European PhD Network **"Insect Science"**

X Annual Meeting

4-6 December 2019

••••

150° Anniversario

Società Entomologica Italiana

6 December 2019

SCIENTIFIC PROGRAM
&
BOOK OF ABSTRACTS

Università degli Studi di Genova
Dipartimento di Scienze della Terra dell'Ambiente e della Vita
Corso Europa, 26 - 16132 Genova
Room 401, 4° floor

INDEX

PROGRAM

Wednesday 4 December 2019

13:00 **Registration**

14:30 **Welcome address**

Senior scientist lecture

14:35 Stefano Vanin – University of Genova, Italy
Insects for justice, insects for history

15:00 Loris Galli – University of Genova, Italy
The Proturologist's hard work

Oral Presentations

15:20 Michele Zaccagno – University of Torino, Italy
Impact of water availability and agricultural management on occurrence and abundance of Large Copper (*Lycaena dispar*) in a rice paddy landscape

15:40 Mokhtar Abdulsattar Arif – University of Palermo, Italy
Attractiveness of volatile *Brassica* spp. seedling components to *Bagrada hilaris* and potential implications for developing habitat management strategies

16:00 Eleonora Barra – University of Napoli, Italy
Immune suppressive dsRNA in *Spodoptera littoralis* enhance the impact of the entomopathogen *Bacillus thuringiensis*

16:20 Andrea Becchimanzi – University of Napoli, Italy
A *Varroa destructor* salivary chitinase is involved in the physiological regulation of infested honeybee pupae

16:40 Nicola Bodino – CNR, Torino, Italy
Phenology and host-plant association of spittlebugs (Hemiptera: Aphrophoridae) in Mediterranean olive groves

17:00 **Coffee Break at the "Laboratorio di Biologia Marina" - 6° floor**

17:30 **Poster Presentations**

- Emanuele Berrilli – University of L'Aquila, Italy

The grey area of DNA barcoding: how to improve the molecular tool through an integrative taxonomy pipeline

- Francesca Canuto – University of Torino, Italy

Honeybee pathogens and antimicrobial peptides expression: seasonal and local variations in piedmontese apiaries

- Andree Cappellari – University of Padova, Italy

Effects of managed honeybee abundance on specialization of wild pollinators

- Daniele Cornara – CIHEAM, Mediterranean Agronomic Institute of Bari, Italy

Evaluation of different compounds for the control of the Orange Spiny Whitefly *Aleurocanthus spiniferus* in Citrus spp. under organic management

- Serena Malabusini – University of Milano, Italy, and Zahra Golparvar – University of Mohaghegh Ardebili, Iran

Segregation and behaviour of the parasitoid of longhorn beetles *Sclerodermus brevicornis*

(Hymenoptera Bethylidae) in laboratory choice tests

- Marco Molfini – University of Roma Tre, Italy

A preliminary prioritized list of Italian alien terrestrial invertebrate species

- Davide Nardi – University of Padova, Italy

VAIA windstorm: understanding outcomes and future trends on forest biodiversity through a DNA metabarcoding approach

- Giacomo Ortis – University of Padova, Italy

First record of *Pseudocleruchs triclavatus* (Hymenoptera: Mymaridae) from eggs of the forest pest *Barbitistes vicetinus* (Orthoptera: Tettigoniidae)

- Sara Ottati – CNR, Torino, Italy

Towards the production of an infectious viral clone to interfere with phytoplasma transmission by the leafhopper vector

- Stefan Cristian Prazaru – University of Padova, Italy

Biological control of the Nearctic leafhopper *Erasmoneura vulnerata* (Fitch) using generalist predators

- Merlin Rensing – Swedish University of Agricultural Sciences, Sweden

Inter plant-plant communication, aphid response and sustainable crop production

- Molly Rogers – University of Bristol, UK

Uncovering the spatial characteristics of electroreception in the Buff-tailed Bumblebee, *Bombus terrestris*

- Julian Winkler – University of Kassel, Germany

Response of alate aphids to organic mulch materials

Thursday 5 December 2019

08:30 **Senior scientist lecture**
David Giron – University of Tours, France
An integrative approach on plant manipulating Lepidoptera: from leaf-miners to gall-inducers

Oral Presentations

09:00 Davide Badano – University of Genova, Italy
Lacewings, dustywings, spongillaflies, mantisflies, owlflies, antlions… the evolutionary history of Neuroptera

09:20 Marco Bonelli – University of Milano, Italy
High mountain plant-pollinator interactions: a little known but critical component of fragile ecosystems - The case of the endangered alpine plant *Androsace brevis*

09:40 Matteo Brunetti – University of Milano, Italy
Cryptic diversity and biological control of weeds: the case of *Psylliodes chalcomera* (Coleoptera: Chrysomelidae)

10:00 Alice Caselli – Scuola Superiore Sant'Anna - Institute of Life Sciences, Italy
Chemical ecology of *Dasineura oleae*: searching for the sexual pheromone

10:20 Elisa Colasanto – University of Genova, Italy
Mediterranean and Antarctic Pycnogonida

10:40 Priscilla Farina – University of Pisa, Italy
Responses from olfactory sensilla of *Sitophilus zeamais* to Andean essential oils

11:00 **Coffee Break at the "Laboratorio di Biologia Marina" - 6° floor**

11:30 Luca Finetti – University of Ferrara, Italy
Molecular characterization and pharmacological profile of type 1 tyramine receptor (TAR1) of the phytophagous insect *Halyomorpha halys*

11:50 Giovanni Jesu – University of Napoli, Italy
New promising control perspectives against Italian Tephritids

12:10 Saetbyeol Lee – Czech University of Life Sciences, Czech Republic
NMR biomarkers of cold stress resistance in honey bees

12:30 Giulia Magoga – University of Milano, Italy
Testing factors affecting molecular species delimitation accuracy on the species-rich beetle family of Chrysomelidae

12:50 Matteo Marchioro – University of Padova, Italy
Light-traps in shipping containers: a new frontier for the early-detection of alien pests

13:10 **Lunch at the "Laboratorio di Biologia Marina" - 6° floor**

14:30 **Senior scientist lecture**
Domenico Bosco – University of Torino, Italy
The struggle of phytoplasmas for transmission by insect vectors: interactive versus independent transmission

Oral Presentations (Edible insects: safe use and future perspectives)

15:00 Sara Bellezza Oddon – University of Torino, Italy
Live insect larvae in broiler nutrition: effects on performance and gut health – preliminary results

15:20 Sara Bortolini – Free University of Bolzano, Italy
***Hermetia illucens* reared on municipal organic waste: a successful outcome for feed production**

15:40 Daniele Bruno – University of Insubria, Italy
The adult *Hermetia illucens* (Diptera: Stratiomyidae) is endowed with a functional digestive system

16:00 Christian Caimi – University of Torino, Italy
***Tenebrio molitor* larvae meal in rainbow trout diets: growth performance and diets digestibility**

16:20 Ellen Gorrens – Lab4Food, Geel Campus, Belgium
Survival and transmission of pathogens in industrially reared insects at Lab4Food

16:40 Dries Vandeweyer – Lab4Food, Geel Campus, Belgium
Rearing and processing insects at industrial scale: Microbiological research at Lab4Food

17:00 **Poster Presentations (Edible insects: safe use and future perspectives)**

- Antonio Franco – University of Basilicata, Italy

Breeding of bioconverter insects for the production of high-quality raw materials for animal feed

- Somaya Naser El Deen – Parthenope University of Napoli, Italy

Analysis of the growth performance of *Tenebrio molitor* (Coleoptera: Tenebrionidae) reared on diets based on by-products for food and feed

Friday 6 December 2019

09:00 **Senior scientist lecture**

Matteo Montagna – University of Milano, Italy
The fossil deposit of Monte San Giorgio (Switzerland-Italy) and its impact on insect evolution

Oral Presentations

09:30 Michele Preti – Free University of Bolzano, Italy
Evaluation of *Cydia pomonella* (Lepidoptera: Tortricidae) management with mass trapping using kairomonal lures

09:50 Beatriz Ramírez Serrano – University of Tours, France
Effects of arbuscular mycorrhizal symbiosis on the performance of *Spodoptera exigua* on maize in relation to the availability of plant nitrogen

10:10 Enrico Ruzzier – University of Padova, Italy
Megatominae larvae (Dermestidae) with major focus on evolution, morphology and ecological function of hastisetae

10:30 Giulia Scarparo – University of Roma Tre, Italy
Integrative approach to the study of functional morphology and parasitic strategies of myrmecophilous hoverflies

10:50 **Break**

11:30 Giorgio Sperandio – University of Brescia, Italy
Towards the development of new methods for the rational control and management of *Popillia japonica*

11:50 Elena Tondini – Scuola Superiore Sant'Anna - Institute of Life Sciences, Italy
Biological control of *Dasineura oleae*: identity and spatio – temporal distribution of its parasitoid complex

12:10 Mizuki Uemura – University of Padova, Italy
Ground dispersing social caterpillars from opposite hemispheres and its associated urtication risks

12:30 Gregorio Vono – Mediterranean University of Reggio Calabria, Italy
Preliminary records on the evolutionary relationships in field populations of *Liothrips oleae* (Costa)

12:50 Nicola Zadra – Fondazione Edmund Mach, Italy
Phylogeny and divergence of Aedini mosquitoes: evolutionary scenarios and genomic perspectives

13:10 **Discussion on PhD education and future careers**

13:30 **Meeting closure**

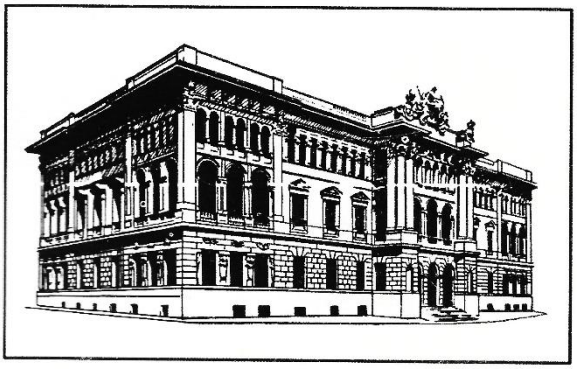
Venerdì 6 Dicembre 2019

150° ANNIVERSARIO della **SOCIETÀ ENTOMOLOGICA ITALIANA (SEI)**

14:00	Cocktail di benvenuto nel *Salone di Paleontologia* - piano terra
15:00	Saluti del Presidente Francesco Pennacchio
15:10	Roberto Poggi **Società Entomologica Italiana, 1869-2019. Breve storia di 150 anni**
15:30	Marco Bologna **Augusto Vigna Taglianti**
16:00	Achille Casale **The contribution of Augusto Vigna Taglianti to the knowledge of carabid beetles**
16:30	Romano Dallai **The sperm ultrastructure of Carabidae reveals a great variability in the group**
17:00	Conclusioni

Museo Civico di Storia Naturale "Giacomo Doria" – Anfiteatro

Via Brigata Liguria, 9 Genova



ORAL PRESENTATIONS

◆

ABSTRACTS

Attractiveness of volatile *Brassica* spp. seedling components to *Bagrada hilaris* and potential implications for developing habitat management strategies

M. A. Arif, S. Guarino, E.Peri, S. Colazza

Dipartimento di Scienze Agrarie, Alimentari e Forestali, Università degli Studi di Palermo, Palermo, Italy

Caper bush (*Capparis spinosa*) is an important cultivation of marginal lands and arid environments as such those of Mediterranean islands. In particular in Pantelleria Island (Italy), caper is appointed with the protected geographical indication by EU. In this island, the caper crop is damaged by *Bagrada hilaris* (Burmeister), a stink bug native from Asia. Recent studies evidenced strong attraction of this species toward plants at the seedlings stage. Objective of this study was to evaluate different seedlings of brassicaceous plants as candidate trap crops for *B. hilaris*, to protect caper bush. The tested seedlings were *Brassica oleracea* var. botrytis, *Eruca sativa* and *Brassica carinata*. In laboratory bioassays, carried out using dual choice arena and olfactometer, adults of *B. hilaris* preferred to orient toward seedlings of *B. oleracea* var. botrytis and *E. sativa* L. over *B. carinata*. Seedlings of *B. oleracea* and *E. sativa* were then tested in the caper fields as attractant lures in traps, determining a substantial number of captures of individuals, respectively 6.29 and 9.54 per trap per inspection (3d). Finally, seedlings were also tested in trap cropping trials, by sawing them in artificial pots and placed in caper field infested by *B. hilaris*. The observations evidenced that hundreds of *B. hilaris* individuals were diverted from capers and attracted to pots of *E. sativa* and *B. oleracea* with a lesser extent to *B. carinata*. Overall, our results indicated that trap crop composed of *B. oleracea* and *E. sativa* seedlings may be an effective habitat management tool for controlling *B. hilaris* populations. Future research should address the appropriate size and placement of trap crop within the capper fields.

Lacewings, dustywings, spongillaflies, mantisflies, owlflies, antlions… the evolutionary history of Neuroptera

D. Badano

Università degli Studi di Genova - Dipartimento di Scienze della Terra dell'Ambiente e della Vita (DISTAV), Italy

Neuroptera, commonly known as lacewings due to their intricately veined wings, are ranked among the minor lineages of holometabolous insects, with ca. 6000 described species. The better known representatives of the group are undoubtedly Chrysopidae, or green lacewings, which are highly valued in biological control since their larvae are efficient predators of soft-bodied insect pests. Nevertheless, Neuroptera are, by far, more diverse from an ecological point of view including unusual aquatic larvae feeding on freshwater sponges (Sisyridae), mantis-like insects mimicking wasps whose larvae feed on spider eggs (Mantispidae), termitophiles (Berothidae) and a diversified group with ambush hunting larvae with trap-like jaws (Myrmeleontiformia). The later ones include antlions (Myrmeleontidae), one of the very few examples of trap building among animals. The key of their success is the morphology of the larval mouthparts that, shaped and modified in a sucking apparatus, allowed them to exploit disparate niches as predators. In the current ecosystems, lacewings only play the role of minor actors with respect to other insect orders, such as their close relatives, the Coleoptera. In contrast, they were much more diverse in the Mesozoic, which was undoubtedly their "golden age". Recent paleontological findings, especially from Cretaceous Burmese amber, allowed to discover an ancient unsuspected diversity of species often characterized by bizarre morphologies. On the other hand, phylogenomic analyses clarified the relationships among lineages. Merging together these different lines of evidence is possible to shed a new light on the evolution of lacewings, a strange history of peculiar ecological adaptations and remarkable behaviours.

Immune suppressive DSrna in *spodoptera littoralis* enhance the impact of the entomopathogen *bacillus thuringiensis*

E. Barra, I. Di Lelio., F. Pennacchio, S. Caccia

University of Naples "Federico II" - Department of Agricultural Sciences, Italy

RNA interference (RNAi) provides new opportunities for pest control by silencing genes of insect pests which are targeted by virulence factors of natural antagonists. RNAi-mediated silencing of an immune gene (*Sl 102*), targeted by a polydnavirus associated with a parasitic wasp, generates an immunosuppressed phenotype in *Spodoptera littoralis* (Lepidoptera: Noctuidae) larvae, which is by far more susceptible to the entomopathogen *Bacillus thuringiensis*; this is due to a reduced capacity to mount and encapsulation/nodulation response. To limit the environmental degradation of dsRNA molecules in the harsh conditions of the insect gut, we are currently exploring different deliveries strategies: *Escherichia coli* bacteria and tobacco plant expressing *Sl 102* dsRNA. The combined oral administration of transformed bacteria or transgenic plants and of a *Bt*-based biopesticide (Xentari™) resulted in a remarkable enhancement of *Bt* killing activity, paving the way towards possible field application of this plant protection strategy. To assess if the level of immunosuppression can be further enhanced by targeting different arms of the immune response, we are currently exploring the concurrent silencing of a gene controlling phagocytosis (*Sl 102* and *Sl gasmin*). The preliminary results obtained indicate that this strategy seems to be promising, since the level of immune competence in experimental larvae with both encapsulation/nodulation and phagocytosis impaired are by far less capable to face the invasion of foreign intruders. If and how this approach will result in a more effective biological control activity by *Bt* and other entomopathogens is currently being investigated.

A *Varroa destructor* salivary chitinase is involved in the physiological regulation of infested honeybee pupae

A. Becchimanzi[1], R. Tatè[2], E.M. Campbell[3], S. Gigliotti[4], A.S. Bowman[3], F. Pennacchio[1]

[1] *University of Napoli "Federico II" - Department of Agricultural Sciences, Naples, Italy*
[2] *Institute of Genetics and Biophysics "Adriano Buzzati Traverso"- CNR, Naples, Italy*
[3] *University of Aberdeen - School of Biological Sciences (Zoology), Aberdeen, Scotland*
[4] *Institute of Biosciences and Bioresources – CNR, Naples, Italy*

Varroa destructor creates a wound in the host's cuticle through which it feeds on haemolymph and fat body, representing an important stress factor that weakens honeybee colonies and promotes the spreading of diseases. In order to facilitate feeding, this ectoparasitic mite delivers a complex of factors, including proteins and viruses, through its salivary secretions. The characterization of these factors is still largely elusive and any progress in this area will offer new insights into the molecular basis of *Varroa*-honeybee interactions, on which to develop new sustainable strategies of mite control. Here, we have used a functional genomics pipeline to identify *V. destructor* candidate salivary proteins, along with qPCR and *in situ* hybridization detection to assess their expression in salivary glands. This process allowed the identification of a salivary chitinase, which was subsequently studied from a functional point of view. *In vivo* studies were based on gene knockdown followed by artificial infestation of honeybee pupae. The effectiveness and the time course of the silencing were then assessed by qRT-PCR and associated with the observed level of mortality on targeted *Varroa* mites. To assess the effects of the salivary chitinase of *V. destructor* on honeybee gene expression, we analyzed by RNA seq the transcriptome of worker pupae in response to parasitism by silenced mites.

Live insect larvae in broiler nutrition: effects on performance and gut health – preliminary results

S. Bellezza Oddon[1], I. Biasato[2], S. Dabbou[1], M. Renna[1], M. Meneguz[2], M. Gariglio[2], E. Colombino[1], M.T. Capucchio[1], A. Imarisio[1], C. Caimi[2], L. Gasco[2], A. Schiavone[1]

[1] *Department of Veterinary Sciences, University of Turin, Italy*
[2] *Department of Agricultural, Forest and Food Sciences, University of Turin, Italy*

Insect larvae can be used as environmental and nutritional enrichment in the intensive farming of broiler chicken in order to reduce feather picking and improve animal welfare. The aim of the study is to evaluate the effects of the introduction of live larvae in the diets of broiler chickens on growth performance, carcass yield and gut health.
The experimental protocol (ID 814715) was approved by the Ethical Committee of the University of Torino (Italy). Four-day-old males broiler chicken (Ross 308; average initial live weight (ILW): 88.6 ± 9.8 g) were randomly allotted in 18 pens. Each pen was assigned to one of the three dietary treatments (6 replicates/treatment, 10 birds/replicate) as follow: i) control diet (C): commercial feed (two feeding phases: starter (4-11 d) and grower (12-38 d)), ii) HI: C + *Hermetia illucens* live larvae, and iii) TM: C + *Tenebrio molitor* live larvae. The commercial diet was distributed *ad libitum* in all treatments and the amount of live larvae distributed based on 5% of the expected daily feed intake. Every day, the time spent by birds to ingest larvae was recorded. At the end of the trial (38 day-old) all birds were weighted (final live weight - FLW) and feed conversion ratio (FCR) was calculated for the whole trial. After 12 hours of starvation, thirty animals per treatment (5 chicken/replicate) were slaughtered, weighted, and eviscerated. The hot carcass weight (HCW) was recorded. After 24 hours of chilling (+4°C), cold carcass weight (CCW) was recorded and carcass were dissected; carcass (hot and chilled), breast and thigh weight were used to calculate yields.
Data were analyzed by means of One-way ANOVA and General Linear Mixed Model (IBM SPSS Statistics V20.0.0, P value < 0.05).
TM broilers showed lower intake times of larvae than the HI birds ($P < 0.05$), with the fastest larva consumption being also recorded during the second week of the trial for both groups ($P < 0.05$). ILW and FLW did not differ among groups. HI and TM broilers showed a lower FCR than the control group ($P < 0.05$) (1.275, 1.255 and 1.297, respectively).
No differences were observed for breast yield, thigh yield, hot and cold carcass yield. Independently of insect larvae administration, a proximo-distal decreasing gradient of the morphometric indices from the duodenum to the ileum was observed ($P < 0.05$).
This preliminary investigation indicates that broiler chicken were very eager to eat live larvae, especially TM larvae. The addition of live larvae to the standard diet has led to a decrease of FCR in HI and TM treatments. The introduction of HI and TM larvae in the diets of broiler does not negatively affect breast yield, thigh yield, hot and cold carcass yield.
Tenebrio molitor and *Hermetia illucens* live larvae can be use as environmental and nutritional enrichment in the diets of broiler chicken since they have not negative effects on growth performance, carcass yield and gut health.
Further assessments on microbiota, fecal corticosterone and animal behaviour are under investigation.
Acknowledgments: Research supported by EIT FOOD 2019 (ID: 19122) “FROM WASTE TO FARM: insect larvae as tool for welfare improvement in poultry”

Phenology and host-plant association of spittlebugs (Hemiptera: Aphrophoridae) in Mediterranean olive groves

N. Bodino[1], V. Cavalieri[2], C. Dongiovanni[3], E. Plazio[1], M.A. Saladini[4], S. Volani[5], A. Simonetto[5], G. Fumarola[3], M. Di Carolo[3], F. Porcelli[6], G. Gilioli[5], D. Bosco[1,4]

[1] CNR - Istituto per la Protezione Sostenibile delle Piante, sede Torino, Italy
[2] CNR - Istituto per la Protezione Sostenibile delle Piante, SS Bari, Italy
[3] CRSFA - Centro di Ricerca, Sperimentazione e Formazione in Agricoltura Basile Caramia, Italy
[4] Università degli Studi di Torino - Dipartimento di Scienze Agrarie, Forestali e Alimentari, Italy
[5] Università degli Studi di Brescia - Dipartimento di Medicina Molecolare e Traslazionale, Italy
[6] Università degli Studi di Bari Aldo Moro - Dipartimento di Scienze Agro-Ambientali e Territoriali, Italy

Spittlebugs are the key vectors of the bacterium *Xylella fastidiosa* in Europe, the causal agent of olive dieback epidemic in Apulia, Italy. Phenology and ecology of different spittlebug species were investigated during field surveys in 2016–2018 in four olive orchards of Apulia and Liguria regions of Italy. Nymphal population in the herbaceous cover was estimated using quadrat samplings. Adults were collected by sweeping net on three different vegetational components: herbaceous cover, olive canopy and wild woody plants. Three species of spittlebugs were collected: *Philaenus spumarius*, *Neophilaenus campestris* and *Aphrophora alni*. *Philaenus spumarius* was the predominant species both in Apulia and Liguria olive groves. The nymphal population peaks of *P. spumarius* varied from 13 to 30 individuals/m^2 in Liguria, and from 5 to 19 individuals/m^2 in Apulia. Nymphs developed in Liguria between early March and end of May, and in Apulia between the end of February and mid-May. In physiological time, the peak of abundance of *P. spumarius* nymphs was between 150- and 210-degree day (DD) in Liguria, while in Apulia was between 100 and 270 DD. Nymphal stages are highly polyphagous, although they show a strong host-preference for herbaceous plants of the Asteraceae and Fabaceae families. Nymphs of *Aphrophora alni* show a similar host-preference, while those of *N. campestris* were strongly associated with Poaceae. Knowledge on phenological and ecological traits of spittlebugs may permit to design effective control strategies against *X. fastidiosa* vectors in olive groves.

High mountain plant-pollinator interactions: a little known but critical component of fragile ecosystems - The case of the endangered alpine plant *Androsace brevis*

M. Bonelli[1], E. Eustacchio[1], A. Minici[1], A. Melotto[2], E. Dinatale[1], M. Gobbi[3], L. Gianfranceschi[1], M. Casartelli[1], M. Caccianiga[1]

[1] *University of Milan – Department of Biosciences, Italy*
[2] *University of Milan – Department of Environmental Science and Policy, Italy*
[3] *MUSE-Science Museum of Trento – Section of Invertebrate Zoology and Hydrobiology, Italy*

Climate change is a key threat to biodiversity. It is expected to have strong effects on mountain ecosystems, affecting biodiversity at all levels and leading to modifications of the web of interactions. Phenological and altitudinal shifts in flowering species and arthropods could cause mismatches between plant and pollinator populations that can lead to the extinction of both. Notwithstanding its relevance, little is known about high altitude plant-pollinator interactions.
Androsace brevis (Hegetschw.) Ces. (Primulaceae) is a narrow endemic plant flowering immediately after snowmelt. Climate warming represents a serious menace to this species, since the upward shift of its range is almost impossible, due to its occurrence on mountain peaks and ridges. Moreover, an anticipation of its already very early and short flowering period could cause mismatches with pollinators.
We investigated the reproductive biology of *Androsace brevis* and the role of arthropods as pollinators through a multidisciplinary approach involving pollinator exclusion experiments, identification of flower-visiting species and analysis of their behaviour through in-field video recording sessions, and quali-quantitative palynological analyses. Moreover, we conducted preliminary studies to estimate the variability and genetic structure of *A. brevis* populations to assess the relative importance of cross- and self-pollination.
We demonstrated the entomophily of the species and we assessed the ecological and taxonomic diversity of taxa spectrum active on its flowers.
A. brevis represents a very early trophic resource for nectar- and pollen-feeding insects and the identified interactions can be regarded as a model for high-altitude taxa threatened by climate change, giving new insights on plant-pollinator interactions in high-mountain environment.

Hermetia illucens reared on municipal organic waste: a successful outcome for feed production

S. Bortolini[1], M.R. Alam[1], G. Ferrentino[1], M.M. Scampicchio[1], M. Gauly[1], M. Palmitano[2], S. Angeli[1]

[1] *Free University of Bolzano – Faculty of Science and Technology, Italy*
[2] *EcoCenter S.p.A., Italy*

Black soldier fly larvae (BSFL) represent a new tool to convert organic waste into high quality proteins and fats, due to their high-efficient conversion rate and their nutritional properties. BSFL can ingest animal and vegetable wastes, producing protein-rich biomass. Currently, the process performance is variable and studies are needed to understand the decomposition on complex matrices.

The aim of this work was to evaluate the growth parameters of BSFL on the organic fraction of municipal solid waste (OFMSW) of Bolzano (South Tyrol, Italy), at two different temperatures (27 and 31°C). "Gainesville housefly" diet was used as control, to compare larval growth performance. Six hundred 4-days-old larvae were reared on 1 Kg of substrate. Six replicates for each treatment were set up. Larval and prepupal weights were measured three times per week. ANOVA and Tukey test were used for statistics.

On OFMSW, maximum average weight of larvae was registered after 11 days (173±24 mg at 27°C, and 169±25 mg at 31°C), and maximum average weight of prepupae was registered after 14 days (128±20 mg at 27°C, and 141±17 mg at 31°C). OFMSW influenced positively these parameters (p= 0,006 and p= 0,002). The survival rate was 75.92% and 57.43%, respectively. The average waste reduction was 57.05±0.78% at 27°C, and 61.25±2.69% at 31°C.

On these data, large-scale OFMSW treatment of the entire province might be implemented, creating at the same time BSFL meal as protein constituent of a high-value chicken feed.

The project PROINSECT is funded by "European Regional Development Fund (ERDF) 2014-2020".

The struggle of phytoplasmas for transmission by insect vectors: interactive *versus* independent transmission

D. Bosco

University of Torino – Department of Agricultural, Forest and Food Sciences, Italy

Leafhoppers, planthoppers and psyllids are vectors of phytoplasmas, wall-less bacteria that colonize plant phloem of many wild and cultivated species, thus causing heavy damages to crops. Phytoplasmas are transmitted according to a persistent propagative modality and the specificity of the vector-pathogen association is regulated by different factors, such as feeding behavior, host-plant preference, adhesion to and recognition by midgut and salivary gland epithelia, permissivity to phytoplasma multiplication. Vectors can acquire more than one phytoplasma strain by feeding on plants with multiple infections or sequentially on plants infected by different strains. The competition of different phytoplasma species (Aster Yellows, AY, *vs* Flavescence dorée, FD) and of strains within the same species (FD-C *vs* FD-D), was studied in individual vectors by controlled acquisition/transmission experiments and molecular typing of phytoplasmas in field-collected leafhoppers. The results suggest that competition leads to interactive, rather than independent, transmission, and shed light on the epidemiology of phytoplasma-associated diseases.

Cryptic diversity and biological control of weeds: the case of *Psylliodes chalcomera* (Coleoptera: Chrysomelidae)

M. Brunetti[1], A. De Biase[2], L. Smith[3], S. Belvedere[2], S. Primerano[2], G. Antonini[2], A. La Marca[4], P. Audisio[2], M. Biondi[5], M. Cristofaro[6]

[1] *University of Milan – Department of Agricultural and Environmental Sciences, Italy*
[2] *Sapienza Rome University – Department of Biology and Biotechnology ''Charles Darwin'', Italy*
[3] *USDA-ARS, Albany, CA, USA*
[4] *BBCA-onlus, Rome, Italy*
[5] *University of L'Aquila - Department of Health, Life, and Environmental Sciences, Italy*
[6] *ENEA C.R. Casaccia SSPT-BIOAG-PROBIO, Italy*

The flea beetle, *Psylliodes chalcomera* (Coleoptera: Chrysomelidae), was previously permitted as a biological control agent of *Carduus nutans* (musk thistle) in the USA. During exploration for prospective biological control agents of *Centaurea solstitialis* (yellow starthistle), we observed individuals of *P. chalcomera* attacking this plant as well as species in the genus *Onopordum* (cotton thistle). Those observations raised the question whether this beetle is polyphagous, or whether it is comprised of biotypes, host races or cryptic species that are specialized on different host plants. We analyzed a fragment of the *cox1* mitochondrial gene of adult and larval specimens collected from these plant species in Bulgaria, Italy, Russia and Turkey to study the population structure and investigate the divergence among populations feeding on different plants. The results indicate that at least three different groups are present: 1) associated with *C. solstitialis* in Bulgaria, Russia and Turkey, 2) associated with *Onopordum* spp. in Bulgaria, Russia and Turkey, and 3) associated with *Carduus* spp., *Onopordum* spp., and possibly *C. solstitialis*, in Bulgaria, Italy, Russia and Turkey. Adult specimens indicated a fourth group associated with *Onopordum* spp. and *C. solstitialis* in Turkey, but we did not have any larval specimens to confirm the host plant of this group. Our results suggest that at least three of these groups could represent incipient species and could be interesting to evaluate as prospective candidates for classical biological control.

The adult *Hermetia illucens* (Diptera: Stratiomyidae) is endowed with a functional digestive system

D. Bruno[1], M. Bonelli[2], M. Casartelli[2], G. Tettamanti[1]

[1] *University of Insubria - Department of Biotechnology and Life Sciences, Varese, Italy*
[2] *University of Milano - Department of Biosciences, Milano, Italy*

The larvae of black soldier fly (BSF), *Hermetia illucens*, emerge as a relevant resource of protein since they can convert low-quality biomass into nutritionally valuable proteins. Despite the great interest on the use of these larvae by the emerging industrial sector of edible insects, information on the biology of this insect is still scarce. In particular, no information on the structural and functional properties of the digestive system of the adult BSF is available and only few data about the feeding habits of the fly are present in the literature.
In the present work, we investigated the remodeling process that occurs in *H. illucens* larval midgut during metamorphosis. In addition, we analyzed the morphology and function of the adult midgut, and evaluated the feeding habits of the fly.
Our results demonstrate that the larval midgut epithelium of *H. illucens* is removed during metamorphosis and a new pupal-adult epithelium is formed by proliferation and differentiation of intestinal stem cells. During this process, a mobilization of long-term storage molecules, i.e., glycogen and lipids, occurs. Moreover, in contrast to what many literature records have reported so far, our data indicate that the adult insect has a functional digestive system, and that food administration affects the longevity of the fly.
This new scenario not only opens up the possibility to manipulate the feeding substrate of the fly to improve its performances in mass rearing procedures, but could also provide insights into the safety of using this insect for feed production.

Tenebrio molitor larvae meal in rainbow trout diets: growth performance and diets digestibility

C. Caimi[1], I. Biasato[1], G. Chemello[1], A. Schiavone[2,3], M. Meneguz[1], S. Dabbou[2], M. Renna[2], F. Gai[3], L. Gasco[1]

[1] *Department of Agricultural, Forest and Food Sciences, University of Turin, Grugliasco (TO), Italy*
[2] *Department of Veterinary Science, University of Turin, Grugliasco (TO), Italy*
[3] *Institute of Science of Food Production, National Research Council, Grugliasco (TO), Italy*

The aim of this study was to evaluate the substitution of fishmeal with a *Tenebrio molitor* larvae meal (TM) in rainbow trout diets. 252 fish were randomly divided into 12 fiberglass tanks (3 replicates/diet). Four experimental diets were formulated to be isonitrogenous and isoenergetic: TM0 (without TM), and TM25, TM50 and TM100 with TM in substitution of fishmeal. At the end of the trial (154 days), the following performance indexes were calculated: survival, individual weight gain, specific growth rate, feed conversion ratio, and protein efficiency ratio. Fish length and weight was measured to calculate the Fulton's condition factor (K). The fish were dissected to determine the carcass yield (CY), hepatosomatic index (HSI), viscerosomatic index (VSI), and the coefficient of fatness (CF). A digestibility trial was also contemporarily performed to determine the apparent digestibility coefficients (ADC) of the diets. 180 fish were divided into 12 cylindroconical tanks (3 replicates/diet). Fish were fed twice a day with the same diets used in the growth trial. The faeces were collected daily using a Choubert' system, freeze dried and frozen (-20°C) until analysed. All data were statistically analysed by IBMSPSS Statistics V20.0.0 software ($p < .05$). No differences between treatments were observed for the performance indexes. No differences were highlighted for K, CY, VSI, and CF, but HSI resulted higher in the fish fed TM20 compared to those fed TM0. All the ADC values results higher than 93%. Differences were recorded for all the ADC parameters ($p < .05$). TM5 diet showed the highest values.

Chemical ecology of *Dasineura oleae*: searching for the sexual pheromone

A. Caselli[1], S. Angeli[2], R. Favaro[2], R. Petacchi[1]

[1] *Scuola Superiore Sant'Anna - Institute of Life Sciences, Italy*
[2] *Free University of Bozen-Bolzano - Faculty of Science and Technology, Italy*

The use of techniques that can manipulate insect behavior in agricultural systems is getting a foothold, since several countries worldwide have imposed strict regulations about the use of chemicals, promoting eco-friendly control methods. Pheromones are largely employed for pest monitoring, mass trapping and disturbing pest behavior. They have an important role in determining the proper timing for insecticide use, avoiding excess of chemical applications. In the olive grove, pest control measures have mostly relied on chemical insecticides, potentially dangerous not only for human and environmental health, but also for the development of resistance. In this agroecosystem, the use of pheromones is restricted just to, *Bactrocera oleae* and *Prays oleae*. However, recently, several Mediterranean countries recorded alarming outbreaks of another insect pest of olive trees, *Dasineura oleae*. Therefore, we started some investigations about the biology of *D. oleae* and the characterization of potential pheromones. During 2019 we collected several individuals of *D. oleae* from the field and we performed GC-MS analysis of whole-body extracts in dichromethane, separating males and females. Chromatographic results revealed clear differences between males and females. We found one compound with a ketone structure only released by females, which may function as a sex pheromone. Our findings agree with previous studies in other species reporting that female midges release volatile compounds with ketone functional groups as components of their sexual pheromone. However, further investigations are needed in order to understand the perception and the ecological role of this compound as well as the potential use in pest control.

Mediterranean and Antarctic Pyconogonida

E. Colasanto, L. Galli

University of Genoa - Dipartimento di Scienze della Terra, dell'Ambiente e della Vita - Genoa - Italy

The Pycnogonida is a poorly known class of marine arthropods which can be included in entomology's studies (in the broad sense). My research project is aimed in increasing knowledges about Mediterranean and Antarctic Pycnogonida.
There are 56 species known in the Mediterranean Sea, while in the Italian seas 45 species are recorded. Generally, there are few information about Pycnogonid fauna of Italian waters: the most specific studies on this theme were all focused on South-Central and Southern Italy and other data come from sporadic collections from 1940 to 2000. In addition, an annual study has been conducted by our research team to deepen knowledges about biodiversity of this taxonomical group in the Ligurian Sea, especially near Portofino.
Some data on specimens collected in this area (mainly in the Portofino shallow waters and on a *Posidonia oceanica* prairie near Santa Margherita Ligure) and in Tyrrhenian Sea (especially near Torrevaldaliga, Civitavecchia, RM) are reported. Moreover, they allowed us to record the presence of a species not still known in the Mediterranean fauna: *Endeis biseriata* Stock, 1968.
Other research lines concern the analysis of specimens stored in Museo Nazionale dell'Antartide (MNA) in Genoa, Italy: this work will focus on the morphological and genetic features of such specimens and on their identification (when possible) to the species level.

Responses from olfactory sensilla of *Sitophilus zeamais* to Andean essential oils

P. Farina[1], S. Bedini[1], R. Romani[2], B. Conti[1]

[1] *University of Pisa - Department of Agriculture, Food and Environment, Italy*
[2] *University of Perugia - Department of Agricultural, Food and Environmental Sciences, Italy*

Lamiaceae species are well-known in traditional medicine. In the last years, Essential Oils (EOs) of many Lamiaceae have showed to be excellent repellents and/or insecticides. Tropical Andes are extremely rich in endemic flora, possible source of new bioactive substances. Here, we verified the insect repellent activity of the EOs extracted from *Clinopodium tomentosum* and *C. nubigenum*, two Lamiaceae typical of the Ecuadorian Andes. The two EOs were tested against the maize weevil *Sitophilus zeamais* (Motschulsky) (Coleoptera: Curculionidae), one of the most destructive pests of stored and processed cereals. To characterize the olfactory sensilla of *S. zeamais*, its antennal structure was investigated by scanning and transmission electron microscopy. The electrophysiological and behavioural responses of the insect to the EOs were then investigated by electroantennography and olfactometer trials. The morphological study revealed the presence of three types of sensilla (Basiconic Sensillum 1, 2, and Grooved Peg Sensillum), that could be involved in the perception of the EOs volatile compounds. Accordingly, the electroantennography showed a positive dose-dependent response of the insect antennae to both the EOs. The behavioural tests displayed a significative repellence of the EOs, starting from 8.4 µL L^{-1} air, and that the efficacy and readiness of the response to the stimulus was higher for *C. tomentosum*. In conclusion, both the EOs are detected by the insect by its antennae and exert a strong repellent effect. The results confirm that Andean flora represents a valuable source of unexploited bioactive substances that can be utilized as promising tools for foodstuff pests' control.

Molecular characterization and pharmacological profile of type 1 tyramine receptor (TAR1) of the phytophagous insect *Halyomorpha halys*

L. Finetti[1], S. Civolani[2], M. De Bastiani[1], G. Calò[3], C. Scapoli[1], G. Bernacchia[1]

[1]*University of Ferrara - Department of Life Sciences and Biotechnology, Ferrara, Italy*
[2] *InnovaRicerca s.r.l. Monestirolo, Italy*
[3]*University of Ferrara - Department of Medical Sciences, Section of Pharmacology, Ferrara, Italy*

Halyomorpha halys (Heteroptera: Pentatomidae) is native to Asia and was recently introduced into Europe and the United States. This invasive insect has rapidly become one of the major agriculture pests, being able to attack over 100 different plant species. Furthermore, its control has proven difficult by chemical methods as well as containment strategies. Unfortunately, studies on *H. halys* are still limited and, for this reason, its physiology and behavior are less known.
Octopamine (OA) and tyramine (TA) are biogenic amines that regulate numerous physiological processes in insects. They exert their effects by binding to specific receptors that belong to the superfamily of G-Protein Coupled Receptors (GPCRs).
Here we report the cloning and the characterization of *Halyomorpha halys* type 1 tyramine receptor (HhTAR1). The cDNA is 1.35kb long and codes for a 448 amino acid polypeptide featuring seven transmembrane domains, as expected for a GPCR. HhTAR1 deduced sequence was compared to the amino acid sequence of OA/TA receptors from other insects and analysed by phylogenetic techniques.
CHO cell line stably expressing HhTAR1 was tested for responsiveness to the natural agonists TA, OA and to the antagonist yohimbine by calcium mobilization assays.
Furthermore, the expression level of the receptor was studied by qRT-PCR analysis in different organs of adult *Halyomorpha halys* male and female (antennae, brain, midgut, females and males reproductive organs) and in different development stages.
HhTAR1 represents the first TA receptor characterized in *Halyomorpha haly*s and its study will help understand the role of TA in the physiology and behaviour of this dangerous pest.

The Proturologist's hard work

L. Galli

Genoa University - Department of Earth, Environment and Life Sciences (DISTAV) – Genoa, Italy

Protura is a small Class of entognathous hexapods described in 1907 by the Italian entomologist Filippo Silvestri. Even though the greatest progress in proturan research since then has been made in the field of taxonomy, "the road of taxonomy was bumpy and the proturans proved to be awkward travel companions" (Pass & Szucsich, 2011). Species identification is rather difficult and all over the world there are currently no more than ten scientists that are able to identify specimens at the species level. Morphological and morphometric characters traditionally used in Protura systematics (e.g. chaetotaxy, porotaxy, shape and size of foretarsal sensilla) are difficult to be checked, and not always unambiguous. Moreover, the contribution from genetic analysis (e.g. DNA barcoding) suffers from a delay of some years compared to other taxa, due to methodological problems and to the general lack of interest in this group.

An integrative approach on plant manipulating Lepidoptera: from leaf-miners to gall-inducers

D. Giron

Insect Biology Research Institute (IRBI) – National Center for Scientific Research - University of Tours, France

Gall-inducing insects are iconic examples in the manipulation and reprogramming of plant development, inducing spectacular morphological and physiological changes of host-plant tissues within which the insect feeds and grows. Despite decades of research, basic mechanisms of gall formation remain unknown. Recent research suggests that some aspects of the plant manipulation shown by gall-inducers may be shared with other insect herbivorous life histories. The ability of leaf-mining insects to manipulate their host plant physiology ask whether leaf-miners can also be considered to be plant reprogrammers. Understanding the evolution and adaptive significance of plant manipulation needs to contrast feeding strategies of different species in an evolutionary framework. It also needs to understand how insects manipulate the physiology and the anatomy of their host-plant. We focused our study on Gracillariidae (Lepidoptera), the majority of which are leaf miners. This family contains around 2000 species but includes only few galligenous species. We conducted an integrative approach on various plant manipulators to shed light on the origin of gall induction by insects and help to understand the mechanisms of gall morphogenesis. We demonstrate the existence of mix-strategies between leaf-mining and gall-inducing highlighting evolutionary convergences.

Survival and transmission of pathogens in industrially reared insects at Lab4Food

E. Gorrens, J. De Smet, L. Van Campenhout

KU Leuven – Department of Microbial and Molecular Systems – Lab4Food – Geel Campus – Belgium

During rearing of insects, the presence of food pathogens, such as *Salmonella* sp., must be avoided. Little is known about the survival and transmission of pathogens during rearing. Therefore, we present already performed and future work at Lab4Food on microbiological challenge testing. Transmission of a mixture of three *Salmonella enterica* strains has been monitored on mealworms (*Tenebrio molitor*) fed with contaminated wheat bran. Three inoculation levels were studied, being 7, 4, and 2 log cfu/g. *Salmonella* sp. remained present for at least seven days in the wheat bran without larvae, indicating that it could survive in the substrate during storage. However, the survival rate of *Salmonella* sp. was influenced on the one hand by the presence of the larvae and on the other hand by the contamination level. At a contamination level of 2 log cfu/g, the pathogen was not found in the larvae, but remained present in some wheat bran samples. Competitive exclusion and/or the production of antibacterial compounds might explain the reduction. Similar experiments are currently performed on the black soldier fly larvae (*Hermetia illucens*). In these tests, the *Salmonella* strains needed an additional selection marker in order to selectively count *Salmonella* on the medium used. An antibiotic resistance and fluorescent gene were introduced. In the future, different pathogens, such as *Salmonella*, *Campylobacter jejuni*, *Listeria monocytogenes*, *Bacillus cereus*, will be challenged in the presence of black soldier fly, housefly, crickets and grasshoppers in the context of the Horizon 2020 project SUSINCHAIN.

New promising control perspectives against Italian Tephritids

G. Jesu[1], S. Laudonia[1], S.G. Germinara[2], G. Bonanomi[1], F. Vinale[3,4]

[1] University of Naples "Federico II" – Department of Agriculture, Italy
[2] University of Foggia – Department of the Sciences of Agriculture, Food and Environment, Italy
[3] CNR – Institute for Sustainable Plant Protection (IPSP), Italy
[4] University of Naples "Federico II" – Department of Veterinary Medicine and Animal Productions, Italy

The fruit flies (Diptera: Tephritidae) are among the most destructive agricultural pests in the world. In this study, field experiments have been carried out in order to evaluate the activity of natural compounds (previously selected with olfactometry assays) towards *Bactrocera oleae* (Rossi), the olive fruit fly. In particular, repulsive efficacy against *B. oleae* of isopropyl-myristate and plant-derived smoke waters have been assessed in different pedoclimatic conditions, in South and Central Italy. The effectiveness of treatments has been measured considering the level of drupe infestation and adults' catches in chemio-chromotropic traps, using agricultural kaolin clay as positive control. Isopropyl-myristate showed highest activity compared with control and other treatments. The attractiveness of pheromones to the thistle fly *Terellia fuscicornis* (Loew) has also been tested. For this purpose, extracted male pheromones have been tested using sticky traps, randomly disposed in a thistles field. Traps of 2 different colours have been used due to their strong and poor attractiveness (purple and white respectively) and data have been collected by counting catches for both sexes. The pheromone was found to be attractive with a significant difference between the sexes. The results obtained encourage further studies for both species in order to find new promising IPM strategies against Italian Tephritids.

NMR Biomarkers of Cold Stress Resistance in Honey Bees

S. Lee

Czech University of Life Sciences Prauge-Department of Food Science, Czech Republic

Honey bees fall into a comatose state in the ambient temperature ranges of 9 to 12°C with cold death occuring at -2 to -6°C. This study placed honey bees (*Apis mellifera*) into low temperature (7.6°C), and observed honey bees falling into a comatose state. We found that approximately the half of the honey bees fell into a chill coma, and the others did not fall into a comatose state but remaining alert. To determine the metabolic differences between honey bee group which fell into a comatose state and the honey bee group which did not fall into a comatose state, the present study used ^{1}H NMR (Nuclear Magnetic Resonance) spectroscopy to measure the metabolomic responses. This study detected 11 of significant metabolic features: AMP, acetate, carnitine, glutamine, methylguanidine, NAD+, o-phosphocholine, phenylalanine, putrescine, trehalose, and β-alanine. Trehalose, as well as amino acids were higher in both honey bees groups. However, all of the significant compounds in the non-coma honey bee group (except for phenylalaine) was 1.2 times to 2.4 times higher than in the honey bee group which fell into a comatose state. The highest compound was dissacharide, trehalose which is known as a blood sugar compound in insects, and is also an important cryoprotectant for insects. Amino acids, alanin and proline were not shown significant defferences between two groups. However, glutamine concentrations were significant in the non-coma honey bees group as well as carnitine which is crucial for fatty acid oxdiation.

Testing factors affecting molecular species delimitation accuracy on the species-rich beetle family of Chrysomelidae

G. Magoga[1], M. Brunetti[1], D. Fontaneto[2], M. Montagna[1]

[1] *Università degli studi di Milano – DISAA, Italy*
[2] *Consiglio Nazionale delle Ricerche–Istituto per lo Studio degli Ecosistemi, Verbania, Italy*

In the last decade, many molecular species delimitation methods have been proposed. Using these methods, it is possible to infer hypothetic species from DNA information without a priori knowledge about organisms morphology. The accuracy of these methods has been already demonstrated, but the impact of factors inherent to study design and to analysed species biology on species delimitation is not clearly defined. In order to test which factors affect the molecular species delimitation accuracy, 7,237 Cytochrome c oxidase subunit I sequences of 552 Chrysomelidae species were analysed using four commonly adopted species delimitation approaches: two coalescent tree-based methods Generalized Mixed Yule Coalescent method and Multi-rate Poisson tree processes, and two nucleotide distance-based methods Automatic Barcoding Gap Discover and 3% nucleotide distance threshold. Factors possibly affecting species delimitation accuracy (i.e. number of haplotypes per species, number of morphological species, presence within datasets of species difficult to be morphologically identified, geographical distance among sampling points, delimitation method used and taxonomic composition of datasets) were tested fitting a linear mixed model analysis. The accuracy was defined as the percentage of matches between morphological species and molecular identified units. Our results indicate that distance-based methods are more accurate in the delimitation than tree based, while the taxonomic composition of the dataset has no influence on delimitation performance. High geographic distance among collection points of individuals from the same species is related to better performances of the methods. Finally, the presence of species highly difficult to be identified morphologically strongly decreases molecular delimitation accuracy.

Light-traps in shipping containers: a new frontier for the early-detection of alien pests

M. Marchioro, A. Battisti, M. Faccoli

University of Padua - Department of Agronomy, Food, Natural Resources, Animals and Environment (DAFNAE), Italy

Insects represent one of the most successful groups of invasive species, and the number of new introductions is increasing in the last decades. Insect invasions are affected mainly by the increase of international trade, as most of them are travelling across the world within shipping containers. The aim of this study is to test the effectiveness of sticky light traps for the interception of alien pests occurring inside the containers during shipment. We tested if light traps have a valuable broad-spectrum attraction and if the trapping performance differs between empty or full containers. Trapping tests were carried out on *Cadra cautella* (Lepidoptera), *Drosophila melanogaster* (Diptera), *Sithophilus zeamais* and *Ips typographus* (Coleoptera) released (50 individuals per replicate) within a standard shipping container where standard traps (TransTrap™) were deployed in empty and full conditions. The light of the trap could be on (activated trap) or off (control trap). In the empty container, activated traps captured more insects than the control for Diptera and Lepidoptera, while Coleoptera were caught only in a low number in activated traps. Light traps captured more *C. cautella* and *D. melanogaster* than the control, with no differences between empty and full conditions. In conclusion, results show that this trap model is effective mainly against Lepidoptera and Diptera, while it does not work for Coleoptera. Moreover, traps are effective also in loaded containers, making them a good tool for intercepting Lepidoptera and Diptera travelling with the shipments. The reasons why they are not effective against Coleoptera are discussed.

The fossil deposit of Monte San Giorgio (Switzerland-Italy) and its impact on insect evolution

M. Montagna[1], G. Magoga[1], A. Tintori[2]

[1] *Università degli Studi di Milano - Dipartimento di Scienze Agrarie e Ambientali, Italy*
[2] *Università degli Studi di Milano - Dipartimento di Scienze della Terra "Ardito Desio", Italy*

Insects, the most diverse animal group on Earth, have evolved an extraordinary range of traits, from flight to complete metamorphosis and advanced eusociality. Understanding the timeframe for their evolution is of considerable interest. Although the fossil record of insects is extensive, data are scarce for a number of key periods. One such period is that following the Permian-Triassic mass extinction event – recognized as the most catastrophic of all major extinction events. Insects are thought to be not excluded by this extinction event. We have recently discovered a remarkable collection of 240 million-year-old insect fossils from the Monte San Giorgio Lagerstätte (Switzerland-Italy). These fossils, in addition of having uniquely preserved soft tissues and internal organs, backdate the origin of several insect lineages by up to 200 million years (e.g. Archaeognatha: Machilidae and Hemiptera: Tingidae). Phylogenomic and molecular clock analyses were performed using eight key fossils from Monte San Giorgio as calibration points, plus 34 insect fossils previously identified as suitable for such analyses. Our date estimates for several major lineages, including the hyperdiverse crown groups of Lepidoptera, Hemiptera: Heteroptera and Diptera, are substantially older than their currently accepted post-Permian origin. Our results indicate that major evolutionary innovations, including flight and metamorphosis, appeared significantly earlier than previously thought, and that the bulk of extant insect lineages survived through the Permian-Triassic mass extinction event. These results have numerous implications for understanding the evolution of insects and their resilience in the face of extreme events such as the End-Permian extinction.

Evaluation of *Cydia pomonella* (Lepidoptera: Tortricidae) management with mass trapping using kairomonal lures

M. Preti[1], A. L. Knight[2], E. Basoalto[3], M.V. Mujica[4], S. Angeli[1]

[1] *Faculty of Science and Technology, Free University of Bozen-Bolzano, Bolzano, Italy*
[2] *Instar Biologicals, Yakima, Washington, USA*
[3] *Universidad Austral de Chile, Valdivia, Chile*
[4] *Instituto Nacional de Investigación Agropecuaria (INIA) Montevideo, Uruguay*

In organic farming and in sustainable insect pest management there is a need to improve eco-friendly approaches of pest control, such as Mating Disruption (MD). The codling moth, *Cydia pomonella* (Lepidoptera: Tortricidae), is one of the key pest in pome fruit orchards. In case the insect populations overcome a certain density the use of organic insecticides and MD alone are not able to control this pest, resulting in important fruit damages. This study evaluates a complementary approach: the reduction of *C. pomonella* populations through Mass Trapping (MT) in several organic pome fruit orchards located in USA. In each orchard, a minimum surface of 0.5-1 ha was treated with MT in addition to the local farmer's practices and these plots were compared with similar plots without MT. To perform MT, bucket traps filled with mineral oil and baited with kairomonal lures (Megalure 4K®, Trécé Inc., USA) were used, adopting a certain trap density per surface (*e.g.,* 48 traps/ha). Insect removal was evaluated counting the caught per trap, while the level of fruit injury was assessed by visual observation of the fruits. The adults caught were sexed and the females dissected to verify the mating status. Due to the high cost of commercial bucket traps and considering the total amount required in a MT approach, we also compared the efficacy in trapping of commercial traps with less expensive devices such as 'milk jugs'. The results highlight the good performance of MT as management tool creating the basis for its massive adoption.

Effects of arbuscular mycorrizhal symbiosis on the performance of *Spodoptera exigua* on maize in relation to the availability of plant Nitrogen

B. Ramírez Serrano[1], M. Pozo[2], G. Dubreuil[1], D. Giron[1]

[1] *Institut de Recherche sur la Biologie de l'Insecte (IRBI), UMR 7261 CNRS/Université de Tours, Tours, France*
[2] *Department of Soil Microbiology and Symbiotic Systems, Estación Experimental del Zaidín – Consejo Superior de Investigaciones Científicas (CSIC), Granada, Spain*

Nitrogen (N) is a critical chemical element in tritrophic interactions. N is utilized by the plants for growth and the synthesis of defensive compounds. Plants supplemented with N generally show higher biomass and greater total protein content. Arbuscular mycorrhizal fungi (AMF) are soilborne microorganisms that establish symbiotic associations with plants roots. AMF influence the plant N uptake and consequently, the plant N status can be improved. N is also an essential nutrient for insects affecting their growth and survival. Phytophagous insect that feed on host plant high in N typically have greater growth rates and shorter developmental times. Insects, like plants, establish mutualistic relationships with symbionts that improve the efficiency of conversion of ingested food and assist in the detoxification of harmful compounds. In this study, we investigate the effects of AMF colonisation on *Spodoptera exigua* larval performance and the consequences of this symbiosis on the gut microbiota of insects feeding on maize (*Zea Mais*) plants treated with two different levels of N. We hypothesize that AMF colonisation influences the performance of *S. exigua* due to alteration of the larvae endosymbionts.

This project has received funding from the European Union's Horizon 2020 research and Innovation programme under grant agreement No 765290.

Megatominae larvae (Dermestidae) with major focus on evolution, morphology and ecological function of Hastisetae

E. Ruzzier

Università degli Studi di Padova - Department of Agronomy, Food, Natural Resources, Animals and the Environment (DAFNAE), Italy

"Hastisetae are a specific group of detachable setae characterizing Megatominae larvae (Coleoptera: Dermestidae). These setae, located on both thoracic and abdominal tergites, apparently evolved as primary defense of the larva against invertebrate predators. According to the limited observations available these setae act as mechanical obstacle, entangling cuticular structures (spines and hairs) and body appendages (antennae, legs and mouthparts) of the predator; it has been observed however that this kind of hairs may affect vertebrates as well. Although information on the impacts of vertebrate predators of the beetles is lacking, hastisetae have been shown to be a threat for human health as contaminant of stored products (food and fabric), work and living environment. This presentation wants to offer a short review of the present knowledge on Megatominae larvae, highlighting in particular the link between the evolution of hastisetae, larval biology and biological success of the Megatominae. Furthermore, will be presented and discussed future research perspectives intended to fill the existing knowledge gaps."

Integrative approach to the study of functional morphology and parasitic strategies of myrmecophilous hoverflies

G. Scarparo[1,2], P. d'Ettorre[3], Q. S. McFrederick[4], P. Rugman-Jones[4], M. Gebiola[4], R. Wolton[5], A. Di Giulio[1,2]

[1] University Roma Tre - Department of Science, Rome, Italy
[2] University Roma Tre - Laboratorio Interdipartimentale di Microscopia Elettronica (LIME), Rome, Italy
[3] Université Paris 13 - Laboratoire d'Ethologie Expérimentale et Comparée, Sorbonne Paris Cité, Villetaneuse, France
[4] University of California - Department of Entomology, Riverside, USA
[5] Locks Park Farm, Hatherleigh, Okehampton, Devon, England

Hoverflies (Diptera, Syrphidae) of the social parasitic *Microdon* genus exhibit slug-like larvae that live in ant nests where they feed on ant brood. To improve the knowledge about the scarcely known *Microdon* species, we analysed the morphology and anatomy of the European species, integrating optical microscopy with focused ion beam-scanning electron microscopy. Additionally, in order to discover which chemical strategy these parasites have evolved, the cuticular hydrocarbons of *Microdon* larvae and their host ants were analysed with gas chromatography-mass spectrometry. Finally using high throughput 16S rRNA gene amplicon sequencing, we provide the first microbiome survey of *Microdon* larvae and its ant host. *Microdon* larvae demonstrated to use a mixture of strategies to survive inside the host nests. The chemical mimicry ensures them to be recognized as nestmates rather than intruders. However, since this mimicry could be potentially unmasked provoking aggressive behaviours of workers toward the parasites, the peculiar dome-shaped morphology, with thick cuticle and no appendages could protect the hoverfly larvae to bites and attacks. It is possible that *Microdon* larvae, thanks to its symbiosis with some bacteria, as for example *Serratia*, could mimic host pheromones to communicate with the ants and, together with chemical mimicry due to biosynthesis of cuticular hydrocarbons remain undetected within the ant colony. The study of these social parasites by integrating different techniques could help to clarify the evolution of this successful parasitic strategy, as well as their uncertain taxonomy and to better understand their still partially obscure life cycle.

Towards the development of new methods for the rational control and management of *Popillia japonica*

G. Sperandio[1,2], A. Battisti[3], N. Mori[3], G. Santoiemma[3], B. Cavagna[4], M. Ciampitti[5], A. Bianchi[5], A. Simonetto[1,2], G. Gilioli[1]

[1] *University of Brescia - Department of Molecular and Translational Medicine, Italy*
[2] *University of Modena and Reggio Emilia - Department of Life Sciences, Italy*
[3] *University of Padova - Department of Agronomy, Food, Natural Resources, Animals and the Environment, Italy*
[4] *Regione Lombardia - Plant Health Service, Italy*
[5] *ERSAF - Plant Health Service, Italy*

The Japanese beetle *Popillia japonica* Newman is an invasive species originated from Japan. The first outbreak in Continental Europe was reported in 2014 in Lombardy and Piedmont regions (Italy) and, from 2017, few occurrences were reported in Switzerland. The species is highly polyphagous. Larval trophic activity might cause damage to the plant's root system while adults may impact on leaves, flowers and fruits of cultivated and spontaneous plants. Since 2014, the Lombardy Region has undertaken actions aimed at monitoring and controlling the species. The GESPO Project was funded by the Lombardy Region with the aim to develop rational (cost-efficient) and sustainable (low-impacts) solutions for managing the diffusion and impacts of *P. japonica*. GESPO aims at: i) investigating the influence of environmental drivers on the species' life-history (e.g., larval survival), ii) exploring the role of land use and environmental variables in determining habitat suitability for the species, iii) developing cost-efficient protocols for monitoring purposes, iv) testing rational control protocols against larval and adult populations, v) developing models predicting the specie's phenology, potential distribution and spread and vi) developing decision support tools making available knowledge, data and models for supporting management decisions. We present preliminary results with particular emphasis on the evaluation of the potential habitat suitability and the phenology of *P. japonica* in the Lombardy Region.
Funding: The Project GESPO was funded by "Direzione Generale Agricoltura - Regione Lombardia - D.d.s. 28 marzo 2018 - n. 4403D.g.r. n. X/7353 14 novembre 2017".

Biological control of *Dasineura oleae*: identity and spatio – temporal distribution of its parasitoid complex

E. Tondini, R. Petacchi

Scuola Superiore Sant'Anna - Institute of Life Sciences, Italy

Dasineura oleae is a monophagous pest of the olive tree. Besides being generally considered as a minor pest, several outbreaks have been recorded in its native range. Since the number of reports of massive attacks of this pest is increasing all over Italy, we investigated the infestation dynamic and the parasitoid complex in one of the outbreaking areas. Furthermore, we tracked the temporal dynamic of the parasitoids in order to evaluate which stages of the pest are attacked and the presence of alternative hosts. We also investigated the factors affecting the spatial distribution of the parasitoids.
Our results showed that the infestation is rapidly increasing in a patchy manner all over the monitored area. Parasitization was detected in few sapling sites, but the presence of parasitoid was significantly correlated with a decrease of the infestation rate. We identified *Mesopolobus aspilus*, *Mesopolobus mediterraneus* (Pteromalidae), *Platygaster demades* and *Platygaster oleae* (Platygastridae) as parasitoids of *D.oleae.* Our results show that the species involved in *D.oleae* control are egg-larval parasitoids that develop one generation in spring, synchronized with the host life cycle. Our evidences suggest that *P. demades* is the main controlling agent of *D. oleae* and that this pest is the major host of *P. demades* . Results concerning the spatial distribution of the parasitoids show that both Platygastrids and Pteromalids are more abundant in the core of the olive orchards respect to the edge and that their distribution is highly variable between sampling sites.

Ground dispersing social caterpillars from opposite hemispheres and its associated urtication risks

M. Uemura[1], A. Battisti[1], M. Zalucki[2]

[1] University of Padova – Department of Agronomy, Food, Natural resources, Animals and Environment, *Italy*
[2] The University of Queensland – School of Biological Sciences, *Italy*

Larval movement plays many important ecological roles, and with the expansion of the human population and development, encounters and conflicts with pest insects have increased. Containment of these pests can become problematic especially when the species are gregarious and are a health risk to humans and animals. A species of recent interest is the processionary caterpillar, *Ochrogaster lunifer* Herrich-Schäffer (Lepidoptera, Notodontidae), an urticating species found in Australia and associated with acacias and eucalypts. Setae (detachable urticating hairs) from the abdominal segments of *O. lunifer* larvae are responsible for foetal loss in pregnant mares and is now an important Lepidoptera species for pest management. A similar species to *O. lunifer* is the European species, pine processionary moth, *Thaumetopoea pityocampa* Dennis & Schiffermüller (Lepidoptera, Notodontidae). A great deal of research has been done on this species because they are destructive defoliators of pine and cedar trees in the Mediterranean Basin and Southern Europe. Although geographically isolated, every year from March to May, *O. lunifer* and *T. pityocampa* caterpillars form processions on the ground in search for pupation sites. This pre-pupation procession behaviour and contact risks associated with *O. lunifer* and *T. pityocampa* were studied and compared in Australia and Italy, respectively. The knowledge of the larval behaviour in this phase is crucial to predict exposure risk and application of pest management strategies.

Rearing and processing insects at industrial scale: microbiological research at Lab4Food

D. Vandeweyer, M. Van Der Borght, L. Van Campenhout

KU Leuven – Department of Microbial and Molecular Systems – Lab4Food – Geel Campus, Belgium

Industrial rearing and processing of insects is increasing worldwide. Consequently, the insect sector rises research questions regarding e.g. chemical and microbiological quality of their products. This presentation will provide an overview of accomplished and ongoing research at Lab4Food regarding quality, safety and valorisation of insects, with focus on microbiological aspects. Most projects investigate insects produced in Europe, but a few consider African or Asian species. While lab-scale reared insects can be used in more fundamental experiments, most insect samples originate from large-scale industrial producers. Microbiological quality is assessed using both culture-dependent and -independent techniques including ISO-based plate counting and pathogen detection, isolation and identification, qPCR and sequencing. Research projects are typically categorised as pre- or post-harvest (or both). Pre-harvest research focusses on the rearing phase, for example to elucidate the influence of substrate or rearing practises on the microbiological quality and safety of the insects. After harvest, the impact of existing and new processing techniques and preservation strategies on the microbiological quality and safety of insects is investigated. Examples are fermentation of insects and the comparison of drying techniques (oven, freeze- and microwave). Finally, valorisation of insects in novel food products or as waste treatment are explored by Lab4Food. To support this research program, KU Leuven is currently building a 800 m^2 pilot plant for standardised rearing and processing of insects. The design of the plant as well as hygiene measures taken for working with insects, including an L2-laboratory for challenging living insects with (food) pathogens, will be explained.

Insects for Justice, Insects for History

S. Vanin

Università degli Studi di Genova - Dipartimento di Scienze della Terra dell'Ambiente e della Vita (DISTAV), Italy

Flies (Coleoptera) and beetles (Coleoptera) are the main components of the entomofauna colonizing a body after death. Following the recognition of constant and predictable colonization patterns and the knowledge about the dependence of the insect development to temperature, a new discipline, forensic entomology (FE), has provided information useful to reconstruct criminal events. In fact FE provide a strong scientific evidence to answer the investigative question "When": the time since death. In addition it provides element to demonstrate the transfer of a body from a primary to a secondary crime scene, to detect drugs and poisons when the victim's tissues normally used for toxicological analysis are not available and as well to identify the victim when the cadaver has been removed from the crime scene. This last approach of human DNA extraction from the dipteran larvae is also applied to blood feeding insects, such as fleas, bed bugs, lice and mosquitoes, to reveal the presence of a perpetrator in the crime scene. Funerary archaeoentomology is a discipline created by the French scientist J.B Huchet in 1996, that also applies the same rationale in archaeological contexts. In an archaeological context, the knowledge of the ecological and biological specificity of the species associated with the remains can be especially valuable to reconstruct the funerary practices, to describe the cadaver taphonomy and to understand the hygienic and social conditions of the investigated human populations.

Preliminary records on the evolutionary relationships in field populations of *Liothrips oleae* (Costa)

G. Vono, R. Marullo

Mediterranean University of Reggio Calabria - Department of Agriculture, Italy

Olive growing has always been one of the main agricultural production sector and an identifying component of the Mediterranean landscape. Calabria region, in South Italy, has some of the most intensive producer areas of the crop.
The aim of our study is to investigate the evolutionary relationships of *Liothrips oleae* (Costa) in southern Europe, through the use of molecular methodologies, and to follow the massive infestations that have occurred throughout the regional Ionian coast over the last three years.
The species, known as a secondary pest of olive, because its low population densities that have never required ad hoc interventions for its containment. The knowledge of the life history and the genetic identification of the species could provide suitable shifts in order to implement better sustainable defence strategies from an economic and environmental point of view. In the present communication, the results related to the first molecular characterization of *L. oleae* are reported.
We used the literature recognized methods for the genetic identification of the Thysanoptera through the study of three coding genetic regions (COI, ITS2 and 28S) that have shown the presence of some different genetic groups, in the field olive thrips populations analyzed. Such differences are particularly evident in the mitochondrial COI and ITS2 ribosomal region, while the 28S genetic region is confirmed as the most conserved site in the various populations present in the Calabrian and Sicilian olive crop areas. Further studies will be needed in order to provide new informations related to the ecology of the species.

Impact of water availability and agricultural management on occurrence and abundance of Large Copper (*Lycaena dispar*) in a rice paddy landscape

M. Zaccagno[1], A. von Hardenberg[2], C. Cerrato[3], S. Bonelli[1]

[1] DBIOS, Dept. of Life Sciences and Systems Biology, University of Turin, Italy
[2] Conservation Biology Research Group, Department of Biological Sciences, University of Chester, Chester, UK
[3] Gran Paradiso National Park, Turin, Italy

Global change is affecting water availability on a large-scale in the Mediterranean area. Wetlands are some of the most threatened ecosystems. However, rice fields may represent valuable habitats for wetland species. The North-West region of the Po river plain (Italy) represents the most significant rice field area in Europe. Here we investigate how water availability and agricultural practices influence species distribution and habitat use of *Lycaena dispar*. This species is a good model species because it is a hygrophilous and oligophagous protected butterfly species, which in Italy lives in a mosaic of habitat dominated by rice paddy areas. Our study aims to understand H0) which variables influence species distribution H2) the role of paddies in relation to the latitudinal gradient H3) if the role of paddies changes during butterfly generations H4) if species occurrence and abundance is influenced by host plant presence and nectar resources. We identified four habitat types along a gradient of anthropic pressure and water availability: paddies, paddies with the presence of canals, natural springs, and river oxbows. We analyzed both presence and abundance taking into account imperfect detection, and our results show that *L. dispar* appears to be influenced by habitat type and resources differently through butterfly generations. Water availability appears to be crucial for summer survival, but anthropic management of paddies becomes fundamental for the pre-overwintering generation. These results highlight that water management and agricultural schemes will become crucial for *L. dispar* survival in a future water scarcity scenario.

Phylogeny and divergence of Aedini mosquitoes: evolutionary scenarios and genomic perspectives

N. Zadra[1,2], A. Rizzolli[1], O. Rota-Stabelli[1], R. Feuda[3]

[1] Research and Innovation Centre, Fondazione Edmund Mach - Department of Sustainable Agro-Ecosystems and Bioresources, San Michele all' Adige 38010, Italy
[2] University of Trento - Centre for Integrative Biology, Trento, Italy
[3] School of Biological Sciences and School of Earth Sciences, University of Bristol, Bristol, UK

Mosquitoes are the indirect cause of more morbidity and mortality among humans than any other group of organisms. One-third of all mosquitoes species belong to the Aedini, a tribe comprising common vectors of viral zoonoses[1]. In order to improve our understanding of their evolution, we present a detailed multigene estimate of their phylogeny and divergence based on relaxed clocks and fossil calibrations[2].
Our phylogenies using different replacement models and statistical frameworks recover some recognized clades such as *Stegomyia, Ochlerotatus*, that include new invasive species, arrived in Europe in the last two decades.
Our divergence estimates point toward mosquito radiation in the mid-Jurassic and Aedini radiation from the mid-Cretaceous on: this is compatible with a paleo-ecological scenario in which first lineages of mosquitoes co-radiated with reptiles, followed by diversification of Aedini in a more modern ecosystem characterized by mammals, birds, and angiosperms.
Moreover, phylogenomic studies on opsin evolution were carried out within the Culicidae family. The analysis provide interesting preliminary results pointing out that the *Stegomya* subgenus experienced two duplication event during his evolution. This can be linked with the biology of this group, as their feeding behavior.
Our divergence estimates indicate that emerging model *Aedes albopictus* can be currently compared, from a genomic point of view, only against distantly related *A. aegypti*. genome data from its sister species *A. flavopictus* would more than half the time from common ancestor increasing resolution of comparative genome studies[3], which may be of help in setting the research agenda for future studies.

POSTER PRESENTATIONS

◆

ABSTRACTS

The grey area of DNA barcoding: how to improve the molecular tool through an integrative taxonomy pipeline

E. Berrilli[1], M. Biondi[1], P. D'Alessandro[1], D. Salvi[1,2]

[1] University of L'Aquila - Department of Health, Life and Environmental Sciences, Via Vetoio, 67100 Coppito, L'Aquila, Italy
[2] Universidade do Porto - CIBIO-InBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, Campus Agrário de Vairão, 4485-661 Vairão, Portugal

The use of molecular methods for the identification of species, such as DNA barcoding and species delimitation, has increased over the last decade. The large number of studies that used these methods to classify biodiversity has led to the increase of DNA sequence data uploaded on public repositories such as GenBank and BOLD. However, taxonomic annotation of sequences data often do not pass through adequate quality control by expert taxonomists. Moreover, there is no uniformity of the metadata associated to these sequences. This leads to the presence of identification errors that make the DNA barcoding tool inaccurate. In this work, we evaluated the quality of the molecular data set present on GenBank and BOLD of the leaf beetles of the genus *Longitarsus* (Chrysomelidae, Galerucinae, Alticini), a taxonomic group that requires a high level of expertise for the species recognition based on morphological features. We generated 117 sequences of the standard barcode marker for animals, the mitochondrial *cox1* gene (658 bp), and we compiled these data with those available in GenBank and BOLD. We analysed a final dataset of 1502 sequences of 79 species using the R library *spider* v1.5.0. The aims of this study were: (i) to assess the quality of GenBank and BOLD molecular datasets for the identification of species of the genus *Longitarsus* using DNA barcoding gap analysis, clustering methods, and taxonomic validation; (ii) to identify and flag ambiguous and incorrect sequences; (iii) to describe a pipeline for a posteriori validation and rectification of BOLD data by taxonomists specialised in specific groups.

Honeybee pathogens and antimicrobial peptides expression: seasonal and local variations in piedmontese apiaries

F. Canuto[1,2], G. Molinatto[1,2], A. Manino[1], D. Bosco[1]

[1] *University of Torino – Department of Agricultural, Forest and Food Sciences, Italy*
[2] *CNR-Institute for Sustainable Plant Protection, Torino, Italy*

This work focused on honeybee colonies bred in six piedmontese apiaries. Families have been followed throughout a year in order to describe the seasonal patterns which characterize some of the major biotic stress sources in beehives: in particular, we used real-time qPCR to quantify five viruses (Deformed Wing Virus, Acute Bee Paralysis Virus complex, Chronic Bee Paralysis Virus, SacBrood Virus, Black Queen Cell Virus), the microsporidian *Nosema ceranae*, and the expression level of genes coding antimicrobial peptides such as apidecin, imenoptecin, defensin-2, the receptor PGRP-S1 and the vitellogenin, a protein involved in the regulation of immunocompetence in bees. The protocols used for quantification analysis consists of specific primers, SYBR Green and standard curves obtained from serial diluitions of DNA plasmids. A new protocol for the quantification of *N. ceranae* has been set up following a similar approach. For gene expression analysis we used the ΔCq method, using two housekeeping genes (bee's *actin* and *RPS5*) in order to obtain the normalize expression level of target genes.

Effects of managed honeybee abundance on specialization of wild pollinators

A. Cappellari[1], M. Mei[2], P. Cerretti[2], L. Marini[1]

[1] University of Padua – Department of Agronomy, Food, Natural resources, Animals and Environment, Italy
[2] Sapienza University of Rome – Department of Biology and Biotechnology "Charles Darwin", Italy

The honeybee (*Apis mellifera* Linnaeus) is the most widespread pollinator species in natural and agricultural ecosystems. Native of Europe, Africa and the Middle East, it has been introduced in several regions worldwide and, also within its native range, its abundance has been augmented to boost honey production. However, its effects on wild pollinators are still largely unclear.
We observed plant–pollinator visitation networks between June and August 2019 in 51 grasslands up to 2100 m a.s.l in Northern Italy (Alps and pre–Alps). In each site, each flowering species was identified and observed for 15 minutes, during which all insects touching the reproductive parts of the flowers were collected using a butterfly net. To analyse plant–pollinator interactions, we calculated three indices of specialization for each pollinator species, and then we used linear mixed–effects models to test if species–level specialization changed in relation to honeybee abundance, temperature and richness of flowering plants.
Our preliminary results focus on Hymenopterans. In total, our networks consisted of 273 plant species and 8698 pollinator individuals belonging to 183 species. The honeybee was the most abundant pollinator, consisting in 77% of the entire community. We found that honeybee abundance strongly influenced pollinator specialization, with pollinators becoming more specialized as honeybee abundance increased, while temperature and flowering plant richness had no effect. High density of honeybees can alter the interactions between flowering plants and their pollinators, as many insect species switch to other plant species in order to avoid potential competition with the honeybee.

Evaluation of different compounds for the control of the Orange Spiny Whitefly *Aleurocanthus spiniferus* in *Citrus* spp. under organic management

S. Mokrane, D. Cornara, K. Djelouah, G. Cavallo, V. Verrastro

CIHEAM – Bari – Mediterranean Agronomic Institute of Bari – Via Ceglie 9 – Valenzano (BA), Italy

The Orange Spiny Whitefly (OSW) *Aleurocanthus spiniferus* (Hemiptera: Aleyrodidae) represents a new serious threat to *Citrus* spp. and grapevine, relentlessly spreading throughout the Mediterranean area. In Italy, farmers reacted to the first invasions with untimed and mainly unjustified treatments with wide-spectrum synthetic insecticides that severely affected natural enemies without achieving an effective insect control. Currently, especially considering *Citrus* spp. under organic management, there is a great need of sustainable control strategies and low-impact chemical control limiting the losses associated to OSW infestations. The aim of this work was to assess the effectiveness of different non-synthetic insecticides with theoretically low environmental impact and limited side-effects on non-target organisms, namely sweet orange essential oil, extract of *Clitoria ternatea*, mineral oil, pyrethrin and azadirachtin, for the control of OSW. To this extent we carried out both field and laboratory experiments, beside EPG-assisted observations of the whitefly feeding behaviour in order to determine: i) the efficacy of the different compounds against the different stages of the whitefly; ii) the effect on the host searching and oviposition behaviours; iii) the possible impact on the OSW feeding behaviour. Here we report the results of our experiments discussing possible OSW sustainable control strategies and further research perspectives.

Breeding of bioconverter insects for the production of high-quality raw materials for animal feed

A. Franco, P. Falabella

University of Basilicata – Department of Sciences, Italy

The use of insects as a new source of proteins for animals feed destined for human consumption is a topic of great interest from an environmental and economic point of view. The European institutions are developing strategies to satisfy the need of foods with a high protein content, without import them from other countries. A solution to mitigate the current protein deficit is the breeding of some insect species as a natural component of fish, chicken and pig diets. My PhD project proposes the production of protein meal from *Hermetia illucens*. Different types of organic by-products will be used to feed the insect by exploiting its incredible performances in terms of bioconversion. The possibility to obtain, as a result of bioconversion, valuable products, represents a key element to valorize waste products. *H. illucens'* ability to bioconvert organic substrates into valuable products represents a valid solution to the request for the implementation of sustainable processes from an environmental and economic point of view. The project involves the construction of a biofabric (bio-farm) for the large-scale breeding of *H. illucens* and an automated prototype of a larval stadium breeding plant, suitable for the bioconversion of agri-food by-products. At the end of the bioconversion cycle the larvae will be destined for the production of protein meal for aquaculture and on an experimental basis, for research purposes only, for the feeding of broilers and pigs. The larval frass, for its characteristics, will be used as fertilizer for agriculture with high agronomic value.

Segregation and behavior of the parasitoid of longhorn beetles *Sclerodermus brevicornis* (Hymenoptera Bethylidae) in laboratory choice tests

S. Malabusini[1], N. Mortazavi[2], Z. Golparvar[3], C. Jucker[1], D. Lupi[1]

[1] Università degli Studi Milano – Dipartimento di Scienze per gli Alimenti, la Nutrizione e l'Ambiente, Italy
[2] Tarbiat Modares University Theran - Department of Entomology, Faculty of Agriculture, Iran
[3] University of Mohaghegh Ardebili, Ardebil, Iran

Maternal care is an important and characteristic behavior in quasi-social parasitoids. The coexistence of numerous individuals on the same host helps to protect the offsprings from parasitism and conspecific intruders. Some researches has evidenced that also kinship relation can affect behavior and performances. In this study, we investigated some behavioral traits of *Sclerodermus brevicornis* (Kieffer) (Hymenoptera: Bethylidae), a quasi-social wasp found in association with *Psacothea hilaris hilaris* (Pascoe) (Coleoptera: Cerambycidae). We studied the ability of this species to aggregate/segregate as well as the reproductive ability when two hosts of the same dimension and species are available (*P. h. hilaris* larvae of 0.036±0.02g). Five choice tests, with 14 replicates each, were set up under controlled conditions with a different number of adult females (2-4) and a different degree of kinship (none, two siblings, all siblings) in a completely randomized design. Experiments were observed three times per day until offsprings emergence and data about segregation, movement, oviposition and offspring development were acquired. The aggregation between sibling and non-sibling differed significantly ($F_{4,123}$=3.955, p=0.007) and in detail, in the tested conditions, emerged the preference of being alone or in the company of unrelated. This was also confirmed by the statistically significant differences between oviposition in sibling and non-sibling groups. All groups generally preferred to oviposit on both larvae in the test. Unexpectedly, females changed the host after paralysis and acceptance, moving from one host to the other and influencing, in some cases, the success.

A preliminary prioritized list of Italian alien terrestrial invertebrate species

M. Molfini[1], M. Zapparoli[2], P. Genovesi[3], L. Carnevali[3], P. Audisio[4], A. Di Giulio[1], M.A. Bologna[1]

[1] Roma Tre University – Department of Science, Italy
[2] Tuscia University – DIBAF Department, Italy
[3] ISPRA – Department for the Monitoring and Protection of the Environment and for Biodiversity Conservation, Italy
[4] Sapienza University of Rome – Biology and Biotechnology Department "Charles Darwin" (BBCD), Italy

Invasive alien species (IAS) are considered one of the largest drivers of biodiversity loss worldwide and the negative impacts of IAS can also affect human health and the economy. More than 12,000 alien species occur in Europe and more than half of these are terrestrial invertebrates. The most important European policy against alien species is the EU Regulation 1143/2014 which provides for the development of priority lists of IAS of relevant concern aimed to allow the optimization of intervention measures. Italian policy implemented the EU Regulation with the Legislative Decree No 230/2017 that provides the adoption of a list of IAS of national concern. Aim of this work is to present a preliminary prioritized list of alien terrestrial invertebrates species (ATIS) present in Italy, thus providing an useful tool to identify species to be included in the list of IAS of national concern. We defined criteria for assessing the species and ranking them in a prioritized list on the basis of the magnitude of their potential impact on biodiversity. We identify 233 relevant species (insects represent 81.5% of the total) among the 1,053 ATIS included in the Italian Alien Terrestrial Invertebrate Database, on which the evaluation process started. After the evaluation process, 109 ATIS with considerable impacts on biodiversity were selected and prioritized. We prioritized the species in four priority categories by matching their distribution in Italy with the magnitude of their possible impact on biodiversity.

VAIA windstorm: understanding outcomes and future trends on forest biodiversity through a DNA metabarcoding approach

D. Nardi[1], L. Marini[1], A. Battisti[1], C. Vernesi[2], A. Santini[3]

[1] *Padova University – DAFNAE Department, Italy*
[2] *Fondazione Edmund Mach, Italy*
[3] *IPSP-CNR, Italy*

Alpine forests play a fundamental role in terms of ecosystem services' delivery and economic benefits. Nevertheless, natural disturbances such as windstorms periodically affect forests causing serious ecosystem damages. For instance, gaps made by fallen trees lead to loss of forest habitat and associated biodiversity, but also to possible improvements of regional biodiversity related to increased landscape heterogeneity and habitat diversity. However, huge amount of dead wood on soil surface also increases the probability of pest and pathogen outbreaks. In order to reduce this risk factors, managers carry on salvage logging, despite many studies showed potential negative impacts on biological communities. As the magnitude and frequency of extreme meteorological events are expected to grow due to climate change, we need more information about the potential impacts on biodiversity. On October the 29th 2018, an intense windstorm occurred in NE Italy causing massive damages on spruce forests. Our goals are to understand how windthrow gaps modify communities (especially bark beetles and fungi) and to provide relevant information for policy to find a balance between biodiversity conservation and timber production issues. Bridging DNA-metabarcoding and traditional ecological methods (i.e. spatial statistics, community ecology, and network theory) can help to fill the knowledge gap about the outcomes of severe windthrow events in forests, especially concerning the response of arthropods and associated fungal communities. We will select sites considering intact forests close to VAIA-damaged ones. We will provide an overview of the whole project and sampling design to share with the scientific community.

Analysis of the growth performance of *Tenebrio molitor* (Coleoptera: Tenebrionidae) reared on diets based on by-products for food and feed

S. Naser El Deen[1;2], V. Verrastro[2], F. Lamaj[2], L. Al Bitar[1;2], F. Baldacchino[3]

[1] Parthenope university of Naples - Environment, resources and sustainable development department, 80133 Napoli (NA), Italy
[2] CIHEAM-IAMB Mediterranean Agronomic Institute of Bari - Mediterranean organic agriculture department, 70010 Valenzano (BA), Italy
[3] Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA) *–Trisaia research center - Department SSPT-BIOAG-PROBIO, 75026 Rotondella (MT), Italy*

The rapid growing of the global population is increasing the pressure on the available world's resources to provide enough amount and varieties of food. Particularly, the increasing demand on the animal-based protein is highly causing this pressure and its production in a sustainable manner is very difficult. Therefore, finding alternative sustainable protein sources is necessary. Being part of the traditional diet of some communities, efficient converters, rich in protein, essential fatty acids, vitamins and minerals and environmentally sustainable, insects are considered a promising alternative protein source. The nutritional value of insects varies greatly depending on the species, stage of life, habitat, and diet of the insect. Beetles, as *Tenebrio molitor*, are the most commonly consumed insect globally (31% of the total edible insects are beetles). They are reared as feed for several animals and as food for human. The lifespan, fecundity and the nutritional content of *T.molitor* are profoundly affected by its feed. The main objective behind this study is to analyze the growth performance and fecundity of rearing *T.molitor* larvae and adults on diets based on local agricultural by-products. It is conducted at the insectarium of IAMB research center. The preliminary results showed that protein-rich feed reduces lifespan, larval period and total development time of *T.molitor* and increases the larval and pupal weight and egg production rate. Furthermore, the feeding diet nutritional composition is more important and significantly affects more than the type of by-products used to compose the diet. Here I discuss first findings and further perspectives.

First record of *Pseudocleruchs triclavatus* (Hymenoptera: Mymaridae) from eggs of the forest pest *Barbitistes vicetinus* (Orthoptera: Tettigoniidae)

G. Ortis[1], L. Mazzon[1], S.V. Triapitsyn[2]

[1] University of Padua – Department of Agronomy, Food, Natural resources, Animals and Environment, Italy
[2] University of California – Department of Entomology, USA

Barbitistes vicetinus is an endemic forest pest species described very recently and spread almost exclusively in the Veneto region (NE Italy). Since 2008, severe outbreaks occurred in Euganean Hills affecting the whole hillside area causing defoliations especially to forest species and crops cultivated close to the infested wooded areas, such as vineyards, olive grove and cherry orchards.
Here, we report for the first time in Italy the occurrence of *Pseudocleruchus triclavatus* (Donev & Huber, 2002) previously known only from the mountains in Bulgaria. The parasitoid wasp was obtained from eggs of *B. vicetinus* collected from 240 natural soil samples of Euganean Hills. We found that from a single egg can hatch up to 140 individuals. Moreover, we provide preliminary data about the percentage of eggs parasitism.

Towards the production of an infectious viral clone to interfere with phytoplasma transmission by the leafhopper vector

S. Ottati[1,2]; A. Persico[1,2]; S. Abbà[1]; M. Rossi[1]; L. Galetto[1]; M. Vallino[1]; M. Turina[1], C. Marzachì[1]; D.Bosco[2]

[1] CNR - Istituto per la Protezione Sostenibile delle Piante, Torino, Italy
[2] Università degli Studi di Torino, DISAFA – Entomologia, Grugliasco (TO), Italy

Virus-based biocontrol technologies have been discussed for decades as sustainable alternatives to synthetic pesticides in crop protection. The advent of NGS applied to viral metagenomic analyses of insect populations has significantly increased the possibility to derive new virus-based tools to control pests and plant diseases. In this perspective, the H2020-funded VIROPLANT project aims at identifying potential biocontrol agents from the virosphere of phytoplasma vectors. *Euscelidius variegatus* Kirschbaum (Hemiptera Cicadellidae) is a polivoltine and polyphagous leafhopper and a model vector of phytoplasmas of agricultural importance (i.e. Flavescence dorée of grapevine). During a transcriptomic analysis of an *E. variegatus* laboratory population (EvaTO), a new species of the genus *Iflavirus* was identified among the assembled insect transcripts. The +ssRNA virus was named *E. variegatus* virus 1 (EVV1). EVV1 was further characterized to describe its transmission routes (i.e., fecal-oral, plant-mediated and cuticle penetration), replication strategies, localization within the host and quantitative analysis in different insect life stages and organs. EVV1 negative individuals microinjected with EVV1 macerate were able to vertically transmit the virus to offspring. The virus was present in all assayed organs with different loads and a peak in ovaries. Eggs and the first two instars reached the highest virus load. The production of an infectious clone (IC) derived from EVV1 might provide the unprecedented opportunity to manipulate the expression of endogenous genes by promoting virus-induced gene silencing and interfere with insect ability to transmit phytoplasmas.

Biological control of the Nearctic leafhopper *Erasmoneura vulnerata* (Fitch) using generalist predators

S.C. Prazaru

Department of Agronomy, Food, Natural Resources, Animals and Environment, University of Padua, Agripolis, Italy

Outbreaks of *Erasmoneura vulnerata* are becoming frequent in north-eastern Italy, despite the use of insecticides. This suggests that non-chemical alternatives should be identified. A viable alternative to insecticides is the use of commercially available predatory insects such as *Chrysoperla carnea* and *Orius majusculus*. These predators occur naturally in Italian agro-ecosystems however, their populations are often reduced by the intensive use of insecticides. To determine the effectiveness of these two generalist predators, they were tested in: 1) laboratory and 2) semi-field conditions. Predation experiments were carried out on foliar arenas and on potted plants inside cages. In the cage trials, different densities of *E. vulnerata* nymphs, were offered to *C. carnea* larvae and *O. majusculus* adults. Both predators actively consumed these preysuggesting that they could be released in vineyards. Thus field trials were conducted in a highly infested vineyard, where both predators were released in different plots. In field trials, both predators significantly reduced leafhopper densities but less markedly than in laboratory and semi-field conditions.

Inter plant-plant Communication, aphid response and sustainable crop production

M. Rensing

Swedish University of Agricultural Sciences / Department of Ecology, Sweden

Insect pests are a major problem in crop production, when it comes to maintaining stable yields. Plants under this pressure exchange information with their neighbour. We showed that Barley /Wheat cultivars can warn a neighbouring plant when they are under attack or under stress conditions. The mechanisms behind this include light reflection, volatile organic compounds (VOCs), proximity and soil composition. This communication affects not only the plants but other trophic levels including the attraction of natural enemies. The plant receiving this can increase its defences against the possible insect attacks. Further, we also found that a higher diversity in certain cultivar mixtures the mentioned warning system becomes more efficient. We are testing the reach of this possibility via lab experiments, exposing different cultivars to one another as well as field scale experiments under organic conditions. We are investigating how the exposure of different inducing / receiving plants via VOCs is affecting insect pest acceptance. We found that particular mixtures can reduce this acceptance in a significant way. When we utilize this knowledge we can improve pest management in a sustainable way, with a reduced usage of pesticides. This has an immense impact on the economy and the emergence of resistance problems. One can argue that we take advantage of the already existing natural defence capacities of our crops.

Uncovering the spatial characteristics of electroreception in the Buff-tailed Bumblebee, *Bombus terrestris*

M. Rogers, D. Robert

University of Bristol – School of Biological Sciences, UK

Buff-tailed bumblebees (*Bombus terrestris*) have been shown to be able to perceive and learn the presence of electric fields (Clarke et al. 2013).
Although the adaptive function of electroreception is unknown, it has been hypothesised that this sense is used in the detection and identification of flowers. This has not yet been verified experimentally, and further research is required to elucidate the ecological function(s) of electroreception in bees.
My research aims to clarify the likely function of electroreception in *Bombus terrestris* by defining some of the spatial characteristics of this ability, in particular the distance over which bees are able to sense a biologically relevant electric charge, and whether the bees are able to glean any directional information through electrical signals.

Response of alate aphids to organic mulch materials

J. Winkler

University of Kassel, Department of Agricultural and Biosystems Engineering, Germany

Straw mulch applied on a crop is known to reduce virus incidences e.g. in potatoes by interfering with their landing behavior. To study the effect on aphids' settling response, different mulch materials (comprising grayish and yellowish straw mulches as well as vetch-triticale and alfalfa-gras cuttings) were tested in the field in two consecutive experiments. In Experiment I landing on small mulch plots was tested by putting up transparent glass traps, resulting in mulch:soil as target:background combination. In Experiment II yellow pan traps (YPTs) were used instead of the glass traps, resulting in a YPT:mulch combination. All traps, mulch materials and the soil were characterized spectrometrically in order to predict aphid catches using a color opponency model influenced by the green–blue color opponency values of the target and the background. In Experiment I aphid catches were highest in the glass traps on the soil and lowest in the traps on grayish straw mulch, although numbers were predicted highest for the yellowish straw mulch and approximately equal for the other mulches. In Experiment II aphid catches in the YPTs weren't statistically distinguishable even though the color opponency model predicted clear differences. Thus, differences in the attractiveness of the mulch materials were other than expected and the color opponency model seemed not to predict mulch:soil or YPT:mulch target:background combinations appropriately. Possible mechanisms and implications will be discussed.

150° ANNIVERSARIO
Società Entomologica Italiana

◆

ABSTRACTS

Società Entomologica Italiana: 1869-2019. Breve storia di 150 anni

R. Poggi

Museo Civico di Storia Naturale, Genova, Italy

In occasione delle celebrazioni del 150° della Società Entomologica Italiana, vengono sinteticamente illustrati, con una carrellata di immagini, i fatti più salienti relativi alla nascita e allo sviluppo della Società, ponendo l'accento sui più illustri soci che ne hanno retto le sorti in un secolo e mezzo di vita, dalla fondazione a Firenze (1869) alla crisi successiva alla 1ª guerra mondiale, dal trasferimento a Genova (1922) ai danni subiti nel 1942, dalla ricostruzione postbellica sino ai giorni nostri.

Augusto Vigna Taglianti

M.A. Bologna[1], P. Audisio[2], M. Biondi[3], M. Zapparoli[4]

[1] Dipartimento di Scienze, Università Roma Tre, Viale Marconi 446, 00146 Roma, , Italy
[2] Dipartimento di Biologia e Biotecnologie "C. Darwin", Sapienza Università di Roma, Piazzale Aldo Moro 5, 00186 Roma, Italy
[3] Dipartimento di Medicina clinica, Sanità pubblica, Scienze della Vita e dell'Ambiente, Università dell'Aquila, Via Vetoio snc, 67100 L'Aquila (AQ), Italy
[4] Dipartimento per la Innovazione nei Sistemi Biologici, Agroalimentari e Forestali, Università della Tuscia, Via San Camillo de Lellis s.n.c., 01100 Viterbo, Italy

Augusto Vigna Taglianti (1943-2019) è ricordato in questa commemorazione come ricercatore zoologo, in special modo entomologo e biogeografo, ma anche per aspetti della sua umanità e grande cultura di naturalista.
Professore di Entomologia alla Sapienza Università di Roma, dove svolge tutta la sua carriera universitaria dal 1966 al 2013; Membro Ordinario dell'Accademia Nazionale Italiana di Entomologia e dell'Accademia delle Scienze (detta dei XL); già Presidente della Società Entomologica Italiana e dell'Associazione Romana di Entomologia; già Presidente del Comitato Scientifico per la Fauna d'Italia. Maestro di più generazioni di entomologi e zoologi romani e, più in generale, italiani. Si interessa sin da ragazzo alla Biospeloelogia, all'Entomologia ed alla Biogeografia e svolge numerose spedizioni scientifiche di carattere faunistico in tutte le terre perimediterranee e del Medio Oriente, nelle isole Canarie, in Africa orientale e meridionale, in Ecuador, in Cina. La sua attività di ricerca si rivolge soprattutto ad Amphipoda, Dermaptera e Coleoptera Carabidae. Descrive circa 100 taxa nuovi per la Scienza inclusi tre generi e tre sottogeneri di anfipodi, 7 generi e 2 sottogeneri di coleotteri carabidi. La sua produzione include 415 articoli scientifici, sia su riviste internazionali sia nazionali, relativi soprattutto ai taxa sopra indicati, ma è autore anche di opere di divulgazione naturalistica. Scrive tre monografie inerenti i Carabidae e la Biospeleologia: il primo volume della Fauna d'Italia e la Checklist di questa famiglia di coleotteri, nonché la Fauna cavernicola delle Alpi Liguri. La sua produzione spazia anche su mammiferi e uccelli, ma soprattutto in Biogeografia, con importanti sintesi sui corotipi paleartici, oltre a lavori analitici su settori alpini occidentali. Coordina numerosi progetti di ricerca nazionali e partecipa attivamente alla vita di tante società scientifiche, spesso con cariche istituzionali. Nel 1996 è stato General Secretary del XX International Congress of Entomology di Firenze. Anche nel campo della Museologia scientifica è sempre stato di stimolo a numerose iniziative, così come si è adoperato, in veste di Direttore responsabile, alla cura di riviste scientifiche italiane e, come revisore, anche a molte riviste straniere. Ha dato ampio impulso alla collana Fauna d'Italia, come Presidente del Comitato omonimo, ed ha collaborato al completamento di iniziative come la Checklist della fauna italiana e del progetto CKmap.
Occitano di adozione, ha avuto un vivissimo legame con le montagne e la cultura delle Alpi occidentali e con la storia della Resistenza in queste valli. Il suo impegno culturale e politico lo ha visto attivo e propositivo in iniziative volte alla tutela della natura e nella collaborazione con molte aree protette italiane.
Ci piace ricordare Augusto anche come il "padre brontolone", che ogni tanto ci rimproverava per le nostre vite giovanili più "movimentate" di quanto a lui sembrasse lecito, l'uomo e il docente con grande personalità, autorevole, con i suoi pregi e i suoi difetti, che sempre coinvolgeva quelli che gli erano accanto.

The contribution of Augusto Vigna Taglianti to the knowledge of carabid beetles

A. Casale[1], P. Brandmayr[2], A. Di Giulio[3]

[1] *University of Sassari (Zoology), Sassari, Italy*
[2] *University of Calabria, Department of Biology, Ecology, Earth Science, Rende (Cosenza), Italy*
[3] *University of Roma Tre, Department of Science, Rome, Italy*

Augusto Vigna Taglianti (Borgo S. Dalmazzo, CN, 1943 – Roma 2019), full Professor of Zoology at Sapienza University of Rome, was an excellent teacher of Zoology of vertebrates, Entomology and Biogeography. Besides several important contributions to Crustaceans Amphipoda and Dermaptera, his researches have been mostly devoted to taxonomy, larval morphology, distribution and biogeography of carabid beetles. In particular, Augusto published many papers on subterranean and endogean Carabidae Trechini and Bembidiini Anillina and described several new genera and species from different areas of the world: Italy, Near East, Asia, Central America. But his main interest was focused on the distribution and biogeography of carabids of Italy and the Euro-Mediterranean area, for which he provided detailed checklists and chorotypes of each taxon. That's not all: curious of many aspects of phylogeny, ecology and behavior, he published some papers on fungi (Laboulbeniales) parasites on carabids, and morphology and biology of subterranean or myrmecophilous Ozaenini and Paussini.

The sperm ultrastructure of Carabidae reveals a great variability in the group

R. Dallai

University of Siena-Department of Life Sciences

The sperm structure of Carabidae has been the subject of several studies, the interest of which, however, mainly regarded the origin of spermatozeugmata, the peculiar sperm aggregation shared by several species of the group. Spermatozeugmata with different morphology were described in Brachinini, Harpalini, Sphodrini, Pterostichini, Zabrini, Demetriadini and Carabini. On the contrary, taxa such as Cicindelini, Nebrini, Notiophilini, some Scaritini, Bembidini, Trechini, do not form spermatozeugmata and exhibit free sperm. Moreover, within these tribes, the position of the sperm components is not uniform and either some of those forming spermatozeugmata as well as those having free sperm show nucleus and axoneme running in parallel, starting from the acrosome up to almost the tail end. At present, only Notiophilini, Nebrini, and Carabini, have a more typical insect sperm with sperm components, acrosome, nucleus and flagellar axoneme, arranged in a sequence. Minor, but not less important differences, are present in each species examined dealing with the shape of nucleus, the size of mitochondrial derivatives and of accessory bodies.

NOTE

NOTE

NOTE

NOTE

NOTE

EVENT PLANET SRL
www.eventplanetgroup.com

Sede Legale Capri
Via Pagliaro, 7
80071 Anacapri (Isola di Capri – Na)

Milano
Via Matteotti, 52/1
20068 Peschiera Borromeo (MI)

Napoli
C.so Umberto I, 90
80138 - Napoli

London
London WC1
40 Bloomsbury Way
WC1A 2SE