Detection of the Large White butterfly *Pieris brassicae* (Linnaeus, 1758) (Lepidoptera, Pieridae) in Rapa Nui (Easter Island)

Darko D. Cotoras[1,2], Sebastián Yancovic Pakarati[3]

1 *Department of Terrestrial Zoology, Senckenberg Research Institute and Natural History Museum. Senckenberganlage 25, 60325 Frankfurt am Main, Germany; darkocotoras@gmail.com*

2 *Department of Entomology, California Academy of Sciences. 55 Music Concourse Dr. Golden Gate Park, San Francisco, CA 94118, USA*

3 *Manu Project, Hanga Roa, Rapa Nui/Isla de Pascua, Chile; sebastian.yancovic@gmail.com*

https://zoobank.org/07E07B1A-0524-4EB0-A850-A34E9E7F8280

Received 6 December 2022; accepted 13 February 2023; published: 23 February 2023
Subject Editor: Martin Wiemers.

Abstract. The Large White butterfly (*Pieris brassicae* (Linnaeus, 1758)) originally from the Palaearctic and previously introduced to South Africa and Chile is detected on Rapa Nui (Easter Island). The records correspond to all stages of the life cycle: eggs, caterpillars, pupa and adults. Caterpillars were found feeding on *Tropaeolum majus*. The introduction is likely to have occurred from mainland Chile, as the species has not been reported in French Polynesia. A dark green coloration present on the underside of the wings is congruent with the one reported from the Chilean population. The origin of colonisation still remains to be tested using molecular tools.

Introduction

The Large White butterfly (*Pieris brassicae* (Linnaeus, 1758)) is a Palaearctic species also introduced to South Africa, Chile and with scattered records elsewhere (https://www.gbif.org/species/1920506). As its name suggests, this butterfly feeds on plants from the family Brassicaceae (Cruciferae nom. cons.). Among those is *Brassica oleracea* L. from which different vegetables are derived (cabbage, cauliflower, broccoli, Brussels sprouts, etc.) (CABI 2022). The newly hatched caterpillars can completely defoliate a cabbage leaf leaving the veins intact. In its native range, the population is controlled by the parasitic Hymenoptera *Cotesia glomerata* (Linnaeus, 1758) (Braconidae) and *Pteromalus puparum* (Linnaeus, 1758) (Pteromalidae) (Herreros 1971).

This species was first recorded in Chile in the city of Viña del Mar in November, 1970; a few months after that record, other occurrences were found near Valparaíso (Herreros 1971). In 1972, the butterfly was detected in Santiago, which is about 100 kilometers inland from the original record (Gardiner 1974). Chilean entomologist Luis Peña suggested that the species came from Eastern Europe (Gardiner 1974). Since that initial introduction the species has expanded to the north into the Antofagasta region and to the south into the Los Lagos region (Benyamini et al. 2014; Zúñiga-Reinoso and Mardones 2014; Contreras 2020). The species has not been previously recorded on Rapa Nui (Holloway 1990; Tennent 2006).

Several natural enemies have been reported in Chile (Neira et al. 1989; Prado 1991). The caterpillar is parasitized by *C. glomerata* and *Apanteles* sp. (Braconidae) (Neira et al. 1989; Araya et al. 2005) and by *Incamyia chilensis* Aldrich, 1928 and *Incamyia spinicosta* Aldrich, 1928 (Tachinidae) (Prado 1991). The pupal stage is subject to various degrees of parasitism including from *P. puparum* (Pteromalidae), *Coccygomimus fuscipes* (Brullé, 1846) (Ichneumonidae) and infection by the fungus *Beauveria brongniartii* (Sacc.) Petch, 1926 (Cordycipitaceae) (Neira et al. 1989). Overall, in Chile it is considered only as a secondary pest (Araya et al. 2005).

Methods

Specimens were found and photographed in the field. Two additional records were retrieved from the platform iNaturalist. Taxonomic identification followed Gardiner (1974) and Zúñiga-Reinoso and Mardones (2014).

Results

We report the first detections of the species on Rapa Nui (Isla de Pascua/Easter Island; 27°07'S, 109°22'W). The records correspond to all stages of the life cycle: eggs (on cabbage (Brassicaceae) on 19.viii.2021. Fig. 1a), caterpillars (on *Tropaeolum majus* L. (Brassicales: Tropaeolaceae) on 15.vii.2021. Fig. 1b), a pupa (20.vii. 2021. Fig. 1c) and adults (on cabbage on 19.viii.2021. Fig. 1d; nectaring on *Lantana camara* L. on 15.vii.2021. Fig. 1e; 10.viii.2021). In addition, at the platform iNaturalist, there are two independent records of adults of the species present on the island on 21.v.2021 (Ramírez 2021) and on 01.x.2022 (Barnard 2022).

Due to the extent of dark pigmentation on the forewings, and the very different morphology and gregarious behavior of the caterpillars it can be distinguished from *Pieris rapae* (Linnaeus, 1758). *P. rapae* is originally from Europe and has been introduced to every continent except for South America and Antarctica (Ryan et al. 2019).

Discussion

The introduction of *P. brassicae* to Rapa Nui (butterflies are locally referred to as “Pepeka”) is likely to have occurred from mainland Chile due to the constant movement of goods and produce via air and sea transportation. The frequency of the flights to the island vary depending on the season. Normally, it is one or two per day, but it can go up to three during exceptionally high travel season. Between 2020 and 2021, the commercial flights almost completely stopped due to the COVID pandemic. However, some chartered flights with goods from the continent continued. The island is also supplied by ships, with three regular arrivals every month and a half, and a forth one sporadically. These two routes represent the most likely entry mechanism for the species, but it is difficult to ascertain which one. Tahiti in the Society Islands is the other regular air connection to the island, but the species has not been reported in French Polynesia (Tennent 2006; GBIF 2022). A similar introduction mechanism could explain the record of the species in a patch of native forest on Robinson Crusoe island (specimen 571_UCCC_MZUC_LEP_2015; Museo de Zoología de la Universidad de Concepción) on 20.i.1996. This is another volcanic island belonging to the Juan Fernández archipelago off the coast of central Chile.

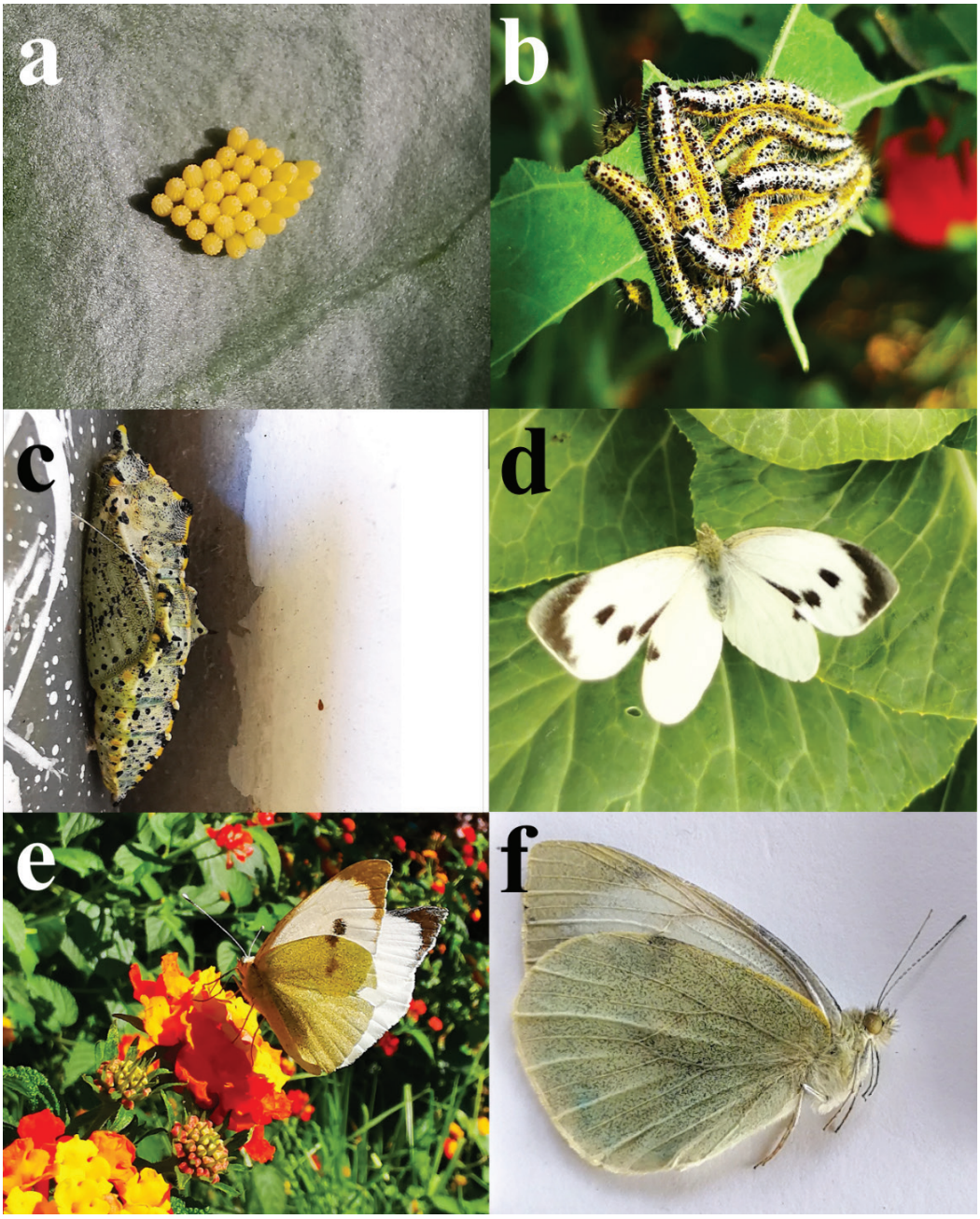

Figure 1. Different life stages of *P. brassicae* documented in Rapa Nui. **a.** Eggs; **b.** Aggregation of caterpillars; **c.** Pupa; **d.** An adult female on a cabbage plant; **e.** An adult male on a *L. camara* flower and **f.** The underside of the wings of an adult showing dark greenish coloration.

Gardiner (1974) described a dark green coloration on the underside of the wings of the individuals from the Large White population present in continental Chile. That trait was also found in the butterflies recorded from Rapa Nui (Fig. 1f). The colouration of the eggs, caterpillar and pupa, as

well as the gregarious behaviour of the caterpillar (Fig. 1b) are also congruent with what has been previously reported from mainland Chile (Gardiner 1974). However, a hypothesis of an origin from continental Chile remains to be tested using molecular tools.

A summer diapause was described in populations of the southwest distribution of the native range of *P. brassicae* in the Iberian Peninsula (Spieth et al. 2011) and for the introduced population in Chile (Benyamini 1995). In Chile, this local adaptation has been associated with a physiological strategy to avoid the dry summers of the Mediterranean climate where there is a lack of food sources (Benyamini 1995). This summer diapause is followed by an increase in abundance of the adults which peaks in May before the winter time. Indeed, in the first record of the species in Chile there is a reference to an increase in population density towards May and an abrupt collapse in June as the southern winter starts (Herreros 1971). In Rapa Nui, by contrast, *P. brassicae* appears to have retained the summer diapause, but has a continuous activity throughout the winter months (Yancovic Pakarati pers. obs.).

Regarding the previously reported enemies of the species, in Rapa Nui a potential braconid parasitoid from the genus *Apanteles* has been recorded (Rojas 1981; Ripa et al. 1995). Therefore, its populations might be controlled by a parasitoid species already present on the island. However, there is no evidence of the existence of that interaction.

Conclusion

This record is relevant as a baseline for monitoring the species, assessing its impact on the local biodiversity of Rapa Nui and evaluating its management strategy. *P. brassicae* was successfully eradicated from New Zealand 6.5 years after its original detection and following four years of an active integrated pest eradication strategy (Phillips et al. 2020). An early detection of introduced arthropod species into oceanic islands is key (Cotoras et al. 2017; González et al. 2020; Pérez-González et al. 2020) to preventing larger ecological and economic damage, as well as in minimizing management costs.

Acknowledgements

We are grateful to the comments and encouragement provided on early stages of the manuscript preparation by Jut Wynne and Francis Howarth, as well as an anonymous reviewer. We are grateful for the support of Societas Europaea Lepidopterologica, and Tahira Edmunds through the project Estudio bio-socioambiental de los húmedales de Rapa Nui (CONADI-CONAF). DDC was supported by a postdoctoral fellowship from the Alexander von Humboldt foundation.

References

Araya MA, Guerrero A, Sanhueza E, Viñuela E (2005) *Apanteles glomeratus*, parasitoide de larvas de la mariposa blanca de la col, *Pieris brassicae*. Phytohemeroteca 169: 58–64.

Barnard A (2022) iNaturalist observation. https://www.inaturalist.org/observations/137414823 [Accessed on 13.xii.2022]

Benyamini D (1995) Pupal summer diapause in Chilean *Pieris brassicae* (Linnaeus, 1758) (Lepidoptera, Pieridae). Nota Lepidopterologica 18: 184–192.

Benyamini D, Ugarte A, Shapiro AM, Hendrik Mielke OH, Pyrcz T, Bálint Z (2014) An updated list of the butterflies of Chile (Lepidoptera, Papilionoidea and Hesperioidea) including distribution, flight period and conservation status Part I, comprising the families: Papilionidae, Pieridae, Nymphalidae (in part) and Hesperiidae describing a new species of *Hypsochila* (Pieridae) and a new subspecies of *Yramea modesta*

(Nymphalidae). Boletín del Museo Nacional de Historia Natural, Chile 63: 9–31. https://doi.org/10.54830/bmnhn.v63.2014.122

CABI (2022) *Pieris brassicae*. In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc

Contreras JM (2020) iNaturalist observation. https://www.inaturalist.org/observations/56432314 [Accessed on 13.xii.2022]

Cotoras DD, Murray GGR, Kapp J, Gillespie RG, Griswold C, Simison WB, Green RE, Shapiro B (2017) Ancient DNA resolves the history of *Tetragnatha* (Araneae, Tetragnathidae) spiders on Rapa Nui. Genes 8: 403. https://doi.org/10.3390/genes8120403

Gardiner B (1974) *Pieris brassicae* (L.) established in Chile: another palearctic pest crosses the Atlantic (Pieridae). Journal of the Lepidopterists' Society 28: 269–277.

GBIF [GBIF.org] (2022) GBIF Occurrence Download: "*Pieris brassicae* (Linnaeus, 1758)". [Accessed on 13.xii.2022]

González G, Cotoras DD, Grez A (2020) Annotated list of island lady beetles from Chile (Coleoptera: Coccinellidae). Zootaxa 4852: 501–526. https://doi.org/10.11646/zootaxa.4852.5.1

Herreros A (1971) Presencia de *Pieris brassicae* (Lep.: Pieridae) en Chile. Anales del Museo de Historia Natural 4: 349–350.

Holloway JD (1990) The Lepidoptera of Easter, Pitcairn and Henderson Islands. Journal of Natural History 24: 719–729. https://doi.org/10.1080/00222939000770501

Neira CM, Ruff FJ, Mundaca BN (1989) Natural enemies of *Pieris brassicae* L. (Lepidoptera: Pieridae) from cultivated crucifers in Valdivia. (Enemigos naturales de *Pieris brassicae* L. (Lepidoptera: Pieridae) en cultivos de cruciferas en Valdivia.). Agro–Ciencia 5: 5–10.

Pérez-González A, Cotoras DD, Acosta LE (2020) Early detection of an invasive harvestman in an oceanic island? Remarkable findings of *Parabalta reedii* (Opiliones, Gonyleptidae) in the Juan Fernández archipelago, Chile. Studies on Neotropical Fauna and Environment 57: 43–50. https://doi.org/10.1080/01650521.2020.1809611

Phillips CB, Brown K, Green C, Toft R, Walker G, Broome K (2020) Eradicating the large white butterfly from New Zealand eliminates a threat to endemic Brassicaceae. PLoS ONE 15: e0236791. https://doi.org/10.1371/journal.pone.0236791

Prado E (1991) Artrópodos y sus enemigos naturales asociados a plantas cultivadas en Chile, Santiago. INIA, Boletín Técnico 169: 1–207.

Ramírez M (2021) iNaturalist observation. https://www.inaturalist.org/observations/79701385 [Accessed on 13.xii.2022]

Ripa SR, Rojas PS, Velasco G (1995) Releases of biological control agents of insect pests on Easter Island (Pacific Ocean). Biocontrol 40: 427–440. https://doi.org/10.1007/BF02373730

Rojas SR (1981) Agricultura de Isla de Pascua: Plagas y Proyecciones. Informe Instituto de investigaciones Agropecuarias.

Ryan SF, Lombaert E, Espeset A, Vila R, Talavera G, Dincă V, Doellman MM, Renshaw MA, Eng MW, Hornett EA, Li Y, Pfrender ME, Shoemaker D (2019) Global invasion history of the agricultural pest butterfly *Pieris rapae* revealed with genomics and citizen science. Proceedings of the National Academy of Sciences of the United States of America 116: 20015–20024. https://doi.org/10.1073/pnas.1907492116

Spieth HR, Pörschmann U, Teiwes C (2011) The occurrence of summer diapause in the large white butterfly *Pieris brassicae* (Lepidoptera: Pieridae): A geographical perspective. European Journal of Entomology 108: 377–384. https://doi.org/10.14411/eje.2011.047

Tennent J (2006) A checklist of the butterflies of Melanesia, Micronesia, Polynesia and some adjacent areas. Zootaxa 1178: 1–186. https://doi.org/10.11646/zootaxa.1178.1.1

Zúñiga-Reinoso A, Mardones D (2014) Primer registro de la especie exótica *Pieris brassicae* (Linnaeus, 1758) (Lepidoptera: Pieridae) en la Región de Atacama, Chile. IDESIA 32: 117–118. https://doi.org/10.4067/S0718-34292014000300015