

THE STEINHARDT
museum
of natural
history
מוזיאון
הטבע
 שטיינהרדט
متحف
الطبيعة
 شتاينهارت

ANNUAL
REPORT
 2022/
 2023

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



יד הנדיב Yad Hanadiv



המשרד להגנת הסביבה
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 Ministry of Environmental Protection



משרד החינוך
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רשות הטבע והגנים
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Annual Report

Academic year 2022/2023

The George S. Wise Faculty of Life Sciences, Tel Aviv University

- School of Zoology
- School of Plant Sciences and Food Security

The Lester and Sally Entin Faculty of Humanities, Tel Aviv University

- The Sonia and Marco Nadler Institute of Archaeology
- Department of Archaeology and Ancient Near Eastern Cultures

The Sackler Faculty of Medicine, Tel Aviv University

- Department of Anatomy and Anthropology
- Department of Human Molecular Genetics and Biochemistry
- The Maurice and Gabriela Goldschleger School of Dental Medicine

The Gershon H. Gordon Faculty of Social Sciences, Tel Aviv University

- School of Social and Policy Studies

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Opposite page: The *Passage* exhibition by Rotem Rashef in the Galil Plaza at the museum's entrance. (Photo: Avi Amsalem)

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September 2024



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

Academic Courses Unit

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

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HONORARY PRESIDENT

Michael Steinhardt

SCIENTIFIC AND PUBLIC COUNCIL

The Steinhardt Museum of Natural History is a national research infrastructure. The Scientific and Public Council comprises leaders, who represent the public interest in their diverse fields: Itamar Borowitz, Ruth Arnon, Gedalia Gal, Ariel David, Yael Dayan, Ariel Weiss, Samuel Hayek, Ilan Chet, Yaakov Turkel, Ami Federman, Aharon Ciechanover, Shony Rivnay, Shimshon Shoshani, Michael Steinhardt, Martin Weyl.

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Tamar Dayan (Chair), Aharon Fogel, Itamar Borowitz, Ami Federman, Izhar Kanne, Doron Sapir, Gady Frank, Dudu Zaken, Motti Kohn, Neri Azogui, Menachem Goren, Alon Sapan (Observers).

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MUSEUM STAFF

Directorate

- Prof. Tamar Dayan — Chair
- Dr Menachem Goren — Deputy-Chair
- Alon Sapan — Director
- Dana Silvera-Sharir — Administrative Manager
- Lahan Yosef — Secretary

Marketing & Strategy Department

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- Galit Benschahar-Abadi — Sales, Events and Visitor Front Desk Manager
- Daniela Kenan Gazit — Sales, Group Visits Manager
- Ruth Uzar — Customer Service Supervisor and Sales

- Adi Gov — Marketing Communication and Website
- Anat Zohar — Production coordinator, website admin and marketing communications

OPERATIONS DEPARTMENT

- Adi Katz Shapira — Head of Operations
- Doron Ninio — Museum maintenance
- Andrei Lapicov — Museum maintenance
- Anat Shoham — Museum Operations
- Shir Sali Franco — Museum Operations
- Anastasia Karpenko — Museum Operations
- Gabriela Gleizer — Museum Operations
- Dr Elizabeth (Liz) Morgulis — Live Insects display
- Eran Keidar — IT Coordinator
- ~30 ushers and cashiers

EDUCATION & SCIENCE COMMUNICATION DEPARTMENT

- Dr Ilil Pratt — Head of Education and Science Communication
- Dr Mey-Tal Gewing — Manager of Content Development
- Dr Shira Penner — Botanical Content Developer
- Inbar Schwartz Belkin — Scientific Content Developer
- Dr Yael Navon Furman — Online Content Writer
- Dafna Lev — Coordinator of Educational Projects
- Irit Sidis — Coordinator of Public Programs
- ~70 graduate students as guides

COLLECTIONS AND RESEARCH DIVISION

Museum Committee: Tamar Dayan (Chair), Menachem Goren, Alon Sapan (Observer), Revital Ben-David-Zaslow (Coordinator), Shai Meiri, Eli Geffen, Yossi Yovel, Eran Levin, Karin Tamar, Jonathan Belmaker, Roi Holtzman, Shevy Rothman, Noa Shenkar, Omri Bronstein, Frida Ben-Ami, Micha Ilan, Netta Dorchin, Moshe Guershon, Gal Ribak, Gideon Pisanty, Zohar Yanai, Zafrir Kuplik, Liron Goren, Dorothee Huchon, Yuval Sapir, Hila May, Rachel Sarig, Dafna Langgut, Lidar Sapir-Hen, Meirav Meiri.

Dr Revital Ben-David-Zaslow— Chief Collections Manager
Yonatan Gur — Database Manager

The Entomology Section

- Prof. Netta Dorchin — Chief Curator (flies)
- Dr Sergey Zonstein — Curator (spiders)
- Dr Gal Ribak — Curator (beetles)
- Dr Gideon Pisanty — Curator (Apocrita and parasitic wasps)
- Dr Zohar Yanai — Curator (aquatic insects)
- Prof. Vladimir Chikatunov — Curator (beetles)
- Prof. Abraham Hefetz — Curator Emeritus (bees)
- Dr Dany Simon — Curator Emeritus (lacewings)
- Dr David Furth — Associate Curator (Smithsonian Institution and TAU) (beetles)
- Dr Inon Scharf — Associate Curator (lacewings)

- Dr Yael Mandelik — Associate Curator (Hebrew University of Jerusalem) (bees)
- Dr Tatyana Novoselsky — Collections Manager (bugs)
- Dr Malkie Spodek — Collections Manager (Sternorrhyncha and Auchenorrhyncha)
- Ariel-Leib-Leonid Friedman — Collections Manager (beetles)
- Oz Rittner — Collections Manager (moths and butterflies)
- Ofir Tomer — Collections Manager (moths and butterflies)
- Dr Mike Mostovski — Collections Manager (flies)
- Dr Elizabeth (Liz) Morgulis — Collections Manager (flies)
- Dr Moshe Guershon — Collections Manager (bees) and Staff Director for Entomology
- Dr Armin Ionescu — Collections Manager (ants)
- Prof. Zoya Yefremova — Collections Manager (parasitic wasps)
- Dr Wolf Kuslitzky — Collections Manager (parasitic wasps)
- Ida Rotter — Technical Assistant
- Noah Michaeli — Technical Assistant
- Dr Avi Keysary — Volunteer
- Dr Binyamin Shalmon — Volunteer
- Amir Weinstein — Volunteer
- Tirza Stern — Volunteer

The Marine & Freshwater Section

Invertebrates

- 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 (Coelenterata)
- Dr Liron Goren — Curator (worms and crustaceans)
- Dr Stanislav Pen-Mouratov — Curator (nematodes)
- Prof. Joseph Loya — Curator Emeritus (stony corals)
- Prof. Yehuda Benayahu — Curator Emeritus (soft corals)
- Dr Bella Galil — Curator Emeritus (crustaceans)
- Henk K. Mienis — Collections Manager (molluscs)
- Oz Rittner — Collections Manager (molluscs)
- Dr Sigal Shefer — Collections Manager (sponges)
- Lion Novak — Collections Manager (ascidians)
- Dr Noga Sokolover — Collection Manager (bryozoans and echinoderms)
- Dana Goldwasser — Technical Assistant (worms and echinoderms)
- Tom Morav — Technical Assistant (sponges)
- Nathan Sharon — Volunteer
- Ronit Vilker Alhadeef — Volunteer

Fishes

- Prof. Jonathan (Yoni) Belmaker — Curator
- Prof. Roi Holzman — Curator
- Dr Bat-Sheva (Shevy) Rothman — Curator
- Dr Menachem Goren — Curator Emeritus
- Dr Nir Stern — Associate Curator (IOLR)

- Avery Lynne — Technical Assistant
- Assaf Nashiv — Technical Assistant
- Moty Ginter — Volunteer

The Terrestrial Vertebrates Section

- Prof. Shai Meiri — Curator (reptiles, mammals and birds)
- Prof. Eli Geffen — Curator (mammals and amphibians)
- Prof. Tamar Dayan — Curator (mammals)
- Dr Eran Levin — Curator (mammals)
- Prof. Yossi Yovel — Curator (bats)
- Dr Karin Tamar — Curator (mammals, reptiles and amphibians)
- Prof. Yoram Yom-Tov — Curator Emeritus (reptiles, mammals and birds)
- Prof. Yoel Rak — Curator Emeritus (early hominids)
- Dr Roi Dor — Associate Curator (birds)
- Dr Amos Belmaker — Collections Manager (birds)
- Daniel Berkowicz — Collections Manager (birds)
- Avigail Ben-Dov Segal — Technical Assistant (birds and feathers)
- Moshe Geizler — Volunteer
- Mira Ideles — Volunteer
- Avraham (Rami) Biran — Volunteer
- David Kobiler — Volunteer
- Matan Hayun — Volunteer
- Igor Gavrilov — Chief Taxidermist
- Dr Stanislav Volynchik — Taxidermist and Preparator
- Yulia Gordover — Technical Assistant
- Tal Vardi — Technical Assistant

The Herbarium

- Dr Yuval Sapir — Curator
- Prof. Jacob Garty — Curator Emeritus (lichens)
- Dr Jotham Ziffer-Berger — Associate Curator and Collections Manager (plants)
- Bruria Gal — Collections Manager (fungi)
- Yonatan Gur — Collections Manager (fungi)
- Dr Razy Hoffman — Collections Manager (water plants, cyanobacteria and water fungi)
- Ehud Behar — Technical Assistant
- Horesh Zaharia — Technical Assistant

The Palaeosciences Section

Palaeontology

- Dr Yuri Katz — Curator
- Dr Olga Orlov-Labkovsky — Curator (micropalaeontology)
- Prof. Sigal Abramovich — Associate Curator (Ben Gurion University of the Negev)
- Dr Daniella E. Bar-Yosef Mayer — Collections Manager

Biological archaeology

- Dr Dafna Langgut — Curator (palynology and archaeobotany)
- Dr Lidar Sapir-Hen — Curator (archaeozoology)

- Dr Irit Zohar — Curator (fish osteology)
- Dr Meirav Meiri — Curator and Ancient DNA Lab Manager
- Prof. Miriam Belmaker — Associate Curator (archaeozoology; University of Tulsa, OK, USA)

Dan David Center for Human Evolution and Bio-History Research

Physical Anthropology

- Prof. Rachel Sarig — Director
- Dr Hila May — Curator
- Dr Viviane Slon — Curator
- Prof. Baruch Arensburg — Curator Emeritus
- Prof. Israel Hershkovitz — Curator Emeritus
- Nili Zilberberg — Administrative Manager
- Julia Makoviychuk — Technical Assistant
- Alina Revda — Technical Assistant
- Efrat Kaisler — Technical Assistant

Molecular Systematics and Tissue Collection

- Prof. Dorothée Huchon — Curator
- Dr Tamar Feldstein-Farkash — Collections and Molecular Systematics Laboratory Manager
- Sahar Haj Yahya — Technical Assistant

CITIZEN SCIENCE NATIONAL CENTER

- Dr Tomer Gueta — Center Development Director
- Dr Nirit Lavie-Alon — Head of Citizen Science Practice
- Dr Yaela Golumbic — Head of Citizen Science Research & Development
- Shlomo Preiss-Bloom — Content and UI Translator
- Zohar Afek — Training Materials Designer and Developer
- Naama Arkin — Head of Technology Infrastructure Development

Scientific Committee:

- Prof. Ofer Arazy — University of Haifa (Chairman)
- Dr Yehoshua Shkedy — Israel Nature and Parks Authority
- Dr Ofer Steinitz — Israel Nature and Parks Authority
- Dr Neta Lipman — Ministry of Environmental Protection
- Dr Anna Trajtenbrot — Ministry of Environmental Protection
- Dr Doron Markel — Keren Kayemeth Lelsrael — Jewish National Fund
- Dr Gilad Ostrovsky — Keren Kayemeth Lelsrael — Jewish National Fund
- Dr Yoav Perlman — Society for the Protection of Nature in Israel
- Dr Liat Hadar — Ramat Hanadiv
- Dr Uri Roll — Ben-Gurion University of the Negev
- Dr Ori Sharon — Bar Ilan University
- Prof. Dan Malkinson — University of Haifa
- Prof. Jonathan Belmaker — Tel Aviv University
- Dr Shay Rotics — Tel Aviv University
- Dr Yael Mandelik — The Hebrew University of Jerusalem
- Dr Yehezkel Resheff — The Hebrew University of Jerusalem

- Prof. Tali Tal — Technion-Israel Institute of Technology
- Prof. Assaf Shwartz — Technion-Israel Institute of Technology
- Prof. Gil Rilov — Israel Oceanographic and Limnological Research Institute
- Prof. Ron Milo — Weizmann Institute of Science
- Prof. Ayelet Shavit — Tel-Hai College

ACADEMIC COURSES UNIT

Management:

- Dr Menachem Goren — Steinhardt Museum of Natural History
- Dr Tom Shlesinger — Steinhardt Museum of Natural History
- Dr Zafir Kuplik — Steinhardt Museum of Natural History

Teaching Committee:

- Prof. Shai Meiri — Steinhardt Museum of Natural History
- Prof. Dorothee Huchon — Steinhardt Museum of Natural History
- Dr Dafna Langgut — Steinhardt Museum of Natural History

Teaching coordinator:

Dr Noga Sokolover — Steinhardt Museum of Natural History

Scientific Committee:

- Prof. Michal Segoli — Ben Gurion University of the Negev
- 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

APPLIED RESEARCH DIVISION

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

The Israel National Center for Aquatic Ecology

Steering Committee:

- Dr Dana Milstein — Israel Nature and Parks Authority (Chair)
- Dr Neta Lipman — Ministry of Environmental Protection
- Amir Erez — Ministry of Environmental Protection
- Nissim Keshet — Israel Nature and Parks Authority
- Dr Asaf Tsoar — Israel Nature and Parks Authority
- Dr Yehonathan Bar-Yosef — Keren Kayemeth Lelsrael — Jewish National Fund
- Dr Doron Markel — Keren Kayemeth Lelsrael — Jewish National Fund
- Dr Menachem Goren — Steinhardt Museum of Natural History

- Prof. Tamar Dayan — Tel Aviv University
- Hanoch Ilssar — The Rothschild Foundation

Staff

- Dr Yaron Hershkovitz — Director
- Tuvia Eshcoly — Lab Manager
- Noa Zanzuri — Administrative Manager
- Naomi Gordon — Taxonomy
- Avital Katz — Database Manager
- Etai Kahana — Dipteran taxonomy and GIS
- Adi Weiss — Taxonomy and Reports
- Dafi 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 — Steinhardt Museum of Natural History
- Dr Inon Scharf — Tel Aviv University

Staff

- 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
- Carmel Herold-Lozover — PhD student

HaMaarag — Israel's Nature Assessment Program

HaMaarag Board of Directors:

- Prof. Tamar Dayan — Tel Aviv University
- Dr Yehoshua Shkedy — Israel Nature and Parks Authority
- Dr Ittai Renan — Tel Aviv University
- Dr Gilad Ostrovsky — Keren Kayemeth Lelsrael — Jewish National Fund
- Tamar Raviv — Ministry of Environmental Protection

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 Lelsrael — Jewish National Fund

Staff

- Dr Ittai Renan — Manager
- Dr Ron Chen — Quantitative Ecology Coordinator
- Tomer Karni — Monitoring Programs Coordinator
- Dr Orr Comay — Quantitative Ecologist
- Michal Koren — Geographic Information System and Cartography Coordinator
- Ido Livne — Remote Sensing Coordinator
- Ella Pasternak — Ecologist and Zoologist
- Ori Ismach — Research Assistant
- Shira Grossbard — State of Nature Report editor
- Iris Yerushalmi — Administrative Manager
- Zohar Afek — MSc student
- Bar Pezarker — MSc student

The Open Landscape Institute

Council (Board):

- Yoav Sagi, Chair — Society for Protection of Nature in Israel (ret.)
- Amir Ritov, Co-Chair — Head of Lev HaSharon Regional Council
- Dr Gilad Ostrovsky — Keren Kayemeth Lelsrael — Jewish National Fund
- Asaf Krarwani — Keren Kayemeth Lelsrael — Jewish National Fund
- Asaf Zanzuri — Israel Nature and Parks Authority
- Tamar Raviv — Ministry of Environmental Protection
- Yahel Porat — Keren Kayemeth Lelsrael — Jewish National Fund
- Dr Yehoshua Shkedy — Israel Nature and Parks Authority
- Dotan Rotem — Israel Nature and Parks Authority
- Nir Angert — Israel Nature and Parks Authority
- Eran Ettinger — Ministry of Agriculture
- Nir Papay — Society for the Protection of Nature in Israel
- Dror Boymel — Society for the Protection of Nature in Israel
- Milka Carmel — Regional Council's Organization
- Hila Akerman — Regional Council's Organization
- Hanoch Ilssar — The Rothschild Foundation
- Dr Anna Trajtenbrot — Ministry of Environmental Protection
- Prof. Eran Feitelson — The Hebrew University of Jerusalem
- Prof. Yael Mandelik — The Hebrew University of Jerusalem
- Prof. Tali Mozes — Technion
- Dr Hana Sweid — the Arab Center for Alternative Planning
- Prof. Tamar Dayan — Tel Aviv University
- Alon Sapan — Tel Aviv University

Staff

- Uri Ramon — Director
- Dr Amir Perelberg — Head of Survey Unit
- Aviv Avisar — Head of the Research Unit
- Dr Rona Winter-Livne — GIS Unit Manager
- Achiad Sade — Mazav Hayar survey Manager
- Nadav Sade — Assimilation and Social visibility

- Hila Gil — Hotspots Research Coordinator
- Dr Liron Amdur — Researcher
- Dana Ginosar — Researcher
- Noa Zanzuri — Administrative Manager
- Evgeny Hemlin — GIS Coordinator
- Eitan Romem — Survey Manager
- Bar Shemesh — Head of Botanical Research
- Dvora Lev-Ramati — Survey Manager
- Miryam Ron — Senior Botanist
- Amit Mendelson — Survey Manager
- Idan Talmon — Researcher
- Liraz Cabra-Leykin — Survey Manager
- Einat Gera — Survey Coordinator
- Dar Ben-Nathan — Botanist
- Lior Enmar — Surveyor
- Ella Dagon — Researcher
- Dar Ben-Nathan — Surveyor
- Reut Loria — Botanist
- Ori Moran — Researcher
- Yitzhak Cohen — Surveyor
- Ori Halberstadt — Surveyor
- Gal Israeli — Surveyor
- Noa Valzer — Surveyor
- Neta Friedman — Surveyor
- Inbar Schnitzer — Surveyor
- Noam Segev — Surveyor
- Daniel Idan — Surveyor



PROGRESS AT THE STEINHARDT MUSEUM OF NATURAL HISTORY

Tamar Dayan and Alon Sapan

The academic year 2022–2023 was an exciting one. It started with yet another wave of Covid and limitations on the numbers of museum visitors, but those restrictions were lifted by the beginning of 2023 and we were free to reactivate the museum with normal procedures, and indeed public visitation and events bounced back to the pre-Covid state.

With the anticipated increase in the public inflow, we kept the *Global Warning* climate change temporary exhibition running for a 2nd year because it was so timely and hence popular among our visitors, many of whom did not get the chance to experience it before. At the same time, we worked on developing the next temporary display, by the talented artist Nevet Yitzhak. A new outdoors art exhibition at the Galil Plaza opened (*Passage*), as was a pop-up exhibition (*Run*), both with strong nature and conservation themes befitting our museum, as were two interactive displays — one on the ecosystem services and one on sustainable nutrition, particularly timely topics, where the museum's contribution was significant. Thus, the museum remains current, active and attractive to the public, and we were rewarded by a really great response to our efforts.

During the academic year, we were happy to continue hiring senior faculty members both at the researcher and at the lecturer tracks, a new opportunity that opened to us with the recognition of the museum as an academic unit at Tel Aviv University. Drs Shay Rotics and Tom Shlezinger were hired as Senior Lecturers on joint appointments with the School of Zoology at the Faculty of Life Sciences, and joined Dr Ronit Justo-Hanani, a joint appointment with the Faculty of Social Sciences. Dr Yaron HersHKovitz was hired on the researcher track, and joined Drs Meirav Meiri, Gidi Pisanty, Karin Tamar, Zohar Yanai, Zafri Kuplik, Liron Goren, and Shevy (Bat-Sheva) Rothman. These enrollments (and those to come) brought much needed taxonomic and ecological expertise and provided considerable strength to the Steinhardt Museum research program.

The Israel Center for Citizen Science made its first steps and the excellent young team led by Dr Tomer Gueta was working hard, forging working relationships with a variety of citizen science projects in Israel and experts abroad, and providing a technological platform and support as well as professional expertise in taxonomy, ecology and education to promote this field of research engagement in Israel.

During the 2023 summer, we opened—with our partners in KKL-JNF—the Center for Ecological Restoration and Nature-Based Solutions, planning to promote ecological restoration in Israel as a sound professional field of scientific activity. This is the UN Decade on Ecological Restoration, and Israel has committed with most other countries in the world to the restoration of large tracts of land, a particularly challenging feat in a small heavily populated country. Scientific expertise is the key and we hope to contribute to this development.

Finally, our Applied Policy-Relevant Research Division, consisting of the Open Landscape Institute, HaMaarag — Israel Nature Assessment Program and the National Center for Aquatic Ecology, continued to conduct extensive surveys, monitoring and research of Israel's ecosystems and their management, to inform professionals and decision makers on the administration of Israel's natural capital.

The Steinhardt Museum has been established to meet the needs of the State of Israel in a National Museum of Natural History — to record and study biodiversity and to share its treasures and legacy with the general public. While the museum's work gains momentum, biodiversity challenges increase, and we continue to work hard with hundreds of scientists and professionals from many Israeli institutions and from the international community, with government agencies and NGOs, to produce the knowledge required for Israel's biodiversity research, conservation and management in times of global change.

COLLECTIONS NEWS

The staff members of the Steinhardt Museum of Natural History (SMNH) continued curation and promotion of our collections. Routine curatorial activities got fully restored after the Covid-19 pandemic during the 2021–2022, and 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.

The SMNH staff continued to be involved in a joint Pest Risk Assessment project with the Plant Protection and Inspection Services, coordinated by Dr Zohar Yanai.

During the 2022–2023 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 2022–2023, almost 34,000 new records were added to the SMNH database, which was duly updated on the Museum Website (<https://smnh.tau.ac.il/en/research/collections-database>).

THE ENTOMOLOGY SECTION (INCLUDING ARACHNIDS)

Netta Dorchin, Inon Scharf, Gal Ribak, Sergei Zonstein, Tanya Novoselsky, Malkie Spodek, Vladimir Chikatunov, David Furth, Arie-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.

Arachnida

S. Zonstein continued day-to-day curation of the arachnid collection and his active research into mygalomorph and other spiders. The collection was expanded with identified spider specimens belonging to the newly added 34 species from Israel and 276 species from other countries. The total number of spider species in the SMNH collection reached 1150. Sergei focused his studies on the Palaearctic and Afrotropical spiders, and travelled to the Naturhistorische Museum Wien (Austria) in October 2022, and the Royal Museum for Central Africa (Tervuren, Belgium) in September 2023, to examine their holdings.

Orthoptera and Dermaptera

M. Guershon was deeply involved in the updating of the Taxonomy and Geography (toponomasticon) tables in the museum's database, and in design of the automated label generation (together with the database manager Yonathan Gur). In June 2023, Moshe hosted and coordinated (along with Netta Dorchin) the Acridoidea (Orthoptera) academic course given by Dr Martin Husemann (Leibniz Institute for Biodiversity, Hamburg, Germany), re-sorted the Acridoidea collection by family and genera following Martin's work on the collection and was busy preparing a list of Orthoptera type (to be published next year). Moshe was also writing an identification key for the Dermaptera of Israel. As part of a broader science engagement, he provided a tour for the museum guides course at the Arthropods gallery and gave a lecture on the use of insect collections within Karin Tamar course for students at Tel Aviv University.

Mantodea

D. Simon and A. Weinstein continued routine curation of the Mantodea collection and devoted much of their effort towards completion of their monograph on praying mantises of Israel and neighbouring regions.

Hemiptera

T. Novoselsky received nine 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. Tania sorted and databased 16,432 specimens of the family Miridae, which is the largest family of Heteroptera, with over 11,000 described species. Mirids are mostly phytophagous and occur in a wide variety of natural environments. Documenting their presence in Israel is particularly relevant, given its exceptionally high diversity. Currently, the Catalogue of Palaearctic Heteroptera (online) lists 91 genera and 253 species of the Miridae in Israel. These are further divided into six subfamilies: Bryocorinae (5 genera, 13 species), Deraeocorinae (5 genera, 11 species), Isometopinae (2 genera, 2 species), Mirinae (27 genera, 60 species), Orthotylinae (16 genera, 44 species) and Phyllinae (36 genera, 123 species). In 2022, Tania and Attilio Carapezza (University of Palermo, Italy) started a project to gain comprehensive knowledge of the Miridae in Israel. They studied the abundant material preserved in SMNH collection and identified five or six species as new to science, and 42 species as new records for Israel; they also corrected several misidentifications. The next step would be publication of an illustrated identification key to all Israeli Miridae species arranged by subfamilies. Tania also continued working on final drafts and proofs of her manuscript on the Scutelleridae and Acanthosomatidae. Upon discussion of the practical and scientific importance of revising the family Membracidae (Auchenorrhyncha) with Guy Sinaiko (SMNH), Tania sorted and databased 441 specimens of this family. 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; she established new collaborations with Dr Attilio Carapezza (University of Palermo, Italy) on the Miridae and with Dr Petr Kment (National Museum of the Czech Republic) on the Pentatomidae. The type material of *Tramafora koachi* (Aphididae), an Israeli endemic described by Barjadze *et al.* (2020) was received, databased and incorporated into our collection. Tania participated and presented at the 9th European Hemiptera Congress (Kurdějov, Czech Rep. 25.6–1.7.2023) and visited the Insect Collection of the National Museum of the Czech Republic.

Coleoptera

Gal Ribak and his research team focused on flight of Coleoptera, Lepidoptera, Odonata and Thysanoptera, including collaborations with Prof. Roi Gurka (Carolina University, SC, USA), Dr Bat-El Pinchasik (Mechanical Engineering, Tel Aviv University) and Prof. Fritz-Olaf Lehmann (Rostock University, Germany) on the aerodynamic and mechanical properties of beetle and fly wings.

L. Friedman continued routine curation of the Coleoptera collection. About 2000 insects from Israel, Near East, Europe, Africa, America and Central Asia were mounted, databased and labelled in 2022–2023. A small collection of weevils from the Near East and North Africa was donated by Dr Guido Sabatinelli, Genève, Switzerland. Collecting in Israel resulted in a number of interesting additions. A series of the rare Afrotropical *Acacia*-dwelling weevils *Sphadasmus maculatus* (Curculionidae) was collected in the Northern Arava. A population of a weevil *Eutrichapion punctigerum* (Apionidae), previously known from Israel from two specimens only, was revealed near Metula; the weevils were found on *Vicia galeata*, which was most probably its host plant; the northernmost point of Israel was the southernmost point of the total distribution of this species. The host plant—the fragrant oxeye *Asteriscus graveolens* (Asteraceae)—was accidentally revealed for the desert leaf-beetle *Chrysolina aeneipennis* (Chrysomelidae). An additional species of the

water beetles of the family Limnichidae was found during his family trip along the water edge in Amnun beach on the norther shore of Lake Kinneret. Large and spectacularly red-coloured Afro-tropical blister-beetles *Horia fabriciana* (Meloidae), the parasitoid of the carpenter bee *Xylocopa pubescens*, were found for the first time in Israel by the locals in the Northern Negev and in the Southern Coastal Plain. L. Friedman, thanks to his numerous connections and personal charm, was able to procure two specimens (a male and a female) of this spectacular beetle for the SMNH collection, along with additional information and photographs of other specimens. The new record was promptly published in the Israel Journal of Entomology (Friedman 2023).

V. Chikaturonov 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 and databasing of the Rhopalocera (butterflies) and Heterocera (moths) collections, respectively. The butterfly collections of Uri Caspi and Eliav Shney-Dor (both members of the Israeli Lepidopterists Society) were donated to our Lepidoptera collection. Several new moth species for Israel from different families (Noctuidae, Cossidae, Choreutidae etc.), as well as a new yet unpublished species of the Cossidae, were discovered during light trapping. In July 2023, the Citizen Science group had its meetings indoors and outdoors (Hosha'aya and Park Ayalon-Canada area). During the National Moth Week in August, we had 34 participants who gave 263 reports; 81 species were reported in total and this happened during only a week! The Citizen Group iNaturalist project AshTag (#עשטג) grew to 30 members, 3753 observations and 531 identified species, and plans were being made to continue with activities and attracting new members.

Diptera

N. Dorchin focused her research on the taxonomy and systematics of gall-midges from Israel, South Africa and Europe, including 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 (PhD student Yael Kenigsberg); the systematics and ecology of riffle beetles (Elmidae) of Israel (MSc student Dafna Luz) in collaboration with Dr Yaron Hershkovitz (Israel National Center for Aquatic Ecology); the taxonomy and ecology of the Trichoptera of Israel (PhD student Almog Hershko-Pnuel) in collaboration with Dr Yaron Hershkovitz; 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, MSc student Ilya Nudelman). As a result of the ongoing projects, our collection 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 and Elmidae 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); Cornelia Klak (University of Cape Town, South Africa); 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); Hans-Henrik Bruun (University of Copenhagen, Denmark);



Contarinia ampelitsiae Dorchin & Fazan, 2023, a new gall-midge species forming galls in flowers of an endemic elm tree species in Crete. (From Fazan *et al.* 2023)

Sébastien Carbonelle (Ministry of Environnement & Nature of Wallonie, Belgium); Robin Adair (Australis Biological, Bittern, Victoria, Australia); Laurence Fazan (University of Fribourg, Switzerland); Manfred Jäch, (Natural History Museum Vienna, Austria); and Martin Husemann (Leibniz Institute for the Analysis of Biodiversity Change (LIB), Hamburg, Germany). In February 2023, Netta was preparing the Harris collection (Surrey, UK) for transfer to the SMNH; in September 2023, she visited Smithsonian National Museum of Natural History (Washington DC, USA) and American Museum of Natural History (New York, USA), working in their Diptera collections. In July 2023, Netta participated in the 8th International Plant Gall Symposium (Chico, CA, USA) and 10th International Congress of Dipterology (Reno, NV, USA). Netta taught the following courses for students of the Faculty of Life Sciences, Tel Aviv University: *World of Insects* (graduate and undergraduate), *Research Skills* (graduate) and *Insects of Israel* (field excursions); in June 2023, she hosted guest teachers for the academic courses on the *Acrididae of Israel* (Dr Martin Husemann, LIB, Hamburg, Germany) and *Urban Entomology* (Dr Andrew Sutherland, University of California, Hayward, USA). She also participated in the risk assessment project and was a member of the committee for introduction of natural enemies (both Plant Protection and Inspection Services, Israel Ministry of Agriculture), and served on the Flora and Fauna committee of the Israel Academy of Sciences and Humanities, on the Advisory Board of the Leibniz Institute for the Analysis of Biodiversity (Bonn and Hamburg, Germany), on the Council of the International Congresses of Dipterology, and as President for the Entomological Society of Israel.

E. Morgulis continued rearranging the Acalyptratae collection, both alphabetically and phylogenetically, and added data (taxonomy, type status, etc.) on several thousands of specimens in the database. She received hundreds of specimens, which had been loaned for identification, and handled this material, including its proper placement in the SMNH collection, recording the types, and its addition to the museum database.

M. Mostovski revisited the oldest remains of the presumed Diptera Brachycera from the Middle Triassic (ca. 245-million-year-old) deposits of the famous Konservat-Lagerstätte Grès à Voltzia in the northern Vosges Mountains in France and hypothesized that they represented a new family Galliidae, which belonged to the stem-group Brachycera along with the Late Triassic Prosechamiidae from the Upper Triassic of the USA. Possible processes of brachycerization in the Diptera evolution were also suggested (Lukashevich & Mostovski 2023).

Hymenoptera

Hymenoptera Apocrita (G. Pisanty): Gidi continued his research into Levantine solitary bees of the genus *Andrena*. In August 2023, he visited the Biologiezentrum in Linz, Austria, to study Western Palaearctic material of *Andrena* and choose specimens for molecular barcoding. He also sent two plates of legs removed from *Andrena* specimens from Israel for barcoding, which was done in collaboration with Dr Sophie Cardinal (Canadian National Collection, Ottawa, Canada) in an effort to barcode the Israeli fauna of *Andrena*, and with Thomas J. Wood (Mons University, Belgium) to identify *Andrena* specimens from Israel and neighbouring countries, and to describe new species and subgenera. Gidi also collaborated with Dr Yael Mandelik and her student Karmit Levy from the Hebrew University, in describing a new species of *Andrena* from Israel's Coastal Plain.

Parasitic Hymenoptera (W. Kuslitzky): Wolf attended to day-to-day curation of collection in his care. He also continued rearing insects under laboratory conditions from seeds of *Acacia saligna*, fruits of *Prosopis farcta*, stem galls of the Poaceae (mainly *Hordeum bulbosum* and *Avena sterilis*), stem galls of *Urospermum picroides*, and galls and seed pods of *Cuscuta campestris*, and identifying new material himself or through cooperation with other taxonomists. It was noted that up to 7.6% of seeds of *Acacia saligna* collected at Nizzanim yielded the leaf-beetle *Stator limbatus* (Coleoptera: Chrysomelidae). Researchers in Israel currently work on containing the expansion of the invasive *Acacia saligna*, an Australian species, by introducing the weevil *Melanterius castaneus* (Curculionidae), also of the Australian origin, as a biocontrol agent. The weevil develops in immature acacia seeds during only a short period of the year, which is clearly a limiting factor for its successful application. In contrast, the larvae of *Stator limbatus* (species of the Central American origin) feed in mature acacia seeds, which are available throughout the year, thus allowing this leaf-beetle to have several generations without competing with the weevil. More-

over, Wolf also reared *S. limbatus* from the fruits of the notorious weed *Prosopis farcta* (Fabaceae), and it should be noted that *S. limbatus* is considered a biocontrol agent of *P. farcta* in Iran (Shamszadeh *et al.* 2017).

Parasitic Hymenoptera (Z. Yefremova): Material of the Eulophidae newly collected in Kenya was sorted and identified, over 100 specimens of the Eulophidae reared from the Gracillariidae (Lepidoptera) in Laos were identified and added to the collection, parasitoids reared from the gall midges (Diptera: Cecidomyiidae) were being sorted and identified. Zoya's research on the genus *Platyplectrus* (Eulophidae) from Kenya, with description of new species was completed, and she focused her studies on the African members of the genus *Euplectrus* (Eulophidae) from Kenya and on the Palearctic and Oriental genus *Kolopterna* (Eulophidae) associated with Cecidomyiidae, with descriptions new species in both genera. Zoya continued her collaboration with Dr Robert Copeland (International Centre of Insect Physiology and Ecology, Nairobi, Kenya); Smithsonian National Museum of Natural History, Washington, DC, USA; Prof. George Japoshvili (Institute of Entomology, Agricultural University of Georgia, Tbilisi, Georgia); and Natalie Dale-Skey (Natural History Museum, London, UK).

Aquatic insects

Zohar Yanai focused on two main research topics:

- Freshwater invertebrate diversity (collaboration with the Aquatic Ecology Center, SMNH, and Prof. Netta Dorchin's lab; the project led by Nili Segman). Most efforts were aimed at Ephemeroptera (mayflies) and Odonata (dragonflies and damselflies), as well as other invertebrates, e.g. caddisflies (Trichoptera), water beetles and annelids.
- Invasive species in freshwater systems. A few projects were in progress, with a major focus on recent crayfish invasions in Israel (see figure on p. 54). With various collaborators, we aimed at understanding crayfish introduction mechanisms, ecological impact and eradication options.

For projects related to mayfly (Ephemeroptera) taxonomy and systematics, Zohar maintained his collaboration with Dr Jean-Luc Gattolliat (Lausanne, Switzerland) and Dr Pavel Sroka (Prague, Czechia). These were ongoing projects, with no new products in during the year of concern. Zohar took part in an inter-institutional taskforce in the issue of invasive crayfish in Israel. Members of this group worked together to identify, monitor, understand and attempt to eradicate crayfish invasions into the freshwater systems in Israel. A targeted effort was done to database the Odonata collection, consisting of both pinned and wet material. Out of 733 databased specimens, 588 were added during the reporting period. The databasing was done with the assistance of Nili Segman, who used to be a temporary, part-time employee in the collections.

Miscellaneous curation

Avi Keysary curated and databased 5774 insect specimens mostly collected during 1930–1950 in Israel (4732 specimens) and abroad (1042). These included mainly Hymenoptera Apoidae (2000) and Vespoidea (1960), as well as Neuroptera (772) among other groups.

Identification Services

Over 1400 specimens were identified by the Entomology staff for the government, academic and private organizations. Full details of identifications done for the Plant Protection and Inspection Services (PPIS), 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, requested by the PPIS, Ministry of Agriculture of Israel, and ca. 100 identifications for private customers in Israel and around the world (both via social media and on the direct request), and for the colleagues from the Ben Gurion University of the Negev (e.g. Dr E. Groner, Dr Y. Ziv, Dr M. Segoli), Bar-Ilan University (Dr E. Weiss), Hebrew University in Jerusalem Rehovot (Dr O. Shelef, Dr Y. Mandelik) and for the museum colleagues (Entomological Laboratory for Applied Ecology, Israel National Center for Aquatic Ecology, etc.).

- Diptera: E. Morgulis assisted Yehonatan Halevi (Prof. Yael Mandelik's lab, The Robert H Smith Faculty of Agriculture, Food and Environment, the Hebrew University of Jerusalem) in the identification of Diptera collected during his project.
- Hymenoptera (Parasitica): Z. Yefremova identified about 58 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 grew 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 went 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 needed to be processed.

N. Dorchin went on multiple field trips to the Jordan Valley, Negev, 'Arava and the Golan Heights, mostly during winter and spring together with students and SMNH collection managers. In June 2023, she collected gall midges on various plants in Denmark; and in September 2023, Netta collected gall midges on various plants in West Virginia (USA).

S. Zonstein went on a field-work trip to Uzbekistan from 25 April – 16 May 2023.

T. Novoselsky conducted extensive fieldwork in Israel, which yielded 601 specimens, and in Czech Republic (South Moravian Region and DĚVÍN), which brought 319 specimens.

L. Friedman undertook 11 collecting trips throughout Israel, and collected ca. 1000 insect specimens, predominantly beetles (mostly weevils). Four trips were joint expeditions: one three-day trip to the Arava Valley, Central and Southern Negev, together with N. Dorchin, her students and S. Zonstein; two one-day trips with S. Zonstein to the Northern Negev, with N. Dorchin to the Upper Galilee, and with students of N. Dorchin, respectively. Four collecting days were initiated by the Israel Nature and Parks Authority (INPA): one-day sampling on Mt. Gerizim in Samaria, in the area intended for construction of a new neighborhood; one-day ecological camp in Rotem-Maskiyyot Nature Reserve, Samarian Desert, with M. Gershon, G. Pisanty, A. Weinstein and N. Michaeli; and two days of sampling while rafting on the southern part of the Jordan River, in cooperation with INPA, IDF and the Jordanian Armed Forces. Three trips were undertaken privately during family travels to Metula (one day), Central Negev and Makhtesh Ramon (two days), Kinneret and Golan Heights (three days). In mid-August 2023, L. Friedman visited his family in New Jersey, USA, and dedicated a part of his visit for intensive collecting, which brought ca. 250 specimens of insects, mainly weevils, which were duly labelled and incorporated in the SMNH collection. The collecting was done in the vicinity of Trenton (Ewing), Freehold (Turkey Swamp Park), and in New York (Manhattan, Central Park). L. Friedman (accompanied by his wife) went on a tour to Bulgaria during 31.08–4.09.2023, spending part of the time for intensive collecting around Sofia (Vitosha Mt., Yuzhen Park), on the banks of the Zlatna-Panega River and in the Karlukovo, Ihtiman, Plovdiv, Studena and Rila Mts. This collecting yielded ca. 2300 specimens of about 100 insect species (Coleoptera, Hymenoptera, Diptera, Hemiptera, Mecoptera, Trichoptera and Orthoptera), most of them new for the SMNH collection, including 25 species of weevils (Apionidae, Nanophyidae and Curculionidae).

O. Rittner went on 14 light-trapping events to Ein Avedat nature reserve, Ein Gedi nature reserve, Einot Tzukim (Ein Feshkha) nature reserve, 'Evrone nature reserve, Hamat Gader area, Hirbet Farj, Hosha'aya, Nabi Hazuri (Golan Heights), Ne'ot Semadar, Park Ayalon-Canada, Shoham forest park, and Tel Zafit national park.

W. Kuslitzky went on numerous one-day trips to Shavei Ziyon, Akko, Palmahim, Tel Aviv, Rehovot, Mishmar Dawid, Zelafon, Nizzanim and Canada Park for collecting phytophagous insects and their parasitoids continued, mainly by rearing them from seeds of *Acacia saligna*, fruits of *Prosopis farcta*, stem galls of the Poaceae (mainly *Hordeum bulbosum* and *Avena sterilis*), stem galls of *Urospermum picroides*, and galls and seed pods of *Cuscuta campestris*. Overall, ca. 1200 insect specimens were collected from nature and bred from various hosts, labelled and entered into the SMNH database.

Z. Yefremova collected Hymenoptera in the vicinity of Nairobi, Kenya, on 10 April 2023, while visiting Dr Robert Copeland at the International Centre of Insect Physiology and Ecology.

G. Pisanty collected 1890 specimens (mostly Hymenoptera) during his 11 field trips to Cyprus (8–14.04.2023); Austria and Hungary (21.08–1.09.2023); Israel: Central Negev (10.03.2023), Golan Heights (14.10.2022), Judean Foothills (10.10.2022, 17.02.2023), Judean Mountains (6.05.2023, 22.06.2023), Mount Carmel (16.03.2023), Mount Hermon (6.10.2022, 23.11.2022), Northern Negev (1.03.2023), NPA Survey in Samaria (Rotem-Maskiot NR) (23.03.2023), Upper Galilee (18–19.05.2023).

Outreach

Netta Dorchin appeared in a radio interview with Sharon Kantor (*3 Who Know*; Kan 11 News, Jan. 2023). She was also interviewed as the scientific editor by Dror Burstein about the book *Small World*.

Gidi Pisanty scientifically edited a popular science book entitled *Pollination in an Israeli Mirror*, by Amots Dafni and Dan Eisikowitch (Pardes Publishing House, in Hebrew). He also accompanied citizen scientists at Ramat Hanadiv Park and assisted them with monitoring populations of wild bees in the field.

Zohar Yanai appeared in a radio interview on invasive crayfish (Radio North, 3 July 2023) and in TV story on invasive crayfish (Kan 11 News, 4 Sep. 2023).

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>), with the addition of Black Beauty stick insect *Peruphasma schultei* Conle & Hennemann, 2005, and stick insect *Hesperophasma* sp., as well as several small colonies of carpenter ants *Camponotus fellah* Dalla Torre, 1893, and *C. jaliensis* Dalla Torre, 1893. and maintained the live insect display at the SMNH.

THE MARINE & FRESHWATER SECTION

THE PORIFERA COLLECTION

Sigal Shefer

Collection and field surveys of the Porifera communities along the Mediterranean coast

The samples added to the collection this year were obtained during excursions to the mesophotic sponge grounds located at depth of 80–100 m off the Mediterranean coast of Israel and from depth down to approximately 30 m along the Mediterranean coast and in Eilat. Other specimens arrived from Prof. Bella Galil, Dr Orit Barnea, and 11 specimens from Bioblitz 2023.

Physical organization and databasing

The database included 1938 specimens, of which 127 lots were entered during 2022–2023. With the invaluable help of Tom Morav, 187 specimens of the Mediterranean sponges from the 1960s–1970s were treated, so multi-specimen jars were separated and all of them were being added to the database and relocated to the right shelves according to their taxonomic affiliation.

Special project – Mediterranean specimens from the 1960s–1970s

This year, we decided to use samples from the collection that had been assembled half a century ago, to examine changes in the sponge community at the mesophotic depths (~70–80 m) off the Mediterranean coast of Israel. The collection included samples obtained from the fisheries authority and researchers during the 1960s–1970s. By looking at the samples I realized that many of them could be identified. Since Prof. Micha Ilan's Lab was investigating sponge grounds located at about 100 m during the last decade, I thought it would be very interesting to compare the

sponge communities and assess temporal changes. May Schwartzman, an undergraduate student, was recruited for the project. As part of the study, we classified all 187 relevant specimens to the best taxonomic level we could. We had some interesting findings such as sponge species that had been very common in the past decades and became rare recently, as well as one species that was not documented along the Israeli coast before. All 187 specimens were being added to the Museum database.

Courses, training and conferences

I participated in the 11th World Sponge Conference, 10–14 October 2022 in Leiden, The Netherlands, and presented a poster “Megabenthic assemblages in eastern Mediterranean mesophotic sponge grounds: does diversity begets diversity?”, together with Dr Liron Goren, Dr Tal Idan and Prof. Micha Ilan.

I also participated in the 5th International Workshop on taxonomy of Atlanto-Mediterranean deep-sea and cave sponges, 11–16 September 2023 in Rapallo, Italy, and presented a poster “News from low light habitats along the Israeli coast of the Mediterranean Sea”, together with Tom Morav, Dr Tamar Feldstein-Farkash, Dr Liron Goren, Dr Tal Idan and Prof. Micha Ilan.

Loans

In January 2023, 35 subsamples from 16 museum samples of *Chondrosia reniformis* were sent to Prof. Ana Riesgo Gil of Museo Nacional de Ciencias Naturales de Madrid Biodiversidad y Biología Evolutiva, Spain.

Taxonomic identification service

I identified *Suberites* sp. from Ashkelon power plant (pier) for Dr Orit Barnea (March 2023), and eight specimens for Bioblitz 2023 (Israel Nature and Parks Authority).

I also participated in the description of a new Red Sea sponge species as part of Lilach Reichman Nagar's PhD research in Prof. M. Ilans' Lab. All type specimens were deposited in our collection.



A new species of sponges *Negombata rotundata* (rounded) co-exists with *N. magnifica* (branched) in Gulf of Aqaba. (Photo from Rajman-Nagar et al. 2023)

THE COELENTERATA COLLECTION

COELENTERATA

Zafrir Kuplik

Curatorial

Overall, 290 new samples were deposited in the coelenterates collection during 2022–2023, many of them are type material of soft corals (Octocorallia), sampled by Prof. Yehuda (Hudi) Benayahu, from specimens deposited in Leiden Natural History Museum (The Netherlands) and Muséum national d'Histoire naturelle (Paris, France). The type material was used for the ongoing process of taxonomy verification, done by Prof. Y. Benayahu and Prof. Catherine S. McFadden of the Harvey Mudd College (Claremont, CA, USA).

Yap, N.W.L., Mitchell, M.L., Quek, Z.B.R., Tan, R., Tan, K.S. & Huang, D. 2023. Taxonomy and molecular phylogeny of the sea anemone *Macroactylia* (Haddon, 1898) (Cnidaria, Actiniaria), with a description of a new species from Singapore. *Zoological Studies*, 62: Art. 29. <https://doi.org/10.6620/zs.2023.62-29>

Research

I am a Work Package Co-Leader in a one-year research cooperation project of Tel Aviv University and Ludwig Maximilians University, Munich, Germany: Modeling and predicting the distribution and impact of the highly invasive freshwater jellyfish *Craspedacusta sowerbii* in the catchment of Lake Kinneret.

In 2023, I won, as a co-PI, the prestigious ISF grant for a five-year study: The biology and physics of the *Rhopilema nomadica* jellyfish swarm dynamics — modeling, experiments and forecasting. In this study, I and Prof. Eyal Heifetz of the Department of Geophysical, Atmospheric and Planetary Sciences (Tel Aviv University) would investigate the biological and physical parameters responsible for the coherence of massive swarms of *Rhopilema nomadica*, the most abundant scyphomedusae in the Israeli Mediterranean coastal waters.

Conferences and workshops

One of the least studied taxa in the Israeli coastal ecosystem are hydrozoans, specifically the benthic populations. To expand our knowledge on hydrozoans, specifically their benthic populations, which are understudied in the Israeli coastal ecosystems, I attended the 10th Hydrozoan Society Workshop which in Bergen (Norway, May 2023). Recent achievements were presented and discussed during the workshop, including practical work on fresh samples.

International octocoral workshop under the auspices of the NSF-BSF funded project *The Indo-Pacific zooxanthellate octocorals: An integrative approach to species delimitation, phylogenetics and biogeography* and MAF WORLD •

COST ACTION CA20102 — *Marine Animal Forest of the World*. The workshop organized by Prof. Y. Benayahu (Tel Aviv University, Israel), Prof. Cathy McFadden (Harvey Mudd College, Claremont, CA, USA); Dr Andrea Quattrini (Smithsonian Institution, National Museum of Natural History, Washington, DC, USA) took place during 23–28 July 2023 at the Interuniversity Institute for Marine Sciences (Eilat, Israel) with 29 participants from 18 countries.

Academic outreach

In 2023, an academic 2-credit course *Jellyfish (Medusozoa): Can't live with them, and possibly can't live without them...* was given for the first time as part of the academic activity of the museum. The course aim was to expose students and professionals to the field of jellyfish research, mainly scyphomedusae and included oral lectures and a one-day fieldtrip.

As the coelenterates curator and an experienced jellyfish researcher, I participated in a plankton course at the the Interuniversity Institute for Marine Sciences (Eilat, Israel) in April 2023, presenting a lecture and conducting field sampling and laboratory work on gelatinous zooplankton.

Public outreach

During summer 2023, I was a frequent guest in media interviews, talking about the absence of the 'regular' summer swarms of *Rhopilema nomadica* in 2023.

SCLERACTINIA

Tom Shlesinger

Scleractinian corals, commonly known as 'hard' or 'stony' corals, form a vital and visually captivating component of marine ecosystems. Their significance extends beyond their aesthetic appeal, as they create complex habitats that harbor a myriad of marine life. Representing a diverse group within the phylum Cnidaria, scleractinian corals are characterized by their ability to construct calcium carbonate skeleton, which constitutes the underlying structure for tropical coral reefs. Thus, scleractinians play a crucial role in supporting marine biodiversity. These remarkable organisms are distributed across global oceans, thriving in a range of environments from tropical to temperate waters. Broadly, coral reefs and particularly stony corals also serve as important indicators of environmental state and anthropogenic and climate change impacts on the world's oceans.



Jellyfish *Rhizostoma pulmo* (jarred) is one of the commonest species in the eastern Mediterranean, along with *Rhopilema nomadica*. (Photo: Haim Lahovitsky)

Curatorial

The scleractinian coral collection housed in the SMNH needed a comprehensive overhaul. Given the significant advancements in the systematics and taxonomy of scleractinian corals over the past decade, the existing collection was not keeping pace with these developments. Consequently, there was a pressing need for a thorough review and update of the collection to reflect the latest changes in the coral taxonomy. To address this, a comprehensive project was planned over the next couple of years, focusing on integrating the recent revisions in the scleractinian taxonomy. This initiative aimed to enhance the accuracy and relevance of the coral collection, aligning it with the most up-to-date scientific understanding of these organisms.

Additionally, a recent contribution to the collection was made in September 2023, consisting of a new set of corals I collected in Palau. While these specimens have been deposited in the SMNH, further work is pending to complete their identification. The ongoing efforts in both revising the existing collection and incorporating new acquisitions underscore our commitment to maintaining a dynamic and scientifically relevant coral collection at the SMNH.

Research

In January 2023, I opened the CORALab (Coral Ontogeny, Reproduction, and Life-histories laboratory) in the SMNH. The lab's primary focus centers on the essential components of the underwater tropical realm: scleractinian corals. Serving as the architects, engineers and artists, stony corals intricately construct and maintain the elaborate structures of reefs, breathing life into these ecosystems. Coral reefs, recognized for their immense biodiversity and invaluable services to humanity, are, unfortunately, under threat from various local and global stressors, making them one of the fastest-degrading ecosystems.



The cover of *iScience* featured a branching stony coral *Acropora hyacinthus* that spawns pinkish bundles of eggs and sperm in the Red Sea. (Rapunano *et al.* 2023; photo: Tom Shlesinger)

Our research group delves into the evolutionary intricacies of marine life, with a particular emphasis on the sexual reproduction of reef-building corals and their responses to environmental changes. Our comprehensive approach encompasses the study of coral evolutionary ecology, biology, life histories, larval behavior, dispersal, taxonomy, and biodiversity. Through a dynamic blend of experiments, fieldwork, laboratory investigations, and computational-statistical models, we aim to fill existing gaps in understanding and address the challenges faced by coral reefs.

The overarching objectives of the lab encompass five key areas: (1) advancing our fundamental knowledge of coral reproduction strategies and life-history trade-offs under diverse conditions; (2) predicting the destiny of coral populations and communities in the face of environmental changes; (3) studying the coral diversity in the Red Sea while describing new species; (4) developing practical tools to guide effective coral-reef conservation and management efforts; and (5) fostering a deeper understanding of natural ecosystems at various levels, spanning from the cellular and individual organism levels to populations, communities, and the ecosystem as a whole.

Public outreach

Together with a committee on behalf of the Academy of the Hebrew Language, I was working in the last two years on putting together a list of Hebrew names to all existing stony coral genera in Israel. This project was covered on *Ynet* (24 January 2023): Nafthulith, Almugalil and also Mohan: Names of 95 corals in Hebrew (<https://www.ynet.co.il/environment-science/article/hjhli02oi>).

FRESHWATER MYXOZOA

Dorothee 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 species using a combination of morphological and molecular approaches.

From September 2022 – February 2023, Prof. Dorothee Huchon was on a sabbatical at the Department of Microbiology (Oregon State University, USA) hosted by Prof. Stephen Atkinson and Prof. Jerry Bartholomew. She went on two field trips to the Foster Dam reservoir (Santiam River, Oregon, USA) with Prof. Atkinson to collect myxozoan-infected salmons, sampling and then sequencing the genome of the Myxozoa *Henneguya salminicola*, which is unique among all multicellular animals in not making use of the aerobic respiration of oxygen but relying instead on an exclusively anaerobic metabolism. This myxozoan also lacks a mitochondrial genome and, therefore, mitochondria.

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

Prof. Dorothee Huchon presented her research at two conferences:

- The 4th meeting of the Israeli Society for Evolutionary Biology, 2–3 April 2023, Haifa University, Israel: *De novo pyrimidine biosynthesis in myxosporea (Myxozoa, Cnidaria)* (poster; Goswami, U. & Huchon, D.).
- The 21st International Conference on Diseases of Fish and Shellfish, 11–14 September 2023, Aberdeen, UK: *De novo nucleotide biosynthesis pathways in myxozoan (Cnidaria)* (poster; Goswami, U. & Huchon, D.); *GenomeFLTR: Filtering reads made easy* (poster; Pupko, T. & Huchon, D.).

THE MOLLUSCA COLLECTION

Henk K. Mienis and Oz Rittner

In the academic year 2022–2023, we more or less finished the incorporation of the large collections of David Bahral, Shmuel Matalon and Yechezkel Nagy into the general Mollusc Collection. These holdings had been donated to the Steinhardt Museum during previous years.

In addition, we continued our research in the fields of taxonomy, systematics, nomenclature, Lessepsian migration, exotic and invasive species in the Israeli malacofauna, and in various aspects of archaeomalacology.

Interesting faunistic records from Israel

Terrestrial Molluscs

Two populations of large terrestrial slugs belonging to the genus *Laevicaulis*, were recently discovered in gardens in Rishon leZiyyon. The identities of these exotic species, most probably of tropical African origin, were not yet been established.

Additional living specimens of *Archachatina degneri* were found by Mrs Svetlana Vaisman in the Central Park of the Ashelim Quarter in Rishon leZiyyon.

Several large living specimens of the West-African land snail *Achatina achatina* were encountered in luggage of a Ghanaian citizen by inspectors of the Ministry of Agriculture, stationed at Ben Gurion Airport.

Freshwater Molluscs

Numerous exotic freshwater molluscs were encountered in irrigation ponds near Sde Eliyahu. Especially common were two viviparous species from Thailand: *Filopaludina martensis* and *Filopaludina polygramma*; less common was the bivalve *Corbicula bocourti*. In addition, all the streams in the neighbourhood of the ponds turned out to be inhabited by a large number of other exotic species, viz. *Mieniplotia scabra*, *Tarebia granifera*, *Pyrgophorus coronata* and *Physella acuta*.



Marine Molluscs

In 2018, a single valve of the Erythraean lucinid *Pegophysema philippiana* was reported from off Tel Aviv in the Eastern Mediterranean (Mienis 2019). In 2023, numerous specimens of various sizes were encountered at a depth of 20–50 m off Yafo showing that a viable population was living off the Mediterranean coast of Israel.

Pegophysema philippiana from off Yafo. (Photo: Oz Rittner)

The connection between terrestrial snails and other animal groups

A first record of predation on a terrestrial snail by Guenther's skink *Chalcides guentheri* near Sha'ar HaGay was mentioned by Mienis (2022).

Support with identifications

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

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

During 2022–2023, Mrs S. Vaisman brought us for verification or identification 110 samples of land and freshwater snails intercepted by the PPIS inspectors from either agricultural merchandise arriving from abroad or found on local material grown in nurseries (samples PPIS 716-826).

After the first discovery of the North American slug *Pallifera dorsalis* on a shipment of *Dieffenbachia* cuttings from the Netherlands, additional specimens were encountered on *Philodendron* cuttings and potted *Calathea* also imported from the Netherlands.

Other interesting records concerned a puzzling "*Lehmannia nyctelia*" species on potted *Cordyline* from the Netherlands. Although the identification was based on verifications of the DNA samples identified as such in the GenBank, the correct identification is rather doubtful since it turned out that the true *Limax nyctelius* Bourguignat, 1861 is a *Letourneuxia* species belonging in the family Arionidae (Hutchinson *et al.* 2022). The species hiding behind the name *Lehmannia nyctelia* in the GenBank is most probably either *Ambigolimax waterstoni* or *Ambigolimax parvipenis*, both recently described by Hutchinson *et al.* (2022).

Another species identified by means of the DNA was *Kalliella scandens* encountered on *Guzmania* imported from the Netherlands.

Cooperation with the Israel Nature and National Parks Protection Authority

Like in previous years, we received some mollusc material collected during the BioBlitz project carried out in several Marine Nature Reserves along the Mediterranean coast of Israel. The results were 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 in the Mollusc Collection 2022–2023

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.

Name	Brief description of the material
D. Ben-Nathan	Land and freshwater molluscs from Israel and Jordan
B.S. Galil	Marine molluscs from the Mediterranean coast
A. Givchin	Terrestrial snails from Israel
Sh. Matalon	A second batch of worldwide 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
Plant Protection and Inspection Services, Ministry of Agriculture	Intercepted material arriving from abroad
O. Rittner	Land snails from Israel and freshwater molluscs from Argentina
S. Vaisman	Land snails from Israel

Computerization of the collection

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

The Malacological library

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

We have received again many reprints and numerous journals from Zoological Institutes or Malacological Societies in exchange of *Triton*, the independent malacological journal published in Israel (Issue 43 was published in January 2023), and the quarterly journal *Natuurhistorische en Andere Notities – Natural History and Other Notes*, of which four issues (36–39) were published.

References

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. 81).

Hutchinson, J.M.C., Reise, H. & Schlitt, B. 2022. Will the real *Limax nyctelius* please step forward: *Lehmannia*, *Ambigolimax* or *Malacolimax*? No, *Letourneuxia*! *Archiv für Molluskenkunde*, 151(1): 19–41.

Mienis, H.K. 2019. A first record of *Anodontia philippiana* from the Mediterranean Sea off Israel. *Triton*, 38: 4–5.

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

During 2022–2023, there were no major movements in the Bryozoa collection, apart from routine curatorial activities.

TERRESTRIAL, FRESHWATER AND MARINE FREE-LIVING NEMATODES

Stanislav Pen-Mouratov

Nematodes are the commonest, most abundant and genetically diverse metazoans on the planet. Among of them the free-living nematodes constitute a large proportion of the total nematode community and are very important and beneficial in the decomposition of the organic matter and recycling of nutrients in the environment. Nematodes play crucial roles in the ecosystem processes. Many are free living and abound in soils and sediments in terrestrial, freshwater, and marine habitats. They parasitize every multicellular group, and occur in all, including extreme and disturbed, ecosystems. The free-living nematodes are useful as biological indicators of soil health, because their number and types reflect changes in the microbiome and physical and chemical properties of the soil. The free-living nematodes contribute to the essential functions in the soil environment, 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 terrestrial and aquatic ecosystems.
- To determine impact of different natural and anthropogenic disturbances on the free-living nematode communities in terrestrial and aquatic environments.

Research projects

- During the reporting period, we continued study the impact of bird nesting and roosting activity on the soil biota in Israel (Pen-Mouratov & Dayan 2019). The main aim of this investigation was to determine the seasonal effect of bird nesting and roosting activity on soil habitats, soil biota abundance, trophic structure, sex ratio and generic diversity of soil free-living nematode communities. We hypothesized that seasonal fluctuations can change this impact (through changes in soil properties) on the abundance, structure and diversity of the soil microbial and free-living nematode communities. We further speculated that the wet season might even attenuate the impact of bird droppings on soil biota. The soil biota, including soil microorganisms and free-living nematodes, and soil properties (soil moisture, conductivity, pH, ammonium, nitrate and phosphorus) were seasonally investigated in the nesting and roosting habitats of colonial birds in Israel's Mediterranean region. Ultimately, our extraordinary efforts were rewarded with the publication of an article in *Frontiers in Microbiology* (Pen-Mouratov & Dayan 2023). The results indicated that droppings of the different species of colonial birds exerted different (stimulatory or inhibitory) effects (mainly through changes in soil properties) on the number of soil microorganisms in the bacterial and fungal communities and on the abundance and diversity of the soil free-living nematodes, affecting the structure of soil nematodes at the generic, trophic and sexual levels. In addition, the seasonal wet–dry fluctuations might significantly change the extent of the colonial birds' impact.
- During the reporting period, I continued to collect, treat and analyze soil free-living nematode samples for scientific publications on *The influence of different wild animal activities on the free-living nematodes and their habitats in Israel*.

Nematode collection

The nematode samples from the above-mentioned study 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 work

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 gather 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 maintained active collaboration with colleagues of different scientific organizations from different countries, and continued to be a member of the Nematological Societies of America and Europe.

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 re-established population following the mass mortality caused by the marine heat wave of July–August 2021 was surveyed at two sites in 2023. The main objectives were documentation of the population status, comprising basic data on the population density.

On October 16, 2022, 84 specimens of the marbled crayfish *Procambarus virginalis* (Lyko, 2017) were collected by O. Kolodny (SMNH AR30237) in Ein Meshotetim, and on October 23, 2022, 63 specimens (SMNH 74 AR30239) were collected by O. Kolodny and M. Truskanov. In January 2023, Prof. Galil surveyed Ein Meshotetim (32.801°N 34.974°E), a spring in a valley descending from the top of the Carmel Ridge to the sea, and observed a flourishing population of this invasive parthenogenetic species. Prof. Galil collaborated with Prof. F. Lyko, Division of Epigenetics, Heidelberg, Germany, who described the species, to publish its first record for Israel and the Levant, which is a considerable expansion of its known distribution range. Prof. Galil alerted Dr D. Milstein (Israel Nature and Parks Authority) to the



Procambarus virginalis in its natural habitat. (Photo: V. Coutinho Carneiro (Coutinho Carneiro et al. 2023))

urgent need to eradicate the population. As of September 2023, both gravid and very young individuals were seen in the spring and adjacent pool.

Prof. Galil identified decapod crustaceans, part of the fouling communities collected between 2021–2023 from Autonomous Reef Monitoring Structures (ARMS) stationed along the Mediterranean coast of Israel, a project led by Dr O. Bronstein.

In May 2023, 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 (IPBES), 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*. The report was published in September 2023.

Visitors

During April–September 2023, Prof. Galil accommodated Caterina Martino, MSc student of University of Pavia, Italy, on the Erasmus+ traineeship program fellowship. Ms Martino identified and studied peracarid crustaceans collected along the coast of Israel, in the framework of a large scale monitoring programme. She focused on marine bioinvasion on man-made and natural hard surfaces, with the goal of enriching the peracarid knowledge base in the Levant part of the Mediterranean Basin, and benefitted the collection of the Steinhardt Museum of Natural History.

Identification services

Prof. Galil identified decapod crustaceans for Drs Nir Stern and Hadas Lubinevsky, Israel Oceanographic and Limnological Research Institute (IOLR).

Field work

Throughout 2023, periodic surveys of the invasive population of *Procambarus virginalis* in Ein Meshotetim, and the invasive population of *Perna perna* in Haifa Bay were conducted by Prof. Galil.

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 three mesophotic ROV (remotely operated vehicle) expeditions with Prof. Micha Ilan's research group. These expeditions were focused on the sponge fauna, but all samples that were collected contained polychaetes, which were promptly 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 polychaete specimens were added to the collection, and 12 entries were created in the SMNH polychaete database.

Collaborations

In 2022–2023, I continued my collaboration with

- Dr Omri Bronstein (SMNH/TAU) in identification of polychaete specimens collected during his *Autonomous Reef Monitoring Structures* project. Analysis of results was still ongoing.
- Dr Elena Kupryianova (Austalian Museum) and Dr Tamar Feldstein-Farkash (SMNH) on the identity of two serpulid species found in the Israeli Mediterranean waters.

Taxonomic identification services

- More than 200 samples of Hirudinea and Polychaeta, as well as 175 samples of freshwater crustaceans, were identified for the Aquatic Ecology Center (SMNH).
- Identification of freshwater invertebrates for Hamaarag's 'swan lake' survey.
- Risk assessment of nematodes in imported agricultural produce for Israel's Ministry of Agriculture.

Courses

I collaborated with Dr Giorgos Chatzigeorgiou (Hellenic Centre for Marine Research) in teaching a Polychaete Identification course. The course was supported and taught at the Steinhardt Museum of Natural history. It was attended by students from Tel Aviv University, Haifa University and Israel Oceanographic and Limnological Research institute.

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 collection continued to be curated and the entire collection was re-filled with 70% ethanol as needed. New identified material was entered into the SMNH database, which was increased by 20 echinoderm records during 2022–2023. The new material represented mainly specimens from Eilat that were preserved frozen to facilitate novel molecular analyses. The frozen material was part of a study to identify an outbreak of a pathogen detrimental to echinoderms.

As in previous years, the contribution of citizen science in the form of reports and collections by recreational divers made a huge contribution to our understanding of the local biodiversity, as well as to the detection of cryptic processes, particularly in the Mediterranean.

Student supervision

Undergraduate students supervised by Omri Bronstein used samples from the Mediterranean and the Red Sea echinoderm collections 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

Two major studies published in 2023 — *Diadema setosum* population outbreak in the Mediterranean Sea, and First reports of *Diadema* mass mortalities in the Mediterranean and Red Sea — received a broadest coverage in Israeli and international media, e.g.:

- BBC: *Mystery sea urchin deaths threaten Red Sea coral reefs*; by Yolande Knell, 2 July 2023. <https://www.bbc.com/news/world-middle-east-66046722>
- FoxNews: *Massive sea urchin die-off in Israeli gulf threatens nearby coral reefs*; 27 May 2023. <https://www.foxnews.com/world/massive-sea-urchin-die-off-israeli-gulf-threatens-nearby-coral-reefs-researchers-say>
- The Financial Express: *Red Sea epidemic kills off sea urchins, imperilling coral*; 24 May 2023. <https://thefinancialexpress.com.bd/world/asia/red-sea-epidemic-kills-off-sea-urchins-imperilling-coral>

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 3000 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

The ascidian collection gained meaningful help when Nathan Sharon, a volunteer at the museum, started working once a week on the database, helping Lion with data insertion, as well as with correction and reorganization where needed.

Noa Shenkar's lab has been continuing to sample ascidians periodically along the Mediterranean and Red Sea coasts of Israel, paying special attention to marinas as being hot spots for invasion, in an effort to enrich the collection, monitor the environment and discover new or invasive species. Part of this effort has been done when taking part in the April '23 Bio-Blitz marine survey, organized by the Israel Nature and Parks Authority.

Research and collaboration

Over 2022–2023, we have hosted both a PhD student from Japan and a group of Chinese researchers for an international workshop we organized.

Mr Naohiro Hasegawa, an ascidian taxonomist in-training from Hokkaido University, Japan, came to learn and work on the ascidian biodiversity at the Gulf of Aqaba. He spent most of his time

working at the Inter-University Institute for Marine Sciences (IUI) in Eilat, followed by a visit and further work at the museum. Ascidian samples from his visit were deposited in the collection and is part of our effort to characterize and enrich the data on Red Sea ascidians.

Later that year, scientists from the Chinese Academy of Sciences, together with the principal investigator Prof. Aibin Zhan, attended the workshop we hosted at the museum and at the IUI in Eilat. As part of the workshop, we took them to a site rich with ascidians along the Mediterranean coast, "Hasela" beach in Bat Yam. They

also learnt about ascidians of the Red Sea, as part of a field trip to Eilat. Prof. Zhan's group is



Mr Naohiro Hasegawa sampling ascidians in the Red Sea off Eilat.

collaborating with us studying ascidians and their adaptations, as a model for marine biological invasions.

Active grants

2020–2023 ISF–NNSC (co-P.I. 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 participated in the *Ascidian Taxonomy Workshop* at Soka University of America, California, thanks to support provided by the SMNH and Shenkar's lab. This was the first taxonomy workshop Lion attended, and was of great importance to Lion's work, both at the museum at Shenkar's lab. The workshop focused on the collection of living specimens from local marinas and included lectures and hands-on identification practice.

In May–June 2023, we organized an international workshop *Mechanisms of rapid local adaptation in marine invaders: ascidians as a case study* at the Steinhardt Museum of Natural History.

MEDITERRANEAN AND RED SEA FISHES

Bat-Sheva (Shevy) Rothman

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, over-fishing 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.

Personnel

In 2022–2023, I was appointed as a faculty member and the curator of the fish and aquatic parasites collections. In addition to the technical assistance of Avery Deveto, we hired Asaf Nashiv as a technician who managed to advance data entering and fish collection maintenance. Moti Gontar continued volunteering in the collection, assisting with various day-to-day assignments.

Collections management, databasing and research

During 2022–2023, nearly 200 collection lots comprising about 1000 fish specimens were registered in the database, thus bringing the total number of fish records to 16,118. Most items originated from the national monitoring campaigns managed by Dr Nir Stern (Israel Oceanographic and Limnological Research) off the Mediterranean coast, others were confiscated by marine rangers (Israel Nature and Parks Authority) or found stranded on the Mediterranean and Red Sea beaches. Some fish originated from our previous research that took place in 2017, when we sampled the ichthyofauna across the continental slope.

I also joined Dr Eldad Elron (EcoStrategies) for sampling freshwater fish by electrofishing in Sa'adia, Zipori and Meshushim streams.

Two species were added to the collection for the first time: (1) *Coryphaena hippurus* (Coryphaenidae), an adult collected in Eilat and a larvae collected in the Mediterranean Sea, and (2) *Synchiropus sechellensis* (Callionymidae), an alien species in the Mediterranean Sea, a first record of this species in Israel. The latter record was mentioned by Langeneck *et al.* (2023).

Scientific collaboration

We provided tissue samples from 15 fish species of the order Syngnathiformes to Dr Peter Rask Møller (Natural History Museum of Denmark, University of Copenhagen) for a phylogenetic study. We also provided tissue samples of various local fish species to Prof. Stéphanie Manel (University of Montpellier and CNRS, France) and to Dr Nir Stern (IOLR) who were establishing a genetic library of the 12S gene for environmental DNA analyses in the future.

Teaching

- In December 2022, I participated as a visiting lecturer in the course *Selected topics in fish biology* held in the Interuniversity Institute for Marine Sciences in Eilat.
- In February 2023, I participated as a lecturer in the course *Scientific collection as an infrastructure for scientific research* held in the Museum, focusing on our fish collection and its application in current studies and scientific consultation.
- In March 2023, the first round of the *Taxonomy, ecology and biology of fishes* course was successfully run at the Museum as part of the Israel Taxonomy Initiative series of courses. It comprised lectures, wet-lab practices, a visit to the fish collection and a field trip to the fishing village Jisr az-Zarqa. The course hosted 15 participants from Tel Aviv University, Ruppin Academic Center, Israel Nature and Parks Authority, and Israel Oceanographic and Limnological Research.

Conferences

I presented a talk *Lagging behind – what do we know about the parasitic fauna of alien fishes in the Mediterranean?* at the XVII European Congress of Ichthyology hosted in Prague by the Czech University of Life Sciences Prague in cooperation with Charles University and the Institute of Animal Physiology and Genetics under the auspices of the European Ichthyological Society (4–8 September 2023).

THE TERRESTRIAL VERTEBRATES SECTION

Shai Meiri, Tamar Dayan, Yossi Yovel, Eran Levin, Orr Shpigel, Eli Gefen, Amos Belmaker, Karin Tamar, Avigail Ben-Dov Segal, Igor Gavrilov, Stanislav (Stas) Volynchik, Daniel Berkowicz, Yulia Gordover, Tal Vardi, David Kobiler, Rami Biran, Zahavit Alon, Yehudit (Dita) Freedman, Sima Kotev

Overview

The tetrapod collections kept growing albeit we slowed down the pace of entering new material, especially of very common species, to take greater care of more useful specimens and better document their data and metadata. We made great strides in arranging the collections, as well as caring better for, and organizing better, what we already had. Our main challenge continued to be person-power of collection managers: effectively we had one-and-a-half positions (full for Amos, 50% for Karin), down 40% from our recent peak of 2.5. This is reflected in the increasing backlog of specimens awaiting processing in our freezers. Other major challenges included databasing (i.e. adjusting to an inflexible new system) and a diminishing storage space in the dry collections. As of the time of reporting, there were no forthcoming solutions for any of these issues. Reducing the rate of specimen acquisition 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. We did, however, take several steps towards controlling the high volume of incoming specimens: (1) we were much stricter than before about only collecting specimens with full accompanying information, unless it was a rare species, we did not accept any specimen without at least the date and place of collection; (2) we only accepted specimens in good condition (unless a skeleton or just a tissue sample is required); and (3) we only accepted a few specimens of each common species a year.

Personnel

This year did not see many staffing changes. Karin and Amos were in charge of the Amphibian, Reptile, Mammal, and Aves collections, respectively, with two part-time students working with Karin and five volunteers with Amos.

Tal Vardi, a BSc student, at his third and final year at Tel Aviv University, started working part time helping Karin organize and maintain the Mammal and Reptile collections.

Yulia Gordover, an MSc student with Profs. Lidar Sapir-Hen and Tamar Dayan, worked part time helping Karin organize the Mammal collection and filling details in Yoel Rak collection database.

Daniel Berkowicz, the manager of the egg and nest collections, finished his PhD and now worked part time with Amos in the bird collection; 2024 would be his last year with us.

Collection management: equipment, infrastructure, storage and curation

We still worked on basic organization of the collections. This included taxonomic organization in the cabinets, better protecting specimens using plastic boxes and plastic sleeves, and inventorying the collections. The latter was necessary as in past decades not enough attention was given to logging where specimens went. Consequently, there were many specimens that we did not know where they were physically located. This process was time consuming and we did not expect it to be finished any time soon.

The nest and egg collection was being moved to new plastic boxes for their protection. The nests found their new permanent home and were ordered taxonomically unlike before. The eggs as well were being organized and that process should be completed soon.

We were still assimilating the A.D. Gordon Museum collection of birds, reptiles, amphibians and mammals into our collection. The work was progressing very slowly due to shortage of manpower. The newest addition to this was the bird collection of the late Haim Hovel, including some specimens of reptiles and mammals. This collection included hundreds of skins that needed to be cataloged and bagged. These proceeded in conjunction with the progress David was making in the inventory of the bird collection to make sure we maintained the order of the specimens in the cabinets.

With the slow progress in the organization of the collections, the future perspectives seemed problematic. At the time, we had space for only ten more storage cabinets (4 for mammals and 6 for birds) in the main hall. These cabinets, when purchased, would quickly fill up just to space out specimens to prevent damage leaving little room for the growth of the collection. We were trying to purge the collection of unimportant specimens (specimens from captivity or with no collection information) and to give them away to the museum's education department and to educational courses of the School of Zoology, Tel Aviv University. However, this would only buy us a little more space rather than solve the problem in the long run. The main conclusion was that the current collection rate could not continue for much longer unless we 'colonize' a different space.

The work in the new database was impeded by missing functionality, including the navigation within the system, accessing filtered data, and flexibility in data management.

Research and Curation

The amphibian collection

The amphibian collection remains the smallest and least active among the other tetrapod collections. From October 2022 through September 2023, the amphibian collection grew by 20 specimens to the total of 2,930 specimens, thus continuing the unfortunate downtrend in collecting activity. The specimens entered to the collection during 2022–2023 were all from Israel and additional specimens still waited in the freezer to be prepared and catalogued later. We continued with the process of preparing skeletons from all Israeli amphibians and we were missing only skeletons of the Arabian treefrog (*Hyla felixarabica*) and the Hula painted frog (*Latonia nigriventer*). Overall, the amphibians collection was taxonomically well organized; we finished inventorying all specimens, comparing their collection details with the collection's database. Unfortunately, we discovered that 158 specimens that were catalogued in the collection were unaccounted for.

The mammal collection

During 2022–2023, the mammal collection incorporated specimens from the Israeli Wildlife Hospital (Safari), Israel Nature and Parks Authority stations, Ramat HaNadiv and Tel Aviv University labs. Additionally, mammal feces found while organizing the collection and from the assimilation of the Beit Gordon collection were also added. Altogether, the collection grew up to the total of 17,781. Many small-sized mammals, mainly rodents and bats, were still in the freezer waiting to be prepared before entering the collection, most likely as skeletons and round skins.

Overall, the mammal collection was fairly well organized, and we have finished inventorying most specimens, comparing their collection details with the collection's database. Specimens

without data were taken out and were given to the museum's educational department, to the zoo-archaeological comparative collection, to the Faunistics class, and other educational courses/collections. We were in the process of improving the maintenance of the collection by placing skulls and skeletons of small-sized species, which were kept in glass tubes, in plastic boxes. We enveloped round skins in plastic sleeves, making sure each specimen had a label. In the near future, we plan to go over the wet collection to check each jar, replace broken or cracked lids and add ethanol where needed. We also plan to continue going over the flat skins collection, inventorying specimens and enveloping each skin in a plastic bag.

The reptile collection

During 2022–2023, the reptile collection grew to 20,856 specimens. We received specimens collected by the School of Zoology labs (mainly by Prof. Shai Meiri's lab members), others from private collectors (with INPA permits), the Israeli Wildlife Hospital (Safari), Israel Nature and Parks Authority stations, and Ramat HaNadiv. As in past years, most specimens belonged to well-known species of the Israeli fauna. We also added to the collection dozens of specimens of the invasive White-spotted wall gecko *Tarentola annularis* collected from Ein Gedi area and Elifaz in the Arava Valley. We additionally received a female of the Komodo dragon *Varanus komodoensis* from the Israeli Wildlife Hospital (Safari); her skeleton was placed in the dry collection and her skin was supposed to go on display. This year, we finished cataloguing specimens from the Beit Gordon and the Beit Shturman collections. We continued preparing skulls and skeletons, and we intended to continue with this project until we have representation of all the species in Israel.

Overall, the reptile collection was taxonomically organized and we finished inventorying all specimens. We finished the routine maintenance of the collection — we checked each jar, replaced broken or cracked lids and added ethanol where needed.

The bird collection

From October 2022 to September 2023, the bird collection grew to 24,750 databased specimens. Mainly due to the attractiveness of birds this collections brought in most volunteers. Each of them had his/her own project/task, which s/he worked on independently. This freed Amos up to work on a few research projects, train the volunteers and consult with the Backyard Bird Count.

- David, Sima and Dita worked on a collection-wide inventory. They checked every specimen for data errors and secured it in a plastic sleeve or box as necessary. David finished everything from ostriches up until shorebirds. Dita and Sima started working on raptors. We expected this project to continue in the next few years. Some of the errors the volunteers found needed more careful attention, which Amos would get at a later stage.
- Rami Biran, started volunteering with Amos as well to work mainly on the long-neglected pellet collection. He was helping better protect and organize the pellets, and curate the associated data.
- Zahavit Alon and David helped out with skin preparation. Our freezers were full and new material was flowing in, so this task never really ends. On a good note, every bird we brought in was cataloged and bagged, so we did not suffer any loss of material due to erased data, tag tears or drying up.
- Rami finished the first step of preparing an elemental bone collection. We are now awaiting a new cabinet, which Doron promised to build for us, to house this new collection. Until then work with this collection was very difficult.

Yoel Rak Collection: Early Hominids

During 2022–2023, we started assimilating the early hominid collection of Prof. Yoel Rak from the Faculty of Medicine, Anatomy and Anthropology at Tel Aviv University. We were in the final stages of inventorying the collection, assigning collection numbers to each specimen. This collection comprises plastic and plaster casts of hominid fossils and other primate species. As of now, the collection includes 947 specimens, mainly of hominid fossils (e.g., *Australopithecus afarensis*, *Homo erectus*, *Homo habilis*), but also apes (e.g., chimpanzee, gorilla, orangutan). As soon as we finish listing all specimens, we will upload them to the museum's database and label each individual.

Conferences

Shai Meiri presented at the following scientific meetings:

- 2023 — 2nd Global Summit on Animal Science and Veterinary Medicine (ASVM2023), Paris, France, June 19–21, 2023. (Invited plenary speaker)
- 2023 — *Assessing terrestrial vertebrates' exposure to future extreme heat event*. Species on the move: Detection, impacts, prediction & adaptation. Bonita Springs, FL, USA, May 14–19, 2023. (Gopal Murali, Takuya Iwamura, Shai Meiri, Uri Roll)

Visits, teaching and loans

During 2022–2023, 22 people visited the collections for a total of 62 times. The visitors were mainly from the Israeli academic institutions (i.e., Tel Aviv University (9), Haifa University (5), Hebrew University (2)), but also from the Israel Nature and Parks Authority (1), or unaffiliated individuals (2). Two visitors were from the USA (San Diego University and University of Connecticut) and one from Hungary (Hungarian Natural History Museum).

Eighteen loans were sent out. Ten of these were for educational purposes and the rest for research (7) and art exhibits (1). Most of the loans were to Israelis (15), and 3 were to overseas researchers from the USA (2) and Germany (1). We noted that sending specimens abroad, and receiving them back, was still a serious issue, necessitating much work, incurring expenses, and sometimes resulting in specimens getting 'lost'. Three courses used our collection materials.

This 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 also learn about the collection. The cadavers were then returned to us to prepare skeletons. This experiment proved very successful and the students (and their teachers!) really enjoyed seeing a diverse set of species rather than just one as per normal.

Public outreach

Yossi Yovel was featured along with his Tel Aviv University colleagues in a popular article:

Schuster, R. 2023. Plants aren't Silent, Tel Aviv University team discovers. *Haaretz*, 30 May 2023. <https://www.haaretz.com/israel-news/science/2023-03-30/ty-article/plants-arent-silent-tel-aviv-university-team-discovers/00000187-2d5d-da89-a39f-2d7d58140000>

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 since then, the Lab provides on average 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 receives various animal remains to identify, whether a partial body, several feathers, just a crumb of a feather or a smear of blood, so the Lab's work is forensic by nature. 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 25,000 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 high priority cases such as damaged aircrafts, illegal poaching and crucial ecological surveys. During 2022–2023, the Molecular Lab examined 61 bird strike cases for the Israel Airports Authority, 43 cases for the Israeli Airforce, and 65 cases from the Israel Nature and Parks Authority.

During the reporting period of 2022–2023, the Feather Identification Lab examined 229 bird strike cases and 1059 cases for the Israel Nature and Parks Authority, which was almost a four-fold increase compared to the previous year.

THE HERBARIUM

THE WATER PLANTS, CYANOBACTERIA AND WATER FUNGI COLLECTIONS

Razy Hoffman

Research and curation

In 2022–2023, surveys and collecting trips continued and the herbarium was enriched with some 1000 new specimens of seaweeds, cyanobacteria and seagrasses from the Mediterranean and the Red Sea. Freshwater Bryophyta and Charophyta were collected from inland waters. Surveys of



Massive drift of the alien macrophyte alga *Codium parvulum* at north of BayPort, Haifa, Israel, February 2023. (Langeneck *et al.* 2023; photo: M. Mendelson)

2022–2023 revealed some new alien seaweeds that had never been reported from the Levantine shore of Israel before. Some of them were the first records from the Mediterranean Sea.

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

Maintenance and cataloging of Lipkin's and Hoffman's dry collections continued in 2022–2023.

Collaborative studies

Several projects with Dr Frederik Leliaert and Prof. Olivier De Clerck from Ghent University, Belgium, continued and the molecular studies that took place in Ghent University and Meise Botanic Garden revealed several

green non-native seaweed invaders, as well as some new species of the Chlorophyta.

A collaborative study with Dror Melamed (a citizen scientist from Tel Aviv) of the liverwort genus *Riella* continued, and the collection of sediments yielded more new strains of the genus.

A project on the phylogenetic analysis of the genus *Lophocladia* (Rhodomelaceae, Rhodophyta) initiated in 2021–2022 and supervised by Prof. Maria Alba Vergés Guirado (University of Girona, Spain) revealed that the invasive red alga *Lophocladia lallemandii* is not a valid species, but rather a synonym of *Lophocladia trichoclados*.

LAND PLANTS COLLECTION

Yuval Sapir and Jotham Ziffer-Berger

Personnel

In 2022–2023, the herbarium hired a new curator assistant, Horesh Zecharya.

Research

During the 2022–2023 academic year, we continued focusing our research efforts on:

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

Collaboration

- We assisted the Ashdod port customs with a criminal investigation of a major plant smuggling operation. A classified report was submitted to the State Attorney.
- We renewed our contract of cooperation with the Israel GenBank to provide voucher identification and storage services.
- Ronen Shtein assisted with identification of *Kalanchoe* spp. for the Tsimbazaza Herbarium, Antananarivo, Madagascar.

Field trips

Ronen Shtein collected in Madagascar (15 Sep. — 2 Nov. 2023), including Réserve Naturelle Intégrale Tsaratanana, Tsingy de Bemaraha National Park and Andasibe-Mantadia National Park, on a joint collecting trip with Dr Rokiman Letsara (Parc Botanique et Zoologique de Tsimbazaza), Seraina Rodewald, Luo Chen (both Ludwig-Maximilians-Universität München), David-Paul Klein (Humboldt-Universität zu Berlin). The expedition focused primarily on *Kalanchoe* spp. (Crassulaceae) and *Medinilla* spp. (Melastomataceae).

Conferences

In July 2023, we organized the yearly Botanical Conference at the Museum, this time dedicated to our late colleague Dini Isaacovitch.

Teaching

The following academic courses were offered:

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



Kalanchoe apiifolia in its natural habitat in the Tsaratanana Massif, Madagascar. (Photo: R. Shtein)

THE PALAEOSCIENCES SECTION

THE PALAEONTOLOGICAL COLLECTION

Daniella E. Bar-Yosef Mayer

In 2022–2023, substantial progress with databasing of the Bytinski-Salz fossil collection was made, with almost 4500 new entries. New metal cabinets were ordered from the Delta company. Based on the catalogued and uncatalogued databases, preparations were made for the transfer of the collection to the new cabinets.

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 analysis of the magneto-tectonic evolution in the Eastern Mediterranean.

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). The Permian–Triassic extinction occurred at 252 Mya and was by far the greatest event of this kind that wiped 57% of all families, 83% of all genera and 90–96% of all species from the planet. This catastrophic episode happened in just less than 200,000 years, i.e. almost instantly by geological standards, but it took next 50–100 million years to restore the global biodiversity. We studied foraminifera from the Upper Permian mid-shelf sedimentary succession from the subsurface of the southern Levant Basin (David 1 and Pleshet 1 boreholes, Saad and 'Arqov Formations, central Coastal Plain of Israel), complemented by analyses of microfacies geochemical proxies (stable isotopes ratios and percentage carbonate content). A unique palaeo-location on the northern edge of the siliciclastic belt extended along the northern margins of Gondwana within the Southern Hemisphere, and within the circum-tropic belt, made the succession a sensitive tracking device for global changes of the time. We found that representatives of the superorders Fusulinoida and Endothyroida completely died out by the end of the Late Permian as a result of the P/T mass extinction. Rare representatives of the Nodosariida, Milioliida and Ammodiscidida were found in the Lower Triassic, among which only two species of ammodiscids and one species of miliolid passed from the Upper Permian. The number of species found in the Upper Permian parts of David 1 and Pleshet 1 boreholes ranges from 70–84 species, while the Triassic parts of the same boreholes yield 6 or 7 species only.

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 in 2022–2023

- 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 GBNBA (Gesher Bnot Ya'akov, North Bridge Acheulian).

Active grants

- 2022–2024 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-water-bodies.* (P.I. NIS 420,000, equivalent to US\$125,000).
- 2022–2024 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'akov Formation.* (together with G. Sharon) (P.I. NIS 20,000, equivalent to US\$6,000).
- 2022–2024 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).

2023–2024 “TAD and the Humanities”: Research grant from the School of Jewish Studies and Archaeology, TAU. *The reconstruction of Jordan Valley vegetation and climate conditions during the last 2 million years* (P.I. \$11,000).

2023–2024 Israel Institute of Advanced Studies. A member of the research group: *Desert Sea Connectivity: Arid-Zone Food Security and Climate Change in Late Antiquity*.

Research projects in 2022–2023

- Paleoenvironment of the Levantine Corridor during early *Homo* dispersals Out-of-Africa.
- The beginning of fruit tree cultivation.
- The reconstruction of gardens in Pompeii.
- The role of the environment in the transition to agriculture.
- Changes in the woody vegetation of the Jordan Valley during the last million years.
- Tel Megiddo and its environs.

Supervision of students

In 2022–2023, 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

Conferences organization

July 2023 — The Second Annual Meeting of the Israeli Botanical Forum: *Past-Present-Future in the Botany of Israel*, Tel Aviv University (organized together with J. Ziffer-Berger and Y. Sapir).

Local conferences

- Jerusalem the Navel of the Earth — Yad Izhak Ben-Zvi, Jerusalem, July 2023. Paper presented: *The turning of Jerusalem's Mountain peaks into political landmarks* (with Y. Gadot [presenter]).
- The 2nd meeting of the Israeli Botanical Forum: *Past, Present, Future*. The Steinhardt Museum of Natural History, Tel Aviv University, July 2023. Paper presented: *Fruit trees domestication: Who, When, Where and Why?*

International conferences

- EU Operational Program Research, Development and Education: International Seminar Course, Charles University, Prague, 27 October 2022. Invited seminar: *The natural and cultural landscape of Judea: between climate crises and royal gardens*.
- The 2022 Annual Meeting of the American Schools of Oriental Research (ASOR), Boston, USA, November 2022. Papers presented: *Gardens and political landscape around Jerusalem during the Iron Age and Persian period* (together with Y. Gadot [presenter]); *The emergence of fruit tree horticulture: new 7,000-year-old findings from the southern Levant*; *Garden ceramics at Jericho as evidence for an important horticultural trend in Royal Gardens* (together with K. Gleason and R. Bar-Nathan).
- International workshop on *Scientific insights on diet at the Ancient Near East during the 2nd–1st millennia BC*, Munich University, Germany, March 2023. Invited lecture: *The history of intestinal parasite diseases in ancient Israel*.
- The 13th International Congress on the Archaeology of the Ancient Near East, Copenhagen, Denmark, May 2022. Invited lecture: *What was the role of climate in the Neolithic domestication (ca. 10,500 BP) and Chalcolithic fruit-tree horticulture (ca. 7,000 BP)? A Near Eastern perspective* (part of the workshop on Holocene Human-Environment Interactions in South-West Asia: Trends in Population, Climate, and Vegetation).
- The 8th International Anthracology Meeting, Porto, Portugal, August 2023. Papers presented: *The lost ancient Juniper stands of the Southern Levant* (together with M. Cavanagh [presenter]); *Fruit tree horticulture: new 7,000-year-old charcoal remains from the central Jordan Valley (Israel)*.

Awards

- *Excellency in Teaching Award* (“100 Club”; for the 2022 academic year).

- *Brono Award* (2023). The award is given annually to three to mid-career (age <50) Israeli scholars, working in any field, who have demonstrated exceptional originality of mind, dedication and ground-breaking impact in their research, and who have managed to influence and reshape their field of expertise.
- *The Kadar Family Award for Outstanding Research* (2023).

ARCHAEOMALACOLOGY

Daniella E. Bar-Yosef Mayer

Scientific collaborations

In March 2023, I visited the Wadi Feynan regional museum in Jordan, studying shells and beads from a Neolithic site that was excavated nearby; I also participated in the field work. The project was headed by Prof. Steven Mithen, University of Reading (UK) with whom I collaborated. Other participants in this mission included Heeli Schechter from the Hebrew University of Jerusalem and Dave Smith from University of Reading.

Conferences and invited lectures

- *The use of shells by humans*. Paper presented at the International Workshop *Shell and Personal Adornment in Neolithic Cultures* organized at the Steinhardt Museum of Natural History, Tel Aviv University (November 2022) and sponsored by the Israel Science Foundation.
- *Shell beads of the Middle Palaeolithic: Misliya and Qafzeh as case studies*. The 15th international meeting of the ICAZ-ASWA, Tokyo, December 2022.
- *Introduction to Archaeomalacology*. Course taught at University of Naples L'Orientale, Italy, May 2023.
- *The sensory experience of shells and various beads*. Paper presented at the *Sensorial Experience of Body-worn Objects* Workshop in the framework of the Stamp Seals from the Southern Levant project. Tel Aviv University, August 2023.
- *Middle Palaeolithic personal ornaments*. Paper presented at the *Neanderthal and Homo sapiens material culture in Middle Paleolithic Western Asia* Training School at University of Haifa, March 2023.
- *Shell beads of the Middle Palaeolithic: Misliya and Qafzeh as case studies*. Paleoanthropology Society Annual Meeting, Portland, OR, USA, April 2023.
- *Shells in Chalcolithic sites and their role in ritual and beliefs*. Chalcolithic Forum, Ben Gurion University, Israel, February 2023.

Student supervision

- Michele Maurici, PhD, University of Naples L'Orientale, Italy: *Shells and shell artifacts from archaeological contexts of ancient Egyptian and Nubian cultures between the third and first half of the second millennia BCE*. (Co-advisors: Prof. Andrea Manzo, University of Naples and Prof. Gianluca Miniaci, University of Pisa)
- 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 Shafir, MA, University of Haifa: *The Plaster beads of Nahal Hemar Cave, A Neolithic site in the Judean Desert*.

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

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

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 Timna, Tel Azekah, Tel Hadid and Tel Hazor. My participation included advising site directors on retrieval methods, and lectures to students at the field school using comparative collections.

Conferences

2022 — The American Schools of Oriental Research Annual Meeting (Boston, USA). Lecture: *Economic and symbolic roles of wild animals during the Late Bronze and Iron Ages of the southern Levant*.

2022 — Minerva Gentner Symposium, Urbanism in the Iron Age Levant and Beyond: Archaeological, textual, and comparative perspectives (Ramat Gan, Israel). Lecture: *Urban Nature: The impact of urbanism in the Iron Age on the animal economy*.

2022 — Seminar, Department of Bible, Archaeology and the Ancient Near East, Ben-Gurion University of the Negev (Israel). Invited lecture: *Symbolic and economic roles of livestock and wild animals in the LB-IA*.

2023 — Conceptualizing Nature, the Emory-TAU Colloquium (Tel Aviv, Israel). Invited lecture: *Conceptions of wild and domestic animals during the 2nd—1st Millennia BCE: The zooarchaeological evidence*.

2023 — Departmental seminar, Kimmel Center, Weizmann Institute of Science (Rehovot, Israel). Invited lecture: *The zooarchaeological study of the Late Bronze and Iron Ages*.

2023 — 13th International Congress on the Archaeology of the Ancient Near East (Copenhagen, Denmark). Lectures: *Urban Nature — Wild animals in the Iron Age of the southern Levant*; *Between cities and villages: The Islamic and Ottoman animal economies*.

Student supervision

I advised five MA, one MSc and one PhD students. In addition, one student from the MASA program worked for four months in the lab. The students' work was based on faunal assemblages from archaeological sites (zooarchaeological collection) and relied on the mammals and birds comparative collections.

Teaching

Teaching at Tel Aviv University: *Introduction to archaeozoology*, *Practical workshop in 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);
- Dr Aaron Sasson (San Diego Natural History Museum, CA, USA).

Public outreach

Sapir-Hen, L. & Fulton, D.N. 2023. Dogs as part of the social fabric of Iron Age settlements. *The Ancient Near East Today* 11.10. <https://www.asor.org/anetoday/2023/10/dogs-social-fabric>

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

A number species of fish collected by the Israel Oceanographic and Limnological Research, Haifa, were added to the reference collection. Complete specimens of *Sparus aurata* from the SMNH wet collection and jaws from the osteological collections were scanned with the microCT.

Research

During 2022–2023, the following research projects were active:

- Fish exploitation and the beginning of protoaquaculture in the Iberian Peninsula: Collaborative research with Prof. Arturo Morales-Muñiz Prof. Eufrosia Roselló-Izquierdo from the Universidad Autónoma de Madrid, Spain.
- Isotopic composition study: Evaluating the effect of diagenesis on isotopic composition ($^{87}\text{Sr}/^{86}\text{Sr}$, $\delta^{13}\text{C}/\delta^{15}\text{N}$ and $^{18}\text{O}/^{16}\text{O}$ in carbonate and phosphate fractions) in fish bones, teeth and otoliths from various species of the families Sparidae, Cyprinidae, Cichlidae, Mugilidae and Scariidae. The isotopic signature was used as environmental and cultural proxy. This collaborative study involved researchers from the Israel Oceanographic and Limnological Research (Haifa, Israel), the Institute for Geosciences, Johannes-Gutenberg, University of Mainz (Germany) and Faculty of Archaeology at the Leiden University (The Netherlands).
- Identification of thermal alteration: Collaborative research with Dr Jens Najorka from the Natural History Museum, London, UK, using XRD techniques to identify thermal alteration in fish teeth, resulting from controlled heat (cooking).
- MicroCT as a tool for the study of fish osteology: Collaborative research with Prof. Israel Hershkovitz from the Department of Anatomy and Anthropology, Faculty of Medicine, and Dan David Center for Human Evolution and Biohistory, Tel Aviv University, Israel.

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. Eufrosia 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

- February 2023 — DissCo Prepare, Natural History Museum, Brussels, Belgium: *Revealing secrets from the Acheulian cuisine: The application of X-ray powder diffraction (XRD) technique to identify heat induced changes in fish remains.*
- December 2022 — The Israel Prehistoric Society Annual meeting at the Hebrew University of Jerusalem: *The role of aquatic habitats to human evolution.*

Participation in Courses

- February 2023 — 4th MOBILISE training school at the Natural History Museum, Brussels, Belgium.

Invited Lectures

- 2022 — Department of Archaeology, Tel Aviv University: *Fish exploitation during the Iron Age period.*
- 2023 — Department of Biology of Environment, University of Haifa, Oranim Campus: *The use of fish remains in reconstructing the paleoenvironment and understanding their significance in the diet and evolution of hominids.*

PALAEOGENOMICS LABORATORY

Meirav Meiri

The Paleogenomics Laboratory 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 the species' 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.*

2022—2023 Tel Aviv University — University of Manchester Research Fund (21,000 NIS).

Project: *Using multiomic approaches to understanding ancient biomolecule preservation.*

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 focus 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 in 2022–2023

- The teeth from Misliya and Qesem Caves: *Who were the Achelu-Yabrudians?*
- The Qafzeh Cave hominins: *Mal occlusion or mal adaptation?*
- Timna human remains: *Who were the people of Timna?*
- Violence: *The origin of warfare in the southern Levant.*
- Yarmut human remains: *Reconstructing the life history of the Yarmut people.*
- Yodfat human remains: *Physical evidence of the Roman massacre in Yodfat.*
- Asawir human remains: *Reconstructing life history at the early Chalcolithic period.*
- Motza human remains: *Reconstructing life history at the Pre-Pottery Neolithic period.*

Running field projects in 2022–2023

- Tinsmet Cave Project (Middle Paleolithic);
- Skhul Cave Project (Middle Paleolithic);
- Tabun Cave Project (Middle Paleolithic);
- Timna Valley Project (Early Bronze Age — Iron Age);
- Emireh Cave Project (Upper Paleolithic);
- Qadim Cave Project (Late–Early Neolithic);
- Tel Azeka Project (Bronze Age)

Active grants in 2022–2023

Israel Research Foundation (ISF)	1,300,000 NIS
Israel Research Foundation (ISF)	1,000,000 NIS
Israel Research Foundation (ISF)	1,500,000 NIS
BSF	320,000 USD
BSF	284,000 USD
Australian Research Council	254,000 USD
Dan David Foundation	110,000 USD
Yehud Project — Israel Antiquities Authority	227,700 NIS
Yavne Project — Israel Antiquities Authority	155,000 NIS
Research Donations	60,000 USD
Dan David Center for Human Evolution and Biohistory Research	150,000 NIS
Abraham Finkelson Foundation	75,000 NIS
Koret-Berkeley-TAU Initiative	250,000 USD
Gerda-Henkel Foundation	84,000 Euro
Allessia Kantur Foundation	14,000 USD

Active collaboration projects with foreign researchers in 2022–2023

- Prof. Gerhard Weber, University of Vienna, Austria;
- Prof. David Reich, Harvard University, MA, USA;
- Prof. Svante Pääbo, Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany;
- Prof. Johannes Krause, Max Planck Institute of Geoanthropology, Jena, Germany;
- Prof. Rolf Quam, Binghamton University, NY, USA;
- Prof. Bruce Latimer, Case Western Reserve University, OH, USA;
- Prof. Luca Fiorenza, Monash University, Australia;

- Prof. Stefano Benazzi, University of Bologna, Italy;
- Prof. Frank Ruhli, University of Zurich, Switzerland;
- Prof. Antoine Balzeau, Histoire Naturelle de l'Homme Préhistorique, CNRS, France;
- Dr Matthias Meyer, Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany;
- Dr Priya Moorjani, University of Berkeley, CA, USA;
- Dr Marine Frouin, University of Stony Brook, NY, USA;
- Dr Andrew Kandel, University of Tübingen, Germany;
- Dr Maria Spyrou, University of Tübingen, Germany;
- Dr Matasha Mazis, Technical University of Darmstadt, Germany;
- Dr Nohemi Sala, CENIEH, Burgos, Spain;
- Dr Markus Bastir, Museo Nacional de Ciencias Naturales, Madrid, Spain.

Active collaboration projects (including joint research grants) with Israeli archaeologists in 2022–2023

- 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;
- Prof. Gonen Sharon, Tel Hai College;
- Prof. Yuval Gadot, Tel Aviv University;
- Prof. Oded Lipschits, Tel Aviv University;
- Dr Ianir Milevski, Israel Antiquities Authority;
- Prof. Leore Grossman, Hebrew University;
- Dr Ella Assaf, Tel Aviv University;
- Dr Michal Birkenfeld, Ben Gurion University;
- Prof. Dani Rosenberg, Haifa University;
- Dr Pablo Bezer, Israel Antiquity Authority;
- Dr Rabia Khamissa, Haifa University;
- Dr Michael Eisenberg, Haifa University;
- Prof. Lidar Sapir-Hen, Tel Aviv University.

Conferences

- *Revolutionizing Next-Generation Sequencing (5th Edition)*. 27–28 March 2023. Ghent, Belgium.
- *The Fourth Meeting of the Israeli Society for Evolutionary Biology*. 2–3 April 2023, University of Haifa, Israel.
- *Clinical and Research Excellence Symposium 2023*. 19–20 July 2023, University of Otago, New Zealand.
- *XXI Congress of the International Union for Quaternary Research “Time for Change”*. 14–20 July 2023, Sapienza University of Rome, Italy.

MOLECULAR SYSTEMATICS LABORATORY AND TISSUE COLLECTION

Dorothee 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 500 animal specimens, including mammals, birds, reptiles, fish, echinoderms, polychaetes, mollusks, crustaceans, insects, sponges and fungi were processed for molecular identification. The molecular work, in collaboration with the morphological identification by the SMNH collection managers and researchers working in the other collections, proved to be highly important for the curation of the samples and for promotion of the zoological and ecological research.

The Lab also supported morphological identifications in a couple of services provided to the Israel Ministry of Agriculture regarding species invasion and the enforcement of the regulations for import of animals.

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 2022–2023, 970 tissue samples were added to the Museum tissue collection, including 199 mammal tissue samples (90 individuals, 33 species), 560 birds (271 individuals, 149 species) birds and 211 reptiles (187 individuals, 50 species). Tissue samples from the bird collection were loaned to researches from Denmark, Israel and Spain; from the reptile collection to researchers from Slovakia and Spain; from the sponge collection tissue samples were sent to Ana Riesgo from Spain. Dr Miller from the United Arab Emirates visited the molecular systematics lab and extracted bird DNA for his research, in collaboration with the Israel Nature and Parks Authority.

PEST RISK ASSESSMENT PROJECT

Zohar Yanai

Since December 2021, SMNH staff have been involved in a joint Pest Risk Assessment (PRA) project with the Plant Protection and Inspection Services at the Ministry of Agriculture. Due to changes in import regulations, initiated by the Government, the Plant Protection and Inspection Services at the Ministry of Agriculture and Rural Development (PPIS) have been requested to prepare a scholarly based file for each agricultural good that may be imported to Israel. This file aligns with the international standards of PRAs and includes various details regarding potential pests that may infect, and transfer with, each product. Upon PPIS' request, the SMNH staff obtains relevant pest lists, and each of them is being evaluated by the in-house expert who provides information regarding their biology, distribution, economic impact, etc. Based on this information the PPIS staff can formulate product-specific regulations and measures. This joint project is of the highest importance for protecting Israel's agriculture and nature from invasive pests.

During 2022–2023, 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, and Ofir Tomer. They contributed a total of 304 labour hours and assessed four products. The project is coordinated by Dr Zohar Yanai.

THE MUSEUM DATABASE

Yonatan Gur and Tirza Stern

During 2022–2023, we continued improving the usability, Interface and performance of our centralized database. During the reporting year, we registered and trained another 13 users that have joined our growing team.

We also updated and published our dataset on the Museum's website, to make it searchable to the public and researchers: <https://smnh.tau.ac.il/en/research-at-smnh-2/collections-database>. During 2022–2023, 98 new users from 19 countries, with 70 of them from 32 different institutions registered for the academic use, 19 registered for private usage and 9 registered for 'other' type usage. During the same period, 1845 data queries (searches) were performed by 118 users.

In 2022–2023, 33,839 new records were added to the SMNH database, while quite a few old records were migrated to the new system and erroneous items were removed (hence there can be seeming discrepancies compared to the previous years' figures for some collections), to a grand total of 664,987 entries. At present, the database contains the following numbers of entries in the following groups, with the number of new records in parentheses:

- Amphibia — 2930 (20)
- Aquatic parasites — 65 (0)
- Archaeobotany — 1012 (0)
- Arthropoda (other than insects) — 6998 (137)
- Ascidiacea — 1440 (128)
- Aves — 24750 (515)
- Brachiopoda — 47 (0)
- Bryozoa — 480 (0)
- Coelenterata — 14506 (290)
- Echinodermata — 2476 (20)
- Feather Identification Lab — 3308 (488)
- Foraminifera — 786 (0)
- Fossils — 12465 (4443)
- Insecta — 454051 (25415)
- Lichens — 1911 (0)
- Mammalia — 17781 (165)
- Molecular Laboratory — 2830 (500)
- Mollusca — 68561 (1143)
- Pisces — 16118 (201)
- Porifera — 1938 (127)
- Reptilia — 20856 (235)
- Vascular plants — 3486 (0)
- Vermes — 284 (12)
- Water plants — 5908 (0)



THE ACADEMIC COURSES UNIT

Menachem Goren and Noga Sokolover

The Academic Courses Unit of the Steinhardt Museum of Natural History and the National Center for Biodiversity Research offers courses taught by museum scientists and guest experts. These courses are free and open to students from all universities (BSc, MSc and PhD students), as well as to staff from government and non-government organizations. Students receive academic credits for these courses.

The courses are organized into two divisions:

- The **Taxonomy Initiative Division** includes courses on taxonomy, systematics and the phylogenetics of groups such as fish, crustaceans and bees.
- The **Biodiversity Division** offers courses on biodiversity research, management and policy.

List of courses

- Dr Yaela Golumbic and Prof. Noa Shenkar — Science Communication.
- Dr Yaela Golumbic — Citizen Science.
- Dr Ronit Justo-Hanani — The biodiversity crises: Policy, politics and regulation.
- Dr Zohar Yanai — Biological invasions.
- Prof. Shai Meiri and Dr Meirav Meiri — Extinctions in the Quaternary period: Why did they happen? How many occurred? Where did they take place? And how do we know about them?
- Dr Bat-Sheva (Shevy) Rothman — Systematics and biology of fish.
- Dr Yaron Hershkovitz — Ecology of rivers: from basics to practice.
- Dr Zohar Yanai and Dr Liron Goren — Ecology of winter ponds.
- Drs. Liron Goren and Tom Shlesinger — Taxonomy and systematics, the basics of life sciences.
- Dr Karin Tamar — Natural collections, the infrastructure of scientific research.
- Dr Gideon Pisanty — Ecology and evolution of bees.
- Dr Zafrir Kuplik — The mystery world of jellyfish.
- Dr Zafrir Kuplik and Dr Bat-Sheva (Shevy) Rothman — Sustainable mariculture.
- Prof. Mark T. Clementz — Topics in stable isotope paleoecology.



Tal Levanony, curator of the Botanical Gardens, was a guest lecturer for the *Ecology of winter ponds* course in the field (April 2023). *Inset*: Invasive freshwater crayfish *Procambarus virginalis* from 'En Meshotetim, Haifa. (Photos: Zohar Yanai)

PUBLIC ENGAGEMENT AND OPERATIONS

Tamar Zadok

During this academic year we marked the fifth anniversary of the museum's opening to the general public. The closures and restrictions the COVID-19 pandemic inflicted on public institutions were lifted following the first quarter of the academic year, and the museum returned to its routine mode of operation.

Since the museum's opening in the summer of 2018 and to the end of the 2022–2023 academic year, we received over 720,000 visitors. In 2023 alone, more than 150,000 people from all over the country, families and nature enthusiasts, schoolchildren, students and researchers passed through our doors.

Exhibitions

The main temporary exhibition *GLOBAL WARNING: The Climate, the Crisis and Us* was presented throughout the year. The exhibition illustrated the complex environmental reality and the underlying processes, alongside the predictions for the future, in an experiential way that aroused the visitors' curiosity, posed questions and suggested the possibility of changing personal habits. The latest scientific findings in the field and the impact of the crisis on humankind and the nature around us, in the world and in Israel, were presented at the exhibition using interactive means, videos and an online calculator for checking a personal carbon footprint, which was developed especially for the display and adapted to Israel. The exhibition stayed at the museum for 25 months, until September 2023.



RUN by the artist Ronit Kerat, a pop-up exhibition that combined video and a styrofoam sculpture, expanded the engagement with the climate crisis, at the same time as the *Global Warning* exhibition. In her work, the artist and researcher sought to shout the cry of the animals, and invited us, humans, to wake up to the alarming reality and take responsibility for the environment before it is too late.

A new interactive display *Ecosystem Services* was added to *The Web of Life* exhibition on the first floor of the museum.

In the Galil Plaza of the museum, the *Passage* exhibition by the artist Rotem Rashef was on show, open to all visitors with no admission fees. The exhibition strived to raise awareness of issues related to interactions between humans and nature, such as climate change, natural resource exploitation, and the disrupted cycles of the seasons, and was based on a collection of plants and archives. In creating the exhibition, Reshef used cuttings from the botanical garden and the Tel Aviv urban environment.

The Planet Is on Your Plate, an interactive exhibit presented three 'stories To *The Web of Life* exhibition on the first floor of the museum about our eating and consumer habits and proposed simple steps that could help us make meaningful changes. The exhibition allowed visitors to examine the journey our food takes, and its impact, on both us and nature. The display was curated in collaboration with *The Israel Forum for Sustainable Nutrition*. With the opening of the exhibition, special activities were held on the United Nations Food Security Day, in cooperation with

the Authority for Sustainability and Environmental Quality of the Municipality of Tel Aviv—Yafo. In addition, a series of lectures on food topics was planned for the public.

During the year, we developed *Here Be Dragons*, an original exhibition of the Israeli video and installation artist Nevet Yitzhak, who holds an MFA from Bezalel Academy of Art and Design in Jerusalem. The exhibition was commissioned by the museum and created based on research in the museum's collections and archives. Following a process that included a long stay in the collection's rooms, extensive research about it and meetings with researchers and curators at the museum, Yitzhak created a surreal show—perceived as a dream-like experience—in which the boundaries between knowledge and imagination were phantasmagorically blurred.

Public relations

At the beginning of 2023, big events resumed at the museum including a conference of the *HaAretz* newspaper and the launch of the 60+ Tel Aviv Resident Club in cooperation with the Municipality of Tel Aviv—Yafo. Also, on the occasion of marking five years since the opening of the museum, two prominent summer events for families and for young people aged 20–35 were organized in cooperation with the municipality and attracted thousands of visitors.

On International Biodiversity Day, held on 22 May, three videos were produced with the participation of the museum's researchers to present the uniqueness of the museum-based research.

The museum launched together with the rock artist Shahar Even-Tzur (*Monica Sex* rock band) the first Hebrew Zoological Album *Living Legend* — a collection of ten original songs about the unknown stars of Israel's biodiversity. Along with the songs, animated music videos were created, a children's book was written and a successful concert tour performed. The songs received tens of thousands of views on YouTube, Spotify and Apple Music. This was a great approach to expose the museum and the diversity of animals to new audiences through an original medium of songs and music for the whole family.

Public relations and media continued promoting the exposure of research and professional work in the museum. Both the scientific and curatorial aspects received a lot of exposure, also in cooperation with the Tel Aviv University spokespersons.

Finances

The museum's income in its public division was around 6,000,000 NIS from collected fees, the support of the Ministry of Culture amounted to about 900,000 NIS, and the Ministry of Education contributed about 300,000 NIS. The generous support of donors, led by the Steinhardt family, supplemented the museum's own income and enabled the continuation of its public activities.



EDUCATION AND SCIENCE COMMUNICATION DEPARTMENT

Ilil Pratt

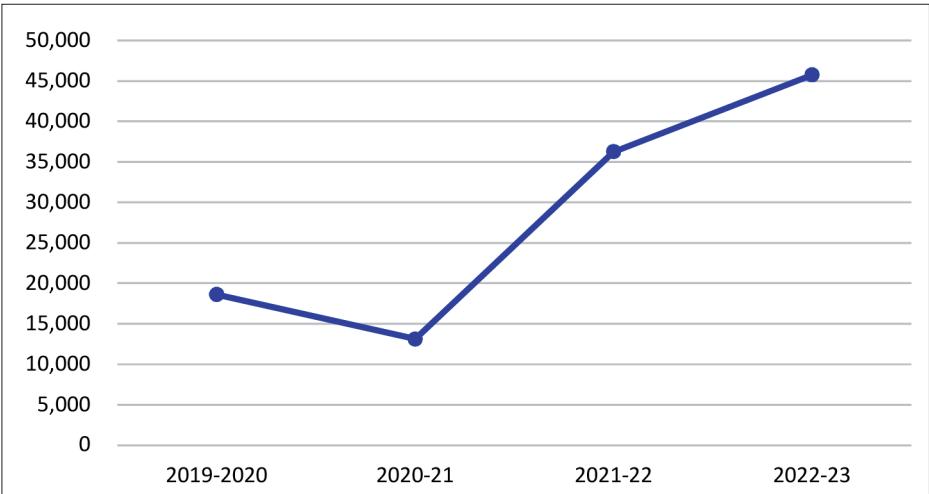
Throughout the academic year of 2022–2023, the museum experienced a notable surge in guided visits, witnessing an increase of 9,473 visitors compared to the previous year.

The temporary exhibition *Global Warming: The Climate, the Crisis and Us* captivated audiences during its second and final year, drawing in around 4,000 guided visitors.

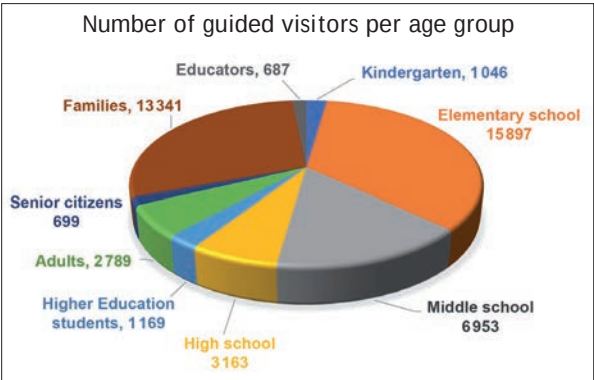
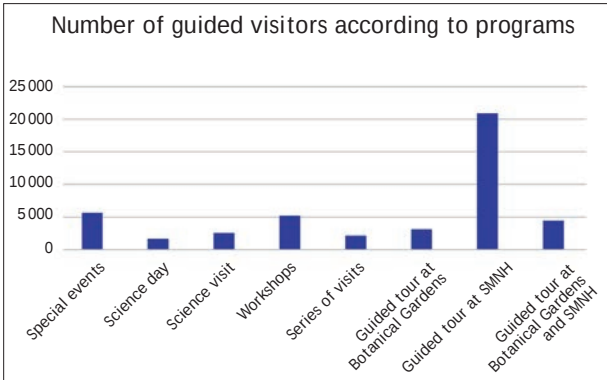
During the academic year of 2022–2023, we introduced various continuous programs for the adult audience. Notable among these was the lecture series *Vanishing World?* conducted in collaboration with the Israel Society of Ecology and Environmental Sciences, alongside the *Natural Light* series featuring movie screenings and scientist talks.

This year, we produced two sets of short videos. One set celebrated Darwin Day and the second marked Biodiversity Day. These informative videos showcased our scientists explaining their research and curators delving into the taxonomic groups they oversee.

In adherence to our annual tradition of acknowledging International Darwin Day, this year, we expanded our focus to include the International Day of Women and Girls in Science. The museum hosted a special *Woman Evolutionists Event*, encompassing exclusive tours led by scientific curators, talks by female scientists, and various engaging activities.



The number of guided visitors in 2022–2023 tripled compared to the COVID-19 recession of 2020–2021.



Left: As in previous years, our most common activity in 2022–2023 was a guided tour around the museum.
Right: Approximately 60% of our guided audience was from the education system, mostly elementary school. This year saw an increase of over 40% in the number of elementary school visitors.

In June 2023, the museum launched its interactive exhibit, *The Planet is on Your Plate*, in partnership with the Israeli Forum for Sustainable Nutrition. On six huge touch screens, the exhibit invites visitors to discover how changes in our nutrition can improve our health and help the environment. The exhibit's opening was commemorated with an extended weekend of activities for the general audience, featuring webinars in both Hebrew and Arabic, workshops, and informative talks.

Lastly, we established a successful collaboration with Israel Nature and Parks Authority, in which our guides held special Show & Tell activities in Tel Afeq Natural Park, engaging with over 1000 visitors at the park.

Visitors according to program

Program	Number of visitors
Guided tour at SMNH	20,925
Guided tour (incl. the Botanical Gardens)	4,463
Guided tour at the Botanical Gardens	3,141
Science day	1,657
Science visit	2,545
Series of science visits/days	2,129
Workshops	5,246
Special events	5,638
Total	45,744

Visitors according to age group

Age group	Number of visitors
Kindergarten	1,046
Elementary school	15,897
Middle school	6,953
High school	3,163
Higher education students	1,169
Families	13,341
Adults	2,789
Senior citizens	699
Educators	687
Total	45,744



ISRAEL CENTER FOR CITIZEN SCIENCE

Tomer Gueta, Yaela Golumbic, Naama Arkin, Nirit Lavie-Alon, Shlomo Preiss-Bloom, Zohar Afek

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 Schwartz (Technion), Prof. Gil Rilov (IOLR), Prof. Ron Milo (Weizmann Institute), Prof. Ayelet Shavit (Tel-Hai College).

The Israel Center for Citizen Science at the Steinhardt Museum of Natural History was established in early 2022, to support public participation in environmental research and promote participatory biodiversity science and conservation in Israel. The center fosters sustainable technological, scientific and social facets, to forge stronger foundations for citizen science in Israel, and aims to serve as a source of knowledge and support for citizen science programs, nationally.

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 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 initiatives 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 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.

Examples of supporting projects

- **Project enhancement — Backyard Bird Count 2023:** The Backyard Bird Count (BBC) is a long-lasting citizen science project in Israel, active since 2006. This project has three objectives: scientific — to create a multi-year database of wild bird species and characterize trends and

changes in their frequency over the years; public — to increase involvement in nature conservation; and educational — to raise awareness and interest in birds around us, deepening familiarity, knowledge and education for active citizenship. The Israel Center for Citizen Science has joined the leadership team of the BBC in 2022, enhancing its scientific output and public reach. During BBC 2023, we have designed new resources and organized a series of events to promote the project, such as webinars, training sessions and opening a WhatsApp group for streamlining communication with participants.

- **Project initiation — National Moth Week 2023:** National Moth Week is held annually worldwide during the last full week of July and celebrates the beauty, life cycles and habitats of moths around the world. In collaboration with Oz Ritner (SMNH; moth collection manager), we planned and carried out a series of events during the moth week (July 23–30, 2023). Those included an opening event (virtual Zoom meeting) and two community gatherings (one in the north and one in the center of the country) featuring moth light traps installations.

Citizen science research

Active grants

2023–2025 Keren Kayemet Lelsrael—Jewish National Fund (KKL-JNF) — Reconnecting people with nature, and encouraging conservation behaviors through citizen science (360,000 NIS).

On-going research projects

- **Citizen Science as a Tool for Connecting People to Nature** — A study funded by the KKL-JNF that examines ways to develop citizen science projects promoting nature connectiveness among diverse audiences and increases public awareness of the environment and its protection.
- **Volunteer Participation Patterns in Biodiversity Monitoring** — This study examines the motivation, preferences and frequency of participation of the most active participants on the iNaturalist citizen science platform for monitoring biodiversity.
- **Scientists' Journey into Citizen Science** — This research project examines professionals' attitude towards citizen science, their willingness to participate or lead initiatives, and identifies changes in their perspectives and activities over time.

Active scientific collaborations

In Israel

- Dr Idit Adler, Constantiner School of Education, Tel Aviv University.
- Prof. Frida Ben-Ami, School of Zoology, Tel Aviv University
- Taking Citizen Science to School (TCSS) research center, Haifa University & the Technion.

International collaborations

- Prof. Alice Motion, School of Chemistry, Sydney University, Australia.
- Dr Joseph Roche, School of Education, Trinity College Dublin, Ireland.
- Dr Joana Magalhães, Science For Change, Barcelona, Spain.
- Marius Oesterheld, Museum für Naturkunde Berlin, Germany

Teaching

Yaela Golumbic led a course on citizen science course and its benefits for science and society (Tel Aviv University).

Teacher training on iNaturalist and citizen science, at the Ecology and Environmental Science Association teacher development series, Israel.

Conferences

- *Israel Citizen Science centre — Establishment perspectives.* ECSA Conference // 2022: Citizen science for planetary health. October 5–8, 2022, Museum für Naturkunde Berlin & European Citizen Science Association, Berlin, Germany.
- *Public participation in early detection of invasive species.* Israeli Association of Sociology Conference, February 19–21, 2023, Tel Aviv University. (Talk; Golumbic Y.)
- *The Israel center for citizen science.* The 51st Annual Conference for Science and Environment, July 12–13, 2023, Tel Aviv.

THE ISRAEL NATIONAL CENTER FOR AQUATIC ECOLOGY

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

Steering Committee: Prof. Tamar Dayan (TAU), Dr Menachem Goren (TAU), Dr Assaf Tzhoar (INPA), Dr Dana Milstein (INPA), Dr Neta Lipman (IMEP), Dr Amir Erez (IMEP), Hanoch Ilssar (Yad Hanadiv), Dr Doron Markel (KKL-JNF), Dr Yehonatan Bar-Yosef (KKL-JNF).

Members: Dr Yaron HersHKovitz, Tuvia Eshcoli, Avital Katz, Nili Segman, Yoni Nisim, Nadine Gavrieli, Dr Ori Segev.

MSc/MA students: Almog HersHko-Pnuel, Dafi Luz, Tal Ratner.

The Israel Center for Aquatic Ecology (ICAE) was established in 2015 as part of the Steinhardt Museum of Natural History (SMNH). Our main goal is to conduct a national long-term biological assessment of streams in Israel. The ICAE's activities are supported jointly by the Israel Nature and Parks Authority (INPA), The Ministry of Environmental Protection, the Jewish National Fund (Keren Kayemeth Lelsrael, KKL-JNF) and Yad Hanadiv Foundation. Additionally, we perform ecological monitoring of restoration projects for river authorities.

Objectives

- The ICAE's primary objective is to develop and implement a national stream monitoring program within the context of monitoring and assessing the state of streams in Israel.
- Tool creation: We create tools to monitor actions related to stream restoration, which includes monitoring restoration activities and overall stream management.
- Ecological research: Fundamental ecological research is conducted to enhance our understanding of biological diversity, species distribution and ecological traits.
- Database management: Ecological databases are managed to store data and assimilate information, generating a comprehensive understanding of factors influencing stream conditions and deriving practical conclusions.
- Knowledge dissemination: Initiatives are undertaken to make knowledge accessible by disseminating information to decision makers and the public.
- International collaboration: We strengthen international collaborations by working with organizations involved in river restoration and monitoring, both in Israel and globally.

Main activities in 2022–2023

National Biomonitoring Scheme: Development and implementation of a national biomonitoring scheme for streams in Israel.

- In 2022–2023, we conducted the second year of biological monitoring for the Hadera catchment, partially supported by the Sharon Drainage Authority.
- In 2023, we initiated a two-year project for the development of biological assessment for the Tananim-Ada catchments.

Biological Monitoring of Restoration Projects:

- Cattle management in the Golan Heights, supported by the Israel Nature and Parks Authority.
- Routine seasonal monitoring of the Kishon stream, supported by the Kishon River Authority.
- Accompanying the ecological restoration plan of the Tzipori watershed restoration project, including monitoring the effects of weirs and dams on the macroinvertebrate community and stream continuity, supported by the Kishon Drainage Authority.
- Monitoring of the restoration efforts in the Saadia stream, supported by the Kishon River Authority.
- Routine monitoring of the Yarkon River and its tributaries, supported by the Yarkon River Authority.

- Monitoring of the restoration efforts of the Kana-Hadar project, supported by the Yarkon River Authority.
- Assessment of the sensitivity of the Yarkon tributaries to routine riparian maintenance for the Deshe Institute.
- Leading the ecological assessment of the Tzipori restoration project, supported by the Kishon River Authority.

Scientific collaborations

- EU-Horizon 2020: Research and Innovations Actions project MERLIN — Mainstreaming ecological restoration of freshwater-related ecosystems in a landscape context: innovation, upscaling and transformation.
- Development of an Integrated Monitoring Framework to streamline the Management and Restoration of Rivers and their Floodplains (DEMOSTREAM).

Collections management and databasing

During the reporting period, the IAEC teams collected 136 macroinvertebrate samples from 29 streams in six catchments: Kinneret, Kishon, Dalya, Taninim, Hadera and Yarkon. These samples were added to the national collection at the SMNH.

Teaching

- *Pollution and Rehabilitation of Aquatic Systems*. Porter school of environmental studies, 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.

Graduate students

- Almog Hershko-Pnuel (MSc, Tel-Aviv University): *Taxonomy and ecology of Hydropsychidae larvae as bioindicator species in freshwater ecosystems in Israel*.
- Dafi Luz (MSc, Tel-Aviv University): *Taxonomy and ecology of Elmidae as bioindicator species in freshwater ecosystems in Israel*.
- Tal Ratner (MA, Tel-Aviv University): *Implementation of integrated watershed management and its connection to the development of social and environmental measures of streams restoration — Tavor Valley case study*.

Talks and presentations

- *Floodier, drier, and hotter: The challenge of protecting biodiversity in Mediterranean freshwater ecosystems*. UN Climate Change Conference (COP27), Sharm El-Sheikh, Egypt (16.11.2022).
- *This is how we preserve nature: What is the degree of success in long-term projects? Long-term monitoring and assessment of the ecological status of Israel's streams* (presented by Dr Dana Milstein, INPA). Israel Nature and Parks Authority Meeting (16.03.2023).
- *Water / People / Nature — key ingredients for any successful restoration project: the case of the Tzipori stream, Israel*. Symposium for European Freshwater Sciences (SEFS13) Newcastle, UK (19–23.06.2023).
- *Applying DPSIR as a framework for an integrated catchment-scale management: the Tzipori stream (Israel) as a model*. Scientific Advances in River Restoration Conference (SARR 2023), Liverpool, UK (6–8.09.2023).

Education/public outreach

- *Is our stream 'healthy'? Application of biological indicators to assess the condition of streams in the restoration process*. Webinar for drainage authorities, online (AGMA) (13.03.2023).
- *What is a stream? Stream typologies in Israel and their functions*. Ministry of Environmental Protection — Water, wastewater, and streams professional course (18.12.2022).
- *The national rehabilitation project of Nahal Tzipori: the ecological perspective*. AGMA Webinar (25.10.2022).

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.

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 Evrona Salt Pan near Eilat. The current research projects deal with

- Long-term monitoring of arthropods across Israel's ecological units;
- 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;
- Monitoring endangered arthropod species;
- Coordinating the compilation of the Israeli endangered invertebrate species 'red list';
- 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 16 research projects, published 16 reports and presented at four 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 5 years of sampling data.* For INPA.
- *The effect of the 2017 pollution event on the arthropod community of Wadi Ashalim — a summary of 5 years of sampling data.* For HaMaarag and INPA.
- *Effective protocols for the eradication of the Little Fire Ant in gardens — results of the a two-year experiment.* 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 the 2022–2023 sampling season.* For the Ministry of Energy and Infrastructure, and the Ministry of Environmental Protection.

- *Negev Highlands snails sampling in the winters of 2021–2022 and 2022–2023.* For HaMaarag.
- *The effect of grazing intensity on butterflies community in Mount Carmel Nature Reserve – spring 2023.* For INPA.
- *Bio-acoustic survey of the Dead Sea Mole Cricket (*Gryllotalpa marismortui*) – summer 2023.* For INPA.
- *The “black book” of invasive ants in Israel.* For INPA.
- *Snail community in Upper Wadi Ashalim and reference Wadis attest to the effect of both soil and air pollution events.* For Hamaarag and INPA.
- *Differences in ant communities in “Swan Lake” coasts near and far from pollution source.* For Hamaarag and INPA.
- *Effects of soil removal on the recovery of oil-polluted soils in Evrona Nature Reserve – 1st year of monitoring.* For Hamaarag and INPA.
- *What did we learn about flying arthropod phenology and its relation to climate factors from a 2-year sampling with Malaise trap in Ramat Hanadiv?* For Yad Hanadiv.
- *Pollinator sampling in Avocado plantations sown with oat seed monoculture compared to varied seed mixture.* For Deshe Institute and Milopri.
- *Results of monitoring of riparian arthropod communities in Nahal Tsipori.* For Kishon Drainage and Streams Authority.
- *Terrestrial arthropod communities sampling in Ein Gedi nature reserve in spring 2023: What does it tell us about visitor pressure?* For INPA.
- *The effectiveness of Top-Gel in eradication of the Little Fire Ant.* For the Ministry of Environment Protection and “Rimi”.

Invited lectures

- *Polluted Status Quo: 5 years of arthropod monitoring in Wadi Ashalim.* Presented at the Wadi Ashalim project 2023 final conference.
- *Arthropod long-term monitoring and its importance for ecosystem conservation.* Presented at the Israel Society Ecology and Environmental Sciences 2023 conference.
- *Changes in the distribution of Bioindicator key species in the Negev Highlands: Are they a result of climate change.* Presented at the 2022 conference of the Zoological Society of Israel.
- *Eradication strategies of the Little Fire Ant in gardens – their effectiveness and their effect on non-target arthropod species.* Presented at the 2022 conference of the Zoological Society of Israel.



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 2022—2023

State of Nature Report

The *State of Nature in Israel* report 2023 will be published on May 2024. The report will focus on the state of biodiversity in Israel, and will summarize ten years of the national terrestrial monitoring program.

Ashalim Stream Ecosystem Monitoring Program

Following a severe pollution incident in the Ashalim stream in 2017, HaMaarag is heading a multi-annual monitoring program, run by the Israel Nature and Parks Authority Science Division. The monitoring is based on sampling and testing activities of 15 groups from different research institutions. The monitoring program aims to identify and characterize the impact of the pollution on the ecosystems along the stream. The monitoring results indicate a severe damage to various components of the ecosystem, but also a slow restorative process in some parts of the stream. We completed the fifth and final year of the monitoring program, and attended to summarizing the findings. Considering the rehabilitation that was conducted in the reserve during the past 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.

The National Program for Terrestrial Biodiversity Monitoring

We finished the fifth monitoring cycle of the National Program for Terrestrial Biodiversity Monitoring. The program aims to assess the state of Israel's biodiversity and nature, and significant changes taking place within them. The program monitored the flora and fauna throughout Israel on a regular basis through field surveys, surveillance cameras and sensors. The monitoring system comprised approximately 900 sampling plots in nine monitoring units that represented various habitats in Israel. The groups sampled in the monitoring units included plants, arthropods, reptiles, birds and mammals, both in close vicinity to settlements or farmlands and more distant from them.

Evrona Nature Reserve Ecosystem Monitoring Program

The fifth year of the five-year monitoring program was finished. The program assessed the effects of the oil spill in Evrona Nature Reserve, and submitted an interim report to the Israel Nature and Parks Authority. Considering the rehabilitation that was conducted in the reserve on 2021, Hamaarag started a continuous monitoring program in 2022, with an emphasis on examining the impact of the rehabilitation effort on the ecosystem.

The Red Book of Invertebrates in Israel

As growing evidences for a significant decline in arthropod diversity worldwide, HaMaarag promotes work on a *Red Book of Invertebrates in Israel*. The main goals of the book are: (1) a qualitative

and quantitative assessments of the degree of the threat to various taxonomic groups and to individual species as a future baseline for the status of the species and the quality of their habitats; (2) identifying bio-indicators for habitats under threat, as a tool for nature reserves and managed sites, and for the promotion of the protection of natural open areas; and (3) identifying key habitats to be conserved, both inside and outside protected areas. The *Red Book of Invertebrates in Israel* is compiled by the Entomological Laboratory for Applied Ecology and Hamaarag, in collaboration with the Israel Nature and Parks Authority, the Jewish National Fund, and researchers from Israel and abroad. So far, threat assessments for 421 species were prepared, including butterflies, land snails and slugs, scorpions, ants and mayflies.

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 in December 2023.

Monitoring forest fires in the Judean Mountains

In the summer of 2021, there was a forest fire in the area of Ya'ar HaKdoshim in the Judean Mountains, which was large in both its intensity and the area it covered. The natural regeneration processes of the forest after the fire, along with management activities supporting the necessary restoration processes, will determine to a large extent the future composition of the species and the forest landscape. HaMaarag is, therefore, conducting a long-term monitoring program under the management of the Jewish National Fund, whose aim is to examine the impact of the fire on key factors in the ecosystem to understand recovery processes and assist in the preparation of optimal restoration programs for Ya'ar HaKdoshim and other forests.

Mapping uncropped areas in agricultural fields

Despite the fact that they are statutorily defined as cultivated land, many areas in cultivated fields are not actually utilized for agriculture, or are only partially utilized. Such areas can be divided into two categories: (1) islands of uncultivated land within a field (for example, a group of trees); and (2) areas at the edges of the field, which are not cultivated or only partially cultivated because of technical difficulties or their proximity to roads. HaMaarag, together with the Israel Ministry of Agriculture and Rural Development, are interested in identifying and mapping such areas. Therefore, HaMaarag has developed an easy-to-apply tool, based on remote-sensing, which analyses a time series of multi-channel satellite photographs, and maps each agricultural field. This tool has been automated and can now be used without human intervention, reviewing all of the statutory mapped agricultural plots—nearly 200,000—which exist today in Israel.

The effect of environmental factors on trends in the population of two butterflies – *Tomares nesimachus* and *Cigaritis cilissa*

In recent years, we have observed a sharp declining trend in the abundance of the threatened butterflies *Tomares nesimachus* and *Cigaritis cilissa* in several areas in Israel. This study examines this trend in the entire *Tomares nesimachus* population between 2004–2022, and in the *Cigaritis cilissa* populations in the Sharon area between 2006–2021, as well as the effect of several environmental factors, such as climate conditions, type of habitat, construction and development on the abundance of these butterfly species. The research is based on data from surveys undertaken during the flight season of mature individuals of both species, conducted over several years, most of them thanks to citizen science endeavors, with the participation of the Israeli Lepidopterists Society. The research was conducted under the guidance of Prof. Tamar Dayan and Dr Orr Comay.

The influence of settlements on the diurnal activity patterns of mammals in Israel

An increase in the human population density in Israel causes both the expansion and the intensification of the impact of human activities on wild animals. In areas where animals exist in close proximity to humans, some species change their spatial and temporal activity patterns to reduce their chances of encountering humans. Changes in the temporal activity of a species affect diverse aspects of the animal behavior and physiology. Behavioral patterns are expected to respond to

changes in environmental conditions before changes in the size of the population occur, and monitoring these would allow early identification of human influence on the wildlife. Understanding the effect of human settlements on the diurnal activities of mammals was important in order to preserve species and the ecosystems they inhabit. The research goal was to quantify the influence of human settlements on the temporal activity patterns of medium and large mammals. The research was conducted under the guidance of Prof. Jonathan Belmaker and Dr Ron Chen, and was completed on October 2022.

Monitoring and evaluating the density and composition of stray cat populations in rural areas

HaMaarag operates a monitoring program which evaluates the density and composition of stray cat populations in rural areas, as part of the call for *Cat Monitoring Research* funded by the Ministry of Agriculture and Rural Development. The goals of the project are: (1) determining the relationships between the density and composition of stray cat populations and their proximity to settlements; (2) determining the change in the density and composition of stray cat populations over time, and in accordance with the population management activities undertaken and with the available food sources; and (3) determining the relationship between the density and composition of stray cat populations and the diversity and activity of other wild animals. The research is conducted under the guidance of Prof. Tamar Dayan and Dr Orr Comay.

Conferences

- May 2023 — *Fifth year summary of the Ashalim Stream Monitoring Program*. A full day seminar conducted by the HaMaarag at the Steinhardt Museum of Natural History.

Publications

Dubiner, S., Namir, I., Chen, R., & Levin, E. 2023. Distance from human settlements favors wild-type appearance of feral cats (*Felis catus*) in Mediterranean woodland. *Ecology and Evolution*, 13(7), e10261. <https://doi.org/10.1002/ece3.10261>



THE OPEN LANDSCAPE INSTITUTE

Uri Ramon, Amir Perelberg, Aviv Avisar

This was the eighth 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 further, 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 Lelsrael — Jewish National Fund (KKL-JNF) continued to expand, and the Open Landscape Institute (OLI) staff conducted core surveys for forest management. The Society for the Protection of Nature in Israel (SPNI) continued its annual support together with the Israel Nature and Parks Authority (INPA) and the Ministry of Environmental Protection.

Overview of activities during 2022–2023

Streams restoration is an extensive project of tools development for eco-hydrological restoration of streams, developed over the last three 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, Dead Sea & Fault Cliff, West Galilee forests, Shmaria stream upper basin, volcanic mounds in the Golan Heights, wild olive trees on the Atlit ridge, Yarkon basin streams and West Galilee streams. The following 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 & flag plant species in KKL-JNF forests*; *Endangered plant species — INPA*; *Monitoring of the Ashalim stream following the ecological disaster*; and *Monitoring of Kishyon springs and Yarkon-Kana-Hadar streams as a baseline before restoration projects*.

The Open Landscape Institute 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; 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 2022–2023 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 partner organizations in the Steinhart 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 2022–2023 — Nature and Landscape Surveys

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'etkim Cliff, along the Syro-African Rift valley. This area has geological features 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 tourist facilities and increased agricultural areas. The purpose of this survey was 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 was completed and a final draft was submitted.

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 watercourses 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 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 was to prepare a comprehensive environmental (ecology, landscape, human heritage, and leisure and recreation) background, which would serve as the basis for planning, management and maintenance of the open landscape in general and KKL-JNF forests in particular. The field work was completed and a final report is to be submitted soon.

West Galilee streams survey

The survey was planned to be conducted along eight stream basins under the responsibility of the Western Galilee Drainage and Streams Authority. The survey had two main goals: (1) to partially update of the ecological valence survey of the streams that had been 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) to 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 was completed and a final draft was submitted.

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 survey was completed and a final draft was submitted.

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 had been already surveyed, or being under survey by other OLI projects. The current study 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 survey was completed and a final draft was submitted.

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. This unique region harbours various aquatic habitats: springs, winter ponds, shallow wetlands and steep canyons with flowing streams. These features support a nationally exceptional biodiversity that should be carefully protected. The survey was meant to provide a detailed background to support future and current planning processes and an improved database for policymakers. The survey was completed and a final draft was submitted.

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 was 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 second out of three years of this survey and the annual report was submitted. The final year of the survey was planned to be completed in the following year.

Shmaria stream upper basin

Shmaria stream is a fairly shallow channel that runs through the agricultural region between Patish and Grar streams. The stream and its tributaries have the potential to serve as a regional ecological corridor, connecting the Lahav Hills in the east to Grar and Patish streams in the west. The importance of this corridor is due to the expansion of the cities of Rahat and Beer Sheva, as well as national infrastructures and main transportation routes. In addition, this area has a large and unused potential to serve as a hiking and leisure place for residents and visitors, partly based on potential attractions such as the Shmaria ruins hill, the Turkish railway remains and the decades-old largest agave plantation in Israel. The geology of the area comprises loess soils, a national-level threatened ecosystem that is underrepresented in national protected areas. The survey was planned to assist the regional municipalities' master-plan to optimally recognize the important natural values, landscapes and human heritage in the survey area, thereby highlighting the possibilities for their preservation, alongside sustainable development. The first stage report was submitted.

Vegetation monitoring of the Ashalim stream following an ecological disaster (for HaMaarag)

On June 30, 2017, a 60-meter wall collapsed in the wastewater reservoir of the ICL Group plant in the Rotem industrial area. As a result, about 100,000 cubic meters of acidic gypsum wastewater flowed along a 20-kilometer route along the Ashalim stream. The pollution caused heavy damage

to the ecosystem in the area, and the INPA, together with HaMaarag, began to monitor the ecosystem in spring 2018. The purpose of the monitoring was to examine the effects of pollution on the vegetation in the Ashalim stream over time, thus helping to build rehabilitation plans for the damaged area. The OLI was in charge of the monitoring in the sixth year of study. The field work was completed, and a final report was to be submitted in the following months.

Vegetation monitoring of Kishyon springs and Yarkon—Kana—Hadar streams as baseline before stream restoration projects

In previous ecological streams restoration projects, no baseline surveys prior to restoration were conducted, and therefore it was impossible to define clear indicators for success. Based on this insight, the existing restoration programs focused on building methodology that would take under consideration the current state of the streams and their surroundings before restoration. During the reporting year, we conducted two such baseline surveys — in Kishyon springs and in the Yarkon stream. The field work was completed for both projects, and an annual report was to be submitted in the following months.

Protected nature values 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, which are 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 KKL-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, the 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. This year we completed the first year of this routine, the annual report was submitted, and the project was ongoing with a fixed annual budget allocated for it by KKL-JNF.

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 moved into the routine survey phase, aiming to cover the survey of all KKL-JNF forests in Israel within 5–6 years. We completed the second year of this routine.

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

KKL-JNF manages over 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. Great advances in remote sensing of forests from space in the past decade, thanks to the access to sensors with improved spatial, temporal and spectral resolutions, and the Google Earth Platform, enable to run global analyses. Recent studies in Israel demonstrated a potential to map natural vegetation in fine detail, but some of those studies were based on drones or on aerial hyperspectral sensors with high abilities; they are costly and cover small areas. In the 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; and 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 second year of this research was completed according to the plan and the annual report was submitted.

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 human development and under-represented in nature reserves and national parks: deep, heavy soils in valleys (mostly cultivated) and light soils on 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 threatened but represent cultural values and attract visitors. Protection of these assets serves multiple purposes: preventing harm to protected natural values (state law), preserving biodiversity, maintaining proper function of ecosystems, compliance with international treaties' requirements for the protection of biodiversity, and protecting flag species that bear cultural value. All the activities conform to the protocol for the management of sustainable forests adopted by KKL-JNF. The 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 to assess their habitat quality. In the research aspect, an observational study examines 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 second year of this research was completed (there was one-year delay in the planned schedule due to administrative problems) and the annual 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 was 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, (5) species with taxonomic uncertainty/complexity, and (6) hot-spot habitats of endangered plants. The annual report was submitted to the INPA.

Coastal Assemblies analysis and classification project

The need for this work stemmed from a proposed change to National Development Plan 1, led by the National Planning Administration, regarding the possibility of setting-up overnight parking lots in designated coastal assemblies. There are 12 such assemblies, for which this project provided proposed guidelines for wise policy and decision making: the exclusion of certain assemblies and development restrictions on others, based on ecological and scenic characteristics of these assets. We recommended that two of these assemblies would be excluded from overnight parking, and in most other assemblies, areas for overnight parking should only be allocated at the edges of each assembly and adjacent to an existing construction. Additionally, we proposed to allow night-parking in places far from the coastline itself, and if necessary, block car access to the coastal strip at night during the months of sea turtle spawning and hatching. This project was completed and the final report was submitted.

Advanced field course for botanists

This year, we continued the development of the botanical skills of field workers, emphasizing the training of the institute's staff.

Surveys and projects not yet approved

Central Golan basalt planes (awaits approval), Tamar regional council (awaits bidding), Southern Sharon regional council (awaits bidding), Taninim stream basin (submitted to the Open Landscape Protection Fund), Alexander Taninim stream basin (submitted to the Open Landscape Protection

Fund), Southern Pleshet lowland (submitted to the Open Landscape Protection Fund), Tsiפור stream botanical monitoring (awaits approval).

Plans for 2023–2024 — Nature and Landscape Surveys

Central Arava regional council

The area of Central Arava regional council is characterized by an unusual mosaic of agricultural areas and sparsely scattered settlements, embedded in a national-scale extensive range of natural landscapes, including many scenery and heritage features: the ravines of the Lisan Formation, the anticlines of the Negev Mountains, large Negev streams and their deep canyons, as well as the wide plains of the Arava valley. The wild, open and relatively undisturbed extensive landscape is used for recreational activities by hundreds of thousands of travelers every year. Building an up-to-date extensive database of natural assets, sites and environmental hazards, and the preparation of guidelines for hazard mitigation and natural assets management, are necessary tools for officials and planners to facilitate a sustainable use and biodiversity conservation-oriented planning of the municipality's area, including the restoration of disturbed landscapes that can be made accessible to the public, strengthening the residents' sense of belonging and local identity, and the preservation of natural ecosystems and habitats. The survey is planned to begin in 2024, and to be completed in 2025.

Hevel Modi'in regional council

The Hevel Modi'in regional council is in the preparation process of a comprehensive master plan. The eastern part of the council was covered by a nature and landscape survey carried out by OLI more than a decade ago, but the western part was not surveyed. A full survey in the western part, as well as the completion and update of the data collected in the eastern part, are essential in order to receive a comprehensive updated information about the natural and cultural assets in the municipality's area. The project should significantly contribute to the preparation of a sustainable master plan that would take into account the natural biodiversity assets, the landscape and the human heritage sites, for the mutual benefit of humans and nature alike. The survey is planned to begin in 2024, and to be completed in 2025.

Central Golan basalt planes

The National Planning Administration has begun preparation of a partial update to the North District Regional Development Plan, which will include the entire Golan Subdistrict. As part of the preparation of the ecological background for the strategic plan for the Golan that has been recently completed, the OLI prepared the ecology current situation chapter, based on the existing data and analysis, but as of today, no comprehensive survey of the Golan was conducted, except in the Golan volcanic mounds (see above). In order to complete the missing ecological background for the update of the Regional Development Plan, it has been decided that the area where information is most lacking is the basalt plains of the central Golan. This area includes three proposed reserves, as well as a proposed ecological corridor. The survey aims to create a comprehensive ecological and landscape database of this area, and to characterize and value these assets. This could be used as a background for a wise policy-making and planning, which will take into account the values of nature, the landscape, human heritage and leisure and recreation values in the region, and help focus and also direct management operations by field managers. The survey is planned to begin in 2024, and to be completed in 2025.

Upper Galilee & Hula valley

The purpose of the survey in the Upper Galilee regional municipality is to create a database that will serve as a tool for the planning and sustainable management of the natural landscapes within the council's area, taking under consideration the natural ecosystems and biodiversity, as well as the environmental hazards in the area. The database will provide a comprehensive picture of natural assets, sites, habitats, flora and fauna, as well as connectivity, ecological corridors, 'bottlenecks' and stepping stones. In addition, the survey will assist the council to strengthen the familiarity and identification of the residents with the local nature, and prepare an action plan for hazard mitigation. The survey is planned to begin in 2024, and to be completed in 2025.

Shmaria stream upper basin

Shamaria stream is a fairly shallow channel that runs through the agricultural region between Patish and Garar streams. The stream and its tributaries have the potential to serve as a regional ecological corridor, connecting the Lahav Hills in the east to Garar and Patish streams in the west. The importance of this corridor is due to the expansion of the cities of Rahat and Beer Sheva, as well as national infrastructures and main transportation arteries. In addition, this area has a large and unused potential to serve as a hiking and leisure place for residents and visitors, partly based on potential attractions such as the Shmaria ruins hill, the Turkish railway remains and the decades-old largest agave plantation in Israel. The geology of the area includes loess soils, a national-level threatened ecosystem that is underrepresented in national protected areas. The survey is planned to assist the regional municipalities' master-plan to optimally recognize the important natural values, landscapes and human heritage in the survey area, thereby highlighting the possibilities for their preservation, alongside sustainable development. The first stage report has been submitted and the survey is planned to be completed in 2024.

Southern Nazareth — Hamoreh hill

This region has been estimated by the OLI as one of the most urgent places for survey on a national scale, with a lack of the up-to-date detail survey data on one hand and strong environmental pressures on the other hand. This area is characterized by many natural and heritage features in a unique combination of open landscapes in the Lower Galilee (nature reserves/national parks, KKL-JNF forests, agricultural areas and drainage channels located in the ridge of the national watershed between the Kishon basin and the Jordan basin) and two ecosystems which are underrepresented in protected areas — a Mediterranean Batha and Mediterranean alluvial valleys. A comprehensive environmental, ecological, landscape, human heritage and leisure and recreation background will serve as a basis for wise and sustainable planning and management of the open landscapes. The survey will also aid the needs of KKL-JNF, which intends to prepare master plans and long-term maintenance policies for the forests in this region. The survey is planned to begin in 2024, and to be completed by the end of 2024.

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. Two years of this survey have been completed, and one more year is planned (2023–2024).

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, (5) species with taxonomic uncertainty/complexity, and (6) hot-spot habitats of endangered plants. The survey is planned to continue in 2023–2024, depending on budget allocation, not yet secured by the INPA.

Vegetation monitoring of the Ashalim stream following an ecological disaster (for HaMaarag)

On June 30, 2017, a 60-meter wall collapsed in the wastewater reservoir of the ICL Group plant in the Rotem industrial area. As a result, about 100,000 cubic meters of acidic gypsum wastewater flowed along a 20-kilometer route along the Ashalim stream. The pollution caused heavy damage to the ecosystem in the area, and the INPA, together with HaMaarag, began to monitor the ecosystem in spring 2018. The purpose of the monitoring was to examine the effects of pollution on the vegetation in the Ashalim stream over time, thus helping to build rehabilitation plans for the damaged area. The OLI was in charge of the monitoring in the sixth year of study. The field work was completed, and data analysis and final report completion are planned to be done in 2023–2024.

Vegetation monitoring of Kishyon springs, Yarkon-Kana-Hadar streams and Tsipori stream, as baseline before restoration projects

In previous ecological streams restoration projects, no baseline surveys prior to restoration were conducted, and therefore it was impossible to define clear indicators for success. Based on this insight, current restoration programs deal with building methodology that will consider the existing state of the stream and its environs before restoration. In 2023–2024, we plan to conduct three such surveys, in Kishyon springs, along the Yarkon stream and along the Tsipori stream.

Protected nature values 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. We plan to continue with the second year of this routine, with a fixed annual budget allocated for it by KKL-JNF.

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. We plan to continue the third year of this routine in 2023–2024.

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 global analyses. Recent studies in Israel demonstrated a potential to map natural vegetation in fine 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 parameters: percent cover of perennial vegetation, annual vegetation, non-photosynthetic vegetation and bare soil; trends in vegetation cover; canopy height; burnt areas and fire severity; and 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 allow 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 be completed in the coming year of 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 have been widely affected by human 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 tarred and under concrete). The forecasted further development, according to the anticipated population growth in Israel, 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 threatened 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 the activities agree with the protocol for the management of sustainable forests adopted by KKL-JNF. The 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 lays a long-term plan consisting of two aspects, viz. monitoring and research. In the monitoring part, 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 be completed in 2023–2024.

Tools Development and Research – Detailed Report for 2022–2023

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

Funding source: Hanadiv Foundation, drainage and streams authorities.

Research partners: Moran Development and Consulting firm; Southern-Jordan, Soreq-Lakhish and Yarkon stream and drainage authorities.

Current project status: Ongoing.

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 in buffer zones is a natural and sustainable process, which supports both the stability of stream banks and the functionality of the stream's ecological system. Still, several core issues in the implementation of this method are yet to be resolved. The OLI, in collaboration with Moran Development and Consulting firm, promotes actions that would make nature-based solutions more practical, accessible and 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) Collect data, analyze and draw conclusions regarding streams in different geographical areas where riverbank stabilization with vegetation was implemented; (3) Develop planning and implementation protocol and guide for the stabilization of riverbanks using vegetation, addressing dissimilarities of streams and geographical areas; (4) Information diffusion and assimilation, in collaboration with the 'AGMA'—streams and watersheds knowledge center.

During 2022–2023, 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 and interim reports were dispatched.

2. 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 Applied Ecology, SMNH.

Current project status: Ongoing.

To meet Israel's targets of 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 sustainable 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 by 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 the composition parameters of the ecological communities. Zero-time sampling (before the establishment of the facilities) of arthropods was carried out, and a report was prepared for submission to the Ministry of Energy.

During 2023, certain challenges—sorting suitable plots and budget constraints—came up. We hope that the project will resume at full scale, but it is not guaranteed.

3. 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 had been studied very little in recent decades. Being a direct continuation of Danin's geo-botanical research in the 1970s, the study aimed to map the physical conditions (soil and hydrology) that would allow to monitor 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 rehabilitation. Our research established the knowledge base and collaborations required to advance this goal.

4. Formulation of principles for planning, restoration and management of forests on river banks in KKL-JNF land

Funding source: KKL-JNF.

Research partners: KKL-JNF.

Current project status: Ongoing.

The study aims to formulate principles for planning, restoration and maintenance of streams on 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. An ecological field survey in the Baram forests (as a case study) was conducted by a multi-disciplinary group, to determine a generic method for collecting data as a background for the planning and management of streams. The analysis of data was under preparation for KKL-JNF and other stakeholders in the stream's restoration.

5. 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 Development, the Ministry of Environmental Protection, the Society for the Protection of Nature in Israel, the Israel Nature and Parks Authority, KKL-JNF, Israel's Planning Authority, Regional Councils Center, drainage and streams authorities.

Current project status: The final report was submitted to The Open Landscape Protection Fund. The study aimed to formulate a 'road map' for authorities for the multifunctional use 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 pointed 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.

6. Basin Atlas Project

Funding source: Ministry of Agriculture and Rural Development.

Research partners: Alluvial Research Station of the Ministry of Agriculture and Rural Development, Western Galilee Drainage and Steams Authority.

Current project status: Ongoing.

Nature-Based Solutions (NBS) for flood regulation is a new approach that seeks to preserve, rehabilitate and establish functional ecosystems in the basins, capable of providing flood regulation services at a higher level.

The Basin Atlas project is a GIS-based tool that aims to promote the implementation of NBS to reduce flood damage through a catchment basin analysis of the ecosystems and hydrological and geomorphological aspects. The Basin Atlas includes a geo-database that allows accessing existing information, cutting and querying between different layers and datasets, as well as web applications that enable interactive accessibility of content and information. The current project is focused on the catchment basin area of Nahal Hilazon, within the boundaries of the Western Galilee Drainage and Steams Authority. The Basin Atlas enables efficacy in the decision-making process during the planning stages, it enables management of the drainage network in the catchment basin of Nahal Hilazon, and potential sites for applying NBS to regulate floods were mapped. A concluding report of the project and the project GIS products were submitted to the Ministry of Agriculture and Rural Development. The last stage of the project will be presented to the Western Galilee Drainage and Steams Authority at the end of May 2024.

7. Ancient agriculture systems in the Negev

Funding source: KKL-JNF.

Research partners: The Israel Nature and Park Authority, the Israel Antiquity Authority, the Geological Survey of Israel, Dead Sea and Arava Science Center, the KKL-JNF, the Bedouin Development and Settlement Authority in the Negev, the Southern District Planning Administration.

Current project status: Ongoing.

The infrastructure of ancient agriculture systems in the Negev is undergoing a massive process of erosion, some of which is accelerated by recent development — transfer of infrastructure, overuse of land, inconsiderate agricultural practices, to name a few. The erosion of the ancient agricultural terraces, soil erosion and desertification processes increase in a positive feedback loop. Although this setup is an ancient and important feature, there is no intention to declare all these systems as 'sites of antiquities', mainly due to the enormous scope of their spread. The project aims to moderate the erosion processes of the ancient terraces, first by promoting awareness of their presence and great importance, and, second, by developing a professional and organizational roadmap to facilitate a change in the planning of infrastructure and implementation and environmental and agricultural development.

During the last year and a half of this project, we have operated and collaborated with numerous role-players such as the Israel Nature and Park Authority, the Israel Antiquity Authority, the Geological Survey of Israel, Dead Sea and Arava Science Center, the KKL-JNF, the Bedouin Development and Settlement Authority in the Negev, the Southern District Planning Administration, as well as several present-day farmers in the Negev. We examined how these authorities and current settlers (Bedouins or modern farmers) relate and operate in areas where ancient terraces are present. In addition, we have located and mapped all current terraces within our study area. We have submitted this GIS layer and the first-year report to the JNF. Currently, we are working on a professional and organizational roadmap for the development of tools and processes that will minimize the damage to this ancient infrastructure.

8. Supportive agriculture for natural ecosystems in 'Milopri' Avocado orchards

Research partners: Milopri Corporation, Western Galilee Cities Association, Western Galilee Drainage and Steams Authority, The Israel Nature and Parks Authority, the Entomological Laboratory for Applied Ecology (SMNH), and 25 kibbutzim.

Current project status: Ongoing.

The OLI research unit leads and provides ecological background for the project between Milopri Corporation and Western Galilee Cities Association, Western Galilee Drainage and Steams Authority, and 25 kibbutzim. These are all partners in Milopri Corporation that unites avocado growers of Western Galilee. The orchards are spread over 35,000 dunams (3500 ha). With our partners, we have raised about NIS 1,200,000 for the restoration of field remnants (small areas that are not cultivated within the farmer's managed territory). We carried out a vast survey of all field remnants in 2021 and 2022. We then continued to the first phase (2023) of ecological restoration

in 29 patches, in an aggregate area of about 80 dunams within the scope of seven farms. A further step will comprise preparation of detail plans for the restoration of 120 additional plots in the area of another 14 kibbutzim.

In addition, we accompanied the corporation in the carbon credit audit and prepared materials documenting the project for the controllers of the European Union. We also conducted joint research with the Israel Nature and Parks Authority and the Entomological Laboratory for Applied Ecology at the museum to monitor the effect of a diverse plant cover on avocado pollinators.

9. Tools for effective restoration of ecosystems' main functions

Funding source: The Ministry of Environmental Protection.

Research partners: The Ministry of Environmental Protection.

Current project status: Ongoing.

This is a joint project with the Ministry of Environmental Protection as part of a series of studies to develop restoration tools for ecosystems at risk in Israel. The purpose of the study is to map the current conservation status, to record flora and fauna that characterize it, and to locate opportunities for restoration within this framework. By analyzing various reports and conducting a dedicated survey of areas that underwent spontaneous and active restoration, we try to identify possible tools for the effective restoration of ecosystems. As part of the research, a case study was carried out for the rehabilitation of the Kurkar Quarry in the Carmel Coast area. Another case study will be conducted in the area of a planted forest in the southern district of KKL-JNF.

10. A joint project for the rivers in the JNF-KKL forests: new publications (2023–2024)

Funding source: The Ministry of Agriculture and Rural Development.

Research partners: The Ministry of Agriculture and Rural Development.

Current project status: Ongoing.

A joint publication with the Ministry of Agriculture and Rural Development (Soil Erosion Research Station) will be published in KKL-JNF magazine Ya'ar ('Forest') and will review the ecosystem services of woody vegetation on river banks, describe the woody vegetation typical of the Mediterranean streams in Israel, and address the barriers to its optimal functioning. Finally, the article will define the principles for the vegetation restoration.

Another project will provide guidance and terms of reference for ecological surveys, to enhance background for planning and restoration of streams managed by KKL-JNF. The document will comprise professional guidelines for collecting systematic and ordered hydrological, botanical and zoological information. It will contain an organized proposal for dividing each stream into segments and determining the boundaries of the required survey. The publication is based on a survey carried out by the OLI in the Baram forest, as well as on the analysis of previous useful surveys that were identified as a basis for the work.

11. Tools for multi-purpose management of agriculture, recreation activity and natural ecosystems in the Shikma Region

Current project status: Ongoing.

The research is aimed to develop applied tools in the economic, physical, legal and social fields, which will empower regional councils and landscape managers of open spaces to accommodate visitors optimally, to protect wildlife and natural ecosystem functions while responding to the farmers' distress and promoting economically and socially sustainable agriculture and food production systems. The research refers to fencing, agricultural planning and management, as well as communication methods among different stakeholders.

12. Planning, restoration and streams management in forestry lands: Mapping KKL-JNF's partnership and relationship with other stakeholders

Funding source: KKL-JNF.

Research partners: KKL-JNF.

Current project status: Ongoing.

The project is intended to support the process of formulating an organizational policy in KKL-JNF regarding stream's planning and management, following the principles and framework of the strategic plan for forestry lands, and analyzing alternatives of partnerships with other stakeholders.

First and foremost, the question arises about cases where KKL-JNF seeks to become a leading body in the management of streams and about steps that are required to promote this. In other cases, KKL-JNF can focus on the management of forestry lands only, with limited reference to the entire basin.

13. Assessment of different cultivating methods of marginal agricultural areas

Funding source: Ministry of Agriculture and Rural Development.

Research partners: Soil Conservation and Drainage Department of the Ministry of Agriculture and Rural Development, local farmers.

Current project status: Ongoing.

Examining the effects of cultivating methods for marginal agricultural areas, which are characterized by various problems such as high slopes and erosion risks. The research focuses on presentation of an extensive framework for examining a full range of effects: a review of agricultural agronomic aspects such as loss of production and soil erosion and the appearance of agricultural pests, a review of economic aspects — production, quantification of benefits and costs, a review of ecological aspects, recreational uses and interactions between the field and its environment. The project aims to support decision-making processes by the Ministry of Agriculture and Rural Development regarding incentives for better cultivation methods that combine a high level of food production with sustainable cultivation, better ecological functioning and other ecosystem services.



PUBLICATIONS

The Steinhardt Museum of Natural History is an important research infrastructure, used by scientists nationally and internationally. Below is the list of 2022–2023 publications, which covers all works of researchers affiliated with the SMNH. It also includes other publications if those have been 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 Reports are also included below.

Articles in refereed and other journals

1. Angst, P., Ameline, C., Haag, C.R., Ben-Ami, F., Ebert, D. & Fields, P.D. 2022. Genetic drift shapes the evolution of a highly dynamic metapopulation. *Molecular Biology and Evolution*, 39(12), msac264. <https://doi.org/10.1093/molbev/msac264>
2. Avni, H.L., Shvalb, N., Pokhraj, A., Francis, S., Pelleg-Kallevag, R., Roul, V., Hublin, J.J.H., Rühli, F. & May, H. 2023. Evolutionary roots of the risk of hip fracture in humans. *Communications Biology*, 6, Art. 283. <https://doi.org/10.1038/s42003-023-04633-4>
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4. Barash, A., Preiss-Bloom, S., Machluf, Y., Fabbri, E., Malkinson, D., Velli, E., Mucci, N., Barash, A., Caniglia, R., Dayan, T. & Dekel, Y. 2023. Possible origins and implications of atypical morphologies and domestication-like traits in wild golden jackals (*Canis aureus*). *Scientific Reports*, 13, Art. 7388. <https://doi.org/10.1038/s41598-023-34533-w>
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9. Bogorodsky, S.V. & Goren, M. 2023. An updated checklist of the Red Sea gobioid species (Teleostei: Gobiiformes), with four new records. *Zoology in the Middle East*, 69(2), 123–163. <https://doi.org/10.1080/09397140.2023.2203978>
10. Brink, E.C.M., van den, Horwitz, L.K., Marder, O. & Mienis, H.K. 2022. Early Bronze Age IA settlement remains at Horbat Hammim (South), near Modi'in. *Atiqot*, 108, 113–143.
11. Bronstein, O., Motro, U., Simon-Blecher, N., Ndao, P.D., Savaya, A. & Achituv, Y. 2023. Molecular analysis separates the Atlantic population of Montagu's stellate barnacle into two cryptic species. *Zoologica Scripta*, 52, 654–661. <https://doi.org/10.1111/zsc.12621>
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14. May, H. 2023. The evolutionary root of frequent modern human disorders. *In: The Fourth Meeting of the Israeli Society for Evolutionary Biology*. 2–3 April 2023, University of Haifa, Israel. Abstract Book, p. [41].
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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— 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— Yael Goll (E. Geffen)
Leadership in rock hyrax society.
- 2015— Victoria Roul (H. May)
3-D shape of the femur and its association with osteoarthritis of the knee.
- 2015— Erez Shoham (Y. Benayahu)
Mesophotic octocorals of Eilat, northern Red Sea.
- 2015—2023 Hezi Buba (J. Belmaker)
Functional response in Mediterranean fishes.
- 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— Lilah Rajzman (M. Ilan)
Red Sea mesophotic sponges.
- 2016— Svetlana Vaisman (T. Dayan)
Exotic and invasive molluscs in Israel (provisionary title).
- 2016— Heeli Schechter (D.E. Bar-Yosef Mayer and N. Goring-Morris)
The social, economic and symbolic uses of marine mollusks in the Neolithic of the Southern Levant.
- 2016—2023 Renanel Pickholtz (J. Belmaker)
Stress and movement patterns of fishes.
- 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 Rapoport (H. May and I. Hershkovitz)
Middle Paleolithic child from Tinsmet 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 *Neoliturus* (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— Mark Cavanagh (D. Langgut and E. Ben Yosef)
The paleoenvironment of the southern Arava during historical periods.
- 2018— Nitsan Ben Melech (D. Langgut and Y. Gadot)
Chronology and Landscape Archaeology — The use of OSL dating in the Judean Mountains.
- 2018— Hanna Rapuano (O. Bronstein and Y. Loya)
Aspects of aging in colonial and solitary scleractinian corals.
- 2018–2023 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 Vered (N. Shenkar)
Monitoring the effects of microplastic in tropical environments.
- 2019— Yael Hockema (D. Langgut and Y. Gadot)
The use of wood beams in monumental buildings in ancient Jerusalem.
- 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— 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?
- 2022— Inbar Dahan (J. Belmaker)
Mesophotic reef diversity.
- 2022— Jacob Dembitzer (S. Meiri and P. Raia; University of Napoli, Italy)
Morphological and lineage diversification in Mesozoic and recent Synapsids and Sauropsids.
- 2022— Michele Maurici, University of Naples L'Orientale, Italy (D.E. Bar-Yosef Mayer, with Prof. Andrea Manzo, University of Naples and Prof. Gianluca Miniaci, University of Pisa, Italy)
Shells and shell artifacts from archaeological contexts of ancient Egyptian and Nubian cultures between the third and first half of the second millennia BCE.
- 2022— Minji Jin (D. Langgut)
Early Pleistocene palynological reconstruction at 'Ubeidiya.
- 2023— Yael Klirs (D. Huchon)
Unusual animal mitochondrial genomes.
- 2023— Almog Hershko-Pnuel (N. Dorchin)
Taxonomy and ecology of Israeli Trichoptera.
- 2023— Yael Kenigsberg (N. Dorchin)
Insect-plant-fungus interactions in cecidomyiid galls.

MSc / MA students

- 2013— Michal Zeitsov (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.
- 2019— Karin Meschiany Sabag (R. Sarig)
The evolutionary transition from the second to the first molar dominance.
- 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—2023 Inbar Fridman (D. Langgut)
Vegetation and environmental reconstruction of the central Negev Desert during the Early Pleistocene based on palynological analysis.
- 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— Daria Leibin Graiver (D.E. Bar-Yosef Mayer, O. Lipschitz and I. Koch)
Shells from Iron Ages sites in Judah.
- 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— Timrat Leniado (S. Meiri and U. Roll)
Effects of taxonomic practice on reptile threat assessments.
- 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— Fatma Rayyan (R. Sarig)
Histomorphometric study of a novel magnesium-based bioresorbable membrane in critical size defects of rabbit's calvaria.
- 2020—2022 Einav Lazar (Y. Benayahu and D. Huchon)
The soft corals genera *Cladiella* and *Klyxum*: taxonomy and their symbiotic unicellular algae.
- 2020—2022 Yael Klirs (D. Huchon)
The mitochondrial genome of *Oikopleura dioica* (Appendicularia).
- 2020—2023 Tal Ratner (Y. Hershkovitz)
Implementation of integrated watershed management and its connection to the development of social and environmental measures of streams restoration — Tavor Valley case study.
- 2020—2023 Almog Hershko-Pnuel (N. Dorchin)
Taxonomy and ecology of Hydropsychidae (Trichoptera) as bioindicators for stream health in Israel.
- 2020—2023 Oriel Fischer (N. Dorchin)
A test of the plant vigor hypothesis in relation to photosynthetic pathways in plants.
- 2020—2023 Yael Kenigsberg (N. Dorchin)
Photosynthetic pathways in plants and diet breadth of galling insects.
- 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) 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—2023 Eden Harel (N. Shenkar)
Interaction of plastic particles with marine organisms.
- 2022— May Hershkovich-Reshef (G. Ribak)
Effect of larval growth conditions on the adult flight performance.
- 2022— Bar Gabso (N. Shenkar and Y. Yovel)
Learning and memory storage in the solitary ascidian *Polycarpa mytiligera*.
- 2022— Amit Unger (N. Shenkar)
Impact of global change on ascidian physiology and distribution.
- 2022— Racheli Hadjez (D. Huchon)
The genome of the myxozoan *Henneguya salminicola*.

- 2022— Elad Ben Yehuda (L. Sapir-Hen)
Iron I cultures.
- 2022—2023 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— Iris Bernstein, *Ecological tools and their applications for integrating biodiversity aspects in land-use planning*.
- 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— Gabriel Henrique de Oliveira Caetano, *New methods of assessment of the conservation status of reptiles*.
- 2020— Pnina Cohen, *The Byzantine viticulture*.
- 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*.
- 2022—2023 Urvashi Goswami, *Myxozoan metabolic pathways*.
- 2022—2023 Netanel Kramer, *Effect of light pollution on the skeletal morphology of corals*.



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 2022–2023. 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
2022-2023	S. Vaisman	Plant Protection and Inspection Services	Israel	Mollusca
2022-2023	Ch. Makarewicz	Kiel University	Germany	Archaeozoology
2022-2023	H. Greenfield	University of Manitoba	Canada	Archaeozoology
2022-2023	D. Fulton	Baylor University, TX	USA	Archaeozoology
2022-2023	A. Sasson	San Diego Natural History Museum, CA	USA	Archaeozoology
11/2022	M. Miller	Reneco International Wildlife Consultants	UAE	Conservation genetics
11/2022	M. Hauser	California Dept. of Food & Agriculture, CA	USA	Diptera
11/2022	Th. Pape	Zoological Museum, Copenhagen	Denmark	Diptera
11/2022	A. Carapezza	University of Palermo	Italy	Heteroptera
12/2022	S. Ziani	Meldola	Italy	Coleoptera
01/2023	N. Hasegawa	Hokkaido University	Japan	Ascidians
01/2023	J. Buse	Black Forest NP	Germany	Coleoptera
01/2023	A. Israel	Oceanographic and Limnological Research	Israel	Seaweeds aquaculture
02/2023	N. Yap	St John's Island National Marine Laboratory	Singapore	Cnidaria
02/2023	K. Fadeev	Zoological Institute, St. Petersburg	Russia	Hymenoptera
02/2023	S. Kadowaki	Nagoya University	Japan	Archaeology
03/2023	G. Sabatinelli	Musee Historie Naturelle, Genève	Switzerland	Coleoptera
03/2023	Ch. Feld	University of Duisburg-Essen	Germany	Aquatic ecology
03/2023	A. Lorenz	University of Duisburg-Essen	Germany	Aquatic ecology

Date	Name	Institute	Country	Expertise
03/2023	D. Melamed	Citizen scientist	Israel	Bryophyta
04/2023	H. Taskiran	Ankara University	Turkey	Archaeology
04/2023	J. Eberle	University of Salzburg	Austria	Coleoptera
04/2023	D. Lukic	University of Salzburg	Austria	Coleoptera
04-09/2023	C. Martino	University of Pavia	Italy	Crustacea
05/2023	V. Korneev	Schmalhausen Institute of Zoology, Kyiv	Ukraine	Diptera
05/2023	E. Kameneva	Schmalhausen Institute of Zoology, Kyiv	Ukraine	Diptera
05/2023	P. Malec	Moravské zemské muzeum, Brno	Czech Republic	Coleoptera
05/2023	L. Bures	Moravské zemské muzeum, Brno	Czech Republic	Coleoptera
05-06/2023	Aibin Zhan	Chinese Academy of Sciences	China	Ascidians
05-06/2023	Shiguo Li	Chinese Academy of Sciences	China	Ascidians
05-06/2023	Xuena Huang	Chinese Academy of Sciences	China	Ascidians
05-06/2023	Yiyong Chen	Chinese Academy of Sciences	China	Ascidians
05-06/2023	Wei Xiong	Chinese Academy of Sciences	China	Ascidians
06/2023	V. Fritzova	Charles University	Czech Rep.	Archaeology
06/2023	S. Abramovich	Ben Gurion University	Israel	Palaeontology
06/2023	M. Husemann	Leibniz Institute for Biodiversity, Hamburg	Germany	Insects
06/2023	A. Sutherland	University of California, Hayward	USA	Insects, Pest Management
07/2023	O. Volovych	Hebrew University of Jerusalem	Israel	Solifugae
08/2023	L. Macrina	King Abdullah University of Science and Technology	Saudi Arabia	Gorgonian octocorals
08/2023	R. Shaishe	University of Haifa	Israel	Odonata
08/2023	D. Kotter	Citizen scientist	Israel	Odonata
09/2023	E. Amsalem	Penn. State University	USA	Hymenoptera

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 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
International octocoral workshop	Y. Benayahu	IUI, Eilat, Israel	Octocorals
World of Insects	N. Dorchin	Tel Aviv University	Insects
Research Skills	N. Dorchin N. Shenkar	Tel Aviv University	Insects Marine invertebrates
Insects of Israel: field excursions	N. Dorchin	Tel Aviv University	Insects
Winter Ponds Ecology	Z. Yanai L. Goren	Tel Aviv University Haifa University	Aquatic invertebrates
Pollination Ecology	A. Dag	Bar-Ilan University	Hymenoptera (<i>Anthophila</i>)
Invertebrates for advanced students	N. Shenkar	Tel Aviv University	Marine invertebrates, ascidians
Discovering the sea	N. Shenkar	Tel Aviv University	General, ascidians
Ascidian Taxonomy Workshop	L. Novak	Soka University of America, CA, USA	Ascidians
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	IUI, Eilat	Fish

Course	Name	Institute	Taxonomic group
Scientific collection as an infrastructure for scientific research	K. Tamar	Tel Aviv University	Fish
Taxonomy, ecology and biology of fishes	Sh. Rothman	Tel Aviv University	Fish
Introduction to archaeozoology	L. Sapir-Hen	Tel Aviv University	Mammals, birds
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
Vertebrate anatomy and evolution	I. Zohar	Oranim College/ University of Haifa	Vertebrates
Pollution and Rehabilitation of Aquatic Systems	Y. HersHKovitz	Tel Aviv University	All
Introduction to archaeomalacology	D. Bar-Yosef Mayer	Univ. of Naples L'Orientale, Italy	Molluscs

SUPPORT FOR ORGANIZATIONS & INDIVIDUALS

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 2022–2023. 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	A. Riesgo Gil	Museo Nacional de Ciencias Naturales, Spain	Porifera
Loan	H. Csillag	Tal Aviv University, Israel	Aves
Loan	L. Sapir-Hen	Tel Aviv University, Israel	Mammalia
Loan	E. Geffen	Tel Aviv University, Israel	Mammalia
Loan	Feonistics class	Tel Aviv University, Israel	Mammalia
Loan	E. Mazak	Tel Aviv University, Israel	Tetrapoda, Aves
Loan	R. Zigler	Tel Aviv University, Israel	Tetrapoda
Loan	O. Prital	MOP Hatzeva, Israel	Tetrapoda
Loan	Sh. Kedem	Private, Israel	Tetrapoda
Loan	M.W. Majesky	University of Washington, USA	Mammalia
Loan	G. Babocsay	Hebrew University, Israel	Reptilia
Loan	C. Koch	Museum Koenig Bonn, Germany	Reptilia
Loan	R. Lebenzon	University of Connecticut, USA	Mammalia
Loan	M. Belmaker	Tulsa University, USA	Mammalia
Loan	Education Dept.	SMNH, Israel	Mammalia
Loan	Jin-Koo Kim	Ichthyology Laboratory, Yongso-ro, Nam-gu, South Korea	Fish
Loan	Th. Wood	Mons University, Belgium	Hymenoptera
Loan	R. Le Divelec	Mons University, Belgium	Hymenoptera
Gift of paratypes	F. Bakker	Naturalis Biodiversity Center, the Netherlands	Hymenoptera
Gift of paratypes	F. Koch	Museum für Naturkunde Berlin, Germany	Hymenoptera
Gift of paratypes	E. Scheuchl	Private researcher, Germany	Hymenoptera

Purpose	Name	Institute	Taxonomic group
Gift of paratypes	G. Broad	Natural History Museum, London, UK	Hymenoptera
Gift of paratypes	E. Ockermüller	Biologiezentrum Linz, Austria	Hymenoptera
Gift of paratypes	S. Schmidt	Zoologische Staatssammlung München, Germany	Hymenoptera
DNA loan	M. Miller	Reneco, United Arab Emirates	Birds
Tissue loan	D. Bilyeli Øksnebjerg	University of Copenhagen, Denmark	Birds
Tissue loan	C. Vilà	Estación Biológica de Doñana, Spain	Birds
Tissue loan	R. Dor	The Open University, Israel	Birds
Tissue loan	D. Jablonski	Comenius University in Bratislava, Slovakia	Reptiles
Tissue loan	S. Carranza	Universitat Pompeu Fabra, Spain	Reptiles
Tissue loan	A. Riesgo	Museo Nacional de Ciencias Naturales de Madrid, Spain	Sponges
Tissue loan	N. Stern	Israel Oceanographic and Limnological Research, Israel	Fish
Tissue loan	P. Rask Møller	The Natural History Museum of Denmark	Fish
Tissue loan	S. Manel	University Montpellier, France	Fish
Molecular ID	H. Noyberger	Ministry of Agriculture, Israel	Crustaceans
Molecular ID	B. Galil	SMNH, Israel	Crustaceans
Molecular ID	A. Belmaker	SMNH, Israel	Birds
Molecular ID	Sh. Rothman	SMNH, Israel	Fish
Molecular ID	B. Gal	SMNH, Israel	Fungi
Molecular ID	D. Simon	SMNH, Israel	Insects
Molecular ID	O. Rittner	SMNH, Israel	Insects
Molecular ID	Z. Efremova	SMNH, Israel	Insects
Molecular ID	H. Mienis	SMNH, Israel	Mollusca
Molecular ID	L. Goren	SMNH, Israel	Polychaeta
Molecular ID	D. Furth	Smithsonian National Museum of Natural History, USA	Insects

Purpose	Name	Institute	Taxonomic group
Molecular ID	M. Ilan	Tel Aviv University, Israel	Porifera
Molecular ID	Sh. Meiri	Tel Aviv University, Israel	Reptiles
Molecular ID	O. Bronstein	Tel Aviv University, Israel	Echinoderms
Molecular ID	F. Ben-Ami	Tel Aviv University, Israel	Crustaceans
Molecular ID	M. Zaitzove-Raz	Tel Aviv University, Israel	Mammals
Molecular ID	G. Ben Zvi	SMNH, Israel	Insects
Identification	L. Segal	Independent artist, Israel	Glass artifacts
Identification	Plant Protection and Inspection Services, Israel		Insects, molluscs
Identification	N. Stern	Israel Oceanographic and Limnological Research	Crustacea
Identification	H. Lubinevsky	Israel Oceanographic and Limnological Research	Crustacea
Identification	A. Müller	Private researcher, Switzerland	Hymenoptera
Identification	M. Terzo	Mons University, Belgium	Hymenoptera
Identification	H. Dathe	Senckenberg Research Institute, Germany	Hymenoptera
Identification	A. Dorchin	Mons University, Belgium	Hymenoptera
Identification	Y. Mandelik	Hebrew University of Jerusalem	Hymenoptera
Identification	Y. HersHKovitz	Israel National Center for Aquatic Ecology, SMNH	Ephemeroptera
Identification	Israel Oceanographic and Limnological Research		Echinodermata
Identification	E. Elron	Elron – Ecology and Environment, Israel	Freshwater invertebrates, Fish
Identification	R Yahel	Israel Nature and Parks Authority	Fish
Deposition of specimens	R. Shtein	Tel Aviv University	Crassulaceae
Data provision	A. Israel	Israel Oceanographic and Limnological Research	Seaweeds
Data provision	A. Konter	Natural History Museum, Luxembourg	Aves
Data provision	D. Lokshin	University of Haifa, Israel	Mammalia

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