNF forests

Thinning of forests and renewal of degraded forest stands are the most important and significant maintenance activities in the Israeli planted forests, essential for the health and proper development of the trees, for the natural regeneration of the forest undergrowth and for increasing its plant diversity. A three-year study was completed, aiming to develop protocols for ecological surveys in JNF forests designated for thinning or renewal, to locate, map and mark protected natural assets before thinning/renewal, and to develop a suitable GIS database to mitigate the damage to these assets as much as possible. The project was completed, a final report was submitted, and the project passed from the development phase to a routine process, as part of the surveys' unit annual plan.

KKL-JNF upgrade of the forests survey system

KKL-JNF began a process of unifying and standardizing its national forest surveys, based on the recently approved forest management policy. The basic development phase was completed, the survey manuals and protocols were prepared, and the project moved into the routine survey phase, aiming to cover all KKL-JNF forests in Israel within 5—6 years.

Integration of remote sensing methods in KKL-JNF forests survey system (in collaboration with Prof. Noam Levin, HUJI)

KKL-JNF manages more than 10,000 ha of forests, and the forest survey is one of its major tools for planning and management. The forest database accepts zoning the forests into polygons, characterized by many attributes using traditional field methods. The limitations of this database include the high cost of time and workforce required to map the forests, and thus surveying all forests takes at least 10 years. In the past decade, there were great advances in remote sensing of forests from space, thanks to the access to sensors with improved spatial, temporal and spectral resolutions, and the Google Earth Platform, enabling running global analyses. Recent studies in Israel demonstrated a potential to map natural vegetation in high detail, but some of those studies were based on drones or on aerial hyperspectral sensors with high abilities; however, they are costly and cover small areas. In this three-year study (2022—2024), we intend to develop operational tools to collect quantitative metrics for forest surveys using freely available imagery, automatic segmentation and machine learning tools. We use time series of spectral indices calculated from these sensors to quantify the following variables: percent cover of perennial vegetation, annual vegetation, non-photosynthetic vegetation and bare soil; trends in vegetation cover; canopy height; burnt areas and fire severity; segmentation of tree canopies (in sparse forests) and of forest stands. The remote sensing analysis is to be accompanied by field surveys of

the same variables for calibration and validation of the models, in selected forests in the three districts of KKL-JNF, representing different climate conditions and forest types. This study will enable KKL-JNF to advance the operational use of remote sensing for monitoring and managing its forests, reducing costs and shortening field work, better directing field surveys, and providing annual products of the state of the forest benefiting the public. The study is planned to continue for the next two years (2023—2024).

Long-term monitoring of endangered & rare plant species in KKL-JNF forests

KKL-JNF-managed open landscapes are of primary ecological importance in habitats that were widely affected by anthropogenic development and under-represented in nature reserves and national parks: deep, heavy soils in valleys (mostly cultivated) and light soils in the coastal plain (mostly covered by asphalt and concrete). The predicted further development, according to Israeli population growth forecasts, is expected to exacerbate this trend. Thus, KKL-JNF forests constitute a potential refuge to rare and endangered plant species, as well as to flag-species that are not endangered but represent cultural values and attract visitors. Protecting these species serves multiple purposes: preventing harm to protected natural values (state law), preserving biodiversity, maintaining proper function of ecosystems, fulfilling international treaties requirements for the protection of biodiversity, and protecting flag-species that bear cultural values. All coincide with the protocol for the management of sustainable forests adopted by KKL-JNF. Optimal protection of target species requires long-term monitoring, as well as the characterization of environmental factors and management actions that influence the fitness of the populations. This study will lay a long-term plan composed of two aspects, i.e. monitoring and research. In the monitoring aspect, annual surveys are to be performed to map the distribution and size of the target species populations and assess their habitat quality. In the research aspect, an observational study is to be carried out to examine the effect of selected environmental, management and use variables on the spatiotemporal population dynamics, to optimize forest management for the benefit of the focal species and the forest as a whole. The study is planned to continue for the next two years (2023—2024).

Tools Development and Research — Detailed Report for 2021—2022

1. Project: Strategy for the optimal management of open land spaces. Implementation of ecological principles for growing vines at 'Barkan' Winery

Funding source: The Society for the Protection of Nature, the Ministry of Environmental Protection, the Nature and Parks Authority.
Project partners: The Society for the Protection of Nature.
Current project status: A final report was submitted to customers, who commissioned the work, and the project ended. Continued monitoring of planted endangered species was on-going.
The project 'Biodiversity in Business' is under the Society for the Protection of Nature, the Ministry of Environmental Protection and the Israel Nature and Parks Authority auspices. Barkan Winery controls about 10,000 dunams (1000 ha) of vineyards from the Upper Galilee in the north to Mitzpe Ramon in the south, in the Jerusalem Mountains and the Judean plain. As part of the project, an endangered plant species was restored to the vineyards margins in the Judean lowlands. This species was extinct in the area as a result of development and agriculture. In addition, a survey was conducted to map the presence of endangered plant species on the Dalton Plateau (Upper Galilee). A protocol was written for the timing of the agricultural activities in a way that protects those species, and generic protocols were prepared. The latter relate to different stages in the cultivation of the vineyard and to various elements in its management based on principles of biodiversity conservation.

2. Project: Avocado plantations in Milopri — Phase III

Funding source: Milopri, Israel Land Authority.
Project partners: The Western Galilee Cities Association, the Western Galilee Drainage and Rest Authority.
Current project status: On-going.

In 2019—2018, various pilot projects were carried out to test the suitability of different ecological interfaces for growing avocados. In the process, cipher plants were planted, supporting various pollinators along fields margins, various cover crops were tested, and a natural winter pond was restored as part of solving drainage problems. 'Shelter gardens' were also established on the of agricultural margin on three sites, where endangered plants species were planted as a future source of seeds. The project resulted in the development of protocols for ecological principles in avocado orchards management, i.e. 'biodiversity protocols'.

During 2020—2021, we implemented the biodiversity protocols among the pilot growers (Kabri and Gesher Haziv). We also tried to adjust a unique protocol for each avocado plot. The plots were rated according to their importance for maintaining ecological connectivity at the local and national levels, and each plot received a set of guidelines based on the level of importance of the plot for ecological connectivity and its age. We also conducted a filed margin survey mapping native habitat, invasive species, restoration potential and other hazards, applied for restoration funding from the Israel Land Authority and were awarded it.

In 2022, part of margin restoration plans were implemented, as well as biodiversity protocols for the farms. We also accompanied a project for invasive species clearing. Kikayon (*Ricinus communis*) is an invasive plant species growing in avocado orchard margins and riverbanks. It is a surrogate for the quarantine pest harming the crops and jeopardizing export. Additional proposals were submitted to the Open Space Fund and the Point Point Foundation for further treatment of the rest of the field.

The consultation for the corporation continues. As part of it, the OLI staff assists in the coordination and cooperation with external bodies (Drainage Authority, Nature and Parks Authority, Ministry of Agriculture, Ministry of Environmental Protection, Society for the Protection of Nature, etc.), assists in the treatment of invasive species that are harmful to avocados, prepares ongoing plans for the rehabilitation of the edges of agricultural tracts in collaboration with farmers, and provides answering agro-ecological issues in the plantation.

In addition, during 2022 we submitted with partners a request for seed funding to the Israel Land Authority to carry out another phase of the survey of the agricultural margins as a basis for raising future budgets to carry out the actual ecological restoration.

3. Research: Vegetation as a tool for stabilizing streams and drainage canals

Funding source: Hanadiv Foundation.

Research partners: Moran Development and Consulting firm, Stream and Drainage Authorities: Southern-Jordan, Soreq-Lakhish and Yarkon.

Current project status: On-going.

Riverbanks stabilization is a pivotal topic in the rehabilitation and restoration of rivers and streams worldwide. There are several methods to protect riverbanks by decreasing their vulnerability to erosion. The development of riparian plants on banks and buffer zones is a natural and sustainable process, which supports both the goal of stability in banks and the functionality of the stream's ecological system. Still, several core issues in the application of this method are yet to be resolved. The Open Landscape Institute in collaboration with Moran Development and Consulting firm, promote actions that would make nature-based solutions more practical and accessible, incorporated in the development and maintenance scheme of the stream and drainage authorities in Israel.

Project targets: (1) Create a partnership with three stream and drainage authorities, based on a collaborative learning process; (2) Perform data collection, analyze and draw conclusions regarding streams in different geographical areas where riverbank stabilization using vegetation was executed; (3) Construct a design and execution protocol for the stabilization of riverbanks using vegetation, addressing the differences between disparate streams/geographical areas; (4) Information diffusion and assimilation, in collaboration with the 'AGMA' knowledge center.

During 2022, our collaboration was extended to the Yarkon Stream and Drainage Authority. Sample parcels were constructed representing different methods of riverbank stabilization in the Shapirim stream. The second monitoring process was conducted in the other streams.

4. Research: Israel's streams under climate change — implications and recommendations for action

Funding source: Hanadiv foundation.
Research partners: The Society for the Protection of Nature, the Israel Center for Aquatic Ecology.
Current project status: On-going.
The aim of the study—the first of its kind in Israel—is to gather existing knowledge from Israel and the world, to analyze and map knowledge gaps and ways to mitigate the expected change in aquatic habitats during the anticipated climate change in the Middle East. The outcome will be presented as a report detailing the expected changes to springs and streams in various warming scenarios of the Intergovernmental Panel on Climate Change, and as a list of concrete medium- and long-term policy and action recommendations for the public sector decision-makers. We completed the literature review of the expected effects of the climate change on streams and mapped bioindicators for various aspects of this process. The analysis of the hydrological case study of the Hermon River (one of the pilot streams representing a river where the human impact is minor) is completed. A case study also surveyed challenges and opportunities around the river, and forecasts for the expected effects of the river as a result of the change in water regime and temperature, as well as indirect effects (i.e. the effect of the climate change on humans and humans on the stream). A chapter addressing policy tools for managing and mitigating the climate change in rivers in Europe, US and Australia was also completed. Now we are dealing with the last part of the study, which includes adaptation and integration of the existing tools to the reality of the climate change in Israel.

The research is in progress, a report on the various aspects was uploaded to the institutional website for public use. As part of this project, EU Directives were analyzed to assess what can be adopted in Israel. The research helps raise public awareness and stimulate an important public debate.

5. Research: Examining the effects of agro-voltaic dual-use on the ecological and agricultural system as reflected in the composition of arthropods

Funding source: The Ministry of Energy.
Research partners: The Entomological Laboratory for Ecological Research, SMNH.
Current project status: On-going.
In order to meet the Ministry of Energy's targets for reducing 80% of greenhouse gas emissions by 2050, between 100,000 and 800,000 dunams will be required for the production of solar energy. A large part of these areas is expected to be based on agricultural lands. Accepting that the tested solution is effective and uses the land efficiently, the vital ecological functioning of the agricultural areas must also be considered. The existing scientific information regarding the potential effects of agro-voltaic land use on ecological functioning is very limited. Our research seeks to bridge knowledge gaps addressing the ecological effects of the dual use. By monitoring ground-dwelling and flying arthropods and analyzing data regarding agricultural pests and beneficial arthropods in various crops in different parts of the country, we will identify the impact of the voltaic facilities on ecosystems. We will examine the phenology, abundance, and richness of the species and analyze composition parameters of the ecological communities. Zero-time sampling (before the establishment of the facilities) of arthropods was carried out, and a report was being prepared for submission to the Ministry of Energy.

6. Tools for the preservation and restoration of coastal salt marshes in Israel

Funding source: Ministry of the Environmental Protection.
Current project status: The study was completed and a summary report was submitted to the Ministry of Environmental Protection to be used immediately as a planning tool.
The shoreline habitat was studied very little in recent decades and was a direct continuation of Danin's geo-botanical research from the 1970s. The aim of the study was to map the physical conditions (soil and hydrology) that allow the development of salinity and the unique plant assemblage. The study mapped the coastal salt marshes in Israel and classified them into different types

focusing on the Naaman salt marsh. We also studied test cases, where salinity had been restored, and provided a toolbox for their restoration. Our research established the knowledge base and collaborations required to advance this goal.

7. Formulation of principles for planning, restoration, interface and maintenance of forests on river banks in KKL-JNF land

Funding source: KKL-JNF.
Current study status: On-going.
The goal of the study is to formulate principles for planning, restoration, interface and maintenance of streams in the KKL-JNF land. Through a literature review, we answered key questions dealing with river management, and through a field case study, we offered solutions to mitigate the challenge of river management. We are conducting a filed survey in the Baram forests (as a case study), to determine a generic method for collecting data as a background for the planning and maintenance of streams.

An ecological survey in the Baram forest was conducted by a multi-disciplinary group. An analysis was under prepation for KKL-JNF and other stakeholders in stream restoration.

8. Research: Multifunctional agriculture — development of tools for a better co-use

Funding source: The Open Landscape Protection Fund.
Research partners: The Ministry of Agriculture and rural Develpoment, the Ministry of Environmental Protection, the Society for the Protection of Nature, the Nature and Parks Authority, KKL-JNF, Israel's Planning Authority, Regional Councils Center, Drainage and Streams Authorities.
Current study status: The final report was submitted to The Open Landscape Protection Fund.
The study aimed to formulate a "road map" for authorities for a multifunctional usage of agricultural lands. Based mainly on a case study method, the report presented a comparative analysis of several economic, legal and social marketing tools and points out the benefits of a cooperative approach. The conclusions emphasized the importance of taking into account the diverse needs of stakeholders, including a trusted mechanism for proper compensation to farmers, in case of damage to crops, as a result of other planned public uses.

PUBLICATIONS

The Steinhardt Museum of Natural History is an important research infrastructure, used by scientists nationally and internationally. Below is the list of 2021—2022 publications, which covers works of researchers affiliated with the SMNH. It also includes publications of researchers from other institutions if they are entirely or partly based on our holdings, but our follow-up is far from complete in this regard. Publications that were inadvertently omitted from the previous Annual Report are also included below.

Articles in refereed and other journals

1. Abbas, J., Peled, N., Hershkovitz, I. & Hamoud, K. 2021. The role of vertebral morphometry in the pathogenesis of degenerative lumbar spinal stenosis. *BioMed Research International*, Art. 7093745. https://doi.org/10.1155/2021/7093745
2. Allen-Perkins, A., Magrach, A., Dainese, M., Garibaldi, L.A., Kleijn, D., Rader, R., Reilly, J.R., Winfree, R., Lundin, O., McGrady, C.M., Brittain, C., Biddinger, D.J., Artz, D.R., Elle, E., Hoffman, G., Ellis, J.D., Daniels, J., Gibbs, J., Campbell, J.W., Brokaw, J., Wilson, J.K., Mason, K., Ward, K.L., Gundersen, K.B., Bobiwash, K., Gut, L., Rowe, L.M., Boyle, N.K., Williams, N.M., Joshi, N.K., Rothwell, N., Gillespie, R.L., Isaacs, R., Fleischer, S.J., Peterson, S.S., Rao, S., Pitts-Singer, T.L., Fijen, T., Boreux, V., Rundlöf, M., Viana, B.F., Klein, A.-M., Smith, H.G., Bommarco, R., Carvalheiro, L.G., Ricketts, T.H., Ghazoul, J., Krishnan, S., Benjamin, F.E., Loureiro, J., Castro, S., Raine, N.E., de Groot, G.A., Horgan, F.G., Hipólito, J., Smagghe, G., Meeus, I., Eeraerts, M., Potts, S.G., Kremen, C., García, D., Miñarro, M., Crowder, D.W., Pisanty, G., Mandelik, Y., Vereecken, N.J., Leclercq, N., Weekers, T., Lindstrom, S.A.M., Stanley, D.A., Zaragoza-Trello, C., Nicholson, C.C., Scheper, J., Rad, C., Marks, E.A.N., Mota, L., Danforth, B., Park, M., Bezerra, A.D.M., Freitas, B.M., Mallinger, R.E., da Silva, F.O., Willcox, B., Ramos, D.L., da Silva e Silva, F.D., Lázaro, A., Alomar, D., González-Estévez, M.A., Taki, H., Cariveau, D.P., Garratt, M.P.D., Nabaes Jodar, D.N., Stewart, R.I.A., Ariza, D., Pisman, M., Lichtenberg, E.M., Schüepp, C., Herzog, F., Entling, M.H., Dupont, Y.L., Michener, C.D., Daily, G.C., Ehrlich, P.R., Burns, K.L.W., Vilà, M., Robson, A., Howlett, B., Blechschmidt, L., Jauker, F., Schwarzbach, F., Nesper, M., Diekötter, T., Wolters, V., Castro, H., Gaspar, H., Nault, B.A., Badenhausser, I., Petersen, J.D., Tscharntke, T., Bretagnolle, V., Chan, D.S.W., Chacoff, N., Andersson, G.K.S., Jha, S., Colville, J.F., Veldtman, R., Coutinho, J., Bianchi, F.J.J.A., Sutter, L., Albrecht, M., Jeanneret, P., Zou, Y., Averill, A.L., Saez, A., Sciligo, A.R., Vergara, C.H., Bloom, E.H., Oeller, E., Badano, E.I., Loeb, G.M., Grab, H., Ekroos, J., Gagic, V., Cunningham, S.A., Åström, J., Cavigliasso, P., Trillo, A., Classen, A., Mauchline, A.L., Montero-Castaño, A., Wilby, A., Woodcock, B.A., Sidhu, C.S., Steffan-Dewenter, I., Vogiatzakis, I.N., Herrera, J.M., Otieno, M., Gikungu, M.W., Cusser, S.J., Nauss, T., Nilsson, L., Knapp, J., Ortega-Marcos, J.J., González, J.A., Osborne, J.L., Blanche, R., Shaw, R.F., Hevia, V., Stout, J., Arthur, A.D., Blochtein, B., Szentgyorgyi, H., Li, J., Mayfield, M.M., Woyciechowski, M., Nunes-Silva, P., de Oliveira, R.H., Henry, S., Simmons, B.I., Dalsgaard, B., Hansen, K., Sritongchuay, T., O'Reilly, A.D., García, F.J.C., Parra, G.N., Pigozo, C.M.& Bartomeus, I. 2022. CropPol: A dynamic, open and global database on crop pollination. *Ecology*, 2021, e3614. https://doi.org/10.1002/ecy.3614
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GRADUATE STUDENTS

Much active scientific research is conducted by graduate students. Below is the list of graduate students of faculty members affiliated to the Steinhardt Museum of Natural History. We list also a few graduate students from other higher education institutions, but many others from Israel and abroad who used the collections are not included.

PhD students

2013— Aviv Avisar (T. Dayan)
Ecological restoration following eucalypt removal from the Nahal Alexander National Park.

2013—2022 Sigal Orlansky (F. Ben-Ami)
The costs and benefits of resistance to parasites: The case of *Daphnia similis*.

2014— Tali Magoty Cohen (R. Dor)
Ecology and genetics of a recent avian invasive species in Israel.

2015— Daniel Berkowic (R. Dor, N. Sapir and Y. Leshem)
Movement ecology of overwintering black kites (*Milvus migrans)* in the North-West Negev.

2015— Yehezkel (Hezi) Buba (J. Belmaker)
Functional response in Mediterranean fishes.

2015— Victoria Roul (H. May)
3-D shape of the femur and its association with osteoarthrithis of the knee.

2015— Erez Shoham (Y. Benayahu)
Mesophotic octocorals of Eilat, northern Red Sea.

2015—2022 Yael Goll (E. Geffen)
Leadership in rock hyrax society.

2016— Ruth Pelleg-Kallevag (H. May)
Changes in lumbar intervertebral discs characteristics with the development of lumbar spinal curvature.

2016— Andressa Duran (S. Meiri and D. Chapple)
Lizard macroecology.

2016— Ziv Kassner (G. Ribak)
The mechanics and behavior of aerial interception by insects.

2016— Michaela Kolker (R. Holzman and S. Meiri)
Early life history of fish in the Mediterranean Sea.

2016— Itay Nudel (R. Sarig)
Secondary dentin evaluation using computerized tomography: application for anthropology and forensics.

2016— Renanel Pickholtz (J. Belmaker)
Stress and movement patterns of fishes.

2016— Lilah Raijman (M. Ilan)
Red Sea mesophotic sponges.

2016— Svetalana Vaisman (T. Dayan)
Exotic and invasive molluscs in Israel (provisionary title).

2016—2021 Ori Frid (J. Belmaker)
Understanding marine protected areas, recreational fisheries catch and by-catch.

2016—2022 Heeli Schechter (D.E. Bar-Yosef Mayer and N. Goring-Morris)
The use of shells as adornments among PPNB communities in the Mediterranean zone of the Southern Levant.

2017— Amal Bader Farraj (R. Sarig)
The evolutionary changes in root morphology of molars and their relation to function.

2017— Waseem Habashi (R. Sarig)
The effect of biomechanics and enamel chemical composition on dental attrition.

2017— Tal Amit (Y. Loya)
Ecology and physiology of coral symbiotic populations.

2017— Assaf Ben-David (T. Dayan)
Citizen science as a tool for strengthening one's sense of community and sense of place through ecological research on the effect of land use on biodiversity.

2017— Francesca Falco (T. Dayan)
Solving scale mismatches in agro-biodiversity conservation policy: an effectiveness comparative analysis.

2017— Talya Shalom (T. Dayan)
Other dimensions of globalization: The evolutionary development of environmental standards for the agricultural industry in a country that leans upon exporting its agricultural production.

2017— Tomer Urca (G. Ribak)
The dispersal flight of (*Batocera rufomaculata*): The biomechanics, physiology and ecology of a tree-boring beetle.

2017— Gay Yohananoff (M. Ilan)
Measuring sponge filtration.

2018— Sarah Borgel (H. May and I. Hershkovitz)
Middle Paleolithic child from Tinshemet cave.

2018— Rona Nadler-Valency (T. Dayan)
Wolf-rancher interactions in the Golan Heights: which practices support coexistence?

2018— Liron Israely (T. Dayan and O. Moshe)
Optimizing riparian buffer restoration in agricultural landscapes: Ecological, economic, and social considerations.

2018— Guy Sinaiko (S. Meiri and Ch. Dietrich)
Taxonomy of the leafhopper genus *Neoaliturus* (Cicadellidae) in Israel.

2018— Sarah Ohayon (J. Belmaker)
Wideband acoustic methods for estimating fish spillover distance from Marine Protected Area.

2018— Shahar Chaikin (J. Belmaker)
Processes underlying fish depth distributions.

2018— Amir Sarig (G. Ribak)
Miniaturization constraints on flight of insects smaller than 1 mm.

2018— Ronen Liberman (Y. Benayahu and D. Huchon)
Symbiotic zooxanthellae in mesophotic octocorals.

2019— Michal Pe'er (R. Sarig)
Thermal alteration of teeth: Changes in volume and morphology.

2019— Mila Rajapova (Hejja) (I. Hershkovitz)
Vertebral body volume and lumbar spinal pathologies.

2019— Einat Kedar (I. Hershkovitz)
The evolution of the human sinus and their functional significance.

2019— Hanan Rapoport (I. Hershkovitz)
Knee morphology in ancient and modern populations.

2019— Linoy Namdar (L. Sapir-Hen)
Villagers of the Islamic and Ottoman periods.

2019— Shani Shoham (M. Ilan)
Arsenic cycle within *Entotheonella* sp.

2019— Gal Eviatar (O. Bronstein)
Unraveling patterns of sexual reproduction — echinoderm reproductive behavior.

2020— Boaz Orel (M. Ilan)
Sponge mariculture.

2020— Raz Moskovich (M. Ilan)
Sponge filtration.

2020— Maya Weinberg (Y. Yovel)
Basic physiology and microbiology of fruit bats: the influence of the fruit bat microbiota on the social behaviour in the colony.

2020— Ofri Eitan (Y. Yovel)
Vocal-based coordinated group flight in bats and birds.

2020— Yomiran Nissan (Y. Yovel)
The genetic basis of behaviour in the Egyptian fruit bat.

2020— Omer Mazar (Y. Yovel)
Why a jamming avoidance response does not help bats deal with jamming.

2020— Yifat Tarnovsky (Y. Yovel)
Understanding the compensation mechanisms for the broad dynamic range of sensory input received in the hearing system.

2020— Ksenia Krivoruchko (Y. Yovel)
Communication and decision-making in freely behaving bats.

2020— Xing Chen (Y. Yovel)
Echolocating bat navigation, on a large-scale map using machine learning methods.

2020— Mark Cavanagh (D. Langgut and E. Ben Yosef)
Coping with hyper-arid conditions -paleoenvironment, sustainability and seasonality in the ancient copper mines of Timna through the archaeobotanical evidence.

2020— Yael Hochma (D. Langgut and Y. Gadot)
Reconstruction of natural and cultural arboreal environment and wood economy of Judah during the Iron and Persian periods.

2020— Nitsan Ben Melech (D. Langgut and Y. Gadot)
Chronology and landscape archaeology: Optically Stimulated Luminescence dating in the Jerusalem Highlands.

2020— Carmel Herold-Lozover (N. Dorchin)
Biology and ecology of the Little Fire Ant, *Wasmannia auropunctata*, as means towards its containment in Israel.

2020— Shahar Dubiner (S. Meiri and E. Levin)
Comparative physiology of reptiles.

2020— Tal Raz (S. Meiri and U. Roll)
Global conservation of reptiles, addressing knowledge shortfalls.

2020— Ayelet Barash (T. Dayan and Y. Dekel)
Analysis of regulatory sequences in developmental genes involved in domestication of Canidae.

2020— Mai Lazarus (R. Holtzman)
Examining relationships between larval, juvenile and adult fish communities.

2020— Dror Malul (R. Holtzman and Uri Shavit, Technion)
The mechanical properties of coral tentacles and their contribution to the efficiency of mass transfer.

2020— Tal Perevolotsky (R. Holtzman and A. Genin, HUJI)
Biomechanics of algal grazing in coral reef fish.

2020— Gal Navon (N. Shenkar)
Assessing the extent and impact of pharmaceutical contamination along the coasts of Israel.

2021— Amit Hadad (H. May)
The association between lower limb morphology and hip osteoarthritis development.

2021— Nihan Dilşad Dağtaş (V. Slon)
Methodological advancements in sedimentary ancient DNA research.

2021— Avery Deveto (J. Belmaker and R. Holzman)
Traits characterizing fish invasion.

2021— Krishna Chaitanya (S. Meiri)
Taxonomy & phylogeny of Indian dragons (Agamidae: *Draco*).

2021— Anna Zimin (S. Meiri and U. Roll, BGU)
Ecological and morphological traits that shape extinction risk in reptiles.

2021— Talya Shalom (T. Dayan and E. Feitelsohn)
Biodiversity conservation under agricultural governance structures.

2021— Shlomo Preis-Bloom (T. Dayan)
How do lethal wolf management and anthropogenic land use shape the mammal community structure of the Golan Heights?

2021— Lachan Roth (O. Bronstein)
Maintaining genetic diversity in broadcast spawning invertebrates.

2021— Lisa-Maria Schmidt (O. Bronstein)
Deciphering sexual reproduction in the genomic era — reproductive dynamics of broadcast spawners revealed through environmental DNA.

2022— Inbar Dahan (J. Belmaker)
Mesophotic reef diversity.

2022— Jacob Dembitzer (S. Meiri and P. Raia; University of Napoli)
Morphological and lineage diversification in Mesozoic and recent Synapsids and Sauropsids,

MSc / MA students

2013— Michal Zeitzov (T. Dayan)
Barn owls as biological control agents in the northern Negev.

2016— Tal Gavriely (J. Belmaker)
Fish movement ecology.

2017— Olga Rybak (R. Dor)
Breeding biology and conservation of Little and Common Terns in Israel.

2017— Amir Rubinstein (J. Belmaker)
Scaling of bird co-occurrence and phylo-diversity.

2018— Nitzan Yitzhak (J. Belmaker and N. Stern)
The ecology of alien Tetraodontidae in the eastern Mediterranean Sea.

2018— Elinor Levy (H. May)
Gracilization of the human skeleton during human history: The biomechanical vs. the 'self-domestication' theories.

2018—2022 Eshel Mor (D. Langgut and R. Greenberg)
Reconstructing Tel Bet Yerah's natural and anthropogenic environment during the Early Bronze Age through wood remains.

2019— Inbar Fridman (D. Langgut)
Vegetation and environmental reconstruction of the central Negev Desert during the Early Pleistocene based on palynological analysis.

2019— Karin Meschiany Sabag (R. Sarig)
The evolutionary transition from the second to the first molar dominancy.

2019— Helena Gondra (H. May)
Changes in osteoporosis prevalence during the Holocene Levant.

2019— Itzhak Dishon (V. Slon)
Pleistocene faunal and floral characterization at the archaeological site of Sefunim Cave, Israel.

2019— Ariana Dann (H. May)
Changes in the shape of the calcaneus following the transition to sedentism.

2019— Liron Chavoinik (H. May)
Biohistory of the early chalcolithic population from Ein Asawir.

2019— Yulia Makoviychuk (H. May)
Who are the people from Nahal Yarmut? A Prepottery Neolithic B site.

2019— Zohar Afek (T. Dayan)
Population dynamics of rare butterfly species (Lepidoptera).

2019— Yulia Gordover (T. Dayan and L. Sapir-Hen)
Human-animal relationship in Middle Pre-Pottery Neolithic B Ein Miri.

2019— Alol Dor (F. Ben-Ami and D.E. Bar-Yosef Mayer)
The freshwater shells of the Epipalaeolithic site of JRD as paleoclimate and paleoenvironment indicators.

2019— Bar Fogel (M. Ilan)
Agelas orides microbiome.

2019— Dorin Shoshan (M. Ilan)
Aquaculture of the sponge *Sarcotragus spinosulus* for biotechnological applications.

2019— Yulia Kushnarev (G. Ribak)
Flight control during the approach of miniature insects to visual targets.

2019— Hagar Csillag (G. Ribak)
Waterfowl swimming hydrodynamics.

2019— Or Filc (G. Ribak and B.-E. Pinchasik)
Aerodynamics and mechanical properties of flapping wings.

2019—2022 Noy Shapira (J. Belmaker)
Functional diversity of Red Sea fishes.

2019—2022 Itai Namir (J. Belmaker and A. Bar Massada)
Temporal activity patterns of mammals in Israel under different human disturbance levels.

2019—2022 Katarina Biljman (Y. Yovel)
The role of sound in spatial navigation and memory.

2019—2022 Omer Segal (N. Dorchin)
Development and dispersal of the weevil *Melanterius compactus* in Israel as a biocontrol agent against *Acacia saligna*.

2020— Shir Michael (M. Ilan)
Sponge associated-bacteria with the potential of arsenite oxidation for arsenic bioremediation from water.

2020— Adi Rachum (Y. Yovel)
Changes in behavior of Egyptian fruit bats in captivity and the wild.

2020— Yael Kenigsberg (N. Dorchin)
Photosynthetic pathways in plants and diet breadth of galling insects.

2020— Almog Hershko-Pnuel (N. Dorchin)
Taxonomy and ecology of Hydropsychidae (Trichoptera) larvae as bioindicators in freshwater ecosystems in Israel.

2020— Oriel Fischer (N. Dorchin)
A test of the plant vigor hypothesis in relation to photosynthetic pathways in plants.

2020— Daria Leibin-Graiver (D.E. Bar-Yosef Mayer, O. Lipschitz and I. Koch)
Mollusc shells as material culture in the Iron Age II of the Southern Levant.

2020— Minji Jin (D. Langgut and O. Lipschits)
Reconstruction of paleoenvironment and wood exploitation at Tel Azekah between the Middle Bronze Age and the Hellenistic Period.

2020— Yael Klirs (D. Huchon)
The mitochondrial genome of *Oikopleura dioica* (Appendicularia).

2020— Einav Lazar (Y. Benayahu and D. Huchon)
The soft corals genera *Cladiella* and *Klyxum*: taxonomy and their symbiotic unicellular algae.

2020— Timrat Leniado (S. Meiri and U. Roll)
Effects of taxonomic practice on reptile threat assessments.

2020— Amal Atallah (L. Sapir-Hen)
Ways of life, culture and environment in Masada during the Great Revolt, as reflected in the analysis of animal bones.

2020— Petunia Fernandez (L. Sapir-Hen)
Animal economy in Azekah during the Middle Bronze Age and the nature of the settlement.

2020— Bin Wang (L. Sapir-Hen)
The donkey economy in the Middle Bronze Age Southern Levant: Tel Azekah as a case study.

2020— Eran Shwartzfuchs (T. Dayan and D. Orenstein)
Analyzing human-wildlife interactions in the urban context.

2020— Zohar Afek (T. Dayan)
Butterfly effect: the survival and crash of the butterflies *Tomars nesimachus* and *Apahatis cilissa*.

2020— Ziad Nasser el-Din (T. Dayan)
Status of the Arabian wolf (*Canis lupus arabs*) in Palestine.

2020— Yuval Goth (J. Belmaker and Y. Ram, TAU)
Phase shifts and alternative stable states.

2020— Yamit Romano (J. Belmaker and J. Benayahu)
Apolonia beach yellow spill.

2020—2022 Ella Fishman (N. Dorchin)
Light in the dark — life history, distribution and effects of light pollution on fireflies (Coleoptera: Lampyridae) in Israel.

2020—2022 Raz Platin (N. Shenkar)
Ecological aspects of the invasive ascidian *Styela plicata* along the Mediterranean coast of Israel.

2021— Yakir Carmeli (H. May)
Development of the articular vertebral process of the lumbar spine during growth: a three-dimensional study.

2021— Dafna Luz (N. Dorchin)
Taxonomy and ecology of Elmidae (Coleoptera) as bioindicators in freshwater ecosystems in Israel.

2021— David Bilbinder (L. Sapir-Hen)
The microfauna from Sefunim Cave.

2021— Uri Wolkowski (M. Meiri and N. Maron, University of Haifa)
Taxonomic and ecological characterization of the extinct Hartebeest (*Alcelaphus* sp.) population in Israel.

2021— Aliza Leit (J. Belmaker and G. Rilov, IOLR)
Abrasion platform restoration.

2021— Ori Hepner (J. Belmaker)
Soft bottom fish community structure.

2021— Jonathan Ben-Simon (S. Meiri and U. Roll, BGU)
Comparing biological traits of extinction and threat.

2021— Anuj Shinde (S. Meiri and U. Roll, BGU)
Comparison of activity time in snakes and lizards.

2021— Chen Donghe (S. Meiri and U. Roll, BGU)
Macroecology of snake traits — species distribution models.

2021— Yan Liberman (S. Meiri and F. Ben-Ami)
Biodiversity in winter pools.

2021— Shoham Zoref (S. Meiri and F. Ben-Ami)
Biodiversity in winter pools in different seasons of the year.

2021— Eden Harel (N. Shenkar)
Interaction of plastic particles with marine organisms.

2021— Yaara Shafrir (D.E. Bar-Yosef Mayer)
The plaster beads of Nahal Hemar Cave, a Neolithic site in the Judean Desert.
2022— Elizabeth Ahola (D. Langgut and V. Heyd, University of Helsinki)
The cultural landscape of Megiddo.

Post-doctoral fellows

2015— Guy Sion, *Laterality in gecko brains — relationships with behaviour and morphology*.
2014— Liat Koch, *Characterising larval starvation using hypothalamic appetite-stimulating neuropeptides*.
2016— Tatiana Tunis-Sella, *The evolutionary history of the human chin*.
2016— Liron Goren, *The diversity of sponge-inhabiting Polychaeta in Israel*.
2016— Shane Blowes, *Scale-dependencies in the drivers of large-scale diversity gradients*.
2016— Iris Bernstein, *Ecological tools and their applications for integrating biodiversity aspects in land-use planning*.
2016— Ronit Justo-Hanani, *Understanding ecological policy innovation in the EU: science and politics in the new bio-invasion legislation and management reform*.
2018— Gal Eyal, *Comprehensive and taxonomical study of the mesophotic coral fauna from the Gulf of Eilat/Aqaba*.
2018— Or Givan, *The Morphological trait structure of nonindigenous fishes in the Mediterranean*.
2019— Shira Penner Rosenvasser, *Taxonomy of Trigonella and Medicago (Fabaceae)*.
2019— Gopal Murali, *Drivers of species diversification rates and endemism in Squamates*.
2020— Aditya Gupta, *Myxozoans of Israel*.
2020— Gabriel Henrique de Oliveira Caetano, *New methods of assessment of the conservation status of reptiles*.
2020— Pnina Cohen, *The Byzantine viticulture*.
2020—2022 Zohar Yanai, T*axonomy and ecology of Hydropsychidae larvae (Insecta: Trichoptera) in Israel*.
2021— Reut Vardi, *Citizen science, urbanization & reptile distribution and physiology*.
2021— Eduardo Arlé, *Modeling invasive species distribution changes*.
2022— Roberta Graboski Mendes, *A phylogenetic-taxonomic survey of the Israeli reptile fauna*.

VISITING SCIENTISTS AT THE STEINHARDT MUSEUM OF NATURAL HISTORY

The attached list includes visitors, who came personally to use the collections of the Steinhardt Museum of Natural History during 2021—2022. Much use was made of the collections by scientists, who did not visit our premises in person. Some researchers got identification services for their projects and others had lists of specimens and locations mailed to them. Moreover, during this period loans of scientific material were dispatched abroad to researchers at their home institutions.

Date	Name	Institute	Country	Expertise
11/2021	A. Barash	Tel Aviv University	Israel	Mammalia
11/2021	D. Yardeni	Tel Aviv University	Israel	Mammalia
11/2021	M. Zaitzove Raz	Tel Aviv University	Israel	Mammalia
12/2021	H. Shirichai	Private	Israel	Aves
12/2021	I. Ktalav	Private	Israel	Mammalia
12/2021	E. Hadad	Israel Nature Reserves and Parks Authority	Israel	Aves
12/2021	J. Dembitzer	Tel Aviv University	Israel	Reptilia
12/2021	M. Lev	Haifa University	Israel	Reptilia
2022	E. Mayzlisch Gati	Israel Gene Bank	Israel	Seed conservation
2022	Sh. Drori	Ariel University	Israel	Viticulture
2022	O. Rahimi	Ariel University	Israel	Viticulture
2022	I. Stern	Research and Development Instutute	Israel	Anatomy
2022	Research staff	Volcani Institute	Israel	Agriculture
1/2022	M. Lev	Haifa University	Israel	Reptilia
12/2021	H. Rothchild	Private	Israel	Aves
2/2021	Y. Kiat	Haifa University	Israel	Aves
2, 5/2022	A. Marom	Technion	Israel	Mammalia
2/2022	M. Zaitzove Raz	Tel Aviv University	Israel	Mammalia
2/2022	L. Horowitz Kolska	Hebrew University	Israel	Aves
2/2022	Z. Turgeman	Haifa University	Israel	Mammalia
2/2022	D. Eilam	Tel Aviv University	Israel	Mammalia

Date	Name	Institute	Country	Expertise
2/2022	A. Slavenko	Tel Aviv University	Israel	Reptilia
3/2022	A. Boonman	Tel Aviv University	Israel	Mammalia
2/05/2022	G. Smarsh	Tel Aviv University	Israel	Mammalia
2—3/2022	C. Planchand	Centre Européen de Recherches Pré-historiques de Tautavel	France	Moulder designer, prehistoric models
3/2022	Th. Assmann	Leuphana University, Lueneburg	Germany	Coleoptera
3/2022	J. Gebert	Schleife-Rohne	Germany	Coleoptera
3/2022	M. Balkenohl	Bonstetten	Switzerland	Coleoptera
3/2022	J. Wexler	Hebrew University	Israel	Hymenoptera
4/2022	A.O. Smith	Purdue University	USA	Coleoptera
4/2022	D. Mora del Pozo	Anticimex España	Spain	Isoptera
4/2022	E. Durany	Alimentaria FoodTech	Spain	Isoptera
5/2022	C. Haidau	Institute of Speleology	Romania	Ancient wolves
5/2022	M. Birkenfeld	Ben-Gurion University of the Negev	Israel	Neolithic in the southern Negev
5/2022	A. Vialet	Muséum National d'Histoire Naturelle	France	*Homo* spp., Neandertals
5/2022	D. Bilbinder	Tel Aviv University	Israel	Mammalia
5—9/2022	A. Zimmin	Tel Aviv University	Israel	Reptilia
6/2022	D. Akkaynak Yellin	University of Haifa	Israel	Marine Technologies
6/2022	O. Eitan	Tel Aviv University	Israel	Mammalia
6/2022	A. Sasson	San Diego University	USA	Mammalia
6/2022	M. Zaitzove Raz	Tel Aviv University	Israel	Mammalia
6/2022	E. Gratsia	University of Crete	Greece	Ascidiaceae
6/2022	G. Chatzigeorgiou	Hellenic Center for Marine Research	Greece	Marine ecology
7/2022	A. Boonman	Tel Aviv University	Israel	Mammalia

Date	Name	Institute	Country	Expertise
7/2022	R. Lebenzon	University of Connecticut	USA	Mammalia
8/2022	L. Horowitz Kolska	Hebrew University	Israel	Mammalia
8/2022	A. Marom	Technion	Israel	Mammalia
8/2022	M. Lev	Haifa University	Israel	Reptilia
8/2022	L. Amos	Haifa University	Israel	Aves
8/2022	Y. Kiat	Israeli banding center	Israel	Aves
9/2022	I. Buzaglo	Tel Aviv University	Israel	Reptilia
9/2022	D. Korngreen	Geological Survey of Israel	Israel	U. Palaeozoic biostratigraphy

SUPPORT FOR ACADEMIC AND OTHER COURSES

The natural history collections of the Steinhardt Museum are extensively used in higher education institutions. Some courses are offered at Tel Aviv University, several of which are compulsory for first and second year students and are taught to hundreds of them. Other universities (Bar-Ilan University, Levinsky Wingate College of Education) use our facilities for their specialized courses. Many activities of the Museum's Education and Science Communication Department also make use of the collections for varied audiences.

Course	Name	Institute	Taxonomic group
World of Insects	N. Dorchin	Tel Aviv University	Insects
Research Skills	N. Dorchin N. Shenkar	Tel Aviv University	Insects Marine invertebrates
Pollination Ecology	A. Dag	Bar-Ilan University	Hymenoptera (*Anthophila*)
Biology and systematics	N. Shenkar	Tel Aviv University	Marine invertebrates
General botany	J. Ziffer-Berger	Levinsky Wingate Academic College	Plants
Introduction to plant sciences	J. Ziffer-Berger	Levinsky Wingate Academic College	Angiosperms, Gymnosperms
Unique phenomena in plants	J. Ziffer-Berger	Levinsky Wingate Academic College	Angiosperms, Gymnosperms, Filices
The plant world	O. Reisman	Open University	Plants
Zoology	G. Ribak	Tel Aviv University	Metazoa
Animals in motion	G. Ribak, D. Eilam	Tel Aviv University	Metazoa
Selected topics in Fish Biology	R. Holzman, M. Kiflawi	IUI, Eilat	Fish
Introduction to archaeozoology	L. Sapir-Hen	Tel Aviv University	Mammals, birds
Using archaeozoological and land vertebrates collections	L. Sapir-Hen	Tel Aviv University	Vertebrates
Mammal and reptile Faunistics	Sh. Meiri	Tel Aviv University	Mammals, reptiles
Biogeography	Sh. Meiri	Tel Aviv University	All
Vertebrate evolution: anatomy, form & function	Sh. Meiri	Tel Aviv University	Vertebrates
Applied molecular species identification	D. Huchon, T. Feldstein-Farkash	Tel Aviv University	Various taxa

SUPPORT FOR VARIOUS INDIVIDUALS & ORGANIZATIONS

The Steinhardt Museum of Natural History functions as a national facility by providing services to the scientific community, other organizations and to the general public. Below we list samples of the services provided by our staff during 2021—2022. The list is not exhaustive, for under the current condition of under-staffing we are unable to monitor and record all such activities.

Purpose	Name	Institute	Taxonomic group
Loan	Th. Pérez	Station Marine, Marseille, France	Sponges
Loan	P. Cardenas	Uppsala University, Sweden	Sponges
Loan	A. Fraley	Institute of Microbiology, Zurich, Switzerland	Sponges
Loan	D.A. Gold	University of California, Davis, US	Sponges
Loan	G. Stephen	Whittier College, USA	Reptilia/Amphibia
Loan	M. Lev	University of Haifa, Israel	Reptilia/Amphibia
Loan	A. Barash	Tal Aviv University, Israel	Mammalia
Loan	M. Zytzove-Raz	Tel Aviv University, Israel	Mammalia
Loan	Z. Hagbi	Tel Aviv University, Israel	Aves
Loan	R. Dor	Open University, Israel	Aves
Loan	M. Pavia	Museo di Geologia e Paleontologia, Torino, Italy	Aves
Loan	A. Mayrose	Israel Nature and Parks Authority	Aves
Loan	E. Zahar	Oranim College, Israel	Aves
Loan	A. Marom	Technion, Israel	Mammalia
Loan	A. Boonman	Tel Aviv University, Israel	Mammalia
Loan	N. Shenkar	Tel Aviv University, Israel	Reptilia
Loan	G. Smarsh	Tel Aviv University, Israel	Mammalia
Loan	G. Ribak	Tel Aviv University, Israel	Aves
Loan	A. Message	Tel Aviv Museum of Art, Israel	Mammalia/Aves
Loan	L. Grismer	La Sierra University, USA	Reptilia
Loan	Sh. Dibiner	Tel Aviv University, Israel	Reptilia

Purpose	Name	Institute	Taxonomic group
Loan	Sh. Peretz	Tel Aviv University, Israel	Reptilia
Loan	A. Sasson	San Diego University, USA	Mammalia
Loan	N. Yizhak	Private, Israel	Mammalia/Aves
Loan	R. Lebenzon	University of Connecticut, USA	Mammalia
Loan	L. Horowitz Kolska	Hebrew University, Israel	Mammalia
Loan	O. Comay	Tel-Hai Academic College, Israel	Owl pellets
Loan	Education Dept.	SMNH, Israel	Aves
Loan	J. Freyhof	Museum für Naturkunde, Berlin	Fish
Loan	Jin-Koo Kim	Ichthyology Laboratory, Yongso-ro, Nam-gu, South Korea	Fish
Loan	Th. Wood	Mons University, Belgium	Insects
Loan	J. Straka	Charles University, Czech Rep.	Insects
Loan	J. Demetriou	University of Athens, Greece	Insects
Loan	J. Mortelmans	KU Leuven, Belgium	Insects
Loan	P. Cardenas	Uppsala University, Sweden	Porifera
Loan	M. Jäch	Vienna Natural History Museum, Austria	Insects
Loan	E.J. Talamas	Florida Department of Agriculture and Consumer Services, USA	Insects
Tissue loan	N. Stern	Israel Oceanographic and Limnological Research (Israel)	Fish
Tissue loan	M. Pavia	Museo di Geologia e Paleontologia, Torino, Italy	Aves
Tissue loan	F. Mayer	Leibniz-Institut für Evolutions- und Biodiversitätsforschung, Germany	Mammalia
Tissue loan	P. Hosner	University of Copenhagen, Denmark	Aves
Tissue loan	E. Geffen	Tel Aviv University, Israel	Mammalia
Tissue loan	A. Barash	Tal Aviv University and Shamir Research Institute	Mammalia
Tissue loan	B. Boljte	University of Ljubljana, Slovenia	Mammalia

Purpose	Name	Institute	Taxonomic group
Tissue loan	E. Fabbri	Istituto Superiore per la Protezione e la Ricerca Ambientale, Italy	Mammalia
Tissue loan	M. Meiri	Tel Aviv University, Israel	Mammalia
Tissue loan	A. Kirschell	University of Cyprus, Cyprus	Aves
Tissue loan	R. Birnbaum	Ben-Gurion University, Israel	Reptilia
Tissue loan	J. Fuchs	Museum of Natural history, France	Aves
Tissue loan	A. Green	Estacion Biologica de Donana - USIC, Spain	Aves
Molecular ID	B. Gal	SMNH, Israel	Fungi
Molecular ID	M. Ilan	SMNH, Israel	Porifera
Molecular ID	L. Goren	SMNH, Israel	Polychaeta
Molecular ID	O. Rittner	SMNH, Israel	Insects
Molecular ID	N. Dorchin	SMNH, Israel	Insects
Molecular ID	Sh. Meiri	SMNH, Israel	Reptiles
Molecular ID	B.Sh. Rothman	SMNH, Israel	Fish
Molecular ID	M. Zaitzove-Raz	Tel Aviv University, Israel	Mammals
DNA extraction	M. Meiri	SMNH, Israel	Mammals
Report on invasive plants	D. Cafri	Plant Protection and Inspection Services	Angiosperms
Identification	E. Mayzlisch	Israel Gene Bank	Angiosperms
Identification	L. Gidron, M. Hadar-Maor	Plant Protection and Inspection Services, Israel	Insects
Identification	Y. Mandelik	Hebrew University of Jerusalem, Israel	Insects
Identification	Y. Halevi	Hebrew University of Jerusalem, Israel	Insects
Identification	M. Segoli	Ben Gurion University of the Negev, Israel	Insects
Identification	I. Sella	EcoConcrete and SeArc Company, Israel	Sponges

Purpose	Name	Institute	Taxonomic group
Identification	G. Ben Zvi	The Entomological Laboratory for Applied Ecology, SMNH	Insects (Hemiptera)
Identification	G. Sinaiko	Tel Aviv University, Israel	Insects (Hemiptera)
Identification	M. Dally,	Hebrew University of Jerusalem	Insects (Hemiptera)
Identification	E. Zchori-Fein	Newe-Ya'ar Research Center, Israel	Insects (Hemiptera)
Identification	E. Elron	Elron — Ecology and Environment, Israel	Fish
Identification of fish images	Sh Chaikin	Tel Aviv University, Israel	Fish
Identification	A. Zvuloni	Israel Nature and Parks Authority	Red Sea fishes
Tel Aviv coast monitoring	R. Trivizky	Atarim, Tel Aviv, Israel	Marine invertebrates Fishes
Deposition of specimens	I. Stein	MOP Mizrah	Angiosperms
Deposition of specimens	R. Shtein	Tel Aviv University	Crassulaceae
Deposition of specimens	G. Yosef	Seminar Hakibbutzin	Angiospems
Deposition of specimens	A. Shmida	Hebrew University of Jerusalem	Plantae
Research	Sh. Drori	Ariel University	Plants: Vitaceae
Research	U. Weiss	Bar Ilan University	Plants: Vitaceae
Research	O. Barazani	Volcani Institute	Brassicaceae
Consultations	E. Zchori-Fein	Newe-Ya'ar Research Center, Israel	Insects
Data provision	H. Ezra	Israel Nature Reserves and Parks Authority, Israel	Aves
Data provision	J. Dembitzer	Tel Aviv University, Israel	Reptilia
Data provision	A. Zimin	Tel Aviv University, Israel	Reptilia
Data provision	N. Munro	Hebrew University, Israel	Mammalia

Purpose	Name	Institute	Taxonomic group
Data provision	M. Todd Clementz	University of Wyoming, USA	Mammalia
Data provision	D. Akkaynak Yellin	University of Haifa, Israel	Tracheophyta
Data provision	U. Nevo	Tel Aviv University, Israel	Charophyta

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