

Hipparchia senthes chrysanthi, a new subspecies from the remote Greek island of Andikíthira (Lepidoptera: Nymphalidae, Satyrinae)

Hristos T. Anastassiou & John G. Coutsis

Abstract. A new subspecies *Hipparchia senthes chrysanthi* ssp. nov. (Lepidoptera: Nymphalidae) from the isolated Greek island of Andikíthira is described. The existence of this particular butterfly population is known from recent records in the literature, however, without it ever being identified with any degree of exactitude. Genitalia examination proves that this taxon provisionally belongs to *Hipparchia senthes* (Fruhstorfer, 1908) rather than to *Hipparchia cretica* (Rebel, 1920). However, constant morphological features differentiate it from nominotypical *H. senthes* found in mainland Greece and other islands, justifying its description as a new subspecies of the latter. The remoteness of Andikíthira, causing endemism to other forms of life as well, raises suspicion that this may even be a separate species of *Hipparchia*, an assumption that presently cannot be confirmed prior to future genetic investigation.

Samenvatting. Een nieuwe ondersoort *Hipparchia senthes chrysanthi* ssp. nov. (Lepidoptera: Nymphalidae) van het geïsoleerde Griekse eiland Andikíthira wordt beschreven. Het bestaan van deze specifieke vlinderpopulatie was reeds bekend uit recente verslagen in de literatuur, zonder dat ze ooit met enige nauwkeurigheid is geïdentificeerd. Onderzoek van de genitaliën toont aan dat dit taxon voorlopig behoort tot *Hipparchia senthes* (Fruhstorfer, 1908) en niet tot *Hipparchia cretica* (Rebel, 1920). De constante morfologische kenmerken onderscheiden het echter van de nominotypische *H. senthes* die op het Griekse vasteland en op andere eilanden is aangetroffen, zodat de beschrijving als nieuwe ondersoort van deze laatste gerechtvaardigd is. De afgelegen ligging van Andikíthira, waardoor ook andere levensvormen endemisch zijn, doet vermoeden dat dit misschien zelfs een aparte soort *Hipparchia* is, een veronderstelling die voornamelijk niet kan worden bevestigd in afwachting van toekomstig genetisch onderzoek.

Résumé. Une nouvelle sous-espèce *Hipparchia senthes chrysanthi* ssp. nov. (Lepidoptera : Nymphalidae) de l'île grecque isolée d'Andikíthira est décrite. L'existence de cette population particulière de papillons est connue par des enregistrements récents dans la littérature, sans qu'elle n'ait jamais été identifiée avec un certain degré d'exactitude. L'examen des organes génitaux prouve que ce taxon appartient provisoirement à *Hipparchia senthes* (Fruhstorfer, 1908) plutôt qu'à *Hipparchia cretica* (Rebel, 1920). Cependant, des caractéristiques morphologiques constantes le différencient de l'*H. senthes* nominotypique trouvée en Grèce continentale et dans d'autres îles, justifiant sa description comme une nouvelle sous-espèce de cette dernière. L'éloignement d'Andikíthira, qui entraîne un endémisme pour d'autres formes de vie également, laisse soupçonner qu'il pourrait même s'agir d'une espèce distincte d'*Hipparchia*, une hypothèse qui ne peut actuellement pas être confirmée en attendant de futures recherches génétiques.

Key words: Island biogeography — New subspecies — Taxonomy — Greece.

Anastassiou H. T.: International Hellenic University, Department of Informatics, Computer and Communications Engineering, end of Magnisías Str., GR-62124 Sérres, Greece. hristosa@ict.ihu.gr

Coutsis J. G.: 4 Glykonos Street, GR-10675 Athens, Greece. kouts@otenet.gr

DOI: 10.6084/m9.figshare.23803434

Introduction

The geography of Greece is singularly complicated and varied, the country harbouring a great multitude of mountain systems, a large number of which surpass 2000 m in altitude, an extremely extended and jagged shoreline, plains, rivers, lakes, marshes, and literally thousands of islands and islets, all of which collectively have contributed to the formation of great habitat diversity, many centres of geographic isolation, and the development of exceptionally rich flora and fauna. To this must also be added the geographic position and geological history of the country, both being responsible for species invasions from both C. Europe and Asia Minor as well as from N. Africa.

Several sites on remote mountains or islands are particularly difficult to access, and therefore their butterfly species capacity may be completely unknown. The island of Andikíthira in southern Greece is a characteristic example of such. With a permanent population of less than 100 inhabitants, lying away from any significant land masses, often subject to severe weather conditions, it is infrequently serviced by ferries

and a visit there may turn into an ordeal. Despite all technical difficulties, an adventurous 4-wheel-drive-on-ferry expedition to Andikíthira was finally carried out in June 2022 by the first author together with his life partner.

The primary purpose of the trip to Andikíthira was to record the butterfly species flying there in June and to discover the true identity of a *Hipparchia semele* (Linnaeus, 1758)-group taxon first reported from Andikíthira by Pamperis (2009) as *Hipparchia senthes?* (Fruhstorfer, 1908). As the island's location is about halfway between S.E. Pelopónnisos and N.W. Kríti (Crete) we were also eager to discover the origins and lineage of its butterfly fauna.

Fortunately, as both S. Pelopónnisos and Kríti each support a single but different species of similar looking brown *Hipparchia* species (*H. senthes* and *Hipparchia cretica* (Rebel, 1916) respectively), each of which has different genitalia, it became evident that a simple investigation of the genitalia of the Andikíthira population would give us the answer to our question, or perhaps even reveal the existence there of an, as yet, unknown species-group taxon. The latter endeavour was carried out by the second author who also produced the detailed drawings

of the genital apparatus of the aforementioned taxon, both male and female, eventually leading to its correct specific identification.

Locality name spelling

The system used throughout is the phonetic one, in place of the usual Latinised one. This was done in order to facilitate the reader to pronounce locality names as close as possible to contemporary Greek pronunciation, as well as the foreign collector in Greece seeking geographic information from the locals.

About the island

Andikíthira Island (Figs 1–2), is equidistant (about 33 km) between the southern tip of Kíthira Island (in itself a geographic extension of the S. E. tip of Pelopónnisos), and the N.W. tip of the island of Kríti, both locations being the closest land masses within its vicinity. Its area is 20.1 km² (including a few adjacent islets) its coastline is 29.72 km long, and its maximum altitude is 378 m (Angelidis *et al.* 2018). The island is composed in its entirety of limestone

and supports over its whole range a single type of biotope characterized by low maquis intermingled with garrigue (Figs 3–5). Freshwater reserves are extremely limited and restricted to a few streams formed by rainfall, mainly during the winter. Its vegetation, though fairly rich in density, is poor in number of species (333 taxa), and is composed mainly of various sorts of cushion shrubs coupled with a fair number of *Juniperus phoenicea* L. bushes to short trees. Cultivations include a few small, sparsely situated olive-groves, sporadic small vineyards and restricted fig-tree plantations.

Although wildlife diversity is rather limited, the island is still exceptionally interesting due to its isolation, resulting in several cases of endemism. According to Angelidis *et al.* (2018), 25 endemic plant species exist there, while the endemic lizard *Podarcis levendis* (Lymberakis, Poulakakis, Kaliontzopoulou, Valakos, Mylonas, 2008) occurs only on the neighbouring islets of Prassonísi and Laghúvardhos. Moreover, the insect fauna is definitely worth studying, but so far research has been restricted to Coleoptera only (Chatzimanolis *et al.* 2002), and known to include the endemic beetle *Dendarus antikythirens* (Trichas, 2008).

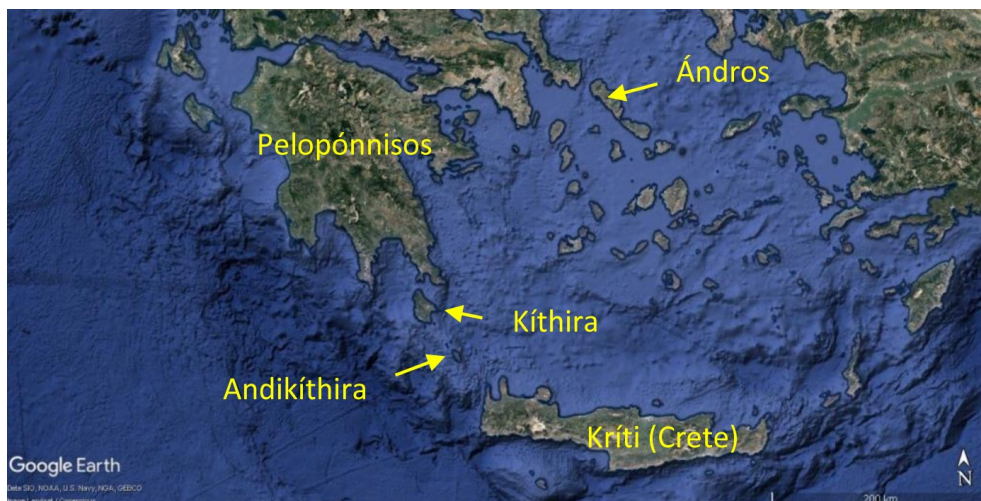


Fig. 1. Google Earth map of southern Greece, including the names of localities cited in the text.

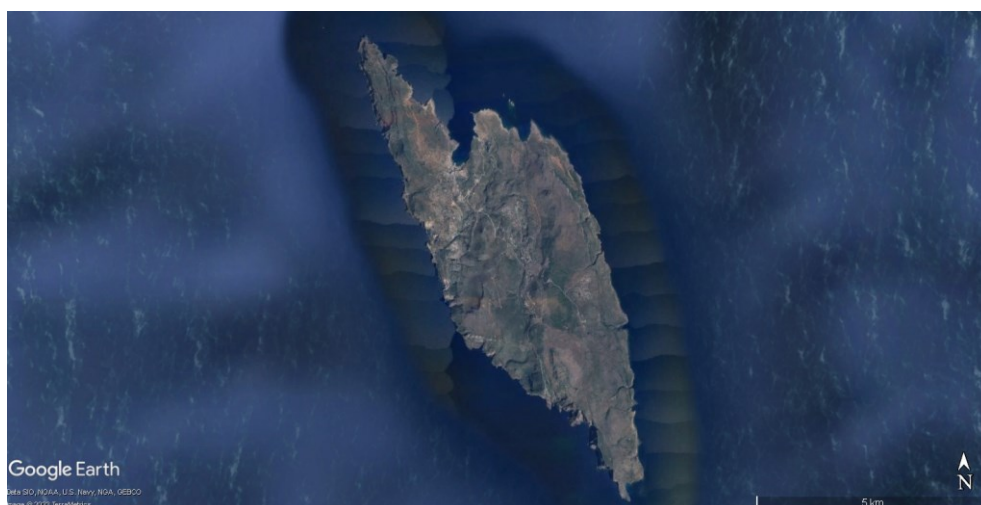


Fig. 2. Google Earth map of Andikíthira Island.



Fig. 3. Typical garrigue habitat on the island of Andikithira, N.W. cape.
© H. T. Anastassiou.



Fig. 4. The habitat of *Hipparchia senthes chrysanthi* on the island of Andikithira, central plateau.
© H. T. Anastassiou.

Visiting the island

The island of Andikithira was for years *terra incognita* insofar as its butterfly fauna was concerned. Angelidis *et al.* (2018) cites unconfirmed and unpublished reports of “*Vanessa atalanta*, *Vanessa cardui*, *Colias croceus*, *Lasiomata megera*, *Pontia daplidice* [sic!], *Pandoriana pandora*, *Danaus chrysippus*, *Lampides boeticus*, *Papilio machaon* and *Hipparchia* sp.”, the latter one obviously requiring identification at species level. Pamperis (2009) first published colour slides of two specimens

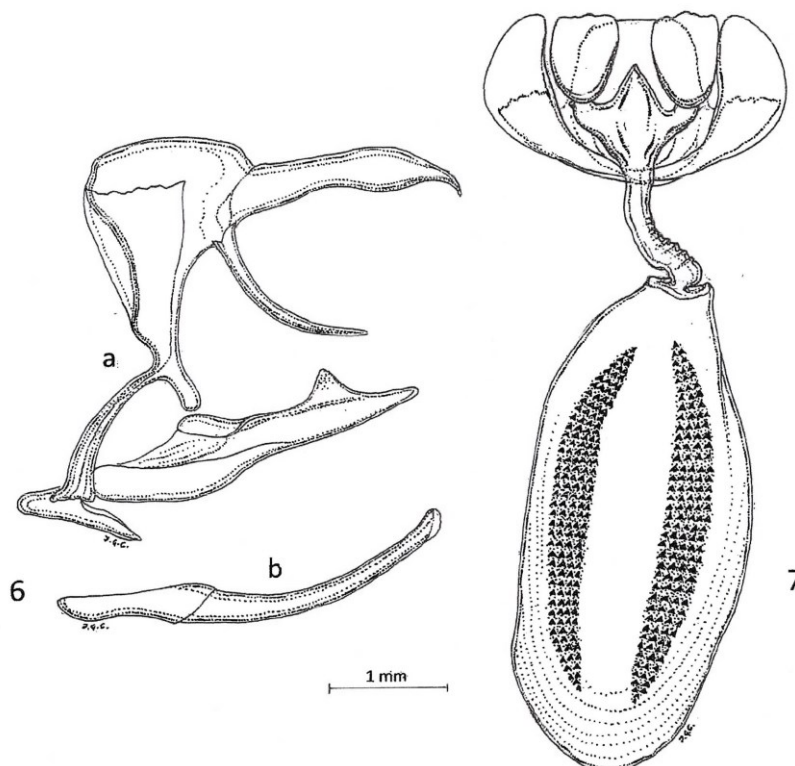
photographed there, a male and a female, belonging to the *Hipparchia semele* (Linnaeus, 1758)-group of Satyrinae butterflies. Unfortunately, not having secured any voucher specimens, which the said author, in general, refuses to do so as a matter of a well-meaning, yet controversial, principle, he was unable to identify them with certainty, having listed them simply as “*Hipparchia senthes*?” This, as already stated, was one of the main reasons that led us to the decision to plan a visit to the island in the first week of June 2022, well within the flight period of butterflies in this group.



Fig. 5. Typical mixed maquis/garrigue habitat on the island of Andikithira, western highlands.
© H.T. Anastassiou.

Indeed, the first author and his life partner visited the island between June 3 and 5, 2022, luckily under excellent weather conditions. The entire island was meticulously explored, and the *Hipparchia* butterfly was found to be in fresh condition and locally abundant, even inside inhabited areas, especially in the northern half of the island, becoming increasingly scarcer towards the south. Actually, it could have been the only butterfly species

encountered, had it not been for the presence of very few specimens of the migratory *Vanessa cardui* (Linnaeus, 1758) and *Colias croceus* (Geoffroy in Fourcroy, 1785), as well as the sedentary *Lasiomata megera* (Linnaeus, 1767), partially confirming the aforementioned reports. Several voucher specimens of both sexes of the *Hipparchia* taxon were eventually collected for the study of their genitalia and the ensuing determination of their specific status.



Figs 6, 7. Genitalia of *Hipparchia senthes chrysanthi* **ssp. nov.**, Greece, Andikithira Island, 0–300 m, 4.vi.2022.

6, male paratype, prep. no. 6206; a, lateral aspect of left side of genital ring with left valva and aedeagus removed; b, lateral aspect of left side of aedeagus.

7, female paratype, prep. no. 6204; dorsal aspect of bursa copulatrix.

© Drawings by J. G. Coutsis.



Fig. 8a–d. *Hipparchia senthes chrysanthi* ssp. nov., Greece, Andikithira Island, 0–300 m, 4.vi.2022; a, c, male paratype; a, upper side; c, underside; b, d, female paratype; b, upper side; d, underside. Scale bar = 1 cm. © J. C. Coutsis.

It must also be added that on September 1, 2022, G. C. Bozano likewise visited the island independently, and despite the lateness of the season was able to observe numerous *Hipparchia* specimens of both genders still on the wing and at various aging stages, but never advanced enough to be in rags. A few of his collected samples were kindly given to us for comparative purposes.

The correct specific identity of the island's single *Hipparchia semele*-group species

Our original assumption was that this particular butterfly should most probably prove to be either *Hipparchia senthes* (Fruhstorfer, 1908), common to both Kithira Island and S.E. Pelopónnisos, or the similar to it by external characters *Hipparchia cretica* (Rebel, 1916), an endemic common to Kríti Island. An examination, however, of both its male and female genitalia (Figs 6–7) proved beyond doubt that the species was indeed *H. senthes*, having genital appendages identical to those of the latter and quite different from those of *H. cretica* (Coutsis 1984). In the male the uncus and brachia are short, being exactly as in *H. senthes* and both much

shorter than in *cretica*; in the female the mid-dorsal, post-vaginal triangular extension of the sterigma is short and wide (long and slender in *cretica*), its dorsal post-vaginal lamellae small (large in *H. cretica*), and the signa in the corpus bursae long (shorter in *H. cretica*), in all three aspects being exactly as in *senthes* and differing from *H. cretica*.

Hipparchia senthes chrysanthi ssp. nov.

LSID: :zoobank.org:pub:B3C3048F-6D88-4409-8A0E-AA1EB8ABB4BE

Although genitalia features are no different from those of nominotypical *H. senthes*, small but constant wing character differences between the *H. senthes* population from Andikithira and those from other areas in Greece, are present. Coupled with the non-migratory and rather sedentary nature of the species as a whole, and the geographic isolation of its Andikithira population in particular, which in itself guarantees genetic isolation, all point to there being legitimate reasons for considering this taxon as representing a valid subspecies in its own right.

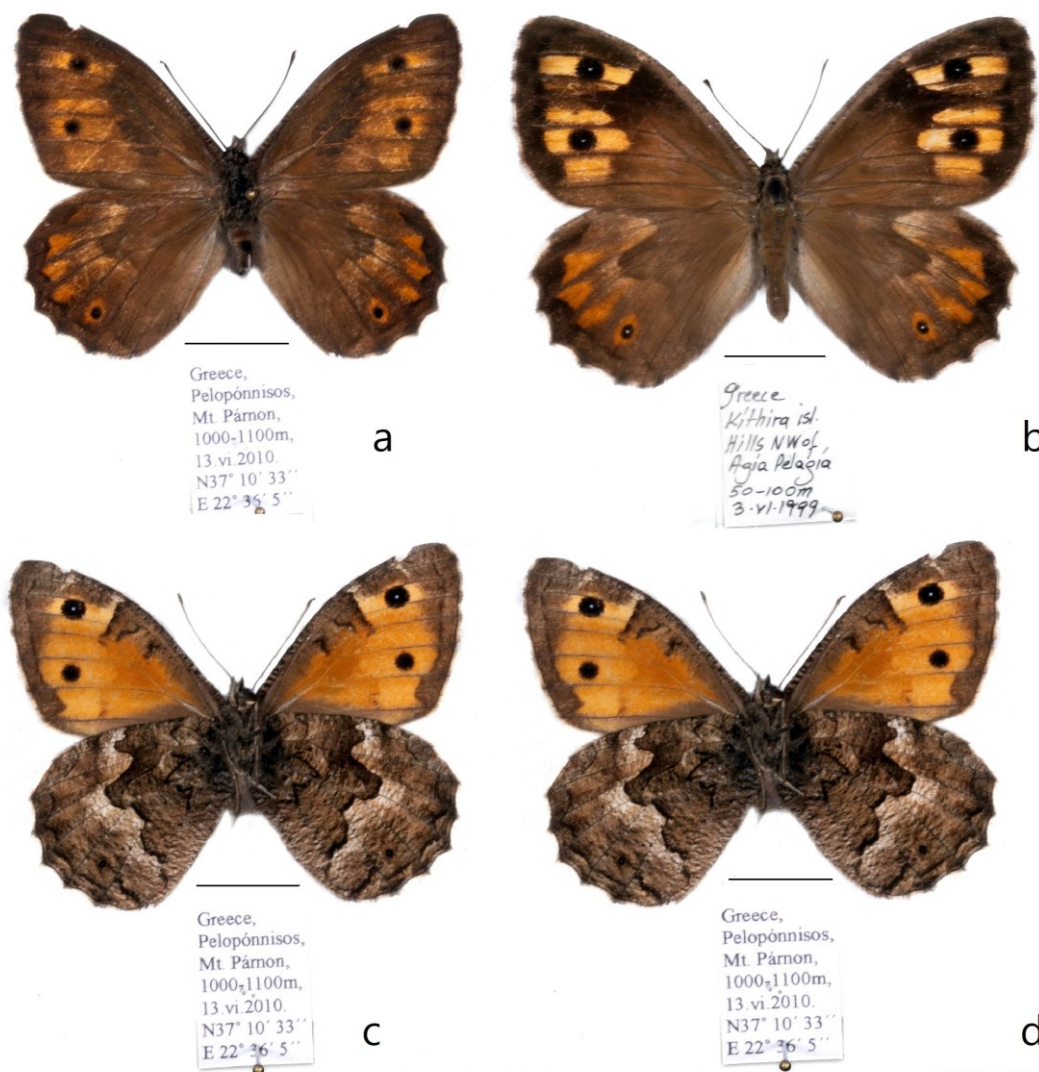



Fig. 9a–d. *Hipparchia senthes senthes* (Fruhstorfer, 1908), Greece. a, c, male, Mt. Pámon, Pelopónnisos, 1000–1100 m, 13.vi.2010; a, upper side; c, underside; b, d, female, Kithira Island, hills N.W. of Ayía Pelayía, 50–100 m, 3.VI.1999; b, upper side; d, underside. Scale bar = 1 cm. © J. C. Coutsis.

Diagnosis

Comparisons between equally fresh specimens of the new ssp. and members of the nominotypical ssp. recorded from locations lying as close as possible to Andikithira, such as Kithira Island and S.E. Pelopónnisos, revealed that both genders of the former differ from those of the latter by a few but constant aspects of their wing characters, which may be summarized as follows (see Figs 8–9):

1. Overall upper side ground colour in *H. senthes chrysanthi* much darker than in nominotypical ssp.
2. Underside hindwing ground colour blackish brown in *H. senthes chrysanthi*, instead of chestnut brown in nominotypical ssp.
3. Contrast between dark- and light-coloured areas on underside of both wings in male *H. senthes chrysanthi* more intense than in male nominotypical ssp.
4. White band on underside of hindwing always absent or vestigial in female *H. senthes chrysanthi*, normally present and obvious in female nominotypical ssp.
5. Upper side forewing black ocelli large and clearly white-pupilled in *H. senthes chrysanthi*, smaller with imperceptibly defined or absent white pupils in nominotypical ssp.
6. Underside small submarginal black ocellus in S2 of hindwing often blurred by equally dark background colour in *H. senthes chrysanthi*, more obvious and well-defined in nominotypical ssp.
7. Size of *H. senthes chrysanthi* constantly larger than in nominotypical ssp. and relatively invariant, as shown by its low standard deviation (Table 1). Specimens comparable in size (but still smaller) than *H. senthes chrysanthi* occur only on the island of Ándros (see Fig. 1). All their other features coincide with those of the nominotypical ssp.

Table 1. Comparative wing size statistics for *Hipparchia senthes senthes* and *Hipparchia senthes chrysanthi* **ssp. nov.**
N is the number of specimens examined in the author's collections. Number of voucher specimens captured on Andikithira in June and September was deliberately kept as low as possible for conservation reasons.

 d (in mm)	<i>H. senthes</i> males (N=18)	<i>H. senthes</i> females (N=8)	<i>H. senthes chrysanthi</i> males (N=11)	<i>H. senthes chrysanthi</i> females (N=6)
Maximum d	30	31	33	34.5
Minimum d	22	25	28.5	32
Average d , $\bar{d} = \frac{1}{N} \sum_{i=1}^N d_i$	26.5	29.25	31.24	33.5
Standard deviation $\sigma = \sqrt{\frac{1}{N} \sum_{i=1}^N (d_i - \bar{d})^2}$	2.06	1.91	1.145	1.00

In Fig. 10, global comparison between eight specimens of *Hipparchia senthes chrysanthi* and other, closely related *Hipparchia* species is performed, so that all aforementioned differentiating features can be clearly seen and fully appreciated.

Description

Approximate length of forewing coastal chord d : 28–33 mm (males), 32–35 mm (females). Upper side: dark brown with dark orange patches; two white-centred, large black ocelli on each forewing in S2 and S5; one, similar but smaller ocellus in S2 on each hindwing. Underside hindwing: ground colour blackish brown in strong contrast to white bands in males, white areas rarely existent in females; submarginal black ocellus in S2 often hardly visible.

Derivatio nominis

The subspecific name chosen for this *Hipparchia* butterfly, i.e., “*chrysanthi*”, which is a latinised version of the Greek name “Χρυσάνθη”, literally meaning “female golden flower”, is derived from the first author’s life partner, Chrysanthi Intzidou, who for years has been patiently, steadily and unflinchingly sharing his eccentric hobby of carrying a net along arduous hikes in often steep, dusty and thorny terrain under the scorching sun (Fig. 4).

Type specimens and depository

Holotype: Male: Greece, Andikithira Island, ca. 300 m, 4.VI.2022, H. T. Anastassiu leg. TL: Andikithira Island, Greece; presently in first author’s collection, soon to be transferred to Naturalis Biodiversity Center, Leiden, The Netherlands.

Paratypes: 6 males, and 5 females:

1 female paratype presently in the first author’s collection, soon to be transferred to Naturalis Biodiversity Center, Leiden, The Netherlands;

3 male and 3 female paratypes in the first author’s collection;

3 male and 1 female paratypes in the second author’s collection.

Locality data of all paratypes as for holotype.

Discussion

The geographic position of Andikithira suggests equal chances of spread to this island of either *H. senthes* or *H. cretica*, or of both, at a time (millions of years ago) when the island was still united geographically with both Pelopónnisos and Kithira Island as well as with Kríti Island. For as yet unknown reasons only the first N. to S. invasion materialised or prevailed. The present **ssp. nov.** is a good example of the degree of external differentiation a given species may be prone to, as a result of its genetic isolation after prolonged geographic isolation. Moreover, given the fact that several endemic taxa of other forms of life occur on the island as well, the local *H. senthes* population should probably be subjected to further research, possibly involving more sophisticated, genetic methods, such as nuclear DNA barcoding. It is not unlikely that *H. senthes chrysanthi* may someday in the future be elevated to species level, since this particular *Hipparchia* group quite unexpectedly encompasses many different species which superficially look almost identical to each other.

Acknowledgements

The authors would like to express their thanks and appreciation to G. C. Bozano for providing us with a number of specimens collected during his September 2022 visit to the island and for helpful discussions.

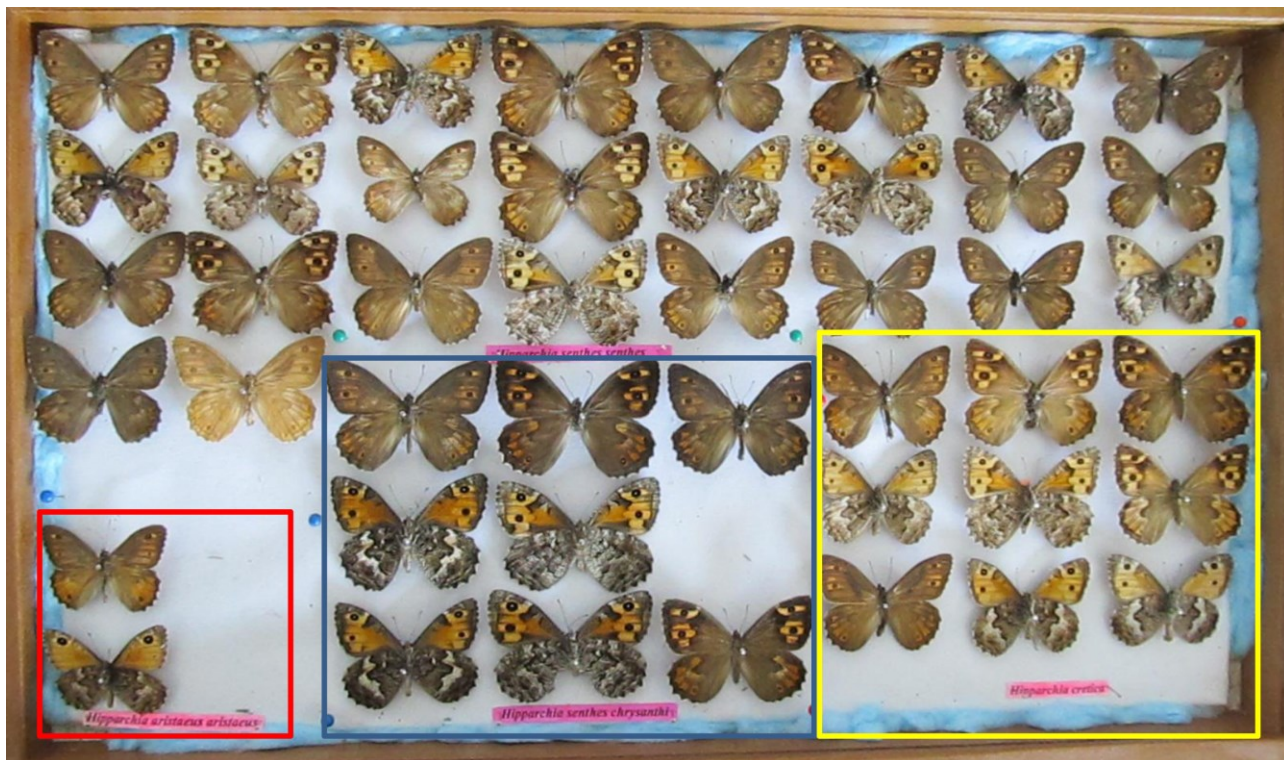


Fig. 10. Global comparison between 8 specimens of *Hipparchia senthes chrysanthi* and other, closely related *Hipparchia* species (upper side and underside). Blue frame: *Hipparchia senthes chrysanthi*. Yellow frame: *Hipparchia cretica*. Red frame: *Hipparchia aristaeus aristaeus*. No frame: *Hipparchia senthes senthes*.

References

- Angelidis Ch., Georgiadis N., Kordopatis P., Portolou D. & Tsiopelas N. 2018. *Inventory and Evaluation of the Natural Environment of Kithira and Andikithira*. — Mediterranean Institute for Nature and Humanity, Hellenic Ornithological Society, Athens. 206 pp. (in Greek).
- Chatzimanolis S., Engel M. S. & Trichas A. 2002. Taxonomic changes for Aegean species of the Mediterranean darkling beetle genus *Dendarus* (Coleoptera: Tenebrionidae). — *Journal of the Kansas Entomological Society* **75**(4): 259–267.
- Coutsis J. G. 1984. Description of the female genitalia of *Hipparchia fagi* Scopoli, *Hipparchia semele* Linnaeus (Satyridae) and their Related Taxa. — *The Journal of Research on the Lepidoptera* **22**(3) (for 1983): 161–203.
- Pamperis L. N. 2009. *The Butterflies of Greece*. — Pamperis Editions, KOAN, Athens, 766 pp.
- Trichas A. 2008. The genus *Dendarus* Latreille 1829 (Coleoptera, Tenebrionidae: Dendarini) in Greece, (a systematic account of the genus with the description of a new species and four new systematic combinations). — In: Makarov S. E., Dimitrijević R. N. (Eds), *Advances in Arachnology and Developmental Biology*. Papers dedicated to Prof. Dr. Božidar Čurčić. — Institute of Zoology, Belgrade; BAS, Sofia; Faculty of Life Sciences, Vienna; SASA, Belgrade and UNESCO MAB Serbia; Vienna, Belgrade, Sofia, pp. 417–462.

