



APACE Newsletter

Asia-Pacific Association of Chemical Ecologists

March 29, 2018

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Special topics of interest:

- Report from the Second International Chemical Ecology Conference (P 2)
- APACE Executive and New Councilors (P 6)
- APACE Life-time Achievement Award (P 11)

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To our readers

We are happy to inform you all that our long-awaited APACE Newsletter for this year is finally ready! In this issue, we begin with a welcoming note from our new President Junji Takabayashi. We then revisit our happy joint ISCE/APACE meeting that took place in serene Kyoto with a brief report and some memorable pictures. We are also reminded of the annual meeting of our sister society, ISCE that will take place in August this year as well as an introduction to the present members of the APACE Executive Committee and Council. We too are proud to announce the recipient of the prestigious 2019 APACE Life-time Achievement Award Winner, Dr. Eric Jang. For the first time in the history of our newsletter, a first-hand insight into the semiochemical industry from an APACE vantage is provided. Not forgotten, the activities of the Hilo fruit fly laboratory in Hawaii is highlighted. Next, we take a nostalgic walk down memory lane through our first and second APACE meetings. The progress of chemical ecology research is also reported in this issue with a reminder of our next APACE meeting that will be held in beautiful Hangzhou in China next year! Enjoy the reading folks!

Alvin Kah-Wei Hee (alvinhee@upm.edu.my)
Editor/APACE Secretary
Department of Biology
Universiti Putra Malaysia



Message from the New President

Dear APACE members,

I would like to briefly introduce myself as the new president of the Asia-Pacific Association of Chemical Ecologists (APACE). I am working for Kyoto University, Center for Chemical Ecology. I have been studying tritrophic interactions consisting of plants, herbivores and carnivorous natural enemies of herbivores, and plant-plant communication since 1990. My favorite natural enemies are parasitoid wasps of genus *Cotesia* and predatory mites *Phytoseiulus persimilis*. I look forward to meeting you in the next 10th APACE conference in Hangzhou, China.

Junji Takabayashi
Professor
Center for Ecological Research
Kyoto University





The Second Joint Meeting of the 33rd Annual Meeting of the ISCE and the 9th Conference of the APACE, Kyoto– A Report by Koji Noge, Nobuhiro Shimizu, Naoki Mori

The Second Joint Meeting of the 33rd Annual Meeting of the ISCE and the 9th Conference of APACE was held in Ryukoku University (Fukakusa Campus, Wagenkan), Kyoto City from August 23rd to 27th 2017. It has been 25 and 10 years since the 9th Annual Meeting of ISCE in Kyoto at 1992, and the 4th meeting of the APACE in Tsukuba city in 2007, respectively. There were 358 participants from 31 different countries, 132 oral presentations and 176 poster presentations.

Prior to the welcome party on the 23rd, we were pleased to have a special program "Symposium to celebrate the 90th birthday of Professor Jerrold Meinwald" designed by Prof. Walter Leal (University of California-Davis). After the celebration lectures, the concert was held in the lecture room, where Professor Meinwald played a recorder and his wife, Charlotte played a harpsichord.

The ISCE/APACE awards ceremony was held on 24th August. The ISCE Silver Medal Award was awarded to Professor Gary J. Blomquist (University of Nevada, Reno, USA). He has been involved in elucidating the biosynthetic pathway of pheromones of the bark beetles, and revealed that most pheromones were synthesized newly in the body of beetles. He brought about a paradigm shift in the pheromone communication of bark beetles in the 1990s. After that, he also revealed the biosynthesis process of hydrocarbons existing on the body surface of insects.

ISCE Silverstein - Simeone Award was awarded to Professor Robert A. Raguso (Cornell University, USA). Professor Raguso focused on the role of chemicals in the plant-pollinator interactions, and showed that volatile compounds derived from flowers have played important direct and indirect roles to establish plant-pollinator interactions on the evolutionary time scale.

Dr. Kerry Mauck (University of California, Riverside, USA) was awarded the ISCE-Early Career Award. She demonstrated that virus altered chemical and visual phenotypes of host plants, which attract insect vectors. In virus-host-vector interactions, these alterations enhanced the transmission of virus to healthy host plants.

In supporting the participation of students, a number of them were awarded the ISCE Student Travel Awards as well as winners for the best presentation for talks and posters. For the first time, 2017 APACE Young Scientist Award was presented to Dr. Kai Lu (China) and Dr. Takuya Uehara (Japan).

The APACE Lifetime Achievement Award was awarded to Prof. Keng Hong Tan (Mobula Research Sdn. Bhd., Malaysia) and Prof. Emeritus Ritsuo Nishida (Kyoto University, Japan). They have formed close collaborative research on the chemical ecology of Asian pest fruit flies for over 30 years and identified attractants for the fruit flies from orchid flowers to control the fruit flies. They also demonstrated that male fruit fly converted the floral compounds to sex pheromones, which attracted females.

In recognition of services to APACE particularly in the reorganization of APACE, and establishing the non-profit status of APACE in the US, Prof. Junwei Jerry Zhu (USA) was conferred the 2017 APACE Excellence in Leadership Award.

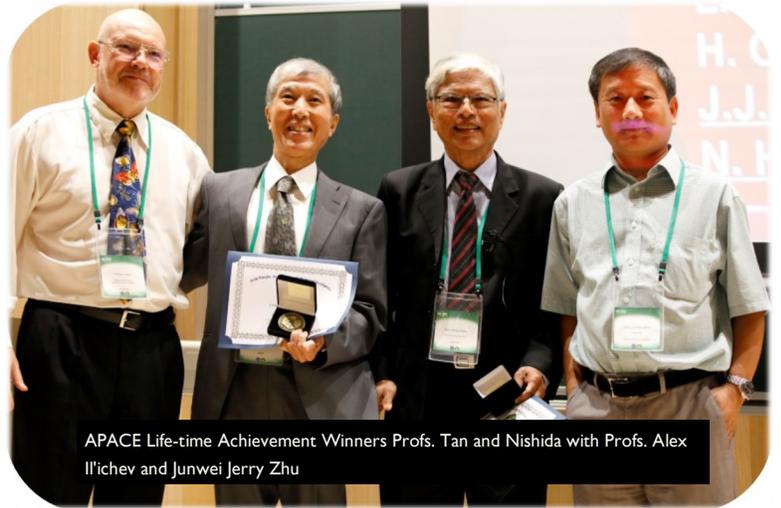
On 25th we had plenary lectures by four speakers- Professor James H. Tumlinson, Professor Wilhelm Boland, Professor Hiroshi Kudoh, and Professor Yongping Huang who presented wonderful and insightful lectures. In addition to the plenary session, this meeting included 15 sessions covering a range of the latest research topics in which active discussions were held.

Finally, we are pleased that Prof. Emeritus Kenji Mori was awarded the "Lifetime Honorary Membership" from ISCE. He had, and still continues to make great contributions to the development of chemical ecology.

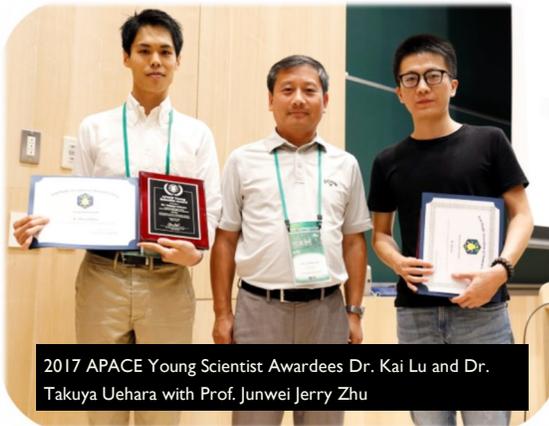
Memories from the Kyoto meeting....



Prof. Gary Blomquist receiving the Silver Medal from Prof. Christer Löfstedt



APACE Life-time Achievement Winners Prof. Tan and Nishida with Prof. Alex Il'ichev and Junwei Jerry Zhu



2017 APACE Young Scientist Awardees Dr. Kai Lu and Dr. Takuya Uehara with Prof. Junwei Jerry Zhu



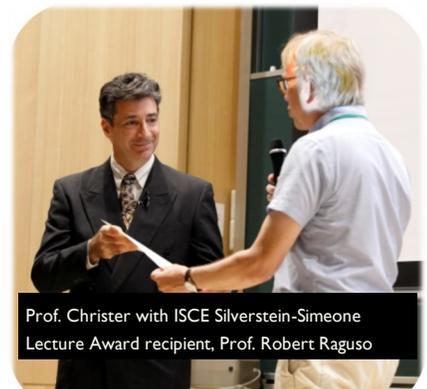
ISCE Student Winners (Best Oral Presenters) (Left: Po-An Lin, Ruth L. Schmidt, Fee L. E. M. Meinzer & Claire Duménil)



Prof. Christer with ISCE Early Career Award recipient, Dr. Kerry Mauck



Prof. Junwei Jerry Zhu receiving the 2017 APACE Excellence in Leadership Award from Prof. Alex Il'ichev



Prof. Christer with ISCE Silverstein-Simeone Lecture Award recipient, Prof. Robert Raguso



2017 ISCE Student Travel Award Winners

More fond memories from the Kyoto meeting....



Prof. Kenji Mori receiving the ISCE Lifetime Honorary Membership from Prof. Christer Löfstedt



Prof. Anne-Geneviève Bagnères being elected as new ISCE President (2017-2018)



Prof. Coby Schal being elected as new ISCE Vice President (2017-2018)



Prof. Consuelo and Fengming Yan with Kerry



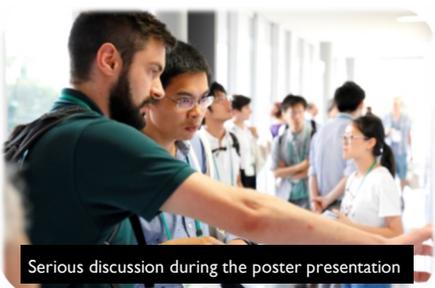
Prof. Kenneth Haynes with the student winners



ISCE Early Career Award Lecture



Prof. Nishida & Tan



Serious discussion during the poster presentation



All eyes on the poster



Alvin and Suk Ling with Prof. Jocelyn, Jeremy and Wilhelm Boland



Chilling out...



In the Banquet Hall



Nice work!



In Wagenkan Hall



Kabuki Performance



Together with Prof. Vincas Būda



All smiles with Drs. Anat Zada and John Byers



2017 ISCE/APACE
August 23-27, 2017
Venue: Wagenkan



Traditional Magic Show



Participants enthralled by the Japanese cultural and magician performance at the Banquet Dinner

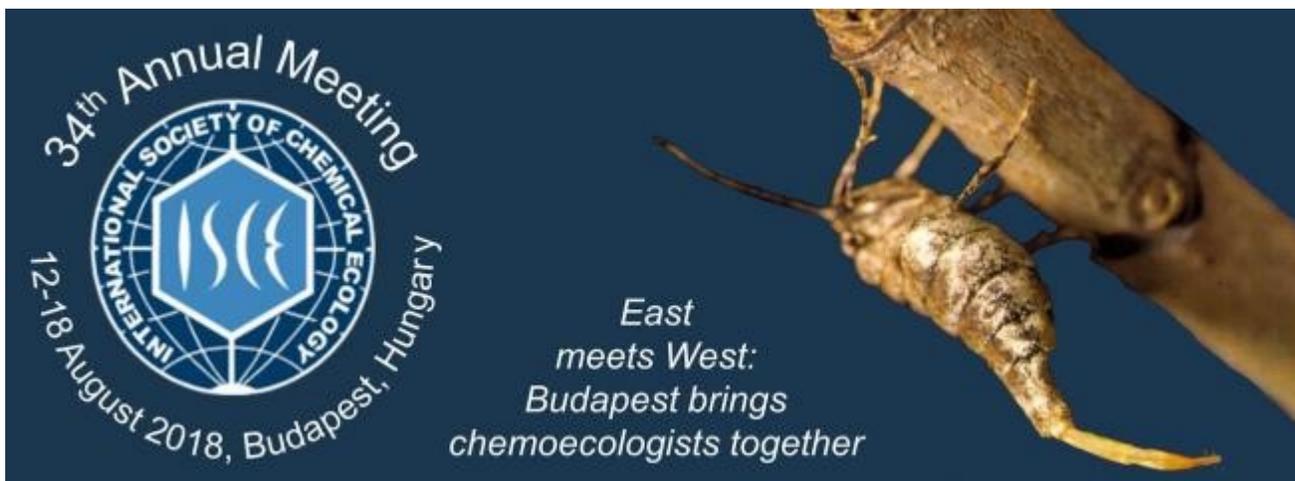


Chamber Music featuring Charlotte Greenspan, Jerrold Meinwald, Keiko Nagono & Toyoko Ogumi



2017 ISCE/APACE Kyoto

Chemical ecology reunion in Kyoto



Dear Colleagues,

We are happy to announce that in 2018 the 34th International Society of Chemical Ecology meeting will be held in Budapest, Hungary (August 12-18, 2018).

Deadline for participant registration and abstract submission: April 30, 2018.

On behalf of the Organizing Committee, we cordially invite you to attend the meeting and present your most recent research achievements. We encourage you to submit presentations (oral and poster) in the following principal sessions:

- 1) New chemical structures;
- 2) Interspecific relationships;
- 3) Intraspecific relationships and
- 4) Practical applications.

Please visit the meeting webpage for more details: <https://isce2018.premium.shp.hu/>

It is our pleasure to invite you to participate at a memorable meeting of high scientific standards in Budapest, a city well worth to visit and to discover.

We are very much looking forward to welcome you all in Budapest!

Miklós Tóth
Academician
Plant Protection Institute, CAR HAS
Hungary

Zoltán Imrei
Organizing Secretary
Hungarian Plant Protection Society
Hungary



For further enquiries, please contact the organizers:

isce2018@agr.ar.mta.hu





APACE New Officers and Councilors

10-th APACE President 2017-2019 Junji Takabayashi (Japan)



- Conference: 10th APACE (China)
- Venue: Hangzhou, China 2019
- Host: Guirong Wang, Yonggen Lou and Baoyu Han (China)
- President: Junji Takabayashi (Japan)
- Vice President: Guirong Wang (China)
- Secretary: Alvin Hee (Malaysia)
- Treasurer: Qinghe Zhang (United States)

With the lineup of APACE new officers, new councilors (2017-2021) were also elected to replace the outgoing ones. On behalf of APACE, we thank the following councilors for their service to the Association. They are as follows: **Rikiya Sasaki** (Japan), **Baoyu Han** (China), **Naoki Mori** (Japan), **Michael Rostas** (New Zealand), **Myron Zalucki** (Australia) and **Agenor Mafra-Neto** (USA).

APACE Councilors (2015-2019)

John Paul Cunningham (Australia)
Chen-Zhu Wang (China)
Joanne Yew (USA)
Gen-Zhong Cui (China)
Matthew Siderhurst (USA)
Shuang-Lin Dong (China)
Dangsheng Liang (USA)
Shigeru Matsuyama (Japan)

APACE Councilors (2017-2021)

Hisashi Omura (Japan)
Jianing Wei (China)
Yooichi Kainoh (Japan)
Andrea Liliana Clavijo Mc.Cormick (New Zealand)
Andrew Hayes (Australia)
Jian Chen (USA)
Suk-Ling Wee (Malaysia)

Congratulations on the appointment of our new councilors! In this issue, we highlight the present and new councilors under the section “Getting to know your APACE councilors”.

“APACE Councilors are to represent various fields of chemical ecology and regions, and to act in an advisory capacity to the Executive Committee in formulating policy”

Becoming an APACE member? Have you renewed your APACE membership fees? APACE fees are cheap, at only US\$20 for two years. Basically your fees are used to support the Association in a number of ways such as running of our official webpage (www.newapace.com) and promotion of chemical ecology particularly in support of students participation in our biennial meetings through regular student travel awards, and awards for the best student oral and poster presentations during the conferences. To subscribe to the Association, please visit the following webpage:

<http://www.newapace.com/members.html>

Getting to know your **APACE** councilors



Joanne Yew first established her research lab at Temasek Life Sciences Laboratory (Singapore) and the National University of Singapore, where she was a principal investigator from in 2010-2015. In 2015, Joanne joined the Pacific Biosciences Research Center at the University of Hawai'i at Mānoa as an assistant professor. Joanne obtained a Ph.D. in Neuroscience from the University of Wisconsin-Madison in 2003 and was a post-doctoral fellow in the Department of Neurobiology at Harvard Medical School from 2004-2009. Joanne's current research combines mass spectrometry approaches with behavioral genetics to understand the evolution, biochemistry, neurobiology of chemical communication in *Drosophila*.



Suk-Ling Wee obtained her Ph.D. in Applied Entomology from Universiti Sains Malaysia (Penang) in 2002 and is currently an Associate Professor of Entomology in Universiti Kebangsaan Malaysia. She was formerly a Research Scientist, Chemical Ecology in Plant and Food Research, Lincoln, Canterbury, New Zealand (2003-2007). Her research interest is on insect behaviour and insect chemical ecology - identification of behaviour modifying semiochemicals that mediate insect-insect, plant-insect and plant-insect-predator interactions, as well as use of sterile insect technique in area-wide control and management of insect pests. Currently she is focused on a diverse range of current chemical ecology projects from that of agricultural pests (fruit flies), biological control (black soldier flies), plant-insect interaction (*Rafflesia*), insect diversity (Diptera, fruit flies, dung beetles) plus forensic entomology (blow flies). Suk-Ling is also a 2016 Endeavour Australia Fellow Alumni hosted by Prof. Tony Clark FRES in Queensland University of Technology (QUT), Brisbane.



Jian Chen serves as a Research Entomologist in the Biological Control of Pests Research Unit, United States Department of Agriculture, Agricultural Research Service (USDA-ARS), Stoneville, Mississippi, USA, and Lead Scientist of a project focusing on developing biologically-based control technologies for managing invasive pest ants, emphasizing imported fire ants and tawny crazy ants. In addition to a better understanding of the behavior, chemical ecology and physiology of the invasive ants, the ultimate goal of his research is to minimize the impact of invasive ants on human health and agriculture by solving long-standing and difficult problems in ant management.



Hisashi Omura is an Associate Professor in the Graduate School of Biosphere Science, Hiroshima University. Dr. Ômura has over 20 years of experience and training in an array of research techniques including natural chemistry (chromatography, spectroscopy, and mass spectrometry for low molecules), insect physiology (electroantennogram and tip-recording), and behavioral bioassay. His research focuses on chemical ecology of butterflies and identification of semiochemicals (allelochemicals and pheromones) involved in their host selection, flower visiting, mate choice, defense against predation, and mutualism with other organisms. These results have been published as over 50 scientific articles in international journals.



Andrea Clavijo McCormick is a passionate scientist, interested in understanding chemical communication between plants and insects and the evolution of plant defence mechanisms. Originally from Colombia (South America), but science has taken her on an amazing journey through many countries - Sweden (M.Sc.), Germany (Ph.D) and Switzerland (Post-doc) - landing in New Zealand two years ago, where she's an Ecology Lecturer and lead the Chemical Ecology Group at Massey University. Her current research interests involve a variety of topics including fern-insect interactions, the role of plant volatiles in competition scenarios, plant-microbe-pollinator interactions and multitrophic interactions in tree species. www.chemical-ecology-at-massey.com

Getting to know your **APACE** councilors



Jianing Wei is currently an Associate Professor in the Institute of Zoology, Chinese Academy of Sciences, Beijing, China. He received his PhD from Kunming Institute of Zoology, Chinese Academy of Science in 2003. His study focuses on understanding the mechanism of plant-insect or plant-plant communications mediated by chemical signaling from insect-inflicted plants. Together with other colleagues, they have developed analytical (EAG, GC-EAD, GC-MS), molecular (real time RT-PCR, mutant lines of agricultural plants, and ect.) and behavioral (Ethovision system, Y-tube and four-arm olfactometers, wind-tunnel, and ect.) tools for chemical ecology studies. Leaf miners and locusts are his main research subjects. He utilizes several techniques such as GC-EAD, SSR, and GC-MS and LC-MS for chemical analyses and undertakes behavioral experiments of insect orientation.



Yooichi Kainoh is currently a Professor and Director, Agricultural and Forestry Research Center, Faculty of Life & Environmental Sciences, University of Tsukuba, Japan. His research focuses on control of insect behavior by semiochemicals and chemical ecology of insect parasitoids. He is currently the Chief Editor of Applied Entomology and Zoology. Prof. Yooichi is a recipient of the Society Fellowship Award by the Japanese Society of Applied Entomology and Zoology.



Andrew Hayes is a Forest Health Research Fellow in the Forest Industries Research Centre at the University of the Sunshine Coast, Queensland, Australia. He began his research career investigating the signals used to maintain social status in wild European rabbits (*Oryctolagus cuniculus*). After completing his PhD he stayed within the field of vertebrate chemical ecology, studying signals linked to genetic relatedness in lemurs (*Propithecus edwardsii*), response to predator odours in Australian native rats (*Uromys*, *Melomys* and *Rattus*) and inter-specific signals in the invasive cane toad (*Bufo marinus*). Since 2008 Andrew's interests have moved to insect chemical ecology, where his research now focuses on control and monitoring tools for insect pests of horticultural crops and forestry plantations. His current projects include: development of an external attractant trap for the Small Hive beetle (*Aethina tumida*), a pest of European honeybees; development of standardised methods to enhance early detection and response to post-border pest and disease incursions on pine plantations in Queensland; an IPM approach to control of pests in macadamia orchards, especially the weevil *Sigastus* sp.; investigation of the attractiveness of generic cerambycid pheromones to Australian species of these wood-boring pests, in collaboration with Prof. Jocelyn Millar (UCR) and Prof. Larry Hanks (UIUC).



Paul Cunningham is a specialist behavioural ecologist with expertise in chemical ecology and insect learning. His PhD is from Imperial College, London, and he has worked extensively in both England and Australia. He is currently a Research Leader, Invertebrate & Weed Sciences, Biosciences Research, Agriculture Victoria. Paul's research focuses on 1) Insect olfaction. Study the odours of host fruits, flowers and leaves by herbivorous insects to find suitable plants on which to feed or lay eggs. Much of the work has focussed on the agricultural pest moth, *Helicoverpa armigera*. His current research focuses on the Queensland fruit fly, *Bactrocera tryoni*, which is to identify and synthesize an attractant odorant that can be used to lure and kill female flies in the field; 2). Insect learning. Using a combination of behavioural and theoretical research to study the importance of learning in the ecology and evolution of herbivorous insects; and 3). Insect pest management. Including (a) using ecological and behavioural theory to predict why current pest management practices might be failing; (b) the use of plant odours to develop new "lure and kill" strategies; and (c) the potential for developing new transgenic plant varieties with decreased attractiveness to insect pests.

Getting to know your **APACE** councilors



Chen-Zhu Wang is a research professor in the Institute of Zoology, the Chinese Academy of Sciences (CAS), Beijing, China. He received his Ph.D. in Entomology from Beijing Agricultural University (now China Agricultural University) in 1991. His research interest focuses on insect-plant interactions and chemical communication. He systematically examined the coevolutionary interactions between *Helicoverpa* species and their host plants, including plant chemical defense to insects and insect adaptation to plant defense, and expanded the interacting insects and plants system to a multitrophic system with emphases on the impact of the third trophic level and host shift on the evolution of insect host range. In the light of coevolution, he is further studying (1) the mechanistic basis of the interactions of *Helicoverpa* species with their host-plants and (2) the genetic basis of female sex pheromone signals and male olfactory responses. In 2009, he was honored to receive National Science Fund for Distinguished Young Scholars from Natural Science Foundation of China. Dr. Wang has published over 100 peer-reviewed papers in scientific journals such as *Insect Biochemistry and Molecular Biology*, *Frontiers in Behavioral Neuroscience*, *Journal of Experimental Biology*, *Insect Molecular Biology*, *Journal of Chemical Ecology* and *Scientific Reports*.



Matthew Siderhurst is an Associate Professor in the Department of Chemistry, Eastern Mennonite University, Virginia, USA. Dr. Siderhurst obtained a Ph.D. in Entomology from Colorado State University and was as a post-doctoral research associate with the USDA-ARS-PBARC in Hilo, Hawai'i, working to identify attractants for several economically important invasive insects. Teaching experience throughout his academic career has lead Dr. Siderhurst to value education as a lifelong process, which especially lends itself to the small institution setting with its small class sizes, close student-professor interactions, and undergraduate-centered research. Dr. Siderhurst's research interests include development of improved attractants for invasive and agriculturally important insect pests including tephritid fruit flies, the little fire ant, and several beetle and moth species, synthesis of small organic molecules related to insect chemical ecology including pheromones and secondary plant compounds, ecology of invasive species studied through trapping or radio tracking and investigating the odor profiles of tropical agricultural products.



Shuang-Lin Dong is a Professor at Department of Entomology, Nanjing Agricultural University, China. His research interests are 1) Identification of insect sex pheromones and their application in integrated pest management; 2) Molecular mechanisms of insect olfaction; and 3) Effects of insecticides and pest resistant transgenic crops on insect sex pheromone communication. He received his Ph.D. in Zoology from Shanghai Institute of Entomology, Chinese Academy of Science in 2000. Dr. Dong has published more than 110 peer-reviewed papers in national and international scientific journals (including *Amino Acids Research*, *Insect Biochemistry and Molecular Biology*, *Insect Molecular Biology*, *Journal of Chemical Ecology*, *Scientific Reports*, *BMC Genomics*, and *PLoS ONE*), and has been honored with 2 national academic awards.



Gen-Zhong Cui is the General Manager of Pherobio Technology Co. Ltd. in China, a company that specializes in researching, developing, manufacturing and marketing of synthetic pheromones and other insect attractants. Together with Dr. Junwei Jerry Zhu, they co-authored an important paper entitled "Pheromone-Based Pest Management in China: Past, Present, and Future Prospects" that appeared in the 2016 issue of *Journal of Chemical Ecology*.

Getting to know your APACE councilors



Shigeru Matsuyama is an Associate Professor in the Graduate School of Life and Environmental Sciences, University of Tsukuba, where he has worked since 2000. Throughout his research career, he has worked in the field of chemical ecology and has published over 60 papers in peer-reviewed journals. He is currently serving as an Editorial Board Member of *Applied Entomology and Zoology*, the official journal of the Japanese Society of Applied Entomology and Zoology. He is a member of seven academic societies including APACE, and actively engaged in academic activities. He also served as the treasurer of APACE for 1998-2000. He has published over 50 peer-review research papers in chemical ecology areas.



Dangsheng Liang is the President of Apex Bait Technologies, Inc. USA, the only company in the world exclusively dedicated to development of insect bait technologies. Dr. Liang is a world leading expert to develop cockroach bait and its related technologies for important urban insect pests. Their products containing Apex bait technologies lead the market not just in technology but in market share in both ant and cockroach bait product segments for professional markets. He also lead a research team to conduct research to monitor the evolution of insect bait resistance including both physiological and behavioral resistance to ensure that roach bait technologies stay ahead of the insect's struggle for survival. Dr. Liang has contributed to APACE tremendously in supporting the conference organization and was awarded 2015 APACE Industry Support Award. He has published many high quality research papers, including PNAS etc., as well as held two US patents for technology transfers. He has also served as the founding president of the Overseas Chinese Entomologist Association, and grant award judge of Intel International Science and Engineering Fair.



2019 APACE Life-time Achievement Award Winner– Dr. Eric B. Jang (Hawaii, USA)



Dr. Eric Jang has been a very active and engaged member right from the first unofficial discussion on November 20, 1997 about the possibility of establishing an Asia-Pacific regional organisation on Chemical Ecology organised by Prof. K.S. Boo during the 3rd Asia-Pacific Conference of Entomology in Taichung, Taiwan. Next day he took an active role in the official inauguration meeting of the Asia-Pacific Association of Chemical Ecologists (APACE) and was appointed as APACE Councillor (1997-2001). Eric attended and actively participated in organisation of all APACE conferences, and in 2005 was appointed as APACE Executive Treasurer (2005-2007) during 3rd APACE conference in Jeju, Korea. During the 4th APACE conference in 2007 in Tsukuba, Japan, Eric was appointed as the APACE Vice-President (2007-2009) and was in charge of organising the 5th APACE conference in Honolulu, Hawaii, USA as the chair of the organising committee. After very successful and productive conference in Honolulu, Dr. Eric Jang served the association as the 6th APACE President (2009-2011). Eric continued to be actively engaged with the association and as the Immediate APACE Past-President (2011-2013) established the official association of the APACE with the Journal of Chemical Ecology in 2012 and actively lobbied Executives of the International Society of Chemical Ecologists (ISCE) to organise the 1st joint ISCE and APACE conference in Melbourne, Australia in 2013. Great success of the 1st joint APACE+ISCE conference attended by more than 400 delegates from 42 countries in Melbourne 2013 achieved a long-term aspiration of our Founders and Executives to establish the tradition of regular joint conferences that continued in 2017 in Kyoto, Japan and in 2021 in Putrajaya, Malaysia. All mentioned above clearly underlined the enormous contribution from Dr. Eric Jang to the APACE development and prosperity over the years from APACE establishment, and strongly supported the nomination of Dr. Eric Jang for the 2019 APACE Life-time Achievement Award.

APACE Executive and Councilor meeting unanimously approved the nomination of Dr. Eric Jang for the 2019 APACE life-time achievement award.

Great congratulations to the 2019 APACE Life-time Achievement Award Winner Dr. Eric Jang!

APACE: A Semiochemical Industry Perspective

By Qing-He Zhang and Jeffery R. Aldrich

The semiochemical-based industry

Semiochemical-based commercial products are the ultimate achievement of applied insect chemical ecology, and play a pivotal role in environmentally sound and sustainable IPM worldwide. Unlike broad-spectrum pesticides, semiochemicals, especially insect pheromones, are target-specific at extremely low levels and, hence, are environmentally safe.

Currently, there are over 50 semiochemically based or related companies primarily in the U.S., Europe and Japan. However, in the past decade or so several new companies have arisen in the Asia-Pacific region, including at least six companies in China (Cui and Zhu, 2016). This budding industry of mostly small businesses (10-200 employees) is focusing principally on two markets: 1) *commercial (agricultural) growers*, who use semiochemical products such as pheromone lures and traps for monitoring or mass-trapping, formulations for attract-and-kill or mating disruption and, lately, attraction inhibitors and repellents and; 2) *consumers (home owners)*, who buy products such as pheromone- or kairomone-based traps to eliminate pests, and formulations to repel pests. Many companies cater to the agricultural market; for examples, Trécé, Inc. (USA), ISCA Technologies, Inc. (USA), ChemTica Internacional, S. A. (Costa Rica), *Pherobio Technology Co., Ltd.* (China), and Alpha Scents, Inc. (USA), among others. These companies each offer many pheromone-related products targeting hundreds of agricultural and forest pest insects. However, sale volumes for these products are relatively low due to the limited extent of infestations for each pest species. Several other companies [e.g. Shin-Etsu Chemical Co., Ltd. (Japan), Scentry Biologicals, Inc. (USA), Pacific Biocontrol Corporation (USA) and Suterra LLC (USA)] target larger agricultural markets, specializing on the mating disruption products for a few globally and regionally important pests, such as codling moth and gypsy moth, with moderate sale volumes for each product. In contrast, only a small number of pheromone/kairomone products are available for the consumer market; they are mostly manufactured and sold by mid-sized to large companies, such as Sterling International, Inc. (Rescue[®]), S. C. Johnson & Son, Inc. (Raid[®]), Woodstream Corporation (Terro[®]/Safer[®]/Victor[®]), Spectrum Brands, Inc. (Blackflag[®]), Springstar, Inc. (BioCare[®]), Insects Limited, Inc., and Farnam Companies, Inc. (Starbar[®]). Due to the cosmopolitan nature of a relatively few urban pest species, the sale volumes for these products are gigantic.

According a new report by Grand View Research, Inc. (January 2018; www.grandviewresearch.com/press-release/global-integrated-pest-management-ipm-market), the global market revenue for pheromones used in IPM programs (including sex pheromones, aggregation pheromones, oviposition deterring and alarm pheromones) is expected to reach 1.5 billion US\$ by 2025. Furthermore, this industry is currently experiencing a compound annual growth rate >12.5%. This impressive growth is being driven by more restrictive regulatory legislation for conventional pesticides, by consumer demand, and as a result of increases in pesticide resistance. North America is the largest regional market for pheromone products, accounting for over 40% of the total market due mainly to increasing usage in the U.S. and Canada. The Asia-Pacific region (about 15% of the global IPM pheromone market in 2016) is expected to witness the fastest growth of semiochemical products due to rapid economic growth in China, and the presence of agriculture-based economies such as India. Similar rapid growth is also expected in Latin America owing to growing agriculture production in South American countries. Europe, on the other hand, as a relatively matured market for agricultural products (accounting for 27.6% of the pheromone global market in 2016), is expected to experience more moderate growth. Although the semiochemical industry is flourishing, the industry also faces daunting challenges. One such challenge is strong regional and international competition among the existing companies. Strong demand for environmentally sound, green pest control products and technology is also incentivizing large crop protection companies (including the powerhouse agrochemical corporations) to acquire smaller companies, so the semiochemical industry may face consolidation in the near future.

APACE and the industry partners

Over the past 20 years, the APACE has grown substantially into a vibrant and internationally recognized scientific society thanks in no small part to the efforts of our current and past presidents and councilors and, last but not least, the generous support from our industry partners.

The semiochemical industry provides sponsorships to APACE conferences, student travel awards, lifetime achievement awards and young scientist awards. In addition, the industry funds many APACE academics to conduct product-oriented applied research. The close relationship between APACE and our industry partners tremendously benefits both our society and industry. In fact, many APACE past and current councilors and executives are from the industry (see Table I). Interestingly, most of these semiochemical companies were originally established, operated or assisted by the 2nd or 3rd generation chemical ecologists academically trained in the U.S., Europe or Japan. In recent years, R&D departments of these companies have provided many career opportunities for young chemical ecologists, especially in our Asia-Pacific region. Additionally, retired chemical ecologists from universities or research institutes (including one of us, J.R.A.) have joined the industry by creating consulting or niche-market firms. Academic research (basic or applied) by our APACE members provides critical, up-to-date knowledge needed by industry to develop new cost-effective, efficacious semiochemical products, thus steadily advancing the science of applied chemical ecology.

Unlike colleagues in academia, industry chemical ecologists do not routinely publish research results in journals such as the *Journal of Chemical Ecology* or the like. However, we do have opportunities to nationally and internationally patent new insect attractant/repellent compositions, formulations, dispenser technology, and trap designs. For example, as the R&D director at Sterling International, Inc., the senior author (Q-H.Z.) has authored 31 U.S. patents and 33 international patents over the past ten years. In some cases scientific publications are encouraged if the intellectual property is patent-protected, and trade secrets are guarded. Perhaps the uttermost professional pride and fulfillment of an industry chemical ecologist is to witness his or her innovative, creative ideas or concepts become successful commercial products that help growers and consumers. In general, industry chemical ecologists strongly advocate for and encourage young chemical ecologists to join the industry brigade to realize their professional aspirations as applied chemical ecologists.

In short, the close collaboration between the academic community, including our APACE members, and the semiochemical industry has been, and will continue to be critically important for the mutual advancement of our respective fields. Successful development and implementation of commercial semiochemical products will likely result in significant reductions of pesticide usage, with corresponding benefits to human and environmental health and quality of life (Baker et al. 2016).

In appreciation of our industry partners, the first APACE Industry Support Awards were presented at the 2017 Joint Conference of ISCE/APACE (Kyoto, Japan) to the following four industry partners, Sterling International, Inc., (USA) (Fig. 1. Left photo), Pherobio Technology Co., Ltd. (China) (Fig. 1. Central photo), Apex Bait Technologies, Inc. (USA) (Fig. 1. Right photo), and ChemTica Internacional, S. A. (Costa Rica).



Fig. 1. The APACE Industry Support Award presented to Sterling International, Inc. (Dr. Qing-He Zhang; left photo), Pherobio Technology Co., Ltd. (Mr. Gen-Zhong Cui; central photo), Apex Technologies, Inc. (Dr. Dangsheng Liang; right photo), and ChemTica Internacional, S.A. (Dr. Cam Oehlschlager; not present) by APACE President, Dr. Jerry Junwei Zhu at the joint ISCE/APACE conference on August 26th, 2017, Kyoto, Japan.

Industry representative	Company name	Role in APACE (Term)
Tatsuji Chuman	Fuji Flavor Co., Ltd., Japan	Councilor (2005-2009)
Satoshi Nojima	Shin-Etsu Chemical Co., Ltd., Japan	Councilor (2009-2013)
Qing-He Zhang	Sterling International, Inc., USA	Councilor (2011-2015), Treasurer (2017-Present)
Rikiya Sasaki	Fuji Flavor Co., Ltd., Japan	Councilor (2013-2017)
Agenor Mafra-Neto	ISCA Technologies, Inc., USA	Councilor (2013-2017)
Dangsheng Liang	Apex Bait Technologies, Inc., USA	Councilor (2015-2019)
Gen-Zhong Cui	Pherobio Technology Co. Ltd., China	Councilor (2015-2019)

Table 1. List of industry representatives as APACE councilors or officers

Cited References:

Cui, G. Z. and Zhu, J. J. 2016. Pheromone-based pest management in China: Past, present, and future prospects. *Journal of Chemical Ecology*, 42:557-570.

Baker, T. C., Zhu, J. J., and Millar, J. G. 2016. Delivering on the Promise of Pheromones. *Journal of Chemical Ecology*, 42:553-556.



Qing-He Zhang is presently the Director of Research at Sterling International, Inc. and APACE Treasurer.



Jeffery R. Aldrich is a retired Entomologist, USDA-ARS and currently a consultant (Jeffrey R. Aldrich consulting, LLC, living in Santa Cruz, CA, and an Associate, Department of Entomology, UC Davis, working with Dr. Frank Zalom).

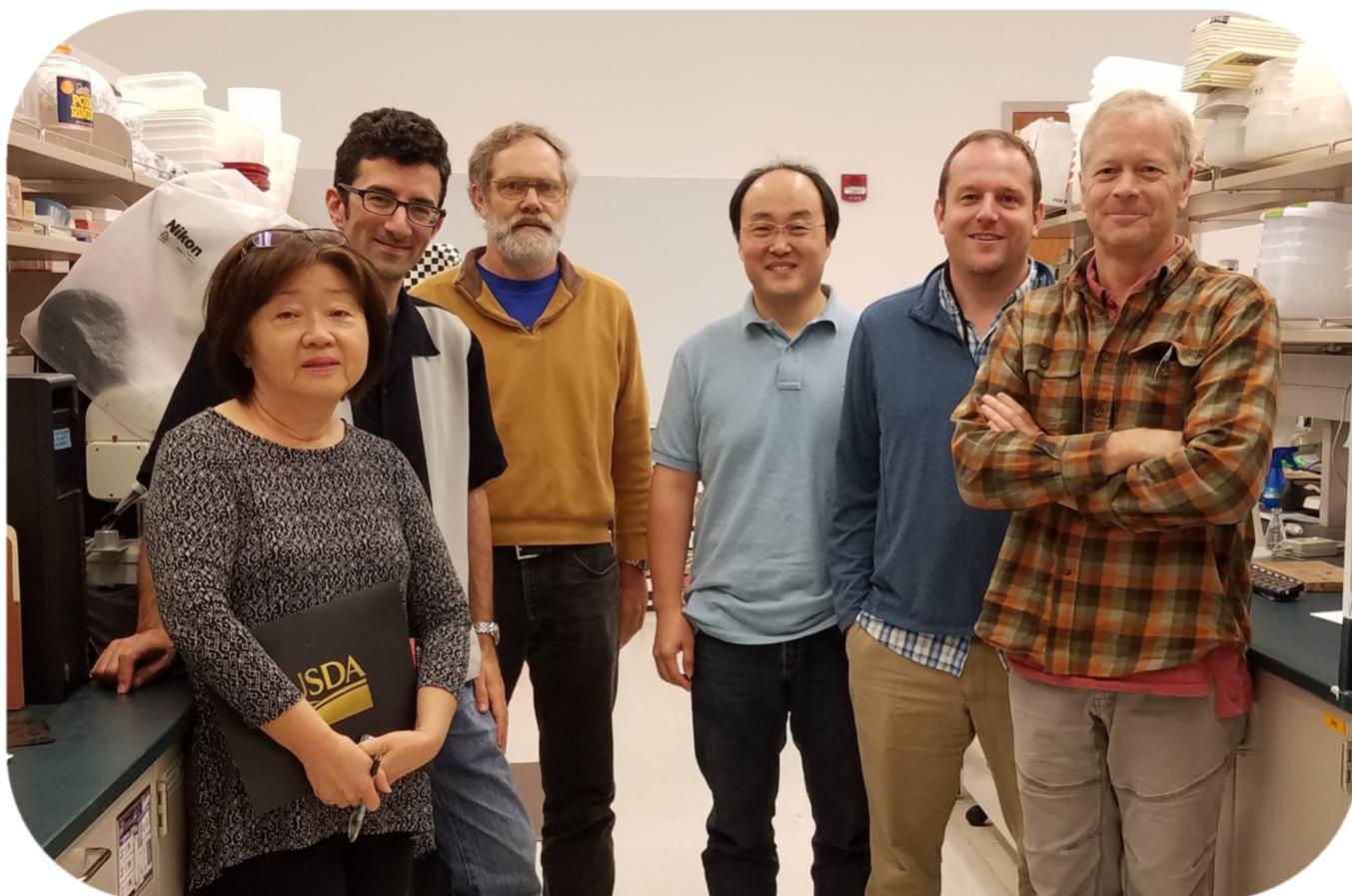
A One-Stop Shop for Tropical Fruit Fly Research

By Dong Cha

At the Daniel K. Inouye US Pacific Basin Agricultural Research Laboratory, USDA-ARS located in Hilo, Hawaii, one of the common purposes among scientists has been to advance the knowledge on the biology, ecology, genetics, proteomics, and chemical ecology of tropical fruit flies and protect our crops from these pests. With the recent passing of Dr. Ernie Harris, who worked at USDA-ARS in Hawaii and pioneered population suppression and eradication strategies of tropical fruit flies with sterile fly releases (SIT), male annihilation (MAT), and augmentative parasitoid releases, it is timely to remember his legacy and visit latest fruit fly research activities in Hawaii. Below are brief updates on some current tropical fruit fly projects.

There are four tropical fruit fly species established in Hawaii, the Mediterranean fruit fly (*Ceratitis capitata*), Oriental fruit fly (*Bactrocera dorsalis*), melon fly (*Zeugodacus cucurbitae*) and Solanaceous fruit fly (*Bactrocera latifrons*) and current detection methods for these species rely mainly on using male lures. To improve detection, Dr. Dong Cha, the chemical ecologist hired after Dr. Eric Jang's retirement, is currently developing female attractants for these flies based on symbiotic microbial semiochemicals. He is also collaborating with Drs. Will Walker, Teun Dekker and Peter Witzgall at Swedish University of Agricultural Sciences to study olfactory-receptor transcriptomes to compare putative chemosensory gene expression in male and female tephritid fruit flies for functional characterization of candidate genes affecting olfactory-based behaviors.

Dr. Scott Geib is using genomics to develop diagnostic tools for source and species determination of invasive tephritid species. This includes de novo genome assemblies, using tools for comparative genomics between species to identify novel phylogenetically informative loci, using genome-wide SNP data and range wide sampling to define population structure, and building robust workflows for phylogenomics and population genetics in a diagnostic context. In addition, he is working to develop novel genetic sexing systems to expand robust SIT programs into new species.



From left: Stella Chang, Nicholas Manoukis, Grant McQuate, Dong Cha, Scott Geib and Peter Follett. (Absent: Roger Vargas and Eric Jang)

With an emphasis on modeling, Dr. Nicholas Manoukis is working to quarantine, to optimize trap density for surveillance, and conducting field experiments. Experiments utilizing Mark-Release-Recapture indicate that the optimal application density for effective MAT against *Bactrocera dorsalis* fruit flies is much lower than that currently used in California and other parts of the world. This finding is counter-intuitive, though it can be explained by the principle of trap interference, known in the literature for decades but never considered or tested in the context of MAT.

Dr. Grant McQuate has been involved in research on attractants and in the development of host database for tephritid fruit flies. Recent research with tephritid attractants has been the assessment of whether eugenol analogs, attractive to several “non-responsive” tephritid fruit fly species, might be attractive to *Bactrocera latifrons*.

Fruit fly incursions can result in new associations between a pest and a commodity. This is particularly true when tropical fruit flies appear in countries with temperate crops like apple, pears, and kiwifruit. Therefore, Dr. Peter Follett is proactively developing tropical fruit fly disinfestation treatments for temperate fruits, as postharvest disinfestation treatments and information on host status is often not available for tropical fruit flies infesting temperate fruits, resulting in quarantine restrictions on the movement of fruit.

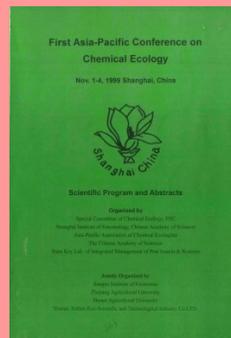
Dr. Roger Vargas has been working in Hawaii USDA-ARS since 1980 and is continuing the legacy of Dr. Harris and expanding SIT, MAT and biological control IPM programs all over the world. He has also been engaged recently with screening tephritids for insecticide resistance.

Contact Dong Cha <Dong.Cha@ARS.USDA.GOV> or Research Leader Nick Manoukis <Nicholas.Manoukis@ARS.USDA.GOV> for more information.

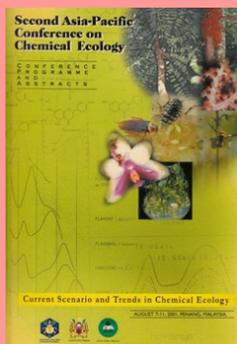
A nostalgic walk down memory lane– Alvin Hee



From left: Suk-Ling, Eric Jang, Ritsuo Nishida, Inoue Takashi, Walter Leal, Keng-Hong Tan, Alvin Hee, Kyung-Saeng Boo



1st APACE Conference in Shanghai, China (1999)



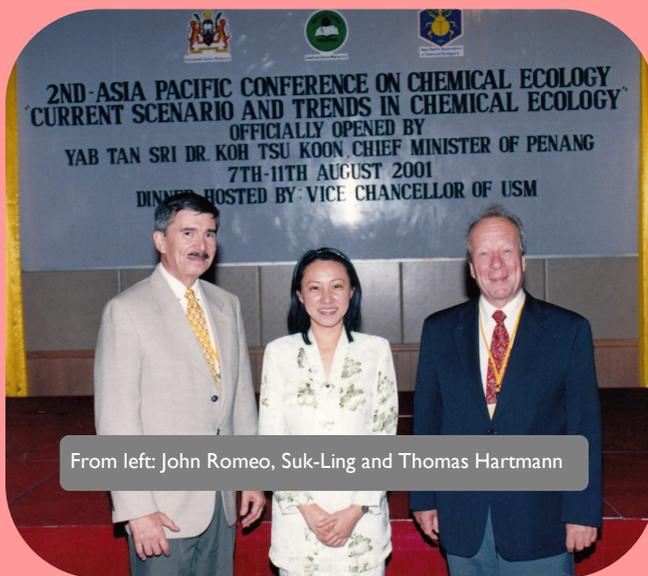
2nd APACE Conference in Penang, Malaysia (1999)



From left: Jean Marc Jallon, Keng-Hong Tan, Harry Fay, Suk-Ling Wee, Max Suckling, Richard Vickers, Miklós Tóth, Alvin Hee



From left: Ritsuo Nishida, Tae-Soo Chon, Ronald Mau, Jan Van der Pers and wife, Suk-Ling, Eric Jang, Max Suckling, Didier Rochat, Alvin Hee



From left: John Romeo, Suk-Ling and Thomas Hartmann

A nostalgic walk down memory lane

2nd APACE Conference in Penang,
Malaysia (1999)



From left: Alvin Hee, Eric Jang, Ritsuo Nishida, Keng-Hong Tan, Lee Chan, Suk-Ling



From left: Hiromi Sasagawa, Masayuki Takuma, Zhen Zhang, Lee Chan, Keng-Hong Tan, Alvin Hee, Suk-Ling, You-Ju Jin and colleagues



From left: Jean Marc Jallon, Alvin Hee, Kenji Mori, Suk-Ling



Members' News

News from China contributed by Prof. Guirong Wang (APACE Vice-President)

Chemical ecologists from research group of insect functional genomics under the leadership of Prof. Guirong Wang, from Institute of Plant Protection, Chinese Academy of Agricultural Sciences, Beijing, P. R. China. In this group, we mainly use olfactory genes or neurons as a target in order to high throughput screening insect behavioral modulators, with the aim to protect crops.

Current project issues include functional genomics of agricultural pests, neural and molecular mechanisms in chemoreception of insects, and the synthesis pathways of secondary plant substances. Progresses as below:

1. Alarm Pheromone Detection in Aphids- this study provides an integrated picture of EBF detection in *Acyrtosiphon pisum* at the cellular and molecular levels. It is for the first time articulated the signal transduction pathway on alarm pheromone detection in aphids. With practical applications in mind, such observation is quite beneficial as it provides the basis for designing new aphid repellents, as active as EBF. The paper published in *Current Biology*.

[http://www.cell.com/current-biology/fulltext/S0960-9822\(16\)31198-8](http://www.cell.com/current-biology/fulltext/S0960-9822(16)31198-8)

2. Pheromone Antagonist Regulates Optimal Mating Time in *Helicoverpa amigera*- Male moths compete to arrive first at a female releasing pheromone. This study reveals that additional pheromone cues released only by younger females may prompt males to avoid them in favor of older but more fecund females, providing novel strategy to disrupt their mating behaviors. This paper published in *Current Biology* and commented by Prof. Neil J. Vikers in *Current Biology*.

<http://dx.doi.org/10.1016/j.cub.2017.04.035>

3. Functional Diversity of Soluble Olfactory Proteins in Insects- this work summarized aspects of structures, physiological functions and evolutions in both reported OBPs and CSPs, and discussed their proposed modes of action in different organs of the insect. It largely enriched the development of biological disciplines of chemosensory gene families. This paper published in *Biological Reviews* together with Prof. Paolo Pelosi.

<http://onlinelibrary.wiley.com/doi/10.1111/bry.12339/full>

4. Secondary plant substances for recruiting natural enemies of rice pest-this study identified key terpene synthase genes from lima bean using technologies of chemical ecology combined with high-throughput sequencing. This study demonstrated that the transformation of rice to produce volatile terpenoids had the potential to enhance plant indirect defence through natural enemy recruitment. This paper published in *Plant, Cell & Environment*, together with scientists in Rothamsted Research.

<http://onlinelibrary.wiley.com/doi/10.1111/pce.12959/full>

5. Reverse chemical ecology: Olfactory proteins from the giant panda and their interactions with putative pheromones and bamboo volatiles-this study identified the OBP repertoire of the giant panda with complementary affinities to different chemical classes and present the 3D structure of one of them. In a reverse chemical ecology approach, which could be adopted for other vertebrates, we use ligand-binding data to suggest putative structures of still unknown sex pheromones. This paper published in *PNAS* together with Prof. Paolo Pelosi.

<http://www.pnas.org/content/early/2017/10/19/1711437114.full.pdf>



More News from China....

The Chemical Ecology Group of Xishuangbanna Tropical Botanical Garden, CAS fully takes advantage of South Western China's biodiversity, focusing on pollinator protection and conservation. They are mainly interested in 1) the interaction between social insects (bees, hornets, termites) and their environment (such as toxic nectar, pesticides, etc.); 2) coevolution between bees, plants, and predators.

In 2017, the Chemical Ecology Group published 7 SCI papers, which were summarized as below:

They found out in social insects, such as honey bees and hornets, whom will use the alarm pheromones to alert mates or deter invaders. They first found out that benzyl acetate was been used as a common components of alarm in *Apis cerana*. when the alarm components increasing up to high concentration in the hive which will reduce the dance and foraging activities.

Sex pheromones also plays important roles in social insects, the sex pheromones of a globally invasive bee predator, the Asian hornet, *Vespa velutina*, was first been identified. It may give a potential reference for controlling the invasive species in Europe. The main components of the alarm pheromones were also identified from the hornet, *Vespa velutina*.

The mandibular pheromones in *Apis cerana* was found out less than in *Apis mellifera*, this would be an nice evidence that suggested there were species-specific sensitivity differences to mandibular pheromone between these two different species.

The interaction between prey and predator, which was fascinate. They found out the ants would eavesdrop on the variational trail pheromone of its termite prey. The prey signal would also mimic by the plant to attract predator help for dispersing their seeds.

Promotions and Announcements:

Prof. Guirong Wang from Institute of Plant Protection, Chinese Academy of Agricultural Sciences, Beijing, P. R. China, has been awarded a grant (National Science Fund for Distinguished Young Scholars) and elected as the recipient of the Thousand of Youth Talents Plan (national level).

Heartiest Congratulations to our APACE Vice President Prof. Guirong Wang!!! 

Plan of approved next APACE Conference with tentative dates, host, venue and other available information:

The 10th APACE conference will be held on August 21-25, 2019 in Hangzhou, China. The conference will be co-organized by Zhejiang University, China Jiliang University and the Tea Research Institute, Chinese Academy of Agricultural Sciences. The meeting venue is The First World Hotel of Hangzhou, which is located in Xiaoshan District, Hangzhou, China.

News from the Journal of Chemical Ecology....



In the January 2018 issue, it has been announced that the Latin American Association of Chemical Ecology (ALAEQ) has joined APACE and ISCE in their partnership with the Journal. This follows the support of both sister societies during the Kyoto Joint ISCE/APACE Meeting that ALAEQ be affiliated with the Journal. It certainly augurs well for the development of chemical ecology today with strong representations from Asia-Pacific and Latin America and APACE also welcomes another sister ALAEQ society in the Journal!



Employment/Training Information

1. PhD Opportunity in Insect Pheromone Biochemistry/Chemical Ecology Department of Biological Sciences, Virginia Tech, United States. <http://chemecol.org/jobs/20180219.pdf>
2. Postdoctoral Researcher, Understanding social evolution through the study of embryogenesis in ants. University of Paris/IGFL, France. <http://chemecol.org/jobs/20180303.pdf>
3. Insect Chemical Ecology Assistant Researcher, University of Florida (in collaboration with USDA APHIS), Buzzards Bay, Massachusetts, United States. <https://www.entsoc.org/insect-chemical-ecology-assistant-researcher>

Upcoming Meetings

1. 34th Meeting of the International Society of Chemical Ecology, Budapest, Hungary, August 12-18, 2018. Theme: East meets West: Budapest brings Chemoecologists together. <https://isce2018.premium.shp.hu/>
2. Entomological Society of America (ESA), Entomological Society of Canada (ESC) and Entomological Society of British Columbia (ESBC) Joint Annual Meeting, Vancouver, British Columbia, Canada, November 11-14, 2018. Theme: Crossing Borders: Entomology in a Changing World. <https://www.entsoc.org/events/annual-meeting>

Future APACE Meetings

1. **10th APACE conference, Hangzhou, China, August 21-25, 2019.** Host: Prof Guirong Wang (Chinese Academy of Agricultural Sciences).
2. **3rd Joint Meeting of ISCE/APACE, Malaysia, 2021.** Host: Alvin Hee (Universiti Putra Malaysia). Following the successful 1st Joint Meeting in Melbourne, Australia (2013) and our recent 2nd Joint Meeting in Kyoto, Japan, the 3rd Joint Meeting of the 37th Annual Meeting of ISCE and 11th APACE Conference will be held in Putrajaya, Malaysia in 2021. It all started with the nomination of Alvin Hee as host for the 11th APACE Conference that was accepted during the APACE Executive Meeting in Anaheim, California, 2015. Following that, under the visionary guidance and tireless effort of Prof. Alex Il'ichev (APACE Past President), Alvin with Alex made an official bid for the 2021 Joint Meeting during the 2016 ISCE Executive Meeting that took place in Foz do Iguaçu, Brazil. Malaysia was finally announced as the host country for the 2021 ISCE Meeting and this was reaffirmed as 2021 Joint Meeting Host, in Kyoto last year.
3. **12th APACE Conference, Victoria, Australia, 2023.** Host: Prof. Paul Cunningham (Agriculture Victoria). We are happy to announce that for the second time, Australia will be the host of the APACE Conference following the first ever ISCE/APACE that took place in Melbourne from August 19-23, 2013.

We take this opportunity to wish the very best to our hosts in organizing the future exciting APACE meetings!