PNIE PROCEEDINGS OF THE NATIONAL INSTITUTE OF ECOLOGY OF THE REPUBLIC OF KOREA

Original Article

PNIE 2024;5(2):60-67
https://doi.org/10.22920/PNIE.2024.5.2.60
pISSN 2765-2203, eISSN 2765-2211

Alien Hitchhiker Insect Species Detected from International Vessels Entering Korea in 2022

Tae Hwa Kang[1,*], Sang Woong Kim[1], Deuk-Soo Choi[2]

[1]Eco-Friendly Agro-Bio Research Center, Jeonnam Bio Foundation, Gokseong-gun, Jeollanam-do, Korea
[2]Quarantine Technology Institute Inc., Gimcheon-si, Gyeongsangbul-do, Korea

ABSTRCT

Hitchhiker insect species from international vessels entering Korea in 2022 were monitored. A total of 947 samples of hitchhiker insects were collected using a simple collection method by hand. Among them, 856 individuals were classified as 374 species of 86 families in 10 orders through integrative analysis with DNA barcoding and morphological examination. The rest 91 individuals were identified only to the family level. As a result of examining the distribution of the 374 species (856 individuals), 38 species (71 individuals) were confirmed as not-distributed species in Korea, including six species (11 individuals) as 'regulated species' listed by the Korean Animal and Plant Quarantine Agency. Of 38 not-distributed species, 10 species were detected multiple times (at least twice). Accordingly, it is necessary to strengthen monitoring of the area around the port of entry along with continuous surveillance to prevent invasion of species detected multiple times. For monitoring alien hitchhiker insect species, this study provided detection information and biological data for alien species.

Keywords: Hitchhiker, Not-distributed species in Korea, International vessel, Monitoring, Quarantine inspection

Introduction

Hitchhiker refers to an organism that is temporarily associated with artificial structures or objects without any biological host relationship (Toy et Newfield 2010). In particular, invasive cases of hitchhiker organisms that temporarily attach to transportation equipment such as cars, ships, aircrafts, and so on are increasing with an increase in international trade (Armstrong & Ball, 2005; Humble, 2009; Toy & Newfield, 2010; Kang *et al*., 2019; Kang T.H., Choi D.-S. *et al*., 2023). The world-famous red fire ant, *Solenopsis invicta*, is known to form a colony in sea container and be moved into other regions by international vessels (Ascune *et al*., 2011). Gypsy moth, *Lymantria dispar*, was reported to be moved as egg-mass laid on surface of sea containers or ships (deWaard *et al*., 2010; Wu *et al*., 2015). In Korea, several alien hitchhiker insect pests such as *Metcalfa pruinosa* (Flatidae, Hemiptera), *Ricania sublimata* (Ricaniidae, Hemiptera), and *Vespa velutina nigrithorax* (Vespidae, Hymenoptera) invaded into Korea. They are occurring in large numbers, causing imbalance in the native ecosystem, economic losses in the agricultural industry, and even medical problems for people (Lee & Wilson, 2010; Choi D.-S. *et al*., 2012; Choi M.B. *et al*., 2012). Recently, it has been discovered that the differential grasshopper (*Melanoplus differentialis*, Acrididae, Orthoptera) distri-buted in North America has settled around Onsan Port, Ulsan, Korea. Monitoring for the occurrence of this grasshopper is in progress (Kang *et al*., 2022). Because such hitchhiking invasions not only occur in neighbor regions,

Received March 7, 2024; Revised March 30, 2024; Accepted April 1, 2024

*Corresponding author: Tae Hwa Kang
e-mail colkth@daum.net
https://orcid.org/0000-0001-7834-4143

but also worldwide, it is difficult to clearly define the direction or tendency. However, it is possible to monitor the hitchhiking pathway based on surveys of previous hitchhiker insect pests.

As invasion of alien organisms increases in the world, monitoring of invasive organisms is being strengthened through international conventions or regulations. Convention on Biological Diversity (CBD) provides risk assessment method on alien organism by establishing COP decision VI/23. International Plant Protection Convention (IPPC) has established monitoring and risk assessment methods for hitchhiker organisms by sea container operating. The sea Container Task Force (SCTF) from 2017 (SCBD 2006, IPPC 2010). In Korea, for analyzing hitchhiking pathway, research studies on hitchhiker insect pests through international vessels have been carried out since 2018. Through these studies, biological information and hitchhiking data on the not-distributed species in Korea were provided (Kang *et al*., 2020; 2021; Kang T.H., Kim N.H., *et al*. 2023; Kang T.H., Choi D.-S. *et al*., 2023).

This study aimed to provide biological information and hitchhiking data of not-distributed species in Korea detected from international vessels in 2022. Therefore, goals of this study were to report not-distributed species in Korea detected and identified in 2022 and provide their biological information including taxonomic information, distribution, and inanimate pathway information.

Materials and Methods

Samples were collected through monitoring by naked eye along corridors from bows to sterns of international vessels entering Korean ports. A total of 947 samples were collected. They were divided into living and dead individuals. For DNA barcoding, genomic DNAs of collected samples were extracted with DNeasy® Blood & Tissue Kit (Qiagen, Leipzig, Germany). Mixtures for polymerase chain reaction (PCR) of target region were then prepared with AccuPower® PCR Premix (Bioneer, Daejeon, Korea), Genonic DNA template 1 μl, LCO1490-HCO2198 primer set each 1 μl, and distilled water 171 μl (Folmer *et al*. 1994). PCR was conducted with PCR Thermal Cycler Dice™ *Touch* (TaKaRa, Shiga, Japan). PCR products were sequenced with a 3730XL DNA Analyzer (Thermo Fisher Scientific, Waltham, MA, USA) by GenCube Plus Co. (Seoul, Korea) a DNA sequencing institute. Obtained DNA barcodes were compared with BLAST in NCBI and Identification Engine using BOLD system version 4. Species identification for each sample was carried out with 2% cutoff rule (Altschul *et al*. 1990; Hebert *et al*. 2003; 2004; Ratnasingham & Hebert 2007). Molecular results of samples were re-examined based on morphological characters at para-taxonomic level. Identification results were compared with National Species List of Korea and Biodiversity of Korean Peninsula (National Institute of Biological Resources, Ministry of Environment, Korea) for analyzing whether the species was distributed in Korea or not (NIBR, 2011; 2019; 2023). For species detected as not-distributed species in Korea, we listed its biological information such as taxonomic position, distribution, collecting data, and so on (Table 1).

Results

Among 947 samples from 308 vessels entering Korea from 27 nations, 856 individuals were classified as 374 species of 86 families in 10 orders. The remaining 91 individuals were identified at the family level. Among those 374 species, 38 species (71 individuals) were discovered as not-distributed species in Korea (Table 1). Species compositions of these not-distributed species in Korea included three species (seven individuals) of three families in Orthoptera, four species (eight individuals) of four families in Hemiptera, three species (four individuals) of two families in Coleoptera, seven species (11 individuals) of three families in Hymenoptera, one species (one individual) of one family in Diptera, and 20 species (40 individuals) of nine families in Lepidoptera. Among them, six species (11 individuals) were confirmed as 'regulated species' listed by Animal and Plant Quarantine Agency in Korea: *Mictis profana* (Coeridae, Hemiptera, one individ.), *Tessaratoma papillosa* (Tessaratomidae, ditto, five individs.), *Sagra femorata* (Chrysomelidae, Coleoptera, one individ.), *Oryctes rhinoceros* (Scarabaeidae, ditto, one individ.), *Oecophylla smaragdina* (Formicidae, Hymenoptera, two individs.), and *Dendrolimus punctatus* (Lasiocampidae, Lepidoptera, one individ.) (Fig. 1, Table 1) (QIA 2013).

Among 71 individuals of 38 not-distributed species in Korea, 54 individuals of 32 species (about 70%) were collected in living condition. Also, 10 species were detected multiple times in living condition: *Tessaratoma papillosa* (Tessaratomidae, Hemiptera, live 2/dead 3), *Dicronocephalus wallichi* (Scarabaeidae, Coleoptera, live 2), *Formica cunicularia* (Formicidae, Hymenoptera, live 2/dead 2), *Oecophylla smaragdina* (Formicidae, Hymenoptera, live 2), *Eumorphobotys eumophalis* (Crambidae, Lepidoptera, live 12/dead 1), *Asota heliconia* (Erebidae, Lepidoptera, live 2), *Lemyra flavalis* (Erebidae, Lepidoptera, live 2), *Lemyra rhodophilodes* (Erebidae, Lepidoptera, live 2/dead 1), *Camptoloma carum* (Nolidae, Lepidoptera, live 3), and *Euhampsonia serratifera* (Notodontidae, Lepidoptera, live 3) (Table 1). These 10 species detected multiple times in a living condition might have a high possibility to colonize in the new environment and cause serious problems in native ecosystem.

Compared with previous surveys (Kang *et al*., 2020; 2021; Kang T.H., Kim N.H. *et al*. 2023), three species (*Lemyra*

rhodophilodes, *Mythimna pallidicosta*, and *Euhampsonia serratifera*) had been detected in 2018, seven species (*Tessaratoma papillosa*, *Dicronocephalus wallichi*, *Formica cunicularia*, *Asota heliconia*, *Comibaena quadricnotata*, *Mythimna pallidicosta*, *Euhampsonia serratifera*) had been detected in 2019, and three species (*Sagra femorata*, *Dendrolimus punctatus*, *Euhampsonia serratifera*) had been detected in 2021. In addition, two species (*Mythimna pallidicosta* and *Euhampsonia serratifera*) were continuously detected over several years. These species might have higher invasive rates than single-detected species. Therefore, it might be necessary to perform occurrence monitoring for species detected multiple times, focusing on port areas.

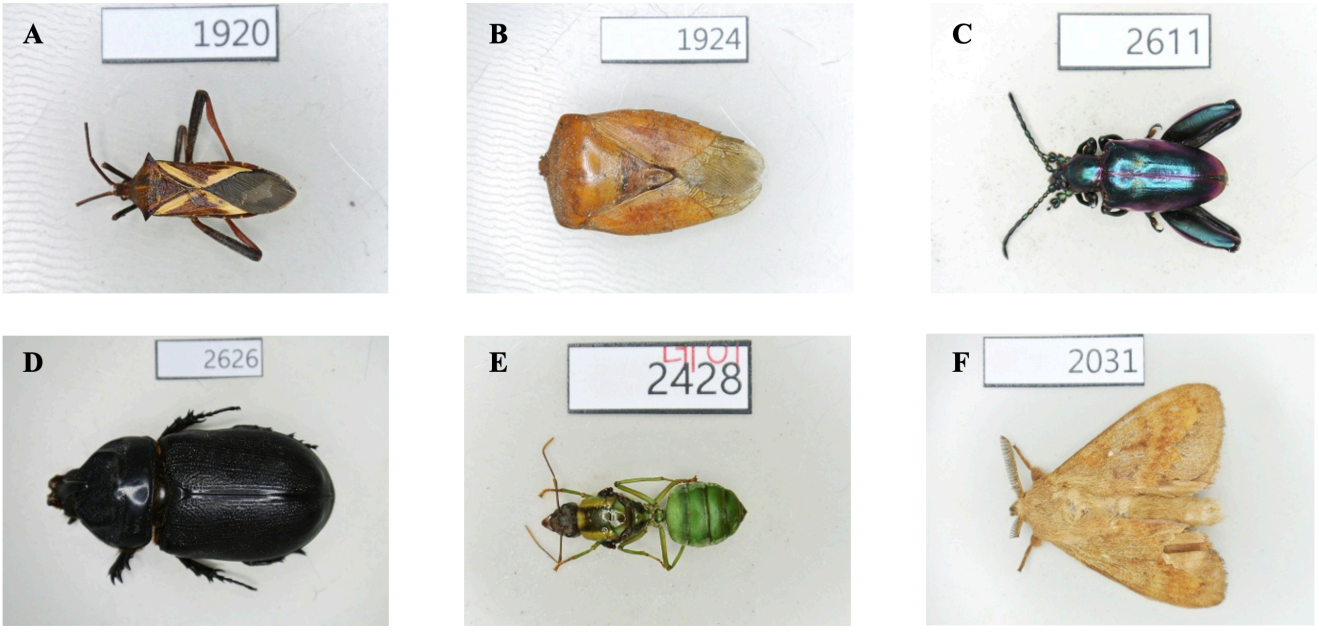

Fig. 1. Body photos of regulated species listed by Animal and Plant Quarantine Agency detected from international vessels entering Korea. A, *Mictis profana* (Coeridae, Hemiptera); B, *Tessaratoma papillosa* (Tessaratomidae, ditto); C, *Sagra femorata* (Chrysomelidae, Coleoptera); D, *Oryctes rhinoceros* (Scarabaeidae, ditto); E, *Oecophylla smaragdina* (Formicidae, Hymenoptera); F, *Dendrolimus punctatus* (Lasiocamidae, Lepidoptera).

Table 1. Summary of data sheet of alien hitchhiker insect species detected from international vessels entering Korea in 2022

No.	Scientific Name	No. of Detected Individuals (Live/Dead)	Distribution	Navigation route and Collecting date (Sample no.; Outport>Transit>Destination; Collecting date)	Remarks
	Order Orthoptera				
	Family Acrididae				
1	*Patanga succincta*	2(1/1)	India, Pakistan, Thailand, Malaysia, Vietnam, Japan, Philippines, Indoneia (Cigliano *et al*. 2024)	1910; Australia (Unknown)>Korea (Daesan)>Korea (Yeosu); 8. v. 2321; China (Unknown)>nonstop>Korea (Ulsan); 5. vi.	
	Family Gryllidae				
2	*Teleogryllus marini*	1(0/1)	Austrailia (native), China, Japan (invasive) (Lu *et al*. 2018, Kim *et al*. 2022)	2082; China (Ningbo)>nonstop>Korea (Yeosu); 25. v.	
	Family Gryllotalpidae				
3	*Gryllotalpa unispina*	4(1/3)	Eastern Europe through to Manchuria (Cigliano *et al*. 2024)	1987; China (Unknown)>nonstop>Korea (Yeosu); 21. v. 2013; Indonesia (Taboneo)>nonstop>Korea (Samcheonpo); 18. v. 2400; China (Tai Cang)>nonstop>Korea (Busan); 24. vi. 2507; China (Shanghai)>Korea (Ulsan)>Korea (Gwangyang); 21. vi.	
	Order Hemiptera Family Cicadidae				
4	*Taiwanosemia hoppoensis* Family Coeridae	1(0/1)	Taiwan (Lee & Hayashi 2003)	2558; Taiwan (Mailia U)>nonstop>Korea (Yeosu); 16. vi.	

5	*Mictis profana*	1(0/1)	Indonesia, Australia, East Timor, Fiji, New Caledonia, PNG (Malipatil 2021)	1920; Australia (Unknown)>Korea (Daesan)>Korea (Yeosu); 8. v.	Regulated species
	Family Dinidoridae				
6	*Cyclopelta parva*	1(1/0)	India, China, Taiwan, Japan (Miyamoto 1965)	2560; China (Xiamen)>Korea (Ulsan)>Korea (Yeosu); 16. vi.	
	Family Tessaratomidae				
7	*Tessaratoma papillosa*	5(2/3)	India, Thailand, Vietnam, China, Taiwan (Wu *et al*. 2022)	1924; Australia (Unknown)>nonstop>Korea (Gwangyang); 10. v. 1952, 1953; China (Unknown)>nonstop>Korea (Yeosu); 15. v. 1963; Vietnam (Vung Tau)>China (Shekou)>Korea (Busan); 12. v. 2029; Taiwan (Keelung)>China (Yangshan)>Korea (Busan); 2. vi.	Regulated species
	Order Coleoptera Family Chrysomelidae				
8	*Sagra femorata*	1(1/0)	Cambodia, India, Laos, Sri Lanka, Myanmar, Thailand, Vietnam, China, Java (Kimoto & Gressitt 1979)	2611; China (Lianyungang)>nonstop>Korea (Yeosu); 6. vii.	Regulated species
	Family Scarabaeidae				
9	*Dicronocephalus wallichi*	2(2/0)	Myanmar, Malaysia, Vietnam, Thailand, China, Taiwan (Šípek *et al*. 2008)	1969; China (Ningbo)>China (Shanghai)>Korea (Busan); 13. v. 2028; Taiwan (Keelung)>China (Yangshan)>Korea (Busan); 2. vi.	
10	*Oryctes rhinoceros*	1(0/1)	Southeastern Asia (Hao *et al*. 2022)	2626; Indonesia (Surabaya)>Philippines (Roxas)>Korea (Busan); 20. vii.	Regulated species
	Order Hymenoptera Family Apidae				
11	*Bombus bicoloratus*	1(1/0)	China, Taiwan (Starr 1992, Ding *et al*. 2019)	2476; Japan (Higashiharima)>Korea (Masan)>Korea (Pyeongtaek); 25. vi.	
	Family Formicidae				
12	*Camponotus variegatus*	1(1/0)	India, Pakistan, China (Khan *et al*. 2019)	2262; Philippines (Batangas)>nonstop>Korea (Yeosu); 2. vi.	
13	*Formica cunicularia*	4(2/2)	Western Europe, southern England, southern Scandinavia to northern Africa, Portugal to the Urals (Seifert & Schultz 2009)	2089; Korea (Ulsan)>nonstop>Korea (Gwangyang); 26. v. 2175; Sri Lanka (Unknown)>nonstop>Korea (Yeosu); 12. vi. 2202; UAE (Fujairah)>nonstop>Korea (Yeosu); 8. vi. 2491; China (Tianjin)>nonstop>Korea (Yeosu); 21. vi.	
14	*Oecophylla smaragdina*	2(2/0)	India, Taiwan, southeast Asia, Australia (Langthasa *et al*. 2017)	2428, 2429; Singapore (Unknown)>China (Lanshan)>Korea (Incheon); 16. vi.	Regulated species
	Family Ichneumonidae				
15	*Alexeter albilabris*	1(1/0)	Sweden, Germany, European Russia, Romania (Constantineanu *et al*. 2009)	1905; Australia (Unknown)>Korea (Daesan)>Korea (Yeosu); 8. v.	
16	*Campoplex difformis*	1(0/1)	Europe up to Caucasus and Uzbekistan, Canary Islands and Madeira, Tunisia and Greenland , Iran (Allahvaisi *et al*. 2021)	1842; USA (Unknown)>Korea (Mokpo)>Korea (Gwangyang); 17. iv.	
17	*Enicospilus formosensis*	1(1/0)	India, Brunei, Vietnam, China, Taiwan, Japan (Pham *et al*. 2023)	2628; China (Jiangyin)> Taiwan (Mailiao)> Korea (Busan); 16. vii.	
	Order Diptera Family Tachinidae				
18	*Phorinia aurifrons*	1(0/1)	Ukraine, Austria, Switzerland, Croatia, Hungry, Romania, Bulgaria, Italy, Greece, France, Belgium, Germany, Russia, Transcaucasia, Iran (Seyyedi-Sahebari *et al*. 2023)	1843; USA (Unknown)>Korea (Mokpo)>Korea (Gwangyang); 17. iv.	
	Order Lepidoptera Family Cossidae				
19	*Polyphagozerra coffeae*	1(1/0)	Moluccas, New Guinea (Holloway 1999)	2364; China (CNYTN)>China (CNTAO)>Korea (Busan); 17. vi.	
	Family Crambidae				
20	*Eumorphobotys eumorphalis*	13(12/1)	China, Taiwan, Japan (Yoshiyasu *et al*. 2022)	2169; Sri Lanka (Unknown)>nonstop>Korea (Yeosu); 12. vi. 2180, 2181, 2183; Taiwan (Taichung)>Korea (Pohang)>Korea (Gwangyang); 10. vi. 2357; Singapore (Unknown)>China (Shekou)>Korea (Busan); 23. vi. 2371; China (Shanghai)>China (Ningbo)>Korea (Busan); 16. vi. 2388; China (Dalian)>nonstop>Korea (Busan); 18. vi. 2502; China (Shanghai)>Korea (Ulsan)>Korea (Gwangyang); 21. vi. 2512; Chian (Gulei)>nonstop>Korea (Yeosu); 15. vi. 2708; China (Ningbo)>China (Shanghai)>Korea (Busan); 9. vii. 2723; China (Yantian)>China (Shanghai)>Korea (Busan); 21. viii.	

				2724; Singapore (Unknown)>Qatar (Ras Laffan)>Korea (Tongyeong); 26. viii. 2734; USA (Long Beach)>China (Yangshan)>Korea (Busan); 22. viii.	
21	*Haritalodes basipunctalis*	1(1/0)	Russia (Ussuri) (Savela 2014)	2102; China (Zhoushan)>nonstop>Korea (Yeosu); 27. v.	
22	*Pediasia aridella*	1(1/0)	Fennoscandia, Lithuania, British Isles, Germany, Holland, Denmark, France (Savela 2014)	2245; China (Rizhao)>nonstop>Korea (Gwangyang); 3. vi.	
	Family Erebidae				
23	*Asota heliconia*	2(2/0)	Indo-Australian tropics east to Queensland and Solomons (Holloway 1999)	2455, 2456; China (Xiamen)>China (Yantian)> Korea (Busan); 5. vii.	
24	*Ericeia subcinerea*	1(1/0)	Celebes, Java (Savela 2014)	2562; China (Xiamen)>Korea (Ulsan)>Korea (Yeosu); 16. vi.	
25	*Euproctis seitzi*	1(1/0)	China (Hongkong) (Savela 2014)	1966; Vietnam (Vung Tau)>China (Shekou)>Korea (Busan); 12. v.	
26	*Hamodes pendleburyi*	1(1/0)	China (Hainan), N.E. Himalaya, Thailand, Malaysia, Sumatra, Borneo (Holloway 1999, Savela 2014)	2059; China (Yantian)>China (Yangshan)>Korea (Busan); 30. v.	
27	*Lemyra flavalis*	2(2/0)	China (Tibet, Yunnan, Sichuan), Nepal, India (Sikkim, Assam), Bhutan, Myanmar (Dubatolov 2005, Savela 2014)	2343; Korea (Yeongheung)>Canada (Roberts Bank)>Korea (Anin); 22. vi. 2350; China (Yantai)>China (Nanjing)>Korea (Okgye); 24. vi.	
28	*Lemyra rhodophilodes*	3(2/1)	Taiwan (Savela 2014)	1998; China (Unknown)>nonstop>Korea (Gwangyang); 19. v. 2065; Thailand (Map Ta Phut)>Japan (Saganoseki)>Korea (Busan); 24. v. 2238; Panamas (Unknown)>Korea (Ulsan)>Korea (Yeosu); 4. vi.	
	Family Geometridae				
29	*Comibaena quadrinotata*	1(1/0)	N.India (Savela 2014)	2249; Japan (Unknown)>nonstop>Korea (Yeosu); 3. vi.	
30	*Heterostegane subtessellata*	1(1/0)	India, Nepal, Myanmar, Sundaland (Holloway 1999, Savela 2014)	1993; China (Unknown)>nonstop>Korea (Yeosu); 20. v.	
31	*Problepsis phoebearia*	1(1/0)	Russia (Amur, Primorye), N.E. China (Savela 2014)	2107; Japan (Chiba)>nonstop>Korea (Yeosu); 29. v.	
	Family Lasiocampidae				
32	*Dendrolimus punctatus*	1(1/0)	Eartern China to Vietnam (CABI 2021)	2031; China (Ningbo)>China (Shanghai)>Korea (Busan); 7. vi.	Regulated species
	Family Noctuidae				
33	*Mythimna pallidicosta*	1(1/0)	N.E. India to W. China, Sundaland, Flores, Philippines (Savela 2014)	2271; China (Yangzhou)>nonstop>Korea (Yeosu); 2. vi.	
34	*Plusia nichollae*	1(1/0)	USA (Alaska to California) (Savela 2014, Lafontaine et Schmidt 2010)	2759; New Zeeland (Marsden Point)>Korea (Yeosu)>Korea (Daesan); 10. viii.	
	Family Nolidae				
35	*Camptoloma carum*	3(3/0)	Taiwan (Savela 2014, Wang et Huang 2005)	2482; Qatar (Ras Laffan)>Saudi Arabia (Ras Tanura)>Korea (Daesan); 5. vii. 2488, 2489; Korea (Yeosu)>Korea (Ulsan)>Korea (Daesan); 4. vii.	
	Family Notodontidae				
36	*Euhampsonia serratifera*	3(3/0)	Thailand, Myanmar, Vietnam, China (Savela 2014)	2414; China (Yingkou)>China (Shidao)>Korea (Incheon); 3. vii. 2654; China (Dalian)>nonstop>Korea (Incheon); 28. vii. 2669; Taiwan (Kaohsiung)>Philippines (Semirara)>Korea (Dangjin); 17. vii.	
37	*Gangarides rufinus*	1(1/0)	Thailand, Myanmar, China (Yunnan) (Schintlmeister 1997, Savela 2014)	2459; Australia (Port Hedland)>Japan (Tonda)>Korea (Geoje); 3. vii.	
	Family Pieridae				
38	*Colias crocea*	1(1/0)	North Africa, Fezzan, Cyrenaica, S. Europe, C. Europe, Asia Minor, Iran, W. Siberia (Savela 2014)	2282; China (Xingang)>nonstop>Korea (Gunsan); 7. vi.	
Total	38 species, 22 families, 6 orders	71 individs.	-	-	6 Regulated species

Discussion

Cases of hitchhiker organisms are increasing with an increase in international trade by transportation equipment such as cars, ships, and airplanes (Armstrong & Ball, 2005; Humble, 2009; Toy & Newfield, 2010; Kang *et al*., 2019; Kang, T.H., Choi, D.-S. *et al*., 2023). In Korea, several cases such as *Melanoplus differentialis* (Acrididae, Ortho-ptera), *Ricania sublimata* (Ricaniidae, Hemiptera), *Brachymna tenuis* (Pentatomidae, Hemiptera), *Ophraella communa* (Chrysomelidae, Coleoptera), *Vespa velutina nigrothorax* (Vespidae, Hymenoptera), *Solenopsis invicta* (Formicidae, Hymenoptera) were discovered or inferred as hitchhiker insect species. Among them, *Melanoplus differentialis* and *Solenopsis invicta* were confirmed as hitchhiker species with their routes being directly detected. The remaining species were inferred as hitchhiker species (Kang *et al*., 2022; Kang,

T.H., Choi, D.-S. *et al*., 2023). Looking at the case of *Melanoplus differentialis*, the species was detected multiple times from international vessels entering Onsan Port, Ulsan, Korea during 2018 and 2019. In August 2019, this species occurred in artificial wetland such as environmentally friendly small waterway around Onsan Port. As a result of analyzing haplotypes of cytochrome c oxidase I (COI) sequences from occurring 82 individuals, a total of 45 haplotypes were detected. Therefore, it was inferred that *Melanoplus differentialis* might have settled in artificial wetland around Onsan Port (Kang *et al*., 2022).

In the result of this study, of 38 species, 10 were detected multiple times in a living condition (Table 1). Among them, 13 individuals of *Eumorphobotys eumorphalis* (Crambidae, Lepidoptera) were detected found, with 12 individuals detected in a living condition (Table 1) and over three individuals of *Camptoloma carum* (Nolidae, Lepidoptera) and *Euhampsonia serratifera* (Notodontidae, Lepidoptera) were detected in a living condition. Compared with previous studies, *Mythimna pallidicosta* (Noctuidae, Lepidoptera) had been detected multiple times in 2018 and 2019 and *Euhampsonia serratifera* was detected in 2018, 2019, and 2021 (Kang *et al*., 2020; 2021; Kang, T.H., Kim, N.H. *et al*., 2023). The increase of multiple hitchhiking frequency might increase the settlement probability as the case of *Melanoplus differentialis* (Lockwood *et al*., 2005; Johnston *et al*., 2009; Kang *et al*., 2022). After examining former invading cases, for three species (*Eumorphobotys eumorphalis*, *Mythimna pallidicosta*, and *Euhampsonia serratifera*) of 38 not-distributed species in Korea detected in 2022, monitoring might be urgent.

For most hitchhiking cases, biological management methods of the species were provided by national agency after settlement of alien species was reported in several areas by academic studies (Ahn *et al*., 2020; Lee & Wilson, 2010; Choi, D.-S. *et al*., 2012; Choi, M.B. *et al*., 2012). These might be caused by the lack of biological information and hitchhiking routes on the target alien species (Toy & Newfield, 2010; Kang *et al*., 2023). Therefore, long term monitoring is needed for hitchhiking insect species by international vessels. For long-term monitoring of hitchhiker insect pests, we provided hitchhiking information of 38 not-distributed species detected in Korea in 2022.

Author Contributions

Tae Hwa Kang: Project manager, project design and conduct, data analysis (DNA barcoding and morphological examination), manuscript draft and editing; Sang Woong Kim: Assistant for project, sample management, morphological examination; Deuk-Soo Choi: Project design, data analysis (morphological examination), manuscript editing.

Conflict of Interest

The author declares that they have no competing interests.

Acknowledgements

This work was supported by the Research of Animal and Plant Quarantine Agency, South Korea (Project Code No. Z-1543086-2021-23-07).

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