國立成功大學 | 台南
National Cheng Kung University | Tainan

20-21 Oct 2018

39th

人人的昆蟲學

台灣昆蟲學會第39屆年會

Annual Meeting of Taiwan Entomological Society

感謝
陶氏(台灣道禮)杜邦農業事業部
贊助第39屆台灣昆蟲學會年會

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陶氏杜邦農業事業部

第三十九屆台灣昆蟲學會年會

The 39th Annual Meeting of Taiwan Entomological Society

2018 年10 月20 - 21 日

台灣，台南，國立成功大學

October 20 - 21, 2018

National Cheng Kung University

Tainan, Taiwan

各位會員與昆蟲同好，大家好!

台灣昆蟲學會成立近 40 年，是台灣昆蟲知識交流的重要組織。今年第 39 屆年會，於 2018 年 10 月 20 日至 21 日，假台南國立成功大學生物科技教學大樓舉行。此次大會主題為「公民科學」，將聚焦當代重要潮流－公民參與、資料共享與數據科學。感謝中央研究院支持，特別邀請沖繩科學與技術學院、主持全球螞蟻多樣性資訊計畫的 Dr. Evan Economo 專題演講，與台灣資料科學家、昆蟲學家對話。此次會議也邀請「台灣生命大百科」許正欣經理舉辦 iNaturalist 工作坊，配合林務局進行保育知識的推廣與交流，並廣邀各大昆蟲討論社團之版主與會，台灣昆蟲學會將陸續推出昆蟲為主角的公民科學計畫，敬請期待！

為了傳達學會承先啟後的精神，本屆年會更安排許祐薰、吳明城與林彥伯三位新進教師演講，以及資深研究人員暨前理事長趙榮台博士的閉幕演講，來為大家說古敘今，相信學會可作為台灣昆蟲學人溫暖後盾。

過去年會舉行地點多位於中、北部，今年年會首次來到歷史悠久的人文古都──台南舉行。感謝地主單位以及學會工作團隊的努力，讓年會成為學術界、產業界、農試單位、以及對昆蟲有興趣的業餘愛好者最佳交流平台。且年會持續國際化，參與人數從過去的兩百多人，逐年提升至四百人以上的規模，近年皆有超過百篇摘要投稿。希望在這短短的兩天內，大家可以感受到我們安排的用心，共享知識饗宴！

理事長  敬上

2018 年 10 月 20 日

第 39 屆昆蟲學會幹部

	姓名	單位
理事長	楊曼妙	國立中興大學 昆蟲學系
President	Man-Miao Yang	Department of Entomology National Chung Hsing University
秘書組	李後鋒	國立中興大學 昆蟲學系
Secretary section	Hou-Feng Li	Department of Entomology National Chung Hsing University
	廖一璋	國立中興大學 昆蟲學系
	Yi-Chang Liao	Department of Entomology National Chung Hsing University
	黃詩穎	國立中興大學 昆蟲學系
	Shih-Ying Huang	Department of Entomology National Chung Hsing University
學術組	陳一菁	國立成功大學 生命科學系
Academic research section	I-Ching Chen	Department of Life Sciences National Cheng Kung University
	韋家軒	國立成功大學 生命科學系
	Chia-Hsuan Wei	Department of Life Sciences National Cheng Kung University
會計組	陳嬿后	國立中興大學 昆蟲學系
Accounting section	Yen-Hou Chen	Department of Entomology National Chung Hsing University
	林振睿	國立中興大學 昆蟲學系
	Jhen-Ruei Lin	Department of Entomology National Chung Hsing University
資訊媒體組	吳士緯	中央研究院 生物多樣性研究中心
Information and media section	Shipher Wu	Research Center for Biodiversity Academia Sinica
活動組	蔡經甫	國立自然科學博物館 生物學組
Activities section	Jing-Fu Tsai	Department of Biology National Museum of Natural Science
出版組	吳明城	國立中興大學 昆蟲學系
Editing and publication section	Ming-Cheng Wu	Department of Entomology National Chung Hsing University

內容 Contents

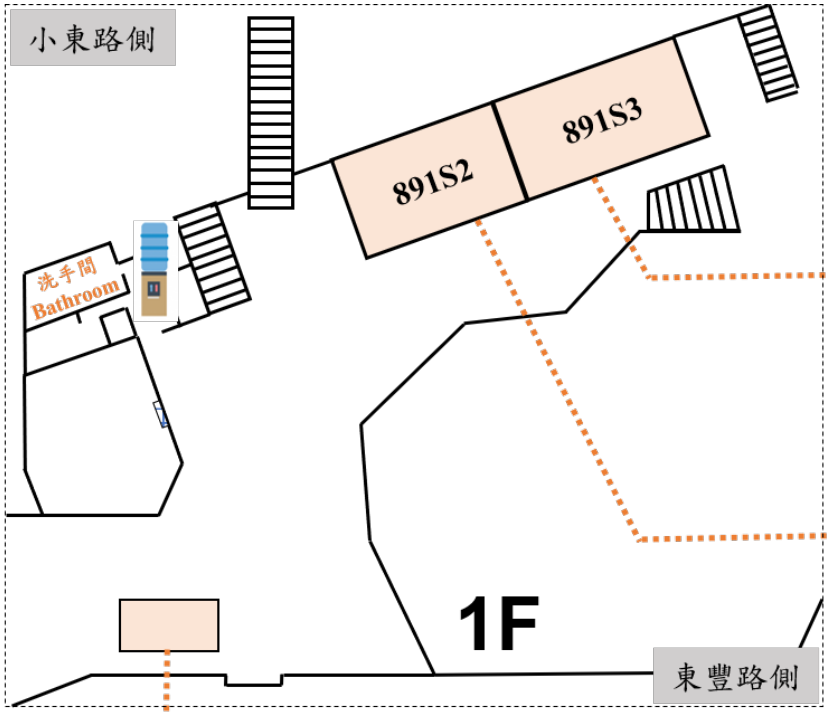
會議地點 Meeting Venue

國立成功大學 生物科技教學大樓

College of Bioscience and Biotechnology, National Cheng Kung University

會場平面圖 Floor Plan

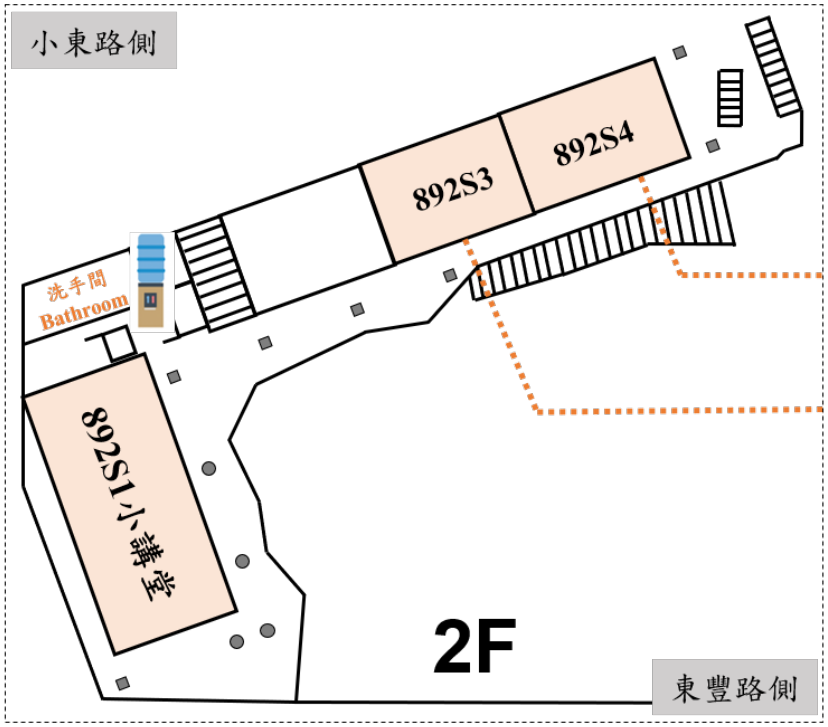
國立成功大學 生物科技教學大樓 平面圖



昆蟲臉書/粉專社團
交流討論
Mini-symposium for
FB insect clubs
臺灣生命大百科交流
工作坊
TaiEOL Workshop

海報區
Poster Area

報到區 Registration



論文宣讀教室

論文宣讀教室

飲水機

大會資訊 Meeting Information

大會地點 Meeting Venue

本屆大會將於國立成功大學（台南市東區大學路1號）生物科技教學大樓舉行。

主要場地包括892S1小講堂、891S2教室、891S3教室、892S3教室及892S4教室。

The conference will be held at the College of Bioscience and Biotechnology of National Cheng Kung University, including 892S1 conference room, classroom 891S2, 891S3, 892S3 and 892S4.

論文宣讀者注意事項 Guidelines for Oral Presenters

所有場地皆備有電腦及投影機,所有講者務必於每一場次開始前將檔案上傳至會場電腦(建議使用mac 的講者自備adaptor)。每位講者有15分鐘，包括演講時間12分鐘，討論、回答提問與換場時間3分鐘。

PC and projectors are provided for all meeting rooms. Presentation files should be uploaded to the laptops before the beginning of the sessions. There are 15 minutes for each speaker; 12 minutes for oral presentation and 3 minutes for discussion

海報宣讀者注意事項 Guidelines for Poster Presenters

海報請於10 月20 日上午09:30-10:20 依所指定之編號張貼於『891S2教室』。海報編號請見大會手冊，會場備有膠帶和剪刀。請宣讀者於當天下午15:15-15:45在海報旁介紹研究內容並回答問題。請務必於閉幕典禮前將海報下架。

The posters can be mounted at 09:30am-10:20am on Oct. 20th in the “classroom 891S2”. The poster numbers are listed in the programme. Tape and scissors are provided. During poster sessions (15:15pm-15:45pm), authors should stand close to their boards to answer questions and facilitate discussions on their work. Posters will be displayed throughout the meeting and have to be removed before the closing ceremony.

大會專題演講 Keynote Speech

時間：10 月 20 日 10:30-11:30
講廳：892S1 小講堂

Biodiversity research from local to global scales: new prospects for scientist-society collaboration in the era of big data

Dr. Evan P. Economo
Biodiversity and Biocomplexity Unit
Okinawa Institute of Science and Technology Graduate University (OIST)

新老師演講 New Faculty Plenary

可能因雄性競爭而導致的形態分化與種化：以中華珈蟌為例

Divergent Sexual Selection via Male-Male Competition Drives Morphological Divergence and Speciation in Damselflies

許祐薰博士 Dr. Yu-Hsun Hsu
國立成功大學 生命科學系
Department of Life Sciences
National Cheng Kung University

蜂群的挑戰與未來

Prospects and Challenges for Honey Bee

吳明城博士 Dr. Ming-Cheng Wu
國立中興大學 昆蟲系
Department of Entomology
National Chung Hsing University

介殼蟲的分子分類和鑑定：對現行作物害蟲診斷和管理效率之提升

Molecular Taxonomy and Diagnostics: Increasing Efficiency in Identifying and Managing Pest Scale Insects

林彥伯博士 Dr. Yen-Po Lin
國立嘉義大學 植物醫學系
Department of Plant Medicine
National Chiayi University

專題討論：公民科學與昆蟲學
Symposium on Entomological Citizen Science

分類學、生物多樣性資訊、公民科學:
蛾類資訊交流在臺灣

Taxonomy, biodiversity informatics, citizen science: moth information exchange in Taiwan

吳士緯博士 Dr. Shipher Wu

中央研究院 生物多樣性中心

Biodiversity Research Center, Academia Sinica

How the OKEON Churamori Project established a sustainable win-win collaboration model based on university-high school partnerships

Dr. Masashi Yoshimura

生物多樣沖繩科學技術大學院大學

生物多樣性與複雜性研究單位

Biodiversity & Biocomplexity Unit, Okinawa Instiruute of Science & Techonology Graduate University

Urban biodiversity, regional planning and citizen participation

Dr. Yuta Uchiyama

東北大學 環境科學研究所

Graduate School of Enviromental Studies, Tohoku University

"狂"蟻。"狂"熱：社群媒體在入侵螞蟻研究中之應用

"Crazy" people are what we need for the "crazy" ant project: the role of social media in invasive ant research

楊景程博士 Dr. Chin-Cheng Yang

京都大學 生存圈研究所

Research Institute for Sustainable Humanosphere, Kyoto Universtiy

大會閉幕演講 Closing Speech

時間：10 月 21 日 15:05-15:45
講廳：892S1 小講堂

職涯心得三五事
Lessons learned in my caree

趙榮台博士 Dr. Jung-Tai Chao
前行政院農業委員會林業試驗所研究員
Ex-Researcher, Forestry Research Institute, Council of Agriculture, Executive Yuan

議程大綱 Program at a Glance

<table>
<tr><th colspan="5">10 月 20 日 2018</th></tr>
<tr><th>地點
時間</th><th>892S1 小講堂
(2F)</th><th>892S4
(2F)</th><th>892S3
(2F)</th><th>891S3
(1F)</th></tr>
<tr><td>09:30-10:20</td><td colspan="4">報到 / 壁報張貼 / 臉書社團設攤</td></tr>
<tr><td>10:20-10:30</td><td>開幕</td><td colspan="3" rowspan="4">Plenary session @ 892S1 小講堂</td></tr>
<tr><td>10:30-11:30</td><td>大會專題演講
Dr. Evan Economo</td></tr>
<tr><td>11:30-11:35</td><td>合照</td></tr>
<tr><td>11:35-12:35</td><td>新老師演講
NF01-03</td></tr>
<tr><td>12:35-13:30</td><td colspan="4">午餐 / 理監事會 (89111 會議室)</td></tr>
<tr><td>13:30-15:15</td><td>專題討論：
公民科學與昆蟲學
S_01-04
［楊曼妙、陳一菁］</td><td>病媒、生物防治、
蟲害管理
OD_01-07
［呂曉鈴］</td><td>病媒、生物防治、
蟲害管理
OD_08-14
［郭美華、趙裕展］</td><td>台灣的昆蟲臉書/粉專
社團小型討論會
［蔡經甫］</td></tr>
<tr><td>15:15-15:45</td><td colspan="4">茶敘 / 海報賞析 (891S2 教室)</td></tr>
<tr><td>15:45-17:30</td><td>生物多樣性、族群與
群聚生態學
OB_01-07
［趙榮台、陸聲山］</td><td>系統分類、
族群遺傳、演化
OS_01-07
［顏聖紘、曾惠芸］</td><td>病媒、生物防治、
蟲害管理
OD_15-21
［林彥伯、蔡志偉］</td><td>台灣的昆蟲臉書/粉專
社團小型討論會
［蔡經甫］</td></tr>
<tr><td>17:30-19:30</td><td colspan="4">晚宴</td></tr>
<tr><td>19:30-</td><td colspan="4">古都自由行</td></tr>
<tr><th colspan="5">10 月 21 日 2018</th></tr>
<tr><th>地點
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(2F)</th><th>891S3
(1F)</th></tr>
<tr><td>09:00-10:30</td><td>生物多樣性、族群與
群聚生態學
OB_08-13
［林旭宏、胡正恆］</td><td>行為、生理、
個體生物學
OE_01-06
［蕭旭峰、楊景程］</td><td>病媒、生物防治、
蟲害管理
OD_22-27
［杜武俊、陳文華］</td><td>2018 臺灣生命大百科
教育推廣
暨交流工作坊
［許正欣］</td></tr>
<tr><td>10:30-10:45</td><td colspan="4">茶敘</td></tr>
<tr><td>10:45-11:45</td><td>全英文場次
OEng_01-04
［陳美娥、鄭任鈞］</td><td>行為、生理、
個體生物學
OE_07-10
［蕭旭峰、楊景程］</td><td>病媒、生物防治、
蟲害管理
OD_28-31
［黃榮南］</td><td>2018 臺灣生命大百科
教育推廣暨
交流工作坊
［許正欣］</td></tr>
<tr><td>11:45-12:30</td><td colspan="4">午餐</td></tr>
<tr><td>12:30-13:15</td><td colspan="4">會員大會 (892S1 小講堂)</td></tr>
<tr><td>13:15-14:45</td><td>全英文場次
OEng_05-10
［陳美娥、鄭任鈞］</td><td>行為、生理、
個體生物學
OE_11-16
［黃佳欣］</td><td>病媒、生物防治、
蟲害管理
OD_32-37
［吳姿嫻］</td><td></td></tr>
<tr><td>14:45-15:05</td><td colspan="4">茶敘</td></tr>
<tr><td>15:05-15:45</td><td>閉幕演講：
職涯心得三五事
趙榮台博士</td><td colspan="3" rowspan="2">Plenary session @ 892S1 小講堂</td></tr>
<tr><td>15:45-16:20</td><td>頒獎典禮</td></tr>
</table>

*午餐、茶敘、晚宴位於一二樓教室；[ ]為主持人

Program at a Glance

October 20, 2018				
Time \ Place	892S1 小講堂 (2F)	892S4 (2F)	892S3 (2F)	891S3 (1F)
09.30-10.20	Registration / Poster Posted / FB Group Booths Settled			
10.20-10.30	Opening Welcome	Plenary session @ 892S1 小講堂		
10.30-11.30	Keynote Speech Dr. Evan Economo			
11.30-11.35	Group Photo			
11.35-12.35	New Faculty Plenary NF_01-03			
12.35-13.30	Lunch / Board of Directors Meeting (89111 Meeting Room)			
13.30-15.15	Symposium: Entomological Citizen Science S_01-04 [Yang, Man-Miao & Chen, I-Ching]	Disease Vector, Biological Control & Pest Management OD_01-07 [Lu, Hsiao-Ling]	Disease Vector, Biological Control & Pest Management OD_08-14 [Kuo, Mei-Hua & Chao, Yu-Chan]	Mini-symposium: Insect Facebook Pages and Groups [Tsai, Jing-Fu]
15.15-15.45	Tea Break / Poster Presentation (891S2 classroom)			
15.45-17.30	Biodiversity, Population & Community Ecology OB_01-07 [Chao, Jung-Tai & Lu, Sheng-Shan]	Systematics, Population Genetics & Evolution OS_01-07 [Yen, Shen-Horn & Tseng, Hui-Yun]	Disease Vector, Biological Control & Pest Management OD_15-21 [Lin, Yen-Po & Tsai, Chih-Wei]	Mini-symposium: Insect Facebook Pages and Groups [Tsai, Jing-Fu]
17:30-19.30	Banquet Dinner			
19:30-	Self-guided Tour			
October 21, 2018				
Time \ Place	892S1 小講堂 (2F)	892S4 (2F)	892S3 (2F)	891S3 (1F)
09.00-10.30	Biodiversity, Population & Community Ecology OB_08-13 [Lin, Hsu-Hung & Hu, Cheng-Heng]	Ethology, Physiology & Organismic Biology OE_01-06 [Hsiao, Hsu-Feng & Yang, Ching-Cheng]	Disease Vector, Biological Control & Pest Management OD_22-27 [Tu, Wu-Chun & Chen, Wen-Hua]	2018 Taiwan Encyclopedia of Life Workshop [Hsu, Cheng-Hsin]
10.30-10.45	Tea Break			
10.45-11.45	Full English Session OEng_01-04 [Chen, Mei-Er & Cheng, Ren-Chung]	Ethology, Physiology & Organismic Biology OE_07-10 [Hsiao, Hsu-Feng & Yang, Ching-Cheng]	Disease Vector, Biological Control & Pest Management OD_28-31 [Huang, Jung-Nan]	2018 Taiwan Encyclopedia of Life Workshop [Hsu, Cheng-Hsin]
11.45-12.30	Lunch			
12.30-13.15	Annual General Meeting (892S1 小講堂)			
13.15-14.45	Full English Session OEng_05-10 [Chen, Mei-Er & Cheng, Ren-Chung]	Ethology, Physiology & Organismic Biology OE_11-16 [Huang, Chia-Hsin]	Disease Vector, Biological Control & Pest Management OD_32-37 [Wu, Tzu-Hsien]	
14.45-15.05	Tea Break			
15.05-15.45	Closing Speech: Lessons learned in my career Dr. Jung-Tai Chao	Plenary session @ 892S1 小講堂		
15.45-16.20	Award Ceremony & Farewell			

* Lunch, Tea Break, Banquet Dinner @ all classrooms; [ ] are the hosts of the session.

編碼對照表

K	大會專題演講 Keynote Speech
NF	新進教師演講 New Faculty Plenary
S	專題討論 Symposium
CS	閉幕演講 Closing Speech
OD	病媒、生物防治與蟲害管理論文宣讀 Oral Session: Disease Vector, Biological Control and Pest Management
OB	昆蟲生物多樣性、族群與群聚生態學論文宣讀 Oral Session: Biodiversity, Population and Community Ecology
OS	昆蟲系統分類、族群遺傳與演化論文宣讀 Oral Session: Systematics, Population Genetics and Evolution
OE	行為、生理與個體生物學論文宣讀 Oral Session: Ethology, Physiology and Organismic Biology
OEng	全英文場次論文宣讀 Oral Session: Full English Session
PD	病媒、生物防治與蟲害管理壁報展示 Posters: Disease Vector, Biological Control and Pest Management
PB	昆蟲生物多樣性、族群與群聚生態學壁報展示 Posters: Biodiversity, Population and Community Ecology
PS	昆蟲系統分類、族群遺傳與演化壁報展示 Posters: Systematics, Population Genetics and Evolution
PE	行為、生理與個體生物學壁報展示 Posters: Ethology, Physiology and Organismic Biology

論文宣讀總表 Conference Agenda

*為發表人，粗體為參加競賽/午餐、茶敘、晚宴位於一二樓教室

<table>
<tr><th colspan="5">10 月 20 日 2018</th></tr>
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<tr><td>10:20-10:30</td><td>開幕</td><td colspan="3" rowspan="6">Plenary session @ 892S1 小講堂</td></tr>
<tr><td>10:30-11:30</td><td>K
Biodiversity research from local to global scales: new prospects for scientist-society collaboration in the era of big data
Dr. Evan Economo</td></tr>
<tr><td>11:30-11:35</td><td>合照</td></tr>
<tr><td>11:35-11:55</td><td>NF_01
可能因雄性競爭而導致的形態分化與種化：以中華珈蟌為例
許祐薰博士</td></tr>
<tr><td>11:55-12:15</td><td>NF_02
蜂群的挑戰與未來
吳明城博士</td></tr>
<tr><td>12:15-12:35</td><td>NF_03
介殼蟲的分子分類和鑑定：對現行作物害蟲診斷和管理效率之提升
林彥伯博士</td></tr>
<tr><td>12:35-13:30</td><td colspan="4">午餐 / 理監事會 (89111 會議室)</td></tr>
</table>

地點 時間	**892S1 小講堂 (2F)**	**892S4 (2F)**	**892S3 (2F)**	**891S3 (1F)**
13:30-13:45	專題討論：公民科學與昆蟲學 Symposium: Entomological Citizen Science S_01 分類學、生物多樣性資訊、公民科學: 蛾類資訊交流在臺灣 吳士緯博士 S_02 How the OKEON Churamori Project established a sustainable win-win collaboration model based on university-high school partnerships Dr. Masashi Yoshimura S_03 Urban biodiversity, regional planning and citizen participation Dr. Yuta Uchiyama S_04 "狂"蟻。"狂"熱：社群媒體在入侵螞蟻研究中之應用 楊景程博士	OD_01 農法與農地地景對臺灣苗栗地區水稻田害蟲及天敵多樣性及豐度之影響 黃寄綸*，陳泓如，劉鈞嘉，林裕彬，蔡志偉	**OD_08** **以常壓非熱電漿之電漿化空氣作為燻蒸劑 應用於蘭花太平洋偽葉蟎防治效果** **魏煜穎*，陳文華**	台灣的昆蟲臉書/粉專社團小型討論會 臺灣昆蟲同好會 慕光之城—探索臺灣蛾類世界 台灣產蝶蛾圖鑑 - 台灣鱗翅目整合型生物多樣性資料庫 台灣的食糞群金龜 台灣的金花蟲 蠆市場名 台灣的水生昆蟲 白蟻(大水蟻)交流社團 地球上的外太空—蟻客世界
13:45-14:00		OD_02 茶樹捲葉蛾類害蟲寄生性天敵之分子鑑定研究 廖證翔*，寧方俞，陳淑佩，廖治榮，林昆鴻	**OD_09** **兩種番茄黃化捲葉病毒在菸草粉蝨(*Bemisia tabaci*) 體內的競爭及病毒競爭對傳播的影響** **李威樺*，牟德芬，蔡志偉**	
14:00-14:15		OD_03 利用低溫休眠特性調整平腹小蜂量產作業 吳怡慧*，潘宣任，李世仰	**OD_10** **寄主植物及抗生素對於菸草粉蝨內共生菌族群的影響** **胡芳瑜*，蔡志偉**	
14:15-14:30		OD_04 金門地區恙蟎及小哺乳動物脾臟攜帶嗜吞噬細胞無形體之分子偵測 鍾珞璿*、王錫杰、蔡坤憲	**OD_11** **台灣柑橘木蝨族群抗藥性及黃龍病帶原頻度調查** **項品慧*，戴淑美，鍾光仁**	
14:30-14:45		OD_05 利用病媒昆蟲法監測台灣畜牧場牛隻病原 曾皓佑*，吳懷慧，丁履紉，張念台，周宜昌，杜武俊	**OD_12** **應用餌劑防治危害芒果樹的台灣家白蟻群體** **賴佑宜*，李後鋒**	
14:45-15:00		OD_06 台灣中部荔枝椿象對六種殺蟲劑之感受性初探 王文龍*、張志弘、張慕瑋、吳昭儀、洪巧珍	**OD_13** **臺灣荔枝瘦蚋寄生蜂及其優勢物種*Quadrastichus* sp.之基礎生物學** **趙宜閔*，林聖豐，楊曼妙**	
15:00-15:15		OD_07 博物館藏品蟲害管理現況 楊若苓*	**OD_14** **台灣都市建築白蟻危害現況及分飛季節之普查** **黃詩穎*，李瑋杰，蔡易穎，李後鋒**	
15:15-15:45	茶敘 / 海報賞析 (891S2 教室)			

地點 時間	892S1 小講堂 (2F)	892S4 (2F)	892S3 (2F)	891S3 (1F)
15:45-16:00	**OB_01** **外來入侵物種紅火蟻分佈與擴散-以台北市為例** **陳昱雄***	**OS_01** **Transoceanic dispersal and biogeography of littoral *Cercyon* Leach (Hydrophilidae) across the Northern Pacific** **Alyssa Suzumura*, Masahiro Ohara**	**OD_15** **硼酸凝膠誘餌：德國蟑螂的新工具（Dictyoptera：Blattellidae）** **Lekhnath Kafle***	台灣的昆蟲臉書/粉專社團小型討論會 螞蟻帝國 台灣蟬保育學會 台灣椿象(蝽類)分類生態誌
16:00-16:15	**OB_02** **苗栗入侵紅火蟻零星發生地區之全面偵查** **謝宗澤*，陳昭汝，李冠欣，王惇彥，郭美華**	**OS_02** **台灣產白蟻領科的分類回顧與分子系統學** **吳佳倩*，李後鋒**	**OD_16** **台灣抗百滅寧品系埃及斑蚊之轉錄體分析** **謝立青。黃思嘉*，戴淑美**	
16:15-16:30	**OB_03** **體型與體色在蝴蝶體溫調控的貢獻** **姜信宏*，俞佑錚，陳一菁**	**OS_03** **表皮烴類合成基因在紅火蟻社會超級基因之重複** **方森婭*，張倪禎，李志琦，廖宗緯，黃屏，王忠信**	**OD_17** **埃及斑蚊解毒作用影響熱煙霧噴灑除蟲菊劑的防治成效** **曾偉倫*，侯佳慧，羅怡珮**	
16:30-16:45	**OB_04** **族群間物候的地區適應化影響其時間空間分佈以及面對全球暖化的脆弱程度** **蔡祥瑜*，沈聖峰**	OS_04 臺灣姬薪蟲科分類之初探 (昆蟲綱，鞘翅目) 賀毓翔*，詹美鈴	**OD_18** **埃及斑蚊 Kdr 抗性基因頻率與抗藥性的關係** **侯佳慧*，曾偉倫，羅怡珮**	
16:45-17:00	OB_05 環境平均溫度決定了生物的溫度耐受度和海拔分布 吳士緯，張譯心*，沈聖峰	OS_05 粒線體全基因體譜系分析意外揭示一個形態與行為特異的水棲熠螢新成員(鞘翅目，螢科，熠螢亞科) 吳立偉，Reagan J. T. Villanueva，鄭明倫*	**OD_19** **臺灣桃園國際機場與其他國家熱帶家蚊之親緣關係** **蔡曜文***	
17:00-17:15	OB_06 種內性狀變異沿海拔梯度的分布與影響機制 呂亞融*，端木茂甯	OS_06 Two new species of genus *Platycheirus* (Diptera: Syrphidae) in Taiwan Shiuh-Feng Shiao, Jeroen van Steenis, Jeffrey H. Skevington, Andrew D. Young, Axel M. Ssymank, Tsung-Hsueh Wu*	**OD_20** **取代動物試驗之防蚊液體外檢測方法-多孔人工餵血系統** **羅怡珮，吳詠群***	

地點 時間	**892S1 小講堂 (2F)**	**892S4 (2F)**	**892S3 (2F)**	**891S3 (1F)**
17:15-17:30	OB_07 居家節肢動物相之公民科學調查推動 詹美鈴*，林劭如，陳玲嬋	OS_07 Revision of the genus *Zeugophora* (Coleoptera, Megalopodidae, Zeugophorinae) from Japan, with a description of new species from Taiwan. 竹本拓矢*，李奇峰	OD_21 台灣鈸蠓的飼養 羅怡珮*	
17:30-19:30	晚宴			
19:30-	古都自由行			

10 月 21 日 2018

地點 / 時間	892S1 小講堂 (2F)	892S4 (2F)	892S3 (2F)	891S3 (1F)
09:00-09:15	OB_08 蘭嶼海岸林隙對螞蟻相與土棲節肢動物之影響 胡正恆*	**OE_01** **桃蚜 (*Myzus persicae*) 在寄主與非寄主植物上的取食行為** **周易萱*，蔡志偉**	OD_22 黑殭菌應在病媒蚊幼蟲防治潛用性 陳柏凱*	2018 臺灣生命大百科教育推廣暨交流工作坊
09:15-09:30	OB_09 水稻田節肢動物多樣性在不同農業經營之影響:以苗栗苑裡地區為例 孫偉哲*，廖一璋，楊曼妙	**OE_02** **長腳捷山蟻的覓食行為研究(蟻科，捷山蟻屬)** **林怡岑*，林宗岐**	OD_23 Reproductive output of *Aedes aegypti* (Diptera: Culicidae) in respond to insecticidal stress Lee-Jin Bong*, Kok-Boon Neoh, Chin-Gi Huang, Rou-Xing Ting, Wu-Chun Tu	
09:30-09:45	OB_10 建立入侵小蜜蜂發生之監測、根除技術與風險評估 (膜翅目：蜜蜂科) 徐培修，陳本翰，林依靜，江旻柔，吳姿嫻，宋一鑫*	**OE_03** **瘤顎家蟻屬(*Strumigenys*)孤雌生殖週期研究 (膜翅目：蟻科)** **宋秉叡*，林宗岐**	OD_24 Silencing of 34-kDa salivary protein of *Aedes aegypti* suppresses Dengue-2 virus replication and transmission Chalida Sri-in*, Shih-Che Weng, Wen-Yu Chen, Betty A. Wu-Hsieh, Shin-Hong Shiao, Wu-Chun Tu	
09:45-10:00	OB_11 台灣穿山甲的食物消化率與覓食季節性 孫敬閔*，羅諠憶，梁竣傑，裴家騏，林宗岐，李後鋒	**OE_04** **黃原鼻白蟻的階級發育彈性** **邱奕寧*，邱俊禕，劉佳穎，林明德，李後鋒**	OD_25 Comparative transcriptome analysis of larval and adult midguts of the yellow fever mosquito *Aedes aegypti* 陳思妤，蘇恬昱，蔡政宏，蔡懷寬，黃佳欣*	

地點 時間	**892S1 小講堂 (2F)**	**892S4 (2F)**	**892S3 (2F)**	**891S3 (1F)**
10:00-10:15	OB_12 台灣土白蟻的覓食物候 邱俊禕*，葉信廷，李百靈，郭致與，蔡明哲，李後鋒	**OE_05** **A comparative view on the distribution of histaminergic channels underlying color processing in fly and butterfly visual systems** **Pei-Ju Chen*, Atsuko Matsushita, Kentaro Arikawa**	OD_26 台灣埃及斑蚊擊昏抗性基因突變現況與除蟲菊精類殺蟲劑抗性之關聯 鍾瀚璿，陳易呈，陳彥圻*，林巧，冨田隆史，鄧華真	2018 臺灣生命大百科教育推廣暨交流工作坊
10:15-10:30	OB_13 半白長轉姬薪蟲 (*Eufallia seminivea*)與環境關係之初探 張瑜庭*，詹美鈴，徐堉峰	**OE_06** **Immune dysfunction caused by the expression of polyglutamine expansion in hemocytes of *Drosophila melanogaster*** **林育賢*， Michal Zurovec**	OD_27 登革熱病媒蚊分佈因子分析及其風險地圖建構 蔡宗儒*，鄭惠菁，陳佩琪，李詩雅，蕭翔宇，黃旌集，杜武俊	
10:30-10:45	茶敘			
10:45-11:00	**OEng_01** **Molecular Basis of the formation of salivary glands in the pea aphid *Acyrthosiphon pisum*** **Chun-Wei Lai*, Chun-Che Chang**	**OE_07** **米爾頓釉小蜂(膜翅目：釉小蜂科)對於蒲桃與不同品種蓮霧之產卵偏好性以及花朵氣味成分分析** **林鈺淳*，廖一璋，林裕哲，楊曼妙**	OD_28 以新式硼酸溶液產卵桶監測防治登革熱病媒蚊之實務評估 賴羿廷*，巫國志，蔡坤憲	2018 臺灣生命大百科教育推廣暨交流工作坊
11:00-11:15	**OEng_02** **Polydnavirus regulate the extracellular adenosine levels in *Spodoptera litura* to suppress its immune system** **Yuan Chang*, Yueh-Lung Wu**	**OE_08** **黃原鼻白蟻之胚胎發育與調控胚胎發育之基因表現分析** **劉佳穎*，邱奕寧，李後鋒，林明德**	OD_29 以社團經營模式深耕校園登革熱防治 陳思恩*，楊佳樺，林宜穎，黃旌集，杜武俊	

地點 時間	**892S1 小講堂 (2F)**	**892S4 (2F)**	**892S3 (2F)**	**891S3 (1F)**
11:15-11:30	**OEng_03 Chronobiological effect on oviposition behavior of *Chrysomya megacephala* (Diptera: Calliphoridae) Feng-Hsuan Chen*, Shiuh-Feng Shiao**	**OE_09 台灣銹蠓之轉錄體表現分析 陳冠宇*，林明德**	OD_30 2018 年新北市登革熱流行特性與防治成效分析 黃基森*，許朝程，許玉芬，李長奎，陳永仁，張少典	2018 臺灣生命大百科教育推廣暨交流工作坊
11:30-11:45	**OEng_04 Display of Surface Protein by Baculovirus for Improving the Stability of Influenza Virus Hemagglutinin through Structure-Guided Motif Swapping Chih-Hsuan Tsai*, Yu-Chan Chao**	OE_10 MicroRNA-encoded homosexual responses in *Drosophila* males 陳秀玲*，廖信博，傅在峰	OD_31 以昆蟲細胞繼代培養 *Wolbachia* 顏采瑩，蔡坤憲*	
11:45-12:30	午餐			
12:30-13:15	會員大會 (892S1 小講堂)			
13:15-13:30	**OEng_05 Effects of encapsulated artificial *Plectranthus amboinicus* essential oil towards *Myzus persicae* and *Plutella xylostella* Xong-Harng Oon*, Rong-Nan Huang**	OE_11 低劑量益達胺對不同齡期蜜蜂基因表現之影響 陳韻如*，曾德維，丁婕，徐培修，吳姿嫻，鍾思林，楊恩誠	OD_32 大豆油乳液在甜瓜葉螨防治上的應用初探 李啟陽*，姚美吉	
13:30-13:45	**OEng_06 Functional characterization of concentrative nucleoside transporter 2 (CNT2) in *Drosophila melanogaster* Houda Ouns Maaroufi*, Michal Zurovec**	OE_12 養菌白蟻與食木白蟻的通道材料與建築行為研究 陳柏曄*，邱俊禕，張芳志，李後鋒	OD_33 基徵草蛉及化學藥劑對草莓田間二點葉螨密度影響 李念臻*，丁漢彥，盧美君	

地點 時間	**892S1 小講堂 (2F)**	**892S4 (2F)**	**892S3 (2F)**	**891S3 (1F)**
13:45-14:00	**OEng_07 Multiple evolutionary origins lead to diversity in the metabolic profiles of ambrosia fungi Yin-Tse Huang*, James Skelton, Jiri Hulcr**	OE_13 視覺刺激對單隻雌性大頭金蠅（雙翅目：麗蠅科）產卵行為之影響 林佳蓉*	OD_34 評估蘇力菌、培丹、因滅汀及得芬諾於田間對荔枝細蛾之防治效果 王泰權*	
14:00-14:15	OEng_08 Developmental distribution of the components in the Dpp signaling pathway implicates how the dorsoventral axis is established in the asexual viviparous pea aphid Yi-min Hsiao*, Chun-che Chang	OE_14 黃喙蜾蠃（*Rhynchium brunneum*）（膜翅目：胡蜂科）築巢策略 徐謙*，陸聲山，蕭旭峰	OD_35 台灣白殭菌菌株對咖啡果小蠹致病力之初步研究 梁鈺平*，王泰權	
14:15-14:30	OEng_09 Histone deacetylase inhibitor treatment strengthens memory, learning, and immune ability in pathogen-infected and neonicotinoid-treated *Apis mellifera* Cheng-Kang Tang*, Yueh-Lung Wu	OE_15 熱帶火蟻體型造成覓食工蟻對搬運與肢解行為的差異 趙子嫣*，邱名鍾，賴麗娟	OD_36 抗褐飛蝨近同源系水稻對台灣褐飛蝨族群之抗性評估 黃守宏*，鄭清煥，李長沛	
14:30-14:45	OEng_10 Microbe-Mosquito Interactions in Stagnant Water Containers Matan Shelomi*	OE_16 根蟎新人工飼料之開發及其效益評估 林政寬*，陳文華	OD_37 農用噴藥無人機應用於防治茶園小型害蟲之成效評估 寧方俞*，江致民，黃仕宗，林昆鴻，蔡憲宗	
14:45-15:05	茶敘			
15:05-15:45	閉幕演講： 職涯心得三五事 趙榮台博士	Plenary session @ 892S1 小講堂		
15:45-16:20	頒獎典禮			

Confernce Agenda

* denotes speakers, bold denotes competition
Lunch, Tea Break, Banquet Dinner @ all classrooms

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<tr><td>09:30-10:20</td><td colspan="4">Registration / Poster Mounted / FB Group Booths Settled</td></tr>
<tr><td>10:20-10:30</td><td>Opening Welcome</td><td colspan="3" rowspan="6">Plenary session @ 892S1 小講堂</td></tr>
<tr><td>10:30-11:30</td><td>K_01
Biodiversity research from local to global scales: new prospects for scientist-society collaboration in the era of big data
Dr. Evan Economo</td></tr>
<tr><td>11:30-11:35</td><td>Group Photo</td></tr>
<tr><td>11:35-11:55</td><td>NF_01
Divergent Sexual Selection via Male-Male Competition Drives Morphological Divergence and Speciation in Damselflies
Dr. Yu-Hsun Hsu</td></tr>
<tr><td>11:55-12:15</td><td>NF_02
Prospects and Challenges for Honey Bee
Dr. Ming-Cheng Wu</td></tr>
<tr><td>12:15-12:35</td><td>NF_03
Molecular Taxonomy and Diagnostics: Increasing Efficiency in Identifying and Managing Pest Scale Insects
Dr. Yen-Po Lin</td></tr>
<tr><td>12:35-13:30</td><td colspan="4">Lunch / Board of Directors Meeting (89111 Meeting Room)</td></tr>
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Place / Time	892S1 小講堂 (2F)	892S4 (2F)	892S3 (2F)	891S3 (1F)
13:30-13:45	Symposium: Entomological Citizen Science S_01 Taxonomy, biodiversity informatics, citizen science: moth information exchange in Taiwan Dr. Shipher Wu S_02 How the OKEON Churamori Project established a sustainable win-win collaboration model based on university-high school partnerships Dr. Masashi Yoshimura S_03 Urban biodiversity, regional planning and citizen participation Dr. Yuta Uchiyama S_04 "Crazy" people are what we need for the "crazy" ant project: the role of social media in invasive ant research Dr. Chin-Cheng Yang	OD_01 The effects of agricultural practice and landscape on the diversity and abundance of pests and natural enemies in the rice fields in Miaoli, Taiwan Chi-Lun,Huang*, Hung-Ju Chen, Chun-Chia Liu, Yu-Pin Lin, Chi-Wei Tsai	**OD_08** **Effect of Plasma Air produced by Atmospheric Non-thermal Plasma as Fumigant Applied to *Tenuipalpus pacificus* Baker on orchid** **Yu-Yin Wei*, Wen-Hua Chen**	Mini-symposium: Insect Facebook Pages and Groups Taiwanese Society of Insect Natural History Taiwan Moth Observation Club-Discovery of moth occurrence and distribution in Taiwan DearLep- The integrative biodiversity platform of Lepidoptera in Taiwan Coprophagous group scarab-beetles of Taiwan Leaf Beetles in Taiwan The Indentification of the Odonata Nymphs Aquatic insects of Taiwan
13:45-14:00		OD_02 Molecular identification of parasitic natural enemies of tea leaf rollers Cheng-Hsiang Liao, Fang-Yu Ning*, Shu-Pei Chen, Jhih-Rong Liao, Kun-Hung Lin	**OD_09** **The competition of two tomato yellow leaf curl viruses in *Bemisia tabaci* and its effect on virus transmission** **Wei-Hua Li*, De-Fen Mou, Chi-Wei Tsai**	
14:00-14:15		OD_03 The mass production progress of *Anastatus* spp. regulated by low temperature through dormant state Yi-Hui Wu*, Hsuan-Jen Pan, Shih-Yang Lee	**OD_10** **The effects of host plant and antibiotic on the population of endosymbionts in *Bemisia tabaci*** **Fang-Yu Hu*, Chi-Wei Tsai**	
14:15-14:30		OD_04 Molecular detection of *Anaplasma phagocytophilum* in chiggers and small mammals spleen in Kinmen Lo-Hsuan Chung*, Hsi-Chieh Wang, Kun-Hsien Tsai	**OD_11** **Investigation of Insecticide resistance and Frequency of *Candidatus Liberibacter asiaticus* on *Diaphorina citri population* in Taiwan** **Ping-Hui Hsiang*, Shu-Mei Dai, Kuang-Ren Chung**	
14:30-14:45		OD_05 The vector-based approach to monitor bovine viral pathogens in Taiwan Hau-You Tzeng*, Huai-Hui Wu, Lu-Jen Ting, Ninan-Tai Chang, Yi-Chang Chou/Wu-Chun Tu	**OD_12** **Baiting Formosan subterranean termite (Blattodea: Rhinotermitidae) in mango trees** **Lai Yu-Yi*, Li Hou-Feng**	

Place / Time	892S1 小講堂 (2F)	892S4 (2F)	892S3 (2F)	891S3 (1F)
14:45-15:00	Symposium: Entomological Citizen Science (continued)	OD_06 Preliminary tests for susceptibility of litchi stink bug, *Tessaratoma papillosa* (Drury) collected from central Taiwan to six insecticides Wen-Lung Wang, Chih-Hung Chang, Mu-Wei Chang, Cho-Yi Wu, Chau-Chin Hung*	**OD_13** **The checklist and seasonal variation of parasitoids on lychee gall midge *Litchiomyia chinensis* Yang & Luo (Diptera: Cecidomyiidae), with biological information of the dominant parasitoid *Quadrastichus* sp. in Taiwan** **Y-Min Chao*, Sheng-Feng Lin, Man-Miao Yang**	Mini-symposium: Insect Facebook Pages and Groups Conversation club of termites Outer space on the Earth: the world of ant and termite guests
15:00-15:15		OD_07 Museum collection pest management in Taiwan Rou-Ling Yang*	**OD_14** **Survey of household termite pests and their dispersal flight season in Taiwan** **Shih-Ying Huang, Wei-Jie Li, Yi-Ying Tsai, Hou-Feng Li***	
15:15-15:45	Tea Break / Poster Presentation (891S2 classroom)			
15:45-16:00	**OB_01** **Distribution and diffusion of invasive alien species- Red Imported Fire Ants - Taipei City as an example** **Yu-Hsiung Chen ***	**OS_01** **Transoceanic dispersal and biogeography of littoral *Cercyon* Leach (Hydrophilidae) across the Northern Pacific** **Alyssa Suzumura*, Masahiro Ohara**	**OD_15** **Boric acid gel bait: A new tool to German cockroaches (Dictyoptera: Blattellidae)** **Lekhnath Kafle***	Mini-symposium: Insect Facebook Pages and Groups Empire of ants Taiwan Cicada Society True bugs of Taiwan: Taxonomy and Ecology
16:00-16:15	**OB_02** **Comprehensive investigation of red imported fire ant (Hymenoptera: Formicidae) in sporadic areas of Miaoli** **Tsung-Tse Hseih, Zhao-Ru Chen, Guan-Sin Li, Dun-Yan Wang, Mei-Hwa Kuo***	**OS_02** **Taxonomic review and molecular systematics of Termitoidae (Blattodea) in Taiwan** **Chia-Chien Wu*, Hou-Feng Li**	**OD_16** **Transcriptome analysis of permethrin-resistant *Aedes aegypti* in Taiwan** **Sih-jia Huang*, Shu-Mei Dai*, Li-Ching Hsieh**	
16:15-16:30	**OB_03** **The effect of body size and melanism on thermoregulation of butterflies** **Shin-Hung, Jiang*, You-Cheng Yu, I-Ching Chen**	**OS_03** **Genes for cuticular hydrocarbon synthesis are duplicated in the social supergene of the fire ant** **Silvia Fontana*, Ni-Chen Chang, Chih-Chi Lee, Wiber Liao, Ping Huang, John Wang***	**OD_17** **Detoxification in *Aedes aegypti* on the efficiency of the thermal fogging spray with pyrethroids** **Wei-Lun Tseng*, Jia-Hui Hou, Yi-Pey Luo**	

Place / Time	892S1 小講堂 (2F)	892S4 (2F)	892S3 (2F)	891S3 (1F)
16:30-16:45	**OB_04** **Locally-Adapted Phenology Drives Spatiotemporal Distribution and Population Vulnerability to Climate Change** **Sheng-Feng Shen*, Hsiang-Yu Tsai**	OS_04 A Preliminary Study of Latridiidae in Taiwan (Insecta, Coleoptera) Yu-Hsiang Ho*, Mei-Ling Chan	**OD_18** **A TaqMan® probe assay for detection knockdown resistance mutations in pyrethroid-resistant *Aedes aegypti*** **Jia-Hui Hou*, Wei-Lun Tseng, Yi-Pey Luo**	
16:45-17:00	OB_05 Mean temperature determines thermal tolerance range and elevational distribution of species Shipher Wu, Yi-Shin Jang*, Sheng-Feng Shen	OS_05 Mitochondrial phylogenomics reveals an unexpected new member of aquatic lucioline fireflies with disparate morphology and ecology (Coleoptera, Lampyridae) Li-Wei Wu/Reagan J.T. Villanueva, Ming-Luen Jeng*	**OD_19** **The phylogenetic analysis of *Culex quinquefasciatus* in Taiwan Taoyuan International Airport and their relationship with other countries** **Tao-Wen Tsai***	
17:00-17:15	OB_06 Patterns and drivers of intraspecific trait variation within ecological communities and their responses to altitudinal gradients Ya-Jung Lu*, Mao-Ning Tuanmu	OS_06 Two new species of genus *Platycheirus* (Diptera: Syrphidae) in Taiwan Shiuh-Feng Shiao, Jeroen van Steenis, Jeffrey H. Skevington, Andrew D. Young, Axel M. Ssymank, Tsung-Hsueh Wu*	**OD_20** **Implementation of the multiple membrane blood-feeding system in mosquito repellent bioassay cooperates to the vertebrate animal use replacement principle.** **Yi-Pey Luo, Yung-Chun Wu ***	
17:15-17:30	OB_07 The promotion of citizen science investigation on household arthropods diversity in Taiwan Mei-Ling Chan*, Shao-Ru Lin, Ling-Hua Chen	OS_07 Revision of the genus *Zeugophora* (Coleoptera, Megalopodidae, Zeugophorinae) from Japan, with a description of new species from Taiwan. Takuya Takemoto*, Chi-Feng Lee	OD_21 Establishing and maintaining colonies of *Forcipomyia taiwana* in a laboratory Yi-Pey Luo*	
17:30-19:30	Banquet Dinner			
19:30-	Self-guided Tour			

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Place / Time	892S1 小講堂 (2F)	892S4 (2F)	892S3 (2F)	891S3 (1F)
09:00-09:15	OB_08 Assessing the Coastal Forest Gap Formation, Ant Fauna, and Arthropod Changes on an Agroforestry Island, Orchid Island (Lanyu) Cheng-Heng Hu* *	**OE_01** **Feeding behavior of *Myzus persicae* on host and non-host plants** **Yi-Syuan Jhou*, Chi-Wei Tsai**	OD_22 Susceptibility of different mosquitoes larvae and pupae to entomopathogenic fungi *Metarhizium anisopliae* Bo-Kai Chen *	2018 Taiwan Encyclopedia of Life Workshop
09:15-09:30	OB_09 Effects of arthropod diversity of rice paddy field under different agriculture managements: an example from the Yuanli area of Miaoli County Wei-Jhe Sun*, Yi-Chang Liao/Man-Miao Yang	**OE_02** **Foraging behavior research of the yellow crazy ant *Anoplolepis gracilipes* (Formicidae, *Anoplolepis*)** **Yi-Tsen Lin*, Chung-Chi Lin**	OD_23 Reproductive output of *Aedes aegypti* (Diptera: Culicidae) in respond to insecticidal stress Lee-Jin Bong*, Kok-Boon Neoh, Chin-Gi Huang, Rou-Xing Ting, Wu-Chun Tu	
09:30-09:45	OB_10 Establish of surveillance, eradication techniques, and risk assessment of dwarf honeybee (Hymenoptera: Apidae) Pei-Shou Hsu, Ben-Han Chen, Yi-Jing Lin, Min-Jou Chiang, Tzu-Hsien Wu, I-Hsin Sung*	**OE_03** **Thelytokous Parthenogenesis Study of *Strumigenys* (Hymenoptera: Formicidae)** **Ping-Jui Sung*, Chung-Chi Lin**	OD_24 Silencing of 34-kDa salivary protein of *Aedes aegypti* suppresses Dengue-2 virus replication and transmission Chalida Sri-in*, Shih-Che Weng, Wen-Yu Chen, Betty A. Wu-Hsieh, Shin-Hong Shiao, Wu-Chun Tu	
09:45-10:00	OB_11 The prey digestibility and foraging seasonality of wild *Formosan pangolins* (Manis pentadactyla pentadactyla) Ching-Min Sun*, Hsuan-Yi Lo, Chun-Chieh Liang, Kurtis Jai-Chyi Pei, Chung-Chi Lin, Hou-Feng Li	**OE_04** **Plasticity of caste development of *Prorhinotermes flavus* (Blattodea: Rhinotermitidae)** **Yi-Ning Chiu*, Chun-I Chiu, Chia-Ying Liu, Ming-Der Lin, Hou-Feng Li**	OD_25 Comparative transcriptome analysis of larval and adult midguts of the yellow fever mosquito *Aedes aegypti* Sih-Yu Chen, Tian-Yu Su, Cheng-Hung Tsai, Huai-Kuang Tsai, Jia-Hsin Huang*	

Place / Time	892S1 小講堂 (2F)	892S4 (2F)	892S3 (2F)	891S3 (1F)
10:00-10:15	OB_12 Foraging phenology of a fungus-growing termite, *Odontotermes formosanus* Chun-I Chiu*, Hsin-Ting Yeh, Pai-Ling Li, Chih-Yu Kuo, Ming-Jer Tsai, Hou-Feng Li	**OE_05** **A comparative view on the distribution of histaminergic channels underlying color processing in fly and butterfly visual systems** **Pei-Ju Chen*, Atsuko Matsushita, Kentaro Arikawa**	OD_26 Current knockdown resistance mutations in Taiwan local *Aedes aegypti* populations and their roles in pyrethroid resistance Han-Hsuan Chung, I-Cheng Cheng, Yen-Chi Chen*, Cheo Lin, Takashi Tomita, Hwa-Jen Teng	2018 Taiwan Encyclopedia of Life Workshop
10:15-10:30	OB_13 A preliminary study on the relationships between *Eufallia seminivea* and environment in its storage room for wet collection Yu-Ting Chang*, Mei -Ling Chan, Yu-Feng Hsu	**OE_06** **Immune dysfunction caused by the expression of polyglutamine expansion in hemocytes of *Drosophila melanogaster*** **Yu-Hsien Lin *, Michal Zurovec**	OD_27 The analysis of dengue vector mosquito distribution and the establishment of dengue risk map Tsung-JU Tsai*, Hui-Ching Cheng, Pei-Qi Chen, Shi-Ya Li, Hsiang-Yu Hsiao, Chin-Gi Huang, Wu-Chun Tu	
10:30-10:45	Tea Break			
10:45-11:00	**OEng_01** **Molecular Basis of the formation of salivary glands in the pea aphid *Acyrthosiphon pisum*** **Chun-Wei Lai*, Chun-che Chang**	**OE_07** **Oviposition preference of *Anselmella miltoni* (Hymenoptera: Eulophidae) to rose apple (*Syzygium jambos*) and different varieties of wax apple (*S. samarangense*) and the analysis of flower volatile** **Yu-Chun Lin*, Yi-Chang Liao, Yu-Che Lin, Man-Miao Yang**	OD_28 Practical evaluation of novel ovitrap with boric acid solution to monitor and control dengue mosquitoes Yi-Ting Lai*, Kuo-Chih Wu, Kun-Hsien Tsai	2018 Taiwan Encyclopedia of Life Workshop
11:00-11:15	**OEng_02** **Polydnavirus regulate the extracellular adenosine levels in *Spodoptera litura* to suppress its immune system** **Yuan Chang*, Yueh-Lung Wu**	**OE_08** **Embryonic development of *Prorhinotermes flavus*: programming of the termite** **Chia-Ying Liu*, Yi-Ning Chiu, Hou-Feng Li, Ming-Der Lin**	OD_29 A strategy of the educational programe on Dengue fever prevention in the junior high school Chen Szu-En*, Chia-Hua Yang, Yi-Ying Lin, Chin-Gi Huang, Wu-Chun Du	

Time \ Place	892S1 小講堂 (2F)	892S4 (2F)	892S3 (2F)	891S3 (1F)
11:15-11:30	**OEng_03** **Chronobiological effect on oviposition behavior of *Chrysomya megacephala* (Diptera: Calliphoridae)** **Feng-Hsuan Chen*, Shiuh-Feng Shiao**	**OE_09** **Transcriptome analysis of *Forcipomyia taiwana*** **Kuan-Yu Chen*, Ming-Der Lin**	OD_30 Dengue fever epidemic features and control efficacy in New Taipei city in 2018 Ji-Sen Hwang*, Chao-Cheng Hsu, Yu-Fen Hsu, Charng-Kwei Lee, Yeong-Ren Chen, Shao-Dian Jhang	2018 Taiwan Encyclopedia of Life Workshop
11:30-11:45	**OEng_04** **Display of Surface Protein by Baculovirus for Improving the Stability of Influenza Virus Hemagglutinin through Structure-Guided Motif Swapping** **Chih-Hsuan Tsai*, Yu-Chan Chao**	OE_10 MicroRNA-encoded homosexual responses in *Drosophila* males Shiu-Ling Chen*, Sin-Bo Liau, Tsai-Feng Fu	OD_31 Stable culture of *Wolbachia* in insect cells Tsai-Ying Yen, Kun-Hsien Tsai*	
11:45-12:30	Lunch			
12:30-13:15	Annual General Meeting (892S1 小講堂)			
13:15-13:30	**OEng_05** **Effects of encapsulated artificial *Plectranthus amboinicus* essential oil towards *Myzus persicae* and *Plutella xylostella*** **Xong-Harng Oon*, Rong-Nan Huang**	OE_11 The effects of sublethal dosage imidacloprid on honey bee gene expression during development Yun-Ru Chen*, David Tzeng, Chieh Ting, Pei-Shou Hsu, Tzu-Hsien Wu, Silin Zhong, En-Cheng Yang	OD_32 A primary study on soybean oil-in-water emulsion as a pesticide to control spider mites on melon Chi-Yang Lee*, Me-Chi Yao	
13:30-13:45	**OEng_06** **Functional characterization of concentrative nucleoside transporter 2 (CNT2) in *Drosophila melanogaster*** **Houda Ouns Maaroufi*, Michal Zurovec**	OE_12 Shelter tube materials and construction behavior of fungus-growing termites and wood-feeding termites (Blattodea：Termitoidae) Bo-Ye Chen*, Chun-I Chiu, Fang-Zhi Chang, Hou-Feng Li	OD_33 The effects of *Mallada basalis* and pesticides on the density of *Tetranychus urticae* on strawberry in the field. Nien-Chen Li*, Han-Yan Ding, Mei-Chun Lu	

Time \ Place	892S1 小講堂 (2F)	892S4 (2F)	892S3 (2F)	891S3 (1F)
13:45-14:00	**OEng_07** **Multiple evolutionary origins lead to diversity in the metabolic profiles of ambrosia fungi** **Yin-Tse Huang*, James Skelton, Jiri Hulcr**	OE_13 Effects of Visual Stimulation on the Oviposition Behavior of Single Female *Chrysomya megacephala* (Fabricius) (Diptera：Calliphoridae) Jia-Rong Lin*	OD_34 Assessment of control efficacy of *Bacillus thuringiensis*, cartap hydrochloride, emamectin benzoate, tebufenozide against litchi fruit borer (*Conopomorpha sinensis*) in litchi orchard Tai-Chuan Wang*	
14:00-14:15	OEng_08 Developmental distribution of the components in the Dpp signaling pathway implicates how the dorsoventral axis is established in the asexual viviparous pea aphid Yi-min Hsiao*, Chun-che Chang	OE_14 Nest-building strategy of *Rhynchium brunneum* (Hymenoptera: Vespidae) Chien Hsu*, Sheng-Shan Lu, Shiuh-Feng Shiao	OD_35 Preliminary study of virulence of *Beauveria bassiana* isolates from Taiwan against the coffee berry borer (Coleoptera: Scolytidae) Yu-Ping Liang*, Tai-Chuan Wang	
14:15-14:30	OEng_09 Histone deacetylase inhibitor treatment strengthens memory, learning, and immune ability in pathogen-infected and neonicotinoid-treated *Apis mellifera* Cheng-Kang Tang*, Yueh-Lung Wu	OE_15 Carrierand cutter, size-related foraging behaviorin the tropical fire ants, *Solenopsis geminata* Tzu-Yen Chao*, Ming-Chung Chiu, Li-Chuan Lai	OD_36 Evaluation of 13 near-isogenic lines with 11 brown planthopper resistant genes in IR24 against brown planthopper populations in Taiwan Shou-Horng Huang*, Ching-Huan Cheng, Charng-Pei Li	
14:30-14:45	OEng_10 Microbe-Mosquito Interactions in Stagnant Water Containers Matan Shelomi*	OE_16 Development of new artificial diets and evaluation of its effectiveness Zheng-kuan Lin*, Wen Hua Chen	OD_37 Evaluation of the effectiveness of agriculture drone sprayer in the control of small pests in tea plantations Fang-Yu Ning*, Chih-Min Chiang, Shih-Tsung Huang, Kun-Hung Lin, Hsien-Tsung Tsai	
14:45-15:05	Tea Break			
15:05-15:45	Closing Speech: Lessons learned in my career Dr. Jung-Tai Chao	Plenary session @ 892S1 小講堂		
15:45-16:20	Award Ceremony & Farewell			

壁報展示總表 Poster List

地點：891S2 教室(1F)

編碼	作者(Authors)	論文標題(Title)
病媒、生物防治、蟲害管理 Disease Vector, Biological Control and Pest Management		
PD_01	王冠智 Kuan-Chih Wang	2018 年台灣登革熱高風險區域使用之防治藥劑對埃及斑蚊的效能 The effect of insecticide used in dengue high-risk area of Taiwan in 2018 on *Aedes aegypti* control
PD_02	陳儀憲、施姿卉、温育德 Yi-Hsein Chen, Tzu-Hui Shih, Yu-Der Wen	應用反射式紅外線光譜分析埃及斑蚊體內沃爾巴克氏菌感染狀態 The application of attenuated total reflection infrared (ATR-IR) spectroscopy analysis for detection of *Wolbachia* in *Aedes aegypti*
PD_03	吳淑娟、王咸雯、羅怡珮 Shu-Juan Wu, Xian-Wen Wang, Yi-Pey Luo	建立防蚊產品對埃及斑蚊空間忌避效果的分析方法 An *in vitro* bioassay system to explore the spatial repellent effecs against *Aedes aegypti*
PD_04	洪佐旻、黃榮南 Tso-Min Hung, Rong-Nan Huang	太赫茲活性水對病媒蚊類非成蟲時期的毒性 Toxicity of terahertz radiation-activity water toward non-adult mosquitoes
PD_05	申屠萱、張淑貞、高靜華 Hsuan Shen-Tu, Shu-Chen Chang, Ching-Hua Kao	應用 ELISA 檢測農產品中殘留之殺蟲劑賽速安 Detection of insecticide thiamethoxam residues in agricultural products using enzyme-linked immunosorbent assay
PD_06	張淑貞、申屠萱、高靜華、黃則豪 Shu-Chen Chang, Hsuan Shen-Tu, Ching-Hua Kao, Tse-hao Huang	殺蟲劑克凡派膠體金側流免疫分析快篩片研發 Development of colloidal-gold based lateral-flow immunoassay for insecticide chlorfenapyr

編碼	作者(Authors)	論文標題(Title)
PD_07	謝佳宏 Chia-Hung Hsieh	外米綴蛾遺傳多樣性與飼育效率評估 Genetic diversity and rearing efficiency evaluation of *Corcyra cephalonica*
PD_08	許北辰、余志儒、董耀仁、林鳳琪、江明耀 Bei-Chen Hsiu, Jih-Zu Yu, Yew-Jen Dong, Feng-Chyi Lin, Ming-Yao Chiang	以旋風分離法分離粉斑螟蛾(*Cadra cautella* Walker)卵粒與鱗粉 Application of cyclonic separation to the eggs and adhesive scales of *Cadra cautella*
PD_09	Yu-Feng Huang, Tzu-Han Chen, Zih-Ting Chang, Tai-Chuan Wang, Yu-Shin Nai	A nucleopolyhedrovirus from golden birdwing larvae (*Troides aeacus formosanus*) revealing a defective Autographa californica NPV genomic features
生物多樣性、族群與群聚生態學 Biodiversity, Population and Community Ecology		
PB_01	黃守宏、黃玉媛、葉懋男、宋一鑫 Shou-Horng Huang, Yu-Yuan Huang, Mao-Nan Yeh, I-Hsin Sung	有機與慣行水稻田無脊椎節肢動物生物量及多樣性調查 Investigations on biomass and diversity of invertebrate arthropods in organic and conventional paddy fields
PB_02	王惇彥、陳昭汝、吳姿嫻、張素貞、邱明智、郭美華 Dunyan Wang, Zhaoru Chen, Zihsian Wu, Sujein Chang, Mingchin Chiu, Meihwa Kuo	不同農法水稻農業生態系之無脊椎動物多樣性 Invertebrate diversity of different farming methods on the rice agroecosystems
PB_03	Saiphon thodthasri, Siriat Toommai, Kittisak Ruampattana, Anothai Wingsanoi	Species Diversity of Rice Insect Pests and Natural Enemies in Thai Hom Mali Rice Paddy Fields
PB_04	吳尹文、張鈞詠 Yin-Wen Wu, Chun-Yung Chang	金門入侵紅火蟻侵入途徑調查 Invasion routes of imported fire ant (*Solenopsis invicta*) in Kinmen

編碼	作者(Authors)	論文標題(Title)
系統分類、族群遺傳與演化　Systematics, Population Genetics and Evolution		
PS_01	Chia-Hsuan Wei, David C. Lees, Shipher Wu, Shen-Horn Yen	Discovery of the immature stages of Neopseustidae and its implication for early evolution of the Lepidoptera and the relationship with Viridiplantae
PS_02	Chia-Hsuan Wei, Shen-Horn Yen, Ming-Luen Jeng, Li-Cheng Shih	Discovery of *Scotopais* (Lepidoptera: Zygaenidae, Chalcosiinae) in Taiwan and its phylogenetic affinity and mimicry with the firefly genus *Vesta*
PS_03	楊昕、顏聖紘 Hsin Yang, Shen-Horn Yen	紫斑蝶的第一個分子系統發育假說與其穆氏擬態環在東南亞演化的意涵 The first molecular phylogenetic hypothesis of *Euploea* butterflies (Lepidoptera: Nymphalidae, Danainae) and its implication of evolution of the Müllerian mimicry rings in SE Asia
PS_04	魏嬗如、顏聖紘 Shann-Ru Wei, Shen-Horn Yen	使用形態特徵檢測 Hypochrosini (Lepidoptera: Geometridae, Ennominae)是否為單系群? Testing the monophyly of Hypochrosini (Lepidoptera: Geometridae, Ennominae): Evidence from morphological characters
PS_05	蔡正隆、趙家慧、施禮正、宋一鑫 Cheng-Lung Tsai, Chia-Hui Chao, Li-Cheng Shih, I-Hsin Sung	鱗翅目檢疫昆蟲 DNA 生命條碼資料建立暨其遺傳變異分析 Establishment of DNA barcode database and genetic variations of lepidopteran quarantine insects
PS_06	蔡正隆、利軒仲、Geonho Cho、廖一璋、楊曼妙、葉文斌 Cheng-Lung Tsai, Hsien-Chung Lee, Geonho Cho, Yi-Chang Liao, Man-Miao Yang, Wen-Bin Yeh	臺灣地區入侵種中國梨木蝨(半翅目：木蝨科)之遺傳變異及起源 Genetic variation and origin of the invasive pear psyllid *Cacopsyll*a *chinensis* (Hemiptera, Psyllidae) in Taiwan

編碼	作者(Authors)	論文標題(Title)
昆蟲行為、生理與個體生物學　Ethology, Physiology and Organismic Biology		
PE_01	王遠騰 Yuan-Teng Wang	狹翅大刀螳與枯葉大刀螳之型態比較 Morphological comparison of *Tenodera angustipennis* and *Tenodera aridifolia* (Mantodea, Mantidae, Mantiane, Polyspilotini)
PE_02	劉佳桀、林宗岐 Chih-Chieh Liu, Chung-Chi Lin	台灣中部地區螞蟻婚飛週期之研究 The Nuptial Flight Pattern of Ants in Central Taiwan
PE_03	林品誌、林宗岐 Ping-Chih Lin, Chung-Chi Lin	大林長腳家蟻不同群落大小對於工具選擇的覓食策略（膜翅目：蟻科） The tool selection of foraging strategy between different colony size in *Aphaenogaster tipuna* （Hymenoptera: Formicidae）
PE_04	Hau Hsu, Hui-Yun Tseng, Chen-Pan Liao, Jung-Ya Hsu, Wen-San Huang	外表很重要: 碎斑硬象鼻蟲(*Eupyrgops waltonianus*)體色傳達的多種訊息 Appearance matters: multiple functional signals of body colors in *Eupyrgops* weevil
PE_05	呂曉鈴、蕭逸旻 Hsiao-ling Lu, Yi-min Hsiao	葡萄根瘤蚜發育基因組序列：基因註解和比較分析 Genomic sequence around phylloxera developmental genes: annotation and comparative analysis
PE_06	林大中、林羿岑、張俊哲 Ta-Chung Lin, Yi-tsen Lin, Chun-che Chang	The impact of temperature on germline development of the pea aphid *Acyrthosiphon pisum*
PE_07	Anothai Wingsanoi, Saiphon thodthasri	Morphology and development of three endoparasitoids of filth fly (Hymenoptera: Pteromalidae, Encyrtidae)
PE_08	陳平、吳岳隆 Ping Chen, Yueh-Lung Wu	DWV 感染與細胞外腺苷信號在西方蜜蜂的神經功能中作用之關聯性 The association of Deformed Wing Virus (DWV) infection and extracellular adenosine signaling in neurological function of *Apis mellifera*

第 39 屆台灣昆蟲學會年會摘要集

Abstract Book

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大會專題演講

Keynote Speech

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Biodiversity research from local to global scales: new prospects for scientist-society collaboration in the era of big data

Evan P. Economo

Biodiversity and Biocomplexity Unit
Okinawa Institute of Science and Technology Graduate University (OIST)

The human domination of the planet has raised monumental challenges for both science and society. The threats to biodiversity in the Anthropocene are myriad and well-known. However, despite wide interest in biodiversity conservation, we still lack adequate geographic and natural history information on most species let alone the dynamics of their communities over time. This is particularly true for hyperdiverse groups such as insects. To have a chance of conserving biodiversity effectively, we need to find ways to both document and monitor it more efficiently. At the same time, in many countries the position of science and scientists within broader society could be improved, and there is an ongoing need to better engage with the public. In the current era, new technologies including data science and computation have raised opportunities for both enhanced scientific discovery, as well as enhanced participation by the larger society. In this talk, I discuss these issues through the lens of two ongoing projects. First, the Okinawa Environmental Observation Network (OKEON) Project, an effort build a local community-collaborative research network for long-term ecological monitoring on the island of Okinawa. The project aims to both achieve scientific goals but also foster interconnectivity between researchers and society in a mutually beneficial fashion. Second, I discuss the Global Ant Biodiversity Informatics (GABI) Project, an effort to synthesize global biodiversity data on a single insect group, ants, for analysis in both basic science and conservation-related questions. In certain countries, citizen science groups are providing invaluable data toward that effort with serious benefit to the science. These examples of scientist-society collaboration, among many others around the world, may provide useful lessons for the ongoing development of collaborative biodiversity research to address the major environmental challenges of the modern era.

新老師演講

New Faculty Plenary

NF_01

可能因雄性競爭而導致的形態分化與種化：以中華珈蟌為例

Divergent Sexual Selection via Male-Male Competition Drives Morphological Divergence and Speciation in Damselflies

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Male-male competition has been neglected in studies of speciation by sexual selection. Traits involved in competition can be used directly to fight (weapons) or indirectly to indicate quality (signals). Weapons preforming better or signals being more effective in particular habitats are expected to be advantageous, thus reinforce divergence between habitats (divergent fighting contexts hypothesis and conspicuous signaling hypothesis, respectively). However, weapons and signals have rarely been considered together in an empirical study. Here we investigate the roles of morphological traits in male-male competition in two Taiwanese *Psolodesmus mandarinus* subspecies: *P. m. mandarinus* and *P. m. dorothea*. Male damselflies compete through aerial contests without physical contact, so traits enhancing energy storage and flight maneuver may function as weapons, whereas other wing pigmentations display signals. Among 582 male *P. m. mandarinus* and 552 male *P. m. dorothea*, heavier individuals had higher mating success, but the positive association between mating success and the size of black wing patch only occurs in *mandarinus*, which distribute in cooler and darker areas. The subspecies-specific conspicuous white wing patch of *P. m. mandarinus* also increases male mating success. Our study supports both hypotheses, and is one of the first to show that weapons and signals can simultaneously promote speciation via male-male competition.

Keywords: male competition, divergence, speciation, damselfly, pigmentation

NF_02

蜂群的挑戰與未來
Prospects and Challenges for Honey Bee

吳明城
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Bee colony loss is a crucial issue started from 2006. Multiple factors have been linked with colony losses, including the parasitic mite *Varroa destructor*, the fungal parasites *Nosema apis*, bacteria, viruses, fragmentation and loss of habitat, climate change and widespread pesticide application. We have found that the sublethal doses of systemic pesticides, imidacloprid have deep impacts on the physiological gene expression of honey bees. When larvae were received 2 ng of imidacloprid, the genes encoding major royal jelly proteins (MRJPs), queen bee determinators and primary nutrient sources for larval development are repressed significantly. Accordingly, we assume that nutrient status of honey bee colony would be hampered if they received low dosage of pesticide. Based on this, we are developing bee breads and exploring bee gut probiotics in order to improve bee health. Regarding bee bread development, we have found that some protein sources can improve nutrient gene expression of honey bee and some oils seem to have the role of phagostimulant. Additionally, we have worked on the functionality of probiotics isolated from honey bee gut system. We expect that the outcome of development of high nutrient bee bread and exploring of probiotics would help honey bee colony healthy development.

Keywords: honey bee, colony loss, nutrition, bee bread, probiotics

NF_03

介殼蟲的分子分類和鑑定：對現行作物害蟲診斷和管理效率之提升
Molecular Taxonomy and Diagnostics: Increasing Efficiency in Identifying and Managing Pest Scale Insects

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介殼蟲屬昆蟲綱 (Insecta)、半翅目 (Hemiptera)、介殼蟲總科 (Coccomorpha)，目前全世界已知 40 餘科 8000 多種，此類昆蟲體型微小，體外多具蠟質分泌物保護，防治不易，是各農林園藝作物的重要害蟲。在診斷鑑定上，本類昆蟲現行分類系統根據雌成蟲形態特徵建立，但標本製備耗時費力，且這些特徵常受環境條件影響而具趨同現象，造成物種鑑定上的困難。因此，可提供相對豐富資訊的 DNA 分子序列或可為介殼蟲的快速鑑定另闢蹊徑。當前節肢動物分子條碼 (DNA barcoding) 鑑定多利用粒線體 (mitochondrial) DNA 之胞色素氧化酶 (*COI*) 序列，但目前此基因之各通用引子對 (universal primers) 在介殼蟲總科上的使用卻頗受局限，可順利擴增的種類數不多，此現象在軟體介殼蟲科 (Coccidae) 與粉介殼蟲科(Pseudococcidae) 種類中尤其突出。本現象或因此類昆蟲起源甚早，但卻於較晚近的進化歷程中快速累積突變所致。故除設計此類昆蟲 *COI* 專一性引子對外，尚需累積其他基因 DNA 序列資料以強化現有分子資料庫代表性，以利往後進行此類昆蟲孤雌生殖的發生、隱蔽種判定、高階分類單元 (屬級以上) 間系統發育、與寄主植物、天敵昆蟲、病原微生物、內共生微生物之間的協同進化等問題之探討。

Keywords: Coccomorpha, Coccoidea, DNA barcode, taxonomy, systematics, species identification, COI

專題討論：公民科學與昆蟲學

Symposium:

Entomological Citizen Science

S_01

Taxonomy, biodiversity informatics, citizen science: moth information exchange in Taiwan

Shipher Wu
Biodiversity Research Center, Academia Sinica

Among one of four speciose insect Orders, Lepidoptera, moths are arguably the ideal group for large-scale studies and biodiversity education due to its high species richness, well-established higher classification and phototactic behavior that facilitates taxon sampling. Originating from the following historical contexts, i.e., recent 25-year progress of fundamental surveys, faunistic publications, systematic studies, and the construction of two major biodiversity databases, DearLep and Taiwan Moth Information Center, the moth social network, Taiwan Moth Observation Club, has been an iconic model for insect citizen science in Taiwan, therefore, enormous occurrence data, voucher specimens and/or images have been documented since 2011. The talk aims to illustrate such historical contexts, introduce the approaches of collaboration between moth taxonomists and citizens and what kinds of moth studies have been published or explored under the basis of citizen science. To conclude, I encourage researchers/citizens focusing on specific insect taxa to step by step establish the integrated networks concerning taxonomy, biodiversity informatics, citizen science and the progress of other related taxa with interactions, to achieve the synchronous growth of Entomology in academia and civil society.

Keywords: Entomology, biodiversity, social network

S_02

How the OKEON Churamori Project established a sustainable win-win collaboration model based on university-high school partnerships

Masashi Yoshimura
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In conservation biology research, citizen-science investigations bring great power to gather a large amount of data over a wide area in a limited time. This framework also brings together knowledge and awareness on the local environmental conservation to the participants. The OKEON Churamori Project, community collaborative environmental monitoring project in Okinawa, Japan also regards as a major goal the promotion of a social network that shares data and utilizes it. Local high schools are one of the major collaborators in the project. We have attempted to establish a new sustainable model of win-win interaction that is beneficial for both of research and education. Until now, high school-university collaboration in Japan is often beneficial for one side, for example, as a vehicle for University promotion. On the other hand, the high school side commonly asks for services from the university such as the career education, advanced level lectures, and/or accepting students as interns. Research investigations involving students could be a win-win model for both sides, however, these are challenging to sustain. In the OKEON Churamori Project, we established a new model of the university-high school collaboration that benefits both research and education. The model consists of (1) providing a package of protocols for ant biodiversity survey useful for high school class activities, (2) providing workshops and personal guidance to teachers for its practice if necessary, (3) encouraging teachers to conduct their own ant research with their students, (4) asking for donating specimens collected in the research to us once the annual research is done. As the result, OKEON obtains a new survey network with a certain protocol similar to the citizen-science observation model. In the same time, teachers can provide their students the higher quality instruction for their science research activities, then student can have an experience to see and contribute toward bigger conservation project covering across Okinawa. In this presentation, I would like to discuss the results of the collaboration model and its future issues.

S_03

Urban biodiversity, regional planning and citizen participation

Yuta Uchiyama
Tohoku University Graduate School of Environmental Studies

The ninth meeting of Conference of the Parties (COP9) officially adopted the issue of local biodiversity degradation including loss of biodiversity in urban areas (Decision XI/28) in 2008. In this international process, Singapore proposed City Biodiversity Index (CBI) (so called Singapore Index) to monitor and evaluate status of biodiversity in urban areas in different regions of the world. The CBI has three main aspects: (i) native biodiversity, (ii) ecosystem service, and (iii) governance and management. These aspects need to be considered in urban and regional planning, and citizens participation is needed to support the monitoring activities and governance of urban biodiversity under the limited budget and human resources in local municipalities. Furthermore, “extinction of experience” of children is paid attention as urgent issue in the fields of environmental education and citizen science. Involving those younger generations in monitoring activities is needed in terms of sustainability education. On the other hand, practical indicators were developed to support the monitoring and evaluation activities conducted by local municipalities. As an example of those indicators, degree of landuse mix which correlates with biodiversity was proposed to estimate the status of biodiversity in local areas. It should be noted that local municipalities have different local contexts of biodiversity conservation. Understanding of those contexts can facilitate the citizens participation and use of the practical indicators. In the international process of biodiversity conservation initiatives, science policy platforms including the Intergovernmental science-policy Platform on Biodiversity and Ecosystem Services (IPBES) and Future Earth promote involving stakeholders in biodiversity policy implementation. Those platforms can contribute to sharing of experience and knowledge beyond individual sectors and regions to conserve biodiversity and enhance well-being of local communities.

S_04

"Crazy" people are what we need for the "crazy" ant project: the role of social media in invasive ant research

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Social media can be used to combat invasive alien species. For instance, Twitter, Facebook and others have helped engage volunteers of the public to participate in invasive species surveillance networks. Numerous studies also have highlighted the importance of social media in facilitating invasive species research; most of which, however, are often restricted to mapping distribution and spread of invasive species. Taking our ongoing project as an example, we attempt to show how social media assists scientists in reconstructing history of a focal invasive species. The project is to employ population genetics to identify native range of a globally distributed invasive ant, longhorn crazy ant (*Paratrechina longicornis*). To ensure our sample collection covers as many geographical populations as possible, we have launched an international ant-hunting citizen science campaign through several social media, in which we have 1) involved citizen scientists across 15 countries in collection of *P. longicornis*, 2) developed a user-friendly field collection toolkit, and 3) offered volunteers online/on-site training on how to identify and collect the ants in the field. More than 2,000 samples of *P. longicornis* from worldwide have been collected by the campaign participants, and are currently being genotyped at 40 microsatellite loci. Preliminary data allow us to speculate India, instead of Africa or Southeast Asia, as the ant's putative native range. What we learned from the campaign includes that 1) public awareness of *P. longicornis* and other invasive ants has been significantly built up in local communities, 2) such a treasure-hunting activity effectively retains enthusiastic participation of volunteers, and 3) participant feedback on social media could inspire more ideas and plays a key role in keeping the campaign evolve. To conclude, our project demonstrates social media/citizen science as a promising avenue for promoting future invasive species research.

閉幕演講

Closing Speech

CS

職涯心得三五事
Lessons learned in my caree

趙榮台
Jung-Tai Chao
前行政院農業委員會林業試驗所研究員
Ex-Researcher, Forestry Research Institute, Council of Agriculture, Executive Yuan

台灣昆蟲學會自 1980 年成立，迄今 38 載。我回國後進入職場，同時加入學會，迄今也有 30 多年。個人在研究、教學、行政、規劃各方面都經歷過挑戰，並參與學會的運作與發展，獲得許多寶貴的經驗。本屆年會應學會邀請，謹以一些親身經驗來說明個人的心得，供會友參考。

病媒、生物防治及蟲害管理

論文宣讀摘要集

Oral Session:

Disease Vector, Biological Control and Pest Management

OD_01

農法與農地地景對臺灣苗栗地區水稻田害蟲及天敵多樣性及豐度之影響

The effects of agricultural practice and landscape on the diversity and abundance of pests and natural enemies in the rice fields in Miaoli, Taiwan

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背景/研究問題/材料方法

近年有機農法日益受到重視，有機操作與水稻田節肢動物相與豐度的關聯性已累積有一些研究。往昔研究指出，有機田的天敵種類及數量較慣行田多；且除施肥、噴藥等耕作措施外，農地地景亦會影響農地的節肢動物相及族群數量。本研究的調查時間為 2017 年 2 月至 2018 年 6 月。於苗栗地區選定三個試驗區 (里山、里地、里海)，自水稻成活期開始，每兩週以掃網方式採集稻株上昆蟲與蜘蛛。本研究的目的是調查苗栗地區水稻田節肢動物相，並比較兩種農法與三種農地地景之水稻田害蟲及天敵的多樣性及豐度。

結果/結論/應用啟示

水稻田害蟲及天敵的物種數於不同農法與農地地景皆無顯著差異，表示害蟲及天敵的多樣性不受影響。以農法區分，掠食者之樣本數於有機田大於慣行田，稻害者之樣本數於有機田小於慣行田。慣行田稻害者樣本數的增加幅度也比有機田來得高，表示有機農法可維持天敵物種的個體數量，進而抑制水稻田中的飛蝨、葉蟬等害蟲族群。以農地地景區分，里山及里地試驗田均較里海試驗田有較多的掠食者、擬寄生者及稻害者，代表不同農地地景亦會對水稻田的天敵及害蟲豐度造成影響。本試驗會持續進行長期調查及分析結果來釐清農法及農地地景與天敵及害蟲的關聯性，並作為農田管理與蟲害防治策略選擇上的一項參考依據。

關鍵字 (Keywords)：有機農法 (organic farming)、慣行農法 (conventional farming)、昆蟲 (insect)、蜘蛛 (spider)、豐度 (abundance)

OD_02

茶樹捲葉蛾類害蟲寄生性天敵之分子鑑定研究
Molecular identification of parasitic natural enemies of tea leaf rollers

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背景/研究問題/材料方法
捲葉蛾類為臺灣茶園的主要害蟲之一，幼蟲吐絲捲起葉片，躲藏於蟲包內取食葉肉，影響芽稍正常發育及營養生長，造成經濟損失。無用藥的茶園中，寄生性天敵種類豐富，捲葉蛾幼蟲棲群及寄生率具正相關性，可見寄生性天敵是維持害蟲族群密度的一關鍵。然目前對於茶園寄生蜂之基礎研究仍十分匱乏，為了解茶捲葉蛾類害蟲為害季節 (每年 4～7 月) 主要發生的寄生蜂種類，本研究針對田間採集的茶捲葉蛾類害蟲(茶姬捲葉蛾、茶捲葉蛾、茶絹扁腹蛾及茶細蛾)之寄生蜂進行分子片段 (COI) 之增幅，定序後進行與資料庫進行比對，以期能協助鑑定寄生蜂種類。

結果/結論/應用啟示
結果發現茶捲葉蛾卵寄生蜂以赤眼蜂科 (Trichogrammatidae) *Trichogramma dendrolimi* 為主；茶姬捲葉蛾蛹寄生蜂以姬蜂科 (Ichneumonidae) 凸臉姬蜂屬 (*Exochus* sp.) 為主；茶姬捲葉蛾、茶捲葉蛾、茶絹扁腹蛾幼蟲寄生蜂則皆以小繭蜂科 (Braconidae) 絨繭蜂屬 (*Apanteles* sp.) 為主；茶細蛾寄生蜂則以釉小蜂科 (Eulophidae) 嗇小蜂屬 (*Aprostocetus* sp.) 為主。其中絨繭蜂屬寄生蜂進一步與其他同屬寄生蜂以最大似然率與貝氏導出式進行分析，結果發現所調查的絨繭蜂屬寄生蜂中包含了三個不同物種，其中接近 *A. galleriae* 的種群在本次調查中為數量最多且寄主最廣的物種，被認為具生物防治潛力。未來期望能進一步與形態鑑定結果做比對，完成物種定名與基礎生物學研究，以提供未來生物防治之用。

關鍵字 (Keywords)：茶樹 (tea tree)、捲葉蛾類 (tea leaf rollers)、寄生蜂 (parasitic natural enemies)、分子鑑定 (molecular identification)

OD_03

利用低溫休眠特性調整平腹小蜂量產作業
The mass production progress of *Anastatus* spp. regulated by low temperature through dormant state

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背景/研究問題/材料方法

荔枝椿象 (*Tessaratoma papillosa*) 為近年危害台灣龍眼及荔枝之重要外來入侵害蟲，為抑制荔枝椿象於田間族群之繁衍，目前建立以替代寄主蓖麻蠶 (*Samia cynthia*)卵量產寄生性天敵平腹小蜂 (*Anastatus* spp.) 之技術，以供田間釋放防治。在量產過程中，為減緩生產排程之壓力及調整平腹小蜂於適當時機羽化，此寄生蜂之低溫休眠 (dormancy) 特性具有重要的應用價值，本研究將經平腹小蜂寄生的蓖麻蠶卵在 26±1℃ 環境下經 0、3、6 日等不同發育階段後進行低溫 (12±1℃) 儲藏 1 至 6 個月，比較不同發育階段及低溫儲藏時間對平腹小蜂羽化之影響。

結果/結論/應用啟示

實驗結果顯示，被平腹小蜂寄生之蓖麻蠶卵經發育 0、3、6 日後進入低溫環境下存放一個月，以寄生後經發育 6 日再進行低溫儲藏平均羽化出平腹小蜂數 13.5±0.7 隻為最高，但三者皆與對照組 (未經低溫保存) 無顯著差異，而發育 6 日之被寄生卵在存放三個月後，平均羽化數即有下降現象。在低溫儲藏時間上，將發育 0 日存放五個月後取出，其平均羽化數為 13.0±0.5 隻與對照組無顯著差異，但第六個月平均羽化數為 9.93±0.9 隻，則有顯著差異。根據上述結果，建議在量產過程直接將被寄生後第 0 天的卵移入低溫環境儲藏，且該被寄生卵在低溫下保存五個月後不影響羽化情形，此結果將可有效應用於累積生產量並減緩生產壓力。

關鍵字 (Keywords)：平腹小蜂 (*Anastatus* spp.)、低溫儲藏 (cold storage)、休眠 (dormancy)、量產 (mass production)、荔枝椿象 (*Teaasratoma papillosa*)

OD_04

金門地區恙蟎及小哺乳動物脾臟攜帶嗜吞噬細胞無形體之分子偵測
Molecular detection of *Anaplasma phagocytophilum* in chiggers and small mammals spleen in Kinmen

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背景/研究問題/材料方法
人類顆粒球無形體症 (human granulocytic anaplasmosis; HGA) 為近年重要新興之蜱媒傳染病，病原體為嗜吞噬細胞無形體 (*Anaplasma phagocytophilum*)，藉由蜱叮咬而傳播，中國大陸、日本、韓國等鄰近地區近年皆有病例發表，臺灣則尚未有病例報告。恙蟲病為臺灣重要的蟲媒立克次體傳染病之一，病原體為恙蟲病立克次體 (*Orientia tsutsugamushi*)，主要藉由恙蟎 (chigger) 叮咬而傳播。由於人類顆粒球無形體症與恙蟲病或其他立克次體傳染病 (例如：斑點熱立克次體病、人類單核球艾利希氏體症等) 初期臨床症狀相似，以發燒、肌肉痛、全身無力、出疹等症狀為主，初期診斷不易。根據疾病管制署通報傳染病資料，實驗室診斷恙蟲病確定病例約佔恙蟲病通報疑似病例的 20%，顯示其他蟲媒立克次體傳染病存在的可能性。本研究於 2016 年 7 月至 2017 年 7 月期間，針對金門地區捕獲之小哺乳動物脾臟及外寄生恙蟎，利用巢式聚合酶連鎖反應及即時定量聚合酶鏈鎖反應進行嗜吞噬細胞無形體 16S rRNA 及 p44 基因之偵測。

結果/結論/應用啟示
本研究共採得小哺乳動物脾臟檢體 160 支及小哺乳動物身上恙蟎 156 池 (50 隻恙蟎/池/動物，恙蟎總數不足 50 隻者則將恙蟎全數計入)，16S rRNA 基因偵測結果顯示：脾臟檢體感染嗜吞噬細胞無形體之陽性率為 15% (24/160)，恙蟎檢體陽性率則為 15.4% (24 池/156 池)，最低感染率 (minimum infection rate, MIR) 為 3.39/1000。此外，16S rRNA 檢測為陽性的恙蟎檢體中，成功檢測出嗜吞噬細胞無形體的 p44 基因 (n=3 池)。本研究結果首次證實金門小哺乳動物及恙蟎攜帶嗜吞噬細胞無形體的核酸片段，未來將進一步釐清金門恙蟎及小哺乳動物在人類顆粒球無形體症所扮演之角色。

關鍵字 (Keywords)：人類顆粒球無形體症 (human granulocytic anaplasmosis; HGA)、嗜吞噬細胞無形體 (*Anaplasma phagocytophilum*)、恙蟲病 (scrub typhus)、巢式聚合酶連鎖反應 (nested polymerase chain reaction)、即時定量聚合酶鏈鎖反應 (real-time polymerase chain reaction)

OD_05

利用病媒昆蟲法監測台灣畜牧場牛隻病原
The vector-based approach to monitor bovine viral pathogens in Taiwan

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背景/研究問題/材料方法
動物健康管理為畜場重要課題，在許多會產生病毒血症的動物病毒檢測與監測上，傳統上均以抽樣採血方式進行；但這樣的作法會有動物容易緊張窘迫、保定費時、採樣人員可能被動物踢傷、採樣數量受限等缺點，且須由專業獸醫師執行。本試驗以吸血蚊蟲做為採血工具，建立動物血液病毒檢測技術。在蚊蟲吸血時段到畜牧場採集飽血蚊蟲並利用組織均質研磨器研磨後萃取核酸物質，再依病毒特性利用反轉錄聚合酶連鎖反應(RT-PCR)技術，即可順利偵測畜場是否含有該病原存在。

結果/結論/應用啟示
本蚊蟲採血技術在 2012 至 2015 年期間於六種蚊蟲(mosquito)以及兩種庫蠓(*Culicoides*)體內，順利監測到五種牛隻病毒性疾病；其中 *Shamonda orthobunyavirus* (Peaton virus) and *Shuni orthobunuavirus* (Aino virus) 這兩種病毒為第一次在台灣記錄到的病毒種類，其次，bovine leukemia virus, Bovine viral diarrhea virus, rotavirus A 等非蟲媒病毒(non-arbovirus)的檢出，顯示利用蚊蟲當動物採血器的概念與技術是一個可以應用於動物健康管理的有利工具。

關鍵字 (Keywords)：吸血昆蟲 (Haemtophagous insects)、蟲媒病毒 (arbovirus)、非蟲媒病毒 (non-arbovirus)

OD_06

台灣中部荔枝椿象對六種殺蟲劑之感受性初探
Preliminary tests for susceptibility of litchi stink bug, *Tessaratoma papillosa* (Drury) collected from central Taiwan to six insecticides

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背景/研究問題/材料方法
荔枝椿象(*Tessaratoma papillosa* (Drury))於1999 年入侵金門，2009 年5 月首度在台灣發現，近兩年已擴散至全台，除危害荔枝、龍眼及台灣欒樹亦影響民眾安全。2013年防檢局公告「龍眼及荔枝上荔枝椿象」緊急用藥；2017 年公告防治荔枝椿象之延伸使用藥劑種類及範圍。為了解公告藥劑及荔枝細蛾(*Conopomorpha sinesis*)防治藥劑對荔枝椿象的防治效果。本試驗於2018 年3 月起，於台中市霧峰區荔枝、龍眼果園採集荔枝椿象。以藥膜法測試荔枝椿象對40.8 %陶斯松EC、2.8%賽洛寧EC、40.34%丁基加保扶EC、20%亞滅培SP(公告藥劑)及2.4%第滅寧SC、85%加保利WP(荔枝細蛾防治藥劑)等6 種藥劑之感受性。

結果/結論/應用啟示
丁基加保扶、第滅寧等藥劑對荔枝椿象雌成蟲效果極佳，可導致 100 %死亡率，陶斯松、賽洛寧、亞滅培的致死率則分別為 96.7 %、86.7 %、53.3 %。對於雄成蟲，陶斯松、賽洛寧、丁基加保扶、第滅寧均可達到 100 %的致死效果，其次為加保利 96.7 %，亞滅培的效果較差，只能造成 36.7 %的死亡率，這 6 種藥劑對 1 齡若蟲的效果皆好，藥劑經 1、3、7、14 日對 1 齡若蟲致死率達 97.1 ~ 100 %。上述結果顯示荔枝椿象對其延伸使用藥劑及荔枝細蛾防治藥劑等 6 種藥劑，於不同蟲期具有不同的感受性，1 齡若蟲對各藥劑皆十分敏感；雄成蟲對藥劑感受性較雌成蟲高，唯獨對亞滅培的感受性相對較雌蟲低。

關鍵詞 (Key words)：荔枝椿象 (*Tessaratoma papillosa* (Drury))、感受性 (susceptibility)、殺蟲劑 (Insecticide)

OD_07

博物館藏品蟲害管理現況
Museum collection pest management in Taiwan

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背景/研究問題/材料方法
近來館際間借展十分頻繁，基於藏品蟲害風險控管，釐清國內藏品蟲害管理現況實有其必要性。國立故宮博物院於 2017 年 9 月底辦理藏品蟲害風險管理工作坊，針對與會學員以問卷方式進行調查，共計發出 250 份問卷，有效回收問卷 111 份，回收率 44.4%，填覆學員中有 80.7%為來自公、私立典藏單位及博物館相關系所師生，結果應具相當代表性。

結果/結論/應用啟示
在 111 份問卷中，有 82.9%學員表示曾遭遇過蟲害問題，並有 35.1%因此希望藉由參加工作坊獲得相關知識與協助。就曾發生蟲害問題案例中，23.9%曾發生在公開展示場所，43.5%曾在典藏庫房發生，發現頻率最高的害蟲種類前五名分別是蟑螂(71.7%)，白蟻 (50%)，嚙蟲 (50%)，衣魚 (50%)，蠹蟲 (39.1%) 及衣蛾 (39.1%)，另有 17.4%不知道種類，顯示國內藏品蟲害管理尚有相當進步的空間。當遭遇蟲害問題，多數學員傾向自行以冷凍或低氧方式除蟲，或用市售殺蟲劑處理，22.8%會尋求專家學者的建議，或請除蟲公司評估處理(29.3%)。有超過八成學員認為關於藏品蟲害管理相關資訊不易獲得，其中缺乏安全可信賴供諮詢蟲害問題的專業平臺，藏品蟲害管理相關知能研習及講座較少，缺乏辨識害蟲種類及其危害特徵的資料庫，及無法分辨資訊的正確性或可靠性是普遍認為最大的困擾。

關鍵字 (Keywords)：蟲害管理 (pest management)、藏品 (collections)

OD_08

以常壓非熱電漿之電漿化空氣作為燻蒸劑 應用於蘭花太平洋偽葉蟎防治效果

Effect of Plasma Air produced by Atmospheric Non-thermal Plasma as Fumigant Applied to *Tenuipalpus pacificus* Baker on orchid

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背景/研究問題/材料方法
常壓非熱電漿技術不同於一般工業用電漿技術，又稱低溫電漿，此技術特質包含溫度低、可控制等離子體在正常氣體中的比例、斷開電源後產生之等離子體/活性氧化物質會迅速還原、可根據輸入的氣體產生不同離子體/活性氧化物質，產生之物質通常對生物具有毒性，於前人文獻已被證明低溫電漿產生的臭氧可對細菌、真菌類微生物及積穀害蟲有很好的致死力。本研究以空氣為原料產生臭氧作為燻蒸劑，以 5 種臭氧濃度分別對太平洋偽葉蟎的雌成蟎、後若蟎、前若蟎、幼蟎進行 3 個不同處理時間之燻蒸試驗，並觀察 36 小時內存活率變化。

結果/結論/應用啟示
由結果顯示，太平洋偽葉蟎在燻蒸處理後不會立即死亡，會產生延遲現象，於 12 小時內大量死亡。以不同齡期耐受性來看，當臭氧濃度 400 ppm 進行燻蒸處理 90 分鐘，幼蟎和前若蟎之 100%死亡率；然而後若蟎和成蟎即使濃度升高至 500ppm 仍僅達到 80%死亡率。試驗中發現，不論燻蒸時間長短，太平洋偽葉蟎須超過 300ppm，方能大幅提升死亡率至 50%以上。然而實際運用下無法選擇蟲隻齡期進行處理，後若蟎和成蟎對臭氧耐受性較高，因此最佳燻蒸條件應為臭氧濃度 500ppm 燻蒸處理 90 分鐘。實際應用於 V3 白花蝴蝶蘭之蘭花品種生理障礙測試，結果顯示該濃度不會造成植株外觀損傷，以此表明利用常壓非熱電漿技術產生臭氧應用於蟲害燻蒸上，是具潛力且值得開發的防治技術。

關鍵字 (Keywords)：常壓非熱電漿 (Atmospheric non-thermal plasmas)、臭氧 (ANTPs)、燻蒸劑 (ozone)、太平洋偽葉蟎 (fumigant)

OD_09

兩種番茄黃化捲葉病毒在菸草粉蝨 (*Bemisia tabaci*) 體內的競爭及病毒競爭對傳播的影響

The competition of two tomato yellow leaf curl viruses in *Bemisia tabaci* and its effect on virus transmission

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背景/研究問題/材料方法

番茄黃化捲葉病是嚴重危害番茄栽培的重要病害之一，目前臺灣番茄田間有 *Tomato leaf curl Taiwan virus* (ToLCTWV) 及 *Tomato yellow leaf curl Thailand virus* (TYLCTHV) 兩種病毒危害。根據前人田間調查，TYLCTHV 在 2005 年入侵臺灣後快速地取代 ToLCTWV，且發現田間罹病株約有 40%為複合感染。於此情況下，粉蝨有機會先後於兩種病毒之罹病株或於複合感染植物上取食獲得兩種病毒。由於這兩種病毒必須由菸草粉蝨傳播，所以田間病毒取代的現象可能與病毒－病媒交互作用有密切的關係。本實驗給予粉蝨先後兩次不同的獲毒時間，分別於感染 TYLCTHV、ToLCTWV 或複合感染的植株上取食獲毒，並以定量 PCR 測定粉蝨唾液中的病毒量，來了解兩種病毒於粉蝨體內的競爭結果，並以傳播試驗來進一步了解病毒競爭對傳播率的影響。

結果/結論/應用啟示

唾液的病毒定量結果顯示在所有處理組中 TYLCTHV 的量皆高於 ToLCTWV。傳播試驗的結果也顯示在所有的處理組中 TYLCTHV 的傳播率均高於 ToLCTWV。此外，不論粉蝨先或後獲得病毒，病毒的傳播率均會低於只獲得其中一種病毒的粉蝨。據以上結果推斷兩種病毒於粉蝨體內具有拮抗作用，但 TYLCTHV 在粉蝨體內有較佳的競爭能力。綜論上述，不論粉蝨先後或同時獲得兩種病毒，TYLCTHV 有較 ToLCTWV 高的機會經由粉蝨的唾液傳播，導致高比例的 TYLCTHV 罹病株。我們認為這可能是造成 TYLCTHV 於入侵臺灣後快速地取代田間的 ToLCTWV 的原因之一。

關鍵字 (Keywords)：番茄捲葉臺灣病毒 (*Tomato leaf curl Taiwan virus*)、番茄黃化捲葉泰國病毒 (*Tomato yellow leaf curl Thailand virus*)、菸草粉蝨 (*Bemisia tabaci*)、病毒－病媒交互作用 (virus-vector interaction)、拮抗作用 (antagonism)

OD_10

寄主植物及抗生素對於菸草粉蝨內共生菌族群的影響
The effects of host plant and antibiotic on the population of endosymbionts in *Bemisia tabaci*

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背景/研究問題/材料方法

菸草粉蝨 (*Bemisia tabaci*) 為世界上重要的農業害蟲之一，除了透過刺吸取食植物汁液造成植物發育不良，也會傳播至少 212 種植物病毒，造成嚴重的農業損失。菸草粉蝨體內有多種共生菌，包含一種主要共生菌 (primary symbiont) 及七種次要共生菌 (secondary symbiont)。主要共生菌可以提供粉蝨必需的營養，而在其他昆蟲中，次要共生菌在營養調控、免疫、生殖、遺傳分化、天敵防禦及環境適應等方面扮演重要的角色，但是對菸草粉蝨的影響仍需進一步研究。本研究的菸草粉蝨擁有主要共生菌 *Portiera aleyrodidarum* 與兩種次要共生菌 *Rickettsia* sp. 及 *Hamiltonella denfensa*。菸草粉蝨分別飼養在不同的寄主植物上及餵食多種抗生素，然後以定量 PCR 檢測每一世代粉蝨內共生菌的數量，以評估寄主植物與抗生素對於內共生菌族群的影響。

結果/結論/應用啟示

實驗結果顯示分別飼養在五種寄主植物上的菸草粉蝨內共生菌數量皆為 *Rickettsia* sp. 最高，*P. aleyrodidarum* 次之，*H. denfensa* 最低。而粉蝨累代取食不同寄主植物會對三種內共生菌的族群造成不同的趨勢變化。相較於寄主植物，抗生素對於內共生菌有更快速且劇烈的影響，餵食 rifampicin 可降低三種內共生菌的數量；餵食 ampicilin 則僅降低 *P. aleyrodidarum* 的數量。本研究初步探究影響粉蝨內共生菌族群的可能因素，以奠定未來研究內共生菌與昆蟲寄主相互作用的基礎。

關鍵字 (Keywords)：菸草粉蝨 (*Bemisia tabaci*)、內共生物 (endosymbiont)、寄主植物 (host plant)、抗生素 (antibiotic)

OD_11

台灣柑橘木蝨族群抗藥性及黃龍病帶原頻度調查
Investigation of Insecticide resistance and Frequency of *Candidatus Liberibacter asiaticus* on *Diaphorina citri* population in Taiwan

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背景/研究問題/材料與方法
柑橘不僅是台灣重要的經濟作物之一，亦是許多國家重要的經濟作物。本次研究針對柑橘上的病蟲害─柑橘木蝨及黃龍病，進行調查。柑橘木蝨除了取食新芽嫩葉造成植物發展不良，所分泌的蜜露亦會造成植物煤煙病，此外亦是黃龍病的傳播媒介。黃龍病會造成植物葉片不規則黃化、果實品質不良等病徵，嚴重則死亡。本篇研究之目的便是調查台灣地區的柑橘木蝨族群是否像國外報導一樣已發展出抗藥性。此外亦進行黃龍病帶病頻度的調查，以了解台灣黃龍病的流行潛勢。本實驗採集台灣七個地區的柑橘木蝨品系、使用七種化學藥劑，以藥膜瓶檢測法 (bottle bioassay)進行抗藥性試驗。黃龍病偵測則是抽取柑橘木蝨 DNA，使用黃龍病專一性引子對進行聚合酶連鎖反應。

結果/討論/應用啟示
在本次的抗藥性研究中，以對藥劑相對比較敏感的北投地區柑橘木蝨作為對照組，發現採自其他地區的柑橘木蝨品系對大滅松、滅必蝨、陶滅蝨、芬普寧、陶斯松之抗性倍率皆低或無明顯差異。然而在馬拉松藥劑試驗中，竹崎品系有 6 倍之抗性倍率；在益達胺藥劑試驗中，內埔地區的柑橘木蝨則有高達 45.2 倍之抗藥性，其次為埔里地區的 35 倍，霧峰及竹崎皆為 17.2 倍。目前台灣柑橘木蝨對多數測試藥劑仍相當敏感，可能與田間很少針對柑橘木蝨進行用藥有關。這些實驗結果顯示，台灣部分地區之柑橘木蝨對益達胺有較高之抗藥性，為避免抗藥性更加嚴重，農藥施用時應以較無抗藥性風險的大滅松、陶滅蝨、芬普寧等藥劑進行輪替管理，減少益達胺的使用。另外黃龍病偵測方面，目前僅北投、霧峰、台中南區族群中有偵測到少量攜帶黃龍病病原菌之柑橘木蝨。

關鍵字 (Keywords)：柑橘木蝨 (*Diaphorina citri*)、黃龍病 (Huanglongbing)、抗藥性 (insecticide resistance)

OD_12

應用餌劑防治危害芒果樹的台灣家白蟻群體
Baiting Formosan subterranean termite (Blattodea: Rhinotermitidae) in mango trees

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背景/研究問題/材料方法

台灣家白蟻 *Coptotermes formosanus* Shiraki 會為害樹木心材，是導致樹幹中空而無預警折斷的原因之一，不僅造成都市樹木資源的損失，亦對人身安全形成隱憂。白蟻餌劑 (termite bait) 是廣泛應用在建築物且能徹底消滅白蟻群體的防治方法。為測試在地下餌站施用白蟻餌劑能否防治危害樹木的台灣家白蟻，本研究選定 11 棵遭受台灣家白蟻危害的芒果樹，以染劑標記樹上發現的白蟻，並在每棵樹周圍埋設 8 個地下餌站，餌站內部含有木材，每兩週檢查所有餌站一次，在確定為害樹幹以及在樹木周圍地下活動的白蟻為同一群體後，再從地下餌站內施用白蟻餌劑並記錄防治結果。

結果/結論/應用啟示

地下餌站的台灣家白蟻取食率高 (63.6%)，有 9 棵芒果樹證實為害樹幹以及在樹木周圍地下活動的白蟻為同一群體。每棵芒果樹約使用 5.8 ± 1.8 支白蟻餌劑，其有效成分六伏隆 (hexaflumuron) 的取食劑量約 1.4 ± 0.6 g，施藥後能在 10.7 ± 6.1 週內消滅危害芒果樹的台灣家白蟻群體。試驗過程中，我們發現單一群體的白蟻能同時為害 3 棵芒果樹，亦發現單一芒果樹同時遭受兩個不同群體的白蟻危害。我們認為防治樹木的白蟻危害須以「群體」為單位，而白蟻餌劑是有效、非破壞性且低藥量的防治方法。

關鍵字 (Keywords)：台灣家白蟻 (*Coptotermes formosanus*)、白蟻餌劑 (termite bait)、白蟻防治 (termite control)、都市樹木保護 (urban tree protection)

OD_13

臺灣荔枝癭蚋寄生蜂及其優勢物種 *Quadrastichus* sp.之基礎生物學
The checklist and seasonal variation of parasitoids on lychee gall midge *Litchiomyia chinensis* Yang & Luo (Diptera: Cecidomyiidae), with biological information of the dominant parasitoid *Quadrastichus* sp. in Taiwan

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背景/研究問題/材料方法

針對 2008 年入侵的害蟲荔枝癭蚋(*Litchiomyia chinensis* Yang & Luo)，臺灣現行的防治方式以藥劑防治為主，雖有效卻無法避免環境汙染。在過往臺灣的荔枝癭蚋相關調查中，已發現一種以上的荔枝癭蚋寄生蜂在田間建立穩定的族群，若能妥善利用，將成為防治荔枝癭蚋的一項利器。本研究於高雄市、臺中市、南投縣、臺南市及彰化縣五個荔枝主要產區採樣並建立荔枝癭蚋寄生蜂不同季節之族群變化。此外，輔以在新竹、嘉義、屏東等地的隨機採樣，建立寄生蜂物種清單。擇其中最優勢者，透過觀察、解剖、飼養及藥劑試驗等方式建立基礎生物學資料，以供未來進行寄生蜂生物防治之用。

結果/結論/應用啟示

自 2016 至 2018 年於田間採樣，共計記錄三科五種寄生蜂及一種客居蜂。荔枝癭蚋寄生率與寄生蜂族群變化隨地區及時間而異，*Quadrastichus* sp.與 Braconinae sp.族群最多，且具有互補情形，但以分布較廣泛、對癭蚋終齡幼蟲行外寄生之 *Quadrastichus* sp. (釉小蜂科: Eulophidae) 為優勢物種。由 *Quadrastichus* sp.之卵巢解剖結果、取食情形及性別比，推測其為可行孤雌生殖之應變式(synovigeny)寄生蜂。以三種荔枝癭蚋推薦藥劑 (40.8%陶斯松乳劑、50%撲滅松乳劑及 85%加保利可濕性粉劑) 對 *Quadrastichus* sp.進行藥劑試驗，顯示三種藥劑對 *Quadrastichus* sp.均可造成強烈毒害。本研究結果建議在擬定荔枝癭蚋生物防治策略時，需同時考慮寄生蜂發生及藥劑施用時機，以使防治效益最佳化。

關鍵字 (Keywords)：荔枝 (Litchi)、寄生蜂 (Parasitoid wasp)、生物防治 (Biocontrol)、季節變化 (Seasonal variation)、急性毒性 (Acute toxicity)

OD_14

台灣都市建築白蟻危害現況及分飛季節之普查
Survey of household termite pests and their dispersal flight season in Taiwan

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背景/研究問題/材料方法
家白蟻屬 (*Coptotermes* spp.) 在台灣有兩物種分布，分別為台灣家白蟻 (*Coptotermes formosanus* (Shiraki)) 及格斯特家白蟻 (*Coptotermes gestroi* Wasmann)，兩個種類皆為重要的都市建築物害蟲，且皆在春夏季傍晚透過有翅生殖型 (winged imago) 的分飛行為 (dispersal flight) 擴散並建立新的群體。為了解兩種家白蟻在台灣的地理分布及分飛行為季節性的差異，本研究透過白蟻物種鑑定服務網 (http://termite.nchu.edu.tw/) 與民眾及防蟲公司合作，收集全台灣兩種白蟻的工蟻、兵蟻及有翅生殖型樣本，分析兩種白蟻的分布及分飛季節。

結果/結論/應用啟示
台灣家白蟻在北北基與台中地區的建築物內危害比例較高，而格斯特家白蟻在高雄及台南地區的建築物內危害比例較高，顯示兩種家白蟻在台灣是以中部為界，具有南北分布差異，而進一步比較兩種家白蟻棲地的環境因子，發現兩者棲地的最暖月最高溫、最冷月最低溫、最濕月雨量及最乾月雨量四種指標均有差異。有翅生殖型的發生資料顯示兩種家白蟻分飛時間不同，格斯特家白蟻的分飛行為高峰在四月中旬，而台灣家白蟻的分飛行為高峰在五月下旬。

關鍵字 (Keywords)：家白蟻屬 (*Coptotermes*)、分飛 (dispersal flight)、有翅生殖型 (winged imago)、都市害蟲 (urban pest)、公民科學 (citizen science)

OD_15

硼酸凝膠誘餌：德國蟑螂的新工具（Dictyoptera：Blattellidae）
Boric acid gel bait: A new tool to German cockroaches (Dictyoptera: Blattellidae)

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Background/Question/Methods

The German cockroach, *Blatella germanica* L. (Dictyoptera: Blattellidae), is the most important insect pests in and around home, as it transmits various parasites, bacteria, nematodes, and viruses. Different forms of boric acid (H3BO3) baits have been used to manage German cockroach populations; however, the gel bait is more consumable, toxic, and kills faster than powder and block baits. It was already proved that the German cockroaches developed resistant against gel baits. However, boric acid baits are not available in gel form. Thus, the present study was done to the best combination of boric acid in the form of gel bait and measure its efficacy (preference and toxicity) against German cockroaches under laboratory conditions.

Results/Conclusions

Among four tested lab baits, the lab bait A caused 100% mortality of cockroaches at six days after treatment that was significantly higher and had less LT50 value than other lab baits tested. The best performing lab bait was compared with four commercial baits containing different active ingredients. There was no significant difference between the lab bait A and commercial on the amount of bait consumed and bait detection time. The result shows the potentiality of using boric acid gel bait for the management of the German cockroach population under laboratory conditions.

關鍵字 (keywords): *Blatella germanica*, lab baits, mortality, commercial baits, detection time

OD_16

台灣抗百滅寧品系埃及斑蚊之轉錄體分析
Transcriptome analysis of permethrin-resistant *Aedes aegypti* in Taiwan

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Background/Question/Methods

Aedes aegypti is a vector of important human diseases, including dengue, yellow fever, chikungunya and Zika virus infection. Since there is no vaccine and prescription to prevent and cure these diseases, vector control by various insecticides is still the primary choice to avoid the spread of disease. However, the high frequent and improper uses of the insecticides, such as permethrin, have resulted in the evolution of insecticide resistance in *Ae. aegypti*. In order to understand the mechanisms involved in permethrin resistance, next-generation sequencing (NGS) was used to sequence the transcriptomes of permethrin-resistant (Per-R) and permethrin-susceptible (NS) strains of *Ae. aegypti*, and TopHat2-Cufflinks-CummeRbund pipeline was used to align, assemble and visualize the sequencing data of NGS.

Results/Conclusions

There are 113 and 156 differential expression genes (DEGs) obtained from larvae and adult female of Per-R strain in comparison with NS strain. These DEGs contain genes of cuticle protein, cytochrome P450 monooxygenase, glutathione S-transferase, serine protease, heat shock protein and miscellaneous proteins, which were found to be involved in various pathways of glutathione metabolism, peroxisome, apoptosis, RNA transport, proteasome, glycerophospholipid metabolism, and protein processing in endoplasmic reticulum.

關鍵字 (Keywords)：*Aedes aegypti*, insecticides, resistance, transcriptome analysis

OD_17

埃及斑蚊解毒作用影響熱煙霧噴灑除蟲菊劑的防治成效
Detoxification in *Aedes aegypti* on the efficiency of the thermal fogging spray with pyrethroids

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背景/研究問題/材料方法
埃及斑蚊是台灣地區傳播登革熱的病媒蚊，緊急防治時，噴灑化學殺蟲劑的防治成效會影響登革熱疫情的控制，而病媒蚊對殺蟲劑產生抗藥性是最大的影響因素。埃及斑蚊的抗性機制主要包括增加解毒酵素活性或是標的部位的不敏感。本研究以熱煙霧噴灑除蟲菊劑進行台南市東區、高雄市鹽埕區及對百滅寧具抗藥性的 LYPR 等品系的藥效試驗，以微量盤法分析解毒酵素，以 ABI SYBR®Green 分析解毒基因的表現，並與實驗室 *Bora-Bora* 敏感品系比較，探討埃及斑蚊解毒作用影響熱煙霧噴灑除蟲菊劑防治成效的相關性。

結果/結論/應用啟示
以熱煙霧噴灑亞滅寧、賽滅寧及依芬寧防治供試埃及斑蚊雌成蟲，分析供試埃及斑蚊對殺蟲劑的穀胱苷肽轉移酶(glutathione transferase)及單加氧酶(monooxygenase)等解毒酵素，並偵測 *CYP6CB1-1*、*CYP6CB1-2*、*CYP6M11*、*CYP9J2*、*CYP9M9*、*CYP9J2*6、*CYP6BB2*、*GSTe3*、*GSTe4*、*GSTe7* 等解毒基因的表現量，結果顯示埃及斑蚊解毒作用的表現會降低熱煙霧噴灑除蟲菊劑的防治成效，相關技術可做為早期偵測田間病媒蚊抗藥性的生化及分子檢測技術。

關鍵字 (Keywords)：埃及斑蚊 (*Aedes aegypti*)、抗藥性 (resistance)、解毒作用 (detoxification)、熱煙霧噴灑 (thermal fogging spray)、除蟲菊劑 (pyrethroids)

OD_18

埃及斑蚊 Kdr 抗性基因頻率與抗藥性的關係
A TaqMan® probe assay for detection knockdown resistance mutations in pyrethroid-resistant *Aedes aegypti*

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背景/研究問題/材料方法
高頻率施用化學殺蟲劑防治登革熱,使得埃及斑蚊對合成除蟲菊殺蟲劑產生抗藥性,探討對合成除蟲菊劑的抗藥性,與埃及斑蚊神經軸突鈉離子通道蛋白的抗擊昏(*Kdr*)基因突變有關聯。文獻記載埃及斑蚊 *Kdr* 基因圖譜至少發現有 7 個點突變,可能導致殺蟲劑對鈉離子通道的親和力降低,使埃及斑蚊對殺蟲劑產生抗藥性。利用局滴加法進行百滅寧的藥效檢測後,以 TaqMan® probe 檢測存活與死亡供試成蚊在 V1023G、D1794Y 及 F1534C 這三個位點的突變頻率。共進行敏感對照組 *Bora-Bora* 品系、106 年大台南及 107 年台南市東區、屏東市、屏東縣潮州鎮、高雄市鹽埕區、高雄市新興區、高雄市苓雅區等 8 個品系。

結果/結論/應用啟示
以局部滴加法檢測南部地區埃及斑蚊對百滅寧及賽滅寧具抗藥性,抗性程度與存活供試成蚊 *Kdr* 突變基因頻率的相關性高於全部供試成蚊,V1023G 的突變基因頻率與抗藥性的相關性高於 D1794Y 及 F1534C。相關技術可應用於埃及斑蚊的抗藥性監測,作為選用防治藥劑的參考。

關鍵字 (Keywords):埃及斑蚊 (*Aedes aegypti*)、抗藥性 (Resistance)、Kdr 基因 (Knockdown resistance gene)、局部滴加法 (Topical application)、鈉離子通道 (Voltage-gated sodium channel)

OD_19

臺灣桃園國際機場與其他國家熱帶家蚊之親緣關係
The phylogenetic analysis of *Culex quinquefasciatus* in Taiwan Taoyuan International Airport and their relationship with other countries

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Background/Question/Methods
As global traffic become more and more convenient, there are more than one hundred thousand flights coming from all over the world in Taiwan Taoyuan International Airport (TPE) every year. In previous study, a large proportion of mosquitoes caught in TPE were *Culex quinquefasciatus*, which can transmit West Nile virus and *Wuchereria* parasite. We want to know if there are foreign *Cx. quinquefasciatus* already dwell in TPE or not. If there are foreign ones, then we should adjust vector control program and prevent potential disease outbreak. In order to distinguish the *Cx. quinquefasciatus* in TPE is native or not, we used mosquito light trap, sweeping net, and larva dipping methods to collect the samples from Taiwan. Samples of mosquito from different counties were used as control and using sweeping net to catch the samples on aircraft from Southeast Asia countries as target groups. There are several potential markers of phylogenetic trees may separate Taiwan's native *Cx. quinquefasciatus* or foreign one, such as 28S rDNA of *Cx. quinquefasciatus*, pp-hC1A_5 of *Wolbachia* pipientis (*w*Pip), and Gp15 of WO prophage of *w*Pip. To achieve that, we used polymerase chain reaction to amplify target DNA fragments, sequencing, and made the phylogenetic trees by MEGA 6.0 software.

Results/Conclusions
The results show that phylogenetic trees by using three different markers can provide different resolution of phylogenetic relationship. In the marker of 28S rDNA one, which only separate India (HM802156) from Taiwan, TPE, and Southeast Asia countries. Another marker, pp-hC1A_5, which can separate into two clades of phylogenetic tree, one contains samples from Taiwan, TPE, and Japan, the other includes samples from Southeast Asia countries. The other marker, Gp15, shows that it can separate Taiwan, Southeast Asia countries, and Japan into three clades. Both pp-hC1A_5 and Gp15 are markers good enough to distinguish whether *Cx. quinquefasciatus* is native or not.

關鍵字 (Keywords)：phylogeny, *Culex quinquefasciatus*, Taiwan Taoyuan International

OD_20

取代動物試驗之防蚊液體外檢測方法-多孔人工餵血系統
Implementation of the multiple membrane blood-feeding system in mosquito repellent bioassay cooperates to the vertebrate animal use replacement principle.

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背景/研究問題/材料方法
防蚊液標準化的檢測方法須確認皮膚單位表面積處理忌避劑的劑量、忌避劑保護時間、供試蚊蟲的種類及生理狀況，及試驗結果需具再現性。以人體試驗或動物試驗進行生物檢測，可能有感染病原及測試化學成分傷害的風險，另外也需考慮實驗動物福祉的問題。為快速且大量評估新忌避劑的效果，使用新穎配方的人工代血，以多孔人工餵血裝置建立防蚊液體外檢測方法，可定量防蚊液的忌避效果，是安全、有效的檢測方法。

結果/結論/應用啟示
供試埃及斑蚊羽化後日齡、每日進行試驗的時間及供試雌成蚊的適應時間均會影響吸食率。在評估防蚊液 DEET 處理後不同時間的忌避效果，適當的空氣流動和溫度處理，與手臂防蚊叮咬試驗結果相似。以多孔人工餵血系統可取代動物試驗進行防蚊液體外忌避效果檢測，是安全、有效的檢測方法，且可快速大量評估新防蚊液的忌避效果。

關鍵字 (Keywords)：埃及斑蚊 (*Aedes aegypti*)、忌避劑 (repellent)、DEET (diethyltoluamide)、多孔餵血系統 (multiple membrane blood-feeding system)、體外生物檢測 (*in vitro* bioassay)

OD_21

台灣銳蠓的飼養
Establishing and maintaining colonies of *Forcipomyia taiwana* in a laboratory

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背景/研究問題/材料方法
台灣銳蠓(*Forcipomyia taiwana*)是台灣地區重要的騷擾性環境衛生害蟲，因受限飼養空間限制對成蟲群舞及交尾行為的影響，近幾年並無實驗室繼代飼育成功的報告。另外，台灣銳蠓雌成蟲需供應血餐才能產卵，也是延滯研發防治技術的阻力。本研究確認台灣銳蠓飼養、交配、產卵、繼代繁殖的流程，可大量在實驗室進行累代飼養。

結果/結論/應用啟示
以人工代血餵飼小黑蚊雌成蟲，飽食血餐的雌性台灣銳蠓產卵於滴加濃縮綠藻液的夯實土壤，孵化幼蟲以綠藻液餵食至化蛹。雌蟲羽化後 2 天，雄蟲羽化後 1 天即可進行交尾。交尾高峰在開燈後 2 小時，中午過後僅零星台灣銳蠓進行交尾，高交尾率會提高小黑蚊的吸血率。本團隊可成功大量累代飼養小黑蚊，單次成功飼養成蟲數量可達 15000 隻，足可提供研發有效防治技術。

關鍵字 (Keywords)：台灣銳蠓 (*Forcipomyia taiwana*)、大量飼養 (Mass rearing)、人工餵血 (artificial blood-feeding)、群舞 (swarming)、交尾率 (mating rates)

OD_22

黑殭菌應在病媒蚊幼蟲防治潛用性

Susceptibility of different mosquitoes larvae and pupae to entomopathogenic fungi *Metarhizium anisopliae*

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背景/研究問題/材料方法

蚊子會傳播瘧疾、登革熱、絲蟲病、日本腦炎等重要人類傳染病，因此被認為是世界上最重要的病媒昆蟲。在蚊蟲的防治上，人們經常依賴化學防治為主，因而導致蚊蟲抗藥性問題日益嚴重，因此對於可以感染蚊蟲的黑殭菌(*Metarhizium anisopliae*)成為一個值得研發的微生物防治方法。本報告探討埃及斑蚊、白線斑蚊、地下家蚊、三斑家蚊、白腹叢蚊等 5 種蚊種幼蟲與蛹對於黑殭菌分生孢子之感受性。

結果/結論/應用啟示

試驗結果顯示黑殭菌對五種病媒蚊幼蟲與蛹均具致死效果，且均以一齡幼蟲對黑殭菌最具敏感性，LC50 隨幼蟲齡期增加而上升；各蚊種則以蛹期對黑殭菌感受性最差。比較不同蚊種對於黑殭菌的感受性，以兩種家蚊感受性最高，其次為兩種斑蚊，最不敏感為白腹叢蚊。黑殭菌為蟲生真菌，在農業上被製成環境友善之微生物農藥，其對病媒蚊蟲幼蟲與蛹均具致死效果，具有發展成為病媒蚊防治資材之潛力。

關鍵字 (Keywords)：黑殭菌 (*Metarhizium anisopliae*)、蚊子 (Mosquito)、幼蟲 (Larvae)、蛹 (Pupae)、半致死濃度 (Lethal concentration 50)

OD_23

Reproductive output of *Aedes aegypti* (Diptera: Culicidae) in respond to insecticidal stress

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Background/Question/Methods

Phenomenal of high egg reproduction when mortality risk rose is very common in mosquito. Yet, the presence of this reproduction advantage in field strain mosquitoes remains unclear. In this study, we evaluated the effect of chlorpyrifos (CP) exposure on the oviposition and survival of *Aedes aegypti* using two field (KHly and TNnorth) and one laboratory susceptible strains (KHsm).

Results/Conclusions

High mortality was recorded in KHsm mosquitoes after contacting with the CP-treated oviposition sites on day 4. Before death, the mosquitoes oviposited large number of eggs indicating the adaptive strategy of the mosquito aimed at maintaining the progeny in the population. However, this reproductive effort was not seen in the two field strains although ~60% of the mosquitoes were killed at 1.0 ppm CP. Mosquitoes from the field are exposed to a variety of insecticide. Coping with the toxicity of insecticides can be costly, and thus energy and resource are redirected to survival instead of reproduction.

關鍵字 (Keywords)：Fitness cost, fecundity, selection, trade-off, dengue

OD_24

Silencing of 34-kDa salivary protein of *Aedes aegypti* suppresses Dengue-2 virus replication and transmission

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Background/Question/Methods

Dengue fever is the most prevalent arthropod-borne viral disease in humans with no effective medication or vaccine. Previous studies have indicated that proteins from mosquito salivary glands may influence the infection of dengue virus (DENV) in humans. However, the functions of salivary proteins on DENV infection in the mosquito *Aedes aegypti* remain largely unknown. Therefore, we hypothesize that some salivary proteins of *Ae. aegypti* may enhance or suppress the replication and transmission of dengue virus. In this study, we show the effect of 34-kDa salivary protein on the regulation of dengue virus replication and transmission. We examined the tissue specific expression of 34-kDa salivary proteins after infection with dengue virus serotype 2 (DENV2). This salivary protein was silenced in mosquito. Then the mosquito was infected with DENV2. To elucidate its effect on DENV2 replication, we made use of qPCR analysis and western blot analysis to examine the DENV2 transcript and E protein expression, respectively. Furthermore, we investigated the effect of 34-kDa on DENV2 transmission by plaque assay and mouse model analysis.

Results/Conclusions

Our results showed that the transcript of 34-kDa salivary protein was up-regulated in the mosquito salivary gland post DENV2 infection. The replication of DENV2 RNA and the expression of DENV2 envelope protein were significantly inhibited when 34-kDa was silenced. Interestingly, we show that silencing of 34-kDa inhibited DENV2 transmission. Taken together, our findings indicate that 34-kDa is important for dengue viral transcription and envelope protein (E-protein) replication in the mosquito salivary gland. Especially, the 34-kDa plays an important role in the transmission of DENV2.

關鍵字 (Keywords)：*Aedes aegypti*, Dengue virus, mosquito saliva, 34-kDa salivary protein, gene silencing

OD_25

Comparative transcriptome analysis of larval and adult midguts of the yellow fever mosquito *Aedes aegypti*

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Background/Question/Methods

The yellow fever mosquito, *Aedes aegypti*, is the primary vector of arboviruses including Zika, chikungunya, and dengue virus. *Ae. aegypti* goes through a transition from the aquatic to the terrestrial environment during its life cycle. Accordingly, the larval midguts are remodeled, undergo morphological changes, thus making the adult female mosquitoes competent to take a blood meal. However, the genome-wide analysis of differentially expressed genes in the *Ae. aegypti* midgut between two distinct stages has not been reported yet. Herein, we conducted an RNA-seq analysis of the midguts of the 4th-instar larvae and adult female mosquitoes to identify the stage-specific genes and their functional regulation.

Results/Conclusions

Approximately 20% of *Ae. aegypti* annotated genes were differentially expressed in the midguts between larval and adult stages. Those differentially expressed genes were enriched for diverse biological function, many of which were related to the nutrient metabolism. This study presents the first comprehensive transcriptome comparison of the midguts between larval and adult *Ae. aegypti* mosquitoes.

關鍵字 (Keywords)：RNA-seq, transcriptome, gut, mosquitoes, *Aedes aegypti*

OD_26

台灣埃及斑蚊擊昏抗性基因突變現況與除蟲菊精類殺蟲劑抗性之關聯

Current knockdown resistance mutations in Taiwan local *Aedes aegypti* populations and their roles in pyrethroid resistance

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Background/Question/Methods

Knockdown resistance (kdr) to pyrethroid is known to link amino acid substitution of voltage-gated sodium channel (VGSC) in *Aedes aegypti*. In Taiwan, pyrethroid insecticides have been heavily used to control mosquito population for decades. Nowadays, two VGSC mutations including V1016G and D1763Y had been described in local *A. aegypti* population. In order to figure out the relationship between kdr mutations and their roles in pyrethroid resistance, we collected *A. aegypti* in Tainan and Kaohsiung of southern Taiwan. Their VGSC gene polymorphism of kdr mutations and the intron flanked by exons 20 and 21 were verified. Their first generation offspring (F1) was used to measure the resistant level to cypermethrin, a pyrothroid insecticide currently used in Taiwan.

Results/Conclusions

The data revealed two other mutations, S989P and F1534C, which have not been reported in Taiwan. Moreover, we also observed two forms (groups A and B) of introns flanked by exons 20 and 21. When those data were taken together, we presumably proposed six haplotypes of VGSC genes currently existing in Taiwan. Triple heterozygous mutations of either S989P/ V1016G/F1534C or V1016G/F1534C/D1763Y can be found in one single *A. aegypti* mosquito. Furthermore, the rate of VGSC mutations was found to be highly relevant to cypermethrin resistance, especially S989P and V1016G. In conclusion, our data may propose an alternative method that the proportion of S989P and V1016G in the population perhaps can serve as a reference to estimate cypermethrin resistance level.

關鍵字 (Keywords)：*Aedes aegypti*, knockdown resistance (kdr), pyrethroids, voltage-gated sodium channel (VGSC)

OD_27

登革熱病媒蚊分佈因子分析及其風險地圖建構
The analysis of dengue vector mosquito distribution and the establishment of dengue risk map

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背景/研究問題/材料方法
登革熱是絕對蚊媒傳染疾病，在臺灣主要病媒蚊是埃及斑蚊與白線斑蚊，白線斑蚊分布臺灣全島海拔 1,500m 以下的地區，而埃及斑蚊只分布在嘉義布袋以南海拔 500m 以下的地區，為了探究近年登革熱病媒蚊在南臺灣都市地區的密度與分布狀況，2016 年 7 月至今，國家蚊媒傳染病防治研究中心與地方政府利用誘卵桶在南高屏三縣市 346 個里進行斑蚊密度變化調查，同時針對其中 148 個里進行斑蚊鑑定與分析，以瞭解不同社區型態的斑蚊組成，提供防疫對策研擬具體參考。

結果/結論/應用啟示
每週所獲得的數據藉由地理資訊系統建構風險地圖，讓管理者可以直接目視瞭解各區里的風險程度。另外也建立 148 個里斑蚊分佈資料，分析其中 77 個里的分佈資料後，發現埃及斑蚊的分布與社區的人口密度、建物面積相關，如埃及斑蚊分佈比率大於 50% 時，人口密度顯著較埃及斑蚊分佈比率小時高。另外，建物面積佔社區面積越高時，埃及斑蚊密度也越高。綜合上述結果，目前已建立一個以病媒蚊密度為依據，每週定期更新資訊且內含病媒蚊分佈的風險地圖系統，是即時管理病媒蚊密度利器，可有效預防登革熱爆發流行。

關鍵字 (Keywords)：蚊媒疾病 (Mosquito-borne Disease)、登革熱 (Dengue fever)、風險地圖 (risk map)

OD_28

以新式硼酸溶液產卵桶監測防治登革熱病媒蚊之實務評估
Practical evaluation of novel ovitrap with boric acid solution to monitor and control dengue mosquitoes

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背景/研究問題/材料方法
誘蚊產卵桶之目的為監測區域內的病媒蚊密度，具備靈敏、被動監測且成本低廉等優點，但產卵桶之佈放亦受疫情影響而忽略管理，反成蚊蟲孳生源。文獻證實 1%硼酸糖水溶液餵食蚊成蟲後，超過 98%蚊成蟲失去活性。實驗室前期測試亦證實不含糖之 1%硼酸溶液會降低成蟲壽命並使一齡幼蟲失去活性。進一步試驗證實不同濃度 (0%、0.5%、1.0%) 之硼酸溶液不影響雌蚊產卵偏好。2016 年 7 月至 2018 年 9 月期間，於臺南和高雄登革熱風險區進行長期實務評估，每兩周監測調查一次，並以國家蚊媒傳染病防治研究中心佈設之誘卵桶資料做比較，以評估新式硼酸溶液產卵桶對成蚊和幼蟲之防治成效。

結果/結論/應用啟示
第一階段 2016 年 7 月至 2017 年 3 月，於臺南和高雄之積水地下室、社區共佈放 154 個硼酸溶液產卵桶，臺南斑蚊產卵率平均 21.2% (0~35.7%; n=184)，高雄斑蚊產卵率平均 19.6% (0~44.4%; n=1,160)，蚊幼蟲孳生率為 0.6% (7/1160; 遮蔽不佳遭雨水滲入稀釋硼酸濃度而孳生蚊幼蟲)。第二階段 2017 年 7 月至 2018 年 9 月，於臺南和高雄之社區、校園共佈放 84 個硼酸誘殺桶，經一年定期監測每兩周回收資料，結果顯示：臺南斑蚊產卵率平均 50.9% (22.7%~84.1%; n=1,216)，高雄斑蚊產卵率平均 56.8% (20.5%~89.2%; n=1,168)。臺南產卵數平均 21.6 顆 (n=1,216)，高雄產卵數平均 30.9 顆 (n=1,168)，蚊幼蟲孳生率為 0。蚊卵經分子檢驗確認為埃及斑蚊為 56.1%，白線斑蚊 40.1%，兩者共存 3.7%。對照國家蚊媒傳染病防治研究中心監測之誘卵桶結果，臺南斑蚊產卵率平均 51.6% (4.0%~88.0%; n=705)，高雄斑蚊產卵率平均 66.4% (25.0%~91.7%; n=709)。臺南產卵數平均 26.6 顆 (n=705)，高雄產卵數平均 45.1 顆 (n=709)。誘蚊產卵桶孳生蚊幼蟲之比率，臺南平均為 10.7% (0~40.0%; n=300)，高雄平均為 23.7% (0~66.7%; n=709)。新式硼酸溶液產卵桶在無外力影響下，兼具誘殺成蚊、降低幼蟲活性之功能，不易形成新生孳生源，藉由觀察蚊卵亦可達到監測之目的，深具應用、防治和推廣之價值。

關鍵字 (Keywords)：登革熱 (Dengue fever)、病媒控制 (Vector control)、產卵桶 (Ovitrap)、硼酸 (Boric acid)

OD_29

以社團經營模式深耕校園登革熱防治
A strategy of the educational programe on Dengue fever prevention in the junior high school

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背景/研究問題/材料方法
蚊媒傳染病的預防首重病媒蚊防治，這是一件需要政府主導、民眾配合的環境管理課題。因此，除了在社區進行民眾推廣教育宣導之外，若能培養學生對於病媒蚊防治、環境管理的進階認識，將有助於防疫深耕。國家蚊媒傳染病防治研究中心於 2017 年 9 月至 2018 年 6 月在台南市國民中學，以「病媒蚊生態與習性認識」、「科學實驗操作」與「教育推廣訓練」三大主軸推動「科學防蚊實驗社」，嘗試結合區公所、社區，並與學校合作方式，以社團經營模式於校園推動病媒蚊防疫深耕工作，讓國中生深刻認識與了解登革熱病媒蚊。本試驗性深耕推廣同時也對參與學生進行問卷調查與分析，以瞭解目前的課程教學對於國中生蚊蟲知識、防疫態度及行為之影響。

結果/結論/應用啟示
經教學後的問卷調查發現，在蚊蟲知識方面 96%的學生表示瞭解登革熱與斑蚊之間的關係，96%的學生瞭解登革熱病媒蚊的辨別與習性，97%的學生瞭解登革熱病媒蚊喜歡棲息的環境；防疫態度及行為部分則是 96%的學生願意主動注意關心校園內與社區內的積水環境，97%的學生對校園社區登革熱防疫產生認同感，93%的學生會願意主動投入登革熱防疫志願服務，顯示學生在教學後的確有效提升蚊蟲知識以及防疫志願服務。未來將與政府合作種子教師培訓，讓學校在登革熱衛生教育與教學上有更多的資源。

關鍵字 (Keywords)：蚊媒疾病 (Mosquito-borne Disease)、登革熱 (Dengue fever)、衛生教育(Health education)

OD_30

2018 年新北市登革熱流行特性與防治成效分析
Dengue fever epidemic features and control efficacy in New Taipei city in 2018

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背景/研究問題/材料方法
近年來臺灣地區登革熱病例、重症與死亡病例、境外移入病例日趨嚴重，2018 年四型病毒之本土病例分別在北、中、南部同時發生。本研究旨在分析新北市 2018 年登革熱的流行特性、病媒蚊習性和防治成效評估，做為今後防治登革熱提供科學依據。研究使用描述性流行病學方法與病媒蚊調查密度指數進行統計分析。

結果/結論/應用啟示
2018 年 7 月至 9 月新北市本土登革熱確定病例共計 35 例，主要來至馬爾地夫第二型病毒株，臨床特徵為發燒(93.8%)、酸痛(71.9%)、出疹(18.8%)與腹瀉(18.8%)。群聚感染依病媒蚊分布包括都會社區型與都會聚落型二傳播模式。病媒蚊為白線斑蚊，感染源環境之幼蟲布氏指數差異大，介於 2.2(2 級)~16.7(5 級)，主要孳生於人工容器與天然容器;成蟲密度偏高介於 1.2~3.5 隻/分，成蟲主要分布於感染源社區建築物室內和室外之周邊、菜園與綠地 100 公尺範圍等地區。地方政府接獲登革熱通報病例後，立即進行疫情調查同時進行感染源環境之現勘，並依病例社區之病媒、人口與環境特性劃定區塊防治範圍，進行緊急防治與孳生源清理。區塊化學防治採圍堵策略，以戶外殘效配合戶內熱煙霧噴撒原則。經由病媒蚊之評估得知，採取緊急與治本等多元防疫策略後，病媒成蟲密度與病例數相繼大幅下降，有效控制登革熱擴散。鑑於白線斑蚊為半家棲蚊種(semi-endophilic species)，其習性迥異分布於南部的埃及斑蚊，因而應有不同防疫策略，新北市白線斑蚊傳播登革熱防治經驗，可供由白線斑蚊傳播地區防疫之參考。

關鍵字 (Keywords)：登革熱 (dengue fever)、白線斑蚊 (*Aedes albopictus*)、化學防治 (chemical control)、群聚感染 (cluster infection)

OD_31

以昆蟲細胞繼代培養 *Wolbachia*
Stable culture of *Wolbachia* in insect cells

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Background/Question/Methods

Wolbachia are obligate intracellular symbiotic bacteria that are found in up to 60% of insects. Application of *Wolbachia* as potential candidates for the control of vector-borne diseases has been demonstrated by either reducing mosquitoes' ability to transmit pathogens or suppressing mosquito populations. However, limited *Wolbachia* strains were utilized in these studies. To further characterize *Wolbachia* from different hosts, a cell culture system permitting maintenance of the bacteria *in vitro* was employed. Ovary homogenates were obtained from *Wolbachia*-infected mosquitoes, and via centrifugation, infection was established in C6/36 cells. In addition, to detect the presence of *Wolbachia*, a polyclonal antibody against *Wolbachia* surface protein was generated by immunization of rabbits.

Results/Conclusions

The polyclonal antibodies were able to detect *Wolbachia* in both mosquito salivary glands and ovaries, hence, it could be applied for future screening of *Wolbachia* infections in field. Immunofluorescence assay has confirmed the stable infections in C6/36 cells. Our results showed that the shell vial technique provided a useful tool to establish different *Wolbachia* infections. Maintenance and amplification of *Wolbachia in vitro* would be helpful for further studies and the production of *Wolbachia*-infected vectors. The effects of various *Wolbachia* isolates on dengue and Zika virus infections will be investigated.

關鍵字 (Keywords)：沃爾巴氏體 (*Wolbachia*)、蚊蟲 (mosquitoes)、C6/36 細胞 (C6/36 cell)、離心瓶技術 (shell vial technique)

OD_32

大豆油乳液在甜瓜葉蟎防治上的應用初探
A primary study on soybean oil-in-water emulsion as a pesticide to control spider mites on melon

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背景/研究問題/材料方法
由於食安及環保意識的普及，生產安全優質的農產品已為全民所共同需求，因此有必要積極研發既可有效防除害蟲又對生物天敵低毒性的植物保護資材。本報告開發新型乳化大豆油植物保護資材，測試其對設施作物甜瓜主要葉蟎的防除效果，試驗設計是參造我國農藥委託試驗設計採逢機完全區集設計。

結果/結論/應用啟示
第一次田間試驗，5 處理，1% 大豆油+一滴淨 1,000X、0.5% 大豆油+一滴淨 1,000X、一滴淨 1,000X、1% 密滅汀乳劑 1,500X 及自來水，4 重複，施藥前葉蟎平均數為 455.8、671.3、727.3、730.3 及 586.8 隻，統計分析無差異。第 1 次施藥後第 7 天防治率 99.2、94.9、19.5 及 100%。第 1 次施藥後第 14 天防治率 97.6、96.5、55.3 及 100%。試驗結果顯示 1% 大豆油+一滴淨 1,000X、0.5% 大豆油+一滴淨 1,000X 具有與 1% 密滅汀乳劑 1,500X 相似防治葉蟎效果。第二次田間試驗，4 種處理，1% 大豆油+一滴淨 1,000X、一滴淨 1,000X、1% 密滅汀乳劑 1,500X 及自來水，4 重複，施藥前葉蟎平均數為 569.8、327.8、327.5 及 375.8 隻，統計分析無差異。第 1 次施藥後第 8 天防治率 100、50.2 及 100%。第 1 次施藥後第 14 天防治率 99.9、51.8 及 100%。試驗結果顯示 1% 大豆油+一滴淨 1,000X 具有與 1% 密滅汀乳劑 1,500X 相似防治葉蟎效果。兩次葉蟎防治田間試驗證明本次配方防治葉蟎具再現性，確認 1% 大豆油+一滴淨 1,000X 具有與 1% 密滅汀乳劑 1,500X 相似防治葉蟎效果。

關鍵字 (Keywords)：防治 (control)、甜瓜 (melon)、葉蟎 (spider mite)、大豆油乳液 (soybean oil-in-water emulsion)

OD_33

基徵草蛉及化學藥劑對草莓田間二點葉蟎密度影響
The effects of *Mallada basalis* and pesticides on the density of *Tetranychus urticae* on strawberry in the field.

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背景/研究問題/材料方法

二點葉蟎為草莓主要害蟲之一，吸食植物汁液使葉綠素流失，影響光合作用，造成葉片焦黃、乾枯，危害嚴重時影響產量，甚至提早結束生產。慣行農法常以化學藥劑防治，因草莓屬連續性採收作物，易有農藥殘留疑慮，又二點葉蟎發育速度快及繁殖量高，頻繁用藥易造成選汰壓力，進而促使抗藥性的產生。本研究於 106 年 10 月 31 日至 107 年 2 月 6 日於生物防治分場試驗田內種植豐香品種草莓，採隨機完全區集設計(RCBD)，探討於二點葉蟎發生後 1.釋放 9 次草蛉幼蟲(1 齡幼蟲 1~8 隻/株/次)及 2 次植物油混方(IPM)、2.輪替使用 5 種作用機制共 10 次殺蟎劑(CP)及 3.完全不防治(CK)三種處理對草莓葉上點葉蟎密度影響。病害防治部分：IPM 施用苗栗活菌 1 號、CP 施用殺菌劑，CK 不防治。每處理種植 30 株，5 重複，自種植日後每隔 7 天每處理每重複調查 10 片中位葉的葉蟎密度，共調查 12 次（前 2 次於田間肉眼目視、之後皆採樣帶回實驗室內鏡檢）。

結果/結論/應用啟示

調查結果發現，二點葉蟎族群密度隨著草莓定植後逐漸上升，於 12 月至 1 月期間達最高(IPM-34.2 隻/葉、CP-462.2 隻/葉、CK-344.8 隻/葉)。釋放草蛉幼蟲可有效減緩二點葉蟎族群密度上升的速度，且與其他處理有顯著差異；而以化學藥劑處理下的二點葉蟎族群密度卻較完全不防治的族群密度高，此結果也顯示頻繁用藥防治並無法降低葉蟎數量，可能加速抗藥性產生或導致葉蟎對藥劑耐受性提高的問題。

關鍵字 (Keywords)：基徵草蛉 (*Mallada basalis*)、草莓 (Strawberry)、二點葉蟎 (*Tetranychus urticae*)

OD_34

評估蘇力菌、培丹、因滅汀及得芬諾於田間對荔枝細蛾之防治效果

Assessment of control efficacy of *Bacillus thuringiensis*, cartap hydrochloride, emamectin benzoate, tebufenozide against litchi fruit borer (*Conopomorpha sinensis*) in litchi orchard

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背景/研究問題/材料方法

荔枝細蛾(*Conopomorpha sinensis*)為荔枝結果期最重要的害蟲，於台灣目前的防治方式以合成除蟲菊、有機磷劑及氨基甲酸鹽類農藥進行化學防治為主，本研究測試54%鮎澤蘇力菌水分散性粒劑(稀釋 1000 倍)、50%培丹可溶性粉劑(稀釋 1000 倍)、2.15%因滅汀乳劑(稀釋 2000 倍)、19.7%得芬諾水懸劑(稀釋 2000 倍)，同時以噴水處理作為負對照組，以 2.4%第滅寧水懸劑(稀釋 1500 倍)及 50%芬殺松乳劑(稀釋 1000 倍)輪用作為正對照組進行藥劑防治效果評估，分別於荔枝花落後 10-20 天開始施藥，施藥日為 4/23、5/02、5/11、5/21 及 5/31，於施藥後每週進行樹上果實產卵數、產卵率與危害率調查，以瞭解供試藥劑的實際防治效果。

結果/結論/應用啟示

田間藥劑試驗結果顯示不同藥劑處理的荔枝樹上果實的荔枝細蛾平均產卵率於果實發育初期的 2.1%上升至 78.5%，平均產卵數由 0.03 顆上升至 2.24 顆，顯示施藥並未對影響荔枝細蛾於果實上的產卵行為；施藥後樹上果實危害率顯示各種藥劑處理於果實發育初期並無顯著差異，於果實發育後期才出現差異，防治效果最佳的藥劑於採收前依序為培丹、正對照組、因滅汀、蘇力菌、負對照組及得芬諾，樹上果危害率分別為 6.3%、26.3%、58.8%、63.8%、66.3%及 75%，顯示培丹為最具有防治荔枝細蛾潛力的藥劑。

關鍵字 (Keywords)：荔枝細蛾 (*Conopomorpha sinensis*)、殺蟲劑 (Insecticides)、防治效果 (Control efficacy)、荔枝 (Litchi)

OD_35

台灣白殭菌菌株對咖啡果小蠹致病力之初步研究
Preliminary study of virulence of *Beauveria bassiana* isolates from Taiwan against the coffee berry borer (Coleoptera: Scolytidae)

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背景/研究問題/材料方法
咖啡果小蠹 (*Hypothenemus hampei*) 為咖啡最嚴重之害蟲，其雌成蟲會鑽入咖啡果實，取食種子胚乳並產卵，幼蟲孵化後亦取食胚乳，造成嚴重經濟損失。國外已有文獻顯示白殭菌 (*Beauveria bassiana*) 對咖啡果小蠹具防治潛力，然而針對國內白殭菌菌株目前仍缺乏相關研究報告。因此，本研究測試自本土之咖啡果小蠹、甘藷蟻象及白殭菌商品上分離的白殭菌菌株 B23、CY-1 及 YM-1 於 25℃ 及 20℃ 下對咖啡果小蠹的致病力，並以浸泡白殭菌孢子懸浮液之咖啡果實，評估於果實施用白殭菌對咖啡果小蠹之防治效果。

結果/結論/應用啟示
白殭菌對咖啡果小蠹致病力結果顯示，於 25℃下，咖啡果小蠹死亡率自處理後第 5 日開始開始迅速上升，第 8 日時 B23、CY-1 及 YM-1 分別導致 97.5%、100%及 92.5%之死亡率，於 20℃下，則 3 菌株造成之死亡率均下降，第 8 日死亡率分別為 87.5%、75%及 60%。以浸泡白殭菌之咖啡果實測試對咖啡果小蠹之防治效果，結果顯示處理 7 天後，B23、CY-1 及 YM-1 處理之果實咖啡果小蠹危害率分別為 50%、47.5%及 57.5%，與對照組 (危害率 60%) 均無顯著差異，而咖啡果小蠹之死亡率則分別為 67.5%、45%及 5%，其中 B23 及 CY-1 與對照組死亡率 (10%) 有顯著差異。本研究結果顯示，本土白殭菌對咖啡果小蠹具良好之致病力，未來應可更進一步研究於田間施用之技術與防治效果。

關鍵字 (Keywords)：咖啡果小蠹 (*Hypothenemus hampei*)、白殭菌 (*Beauveria bassiana*)、致病力 (Virulence)、台灣 (Taiwan)

OD_36

抗褐飛蝨近同源系水稻對台灣褐飛蝨族群之抗性評估
Evaluation of 13 near-isogenic lines with 11 brown planthopper resistant genes in IR24 against brown planthopper populations in Taiwan

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背景/研究問題/材料方法
褐飛蝨為亞洲地區水稻重要且具遷移性之害蟲，嚴重影響各國水稻之安全生產，抗蟲品種為各國防治此害蟲之主要方法。本研究利用國際稻米研究所(IRRI)培育之水稻–IR24 及帶有單一(堆疊)抗褐飛蝨基因近同源系(NIL)，利用秧苗檢定法(MBST)，進行對彰化、南投及花蓮三個地區之褐飛蝨族群的抗性評估，檢測對台灣發生之褐飛蝨族群仍具抗性表現之基因。

結果/結論/應用啟示
初步結果顯示 IR24 單基因 NIL 中，*Bph17* 對三個地區之褐飛蝨族群均具中等抗性表現(秧苗存活率在 35.0-56.7%之間)；其餘各別具中等抗性表現之基因(秧苗存活率在 31.7-51.7%之間)，在彰化地區有 *Bph21*、*Bph26* 及 *Bph32*；在南投地區有 *bph4* 及 *Bph20*；在花蓮地區有 *Bph20* 及 *Bph32*。NIL 帶有 *Bph3+Bph17*、*Bph18+Bph32* 及 *Bph9+Bph32* 等三個組合(秧苗存活率在 61.7-95.0%之間)，對台灣之褐飛蝨族群具有穩定的抗性表現，此等基因之堆疊，可做為台灣增進抗褐飛蝨品種改良之選擇。

關鍵字 (Keywords)：褐飛蝨 (*Nilaparvata lugens* (Stål))、近同源系 (near-isogenic lines)、抗性基因 (resistant gene)

OD_37

農用噴藥無人機應用於防治茶園小型害蟲之成效評估
Evaluation of the effectiveness of agriculture drone sprayer in the control of small pests in tea plantations

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背景/研究問題/材料方法
近年因從農人力老化及缺工問題，政府推動農用噴藥無人機作為提升田間施藥效率的方案。惟目前無人機受限於藥桶乘載容量，必須以高濃度施用既有成品農藥，具有相當的風險。本文以屏東老埤農場的茶園為試驗場域，使用無人機（大疆 MG-1S）為施藥器械，針對小綠葉蟬及薊馬等小型害蟲進行不同施藥量的處理，並評估其藥害、藥效及農藥殘留情況。試驗參考植物保護手冊核准登記每公頃每次用藥量之一倍量(1X)及減半量(0.5X)，試驗處理區分為 1X、0.5X、(0.5X+助劑)及對照組共 4 區，全程共計施藥 3 次，蟲害發生調查 4 次，農藥殘留取樣 1 次。探討不同藥劑施用量對茶園小型害蟲防治率之影響。

結果/結論/應用啟示
藥害及藥效調查結果發現，各處理之茶芽葉並無明顯色澤或形態異常。1X 及(0.5X+助劑)處理對小綠葉蟬的防治率可達 63.14~70.59%，對照組薊馬類及葉蟎類害蟲較少發生，且各處理薊馬類害蟲的防治率無顯著差異。農藥殘留檢驗報告顯示，茶芽樣本檢出小綠葉蟬用藥－納乃得 0.028 至 0.031 ppm（低於我國茶葉殘留農藥安全容許量—1 ppm）。結果顯示無人機施用農藥可以對茶園小綠葉蟬達到防治效果，且供試之藥劑無殘留超標風險。未來可針對其他多種藥劑進行農藥減量及助劑添加之深入研究，讓無人機施用農藥的應用朝向安全環境友善之成效發展。

關鍵字 (Keywords)：農用噴藥無人機 (agriculture drone sprayer)、茶園 (tea plantations)、小型害蟲 (small pest)

生物多樣性、族群與群聚生態學

論文宣讀摘要集

Oral Session:

Biodiversity, Population and Community Ecology

OB_01

外來入侵物種紅火蟻分佈與擴散-以台北市為例
Distribution and diffusion of invasive alien species- Red Imported Fire Ants - Taipei City as an example

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背景/研究問題/材料方法
在雲嘉南地區，目前僅在嘉義縣中埔鄉及水上鄉有較大面積的入侵紅火蟻發生。了解外來入侵種紅火蟻是怎樣入侵與擴散，對整個台灣的未來會造成怎樣的衝擊與結果，好讓我們能更懂得如何預防與防治，提升民眾對入侵紅火蟻的基本知識，讓大家一起來保護台灣寶島不再受紅火蟻的侵襲以及破壞，讓原本的大自然能繼續保持自然的生態平衡。本研究將整合各地紅火蟻發生區域的環境類型及每個年代的情形，SuperGIS 為主要的使用分析軟體，尋找出在台灣各地發生紅火蟻資料。在資料蒐集並建立分析之下，能對於未來防治紅火蟻有效的方法，進而達到民眾與政府的合作關係，並瞭解防治前後的良效，推論出紅火蟻偏好的類型，希望有助於防治的改進。

結果/結論/應用啟示
結果顯示台北市所發生紅火蟻的蟻丘密度及環境類型，以歷年危害數量與分佈所統計分析出來。在蟻丘密度方面，第一級最多，代表即早發現及早防治，可使災害降低。在環境類型方面，因紅火蟻喜愛土壤及水源的地方，所以目前在台北市歷年危害地點較多為開發地。以過去 10 年資料進行整理，分析近十年來的分布變化，進而探討紅火蟻在國內之的擴散分布範圍。

關鍵字 (Keywords)：外來入侵種 (invasive alien species)、外來種 (alien species)、紅火蟻 (*Solenopsis invicta*)、分佈與擴散 (Distribution and diffusion)

OB_02

苗栗入侵紅火蟻零星發生地區之全面偵查
Comprehensive investigation of red imported fire ant (Hymenoptera: Formicidae) in sporadic areas of Miaoli

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背景/研究問題/材料方法

入侵紅火蟻 (*Solenopsis invicta* Buren) 名列聯合國保育聯盟(IUCN)百大入侵物種之一，對農業與畜牧業生產、環境生態、公共設施及人身安全造成威脅，導致財政經濟的損失。入侵紅火蟻於 2003 年入侵臺灣後，官方隨即展開防治及訂定法規控管人為擴散。2009 年前以「撲滅」為目標進行全面防治，然而因為其生態特性不易撲滅，務實調整為「圍堵漸進撲滅」，並在 2012 年依疫情狀況重新劃定南、北防線，並在防線外以即時撲滅為目標。因此針對苗栗零星發生地區 (公館鄉、銅鑼鄉、後龍鎮)以誘餌誘集法，於每四萬平方公尺放置一偵查點，1-3 小時後回收，共調查 3246 偵查點，偵查入侵紅火蟻之發生情形。

結果/結論/應用啟示

2012 年底時防線以南區域共有 24 個通報點為解除列管，然而至 2017 年底時共有 391 個通報點未解除列管，且分布南界已由新竹東區、寶山鄉南移至苗栗造橋。防線外零星發生地區偵查結果為銅鑼鄉九湖村、樟樹村各有 1 點、2 點偵測到入侵紅火蟻。2012 年以新竹頭前溪作為南方圍堵防線至今，入侵紅火蟻已擴散至苗栗造橋一帶。主動偵查零星發生地區能把握防治先機，以利早期防治使當地政府能在限經費下控制入侵紅火蟻擴散情形。

關鍵字 (Keywords)：入侵紅火蟻 (*Solenopsis invicta*)、入侵外來種(invasive alien species)、空間分布偵查(Spatial distribution investigation)

OB_03

體型與體色在蝴蝶體溫調控的貢獻
The effect of body size and melanism on thermoregulation of butterflies

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背景/研究問題/材料方法
外溫動物可透過體色和體型的改變來決定吸散熱與熱儲存的能力，進而適應環境。熱黑化假說(thermal melanism hypothesis)認為體色越深的個體能快速吸熱、較易適應寒冷的環境；熱平衡假說(heat balance hypothesis)認為外溫動物的體型與儲熱能力有關，較冷區域的物種體型應較大。但以蝴蝶而言，大型、深色物種主要分布於熱帶，巨觀尺度的體溫調節機制仍待探討。本研究以實驗與巨觀特徵分析，探討體型與體色如何影響蝴蝶之體溫調控。我們分析台灣蝴蝶群聚對應之環境因子，並使用太陽光模擬器配合熱像儀進行蝴蝶標本加熱實驗，分析體型、黑化程度對軀幹最終平衡體溫與升(降)溫速率的影響。

結果/結論/應用啟示
體型、黑化程度及其交互作用均可解釋軀幹最終體溫。大型物種最終體溫明顯較高，黑化與否無差別；但小體型物種可透過黑化顯著提高最終體溫。蝴蝶標本之升、降溫曲線相互映射，體型與黑化僅其交互作用可解釋升(降)溫速率之差別，顯示隨體型大小，黑化有顯著不同的影響。大體型物種可透過黑化有效增加吸散熱效率，小體型物種吸散熱速率相對快、體黑化與否無顯著差別。從蝴蝶分布資料顯示，較熱群聚體型與變異均較大，推測蝴蝶的巨觀生理調控策略為－在冷的環境下，以偏小體型與黑化來提升吸熱效率以及最高體溫；在熱的環境則可有兩種熱調節策略：小型物種無須投資黑化，但大型物種反而以黑化促進快速散熱，有明顯的體型－黑化取捨(melanism–body size tradeoff)。

關鍵字 (Keywords)：巨觀生理生態 (macrophysiology)、熱黑化假說(Thermal Melanism Hypothesis)、熱平衡假說(heat balance hypothesis)、體型－黑化取捨、(melanism–body size tradeoff)

OB_04

族群間物候的地區適應化影響其時間空間分佈以及面對全球暖化的脆弱程度

Locally-Adapted Phenology Drives Spatiotemporal Distribution and Population Vulnerability to Climate Change

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背景/研究問題/材料方法
隨著氣候變遷日趨劇烈，了解動植物、人類面臨環境變動下的脆弱程度顯得更加重要。不同環境條件下種內表現型的多樣性來源可能是遺傳上分化而造成的地區適應(local adaptation)，也可能為表型可塑性(phenotypic plasticity)。這些源頭的差異可以導致族群在棲位上的不同，也同時影響物種在空間時間上的分佈和面對氣候變遷時的反應。然而過去研究多缺乏實地的實驗，且大多聚焦在植物上，不夠全面性的探討與評估族群間在面對環境變動時演化上的優劣勢。我們選擇尼泊爾埋葬蟲（*Nicrophorus nepalensis*）沿著緯度以及海拔梯度上的五個族群（合歡山、拉拉山、烏來、奄美、夾金山）作為依據，結合野外密度實驗以及室內實驗探討影響其物候不同的機制。

結果/結論/應用啟示
我們發現五個族群從日照長度以及溫度來看棲位上已具有分化，並且皆以光週期作為繁殖的依據，從中挑選台灣地區中部（合歡山）以及北部（烏來）兩個族群進行互換實驗，我們發現族群間已演化出對光週期不同的繁殖策略和性成熟發育，符合地區適應假說。最後我們以 RCP8.5 的情境來探究以及預測五個族群面對氣候變遷時物候的變化以及潛在脆弱程度。本研究不僅讓我們從生態的角度了解探討影響演化方向的性狀(enabler trait)重要性，更能從中精準預測不同緯度、海拔上族群的分佈和演化潛力。

關鍵字 (Keywords)：地區適應化 (local adaptation)、埋葬蟲 (burying beetles)、光週期 (photoperiod)、棲位 (niche)、氣候變遷 (climate change)

OB_05

環境平均溫度決定了生物的溫度耐受度和海拔分布
Mean temperature determines thermal tolerance range and elevational distribution of species

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背景/研究問題/材料方法
氣候變遷的影響下，使得了解生物的分佈範圍(Range size)是在討論生物多樣性和生物如何適應變動環境時首要的議題。氣候變異度假說(Climate variability hypothesis)將環境因子影響生物性狀的演化進而限制了生物的分佈範圍建立了完整的脈絡：海拔或緯度愈高，生物所處的氣候變異度愈大，使其溫度耐受性(Thermal tolerance breadth)愈大，而擁有較大的分佈範圍。平均溫假說(Hotter is better and broader)則認為：生理反應速率隨著溫度上升，導致最適溫度愈高的生物，溫度耐受性愈寬。然而，卻少有研究沿海拔或緯度進行完整的量測分析，因此，我們在臺灣中橫東段沿海拔採集蛾類(共 336 種，2,777 筆樣本)測量溫度耐受性及調查海拔分布，並於森林架設長期微型氣象站。

結果/結論/應用啟示
我們發現生活在平均溫度愈高的物種愈耐熱，但愈不耐冷；相較於低溫耐受度，高溫耐受度隨環境平均溫度上升的變化較大，因此，生活在愈熱環境的生物擁有較大的溫度耐受性。愈耐熱的物種分布下界愈低，但同時海拔分布上界受到牽制(trade-off)也愈低，愈耐冷的物種海拔分布上界愈高，分布下界也愈高，導致溫度耐受性並不影響生物的海拔分布範圍。本研究發現，高海拔的生物較不耐熱且擁有較窄的溫度耐受性，因此，如果溫度耐受度無法迅速隨著環境改變演化，在未來環境溫度上升的情境下，將首當面臨威脅。

關鍵字 (Keywords)：溫度耐受性 (Thermal tolerance breadth)、海拔分布 (Elevational distribution)、Range size、氣候變異度假說 (Climate variability hypothesis)、蛾 (Moth)

OB_06

種內性狀變異沿海拔梯度的分布與影響機制
Patterns and drivers of intraspecific trait variation within ecological communities and their responses to altitudinal gradients

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Background/Question/Methods
Environmental filtering and niche differentiation are two main assembly processes on trait-based studies. The environmental filtering concept considers the environment at a location as a filter that only allows species with particular traits to live and reproduce at the location. Niche differentiation is a density-dependent selection process in which biotic interactions, especially competition, cause differentiation of resource use among species. In this study, we using forewing length and body length as traits of moth communities in Taiwan. To assess the relative strength of environmental filtering and niche differentiation for determining the traits variations, we calculated the three ratios (TIP/IC, TIC/IR and TPC/PR) using the 'cati' package in R statistical software. TIP/IC is the ratio of the within-population trait variance to within-community variance. The lower the ratio, the stronger the niche differentiation among populations. TIC/IR is the ratio of the within-community variance to the total variance in the regional pool. The lower the ratio, the stronger the environmental filtering applied on individuals. TPC/PR is the ratio of the community-wide variance of population means to the total variance in the regional pool. The lower the ratio, the stronger the environmental filtering applied on populations.

Results/Conclusions
The analysis of the morphological traits of moths suggested that the major process determining the trait compositions in moth communities in along the elevational gradient in Taiwan might be the competition among species within a community, showing that niche differentiation strongly affected intraspecific variation in forewing length and body length. The effects of environmental factors on the trait compositions were stronger at higher elevations than at lower elevation. This study quantified the strength of two main assembly process in determining intraspecific trait variation for individual moth communities along altitudinal gradients and provide unique insights into the primary forces structuring communities.

關鍵字 (Keywords)：environmental filtering, intraspecific trait variation, niche differentiation

OB_07

居家節肢動物相之公民科學調查推動
The promotion of citizen science investigation on household arthropods diversity in Taiwan

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背景/研究問題/材料方法
居家節肢動物種類與人類演化與活動息息相關，其存在亦與居家環境因子密切相關，近年來國外已有不少這方面研究，但國內迄今仍無系統性的調查與研究。隨著公民科學的興起，全民參與研究，能在短時間大量提供系統性科學資訊，而加速科學研究，但要應用於居家節肢動物調查，則有其困難度，除隱私權問題外，大多在家中出現的居家肢動物體型微小，不易觀察且容易被忽略，在調查上較無成就感，因此難以號召公民參與。本研究試著從另一角度切入，希望透過網站建置、科普活動、特展和校園巡迴展的推出，讓民眾從認識家中節肢動物，到願意主動協助調查，並提供採集之標本供研究使用。

結果/結論/應用啟示
透過科技部科普計畫經費支持，藉由「Let's 探索家中昆蟲」網站建置，研習營、到校服務，以及特展及巡迴展的推出，再利用「讓家中蟲住民健檢你的家」等研習活動與概念，讓民眾了解蟲與環境間的關係，而願意主動調查與採集，以藉此診斷家中環境狀況，並以正確方式減少家中節肢動物，而調查結果亦同意提供做為研究材料。藉由民眾提供之標本，可看出家中節肢動物之多樣性、物種分布、物種間相關性，以及物種與環境間的關聯性。

關鍵字 (Keywords)：居家節肢動物 (household arthropods)、科普活動 (education activities)、網站 (website)、特展 (exhibition)、公民科學調查 (citizen science investigation)

OB_08

蘭嶼海岸林隙對螞蟻相與土棲節肢動物之影響
Assessing the Coastal Forest Gap Formation, Ant Fauna, and Arthropod Changes on an Agroforestry Island, Orchid Island (Lanyu)

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背景/研究問題/材料方法

蘭嶼社會的園藝果樹林栽植仰賴精細的燒墾、和休耕來控制其獨特的生態需求。此一海岸林地景、森林孔隙、乃至土棲節肢動物相，乃是相互連接作用的三組尺度因素。本研究於 2000-2002 年間應用柏氏漏斗集中法，檢驗蘭嶼螞蟻與節肢動物組成的季節變化，並依據現地拍攝全天光空域、以及對照正射航照影像判釋樹冠層孔隙，來探討熱帶海岸林內的孔隙動態與動物相變化。研究區域分別位於紅頭、朗島、東清與野銀等四村的棋盤腳優勢社會，海拔 10-71 m，距離海岸線都在 1km 範圍內。透過地理資訊系統往前 20 年(1980-2002) 間的航照影像，得到演替歷程的判釋。

結果/結論/應用啟示

結果發現棋盤腳森林內的獵食螞蟻種類數在島嶼東部顯著豐富，同時土棲節肢動物相中則以直翅目、鞘翅目、半翅目、同翅目等最為豐富；雜食螞蟻族群量以島嶼北部最多，應與原住民燒墾的慣行農法有關。當地的雅美/達悟族人迄今仍保持 3-5 年的輪耕制度，使芋田濕地鄰近森林，旱田並在休耕期間成為具高度多樣性的生態交會帶。本研究建議尊重當地農藝森林的土地使用傳統，瞭解小尺度的冠層孔隙干擾於熱帶海岸林內所扮演的角色，與國外相關研究比較，並探討文化慣習在不同地理環境上所造成之差異。

關鍵字 (Keywords)：蘭嶼 (Orchid Island (Lanyu))、柏氏漏斗集中法 (Berlese funnel extraction)、螞蟻 (Ants)、節肢動物 (Arthropods)、雅美/達悟人 (Yami/Tao)

OB_09

水稻田節肢動物多樣性在不同農業經營之影響:以苗栗苑裡地區為例
Effects of arthropod diversity of rice paddy field under different agriculture managements: an example from the Yuanli area of Miaoli County

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背景/研究問題/材料方法
過去慣行農法常使用化學藥劑解決病蟲害問題，卻導致農藥殘留及環境汙染問題，近年來開始提倡以生物間的交互作用抑制病蟲害，希望降低化學藥劑的使用。節肢動物於農業生態系中扮演重要角色，各類型功能群與農作物間形成緊密相連的生態系統，環境的變動會顯示在節肢動物的群集組成，透過節肢動物相與功能群可評估農業生態系的穩定性。相較於慣行農法經營下使用化學藥劑，永續農法則少量或不使用農藥，推測後者的節肢動物多樣性與個體數應較高。為探討此議題，本研究於苗栗縣苑裡地區以 2018 年第一期稻作針對兩種農法之水稻田進行比較，分別於四個大樣區中分別選取一慣行田及一永續田，共八塊田區，以真空採樣器對固定面積內之植株真空吸引 90 秒以取得節肢動物，每個月進行一次採樣，採獲之樣本皆保存於 75%酒精中並鑑定至科級及形態種。

結果/結論/應用啟示
共採集 13 目 185 個形態種 28,927 隻個體，永續田區較慣行田區擁有較高比例的捕食者，且各樣區之形態種數、個體數及優勢類群皆隨著當地耕作期程而有所不同，目前結果顯示節肢動物相與水稻田植株生長期程較相關而與農業經營方式關聯性較低。

關鍵字 (Keywords)：水稻田 (Paddy field)、節肢動物多樣性 (Arthropod diversity)、農業生態 (Agroecosystem)、農法經營 (Agriculture management)

OB_10

建立入侵小蜜蜂發生之監測、根除技術與風險評估 (膜翅目：蜜蜂科)
Establish of surveillance, eradication techniques, and risk assessment of dwarf honeybee (Hymenoptera: Apidae)

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背景/研究問題/材料方法
蜜蜂雖常被認為是有益昆蟲，於 2007 年東方蜜蜂 (*Apis cerana*, AHB) 因族群擴張入侵其非原生地之澳洲本土，成為蜜蜂被視為檢疫害蟲之特例。澳洲政府為維護當地本土蜂種生態與其養蜂產業，進行東方蜜蜂發生之監測及根除作業。有鑑於蜜蜂擴張迅速，澳洲於 2011 年發展從過渡到管理層策略 (transition to management, T2M)，轉變及發展新入侵的 AHB 族群與該物種攜帶寄生蟲之檢測技術。約於 2017 年 10 月南部地區有民眾通報發現疑似外來蜜蜂現蹤台灣，為瞭解其發生概況，隨即由防檢局主持成立工作小組，由苗栗區農業改良場及嘉義大學組成研究團隊執行監測及根除作業。調查期間自 2017 年 11 月至隔年 9 月，不定期至野外調查訪花蜜蜂並紀錄其發生地點、訪花植物與發生密度等。同時藉由主動發佈新聞，籲請民眾、蜂農注意並協助通報，且整理累積根除之蜜蜂巢及其生活習性資料，評估其發生之風險。

結果/結論/應用啟示
以最初通報點為中心調查周遭外來蜜蜂訪花植物，總計超過 10 種以上，蜜蜂造訪停留於綠地之低矮莧科、菊科等花較容易發現，期間不一樣的植物開花，蜜蜂會被蜜源多、短期且集中，或分布不普遍，不易觀察之喬木或草本植物的花所吸引，而不易被監測。於 2017 年 11 月劃定監測範圍達十餘平方公里，隔年 3 月研究團隊偕同主管機關、學者專家進行會勘。同年 4～9 月，陸續接收由民眾、蜂農通報疑似發現外來蜜蜂案件達十餘件，通報物種經形態及分子鑑定均為小蜜蜂 (*Apis florea*)，其中僅有一件採集工蜂位於劃定範圍之外。根除之蜂巢蜂群數量約 380 ~ 5,034 隻不等，目前持續建立體表寄生蟲與病毒種類資料庫。未來，參考澳洲政府防治入侵蜜蜂之經驗，除持續進行根除外，未來擬建立已入侵蜜蜂族群基因庫，以確保未來與可能入侵之新族群之區別鑑定。

關鍵字 (Keywords)：入侵 (invasion)、蜜蜂科 (Apidae)、風險評估 (risk assessment)、根除 (eradication)

OB_11

台灣穿山甲的食物消化率與覓食季節性
The prey digestibility and foraging seasonality of wild Formosan pangolins (*Manis pentadactyla pentadactyla*)

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背景/研究問題/材料方法
穿山甲食性研究主要透過分析胃內含物與檢視排遺內白蟻與螞蟻的殘骸，然而，各階級白蟻與螞蟻體型變異大，而且消化後，排遺內的白蟻與螞蟻的殘留率也未知，因此無法推估穿山甲的實際取食量。本研究檢視 132 份野外穿山甲排遺內的白蟻大顎及螞蟻頭部數量，再以台北市立動物園圈養的四隻穿山甲，進行餵食台灣土白蟻 *Odontotermes formosanus* 和長腳捷蟻 *Anoplolepis gracilipes* 的試驗，計算排遺內的白蟻大顎和螞蟻頭部殘留率，用此推估野外穿山甲的取食量，分析穿山甲取食螞蟻與白蟻是否有季節性，以及總取食量在濕季(4-11 月)和乾季(12-3 月)的差異。

結果/結論/應用啟示
結果顯示排遺中的白蟻殘留率為 0.35 ± 0.1%，螞蟻殘留率為 0.58 ± 0.1%。132 份排遺經過殘留率回乘後，每 10 公克乾重的排遺，平均的白蟻和螞蟻的總個體數為 16,613(1,513–38,168)隻。穿山甲取食量有季節性，濕季的覓食量顯著高於乾季($t = -2.41$, $p < 0.05$)，濕季比乾季取食較多的螞蟻個體數($t = -2.9$, $p < 0.05$)；而乾季比濕季取食較多的白蟻($t = 2.38$, $p < 0.05$)。本研究提供估算穿山甲取食生物量(biomass intake)的依據，未來可結合取食生物量與營養成份分析，深入探討穿山甲的覓食生態學。

關鍵字 (Keywords)：覓食生物量 (biomass intake)、消化能力 (digestibility)、覓食生態學 (foraging ecology)、食蟻性 (myrmecophagy)、季節性 (seasonality)

OB_12

台灣土白蟻的覓食物候

Foraging phenology of a fungus-growing termite, *Odontotermes formosanus*

邱俊禕[1]、葉信廷[2]、李百靈[3]、郭致與[1]、蔡明哲[2]、李後鋒[1]
Chun-I Chiu[1], Hsin-Ting Yeh[2], Pai-Ling Li[3], Chih-Yu Kuo[1], Ming-Jer Tsai[2], Hou-Feng Li[1]
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背景/研究問題/材料方法
養菌白蟻在亞洲及非洲的熱帶及亞熱帶地區是重要的枯落物分解者及農業害蟲，其覓食行為被認為具季節性，且可能與氣候因子及天敵的發生頻率有關。為了驗證這些假說，本研究自 2013 年開始，每月監測 484 根木樁上台灣土白蟻 (*Odontotermes formosanus* (Shiraki)) 的發生率、取食量、及覓食群體大小，並以路徑分析 (path analysis) 檢測氣候因子、螞蟻的發生頻率及兩者的交互作用對台灣土白蟻覓食活動之影響。

結果/結論/應用啟示
分析結果顯示，溫度及雨量為影響台灣土白蟻覓食季節性的主要因子。台灣土白蟻在較濕熱的季節會佔據較少的木樁，該季節的螞蟻的發生頻率亦較高，但路徑分析顯示白蟻與螞蟻的發生頻率並無直接關聯，而是各自反應氣候因子。另外，由於台灣土白蟻每個月捨棄 70–90% 原先已佔據的木樁、並尋找新的木樁，我們推測其具有 ”吃即跑”(eat-and-run) 之覓食策略，推測該覓食策略可能降低台灣土白蟻受天敵攻擊或降雨干擾之風險。

關鍵字 (Keywords)：氣候因子 (climatic factor)、季節性 (seasonality)、養菌白蟻 (fungus-growing termite)、螞蟻 (ant)

OB_13

半白長轉姬薪蟲 *(Eufallia seminivea*) 與環境關係之初探
A preliminary study on the relationships between *Eufallia seminivea* and environment in its storage room for wet collection

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背景/研究問題/材料方法
半白長轉姬薪蟲(*Eufallia seminivea*)屬姬薪蟲科(Latridiidae)，為食菌性昆蟲，近幾來發現大量出現在博物館浸液標本蒐藏庫及其他室內環境中，雖不會直接對標本造成重大為害，但其出現顯示環境中可能存在有不利人體健康之黴菌問題，且屍體常成為其他博物館害蟲食物，不利於標本蒐藏管理工作。為瞭解姬薪蟲的發生與環境間的關係，2014 至 2015 年間在浸液標本蒐藏庫中初步以黏蟲板進行監測，觀察每月族群數量變化，2018 年八月起，再透過黏蟲板及地面採集方式，進行每月監測調查，記錄採得之節肢動物種類與數量以及相關環境因子，並探討其關聯性。

結果/結論/應用啟示
2014 至 2015 年間的每月監測結果顯示姬薪蟲具明顯季節性變化，族群數量從七月起開始增加，至十月後開始略減。2018 年七月在一儲存架間通道地面發現大量死亡屍體，數量甚至高達 2 萬餘隻，原因不明。為探討半白長轉姬薪蟲在浸液標本蒐藏庫中的發生位置及與環境變化關聯性，我們自 2018 年八月繼續透過黏蟲板及地面採集方式進行監測，期能找出最適合姬薪蟲生存之季節與環境因子，藉此作為居家環境的生物指標，提供防治建議，以減少本種對博物館標本蒐藏庫造成的為害。目前發現姬薪蟲的發生位置與可能空調氣流流動及物品種類的放置具關聯性。

關鍵字 (Keywords)：姬薪蟲 (Latridiidae)、半白長轉姬薪蟲 (*Eufallia seminivea*)、監測 (monitoring)、黏蟲板 (sticky traps)、食菌性 (mycophagy)

系統分類、族群遺傳與演化

論文宣讀摘要集

Oral Session:

Systematics, Population Genetics and Evolution

OS_01

Transoceanic dispersal and biogeography of littoral *Cercyon* Leach (Hydrophilidae) across the Northern Pacific

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Background/Question/Methods

Cercyon Leach is a genus of terrestrial hydrophilid beetles in the subfamily Sphaeridiinae comprising over 250 species worldwide (Hansen, 1999). They commonly inhabit dung and decaying plant material but include several halobiont species that specialize in beach shore habitats, all of which are members of the subgenus *Cercyon* Leach. While the taxonomy of this group on the Pacific coast of North America has been well studied by Hatch (1965) and later Smetana (1978, 1988), recent interest in beach fauna for both taxonomic biogeography and ecological research have renewed interest in better understanding this group's systematics and distribution. We compared beach insect species in far East Asia with those distributed on the West coast of North America to understand the patterns of dispersal and adaptation to the beach environment in the Northern Pacific. Specimens were collected from shorelines of Alaska, British Columbia and Washington State and marine littoral members of the genus *Cercyon* from Pacific North America are revised.

Results/Conclusions

Through taxonomic revision of littoral members of the Hydrophilid genus *Cercyon* Leach, new information about the range overlap of different species suggests several routes of distribution between the two regions. The synonymy of *C. setulosus* with *C. tolfino* and the presence of this group on both sides as well as in the Aleutians suggests gradual movement around the Northern Pacific rim. In addition, the timing of the appearance of *C. dux* in the Pacific Northwest following the arrival of tsunami debris from Japan introduces the possibility of a direct trans-Pacific dispersal event via the large amounts of debris generated by large-scale natural disasters such as Tsunami.

關鍵字 (Keywords)：taxonomy, systematics, biogeography

OS_02

台灣產白蟻領科的分類回顧與分子系統學
Taxonomic review and molecular systematics of Termitoidae (Blattodea) in Taiwan.

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背景/研究問題/材料方法
台灣已記錄的白蟻共 5 科，分別為原白蟻科 (Archotermopsidae)、木白蟻科 (Kalotermitidae)、木鼻白蟻科 (Stylotermitidae)、鼻白蟻科 (Rhinotermitidae) 以及白蟻科 (Termitidae)。台灣過往的白蟻分類研究以經濟危害性高的鼻白蟻科及白蟻科最主，原白蟻科、木白蟻科及木鼻白蟻科等則缺乏系統性的分類回顧。本研究檢視台灣各昆蟲典藏單位中共計 5,735 筆的白蟻群體樣本，結合形態及分子特徵 (COII) 探討台灣的白蟻物種多樣性。

結果/結論/應用啟示
根據形態比較及分子特徵結果顯示，台灣產白蟻領科共 5 科 14 屬 22 種。原白蟻科共 1 屬 1 種：原白蟻屬 (*Hodotermopsis* / 1(種))。木白蟻科共 4 屬 7 種：堆砂白蟻屬 (*Cryptotermes* / 1)；樹白蟻屬 (*Glyptotermes* / 3)；楹白蟻屬 (*Incisitermes* / 1)；新白蟻屬 (*Neotermes* / 2)。木鼻白蟻科共 1 屬 1 種：木鼻白蟻屬 (*Stylotermes* / 1)。鼻白蟻科共 3 屬 6 種：家白蟻屬 (*Coptotermes* / 2)；散白蟻屬 (*Reticulitermes* / 3)；原鼻白蟻屬 (*Prorhinotermes* / 1)。白蟻科共 5 屬 7 種：大白蟻屬 (*Macrotermes* / 1)；土白蟻屬 (*Odontotermes* / 1)；象白蟻屬 (*Nasutitermes* / 3)；歪白蟻屬 (*Pericapritermes* / 1)；華歪白蟻屬 (*Sinocapritermes* / 1)。其中，白蟻科的大白蟻屬、木白蟻科的樹白蟻屬及新白蟻屬各有一個物種是新紀錄種。我們將進一步針對新紀錄種進行形態描述，並且整理目前已記錄白蟻物種的種間差異，建立台灣產白蟻領科之物種檢索表。

關鍵字 (Keywords)：台灣 (Taiwan)、白蟻領科 (Termitoidae)、新紀錄種 (new record species)、COII

OS_03

表皮烴類合成基因在紅火蟻社會超級基因之重複

Genes for cuticular hydrocarbon synthesis are duplicated in the social supergene of the fire ant

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Background/Question/Methods
The red imported fire ant *Solenopsis invicta* shows two distinct social forms (monogyne and polygyne colonies, with one and multiple queens, respectively) under genetic control of a ~12.5 Mb supergene. The supergene includes ~600 genes linked together by multiple inversions, which prevents recombination between the two variants, 'Social B' (SB) and 'Social b' (Sb). Monogyne (SB/SB) and polygyne (SB/Sb) queens show different cuticular hydrocarbon (CHC) profiles, leading to differential recognition by the workers: SB/SB queens are rejected from a polygyne colony, while SB/Sb queens are accepted. Thus an important question is: What are the genes that regulate the differences in the queen CHC profiles? In this study we started by conducting a bioinformatic analysis to characterized genetic duplications on the non-recombining social supergene. Fortuitously we may have identified candidate genes for CHC regulation.

Results/Conclusions
We found 430 genes with greater copy number in Sb. We observed transposon accumulation on the Sb allele, confirming the accumulation of repetitive elements on non-recombining chromosomes. Surprisingly, we also found many duplications of non-transposon fire ant genes on Sb, including an enrichment of those encoding putative cuticular hydrocarbon (CHC) synthesis enzymes. We conducted a detailed examination of duplications in a desaturase and an elongase gene, which are potentially responsible for different CHC profiles between SB/SB and SB/Sb queens. These genes, which may be important for queen recognition, show high gene expression in polygyne queens. They seem to have translocated into the supergene from other chromosomes and proliferated by multiple duplication events. We are now conducting RNAi injection experiments to test whether the desaturase is involved in CHC synthesis in polygyne queens. We will show preliminary data of RNAi experiments and subsequent GC/MS analysis of CHCs. Overall, our results suggest that gene duplications may be an important factor leading to monogyne and polygyne ant societies.

關鍵字 (Keywords)：紅火蟻 (red imported fire ant)、社會超級基因 (social supergene)、基因重覆 (gene duplications)、表皮烴類 (cuticular hydrocarbons)

OS_04

臺灣姬薪蟲科分類之初探 (昆蟲綱，鞘翅目)
A Preliminary Study of Latridiidae in Taiwan (Insecta, Coleoptera)

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背景/研究問題/材料方法
姬薪蟲為一類體型小之鞘翅目昆蟲，體色主要為褐色至黑色，身形大多為長橢圓形，體長介於 1-3 公釐之間。牠們大多以真菌為食，廣泛分布於全世界，主要棲息在潮濕的環境之中。有些種類會出現在家中環境，或是曾被記錄為倉儲害蟲，可做為居家環境的生物指標。臺灣的姬薪蟲科目前記錄僅 6 屬 8 種，但因缺乏系統性的研究，所以預估具有更高的多樣性。因此，我們透過採集、檢查博物館標本、比對形態，以及解剖生殖器，以對臺灣姬薪蟲科的分類有更進一步的瞭解。

結果/結論/應用啟示
經由標本的整理和比對，除原有記錄外，我們另發現至少 3 個新記錄屬，和至少 6 個尚未被記錄之形態種，也顯示臺灣姬薪蟲科的多樣性有待更進一步的發掘與研究。除此之外，因為臺灣是一個貿易頻繁的國家，所以許多國外曾被記錄過為木材檢疫害蟲、倉儲害蟲或是居家害蟲的種類，也可能在臺灣被發現，因此，未來可與相關檢疫單位合作，協助標本鑑定與防杜害蟲入侵，同時亦藉此釐清臺灣姬薪蟲科的分類問題。

關鍵字 (Keywords)：姬薪蟲科 (Latridiidae)、臺灣 (Taiwan)、分類學 (Taxonomy)

OS_05

粒線體全基因體譜系分析意外揭示一個形態與行為特異的水棲熠螢新成員(鞘翅目，螢科，熠螢亞科)

Mitochondrial phylogenomics reveals an unexpected new member of aquatic lucioline fireflies with disparate morphology and ecology (Coleoptera, Lampyridae)

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背景/研究問題/材料方法

2015 年起我們在菲律賓陸續發現四種極為特殊的一類甲蟲，外觀類似菊虎，具有前口式與扁平外露的頭部、小複眼、長觸角、發達口器、一對點狀發光器、輕微的性別雙態等特徵。他們敏捷善飛，傍晚時群飛求偶，雌蟲夜間在水邊產卵，能發出微弱點光。這些特殊的形態與行為對判斷其科與亞科的歸屬產生混淆：若為菊虎科，乃首度發現會發光和水生的菊虎；若屬螢科，則不符各亞科既有定義，黃昏群飛求偶亦為首見。我們以先前根據粒線體 COI、16S 及核 DNA 的 Ef-1α 基因所建構的亞洲螢科譜系初步檢測其位置，再選擇具代表性的螢科和數個叩頭蟲總科成員，以次世代定序與總體基因體學技術組建粒線體全基因體共 37 個基因來重建譜系，以決定該類甲蟲的分類。

結果/結論/應用啟示

粒線體全基因體譜系分析結果高度支持該群為螢科之熠螢亞科成員，且與幼蟲具鰓的水棲熠螢支序為姊妹群，其雄蟲外性器形態也符合此支序的共衍徵。分子、形態與行為都顯示其為水棲性，故將新屬命名為奇水仙螢(*Xenonaiad* n.gen.)。該屬特異的自衍徵及黃昏群飛求偶習性與熠螢亞科其他成員差異甚鉅，但基於譜系分類原則不另立族或亞科，而重新界定熠螢亞科。粒線體全基因體序列在螢科屬級至科級能提供強有力的譜系解析。

關鍵字 (Keywords)：熠螢 (Luciolinae)、新屬 (new genus)、水棲螢火蟲 (aquatic firefly)、粒線體總體基因體學 (mitochondrial metagenomics)、菲律賓 (Philippines)

OS_06

Two new species of genus *Platycheirus* (Diptera: Syrphidae) in Taiwan

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Background/Question/Methods

Hover flies (Diptera: Syrphidae) is a group of commonly-seen flies, they are usually found around flowers, bushes or decaying tree holes. About 180 hover fly species have been recorded in Taiwan till 2015, but most of these taxonomic studies were done before 1950. In May and June of 2016, we organized an international research team taking one month to survey hover flies in Taiwan and found some unrecorded species. *Platycheirus* Lepeletier & Serville, 1828 is a genus belongs to subfamily Syrphinae and tribe Melanostomatini. They usually have black and slender bodies, with some greyish or yellowish maculae on thorax, and males have inflated tarsus. *Platycheirus* usually occurred in the cool areas (i.e. boreal area or high-altitude region), and one endemic species has been recorded in Taiwan. Many *Platycheirus* specimens were collected in this trip at Hehuanshan and Siangyang Forest Recreational Area on flowers of *Rhododendron* and *Salix*. Morphological and molecular data of these flies were studied to know their taxonomic status and a diagnostic key for species identification was also provided.

Results/Conclusions

Three species were collected in this trip, including a previously recorded species, *P. formosanus* Shiraki, 1930, as well as two new species. These species were respectively grouped into three different species group. Among them, *P. formosanus* is obviously different from the other two species, and is widespread in high mountains of Taiwan. Those two new species were only found around Hehuanshan area, and were placed under the *peltatus* and *ambiguus* species groups, respectively.

關鍵字 (Keywords)：*Platycheirus*, Syrphidae, new species, taxonomy

OS_07

Revision of the genus *Zeugophora* (Coleoptera, Megalopodidae, Zeugophorinae) from Japan, with a description of new species from Taiwan

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Background/Question/Methods
Genus *Zeugophora* Kunze, 1818 consists of 92 species. In Japan, nine species have been recorded until now. The taxonomy of this genus is not well studied, particularly in descriptions of male and female genitalia (Reid, 1989, 1992; Chûjô, 1952; Suzuki, 2003; Sekerka & Vives, 2013; Geovanni et al., 2017).

Results/Conclusions
In this study, in collecting specimens of *Zeugophora*, a previously undescribed species was found. Nine species are redescribed and a new species are described for the first time. Illustrations of male and female genitalia, pronotum, and meso- and metathoraces, and measurements of external features are presented. In addition, *Zeugophora flavonotata* (Chûjô, 1935) is believed to be distributed in both Japan and Taiwan but after examining Taiwanese specimens, they were found to represent a separate, previously undescribed species.

關鍵字 (Keywords)：Coleoptera, Megalopodidae, Zeugophorinae, *Zeugophora*, Japan, Taiwan, Revision, Taxonomy

行為、生理與生物學

論文宣讀摘要集

Oral Session:

Ethology, Physiology and Organismic Biology

OE_01

桃蚜 (*Myzus persicae*) 在寄主與非寄主植物上的取食行為
Feeding behavior of *Myzus persicae* on host and non-host plants

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背景/研究問題/材料方法

昆蟲透過氣味誘引與視覺找尋合適的寄主植物，降落於植物葉片後，利用視覺、嗅覺、味覺、觸覺等開始檢測葉部氣味、表面結構、化學物質等，接著試探取食偵測內部組成、化學物質等，逐步檢視合適的寄主。蚜蟲在降落於植物葉片後會進行試探取食 (test probing)，如果接受為寄主，則會移動至葉背進行長時間取食 (prolong feeding)。本研究利用昆蟲刺探電位圖譜 (electrical penetration graph, EPG) 監測桃蚜 (*Myzus persicae*) 於寄主植物—油菜及非寄主植物—彩色海芋上的刺探 (probing) 與取食行為，進一步剖析蚜蟲於寄主接受階段的刺探與取食模式。

結果/結論/應用啟示

實驗結果分兩部分討論：口針探尋韌皮部 (phloem) 與韌皮部取食。在口針探尋韌皮部方面，相較於油菜，桃蚜於海芋上需要花較多時間其口針才能抵達韌皮部與成功吸取韌皮部汁液。結果與油菜是寄主植物、海芋不是寄主植物相符合。在韌皮部取食方面，桃蚜於油菜上皆達到韌皮部取食 (phloem feeding) 階段；於海芋上僅四成達到此階段。於韌皮部取食階段，桃蚜於油菜上有較短的 salivation (E1) 與較長的 phloem sap ingestion (E2)；於海芋上有較長的 E1 與較短的 E2。結果顯示桃蚜在油菜上有長時間取食行為，在海芋上則無。結果表示桃蚜於寄主植物的韌皮部短暫的 salivation 之後，就會進入長時間的 sap ingestion；而於非寄主植物的韌皮部，則沒有或相當短暫的 sap ingestion。

關鍵字 (Keywords)：昆蟲刺探電位圖譜 (electrical penetration graph)、取食行為 (feeding behavior)、韌皮部取食 (phloem feeding)、刺探 (probing)、長時間取食 (prolong feeding)

OE_02

長腳捷山蟻的覓食行為研究(蟻科，捷山蟻屬)
Foraging behavior research of the yellow crazy ant *Anoplolepis gracilipes* (Formicidae, *Anoplolepis*)

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背景/研究問題/材料方法
長腳捷山蟻 (*Anoplolepis gracilipes*)， 俗稱黃狂蟻（Yellow Crazy Ant），應是起源於非洲的螞蟻種類，因長期人類的經濟活動，近年來入侵人類的生活環境，不僅影響人類生活品質也對於原生生物造成危害。螞蟻的食性與取食偏好不逕相同，因此若要有效防治特定害蟲螞蟻，需要針對不同種類、濃度的餌劑進行偏好性實驗，並以染色餌劑及顏色標記的方式來了解長腳捷山蟻的覓食後的食物傳遞途徑。

結果/結論/應用啟示
結果支持長腳捷山蟻的一般型工蟻會將大部分所覓食的食物傳給產卵型工蟻，不論使用氨基酸或是蔗糖水作為餌劑。這個實驗也同時觀察到，於不同種類之餌劑皆顯示出幼蟲並不會經一般型工蟻餵食後染色，工蟻並不會直接地將所獲取的食物傳給幼蟲。將其結果放置到田野做對照，並測定一天中的覓食高峰期，以達到最佳防治效果，並提供防治田間長腳捷山蟻族群的參考策略。

關鍵字 (Keywords)：長腳捷山蟻 (*Anoplolepis gracilipes*)、覓食行為 (Foraging behavior)、入侵種螞蟻 (Invasive ant)、產卵型工蟻 (physogastric worker)

OE_03

瘤顎家蟻屬(*Strumigenys*)孤雌生殖週期研究 (膜翅目：蟻科)
Thelytokous Parthenogenesis Study of Strumigenys (Hymenoptera：Formicidae)

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背景/研究問題/材料方法

大部分的動物以及植物都是以有性生殖繁殖後代，少部分的動物會以無性生殖的方式產生後代。螞蟻屬於典型的膜翅目昆蟲，以單雙套系統決定性別，孤雌產雌或是稱為無性生殖，是指雌性個體在未交配行為下，可產下雙倍體的雌性個體，是一種卵未經受精作用便可發育成為新雌性個體的現象。本研究目的為針對具有孤雌產雌生殖淺力的瘤顎家蟻進行生活史觀察紀錄研究。自蟻后出現的時間起，記錄新有翅型處女蟻后的數量，並以每巢單蟻后配置 10 隻工蟻進行生活型態紀錄及飼養，持續觀察記錄。經持續觀察有翅型瘤顎家蟻蟻后脫翅時間、產卵時間，巢內個體總數（卵、幼蟲、蛹、工蟻），得到瘤顎家蟻是否具有孤雌生殖的詳細資料，與對照組（愛美瘤顎家蟻）進行比較，並解剖蟻后生殖腺以確認是否具有孤雌生殖潛力。

結果/結論/應用啟示

研究結果顯示瘤顎家蟻屬目前在臺灣 13 種瘤顎家蟻當中，具有 4 種瘤顎家蟻具有孤雌生殖能力。研究之中，把瘤顎家蟻分為 4 個等級，第一級為瘤顎家蟻具孤雌生殖潛力；第二級為未交配之瘤顎家蟻蟻后產下的幼蟲能羽化成雄蟻；第三級為未交配蟻后能產卵，卻無孵化現象；第四級為未交配蟻后不具產卵現象。研究證明在瘤顎家蟻屬中的部分種類中是具有孤雌生殖週期的。

關鍵字 (Keywords)：單雙套系統 (Haplodiploidy)，孤雌生殖(Parthenogenesis)，孤雌產雌 (Thelytoky)

OE_04

黃原鼻白蟻的階級發育彈性
Plasticity of caste development of *Prorhinotermes flavus* (Blattodea：Rhinotermitidae)

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背景/研究問題/材料方法
白蟻通常透過分飛建立新的群體，脫翅的繁殖型個體即為新巢中的蟻王與蟻后，也被稱為初級繁殖蟻 (primary reproductive)，而巢中透過其他發育路線產生的生殖型個體則稱為次級繁殖蟻 (secondary reproductive) 或補充繁殖蟻 (neotenic)。目前發現原鼻白蟻屬 (*Prorhinotermes*) 物種能產生最多補充繁殖蟻，可占巢中 40%左右的個體。為瞭解原鼻白蟻產生補充繁殖蟻的發育方式，本研究在墾丁及蘭嶼採集黃原鼻白蟻 (*Prorhinotermes flavus*)，透過室內飼育並檢視 328 個野外樣本的頭寬、前胸寬及觸角節數等特徵，分析各階級的形態變化，了解補充繁殖蟻的發育路徑。

結果/結論/應用啟示
黃原鼻白蟻的卵孵化後為 1 齡幼蟲 (larva)，2 齡幼蟲可以發育為前兵蟻 (presoldier) 或者擬工蟻 (pseudergate)，擬工蟻可持續蛻皮 7，體形變大但階級不變，負責大部分工作，擬工蟻在蛻皮 1-7 次後可發育為前兵蟻，擬工蟻在蛻皮 4-6 次後可發育為若蟲 (nymph)，若蟲具有翅芽，若蟲至少再蛻皮 3 次後才轉變為有翅繁殖蟻 (alate)。每個發育路徑產生的前兵蟻，再蛻皮 1 次就變為兵蟻 (soldier)。擬工蟻可在蛻皮 3-8 次後發育為無翅補充繁殖蟻(apterous neotenic)，若蟲也可透過蛻皮發育為短翅補充繁殖蟻 (brachypterous neotenic)。我們推測原鼻白蟻生殖階級發育的彈性有兩個功能，一、於初級繁殖蟻死亡或分巢 (colony budding) 時替補其繁殖功能；二、在環境合適、食物資源充足時快速增加族群的繁殖力。

關鍵字 (Keywords)：階級系統 (caste system)、補充繁殖蟻 (secondary reproductive)、分巢 (colony budding)

OE_05

A comparative view on the distribution of histaminergic channels underlying color processing in fly and butterfly visual systems

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Sokendai

Background/Question/Methods

A recent study demonstrated in *Drosophila* that the terminals of photoreceptors R7 and R8 mutually inhibit in the medulla producing spectral opponency via histamine-gated chloride channels. It suggests that the *Drosophila* visual system extracts chromatic information at the level of photoreceptors. As what has long been considered in insects, the medulla is the most plausible candidate where the processing of color information begins. However, in the lamina of the butterfly *Papilio xuthus*, we have frequently encountered photoreceptors showing spectral opponent responses and numerous synapse-like structures between photoreceptors. Does color processing begin earlier in butterflies than previously hypothesized? Here we used immunohistochemistry to localize two recently identified histamine-gated chloride channels, PxHCLA and PxHCLB, in the *Papilio* eye.

Results/Conclusions

The PxHCLA is expressed in second-order neurons postsynaptic to photoreceptors as is the case in *Drosophila*. The PxHCLB expression is associated with photoreceptor axons. This is similar to the distribution of HCLB in the *Drosophila* medulla but is dissimilar to that in the *Drosophila* lamina, where the channel is exclusively found in glial cells. The *Papilio* histaminergic synapses between photoreceptors suggest that spectral opponent processing starts in the lamina as in the medulla of *Drosophila*. In other words, the lamina is most likely involved in color vision in *Papilio*. The opponent interaction at an earlier visual stage is likely important for the acute color vision of this flower forager.

關鍵字 (Keywords)： color vision, histamine-gated chloride channel, immunohistochemistry, spectral opponency

OE_06

Immune dysfunction caused by the expression of polyglutamine expansion in hemocytes of *Drosophila melanogaster*

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Background/Question/Methods

Several inherited neurodegenerative disorders in human are caused by the expansion of polyglutamine (polyQ) repeats, such as Huntington's disease (HD). The expression of expansive polyQ protein forms an insoluble protein aggregation and compromise fundamental cellular functions resulting in cell death. Although primary pathology in the polyQ diseases are known to arise from aggregation of polyQ in neuronal tissues, the expression of polyQ aggregation has also been found in other non-neuronal tissues, such as immune cells. However, it is still unclear the physiological effect of polyQ aggregation on non-neuronal tissues. Our present study used *Drosophila melanogaster* as a model organism to examine the effect of polyQ in the immune cells. We used GAL4/UAS system expressing first exon of human mutant Huntingtin protein (mHTT), which contains 96 polyQ repeats, in *Drosophila* hemocytes and surveyed their immune responses after wasp or nematode infection.

Results/Conclusions

Our results show that expression of 96 polyQ repeats in hemocytes does not affect the viability of larval or adult flies in contrast to its expression in brain. However, the flies have lower numbers of circulating hemocytes and are highly sensitive to both parasitoid wasp and nematode infections. Our results demonstrate that expression of polyQ expansion in immune cells may suppress the immune function and increased susceptibility to infection.

關鍵字 (Keywords)：polyglutamine, hemocytes, *Drosophila*

OE_07

米爾頓釉小蜂(膜翅目：釉小蜂科)對於蒲桃與不同品種蓮霧之產卵偏好性以及花朵氣味成分分析

Oviposition preference of *Anselmella miltoni* (Hymenoptera：Eulophidae) to rose apple (Syzygium jambos) and different varieties of wax apple (*S. samarangense)* and the analysis of flower volatile

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背景/研究問題/材料方法

米爾頓釉小蜂(膜翅目：釉小蜂科)具造癭習性，目前在台灣的寄主植物為桃金孃科的蒲桃與蓮霧，雌蟲於開花時期產卵於胚珠上，幼蟲於果實內部造癭，形成類種子癭，成蟲羽化後鑽離果肉並於果實表面留下孔洞，雖然不危害果實風味，但為台灣蓮霧出口中國的新興檢疫害蟲，因此造成嚴重外銷損失。依據蓮霧出口中國的檢疫資料顯示，南洋種和印尼種皆被檢出危害，泰國種則沒有危害記錄，為瞭解導致危害率差異的因素，本研究以三品種蓮霧與蒲桃之盛花期為材料，利用 Y 型管氣味裝置測試雌蟲對不同寄主植物花朵氣味之偏好性，記錄雌蟲在不同氣味端所停留的時間長短及初次選擇，再以氣相色譜質譜(GC-MS)分析花朵氣味成分，探討花朵氣味對寄主搜尋的影響。

結果/結論/應用啟示

Y 型管結果顯示，空氣組與單一植物花朵相比，雌蟲在蒲桃端的停留時間最長，其次為南洋種及印尼種，最短則為泰國種；蒲桃花與三品種蓮霧花相比，雌蟲皆在蒲桃端停留較長時間；三品種蓮霧花互相比較，雌蟲在南洋種端停留時間較長，其次為印尼種，最短為泰國種。測試結果顯示偏好性與危害率高低相符，推論花朵氣味為雌蟲選擇寄主的主要因子之一。進一步以 GC-MS 分析蒲桃與蓮霧花之氣味組成，未來將進一步測試各成分的吸引力，找出具有潛力成為田間誘引劑發展之成分。

關鍵字 (Keywords)：Y 型管 (Y-tube olfactometer)、植物氣味 (plant volatile)、寄主搜尋 (host searching)、產卵偏好 (oviposition preference)、造癭昆蟲 (galling insect)

OE_08

黃原鼻白蟻之胚胎發育與調控胚胎發育之基因表現分析
Embryonic development of *Prorhinotermes flavus*: programming of the termite

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背景/研究問題/材料方法
發育遺傳學是一門了解基因如何調控發育過程的科學。於昆蟲學領域中，幾乎大部分重要的胚胎發育遺傳研究均來自雙翅目的黃果蠅。而白蟻的胚胎發育遺傳研究，尚付之闕如。不同於雙翅目黃果蠅的長胚帶胚胎發育模式，白蟻的胚胎發育採用短胚帶胚胎發育模式。於長胚帶胚胎發育模式，胚胎體軸的發育於卵母細胞形成之際就已經決定，然而短胚帶胚胎發育模式的體軸發育決定基因與機制尚未明瞭。本研究利用鼻白蟻科(Rhinotermitidae)原鼻白蟻屬的黃原鼻白蟻 (*Prorhinotermes flavus*)為材料進行黃原鼻白蟻的胚胎發育分析，並利用次世代定序技術分析黃原鼻白蟻轉錄體於胚胎發育過程中之特異性基因表現。

結果/結論/應用啟示
我們首先對黃原鼻白蟻胚胎發育的各個時期做了詳盡的描述與觀察，並利用黃原鼻白蟻於實驗室中易於培養的特性，測試了於攝氏 28 度下，各個胚胎發育階段所需要時間。此外，為了進行黃原鼻白蟻的胚胎發育分析，我們利用了 PacBio 的 IsoSeq 定序技術建構了黃原鼻白蟻的全長轉錄體資料庫。以此為基礎我們亦用 Illumina 的定序平台分析了黃原鼻白蟻不同階級與胚胎的轉錄體資料。我們的後續研究將開拓黃原鼻白蟻作為一個嶄新的短胚帶胚胎發育模式動物。

關鍵字 (Keywords)：白蟻 (termite)、胚胎發育 (embryogenesis)、轉錄體 (transcriptome)

OE_09

台灣銳蠓之轉錄體表現分析
Transcriptome analysis of *Forcipomyia taiwana*

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背景/研究問題/材料方法
台灣銳蠓 *Forcipomyia taiwana* (Shiraki)，為雙翅目(Diptera)、蠓科(Ceratopogonidae)、銳蠓屬(*Forcipomyia*) 的吸血性昆蟲。台灣銳蠓幾乎遍佈全台各縣市，尤以中南部、花東地區最為嚴重，由於近年來氣候暖化其族群與數量有逐年增加的趨勢。其棲息地也因為交通工具的發達，由鄉間與郊外逐步擴展至遊樂區與都會區。被台灣銳蠓叮咬後，約有將近一半的人會產生過敏反應，並有可能併發細菌性二次感染。因此，台灣銳蠓不但對當地居民造成嚴重的干擾，並且衝擊觀光業與經濟發展。台灣銳蠓藉由吸血來獲取卵巢發育所需的養分，為了瞭解台灣銳蠓吸血與懷卵後的基因表現差異，我們分別對雄性台灣銳蠓、雌性處女台灣銳蠓與懷卵台灣銳蠓對進行了轉錄體的序列分析與比對。

結果/結論/應用啟示
為了確切能夠分辨雄性與雌性處女銳蠓的基因表現，也為了避免因為交尾而使雌蟲身上帶有雄蟲的精子而干擾分析，我們利用在實驗室內飼養的雄性與雌性處女台灣銳蠓取其 mRNA 以 illumina 次世代定序技術來分析轉錄體。而對於懷卵的台灣銳蠓，我們則是選用吸血後於攝氏 28 度飼養 40 小時的台灣銳蠓來進行轉錄體分析。台灣銳蠓轉錄體差異性分析的結果顯示在台灣銳蠓吸血後 40 小時，台灣銳蠓基因的表現模式出現了顯著的變化。值得注意的是有部分的嗅覺受器基因分別於台灣銳蠓雄蟲、台灣銳蠓處女雌蟲與懷卵台灣銳蠓有專一性的表現。由於昆蟲的行為仰賴嗅覺受器訊息傳遞的引導，嗅覺對於昆蟲棲地選擇、攝食、交配行為與產卵處所選擇都有關鍵性的影響，我們認為這些特異性表現的嗅覺受器表現很可以直接與成蟲的行為有關，未來可以利用為開發台灣銳蠓誘引劑的標的基因。

關鍵字 (Keywords)：蠓 (midge)、嗅覺受器 (odorant receptor)、轉錄體 (transcriptome)

OE_10

MicroRNA-encoded homosexual responses in *Drosophila* males

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Background/Question/Methods
Brain neurology on animal sexuality has been poorly studied due to the difficulties in tackling brain circuitry in humans. *Drosophila melanogaster* as an idea model provides advanced genetic tools for the neuronal circuit manipulations combined with sophispicated animal behaviors to realize the physiological mechanism underlying the sexual behavior. Animals present several sensory cues to identify the same species and suitable partner for reproduction. Courtship, an instinct of animals in the nature, normally occurs in between opposite sexes. Interestingly, a lot of researches proved that courtship and sexual behaviors existed between the same sexes in many species, but the cellular or molecular mechanism is not clear. MicroRNAs (miRNAs) are small non-coding RNA that only need to pair partially to the target mRNA in order to elicit translational repression.

Results/Conclusions
In this study, we employed a comprehensive screening and evidenced the role of the individual 11 miRNA involves the inter-male courtship responses. Furthermore, we focus on the mir-124 and proposed a series objects (1) to characterize the specific neuronal circuitry involved male-male courtship behavior regulation by mir-124; (2) to identify the miRNAs targets and gain molecular insights in the mechanisms of male fly's homosexual responses. Our long-term goal is to dissect sex processes at biochemical, genetic, anatomical, and behavioral levels. Such "translational" studies of the fly systems neuroscience generate clinically relevant insight into human brain function and ultimately may lead to important advances in the understanding in vertebrate.

關鍵字 (Keywords)：MicroRNA, inter-male courtship

OE_11

低劑量益達胺對不同齡期蜜蜂基因表現之影響
The effects of sublethal dosage imidacloprid on honey bee gene expression during development

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背景/研究問題/材料方法
近年來許多證據指出亞致死劑量益達胺會造成蜜蜂成蜂行為異常，且此影響與蜜蜂衰竭症候群 (colony collapse disorder, CCD) 徵狀相符，因此亞致死劑量益達胺的污染判定為造成蜜蜂衰竭症候群的主因之一。除了成蜂以外，亞致死劑量益達胺對蜜蜂幼蟲造成的影響也逐漸受到重視。為了探討低劑量益達胺對蜜蜂幼蟲所造成的影響，本研究先餵食蜜蜂幼蟲 1 ppb、10 ppb、與 50 ppb 的益達胺，再利用次世代定序技術檢測不同日齡蜜蜂基因表現狀態。

結果/結論/應用啟示
結果顯示，蜜蜂幼蟲連續四天取食益達胺後，在第 9 日齡幼蟲與第 0 日齡成蜂所檢測到的差異性表現基因數目與餵食的益達胺濃度成線性關係,但成蜂到了第 7 日齡時，卻僅有幼蟲期給予 10 ppb 益達胺的組別有檢視到差異性表現基因。隨著蜜蜂發育，第 14 日齡成蜂所檢測到的差異性表現基因超過四千個，且不同益達胺濃度處理的組別所檢測到的差異性表現基因數量相近，到了第 20 日齡時，所有處理組別僅檢測到少量差異性表現基因。此外，在幼蟲期所檢測到的差異性表現基因功能分群與在成蟲期所檢測到者有所差異，顯示在幼蟲時期取食到極低劑量益達胺後造成的影響會隨著蜜蜂發育而改變。此研究結果顯示極低劑量益達胺 (1 ppb) 蜜蜂造成的影響會延伸到成蟲時期，且此影響可能造成蜂巢群落衰弱。

關鍵字 (Keywords)：西洋蜂 (*Apis mellifera*)、亞致死劑量 (sublethal dosage)、益達胺 (imidacloprid)、差異性表現基因 (Differentially Expressed Genes (DEGs))

OE_12

養菌白蟻與食木白蟻的通道材料與建築行為研究
Shelter tube materials and construction behavior of fungus-growing termites and wood-feeding termites (Blattodea：Termitoidae)

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背景/研究問題/材料方法
許多白蟻物種會挖掘隧道或建築地上通道，藉此保護覓食的個體，而不同食性的白蟻可能會以不同的材料與建築行為建築地上通道。為了測試這項假說，本研究分析了兩種食木白蟻 (wood-feeding termites)，高砂象白蟻 (*Nasutitermes takasagoensis*)、台灣家白蟻 (*Coptotermes formosanus*)，與一種養菌白蟻 (fungus-growing termites)，台灣土白蟻(*Odontotermes formosanus*) 的通道有機質含量與建築行為，並推測食性變化與白蟻建築行為與通道成分間的關聯。

結果/結論
高砂象白蟻通道的有機質含量為 95.0±0.8%、台灣家白蟻為 51.5±31.5%，而台灣土白蟻通道有機質含量為 5.9±0.6%，物種間有顯著差異，支持食木白蟻與養菌白蟻使用不同的材料建築通道。推測高砂象白蟻主要以植物組織與糞便為建築材料，台灣土白蟻則以土壤為主，台灣家白蟻則兼用土壤、植物組織與來建築通道，其比例在各地的變異性大。我們觀察到白蟻建築通道主要包含三種行為：放置顆粒狀建築材料、吐液體與排糞。高砂象白蟻的顆粒放置頻度最低 (61.0±0.1%)，而台灣家白蟻 (93.0±0.1%) 與台灣土白蟻 (96.0±0.0%) 無顯著差異。台灣家白蟻吐液體行為發生頻度最高 (90.0±0.1%)，而高砂象白蟻 (55.0±0.1%) 與台灣土白蟻 (70.0±0.1%) 無顯著差異。排糞行為頻度以高砂象白蟻最高 (79.0±0.1%)，台灣家白蟻次之 (40.0±0.2%)，而台灣土白蟻則無排糞行為。這些結果顯示三種白蟻有不同的建築行為頻度。我們推測白蟻通道的有機質含量可能與排糞行為之頻率有關。

關鍵字 (Keywords)：養菌白蟻 (fungus-growing termites)、食木白蟻 (wood-feeding termites)、高砂象白蟻 (*Nasutitermes takasagoensis*)、台灣家白蟻 (*Coptotermes formosanus*)、台灣土白蟻 (*Odontotermes formosanus*)、建築行為 (construction behavior)

OE_13

視覺刺激對單隻雌性大頭金蠅（雙翅目：麗蠅科）產卵行為之影響
Effects of Visual Stimulation on the Oviposition Behavior of Single Female *Chrysomya megacephala* (Fabricius) (Diptera：Calliphoridae)

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背景/研究問題/材料方法
食腐性昆蟲幼蟲的發育狀況對於估算法醫昆蟲學中受害者或動物的死後間隔（post-mortem interval，PMI）至關重要。研究麗蠅的產卵行為有助於增加估算 PMI 的準確性。某些昆蟲表現出多隻雌蟲在同一個地點甚至群集中產卵的群聚產卵行為。在正常的情況下，麗蠅很少在單獨時產卵，但在給予單隻雌性麗蠅視覺刺激（例如不同性別或物種，甚至其他非活體物體）後可引發其產卵。推測麗蠅可能藉由視覺確認產卵的環境是否適合子代生存發育。為了釐清何種視覺因子為引發麗蠅產卵的必要條件，本研究設置了三組測試：給予單隻雌性大頭金蠅產卵基質，並放置麗蠅的二維圖像，麗蠅的白色輪廓圖紙和麗蠅的黑色輪廓圖紙在基質表面，記錄產卵行為有無變化。

結果/結論/應用啟示
結果顯示，在產卵基質上放置麗蠅白色輪廓圖片的雌蟲產卵行為受到改變，其他實驗組則沒有明顯變化。考慮麗蠅屬的複眼光譜感度峰值落在 350nm、490nm，把三組當作視覺刺激的圖紙做反射光譜的測試，麗蠅白色輪廓圖紙在 490nm 與產卵基質的對比差異較大，推論雌蟲確實接收其視覺刺激，進而影響產卵行為。後續的實驗設計也將改變圖片的大小、形狀、顏色及與背景的對比，找出改變產卵行為的關鍵視覺因素，對於之後探討視覺相關問題的研究提供幫助。

關鍵字 (Keywords)：聚集產卵 (gregarious oviposition)、大頭金蠅 (*Chrysomya megacephala*)、單雌 (single female)、視覺刺激 (visual stimulation)、法醫昆蟲 (forensic entomology)

OE_14

黃喙蜾蠃（*Rhynchium brunneum*）（膜翅目：胡蜂科）築巢策略
Nest-building strategy of *Rhynchium brunneum* (Hymenoptera：Vespidae)

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背景/研究問題/材料方法
黃喙蜾蠃(*Rhynchium brunneum* Fabricius, 1793)捕捉多種鱗翅目害蟲作為幼蟲存糧，且因其屬於借坑性蜂類而可透過竹管進行誘引，因此具有生物防治上的應用潛力；然而在進行獨居蜂旅館調查時，卻發現黃喙蜾蠃的築巢空間使用狀況不如預期，部分管道僅建造單個育兒室，或甚至直接將空管道封閉。過去僅有少數研究分析借坑性蜾蠃的築巢空間利用，且研究對象皆為雌蟲體型相對穩定的小型蜾蠃，然而中型蜾蠃在兩性體型上皆具變異性，顯示黃喙蜾蠃對不同築巢空間有與過往研究不同的反應。本研究將自野外誘引黃喙蜾蠃進行人工飼養、給予固定大小的管道供其築巢，並分析在不同管長、管徑下的育兒室數量、長度，及子代性別比、體型。

結果/結論/應用啟示
本研究至今取得 48 根竹管，成功羽化 119 隻成蟲，共計雄蟲 85 隻、雌蟲 34 隻。初步結果顯示，黃喙蜾蠃育兒室數量隨竹管長度及管徑增加皆呈上升趨勢，然而育兒室數量至多僅有八個；而管徑較小的育兒室所產生之雄性與雌性子代體型皆小於較大管徑育兒室所產之子代，且雄蟲比例隨管徑下降而提高，部分管道甚至僅有雄蟲。此外在以竹管誘引野生個體築巢並進行人工飼養的過程中發現，幼蟲存糧量若因後天因素發生改變，羽化後體型則會與同巢其他個體有所差異，顯示雌蟲或許藉由控制獵物量以調控子代體型。

關鍵字 (Keywords)：黃喙蜾蠃 (*Rhynchium brunneum*)、借坑性 (trap-nesting)、生物防治 (biological control)

OE_15

熱帶火蟻體型造成覓食工蟻對搬運與肢解行為的差異
Carrierand cutter, size-related foraging behaviorin the tropical fire ants, *Solenopsis geminata*

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背景 /研究問題 /材料方法
熱帶火蟻 (*Solenopsis geminata*) 是台灣中南部常見的入侵種螞蟻，偏好棲息於受人為干擾較高的地區。先前研究發現，熱帶火蟻工蟻依體型可分成兩群。熱帶火蟻主要取食植物種子與小型無脊椎動物，體型的分化可能與搬運不同重量的種子相關，或增加取食小型無脊椎動物的效率。本研究測試熱帶火蟻處理木麻黃種子與蟋蟀(分別使用整隻冷凍蟋蟀和人工肢解的蟋蟀) 時的行為差異，並比較不同行為的大小型工蟻比例，以檢驗是否體型造成行為分化。

結果/結論/應用啟示
在種子試驗中，顯示大型的覓食工蟻在搬運種子上有較高的效率，但在搬運小型種子時並不明顯。當種子偏大 (3 倍到 12 倍木麻黃種子重量)，大型工蟻佔的比例中位數均約在 13.5~15% 之間，其比例不會因種子的重量增加而持續上升。在蟋蟀試驗中，發現覓食工蟻在處理蟋蟀時的行為明顯受體型影響，負責肢解的工蟻大型個體的比例明顯較高 (中位數約 50%，部分蟻巢工蟻可達 80%)，而搬運蟋蟀與搬運種子的工蟻則沒有體型比例上的差異。本實驗結果顯示，熱帶火蟻的工蟻具有兩種體型的分化，且體型的分化與覓食行為有關，但不受到不同食物種類的影響。熱帶火蟻合作搬運獵物的行為並不明顯，它們傾向把食物拆解再運回巢內，而體型的分化很可能增加覓食效率。

關鍵字 (Keywords)：熱帶火蟻 (*Solenopsis geminata*)、工蟻 (worker)、體型 (body size)、覓食行為 (foraging behavior)

OE_16

根�螨新人工飼料之開發及其效益評估
Development of new artificial diets and evaluation of its effectiveness

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背景/研究問題/材料方法
羅賓根螨（*Rhizoglyphus robini*）為世界與台灣之重要害螨之一，可危害多種經濟作物及觀賞植物。然而在長期使用化學藥劑進行防治，致使台灣地區根螨已產生抗藥性。因此本研究目的開發新人工飼料飼育羅賓根螨以供未來大量繁殖厲螨科（Laelapidae）尖狹下盾螨（*Hypoaspis aculeifer*）進行生物防治。本研究初步評估七種新人工飼料之飼育根螨效益，每 5 日觀察計數一次成螨數量，連續觀察計數 4 次，共 21 天，並測試最佳人工飼料配方飼育羅賓根螨，每日觀察記錄發育情形、產卵量及壽命之生活史特性。

結果/結論/應用啟示
由試驗結果顯示不同人工飼料配方在飼養後第 21 天計數其繁殖數量，以飼料 G 及飼料 A 飼育之成螨數量最多，分別為 45.76 及 44.20 隻成螨。因此進一步比較飼料 G 及飼料 A 飼育根螨之生活史特性，以飼料 A 飼育之雌雄成螨發育日數較短，分別只需 10.49 日及 10.45 日；而每隻雌成螨平均每日產卵量較高，可產 14.28 粒，一生平均產卵量較高，高達 415.92 粒。壽命方面以飼料 G 飼育之雌雄成螨較長，分別平均長達 42.21 日及 169.84 日。飼料 G 及飼料 A 後代雌雄性比分別為 0.55 及 0.53，兩者差異不顯著。經兩性生命表分析求得族群介量，飼料 A 的內在增殖率(r) 0.28、淨增殖率(*R0*) 231.59 及終極增殖率(λ) 1.32 皆為較高，而平均世代時間較短，只需 19.43 天。由此可知以飼料 A 飼育羅賓根螨較能達到快速大量繁殖的效果，可做為未來根螨大量繁殖及其生物防治之螨源。

關鍵字 (Keywords)：羅賓根螨 (*Rhizoglyphus robini*)、人工飼料 (Artificial diet)、生活史 (Life history)、生命表 (Life table)

全英文場次

論文宣讀摘要集

Oral Session:

Full English Session

OEng_01

Molecular Basis of the formation of salivary glands in the pea aphid *Acyrthosiphon pisum*

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Background/Question/Methods

Salivary glands in the pea aphid *Acyrthosiphon pisum*, a piercing-sucking hemipteran pest, secrete saliva into plants to accomplish nutrients intake and meanwhile transmit viruses to plants. Anatomical morphology shows that the glands are paired, half of which consists of a large principle gland and a smaller accessory gland. At molecular basis, nevertheless, how the salivary glands are established during embryogenesis in the asexual viviparous aphids and to which extent it resembles and differs from the known salivary-gland development in the fly *Drosophila melanogaster* remain largely unknown. Here, I selected to study the developmental expression of *forkhead* (*fkh*) mRNA in the pea aphid, assuming that *fkh* plays a conserved role in the development of salivary glands as it acts in that of *D. melanogaster*.

Results/Conclusions

Preliminary data of whole mount *in situ* hybridization shows that antisense riboprobes of *Apfkh*, an orthologue of *Drosophila fkh*, labeled the salivary gland cells in segmenting embryos. Two clusters of *Apfkh*-positive cells arose from the labial segment. After katatrepsis (embryo flip), these cells proliferated, migrated, and then settled in both sides of the foregut to develop into mature salivary glands. Hence, it strongly suggests that *Apfkh* is a conserved salivary-gland marker in the pea aphid. However, how the formation of salivary glands in the pea aphid differs from that of *Drosophila* requires further investigation.

Keywords: sap-sucking, salivary glands, development, *forkhead*, pea aphid

OEng_02

Polydnavirus regulate the extracellular adenosine levels in *Spodoptera litura* to suppress its immune system

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Background/Question/Methods

Immune defense is a mechanism that requires immense energy. As an example, infestation of *Drosophila* larvae by *Leptopilina boulardi* parasitoids may result in delayed larvae development. From this, we can see that effective immune responses involve a metabolic switch to reallocate energy from developmental to immune systems. Extracellular adenosine (e-Ado) is considered to be a signal that mediates the metabolic switch to increase intracellular glycolysis, allowing fat body to convert glucose to trehalose, which is then released to the circulation systems that facilitate immune cell differentiation and activate immune responses. However, this situation differs somewhat for polydnaviruses (PDVs) as they mediate suppression of insect immune defenses. PDVs are parasitoid symbionts that only replicate in parasitoid calyx cells. When the parasitoid *Snellenius manila* injects its eggs into a host body, PDVs are also spread into the host (*Spodoptera litura*). Thus, the immune system of the host is suppressed by the virus. As e-Ado is associated with immune responses, we examined whether adenosine levels decreased due to PDVs immunosuppression.

Results/Conclusions

Our study discovered decreased gene expressions in adenosine receptors and adenosine deaminases due to PDVs infestations in larvae. Besides that, we also discovered larval e-Ado levels decrease during PDVs infected. In our future work, we want to figure out the changes in energy transduction in different tissues of larvae. Therefore, we believe that PDVs may regulate e-Ado levels to cause larvae immunosuppression.

Keywords: Adenosine, energy transduction, immunosuppression, polydnavirus

OEng_03

Chronobiological effect on oviposition behavior of *Chrysomya megacephala* (Diptera: Calliphoridae)

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Background/Question/Methods

The most widely used entomological method of determining time since death (minPMI) for forensic science has been the usage of blow fly developmental data on the deceased body, and it is assumed blow flies are diurnal, meaning oviposition during nighttime is left out in the calculation. However, in recent years' studies, a few cases of nocturnal oviposition were discovered during experiments, and there is not yet an explanation for them. If this phenomenon can be replicated consistently and the reason for it discovered, the way minPMI is calculated could change, making estimations more accurate. Chronobiology, the periodic cycles of living organisms and their affinity to adapt, is a factor that can rule over an animal's behaviors, conforming them to a pattern. Circadian Rhythm has been studied extensively in *Drosophila melanogaster* and proved to be a strong determining factor in their behaviors, but there has yet to be a research strictly focused on the common blow fly species of *Chrysomya megacephala*. By observing and monitoring the locomotion amount/patterns, of forensically important blowflies, and looking at associated behaviors, whether chronobiology plays an important factor in nocturnal oviposition or not can be observed.

Results/Conclusions

Initial result indicates the species *Chrysomya megacephala* does show circadian rhythms in the locomotion activity. But after further experiment, there are no significant differences in the circadian rhythm length between male and female or pre- and post-mating. (Unlike other insects such as cockroaches which exhibit a masking effect post-mating). Although under normal lab condition, nocturnal oviposition has been replicated, circadian rhythm does not seem to be the only factor deciding whether it happens or not. Further research will be done on whether presence of oviposition medium and high egg load pressure with circadian rhythm will consistently result in nocturnal oviposition.

Keywords: Oviposition, circadian rhythm, locomotion, forensic entomology, Calliphoridae

OEng_04

Display of Surface Protein by Baculovirus for Improving the Stability of Influenza Virus Hemagglutinin through Structure-Guided Motif Swapping

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Background/Question/Methods

Hemagglutinin (HA) is the major surface antigen of influenza virus and is the most promising influenza vaccine immunogen. However, HA protein instability reduces the shelf-life and may even impair the immunogenicity of influenza vaccines. Here, we applied a novel structure-guided bioinformatics software, SCHEMA, to rationally design chimeric HA to improve HA protein stability from the A/Anhui/1/2013 (H7N9) viral strain, one of the most fatal influenza viruses threatening birds and humans, but with low protein stability. We used SCHEMA to dissect the structures of HA from H7 and an H3 (A/Aichi/2/1968, H3N2), and recombine their HA1 subunits into six chimeric HA1s. Recombinant baculoviruses expressing the full-length chimeric HAs were constructed by fusing the six chimeric HA1 with HA2 subunit from H7, designated as fC1 to fC6. We infected insect cells with the recombinant baculoviruses and determined the proper cell surface display, bioactivity, thermal stability, antigenicity, as well as immunogenicity of these six full-length chimeric HAs.

Results/Conclusions

We used immunofluorescence staining to determine the surface display of our recombinant proteins, and found only the two parental HAs and the fC2 and fC3 chimeric HAs could be detected on the insect cell membrane. Besides, only fC2 and fC3 showed the hemagglutination activity as did the two parental HAs. In the thermal hemagglutination assay, both the fC2 and fC3-expressing cell samples retained their HA titers under the extended heating. Mice immunized with fC2 and fC3 chimeric HAs elicited comparable parental H7-specific IgG antibodies. The antisera also successfully inhibited H7N9 infection in a microneutralization assay, suggesting that these two chimeric proteins are better candidate vaccine antigens against H7N9. Our study has significant prospects not only for the generation of more stable H7N9 vaccines, but also providing a novel platform by baculovirus surface display for the functional study of dangerous human-infectious viruses.

Keywords: H7N9, hemagglutinin, stability improvement, baculovirus surface display, SCHEMA.

OEng_05

Effects of encapsulated artificial *Plectranthus amboinicus* essential oil towards *Myzus persicae* and *Plutella xylostella*

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Background/Questions/Methods

Essential oils are secondary metabolites produced by many plants which are found possibly crucial in defense mechanism against its natural enemies. Astoundingly, they are also widely known for its medicinal value, as fragrant, antimicrobial properties, insect repellent and deterrent effects. Thus, these compounds prove to have great values towards the management of agricultural pest. Moreover, these oils are environmental friendly and biodegradable in nature. However, essential oils are trivialized for its rapid degradation over a short duration (<24 hours) via vaporization, oxidation, polymerization etc. thus, losing their effects. Consequently, there is a drastic need to assess the existing problem. Encapsulation technologies using polymers renowned for its slow release effects serves as a useful tool. In this study, we evaluated the effect of encapsulated *Plectranthus amboinicus* essential oil towards *Myzus persicae* and *Plutella xylostella.*

Results/Conclusion

Active ingredients of *P. amboinicus* essential oils comprise about 40 complex compounds analyzed by GC-MS and three major components (carvacrol, ρ-cymene and β-caryophyllene) were encapsulated with sodium alginate (SA) to assess their slow release effects. SA polymer was chosen because it is cheap and biodegradable. The results revealed that ρ-cymene was released in higher concentration at 0-72 hours via SPME adsorption then analyzed by GC-MS. Conversely, β-caryophyllene was released in higher concentration from 72-120 hours, whereas lower from 0-72 hours. Further bioassay had confirmed that the encapsulated oils have fumigant toxicity (mortality) and reproductive suppression (number of offspring and eggs) effects for 5 consecutive days towards *M. persicae*. These effects were significant in the first 3 days while declined from fourth day onwards. Conjointly, the effects are similar in bioassay against *P. xylostella*. Meanwhile, higher amount of capsules correlates to higher quantity of essential oil used possess greater effects and vice versa. Conclusively, encapsulation with SA cogently prolonged the effectiveness of artificial *P. amboinicus* essential oils.

Keywords: Encapsulation, sodium alginate, *Plectranthus amboinicus*, *Myzus persicae*, *Plutella xylostella*

OEng_06

Functional characterization of concentrative nucleoside transporter 2 (CNT2) in *Drosophila melanogaster*

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Background/Question/Methods

Adenosine (Ado) is a ubiquitous metabolite that plays a prominent role as a paracrine homeostatic signal of metabolic imbalance within tissues. It quickly responds to various stress stimuli by adjusting energy metabolism and influencing cell growth and survival. Ado homeostasis in tissues is maintained by Adenosine deaminase (ADA) which converts Ado into Inosine, by Adenosine Receptor (AdoR) through which Ado activates a specific signaling pathway regulating the cell growth and by nucleoside transporters. There are two types of nucleoside transporters: the Concentrative nucleoside transporters (CNTs) and the Equilibrative nucleoside transporters (ENTs) which are membrane transport proteins delivering purine and pyrimidine nucleosides across the cytoplasmic membrane. In *Drosophila*, there are two types of CNTs which mediate nucleoside uptake from the extracellular space to the cytoplasm: CNT1 and CNT2. In this project, our focus is directed to describe the physiological function of CNT2 by using *Drosophila* mutants in cnt2. Also, Genetic and pharmacological approaches will be used on these mutants.

Results/Conclusions

The results show that cnt2 mutation causes high lethality in the larval stage, indicating that CNT2 is important for *Drosophila* development. This lethality is linked to the appearance of a strong melanization (due to cell death) which is restricted to the hindgut. These “melanotic tumors” are highly similar to these found in the over-expression of adoR flies. adoR over-expressing flies also showed high mortality due to over-activation of AdoR signaling. Moreover, the RNA expression pattern provided by Flybase showed that cnt2 is highly expressed in the midgut, while adoR is in the hindgut. Hence, we hypothesize that cnt2 mutation causes the accumulation of Ado in *Drosophila* gut lumen. This accumulation leads to the over-activation of AdoR in the hindgut which gives rise to melanization and the death of the cnt2 mutant larvae.

Keywords: *Drosophila*, CNT2, adenosine signaling pathway, digestive truct

OEng_07

Multiple evolutionary origins lead to diversity in the metabolic profiles of ambrosia fungi

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Background/Question/Methods

Fungus-farming of ambrosia beetles is a wide-spread, diverse, and ancient insect agricultural system. Ambrosia fungi are an ecological assemblage of species cultivated by ambrosia beetles in their gallery as required nutrient sources. This nutritional mutualistic relationship with beetles has evolved at least 7 times in Dikarya (Ascomycota and Basidiomycota). However, whether convergence in ecology led to convergent metabolism in ambrosia fungi is still unknown. We compared the assimilation of 190 carbon sources in five independent lineages of ambrosia fungi and closely related, non-ambrosial species. These repeated comparisons, and the use of variation partitioning to separate the effects of phylogeny and ecology, enabled us to assess functional convergence versus phylogenetic divergence in the metabolic diversity of ambrosia fungi.

Results/Conclusions

Our results revealed no convergence in carbon utilization capacities among ambrosia fungi. Instead, metabolic variation among fungi was largely explained by phylogenetic relationships. In addition, the range of carbon usage in ambrosia fungi was equally as diverse as that in non-ambrosial species. Our results demonstrate that carbon metabolism of each ambrosia fungus is determined by its inherited metabolism, rather by the transition towards symbiosis. In contrast to other fungus-farming systems of termites and attine ants, the fungal symbionts of ambrosia beetles are functionally diverse, which reflects their independent evolutionary origins.

Keywords: ambrosia, Scolytinae, Phenotype array, Variation partitioning, Carbon metabolism

OEng_08

Developmental distribution of the components in the Dpp signaling pathway implicates how the dorsoventral axis is established in the asexual viviparous pea aphid

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Background/Questions/Methods

In the asexual viviparous pea aphids, a temporal series of developing oocytes and embryos are enclosed within egg chambers in an ovariole. This feature thus provides an advantage for a consecutive observation of an mRNA from oogenesis to embryogenesis. We explored the formation of anteroposterior (AP) and dorsoventral (DV) axes at the molecular basis, aiming to understand when and where both axes were established. Asymmetric localization of *hunchback* (*Aphb*) mRNA in the anterior poles of oocytes and early embryos, suggesting that the breaking of anterior asymmetry in the oocytes initiates the formation of the anterior axis in the asexual pea aphid. However, how the DV axis forms and whether it occurs simultaneously as the formation of AP axis remains unknown. In this study, we cloned and detected the expression of the developmental toolkit genes for insect DV patterning in the asexual pea aphid, hypothesizing that it also adopts these genes to specify the DV axis.

Results/Conclusion

In total, we examined developmental expression of *decapentaplegic* (*dpp*), *short gastrulation*(*sog*), *mothers against dpp* (*mad*), and *Hox3*/*zerknüllt* (*zen*) orthologs in the asexual pea aphid. Transcripts of the four *dpp* paralogs (*Apdpp1–4*) were not particularly restricted to any subarea of the cytoplasm within uncellularized eggs. Nonetheless, asymmetric signals of the phosphorylated Mad protein (pMad) and *Apzen*mRNA—a conserved marker for the insect extraembryonic tissues—were detected. Localization of the *Apsog* mRNA, an orthologous mRNA of *Drosophila sog*—known as a ventral gene—was identified at the opposite side of pMad and *zen* expressions. The asymmetric localization of pMad/*zen* and *Apsog* was not detected until cellularization of the blastoderm, suggesting that formation of the DV axis stars from blastulation and it follows the formation of the AP axis.

Keywords: body axis, asymmetric localization, extraembryonic membrane, aphid

OEng_09

Histone deacetylase inhibitor treatment strengthens memory, learning, and immune ability in pathogen-infected and neonicotinoid-treated *Apis mellifera*

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Background/Question/Methods

Apis mellifera (western honeybee) is nature's most essential pollinator for plants. The colony collapse disorder (CCD) had fiercely damaged the population of global honeybees. The main reasons for that cause CCD are associated with the variety of pathogens in bee hive and pesticide-caused memory loss. Histone deacetylase inhibitors (HDACi) are chemical compounds that inhibit the activity of histone deacetylases and are known to cause hyperacetylation of histone cores and influence gene expression. In our previous work, we have demonstrated that HDACi sodium butyrate (NaB) are given to honeybees as a dietary supplement and can up-regulate the expression profiles of immunity and detoxification genes, even for the imidacloprid-treated bees. NaB can also strengthen honeybees' tolerance to imidacloprid and invasions of *Nosema ceranae* and viral infections. In this study, we focus on NaB effect on learning and memory ability of imidacloprid-treated honeybees. We use qPCR to quantify gene expression and proboscis extension response (PER) to test learning and memory ability.

Results/Conclusions

The bioassay results showed that honeybees treated with NaB were more tolerant to imidacloprid. And the memory-related genes were up-regulated and higher learning ability examined by proboscis extension reflex (PER). We found that HDACi can boost memory formation and learning of bees. This study investigated the association between gene expression and memory formation from an epigenetic perspective, and demonstrated the possibility of enhancing bee learning using HDACi. We also provide additional data regarding the mechanism by which honeybees react to stress and the potential application of HDACis in beekeeping.

Keywords: Sodium butyrate (NaB), Proboscis extension reflex (PER), Imidacloprid, Nosema cerana, Deformed wing virus

OEng_10

Microbe-Mosquito Interactions in Stagnant Water Containers

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Background/Question/Methods

Mosquitoes breed in standing water containers. We hypothesize that the different microbial biodiversity of natural and artificial containers may be a factor in whether different mosquito species lay eggs in them or not. *Culex*, for example, prefers cloudy, dirty water, while *Aedes* prefers clear water, though neither will oviposit in microbe-free water, nor do larvae develop fully in absence of water microbes. While no specific microbes are essential for mosquito survival, their presence is required, and it is known that adult mosquitoes will preferentially lay eggs in water with certain inocula over others. We have inventoried the insect and microbial diversity of natural and artificial container waters in Dengue-endemic Southern Taiwan with metagenomics and culturing. The goal was to map the ecology of their interactions to explain why different insects prefer different containers.

Results/Conclusions

Our results found an incredible diversity of microbes in different containers, even if said containers were in close physical proximity. The variation is simply too large to determine any meaningful correlations between a mosquito species' presence or absence and the microbiome. However, some bacteria-mosquito interactions were hypothesized based on the data, and we are in the process of testing these hypotheses with controlled laboratory experiments.

Keywords: mosquitoes, *Aedes*, microbes, vector

病媒、生物防治、蟲害管理

壁報展示摘要集

Posters:
Disease Vector, Biological Control and Pest Management

PD_01

2018 年台灣登革熱高風險區域使用之防治藥劑對埃及斑蚊的效能

The effect of insecticide used in dengue high-risk area of Taiwan in 2018 on *Aedes aegypti* control

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背景/研究問題/材料方法
登革熱在台灣 2014 年及 2015 年分別有 15,492 及 43,419 例本土病例，甚至造成死亡，嚴重威脅對台灣民眾的健康。分佈在台灣南部的埃及斑蚊，因其習性而成為登革熱的主要病媒蚊，在長期使用殺蟲劑防治下，已有抗藥性產生。本研究測試高雄及台南使用之合成除蟲菊藥劑分別對兩地區不同品系埃及斑蚊之防治效能，以供防治時參考。試驗於住屋模擬試驗室進行，模擬實際室內防治情形，使用器材為熱煙霧機 (pulsFOG® K-10SP)，依疾病管制署制定的施藥標準，每立方公尺噴灑 1ml 藥劑 (1ml/m3)，紀錄埃及斑蚊 30 分鐘擊昏率及 24 小時死亡率，每一濃度進行三重複試驗。

結果/結論/應用啟示
試驗結果顯示，以高雄使用的 3 種藥劑在建議最高濃度下，不同品系埃及斑蚊 24 小時死亡率分別為 88~100%、70~98%、78~98%、敏感品系均為 100%；台南使用的 4 種藥劑在建議最高濃度下，不同品系埃及斑蚊 24 小時死亡率，分別為 88~100%、100%、93~100%、72~100%、敏感品系均為 100%。

關鍵字 (Keywords)：埃及斑蚊 (*Aedes aegypti*)、合成除蟲菊 (pyrethroid)、登革熱(dengue)

PD_02

應用反射式紅外線光譜分析埃及斑蚊體內沃爾巴克氏菌感染狀態

The application of attenuated total reflection infrared (ATR-IR) spectroscopy analysis for detection of *Wolbachia* in *Aedes aegypti*

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背景/研究問題/材料方法
沃爾巴克氏菌是一種細胞內共生菌，具有影響宿主生殖的能力。利用人工感染的方式，可以將沃爾巴克氏菌送入埃及斑蚊體內，製造出攜帶沃爾巴克氏菌的埃及斑蚊。釋放人工繁殖的攜帶沃爾巴克氏菌的埃及斑蚊，當其與野生種埃及斑蚊交配後，將無法產生後代，藉此達到減少野外埃及斑蚊數量的目地。傳統上檢測斑蚊體內的沃爾巴克氏菌是利用 polymerase chain reaction (PCR)檢測的方式進行，PCR 檢測雖然精準，然而需要較多的反應時間與耗材費用。Attenuated total reflection infrared (ATR-IR) spectroscopy 是一種分析化學分子特性的分析方法。

結果/結論/應用啟示
本研究利用 ATR-IR 檢測埃及斑蚊體內的沃爾巴克菌 wAlbB strain 的感染狀態。結果顯示，ATR-IR 可以區別不同性別、不同日齡的埃及斑蚊，也可以區別有感染與沒有感染沃爾巴克菌 wAlbB strain 的埃及斑蚊。ATR-IR 操作簡便、反應時間短、耗材費用少，適合用於大量樣本分析。

關鍵字 (Keywords)：應用反射式紅外線光譜 (Attenuated total reflection infrared (ATR-IR))、埃及斑蚊 (*Aedes aegypti*)、沃爾巴克菌 (*Wolbachia*)

PD_03

建立防蚊產品對埃及斑蚊空間忌避效果的分析方法
An *in vitro* bioassay system to explore the spatial repellent effecs against *Aedes aegypti*

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背景/研究問題/材料方法
隨著防蚊商品蓬勃發展，許多應用天然植物精油產品，訴求對埃及斑蚊具空間忌避效果，使用後可避免被蚊子叮咬染病的風險。文獻記載空間忌避的檢測方式可在房間處理忌避物質，以產品對人的防蚊叮咬率評估忌避效果，及以 Y 型管檢測產品對供試蚊蟲的驅離效果。本研究以冂型管及模擬小室檢測天然植物精油、防蚊貼、防蚊手環等防蚊產品對埃及斑蚊的忌避效果。

結果/結論/應用啟示
本研究以冂型管可定量天然植物精油對埃及斑蚊的空間忌避效果，當天然植物精油超過一定的使用量，才能對埃及斑蚊成蟲產生忌避的效果，以人的手做為誘引源，可避免被蚊子叮咬的風險，且能正確量化植物精油的忌避效果。以模擬小室可評估防蚊產品對埃及斑蚊空間忌避效果，探討防蚊貼、防蚊手環等防蚊產品的防蚊效果，提出正確使用防蚊產品的建議。

關鍵字 (Keywords)：埃及斑蚊 (*Aedes aegypti*)、空間忌避 (Spatial repellent)、生物檢測 (bioassay)、植物精油 (essential oil)

PD_04

太赫茲活性水對病媒蚊類非成蟲時期的毒性
Toxicity of terahertz radiation-activity water toward non-adult mosquitoes

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背景/研究問題/材料方法

太赫茲活性水的原理是將鈣、鎂等植物營養鹽轉換成具有自我放電性的奈米結構微粒並溶於水中，放出的電流波長為介於 1 mm~10 μm 的太赫茲波、具有電解水分子的活性，可將水解離為氫離子和氫氧根進而活化水體的殺菌活性。在農業上可應用為殺蟲劑，能殺死接觸到太赫茲活性水的害蟲，而不對作物或人體造成影響，是一種環境友善之防治資材。本研究試驗 Santa Mineral 公司之太赫茲水(M717-RT Tera Hunter)對三種常見病媒蚊(埃及斑蚊、白線斑蚊、熱帶家蚊) 非成蟲期之毒性效應，包括卵之孵化率、幼蟲及蛹期毒性及羽化率影響，評估太赫茲活性水應用於病媒蚊幼期防治的潛力。

結果/結論/應用啟示

試驗顯示太赫茲水對蚊幼蟲及蛹期均具有明顯之濃度相關毒性效應，原液稀釋 3000 倍以上的太赫茲水仍對三種病媒蚊的幼蟲和蛹期具有明顯毒性，且白線斑蚊的毒性反應比埃及斑蚊和熱帶家蚊更加敏感，各蚊種在相同濃度下 24 小時後的蛹期死亡率也比 3~4 齡階段的幼蟲期死亡率更高，於白線斑蚊的蛹期試驗中更發現超過 10000 倍稀釋之太赫茲水仍可造成過半死亡率，而未造成蛹體死亡的較低濃度下也會影響其羽化率。雖對埃及斑蚊的卵孵化率無顯著影響，但仍具有對幼蟲及蛹期之防治潛力。

關鍵字 (Keywords)：太赫茲波 (Terahertz radiation)、埃及斑蚊 (*Aedes aegypti*)、白線斑蚊 (*Aedes albopictus*)、熱帶家蚊 (*Culex quinquefasciatus*)、非化學農藥 (Non-chemical pesticides)

PD_05

應用 ELISA 檢測農產品中殘留之殺蟲劑賽速安
Detection of insecticide thiamethoxam residues in agricultural products using enzyme-linked immunosorbent assay

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背景/研究問題/材料方法
賽速安 (Thiamethoxam) 屬新尼古丁類殺蟲劑，可與昆蟲神經系統傳遞物質-乙醯膽鹼競爭、干擾神經訊息傳遞而造成昆蟲死亡。賽速安屬系統性殺蟲劑，可防治蚜蟲、粉蝨、粉介殼蟲、葉蟬等害蟲，使用範圍多達 65 種以上作物，近年常有檢出農產品殘留違規情形。現有農藥檢測方法耗材成本高，儀器昂貴，且耗時費力；免疫檢測具快篩之潛力，可滿足農藥殘留把關需求。本研究應用自行研發的賽速安抗體，經由 ic-ELISA 確認其辨識賽速安的專一性及靈敏度，為縮短檢測時間，接續發展賽速安 dc-ELISA 檢測方法，並以農產品外加賽速安測試及確認賽速安回收率之成效，據以評估其在農藥快篩之可應用性。

結果/結論/應用啟示
應用賽速安抗體進行 ic-ELISA 所得偵測極限即 IC10 為 0.02 ng/mL，對同類農藥賽果培及其他 50 類 91 種非標的農藥之交叉反應皆小於 0.1 %，專一性高。以其進行 dc-ELISA 之 IC10 為 0.05 ng/mL，靈敏度高。將小白菜、高麗菜、油菜、青江菜、柿子等 5 種作物，依公告之農藥殘留容許量外加賽速安使濃度為 0.5~2.0 ppm。風乾後以酒精萃取，並稀釋以降低基質干擾，進行 dc-ELISA 檢測。所得結果經賽速安農藥濃度對數值與 B/B0 之直線回歸方程式回推檢體含農藥量，計算此 5 種作物上的賽速安回收率為 62.2~75.5 %，CV 值介於 2.9~9.2 %，顯示此檢測技術具穩定性，可應用於農產品中賽速安殘留之快篩。

關鍵字 (Keywords)：賽速安 (thiamethoxam)、間接競爭酵素連結免疫分析 (indirect competitive enzyme-linked immunosorbent assay)、間接競爭酵素連結免疫分析 (direct competitive ELISA)、農藥殘留 (pesticide residues)

PD_06

殺蟲劑克凡派膠體金側流免疫分析快篩片研發
Development of colloidal-gold based lateral-flow immunoassay for insecticide chlorfenapyr

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背景/研究問題/材料方法

殺蟲劑克凡派 (Chlorfenapyr) 降低粒線體膜上的氧化磷酸化反應，干擾質子梯度，抑制 ATP 合成以致死昆蟲，為局部系統性農藥，對水中生物、鳥類、蜜蜂有劇毒，常用於蔬果害蟲防治，亦常於農產品檢出殘留不合格。基於抗體與抗原專一性結合的原理，農試所研發克凡派抗體以期應用於農產品農藥快篩檢測。此抗體已授權於鑫準生技股份有限公司，製成克凡派膠體金側流免疫分析快篩片，其在試紙上有 2 條隱形線，上方為 C 線，下方為 T 線 (含克凡派-載體複合體)。

結果/結論/應用啟示

以克凡派抗體進行 ic-ELISA，經克凡派濃度對數值與相應反應抑制率形成之回歸線，估算其反應抑制率為 10%時之克凡派最低偵測極限為 0.19 ng/ml。進而應用克凡派膠體金側流免疫分析快篩片，以克凡派 0 ppb 時的 T 線讀值為母數，計算反應抑制率。當克凡派濃度 100~500 ng/ml 時，其反應抑制率為 38.0-81.7%；若外加克凡派於小白菜上，上述濃度之反應抑制率為 40.0-83.5%，基質干擾不明顯。因克凡派濃度 500 ng/ml 時，T 線深度已達目視極限，故訂此濃度為 cut off 值。根據食藥署公告之克凡派殘留容許量濃度，外加克凡派於蔬果上，經測試此快篩片可應用於小白菜、油菜、芥藍、蘿菜、高麗菜之克凡派檢測。整個操作過程不需儀器輔助，從樣品萃取到目視讀取結果約 10~15 分鐘，適合應用於農產品之農藥初篩。

關鍵字 (Keywords)：克凡派 (chlorfenapyr)、膠體金側流免疫分析 (colloidal-gold based lateral-flow immunoassay)、間接競爭酵素連結免疫分析 (indirect competitive enzyme-linked immunosorbent assay (ic-ELISA))

PD_07

外米綴蛾遺傳多樣性與飼育效率評估
Genetic diversity and rearing efficiency evaluation of *Corcyra cephalonica*

謝佳宏
Chia-Hung Hsieh
中國文化大學 Chinese Culture University

背景/研究問題/材料方法

外米綴蛾(*Corcyra cephalonica*)為重要倉儲害蟲,此種蛾卵被量產應用為赤眼卵蜂與草蛉等生物防治天敵昆蟲的代用寄主。國內外米綴蛾量產族群經長期人工飼養馴化，累代繁殖後因近親交配產生種源品質衰退現象，造成遺傳多樣性喪失，飼育時間延長，導致量產效率變差。本研究採集台灣各地碾米廠的外米綴蛾族群，攜回實驗室建立種原族群,應用分子標記分析族群遺傳多樣性,並進行飼育比較,挑選出最短發育天數及羽化數量最高族群，提供種原替換參考。

結果/結論/應用啟示

台灣碾米廠外米綴蛾共採集 15 筆族群，粒線體基因遺傳多樣性分析，顯示外米綴蛾遺傳多樣性低。外米綴蛾族群遺傳多樣性分析，提供種原替換參考，避免種源衰退，維持量產族群之穩定性。種原族群飼育評估，篩選最短發育時間族群，做為未來更換或補充種原，協助後端大量天敵飼養更經濟有效率

關鍵字 (Keywords)：倉儲害蟲(stored-product pests)、生物防治(biological control)、天敵(natural enemies)

PD_08

以旋風分離法分離粉斑螟蛾(*Cadra cautella* Walker)卵粒與鱗粉
Application of cyclonic separation to the eggs and adhesive scales of *Cadra cautella*

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背景/研究問題/材料方法
粉斑螟蛾 (*Cadra cautella* Walker) 的球形卵粒，常作為生物天敵的替代性飼料，但使用時，卵粒上常沾附的鱗粉除了會干擾操作，還可能造成試驗人員過敏，因此研發分離蛾卵與沾附鱗粉之技術，可能有利於天敵應用。傳統模式為使用篩網過篩法將卵粒與沾附鱗粉分離，但此法除了器械本身體積龐大之外，過篩後卵粒上殘留的鱗粉仍多。本研究以旋風分離法為原理，設計一旋風分離器，藉以將蛾卵粒上的鱗粉去除，並探討由旋風分離法與傳統篩網分離法，所分離之粉斑螟蛾卵粒上沾附鱗粉的效果。

結果/結論/應用啟示
試驗結果顯示經旋風分離處理之卵粒，每粒卵平均殘留 0.1 ± 0.0 片鱗粉，卵粒遺失率為 0.3 ± 0.3 %，與篩網處理組（4.7 ± 0.2 片；10.5 ± 1.0 %）有顯著差異；而旋風處理與篩網處理之卵破損率（0.0 ± 0.0 vs 0.0 ± 0.0 %）及卵孵化率（95.5 ± 0.5 vs 96.5 ± 1.0 %），兩組間皆無顯著差異。綜上所述，旋風分離法對粉斑螟蛾卵粒所沾附之鱗粉分離效果優異，且卵遺失率低，未對卵粒造成破損，且器械簡便，亟具有自動化應用潛力。

關鍵字 (Keywords)：旋風分離 (Cyclonic separation) 、粉斑螟蛾 (Almond Moth (*Cadra cautella* Walker))、卵粒 (Egg)、鱗粉 (Scale)

PD_09

A nucleopolyhedrovirus from golden birdwing larvae (*Troides aeacus formosanus*) revealing a defective Autographa californica NPV genomic features

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Background/Question/Methods

Golden birdwing butterfly (*Troides aeacus)* is a rarely observed species in Taiwan. Recently, a typical symptom of nuclear polyhedrosis was found in reared *T. aeacus* larvae. From the kamura-2-parameter (K-2-P) analysis based on the nucleotide sequence of polyhedron, lef-8, and lef-9 of this isolate, the result showed that it was not belonging to any known NPV species; therefore, this NPV was named provisionally as TraeNPV. To better understand this NPV, the nucleotide sequence of the whole TraeNPV genome was determined by a next-generation sequencing (NGS) technology.

Results/ Conclusion

The genome of TraeNPV consists of 125,477 bp in length with 144 putative open reading frames (ORFs) and GC content is 40.45%. Phylogenetic analysis based on the 37 baculoviral core genes suggested that TraeNPV is a Group I NPV and closely related to Autographa californica nucleopolyhedrovirus (AcMNPV). The genome-wide analysis showed that TraeNPV has some different features in its genome from other NPVs. Two novel ORFs (*Ta75* and *Ta139*), three truncated ORFs (*pcna*, *he65* and *bro*) and one duplicated ORF (*38.7K*) were found in the TraeNPV genome, moreover, there are less homologous regions (hrs) than AcMNPV, which has eight hrs identified among TraeNPV genome. Although the gene content, density, and identity in the genome and gene arrangement of TraeNPV were similar to those of AcMNPV, TraeNPV lacks 15 homologous ORFs of AcMNPV in its genome, including *host cell-specific factor 1* (*hcf-1*) and *apsup*, which might be host range determination genes in alphabaculoviruses. Based on these data, TraeNPV would be clarified as a new NPV species with defective AcMNPV genomic features. Lack of *hcf-1* and *apsup* in the TraeNPV genome could provide useful information for the baculoviral host ranges and evolutionary insights.

關鍵字 (Keywords)：*Troides aeacus*, *Troides aeacus* nucleopolyhedrovirus, TraeNPV

生物多樣性、族群與群聚生態學

壁報展示摘要集

Posters:
Biodiversity, Population and Community Ecology

PB_01

有機與慣行水稻田無脊椎節肢動物生物量及多樣性調查
Investigations on biomass and diversity of invertebrate arthropods in organic and conventional paddy fields

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背景/研究問題/材料方法
水稻害蟲為影響稻作收成損失之重要因子，往昔研究中水稻田的無脊椎動物超過 300 種，顯示水田生物多樣性極為豐富。生物量 (biomass) 所代表的是樣區生物豐富度或生物生產力之基礎生態指標，針對物種數及組成進行的分析常以多樣性指數如 Shannon-Wiener 及物種均勻度 (species evenness) 來比較樣區間物種多樣性之差異。本調查於 2017 年一、二期調查嘉義縣民雄鄉豐收村之慣行及有機水稻田，每期三次調查、採集並紀錄水稻主要生育期之無脊椎節肢動物生物量與多樣性。鑒於缺乏水稻田生物量估算方法，因此以每種至少 20 隻之數量套用體長 - 體重迴歸方程式 (length-weight regressions) 建立無脊椎節肢動物生物量估算之參數，嘗試建構適合於水稻田生物量之估計參數基礎。

結果/結論/應用啟示
慣行與有機田之一期稻作中，分蘗盛期 - 孕穗、抽穗期的 Shannon-Wiener 等指數均較分蘗始期大幅升高；於二期作中，該指數並無太大的改變，一期稻作分蘗始期之分布組成主要受到大量水蚤與搖蚊的影響而造成較低的多樣性指數。在慣行與有機田間多樣性指數的變化，似乎與受到天敵、藥劑施用等干擾因子有若干關聯性。但在生物量的調查中，一期稻作分蘗始期之大量水蚤與搖蚊，佔一期稻作總調查生物量之 89.7%，顯示在探討影響稻田生物與稻作收成之生產力時，生物量可能亦是一項重要指標。生物量與體長的迴歸參數估計，以收集葉蟬科為參考基礎，與 Gruner 研究所提出的參數比較，討論是否有需進一步校正之必要。

關鍵字 (Keywords)：水稻田 (paddy field)、生物量 (biomass)、生物多樣性 (biodiversity)、體長 - 體重迴歸方程式 (length-weight regressions)

PB_02

不同農法水稻農業生態系之無脊椎動物多樣性

Invertebrate diversity of different farming methods on the rice agroecosystems

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Background/Question/Methods

Agricultural environments are different from natural ecosystems. The use of chemical pesticides and fertilizers and other managements affect biodiversity and sustainability of ecosystem services. However, organic farming methods can mitigate the impacts of agricultural activities. Our goal is to understand the influences of organic and conventional farming methods on the invertebrate communities in the rice fields. In this study, invertebrates were sampled in the terrestrial (sweeping method) and aquatic areas (core method) of the organic and conventional rice fields in central Taiwan.

Results/Conclusions

A total of 10010 invertebrates were collected in the terrestrial areas of organic rice fields, including 9569 Insecta (110 families and 10 orders), 407 Arachnida, 7 Gastropoda and 27 Entognatha individuals. In addition, a total of 6045 invertebrates were collected in the terrestrial areas of conventional rice fields, including 5477 Insecta (88 families and 9 orders), 424 Arachnida, 7 Gastropoda and 137 Entognatha individuals. In the aquatic areas of organic rice fields, we collected 25075 invertebrates, including 5691 Insecta (18 families and 5 order), 69 Arachnida, 601 Gastropoda, 9 Clitellata,15 Entognatha, 536 Nematomorpha and 18154 Branchiopoda individuals. In addition, a total of 2116 invertebrates were collected in the aquatic areas of conventional rice fields, including 168 Insecta (15 families and 5 orders), 5 Arachnida, 277 Gastropoda, 37 Clitellata, 23 Entognatha, 31 Nematomorpha and 1575 Branchiopoda individuals. The four indexes (family richness index, Simpson's index, Shannon-Wiener's index, and Pielou's evenness index) all showed that organic rice fields have higher biodiversity than conventional ones. Our results suggested that organic farming methods can achieve the environmental sustainability, which may facilitates conservation of the leopard cat (*Prionailurus bengalensis*).

關鍵字 (Keywords)：石虎 (leopard cat (*Prionailurus bengalensis*))、有機農業 (organic farming)、慣行農業 (conventional farming)、無脊椎動物 (invertebrate)、生物多樣性 (biodiversity)

PB_03

Species Diversity of Rice Insect Pests and Natural Enemies in Thai Hom Mali Rice Paddy Fields

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Background/Question/Methods
Rice (*Oryza sativa* L.) was one of the most important grains for human nutrition. There used the wide areas to do paddy fields so that, there would have many effectives such as tropical humid, temperature, dynamic environment and variety of growth stages. Wes impacted and attracted to others species that were insect pest and natural enemies. Thailand, there have the famous rice that were Thai Hom Mali Rice variety and also it had insect of insect pest and their natural enemies in paddy field. Us to studied the diversity of rice insects and spiders in Thai Hom Mali Rice paddy fields. This study was to determine of the identified insect and spider, Species biodiversity and distribution (Shannon-Wiener) were calculated and the relationship to biotic factor (insect natural enemies and spiders) and abiotic factor (temperature, relative humidity) in Thai Hom Mali rice paddy fields every 14 days. There were investigated using two varieties Of Thai Hom Mali Rice first was RD 15 and second was KDML105 and, both of them were used random sampling method. There may also be the randomized during January 2018 - March 2018 in the sampling at Thailand.

Results/Conclusions
The study showed that insect pest in RD 15 rice paddy fields were found 6 orders 10 families and 20 species, Insect natural were 6 orders 29 families and 42 species, Spider were found 1 orders, 4 families and 7 species for the species diversity and species Evenness of insect pest were 1.76 and 0.58 of those of natural enemies (insect and spider) were 1.51 and 0.39 respectively. Further, Insect pest, insect natural enemy and spider in KDML105Rice paddy field were found 6 order, 10 families and 24 species respectively respectively, the species diversity (H) and species evenness (EH) were 1.83 and 0.57, respectively and natural enemies and spiders were 1.46 and 0.38 respectively. The species number of insect Pests was not related to abiotic factors but related to the species number of natural enemies in both fields (r=6.81 and 7.14 in RD 15 and KDML105 rice paddy field respectively)

關鍵字 (Keywords)：Thai Hom Mali Rice, Biodiversity, Rice Insect

PB_04

金門入侵紅火蟻侵入途徑調查
Invasion routes of imported fire ant (*Solenopsis invicta*) in Kinmen

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背景/研究問題/材料方法
金門在 2014 年發現入侵紅火蟻 (*Solenopsis invicta*)，於 2017 年已擴散至全島，五鄉鎮(金沙鎮、金湖鎮、金寧鄉、金城鎮、烈嶼鄉)已列為普遍發生區域。金門與中國大陸，兩地最短管轄距離不到 2 公里，且金門海岸線超過一半被中國大陸包圍；2004 年廣東省吳川市發現入侵紅火蟻時，已相當嚴重，經過多途徑、多次及多點擴散，於 2008 年廈門集美區發現紅火蟻，接續已在湖里、海倉、同安、翔安等區發現，經過 6 年 (2014 年)金門也發現紅火蟻存在；藉由前人親緣關係推估，金門入侵紅火蟻屬由中國大陸擴散。故本研究從兩地距離及火蟻生存特性，針對海漂垃圾、火蟻婚飛及進口砂石等可能途徑進行調查，欲找出火蟻入侵金門最可能入侵之途徑，利用目視法、誘餌誘集法及欄柵法(馬氏網)等 3 種方法進行調查。

結果/結論/應用啟示
目前在金門本島調查結果，利用目視法及誘餌法觀察，面向中國大陸之海岸線隨處可見海漂垃圾，其海岸線(金沙鎮和金寧鄉、金城鎮之建功嶼)也可發現紅火蟻存在，背對中國大陸之金城鎮海岸，尚未發現；欄柵法僅發現有翅型蟻類，尚未發現入侵紅火蟻。雖然在海岸線及其海漂垃圾附近發現紅火蟻存在，但紅火蟻已在金門多年且已擴散全島，單就此現象推測海漂垃圾入侵有其困難度，必須更積極於海漂垃圾上岸同時馬上進行檢視，再配合長時間監測才能釐清入侵途徑。

關鍵字 (Keywords)：入侵紅火蟻 (imported fire ant)、海漂垃圾 (floating marine debris)、婚飛 (nupital flight)、金門 (Kinmen)

系統分類、族群遺傳與演化

壁報展示摘要集

Posters:
Systematics, Population Genetics and Evolution

PS_01

Discovery of the immature stages of Neopseustidae and its implication for early evolution of the Lepidoptera and the relationship with Viridiplantae

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Background/Question/Methods

The phylogenetic relationships of primitive Lepidoptera are one of the key questions to be addressed for lepidopterists. Resolution of their relationships do not only provide the evolutionary basis for re-arranging the classification, but also offer the phylogenetic backbone for inferring the evolution of the early lineages of the order, particularly the associations with green plants (Viridiplantae). The phylogenetic relationships of the primitive lineages of the Lepidoptera are already resolved. The evolution of host plant uses in immature stages, however, remains puzzled due to the lack of information of biology of Neopseustidae, a family belonging to a clade that is sister to all the Heteroneura. In the present study, we announce that we have discovered the complete life history of Neopseustidae based on *Neopseustis meyricki* in Taiwan and the phylogenetic pattern of host plant association of the entire Lepidoptera is therefore completed.

Results/Conclusions

The major findings of the present study include: (1) to our surprise, the host plant of Neopseustidae is not any primitive or basal plant family as suggested by previous author, but Vitaceae, an Eudicot family originated in early Cretaceous; (2) the time of origin of Neopseustidae is possibly Cretaceous as well; (3) the phylogenetic pattern of hostplant uses shows that exophagous feeding already appeared in Neopseustidae, not Adelidae as previously considered. Host plant association with Eudicot does not occur first in Neptoculoidea, but already in Neopseustidae. Due to the fact that a very large gap in both morphology and ecology occurs between Neopseustidae and other primitive lineages, we assume that some massive extinction of unknown higher groups might happen around early Cretaceous.

關鍵字 (Keywords)：Ditrysia, Angiospermivora, Glossata, Vitaceae, Angiosperms

PS_02

Discovery of *Scotopais* (Lepidoptera: Zygaenidae, Chalcosiinae) in Taiwan and its phylogenetic affinity and mimicry with the firefly genus *Vesta*

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Background/Question/Methods

The monotypic genus *Scotopais* Hering, 1922 was established based on *Phlebhecta tristis* Mell, 1922 from Guangdong Province of China. This species has a junior synonym, namely *Soritia cecilia* Oberthür, 1923 from Yunnan. Since the discovery of this species in the 1920s, only very few specimens were collected again from Guangdong and northern Vietnam, and it was long regarded as an endemic genus from southern China to northern Indo-China. In recent year, we incidentally obtained good material of both adults and larvae of this genus from southern Taiwan. This discovery allows us to infer the phylogenetic position and explore the biology of this very little known genus. We obtained sequence data of three molecular markers, i.e. cytochrome oxidase subunit I (COI), nuclear elongation factor 1 alpha (Ef-1α) and 28S rRNA from around 100 species of Chalcosiinae in order to include all the genera that have similar wing shape and coloration. The phylogeny was inferred by the model-based Maximum likelihood (ML) and Bayesian inference (BI) methods. Meanwhile, we also investigated the potential co-mimicking fireflies in the habitat.

Results/Conclusions

Our phylogenetic analysis reveals that: (1) *Scotopais* is embedded in a clade comprising "*Cyclosia*" *notabilis* and *Histia*; (2) association of the larvae of *Scotopais* with Symplocaceae suggests that the hostplant selection has evolved independently within the tribe; (3) the light color patch on dorsum of the larvae reveal that the character is one of the symapomorphies of the tribe; (4) the similarity with *Phlebohecta* Hampson, 1893 in adult is caused by convergence; and (5) the mimicry relationship with *Vesta* fireflies may represent the first case of firefly mimicry by a lepidopteran species in Asia.

關鍵字 (Keywords)：firefly mimicry, aposematism, convergence, chemical defense, Chalcosiinae

PS_03

紫斑蝶的第一個分子系統發育假說與其穆氏擬態環在東南亞演化的意涵

The first molecular phylogenetic hypothesis of *Euploea* butterflies (Lepidoptera: Nymphalidae, Danainae) and its implication of evolution of the Müllerian mimicry rings in SE Asia

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Background/Question/Methods

The alpha-taxonomy, overwintering ecology and chemical defense of the butterfly genus *Euploea* (Nymphalidae, Danainae) have been studied extensively during the last decades. The wings pattern and unpalatability of them are known to be significant in driving the convergent evolution of colour-patterns of other butterflies and diurnal moths in Indo-Pacific region. Up to date about 60 species and numerous subspecies of *Euploea* are recognized. Although the genus is very often mentioned in studies on overwintering, migration, mimicry and chemical defense, but the majority of the studies confines to less a dozen of the species. The phylogenetic relationships within the genus was only studied once during the 1980s based on morphological characters and a Hennigian approach. However, the previous study neither successfully resolve the phylogeny nor re-organize the classification. Meanwhile, morphological characters are not sufficient to distinguish species with extreme sexual dimorphism, polymorphism, internal mimicry and high individual variability. In order to evaluate the correlations between divergence times, clade age, speciation, biogeography and hostplant associations, we reconstructed the first Bayesian and Maximum likelihood phylogenetic trees of Euploea butterflies using sequence data of 5 loci (COI, EF1a, RPS2, cytochrome b and wingless) from 34 species, and use this tree to assess the correlation between the diversity of mimicry ring and the landmass in SE Asian islands.

Results/Conclusions

Our phylogenetic analysis reveals that: (1) *Euploea* is a monophyletic group comprising at least 9 morphologically distinct and well-supported clades; (2) extreme sexual dimorphism has evolved only once in *E. mulciber* + *E. configurata* clades; (3) convergence in wing pattern appears in every clades with sympatric distribution; (4) the area of island correlates with diversity of mimicry rings, while this phenomenon is not detected in continent; and (5) species diversity of the genus is underestimated.

關鍵字 (Keywords)：phylogenetics, island biogeography, mimicry, polymorphism, cryptic species

PS_04

使用形態特徵檢測 Hypochrosini (Lepidoptera: Geometridae, Ennominae) 是否為單系群?

Testing the monophyly of Hypochrosini (Lepidoptera: Geometridae, Ennominae): Evidence from morphological characters

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Background/Question/Methods
The Lepidoptera are estimated to include more than 200000 described species, of which over 20000 are in the Geometridae – one of the three most species-rich families. Almost half of the geometrid species belong in the subfamily Ennominae, which has a total of about 10000 species worldwide, placed in approximately 28 tribes and 1100 genera. Among them, the tribe Hypochrosini is comparatively a small tribe and accounts about 347 species in 30 genera, widely distributed in Eurasia, SE Asia, Indian subcontinent, Africa and North America. Although most of the lepidopterists recognize that Holloway's revision on the Bornean Hypochroini fauna established the framework of the systematics of the tribe, many genera, however, are poorly defined and the phylogeny and monophyly of the tribe are still inadequately resolved. The purpose of the present study is in order to provide an improved phylogenetic framework of genera, thereby enabling better assessment and understanding of the diversity, biogeography and ecology of the tribe. Due to the rarity of many genera in museum collection, we first investigated the phylogeny using morphological evidence obtained from the adults of 47 species and 27 genera plus a species from Scardamiini as the outgroup taxon. We employed Maximum Parsimony to reconstruct the phylogenetic hypothesis and use the tree to assess the monophyly of the tribe, internal relationships and the current classification.

Results/Conclusions
The phylogenetic pattern shows that the monophyly of the tribe is not supported and the current composition of the tribe is possibly due to misinterpretation of the homology of several characters, such as wing pattern, wing shape, furca in male genitalia and androconial organ. We first discovered that many genera which were never placed in any tribe can be associated with Hypochrosini, while many genera that were placed in Anagonii, but subsequently movedto Hypochrosini, should be removed from this tribe.

關鍵字 (Keywords)：系統發育 (phylogenetics)、雄性生殖器 (androconial organ)、發香器 (male genitalia)、趨同演化 (convergence)、舊大陸 (the Old World)

PS_05

鱗翅目檢疫昆蟲 DNA 生命條碼資料建立暨其遺傳變異分析
Establishment of DNA barcode database and genetic variations of lepidopteran quarantine insects

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背景/研究問題/材料方法
鱗翅目昆蟲多樣性高，為進口貨物常見之防檢疫害蟲，然而查獲樣本常為幼生期或蟲體死亡發黴，形態特徵鑑識不易且保存狀況不佳，即使學有專精的分類專家亦難以將全數標本正確、快速地鑑定至種。近年來，DNA 生命條碼已廣泛應用於昆蟲系統分類及物種鑑定，可協助辨識不同生活史階段的昆蟲，大幅縮短鑑定時程。本研究依據中華民國輸入植物或植物產品檢疫規定中所列之甲、乙項檢疫鱗翅目昆蟲瞭解是否已在臺灣建立族群，並從 GenBank、生命條碼資料庫系統(Barcode of Life Data Systems, BOLD)下載、收集相關物種序列，瞭解各種鱗翅目昆蟲之 DNA 生命條碼建立狀況與其遺傳變異，作為未來防檢疫工作的背景資料。

結果/結論/應用啟示
中華民國輸入植物或植物產品檢疫規定中所列之檢疫鱗翅目昆蟲共計 71 種，自 GenBank、BOLD 資料庫共整理下載 57 種、7,000 餘條 DNA 條碼序列，然而尚有 14 種物種仍未建立 DNA 資料，未來應積極跟國外專家學者取得標本建立 DNA 資料供物種鑑定之需。此外，本研究擬進一步應用 DNA 條碼分析，協助釐清形態鑑定不易的乙項檢疫物種-翠紋鑽瘤蛾(*Earias vittella*)及茶姬捲葉蛾(*Adoxophyes orana*)與臺灣同屬近緣物種的遺傳變異，檢視其分類地位及瞭解是否有隱藏種問題。

關鍵詞 (Key words)：檢疫(quarantine) 、鱗翅目(Lepidoptera)、DNA 生命條碼(DNA barcodes)、遺傳變異(genetic variation)

PS_06

臺灣地區入侵種中國梨木蝨(半翅目：木蝨科)之遺傳變異及起源
Genetic variation and origin of the invasive pear psyllid *Cacopsylla chinensis* (Hemiptera, Psyllidae) in Taiwan

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背景/研究問題/材料方法
中國梨木蝨(*Cacopsylla chinensis* (Yang and Li))於 2002 年發現入侵臺灣中部梨園後，迅速擴散至其他地區，造成梨園重大經濟損失；其得以入侵臺灣，與走私進口的梨接穗有關。梨木蝨體色變異大，可分為冬、夏兩型，其中粒線體細胞色素氧化酶 I (cytochrome oxidase I, COI)及核醣體去氧核醣核酸(16S rDNA)分析結果顯示，臺灣的中國梨木蝨分為兩個支系，其中第一支系與中國北京、新疆樣本相關聯，臺灣各地梨園木蝨多歸於此支系;但新竹尖石及臺中東勢、和平的部分個體則組成第二支系，兩支系遺傳差異高達 3.3%，代表臺灣的中國梨木蝨可能為不同種或不同起源。本研究加入曾被日本及韓國認為是中國梨木蝨的 *Cacopsylla jukyungi* 樣本暨一些走私查獲樣本，並加入核醣體區段(internal transcribed spacer 1, ITS1)序列，檢視臺灣中國梨木蝨第二支系的起源暨其基因交流狀況。

結果/結論/應用啟示
粒線體 COI、16S rDNA 分析結果支持日本及韓國的梨木蝨 *C. jukyungi* 自成一支系；ITS1 分析結果則顯示，分屬兩個粒線體 DNA 支系的中國梨木蝨個體混雜為為同一群，推論不同起源的梨木蝨，進入臺灣後基因交流頻繁，可能因而改變原有遺傳組成及習性，且入侵初期尚未擬定合宜的防治策略，故成為當時防治不易的原因，未來可引以為鑑，作為類似案例參考範例。此外，雖然來自以韓文報紙包裝的走私梨接穗梨木蝨樣本被歸群為第二支系，但要確認此支系的起源，尚需取得韓國或中國東北的梨木蝨樣本，才得以釐清。

關鍵字 (Keywords)：中國梨木蝨 (*Cacopsylla chinensis* (Yang and Li))、核醣體區段 (internal transcribed spacer 1 (ITS1))、遺傳變異 (genetic variation)、基因交流 (gene flow)、起源 (origin)

行為、生理與個體生物學

壁報展示摘要集

Posters:

Ethology, Physiology and Organismic Biology

PE_01

狹翅大刀螳與枯葉大刀螳之型態比較
Morphological comparison of *Tenodera angustipennis* and *Tenodera aridifolia* (Mantodea, Mantidae, Mantiane, Polyspilotini)

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背景/研究問題/材料方法

狹翅大刀螳 *Tenodera angustipennis* (Saussure,1869)雖廣泛分布於朝鮮半島、日本、台灣及中國大陸等地，台灣地區的族群卻相當零星。文獻記錄產地包括新北市瑞芳及南投縣東埔；枯葉大刀螳 *Tenodera aridifolia*(Stoll,1813)則為台灣地區該屬中最為常見的種類，主要分布於全島海拔 1500 公尺以下之草生地及灌木叢中。第一作者於 2015 年 10 月及 2017 年 10 月自新竹縣新豐鄉採集到 3 筆採集紀錄，又由於採集時紀錄活體狀態及檢視乾燥標本的外部型態時，發現分類特徵常用的形態構造如前胸背板形狀，長寬比及邊緣構造、前足基節內側及後翅的斑紋等有顯著差異，蒐集二者之螵蛸時也發現其外部型態、長度、寬度之差異甚大。因此本文將以周倖瑜 陳錦生 詹美玲，2004 的《台灣螳螂目之分類》中描述的枯葉大刀螳外觀形態特徵為基準，比較狹翅大刀螳與枯葉大刀螳雌成蟲乾燥標本時的外部型態，並蒐集二者之螵蛸紀錄外部型態、長度、寬度。以建立本種完整的成蟲及螵蛸之外觀型態描述。

結果/結論/應用啟示

本文透過與 *T.aridifolia* 形態比較後確定了 *T.angustipennis* 成蟲及螵蛸外觀形態特徵及測量數據，包括頭部正面長寬比，*T.angustipennis* 為 1：1.18；*T.aridifolia* 為 1：1.1.5。前胸背板背面長寬(Wa)比值，*T.angustipennis* 為 4.10±0.09；*T.aridifolia* 為 4.14±0.05。前胸背板寬比(Wa：Wm：Wp)，*T.angustipennis* 為 6.25：5.7：6.1；*T.aridifolia* 為 6.63：4.8：5。以利後續之分類研究及行為分析。

關鍵字 (Keywords)：型態比較 (Morphological comparison)、狹翅大刀螳 (*Tenodera angustipennis*)、枯葉大刀螳 (*Tenodera aridifolia*)、差異性 (Difference)

PE_02

台灣中部地區螞蟻婚飛週期之研究
The Nuptial Flight Pattern of Ants in Central Taiwan

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背景/研究問題/材料方法
所有的兩性物種都要經過交配才能讓族群繼續繁衍下去，大多種類的螞蟻則是以婚飛的方式來進行種內的基因交流。然而，螞蟻與其他昆蟲不同，婚飛完後蟻后必須存活下來創巢，所以挑選婚飛時間和地點對於一個物種成功的繁殖有極大的影響。本研究以台灣中部地區螞蟻為主要研究對象，去了解該地區影響不同螞蟻婚飛時間和地點的因子。本研究採集時間從 2014 年 3 月到 2015 年 3 月，以週為單位回收陷阱，使用燈光誘集陷阱來蒐集婚飛個體，放置九個陷阱在彰化縣大村鄉的大葉大學校園內，氣象資料則是採用芬園氣象站的資料。

結果/結論/應用啟示
本研究發現大多數螞蟻物種和個體從 2014 年 5 月 12 日到 2014 年 5 月 19 日這週開始婚飛，這時期降雨量是在本研究期間最高的時候，平均溫度大約 25℃ 和相對濕度是 88.3%。從 2014 年 5 月 12 日開始大量螞蟻物種婚飛持續到 2014 年 8 月 25 日，並隨著時間婚飛的物種漸漸下降，到了 2015 年 1 月 12 日就沒有螞蟻婚飛，一直持續到 2015 年 2 月 9 日才又開始有一些物種婚飛。在本研究的樣本中有發現具有危害性的螞蟻(黑頭慌琉璃蟻和扁琉璃蟻屬)和較稀有的螞蟻(突額針蟻屬、盾角針蟻屬和臀山蟻屬)，可以藉由本研究的結果去了解該地區螞蟻婚飛時間，並制定防治和研究的時間。

關鍵字 (Keywords)：蟻科 (Formicidae)、婚飛 (nuptial flight)、交配 (mating)、繁殖 (reproduction)

PE_03

大林長腳家蟻不同群落大小對於工具選擇的覓食策略（膜翅目：蟻科）

The tool selection of foraging strategy between different colony size in *Aphaenogaster tipuna* （Hymenoptera: Formicidae）

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背景/研究問題/材料方法

近幾十年來，有關於非人類生物使用工具的議題開始受到關注與研究。相較於有著較多人研究的靈長目與鴉科動物，對於昆蟲綱、膜翅目、蟻科使用工具的研究甚少，且過往資料也以觀察記錄的方式為主。前人研究指出，森尼斯長腳家蟻（*Aphaenogaster senilis*）對液態食物有工具選擇的偏好與彈性，但族群大小差異是否影響覓食策略的議題並沒有進一步的探討。因此本研究以大林長腳家蟻（Aphaenogaster tipuna）為實驗對象，欲探討大林長腳家蟻不同群落大小，對液態食物的覓食策略：（1）不同群落大小發現資源的時間是否有差異、（2）不同群落大小第一隻覓食工蟻取食糖水的時間是否有差異、（3）不同群落大小對工具的選擇（海綿、小石礫、土壤顆粒和草片）偏好是否有差異，以及（4）不同群落大小對使用工具的策略是否有差異。

結果/結論/應用啟示

結果顯示不論群落大小，工蟻均可短時間就發現糖水資源。但在與糖水接觸停留的時間方面，大型群落較小型群落短，以利回巢內招募更多的同伴。在工具的偏好方面，大型群落偏好使用海綿，而小型群落則無明顯的工具偏好。而在使用工具的策略上，群落的大小差異會有所不同。這些結果表示，大林長腳家蟻會因群落大小，而對工具的選擇使用策略有所彈性。

關鍵字 (Keywords)：大林長腳家蟻 (*Aphaenogaster tipuna*)、覓食策略 (foraging strategy)、群落 (colony)、工具選擇 (tool selection)

PE_04

外表很重要: 碎斑硬象鼻蟲(*Eupyrgops waltonianus*)體色傳達的多種訊息

Appearance matters: multiple functional signals of body colors in *Eupyrgops* weevil

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Background/Question/Methods

Visual signals in many animals are often shaped by natural and sexual selection, and the coloration on some species might be extremely conspicuous or dull in the wild. For aposematic species, conspicuous individuals may possess the advantages from advertising unprofitability to decrease predation, or even attracting mates to increase reproductive success. On Green Island, the weevil *Eupyrgops waltonianus* with metallic blue spots has been evidenced that the spots were aposematic signals which effectively reduce the predation rate. However, there are still some weevils without conspicuous coloration in the field, and whether dull individuals encounter some disadvantages and the function of coloration on sexual selection are still unknown. In order to realize whether morphological traits affects mating success in E. waltonianus, we compared different traits (e.g. body weight, thorax length, elytra length and ratio of spot area) between mating and non-mating individuals in the field. Manipulated experiments (spot-remained and post-removed) were used to test whether coloration affects mating choice and behavior.

Results/Conclusions

The results showed that body mass and coloration are two important indicators to evaluate the reproductive quality of females. Males preferred to mate with heavier and more conspicuous females. However, females did not display any mate preference. The mating system of *E. waltonianus* is a male dominant system, and intra-sexual competition is stronger in males. Our study demonstrated that conspicuous coloration on female weevils is multiple functions, which can be used as aposematic and attractive signals for different receivers, and males and females face different selection pressure in natural environment.

關鍵字 (Keywords)：aposematism, competition, *Eupyrgops waltonianus*, mating behavior, sexual selection

PE_05

葡萄根瘤蚜發育基因組序列：基因註解和比較分析
Genomic sequence around phylloxera developmental genes: annotation and comparative analysis

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Background/Question/Methods
Aphids exhibit unique polyphenisms that make them a biological model for developmental studies. Grape phylloxera *Daktulosphaira vitifoliae*, the basal phylogenetic relationship to the Aphidoidea (the true aphids), share with aphid complex life cycles that are characterized by the alternation of sexual and asexual generations, and at least four different morphs of adult females can be distinguished in a clone. However, how aphids alternate between viviparity (asexual) and oviparity (sexual) evolved remains unknown. Here, we present a comprehensive survey of developmental toolkit genes in the grape phylloxera. We investigated genes involved in the fundamental developmental processes, including the formation of body axes, segmentation, neurogenesis, eye development, and germline development.

Results/Conclusions
Compared to true aphids and other hemipteran insects, gene duplications and gene losses have occurred in several gene families, yet most developmental toolkit genes were well conserved in the grape phylloxera. In particular, the component of germline determinants, *vasa* and *nanos*, were duplicated, which was also found in the genome of the pea aphid. Strikingly, different to the extraordinary duplicates of 8 *piwi* genes in pea aphid, we only identified two *piwi* genes were encoded in the phylloxera genome. The less copies of *piwi* genes in grape phylloxera may reflect the more ancestral state of oogenesis in cyclical parthenogenesis. Our results demonstrated that expansions and losses of developmental toolkit genes are conserved among aphid subfamilies and rare in other hemipterans, suggesting roles of these genes may facilitate the evolution of polyphenism in aphids.

關鍵字 (Keywords)：基因組註解 (genome annotation)、葡萄根瘤蚜 (phylloxera)、發育基因 (developmental gene)、多型性 (polyphenism)、蚜蟲 (aphids)

PE_06

The impact of temperature on germline development of the pea aphid *Acyrthosiphon pisum*

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Background/Questions/Methods

In animals, thermal stress can regulate growth and reproduction. In the asexual viviparous pea aphid, for example, longevity and fecundity of adult aphids significantly decrease at high temperatures. However, how the thermal stress retards the reproduction of aphids remains unclear. In this study, we aim to investigate how the elevation of temperature regulates the development of germ cells in the asexual viviparous pea aphid. We analyze the numbers of ovarioles per ovary and those of egg chambers per ovariole in aphids that are reared at distinct temperatures, aiming to understand that infertility at high temperatures such as 30ºC is caused by the failure of delivery or by the immaturity of embryos. Examination of the expression of the conserved germline marker *Apvasa1*(*Apvas1*) will be conducted in parallel because it will help us understand the expression of germline gene is temperature-dependent.

Results/Conclusion

Our preliminary results show that the number of egg chambers did not significantly reduce in aphids being cultured at 30ºC from the first instar nymph, suggesting that segregation of egg chambers is not very much hindered by heat stress. Failure of giving birth, we hypothesize, may be caused by other factors such as the death of embryos or reduction of germline gene expression. Accordingly, we will examine the morphology of embryos in ovarioles dissected from aphids being cultured at different temperatures from 20 to 35ºC. Meanwhile, we will analyze the expression of *Apvas1*mRNA using whole-mount *in situ* hybridization (WISH) and quantitative real-time PCR, aiming to clarify the correlation between temperature variation and gene expression. These results will allow us to figure out how the impact of temperature regulates the fertility of asexual viviparous aphids.

關鍵字 (Keywords)：thermal stress, germ cells, vasa, aphid.

PE_07

Morphology and development of three endoparasitoids of filth fly (Hymenoptera: Pteromalidae, Encyrtidae)

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Background/Question/Methods

Filth flies have a close association with human and their environment which they are important for public health because carrying the enteric pathogens of them. A variety of parasitoids attacked filth flies and reduced the reproductive potential of them. Therefore, we studied the biology and development of three filth fly pupa parasitoids to better understand their characteristics. This information is essential for mass rearing and indentication of the filth fly pupa parasitoids. A study on morphology and development of three filth fly pupa parasitoids including Pteromalidae; *Spalangia gemina* and *Pachycrepoidus vindemiae* and Encyrtidae; *Exoristobia philippinensis* were explored. All parasitoid species were wild-caught in cattle farm in Sakon Nakhon province, Thailand and mass reared culture maintained with the house fly, *Musca domestica* in laboratory under the ambient conditions at 25 +2oC, 65+ 5% RH. The morphology and development of *S. gemina* in immature stage was determined by daily dissecting the parasitized house fly pupae until the adult emerged. Dissection was performed under a stereomicroscope. The adult stage was investigated by an adult in plastic test tube. A similar procedure was used to study the *P. vindemiae* and *E. philippinensis*. Each parasitoid species was presented with 20 replications. Data were recorded the biology and development times of all parasitoids.

Results/Conclusions

Development type and eggs of all the three parasitoids are complete metamorphosis and hymenopteriform. The development time of *S. gemina*, *P. vindemiae* and *E. philippinensis* were 14, 15.40 and 14 days on immature stage. The larvae of *S. gemina* has 3 instars whereas, *P. vindemiae* and *E. philippinensis* has 5 instars. Development times of adult stage of *E. philipinensis* were longer than *S. gemina* and *P. vindemiae*. Moreover, the *E. philipinensis* is gregarious parasitoid but *S. gemina* and *P. vindemiae* are solitary parasitoid.

關鍵字 (Keywords)：Pteromalidae, Encyrtidae, insect parasitoid, filth fly, immature stage

PE_08

DWV 感染與細胞外腺苷信號在西方蜜蜂的神經功能中作用之關聯性
The association of Deformed Wing Virus (DWV) infection and extracellular adenosine signaling in neurological function of *Apis mellifera*

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Background/Question/Methods

Apis mellifera, also known as the western honeybee, belongs to the order Hymenoptera and the family Apidae. In recent years, an increasing number of colonies worldwide have been affected by missing worker bees, a condition termed colony collapse disorder (CCD). This phenomenon may be caused by pathogens, pesticides, or even interactions between those two factors by creating stressful environments for honeybees. Honeybees are susceptible to infection by viruses that might cause colony diseases, such as deformed wing virus (DWV). DWV is present in 90% of hives and is the most common virus in Taiwan. DWV infection during the developmental cycle may result in deformed wings and newly emerged worker bees may suffer disabilities or even death, though there are no obvious symptoms when adult bees are infected by DWV. Previous studies have shown that bees infected with DWV display an enhanced response to water and low-concentration sucrose as well as significant effect on learning ability and memory. In the present study, we would like to examine the potential role of adenosine signaling during the DWV infection in the honeybee. Adenosine signaling is one of important pathway regulating the brain and immune function in animals. In the insects, it was recently demonstrated that Ado signaling not only regulates *Drosophila* hematopoietic differentiation, but also plays an important role controlling the metabolic switch between immune system and proliferated tissues during wasp and bacterial infection.

Results/Conclusions

Our preliminary results have confirmed that the learning ability of honeybee is significantly reduced after DWV infection. We attempt to analyze the Ado level as well as the expression of adenosine-related genes in the brains of infected bees and try to clarify whether learning ability in bees is affected by abnormalities in supplied energy caused by differences in brain Ado level following DWV infection.

關鍵字 (Keywords)：西方蜜蜂 (*Apis mellifera*)、腺苷信號 (deformed wing virus)、學習 (Adenosine signaling)

臉書昆蟲社團與粉絲專頁

Mini-Symposium:

Insect Facebook Pages and Groups

臺灣昆蟲同好會
Taiwanese Society of Insect Natural History

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臺灣昆蟲同好會由一群臺灣的昆蟲或蛛形愛好者所組成，並廣納研究同好為會友，基於喜愛昆蟲的公民都可以參與科學研究的想法，認為人人都有機會為昆蟲自然史的發展留下重要的紀錄，期望促進臺灣的昆蟲、蛛形自然史研究之發展。有鑑於臺灣的昆蟲愛好者近年來持續增加，也誕生一些興趣團體，各社團中也不乏出現珍貴的觀察、飼養資訊。但是，諸如此類的資訊常由於網路的資訊覆蓋率高、容易因為外在因素導致文章連結失效等因素而流失。因此，我們期許本會的刊物能作為一個橋梁，在正式學術報告的格式編排的框架下，提供大家一個平易近人的平台，以發表舉凡有關昆蟲或蛛形綱的自然史相關短訊如野外生態行為、區域物種相調查、飼養記錄、形態觀察描述和文化昆蟲學。我們期許本社作為一個正式平台，讓一些優質的觀察文章轉為可供未來引用需要的永久文獻而不再埋沒於社群網站或網頁貼文的洪流；此外，我們更希望本刊能成為相關科系學子練習撰寫正式科學報告的投稿平台，不再讓課堂報告流於交差應付用的作業，而是真的可以為科學研究做出貢獻。

臉書粉絲專頁請搜尋『臺灣昆蟲同好會』

關鍵字 (Keywords)：昆蟲 (insects)、蛛形類 (arachinids)、自然史 (natural history)、地區性同好會 (regional community)、地方性期刊 (local journal)

慕光之城─探索臺灣蛾類世界
Taiwan Moth Observation Club-Discovery of moth occurrence and distribution in Taiwan

施禮正、邱茂銓、廖亭雅、郭姿欣、張智棋、林旭宏
Li-Cheng Shih, Mau-Chiuan Chiu, Ting-Ya Liao, Tzu-Hsin Kuo, Chi-Chih Chang, Hsu-Hong Lin
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臺灣的鱗翅目昆蟲截至目前為止共有多達4,885種，其中4,449種為蛾類，約占91%。相較於僅占9%的蝴蝶，在過去蛾類的相關研究較少，且關注度較低。為了蒐集蛾類物種出現資料(species occurrence data)，並以「全民賞蛾」為主軸推廣蛾類科普知識，特有生物研究保育中心自2011年開始於臉書成立「慕光之城─蛾類世界」社團，以「大眾提供資料，專家提供辨識結果」的互惠模式，藉由公眾參與的方式蒐集蛾類發生的時間與地點資訊，並建置資料庫彙整這些資料。截至目前為止，資料庫裡共建檔超過193,000筆以上的蛾類物種出現資料，已鑑定出74科2,875種。應用這些資料，研究團隊開發了「飛蛾資訊分享站」，將成果回饋參與者。該網站一方面可作為電子圖鑑，另一方面可作為個人觀察紀錄的查詢系統。該批資料採開放資料(Open data)的精神予各界使用，亦提供物種分布資訊給「台灣產蝶蛾圖鑑」，彼此相輔相成。此外，網站還提供「常見蛾種」、「資料視覺化分析」等功能，讓有興趣的民眾能進一步認識臺灣蛾類的現況。慕光之城除了作為昆蟲研究與公民科學結合的案例，可供其他類群參考外，也希望能夠吸引更多人參與蛾類研究，以對臺灣蛾類有更完整的認識。

臉書社團/粉絲專頁請搜尋『慕光之城─蛾類世界』

關鍵字 (Keywords)：公民科學 (citizen science)、群眾外包 (crowd sourcing)、社群網站 (social media)

台灣產蝶蛾圖鑑 - 以網路社群之力集成的生物多樣性資訊平台
DearLep- The integrative biodiversity platform of Lepidoptera in Taiwan

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鱗翅目為昆蟲中四個物種多樣性最高的類群之一，當中包含了大家熟知的蝶類與蛾類。過往台灣坊間鱗翅目相關的出版品、主題網頁少有同時納入考量蝶蛾類群，主要原因在於蝶蛾在系統分類、教育普及都有蝶類領域進程較早的歷史脈絡。「台灣產蝶蛾圖鑑」一網站建置團隊於 2014 年起同時納入此兩大類群，就可獲得的基礎調查、生物相與圖鑑出版品、系統分類文章發表、廣泛類群的分類文獻整理的進展，過往國家型數位典藏計畫與本團隊自行累積之模式系列標本影像，以及對高頻度的分類群學名變動掌握下，以對外美觀的視覺設計與內部高度結構化彼此緊密串聯的知識體系，累積容納上述多型態的資料，使瀏覽者可透過不同分頁獲得以下資訊：（一）、「蝶蛾印象」以等比例呈現蝶蛾交錯紛呈的多樣性；（二）、「圖錄檢索」以複合式屬性篩選（例如照片型態、生活史時期、成蟲出沒海拔、月份、成蟲外觀輪廓、主次色調等）獲得物種影像與延伸介紹，並能直接以連結分享篩選結果給他人；（三）、「物種名錄」呈現全覽或查詢名錄、以及快鍵瀏覽名錄對應分類群影像的便捷、（四）、「食草記錄」可由蝶蛾名尋得寄主植物與其新舊科級歸群資料，或以寄主找蟲名；（五）、「文獻查詢」可藉篩選覓得物種原始文獻；（六）、以上所有頁面中皆可連至「物種頁面」觀看詳細的物種資料，包括串聯自特有生物研究保育中心「飛蛾資訊分享站」的分布點位，與分類、描述、食草等與語意網介接的資訊。（七）、每個頁面中的”藍色小方框”與圖錄檢索共享相同的視覺呈現模組，提供快速瀏覽有類似屬性狀態的物種照片，扣緊本平台上的所有內容主題。本團隊冀望由此一平台提昇自然愛好者對台灣蝶蛾多元面向的認識，開啟多分類群合作的空間與對資訊應用的進一步想像，以及衍生多元文化與藝術創作的契機。

台灣產蝶蛾圖鑑 網址：http://dearlep.tw

關鍵字 (Keywords)：鱗翅目 (Lepidoptera)、生物多樣性資訊 (biodiversity informatics)、資料結構化 (data structuring)、數位典藏 (digital archive)

台灣的食糞群金龜
Coprophagous group scarab-beetles of Taiwan

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食糞群金龜係指一群屬於金龜子總科(Scarabaeoidea)家族中不同科級組成的成員,其生活史必須以動物排遺、食繭、死屍或腐爛真菌等有機物質為食，其中又以取食糞便的物種最多，因此通稱為糞金龜。台灣的食糞群金龜，分屬於金龜子科(Scarabaeidae)的蜣螂亞科(Scarabaeinae)及蜉金龜亞科(Aphodiinae)、雪隱金龜科(Geotrupidae)、厚角金龜科(Bolboceratidae)、紅金龜科(Ochodaeidae)、駝金龜科(Hybosoridae)與皮金龜科(Trogidae)等 6 科 9 亞科，共計約有 160 餘種。由於近年觀察及協助管理過些許社群網頁，明顯發現有許多人對於食糞群金龜是保有興趣或好奇心的，但往往不知如何入門。因此，創立本社群網頁的目的主要有三：第一，分享有關台灣產食糞群金龜的相關知識或提供近似物種之間的簡易辨識教學。第二，提供平台讓社員分享有關食糞群金龜的影像紀錄資訊，藉此收集各物種於台灣地區的分布概況、生態資訊與發生期。第三，透過社團功能來收集具有研究價值的證據標本，採自願制。

臉書社團請搜尋「台灣的食糞群金龜」，更多相關資訊請搜尋「台灣食糞群金龜簡誌」。

關鍵字 (Keywords)：食糞性甲蟲 (coprophagous beetles)、親屍性甲蟲 (necrophilous beetles)、金龜子總科 (Scarabaeoidea)、台灣 (Taiwan)

台灣的金花蟲
Leaf Beetles in Taiwan

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金花蟲是鞘翅目最多樣的類群之一，台灣已記錄超過七百種；此類甲蟲為植食性，其成蟲與幼蟲以植物的組織為食，不少種類為寡食性或單食性；由於不少種類具有獨特的形態及色型，適合當做圖鑑的素材。李奇峯與鄭興宗藉由網路徵集幾位業餘愛好者，包括曹美華、余素芳、李雪、陳厚潔等，訓練成公民科學家並組成“台灣金花蟲研究團隊”，從 2005 年起針對台灣地區做全面性的物種調查，之後陳榮章、廖文泉、郭泊鑫及鍾奕霆加入，增加南部的採集能量，最近則有陸錫峯及黃月琦的加入，彌補了東部長久以來被忽略的窘境。十多年來已出版三本圖鑑，在學術研究上發表論文約 60 篇，新種超過 50 種；2011 年建立臉書社團，藉由協助鑑定及解答疑惑，希望能引起一般大眾對金花蟲的興趣，進一步從民眾的觀察紀錄，可獲得有用的訊息，如入侵種的活動頻度及擴散紀錄、新記錄的食草、新種及新紀錄種的發現，並藉由有興趣的民眾協助採集及觀察，對學術研究及規劃中的圖鑑做實質的貢獻；希望能從密集的合作，培養出新的公民科學家，能而加入此研究團隊。

臉書社團/粉絲專頁請搜尋『台灣的金花蟲』

關鍵字 (Keywords)：金花蟲 (leaf beetles)、臉書社團 (Facebook Groups)、台灣金花蟲研究團隊 (Taiwan Chrysomelid Research Team)

蠼市場名
The Indentification of the Odonata Nymphs

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Lung-Chun Huang, Shih-Jie Chiu
臺北市立動物園 Taipei Zoo

蜻蜓是人們生活中常見的昆蟲之一，也是許多研究者、攝影師的題材。坊間成蟲的相關書籍眾多，與稚蟲有關的書籍較為缺乏，由於蜻蛉目稚蟲常被作為反映水質的指標生物，但目前臺灣僅有 4 科的稚蟲已完成分類研究，因此本粉絲專頁希望能夠建立臺灣產各種水蠼的辨識方式及各科的分類檢索表。

本粉絲專頁主要有三項功能：第一是分享目前已辨識出種類的水蠼照片，包括下唇、側棘、肛錐等分類特徵，目前已分享的種類有 13 科 63 屬 87 種。第二為將同屬或相似的種類合併討論，並提供辨識方法。目前已建立 9 組 18 屬 26 種相近種類的辨識方式。第三則為建立各種水蠼的飼養方式，包含飼養環境、食物等資訊，以對水蠼的生態行為有更多的了解。希望能讓更多人了解水蠼，進而喜歡牠們。

臉書粉絲專頁請搜尋『蠼市場名』

關鍵字 (Keywords)：蜻蛉目 (Odonata)、稚蟲 (nymphs)、分類檢索表 (indentification key)

台灣的水生昆蟲
Aquatic insects of Taiwan

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台灣有著豐沛的雨量及數以萬計的埤塘和水田，孕育出高度的水生昆蟲多樣性，但一些水生昆蟲在網路上的資料非常少且欠缺專家協助鑑定，所以藉由此目的對一般民眾提供正確的知識及對這些類群的認知，筆者的部落格起初以介紹龍蝨科為主，現在逐漸擴展至大部分的水生鞘翅目與水生半翅目做為討論對象，這些種類都是過去鮮少人拍攝並討論的，目前部落格呈現方式是以民眾最容易利用的圖鑑模式，並且不定期發布國內外具學術性質的水生昆蟲相關論文。 我們因應公民的參與所成立了部落格、臉書粉絲專頁、臉書社團，社團由方子卿先生創立，提供廣大的水生昆蟲愛好者參與討論，不論是物種交流、物種鑑定、環境保育及學術討論等等，使民眾更了解台灣水生昆蟲的現況並獲得更多物種的認識。

部落格/粉絲專頁臉書/社團請搜尋 『龍蝨家-台灣水生昆蟲網』、『台灣的水生昆蟲 Aquatic insects of Taiwan』、『臺灣水生昆蟲飼育討論交流會』

關鍵字 (Keywords)：水生昆蟲 (aquatic insect)、鞘翅目 (Coleoptera)、半翅目 (Hemiptera)、濕地 (wetland)

白蟻(大水蟻)交流社團
Conversation club of termites

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本社團之創立，旨在提供對於白蟻相關領域學者、病媒防治業者、對昆蟲有興趣者，以及一般民眾提供一個交流的平台，讓白蟻的資訊能夠廣泛且便利的傳達給想嘗試了解白蟻的每一位民眾。社團中主要的貼文包括民眾拍攝並記錄白蟻、針對白蟻防治與習性的詢問以及社團管理員分享與白蟻有關的知識或趣聞。社團的主要的目標，是希望推廣近年開展的一項公民科學家計畫，希望大家幫忙紀錄周遭的白蟻樣本。這些收集的資料累積起來，可以回答許多重要的科學問題。在我們提供的網站上，每個人可以建立自己的樣本庫，網站會將採集到的樣點標記在地圖上。一旦寄送的樣本經過鑑定，會在網站上顯示結果。此外，民眾也能看到全台採集的樣本資料。公民科學家研究不單純是個研究，也是一個教學相長的活動，民眾透過協助提供樣本，可以了解遇到的白蟻物種名稱並學習到相關白蟻知識，如果有興趣，也能參與更多的白蟻研究；而研究室這邊，我們拿到了許多資訊，可以有效地分析出過去我們迫切想知道的問題。透過氣象資料，我們可能找出不同的白蟻分飛的條件；透過年度間的資料，我們可能找出特定白蟻擴散的腳步。此外，我們也把一些想法跟議題在網路上跟民眾分享，像是利用白蟻巢材進行藝術創作、文學創作，透過眾人的回饋，加以修正、優化，同時也達到以生物題材自娛娛人的樂趣。

關鍵字 (Keywords)：白蟻 (termites)、社會性昆蟲(social insects)、公民科學(citizen science)

地球上的外太空—蟻客世界
Outer space on the Earth: the world of ant and termite guests

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廣義而言，蟻客是在生活史當中，必須要有螞蟻或白蟻才能存續的生物，小的如白蟻菌圃上的蚤蠅，大的如穿山甲。這些蟻客，分屬於多樣的生物類群，過往蟻客研究以新物種發表、新寄主記錄以及蟻客的特化有關。這個臉書專頁主要有三項功能：第一項是分享有關蟻客的趣聞，包括發現歷程、特殊行為並為其撰寫科普文章。第二項是進行以蟻客為主題的擬人繪畫創作，針對蟻客的外型、行為、寄主，我們創作了約二十種蟻客的漫畫人物，衍生出了悠遊卡貼、新年賀卡、紅包、貼圖等科學創作品。此外，我們也跟台中文創園區的模型師合作，將蟻客漫畫人物製作成實體模型。第三項是公告跟科學、科普有關的活動，加強民眾對科學活動的認識跟參與熱誠。專頁經營的過程中，我們將生物學藝術化、趣味化的行動，成功吸引了許多原本對生物學較不感興趣的民眾，基於想了解漫畫人物的設計背景，進而開始想要認識昆蟲，更從中取得樂趣。未來預計持續更新內容，繼續為民眾介紹蟻客這類有趣的生物。

關鍵字 (Keywords)：喜蟻性生物 (myrmecophile) 喜白蟻性生物(termitophile)、寄居生物(inquilines)、共生生物(symbionts)、社會性昆蟲 (social insects)

螞蟻帝國
Empire of ants

王秉誠
Wang Bing Cheng
帝國螞蟻工作室 Empire of ants Studio.

無論在山上、路邊、花叢、公園還是家中，我們總會看到那些勤勞忙碌的生物不斷的出現在我們的眼前，那就是「螞蟻」，螞蟻是世界上物種含量最多也同時是生物量(biomass)最大的生物，其對於生態的重要性極高，但是大眾對於螞蟻的認知或感受普遍都是負面的刻板印象居多，再加上研究難度，使得我們對螞蟻的了解非常有限，因此我們致力於改變現況，開創螞蟻帝國並成立螞蟻帝國粉絲專頁，此專頁主要張貼： 一、螞蟻飼養相關議題，如飼養相關商品、螞蟻飼養的過程、經驗分享。 二、螞蟻知識分享，包含轉貼螞蟻相關的文章、照片、影片，及自身累積的螞蟻相關知識經驗。 三、推廣正確的生態知識及公民科學意識，讓大眾能明白任何生物都有其重要性，並且都具有被研究及認識的價值，並進一步邀請民眾參與觀察、思考甚至研究，讓更多人可以投入相關的議題發展。

我們將繼續努力，讓民眾對於螞蟻的印象改觀，放下以前的負面成見，進而更尊重螞蟻以及任何其他與我們共同居住在這個世界的所有生物。

臉書社團/粉絲專頁請搜尋『螞蟻帝國 Empire of ants』

關鍵字 (Keywords)：螞蟻(ants)、喜蟻性生物(myrmecophile)、白蟻 (termite)、社會性昆蟲 (social insects)

台灣蟬保育學會
Taiwan Cicada Society

陳振祥、薛永志
Chang-Hsiang Chen, Young-Chih Hsueh

當時在 Facebook 創台灣蟬保育學會主要是要給對蟬科(Cicadidae)有興趣的人參加，在社團發表與蟬科有關的任何資訊分享給大家，但大家似乎不僅是發表有關會叫的蟬科，連其他蟬類(Cicadomorpha)、蠟蟬類(Fulgoromorpha)的訊息也很多，於是蟬科學會變成有關任何蟬的學會。蟬科的特色是鳴聲(calling song)，也是除了形態以外的分類依據，在野外常常可以聽到聲音卻不一定找的到蟬個體，但依蟬聲我們就可以知道是哪一種蟬，蟬科目前在台灣約有 60 種，約 60%是特有種，四季皆有成蟬出現，學會也會不定期辦理野外觀察蟬活動，在野外觀察蟬聽音辨位是重要的方法，野外聲音的收錄也是學會推廣的重點之一，學習野外錄音可以讓觀察得到更多的資料。蟬學會也積極參與有關蟬保育的行動，例如台江國家公園的台灣暗蟬(*Taiwanosemia hoppoensis*)棲地保育，原本要在台江國家公園設垃圾掩埋場，因設置地點是台灣暗蟬棲地而暫緩執行，這是台江在地的保育很重要的一頁。未來我們有計畫要結合會員的力量，出版有關蟬類的鑑定圖鑑，初期會以蟬蛻的分類為目標，讓大家方便在野外使用。目前學會會員約 2200 人，希望對蟬有興趣的人可以多多參加。

臉書粉絲專頁請搜尋『台灣蟬保育學會』

關鍵字(Keywords)：蟬(cicada)、蟬科(Cicadidae)、蟬類(Cicadomorpha) 蠟蟬類(Fulgoromorpha)、鳴聲(calling song)

台灣椿象分類生態誌
True bugs of Taiwan: Taxonomy and Ecology

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椿象是不完全變態類昆蟲中，科級和物種多樣性最高的類群，有 90 個科近 40,000 種。牠們佔據各種生態環境，從陸生、水生到潮間帶都不難發現，形態多樣且食性複雜，包含植食、菌食、糞食、肉食、吸血等。台灣椿象種類豐富，文獻紀錄已有 44 科 780 種左右，但估計還不到實際物種總數的 1/2。台灣椿象的物種組成區系也相當複雜，除了本島的特有種外，有更多與鄰近區域相同的物種，使台灣椿象面貌呈現東北亞、華南、東喜馬拉雅、中南半島、與菲律賓等分佈模式，凸顯台灣在東亞地區生物地理的複雜性。而這些共有的物種過去因缺乏區域性的整體了解，因此產生了相當多的同物異名及錯誤鑑定的紀錄，並沿用至今，且廣泛地用在社群網站及圖鑑裡，即使是常見的物種也有學名錯誤的問題，或是已知的物種但實為新種等分類學上的混亂狀態，因此台灣椿象的鑑定並不簡單，且許多種類是無法僅靠照片鑑定到種的情況。台灣椿象分類生態誌草創目的是廣納生態記錄，並協助鑑定身份，至今已有 3500 多位成員。日後經營的方向會朝向：新發表物種的介紹、特定科級及常見類群的鑑定與完整的生活史(主要為若蟲期)與觀察資料累積與介紹、具有農林重要性及外來種的鑑定與監測、具有特殊行為及保育意義的類群介紹、中文俗名的命名與選用等。

臉書社團請搜尋「台灣椿象(蝽類)分類生態誌」

關鍵字(Keywords)：椿象(true bugs)、異翅亞目(Heteroptera)、分類與鑑定問題(taxonomic confusion and identification problem)、同物異名(synonymy)。

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