Baseline Study on the Diversity and Abundance of Pollinators (Apoidea, Syrphidae, Lepidoptera, or other relevant taxonomic groups) in the 6 Pilot Areas of the LIFE Phoenix Project in Crete

**Restoration and improvement of Priority Habitat 9370*
"Palm groves of *Phoenix*"**

LIFE PHOENIX / LIFE22-NAT-ES-LIFE Phoenix

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SUMMARY

This report presents the results of a study on the diversity and abundance of pollinators in the palm forests of *Phoenix theophrasti*, the only native palm species in Europe, from selected locations across Crete: Agios Nikitas and Martsalo Gorge in Heraklion, Vai in Lasithi, Preveli and Souda in Rethymno, and Chrysoskalitissa in Chania.

The study was conducted within the framework of the project "Restoration and Improvement of Priority Habitat 9370* 'Palm Groves of the Genus *Phoenix'* [Project: 101113584 – LIFE22-NAT-ES-LIFE Phoenix – LIFE-2022-SAP-NAT]".

The aim of this report is to assess the status of pollinator communities (bees, flies, and butterflies) in the proposed action areas of the LIFE22-NAT-ES-LIFE Phoenix project. Specific objectives include: the design of a standardized methodology to monitor the status of pollinator communities before and after the implementation of project actions; the analysis of pollinator richness and abundance to describe community composition; and the inventory of pollinators present in each study site.

This baseline will serve as a reference for evaluating the effectiveness of future habitat restoration activities implemented under the LIFE Phoenix project.

1 INTRODUCTION

Pollinators are vital components of terrestrial ecosystems, facilitating the reproduction of a vast majority of angiosperms by enabling the transfer of pollen between flowers. It is estimated that approximately 87% of all flowering plant species rely to some extent on animal-mediated pollination (Ollerton et al., 2011), including 75% of global food crops (Klein et al., 2007). Insect pollinators—particularly bees (Apoidea), hoverflies (Syrphidae), butterflies (Lepidoptera), and certain beetles and flies—play a key role in maintaining plant diversity, ecosystem resilience, and food security.

Over recent decades, however, global pollinator populations have experienced significant declines, driven by factors such as habitat loss and fragmentation, agricultural intensification, climate change, pesticide use, invasive species, and pathogens (Goulson, 2019; Sánchez-Bayo & Wyckhuys, 2019; Wagner et al., 2021). These threats are often exacerbated on islands, where ecological systems are typically more fragile due to geographic isolation and high rates of endemism (Russell & Kueffer, 2019).

The present study was conducted as part of the LIFE22-NAT-ES-LIFE Phoenix project, which aims to restore and improve the conservation status of Priority Habitat 9370* “Palm Groves of the Genus Phoenix” in the Mediterranean region. The project focuses on *Phoenix theophrasti*, a relict and endemic palm species found in Crete.

As part of the baseline ecological assessment, this study investigates the diversity and abundance of pollinator communities in six selected pilot areas across Crete: Agios Nikitas and Martsalo (Heraklion), Chrysoskalitissa (Chania), Vai (Lasithi), Preveli and Souda (Rethymno). The specific objectives of this study are to:

- monitor pollinator communities;
- document species richness and abundance across the six pilot areas;
- calculate biodiversity indices (Simpson, Shannon, Equitability) for comparative analysis;
- establish a baseline dataset for evaluating the future ecological impact of restoration interventions under the LIFE Phoenix project.

This baseline study provides essential data on pollinator assemblages in *Phoenix theophrasti* habitats and will serve as a benchmark for long-term monitoring, adaptive management, and conservation planning.

2 MATERIALS AND METHODS

Pan traps of four colors (yellow, red, white, blue) were deployed at each site between 5–12 April 2025. A total of 15 sampling points were established, with the number of traps per site based on area size and accessibility. Traps were left in the field for approximately two days and insects were preserved in ethanol for subsequent identification. Specimens were identified to species or family level where possible, and their role as pollinators was assessed based on current literature.

Each trap consisted of four plastic bowls approximately 12 cm in diameter, painted red, blue, white, and yellow. These colors cover much of the visible spectrum used by pollinators to locate food[1]. The bowls were filled with water and a small amount of detergent to reduce surface tension and facilitate insect capture. Trap locations were georeferenced using a GIS system for future reference.

Table 1 Coordinates of sampling points (Greek Grid CRS 2100)

ID	DATE	LOCATION	X	Y
1.1	05/04/2025	Agios Nikitas	613795,22	3869724,94
1.2	05/04/2025	Agios Nikitas	613899,55	3869622,34
2.1	05/04/2025	Martsalos	570346,50	3866339,43
2,1	05/04/2025	Martsalos	570332,62	3866320,67
3.1	06/04/2025	Chrisoskalitissa	456748,17	3907179,03
3.2	06/04/2025	Chrisoskalitissa	456785,30	3907157,03
4.1	09/04/2025	Vai	705789,61	3903362,700
4.2	09/04/2025	Vai	705678,38	3903429,14
4.3	09/04/2025	Vai	705437,00	3903375,01
4.4	09/04/2025	Vai	705172,69	3903491,22
5.1	10/04/2025	Preveli	542994,38	3889911,49
5.2	10/04/2025	Preveli	542964,04	3890000,96
5.3	10/04/2025	Preveli	542929,62	3890138,40
6.1	10/04/2025	Souda	532290,77	3894621,65
6.2	10/04/2025	Souda	532439,68	3894613,50

[1] Moreira, E. F., Santos, R. L. D. S., Penna, U. L., Angel-Coca, C., de Oliveira, F. F., & Viana, B. F. (2016). Are pan traps colors complementary to sample community of potential pollinator insects?. Journal of Insect Conservation, 20, 583-596.

The trap colors were selected based on literature regarding insect attraction, as different pollinator species respond to different wavelengths. The traps were mounted on metal stands 60–80 cm above the ground to match the typical flight height of most pollinators.

Traps were placed in the field each morning and remained active for approximately two days (Table 2), between April 5–11, 2025.

Table 2 Duration of trap deployment at each site

ID	LOCATION	DEPLOYMENT DATE	RETRIEVAL DATE	DURATION
1.1	Agios Nikitas	5/4/2025 12:24	7/4/2025 10:51	1 day 22:27:00
1.2	Agios Nikitas	5/4/2025 13:13	7/4/2025 11:31	1 day 22:18:00
2.1	Martsalos	5/4/2025 16:31	7/4/2025 14:47	1 day 22:16:00
2.2	Martsalos	5/4/2025 16:53	7/4/2025 15:10	1 day 22:17:00
3.1	Chrisoskalitissa	6/4/2025 12:05	8/4/2025 11:20	1 day 23:15:00
3.2	Chrisoskalitissa	6/4/2025 12:25	8/4/2025 11:40	1 day 23:15:00
4.1	Vai	9/4/2025 13:08	11/4/2025 13:12	2 days 00:04:00
4.2	Vai	9/4/2025 13:21	11/4/2025 13:43	2 days 00:22:00
4.3	Vai	9/4/2025 13:45	11/4/2025 13:57	2 days 00:12:00
4.4	Vai	9/4/2025 14:12	11/4/2025 14:15	2 days 00:03:00
5.1	Preveli	10/4/2025 13:21	12/4/2025 10:21	1 day 21:00:00
5.2	Preveli	10/4/2025 13:30	12/4/2025 10:35	1 day 21:05:00
5.3	Preveli	10/4/2025 13:40	12/4/2025 10:45	1 day 21:05:00
6.1	Souda	10/4/2025 15:16	12/4/2025 12:25	1 day 21:09:00
6.2	Souda	10/4/2025 15:46	12/4/2025 12:48	1 day 21:02:00

After removal, the trap contents were separated by site and color and stored in >70% ethanol for preservation and further analysis in the lab. In Agios Nikitas, one trap was found destroyed, likely by free-ranging grazing animals. The captured specimens were identified to family or species level where possible, using stereomicroscopy and entomological keys. Pollinator status (i.e. confirmed, potential, or non-pollinator) was assigned based on current literature and expert consensus.

2.1 Agios Nikitas - Heraklion

A total of 12 individuals representing 8 species were collected. Despite the low abundance, species were relatively evenly distributed among effective traps (Shannon Index = 1.98; Equitability = 0.95). Blue and yellow traps captured the highest number of individuals. The high Equitability Index despite low richness suggests a balanced but limited community structure. The ineffectiveness of red traps is already apparent.

Table 3 Order, family, species, and total number of individuals per species recorded at Agios Nikitas - Heraklion.

No	Order	Family	Species	Total No Ind
1	Hemiptera	Miridae	*Horistus infuscatus*	1
2	Diptera	Anthomyiidae	*Anthomyia sp.*	1
3	Diptera 2	Sciaridae	*Bradysia sp.*	2
4	Coleoptera	Melyridae	*Hypebaeus flavicollis*	2
5	Hymenoptera	Vespidae	*Ancistrocerus sp.*	1
6	Lepidoptera	Pieridae	*Pieris rapae*	1
7	Coleoptera	Melyridae	*Dasytes creticus*	3
8	Hymenoptera	Megachilidae	*Osmia sp.*	1
			Total	**12**

Table 4 Number of individuals per pollinator species recorded at Agios Nikitas - Heraklion, categorized by pan trap color (yellow, red, white, blue)

No	Species				
		No	No	No	No
1	*Horistus infuscatus*	1			
2	*Anthomyia sp.*	1			
3	*Bradysia sp.*	1		1	
4	*Hypebaeus flavicollis*	1		1	
5	*Ancistrocerus sp.*				1
6	*Pieris rapae*				1
7	*Dasytes creticus*				3
8	*Osmia sp.*				1
	Total	**4**	**0**	**2**	**6**

Table 5 Biodiversity indices per pan trap color at Agios Nikitas - Heraklion.

INDEX					Overall
Species Richness	4	0	2	4	8
Simpson Index	0	0	0	0,2	0,07576
Shannon Index (ln)	1,386	0	0,6931	1,242	1,979
Equitability Index	1	0	1	0,8962	0,9518

Figure 1 Biodiversity indices calculated for each pan trap color at Agios Nikitas. Bar charts show the Simpson's Index, Shannon's Index (ln), and Equitability Index respectively, highlighting diversity and evenness of pollinator communities per trap color

2.2 Martsalos – Heraklion

Martsalo yielded 188 individuals across 20 species, the second-highest species richness overall. *Dasytes creticus* was dominant, but trap diversity was strong, especially in the white and blue traps. Even with only two trap sites, this area exhibited high diversity and relatively good evenness (Shannon = 1.85), indicating a rich and active pollinator community.

Table 6 Order, family, species, and total number of individuals per species recorded at Martsalos - Heraklion.

No	Order	Family	Species	Total No Ind
1	Diptera	*Phoridae*	*Megaselia sp.*	30
2	Hymenoptera	*Tiphiidae*	*Tiphia sp*	25
3	Diptera	*Tiphiidae*	*Tiphia sp*	2
4	Diptera	*Syrphidae*	*Eumerus sogdianus*	1
5	Diptera	*Heleomyzidae*	*Suillia variegata*	1
6	Hymenoptera	*Bethylidae*	*Sierola sp*	1
7	Coleoptera	*Melyridae*	*Dasytes creticus*	88
8	Hymenoptera	*Halictidae*	*Lasioglossum punctatisimum*	4
9	Diptera	*Muscidae*	*Coenosia infantula*	1
10	Diptera	*Dolichopodidae*	*Sciapus sp.*	1
11	Diptera	*Anthomyiidae*	*Delia antiqua*	2
12	Diptera	*Sphaeroceridae*	*Lotophila sp*	1
13	Diptera	*Cecidomyiidae*	*Resseliella sp.*	2
14	Lepidoptera	*Nepticulidae*	*Acalyptris sp*	1
15	Coleoptera	*Dermestidae*	*Anthrenus pimpinellae*	4
16	Diptera	*Lauxaniidae*	*Lauxania shewelli*	2
17	Coleoptera	*Scarabaeidae*	*Oxythyrea cinctella*	13
18	Coleoptera	*Scarabaeidae*	*Tropinota squalida*	4
19	Coleoptera	*Buprestidae*	*Anthaxia brevis*	2
20	Diptera	*Drosophilidae*	*Drosophila funebris*	3
			Total	**188**

Table 7 Number of individuals per pollinator species recorded at Martsalos - Heraklion, categorized by pan trap color (yellow, red, white, blue)

No	Species				
		No	**No**	**No**	**No**
1	*Megaselia sp.*	12	3	8	7
2	*Tiphia sp*	7		1	17
3	*Tiphia sp*	1	1		
4	*Eumerus sogdianus*	1			
5	*Suillia variegata*	1			

No	Species				
		No	No	No	No
6	*Sierola sp*	1			
7	*Dasytes creticus*	8	4	21	55
8	*Lasioglossum punctatisimum*	1		1	2
9	*Coenosia infantula*	1			
10	*Sciapus sp.*	1			
11	*Delia antiqua*	1		1	
12	*Lotophila sp*	1			
13	*Resseliella sp.*		1		**1**
14	Acalyptris sp		1		
15	Anthrenus pimpinellae		1		3
16	*Lauxania shewelli*				2
17	*Oxythyrea cinctella*			1	12
18	*Tropinota squalida*				4
19	*Anthaxia brevis*				2
20	*Drosophila funebris*				3
		36	**11**	**33**	**108**

Table 8 Biodiversity indices per pan trap color at Martsalos - Heraklion.

INDEX					Overall
Species Richness	12	6	6	11	20
Simpson Index	0,1825	0,1636	0,4508	0,2982	0,2655
Shannon Index (ln)	1,915	1,594	1,055	1,642	1,85
Equitability Index	0,7706	0,8897	0,5888	0,6849	0,6174

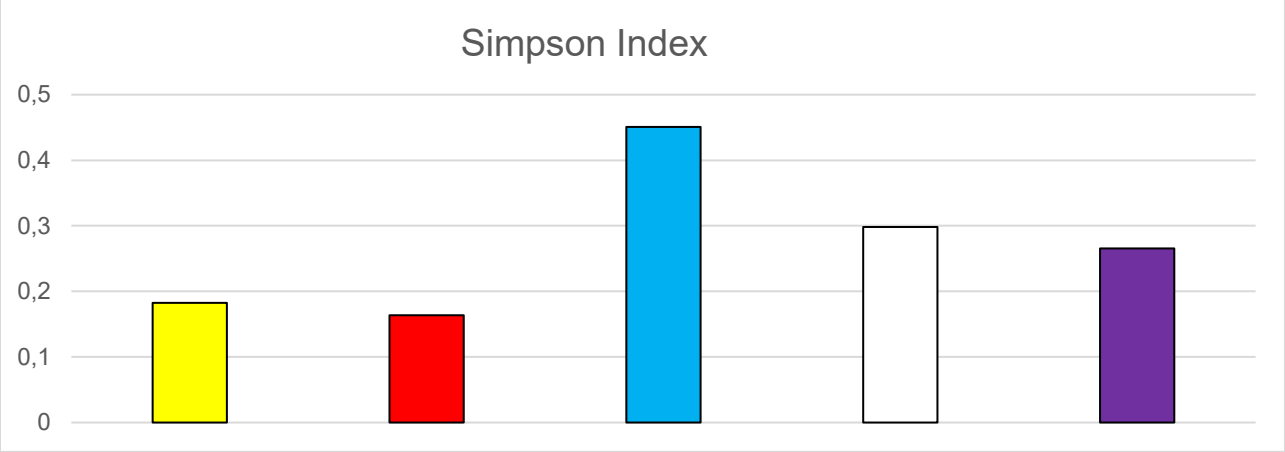


Figure 2 Biodiversity indices calculated for each pan trap color at Martsalos - Heraklion.

2.3 Chrysoskalitissa - Chania

168 individuals from 8 species were collected, dominated by *Dasytes creticus*. The Equitability Index was low (0.33), reflecting uneven community structure. High abundance does not equate to high diversity. The strong dominance of one species indicates low ecological balance or possible habitat disturbance.

Table 9 Order, family, species, and total number of individuals per species recorded at Chrysoskalitissa – Chania.

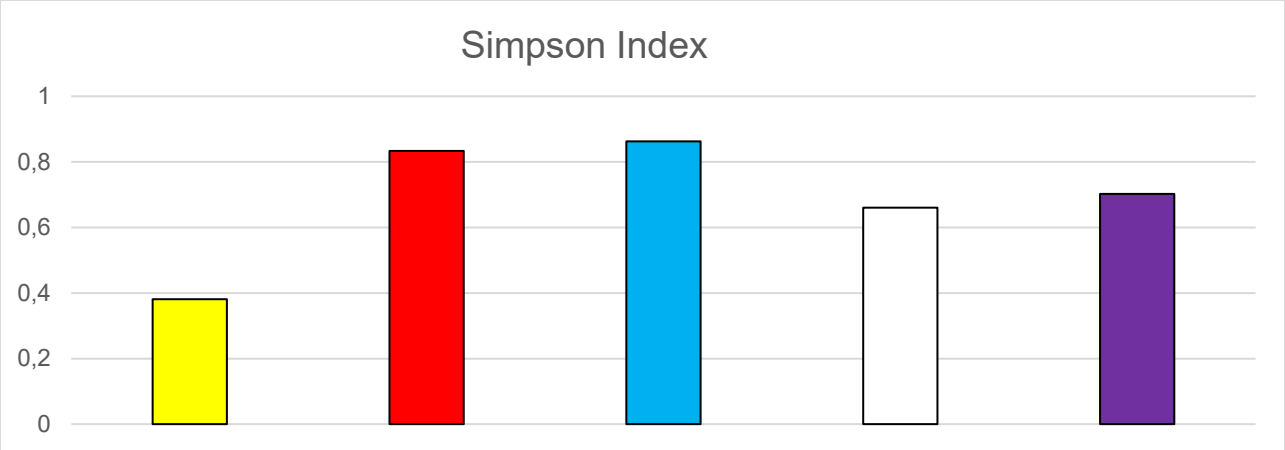
No	Order	Family	Species	Total No
1	Hymenoptera	Megachilidae	*Osmia sp.*	5
2	Hymenoptera	Apidae	*Apis melifera*	4
3	Diptera	Tachinidae	*Linnaemya sorror*	1
4	Diptera	Dolichopodidae	*Sciapus sp.*	1
5	Coleoptera	Melyridae	*Dasytes cretica*	140
6	Coleoptera	Melyridae	*Hypebaeus flavicollis*	1
7	Hymenoptera	Halictidae	*Lasioglossum sp.*	15
8	Lepidoptera	Noctuidae	*Autographa gamma*	1
			Total	**168**

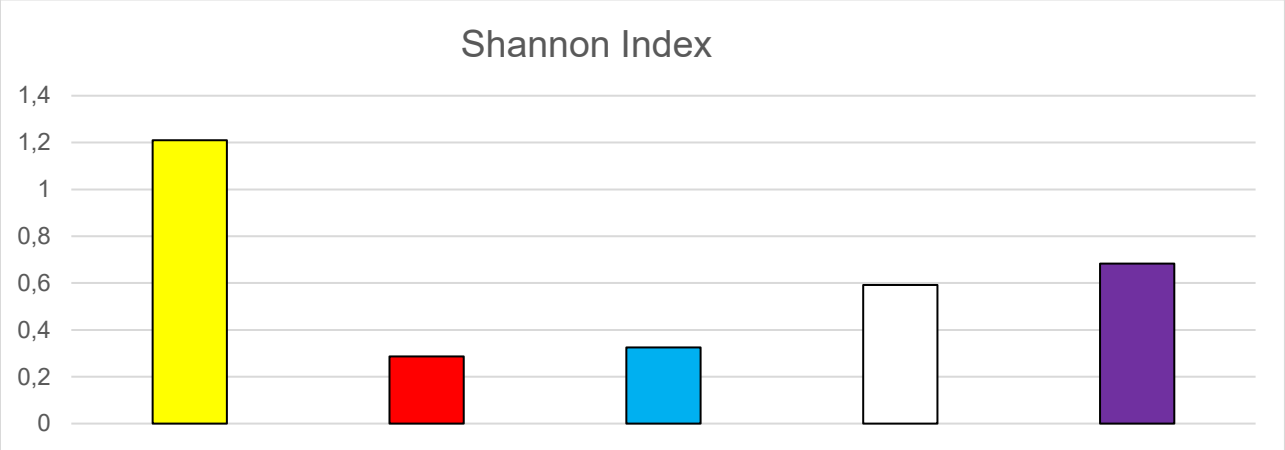
Table 10 Number of individuals per pollinator species recorded at Chrysoskalitissa - Chania, categorized by pan trap color (yellow, red, white, blue)

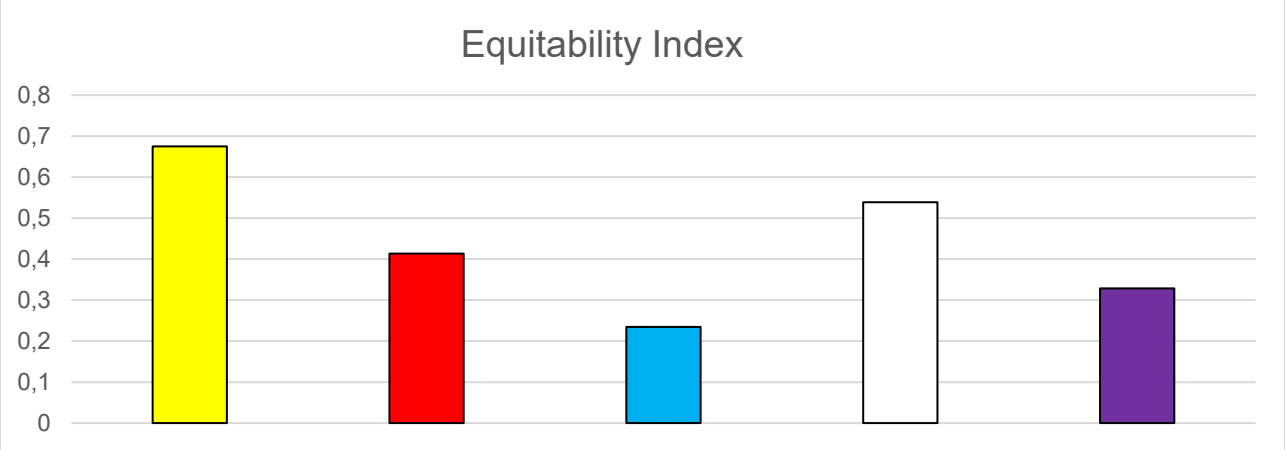
No	Species				
		No	**No**	**No**	**No**
1	*Osmia sp.*	5			
2	*Apis melifera*	1		1	2
3	*Linnaemya sorror*	1			
4	*Sciapus sp.*	1			
5	*Dasytes cretica*	13	11	65	51
6	*Hypebaeus flavicollis*	1			
7	*Lasioglossum sp.*		1	3	11
8	*Autographa gamma*			1	
		22	**12**	**70**	**64**

Table 11 Biodiversity indices per pan trap color at Chrysoskalitissa - Chania

INDEX					Overall
Species Richness	6	2	4	3	8
Simpson Index	0,381	0,8333	0,8625	0,6602	0,7022
Shannon Index (ln)	1,21	0,2868	0,3252	0,5919	0,6832
Equitability Index	0,6751	0,4138	0,2346	0,5388	0,3286


Simpson Index
1
0,8
0,6
0,4
0,2
0


Shannon Index
1,4
1,2
1
0,8
0,6
0,4
0,2
0


Equitability Index
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0

2.4 Vai – Lasithi

Vai recorded 89 individuals from 37 species — the highest richness and diversity across all sites. Biodiversity indices support this observation (Shannon = 3.07; Equitability = 0.85).
The combination of high species richness, balanced distribution, and a large, diverse floral habitat suggests that Vai is in excellent ecological condition.

Table 12 Order, family, species, and total number of individuals per species recorded at Vai - Lasithi.

No	Order	Family	Species	Total No
1	Hymenoptera	Apidae	*Apis melifera*	20
2	Coleoptera	Scarabeidae	*Tropinota squalida*	6
3	Diptera 14	Sarcophagidae	*Sarcophaga argyrostoma*	1
4	Diptera	Syrphidae	*Eumerus sogdianus*	1
5	Diptera 15 female	Rhiniidae	*Stomorhina lunata*	4
6	Diptera 16 male	Rhiniidae	*Stomorhina lunata*	1
7	Coleoptera	Scraptiidae	*Anaspis flava*	5
8	Coleoptera	Malachiidae	*Anthocomus fenestratus*	2
9	Coleoptera	Melyridae	*Dasytes creticus*	7
10	Diptera 17	Muscidae	*Spilogona dispar*	1
11	Diptera 23	Dolichopodidae	*Sciapus platypterus*	1
12	Diptera 24	Muscidae	*Coenosia infantula*	1
13	Diptera 25	Hybotidae	*Drapetis sp.*	1
14	Diptera 26	Ephydridae	*Hecamede albicans*	2
15	Diptera 27	Sciaridae	*Bradysia sp.*	1
16	Diptera 27	Sciaridae	*Bradysia sp.*	1
17	Diptera 28	Ephydridae	*Hecamede albicans*	4
18	Diptera 32	Chloropidae	*Hippelates plebejus*	1
19	Diptera 33	Hybotidae	*Drapetis sp.*	1
20	Coleoptera	Scarabeidae	*Oxythyrea cinctella*	2
21	Hymenoptera	Crabronidae	*Astata boops*	1
22	Diptera 34	Sarcophagidae	*Sarcophaga argyrostoma*	1
23	Diptera	Sciaridae 1	*Bradysia sp.*	1
24	Coleoptera	Buprestidae	*Anthaxia brevis*	1
25	Diptera 36	Chloropidae	*Hippelates plebejus*	1
26	Diptera 37	Sciaridae	*Bradysia sp.*	2
27	Lepidoptera	Noctuidae	*Auographa gamma*	1
28	Hymenoptera	Vespidae	*Ancistrocerus nigricornis*	1
29	Hemiptera	Miridae 2	*Pantilius tunicatus*	1
30	Hymenoptera	Megachilidae	*Megachile sicula*	1
31	Hymenoptera 2	Braconidae	*Chelonus sp.*	1

No	Order	Family	Species	Total No
32	Hymenoptera	Megachilidae	*Lasioglossum villosulum*	5
33	Diptera 38	Hybotidae	*Drapetis sp.*	1
34	Hymenoptera	Pompilidae	*Anoplius sp.*	1
35	Hymenoptera	Scolidae	*Colpa quinquecinta*	2
36	Lepidoptera	Pieridae	*Colias croceus*	1
37	Coleoptera	Dermestidae	*Anthrenus sp.*	1
			Total	**86**

Table 13 Number of individuals per pollinator species recorded at Vai - Lasithi, categorized by pan trap color (yellow, red, white, blue)

No	Species				
		No	No	No	No
1	*Apis melifera*	1	1	8	10
2	*Tropinota squalida*	1	1	1	3
3	*Sarcophaga argyrostoma*	1			
4	*Eumerus sogdianus*	1			
5	*Stomorhina lunata*	1	1	2	
6	*Stomorhina lunata*	1			
7	*Anaspis flava*	1		2	2
8	*Anthocomus fenestratus*	1			1
9	*Dasytes creticus*	1		3	3
10	*Spilogona dispar*	1			
11	*Sciapus platypterus*	1			
12	*Coenosia infantula*	1			
13	*Drapetis sp.*	1			
14	*Hecamede albicans*	2			
15	*Bradysia sp.*	1			
16	*Bradysia sp.*	1			
17	*Hecamede albicans*	7			
18	*Hippelates plebejus*	1			
19	*Drapetis sp.*	1			
20	*Oxythyrea cinctella*		1		1
21	*Astata boops*		1		
22	*Sarcophaga argyrostoma*		1		
23	*Bradysia sp.*		1		
24	*Anthaxia brevis*		1		
25	*Hippelates plebejus*		1		
26	*Bradysia sp.*		2		
27	*Auographa gamma*			1	

No	Species				
		No	No	No	No
28	*Ancistrocerus nigricornis*			1	
29	*Pantilius tunicatus*			1	
30	*Megachile sicula*			1	
31	*Chelonus sp.*			1	
32	*Lasioglossum villosulum*			2	3
33	*Drapetis sp.*			1	
34	*Anoplius sp.*				1
35	*Colpa quinquecinta*				2
36	*Colias croceus*				1
37	*Anthrenus sp.*				1
	Total	**26**	**11**	**24**	**28**

Table 14 Biodiversity indices per pan trap color at Vai – Lasithi.

INDEX					Overall
Species Richness	19	10	12	11	37
Simpson Index	0,06769	0,01515	0,1232	0,1481	0,07099
Shannon Index (ln)	2,681	2,369	2,174	2,058	3,068
Equitability Index	0,9105	0,9881	0,875	0,8581	0,8495

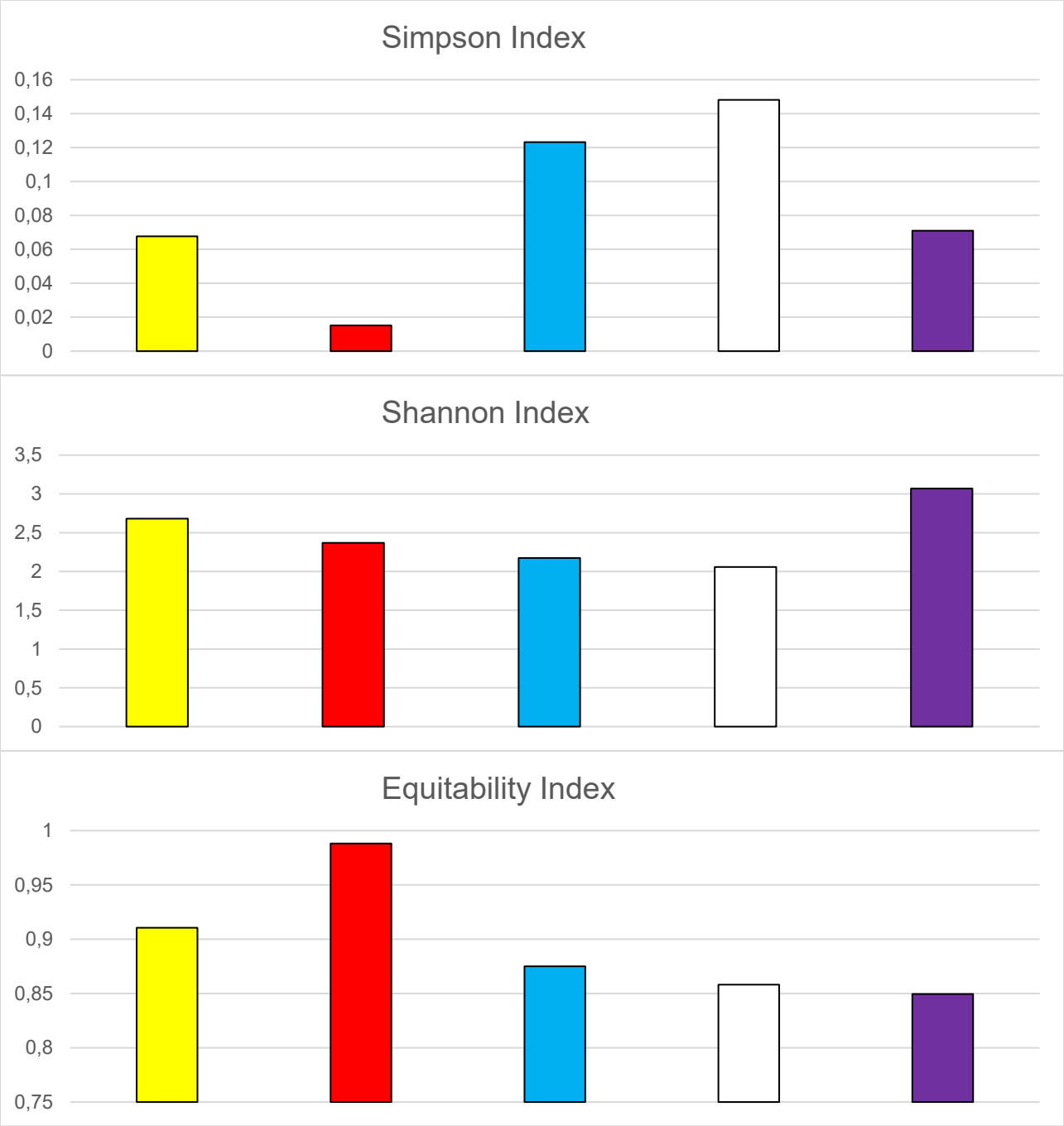


Figure 3 1 Biodiversity indices calculated for each pan trap color at Vai

2.5 Preveli – Rethymno

Thirteen species and 71 individuals were collected in Preveli forest. White traps were most effective, and Shannon Index was moderate (1.48). The site hosts a moderately diverse community. Performance is comparable to Souda, with yellow and white traps again proving most attractive.

Table 15 Order, family, species, and total number of individuals per species recorded at Preveli - Rethymno.

No	Order	Family	Species	Total No
1	Hymenoptera	Apidae	*Apis melifera*	23
2	Coleoptera	Scarabeidae	*Tropinota hirta*	1
3	Coleoptera	Melyridae	*Dasytes creticus*	34
4	Coleoptera	Melyridae	*Hypebaeus flavicollis*	1
5	Lepidoptera	Papilionidae	*Zerynthia cretica*	1
6	Lepidoptera	Noctuidae	*Heliothis peltigera*	1
7	Hemiptera	Miridae	*Closterotomus annulus*	1
8	Hemiptera	Miridae	*Closterotomus norwegicus*	1
9	Coleoptera	Melyridae	*Enicopus ater*	1
10	Hymenoptera	Formicidae	*Crematogaster sp.*	1
11	Hymenoptera	Halictidae	*Lasioglossum sp.*	4
12	Coleoptera	Buprestidae	*Anthaxia brevis*	1
13	Lepidoptera	Pieridae	*Pieris brassicae*	1
			Total	**71**

Table 16 Number of individuals per pollinator species recorded at Preveli - Rethymno, categorized by pan trap color (yellow, red, white, blue)

No	Species				
		No	**No**	**No**	**No**
1	*Apis melifera*	4	1	7	11
2	*Tropinota hirta*	1			
3	*Dasytes creticus*	12	1	8	13
4	*Hypebaeus flavicollis*		1		
5	*Zerynthia cretica*			1	
6	*Heliothis peltigera*			1	
7	*Closterotomus annulus*			1	
8	*Closterotomus norwegicus*			1	
9	*Enicopus ater*			1	
10	*Crematogaster sp.*			1	
11	*Lasioglossum sp.*				4
12	*Anthaxia brevis*				1
13	*Pieris brassicae*				1
	Total	**17**	**3**	**21**	**30**

Table 17 Biodiversity indices per pan trap color at Preveli - Rethymno

INDEX					Overall
Species Richness	3	3	8	5	13
Simpson Index	0,5294	0	0,2333	0,3195	0,33
Shannon Index (ln)	0,753	1,099	1,604	1,226	1,48
Equitability Index	0,6854	1	0,7712	0,7615	0,5771

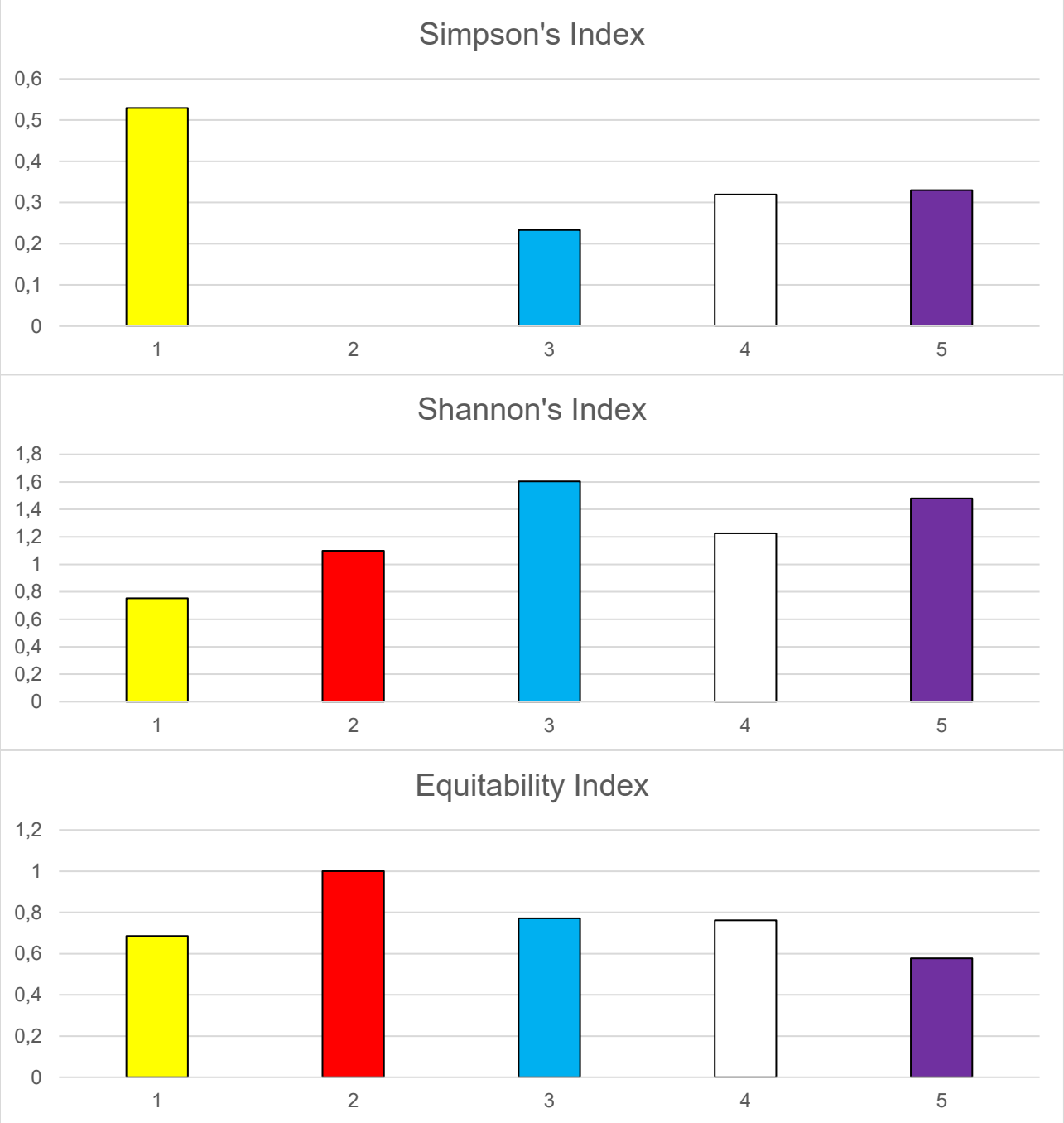


Figure 4 1 Biodiversity indices calculated for each pan trap color at Preveli

2.6 Souda – Rethymno

Ten species and 84 individuals were collected. Red traps were almost completely ineffective (1 insect). Diversity was moderate (Shannon = 1.64). A moderately diverse pollinator community, consistent with similar trap settings at other sites.

Table 18 Order, family, species, and total number of individuals per species recorded at Souda - Rethymno.

No	Order	Family	Species	Total No Ind
1	Lepidoptera	Noctuidae	*Auographa gamma*	1
2	Coleoptera	Scarabeidae	*Tropinota hirta*	6
3	Hymenoptera	Apidae	*Apis melifera*	27
4	Hymenoptera	Megachilidae	*Osmia sp.*	10
5	Coleoptera	Melyridae	*Dasytes creticus*	30
6	Hemiptera	Miridae	*Closterotomus norwegicus*	1
7	Lepidoptera	Adelidae	*Adela orientella*	1
8	Lepidoptera	Pieridae	*Pieris brassicae*	1
9	Coleoptera	Cleridae	*Trichodes creticus*	2
10	Coleoptera	Scarabeidae	*Oxythyrea cinctella*	5
			Total	**84**

Table 19 Number of individuals per pollinator species recorded at Souda - Rethymno, categorized by pan trap color (yellow, red, white, blue)

No	Species				
		No	**No**	**No**	**No**
1	*Auographa gamma*	1			
2	*Tropinota hirta*	2		2	2
3	*Apis melifera*	2		10	15
4	*Osmia sp.*	1		2	7
5	*Dasytes creticus*	3		15	12
6	*Closterotomus norwegicus*		1		
7	*Adela orientella*			1	
8	*Pieris brassicae*				1
9	*Trichodes creticus*				2
10	*Oxythyrea cinctella*				5
	Total	**9**	**1**	**30**	**44**

Table 20 Biodiversity indices per pan trap color at Souda - Rethymno

INDEX					Overall
Species Richness	5	1	5	7	10
Simpson Index	0,1389	NA	0,3494	0,2156	0,2458
Shannon Index (ln)	1,523	NA	1,187	1,628	1,642
Equitability Index	0,9463	NA	0,7377	0,8365	0,7133

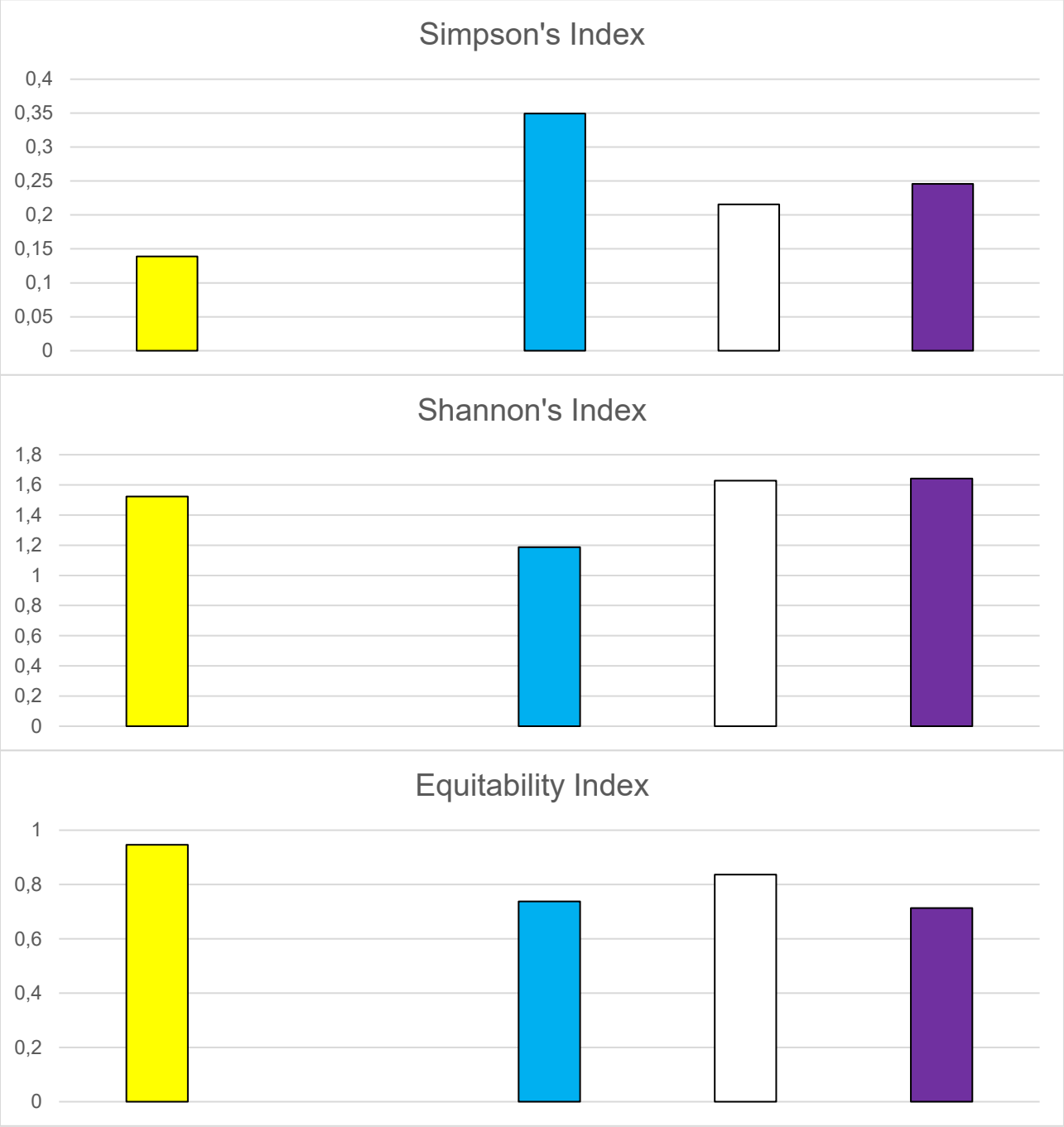


Figure 5 Biodiversity indices calculated for each pan trap color at Souda - Rethymno

3 CONCLUSIONS

Across all six pilot areas, 612 individuals representing 59 species were recorded.
Red traps consistently underperformed. Blue, yellow, and white traps attracted the highest richness and abundance.

- **Vai** was the richest and most balanced site, suggesting healthy habitat structure.
- **Martsalo** ranked second in diversity despite minimal sampling effort, indicating a high ecological value.
- **Agios Nikitas** had low richness but high evenness, possibly reflecting a small but stable pollinator community.

Table 21 Number of unique species and total insect individuals collected per pan trap color at each of the six pilot areas.

HABITAT	Unique Species	Total no	No	No	No	No	Pan traps
AGIOS NIKITAS	8	12	4		2	6	1
CHRYSOSKALITISSA	8	168	22	12	70	64	2
MARTSALO	19	188	36	11	33	108	2
PREVELI	13	71	17	3	21	30	3
SOUDA	10	84	9	1	30	44	2
VAI	28	89	26	11	24	28	4
Total		612	114	38	180	280	14

The most abundant species was ***Dasytes creticus*** **(**302 individuals**)**, found in all six areas. Other frequent species included ***Apis mellifera*** (74 ind.), ***Megaselia sp.*** (30 ind.), and ***Tiphia* sp.** (27 ind.).

Table 22 Abundance of insect taxa across sampling sites. The table includes the number of individuals per species per location, taxonomic group and pollination status.

Taxon	Agios Nikitas	Chryso skalitisa	Martsalo	Preveli	Souda	Vai	Total	Group	Pollination Status
Dasytes creticus	3	140	88	34	30	7	302	Beetle	Yes
Apis melifera		4		23	27	20	74	Bee	Yes
Megaselia sp.			30				30	Fly	Possible
Tiphia sp			27				27	Wasp	Possible
Oxythyrea cinctella			13		5	2	20	Beetle	Yes
Lasioglossum sp.		15		4			19	Bee	Yes
Osmia sp.	1	5			10		16	Bee	Yes
Tropinota squalida			4			6	10	Beetle	Yes
Hecamede albicans						9	9	Fly	No

Bradysia sp.	2					5	7	Fly	Possible
Tropinota hirta				1	6		7	Beetle	Yes
Anaspis flava						5	5	Beetle	Yes
Lasioglossum villosulum						5	5	Bee	Yes
Stomorhina lunata						5	5	Fly	Yes
Anthaxia brevis			2	1		1	4	Beetle	Yes
Anthrenus pimpinellae			4				4	Beetle	No
Hypebaeus flavicollis	2	1		1			4	Beetle	No
Lasioglossum punctatisimum			4				4	Bee	Yes
Drapetis sp.						3	3	Fly	No
Drosophila funebris			3				3	Fly	Possible
Autographa gamma		1			1	1	3	Butterfly	Yes
Resseliella sp.			2				2	Fly	Possible
Trichodes creticus					2		2	Beetle	Yes
Sciapus sp.		1	1				2	Fly	Possible
Delia antiqua			2				2	Fly	Possible
Pieris brassicae				1	1		2	Butterfly	Yes
Eumerus sogdianus			1			1	2	Fly	Yes
Sarcophaga argyrostoma						2	2	Fly	Possible
Hippelates plebejus						2	2	Fly	Possible
Anthocomus fenestratus						2	2	Beetle	No
Closterotomus norwegicus				1	1		2	Hemiptera	No
Colpa quinquecinta						2	2	Wasp	No
Lauxania shewelli			2				2	Fly	Possible
Coenosia infantula			1			1	2	Fly	No
Crematogaster sp.				1			1	Ant	No
Ancistrocerus nigricornis						1	1	Wasp	No
Suillia variegata			1				1	Fly	Possible
Anthrenus sp.						1	1	Beetle	No
Acalyptris sp			1				1	Moth	No
Enicopus ater				1			1	Beetle	No
Spilogona dispar						1	1	Fly	Possible

Anthomyia sp.	1						1	Fly	Possible
Astata boops						1	1	Wasp	No
Lotophila sp			1				1	Fly	Possible
Zerynthia cretica				1			1	Butterfly	Yes
Megachile sicula						1	1	Bee	Yes
Sciapus platypterus						1	1	Fly	Possible
Ancistrocerus sp.	1						1	Wasp	No
Sierola sp			1				1	Wasp	No
Anoplius sp.						1	1	Wasp	No
Closterotomus annulus				1			1	Hemiptera	No
Chelonus sp.						1	1	Wasp	No
Horistus infuscatus	1						1	Bug	No
Pantilius tunicatus						1	1	Hemiptera	No
Adela orientella					1		1	Butterfly	Yes
Colias croceus						1	1	Butterfly	Yes
Pieris rapae	1						1	Butterfly	Yes
Linnaemya sorror		1					1	Fly	No
Heliothis peltigera				1			1	Butterfly	Yes
Grand Total	12	168	188	71	84	89	612		

Simpson's index is a diversity index that quantifies the probability of two randomly selected individuals belonging to the same species. A higher index value indicates lower diversity, meaning there is a greater probability that two randomly selected individuals will belong to the same species. The Shannon-Wiener Index (also known as the Shannon Index) is a widely used measure of biodiversity that combines species richness and species equitability (evenness). It quantifies the uncertainty in predicting the next individual's species when randomly selecting from a community. A higher index value indicates greater diversity within the community. Finally, Shannon-Wiener Equitability Index is a measure that quantifies the evenness or distribution of species within a community. It assesses how equally abundant each species is in comparison to the others.

Overall, Vai had the richest entomofauna (37 species), followed by Martsalo (20 species) – nevertheless, in this comparison it should also be pointed out that sampling effort was not uniform among the areas, as the number of pan-traps was directly related to the size of each area (3 traps in Preveli, 4 traps in Vai, and 2 traps in every other area).

Despite the above-mentioned admission, the outperformance of Vai is efficiently demonstrated by all diversity indices. Consequently, it can be safely deducted that this result is not only due to the number of pan traps installed, but also due to the overall better condition of Vai compared to the other areas (e.g. larger area, more diverse flora).

Shannon-Wiener index exhibited the highest value for Vai, something that coupled with the high Equitability Index (0.8495) value, support well the good condition of Vai, compared to the other areas. In Agios Nikitas, the high value of the Equitability Index is predominantly an artifact of the low yet nicely distributed species and does not necessarily reflect the real condition of the area.
To further verify the fact that the number of traps did not induce a strong bias, Martsalos, with only two traps, had the second richest community of pollinators (20 species), though only two traps were deployed. On the contrary, in Preveli where three traps were deployed, 13 species were collected, a result directly comparable with the performance in Souda (10 species).
In all areas, regardless of the number of pan-traps deployed, the red color remained the less preferred color, with some cases where no insect (Agios Nikitas) or only one species (Souda) was attracted to this color. On the contrary, yellow and white colors attracted almost consistently the majority of species recorded, with the blue being ranked third.

Table 23 Biodiversity indices per pan trap color

Index	Location					Overall
Species Richness	Agios Nikitas	4	0	2	4	8
	Martsalo	12	6	6	11	20
	Chrysoskalitissa	6	2	4	3	8
	Vai	19	10	12	11	37
	Preveli	3	3	8	5	13
	Souda	5	1	5	7	10
Simpson Index	Agios Nikitas	0	0	0	0,2	0,07576
	Martsalo	0,1825	0,1636	0,4508	0,2982	0,2655
	Chrysoskalitissa	0,381	0,8333	0,8625	0,6602	0,7022
	Vai	0,06769	0,01515	0,1232	0,1481	0,07099
	Preveli	0,5294	0	0,2333	0,3195	0,33
	Souda	0,1389	NA	0,3494	0,2156	0,2458
Shannon Index (ln)	Agios Nikitas	1,386	0	0,6931	1,242	1,979
	Martsalo	1,915	1,594	1,055	1,642	1,85
	Chrysoskalitissa	1,21	0,2868	0,3252	0,5919	0,6832
	Vai	2,681	2,369	2,174	2,058	3,068
	Preveli	0,753	1,099	1,604	1,226	1,48
	Souda	1,523	NA	1,187	1,628	1,642
Equitability Index	Agios Nikitas	1	0	1	0,8962	0,9518
	Martsalo	0,7706	0,8897	0,5888	0,6849	0,6174
	Chrysoskalitissa	0,6751	0,4138	0,2346	0,5388	0,3286
	Vai	0,9105	0,9881	0,875	0,8581	0,8495
	Preveli	0,6854	1	0,7712	0,7615	0,5771
	Souda	0,9463	NA	0,7377	0,8365	0,7133

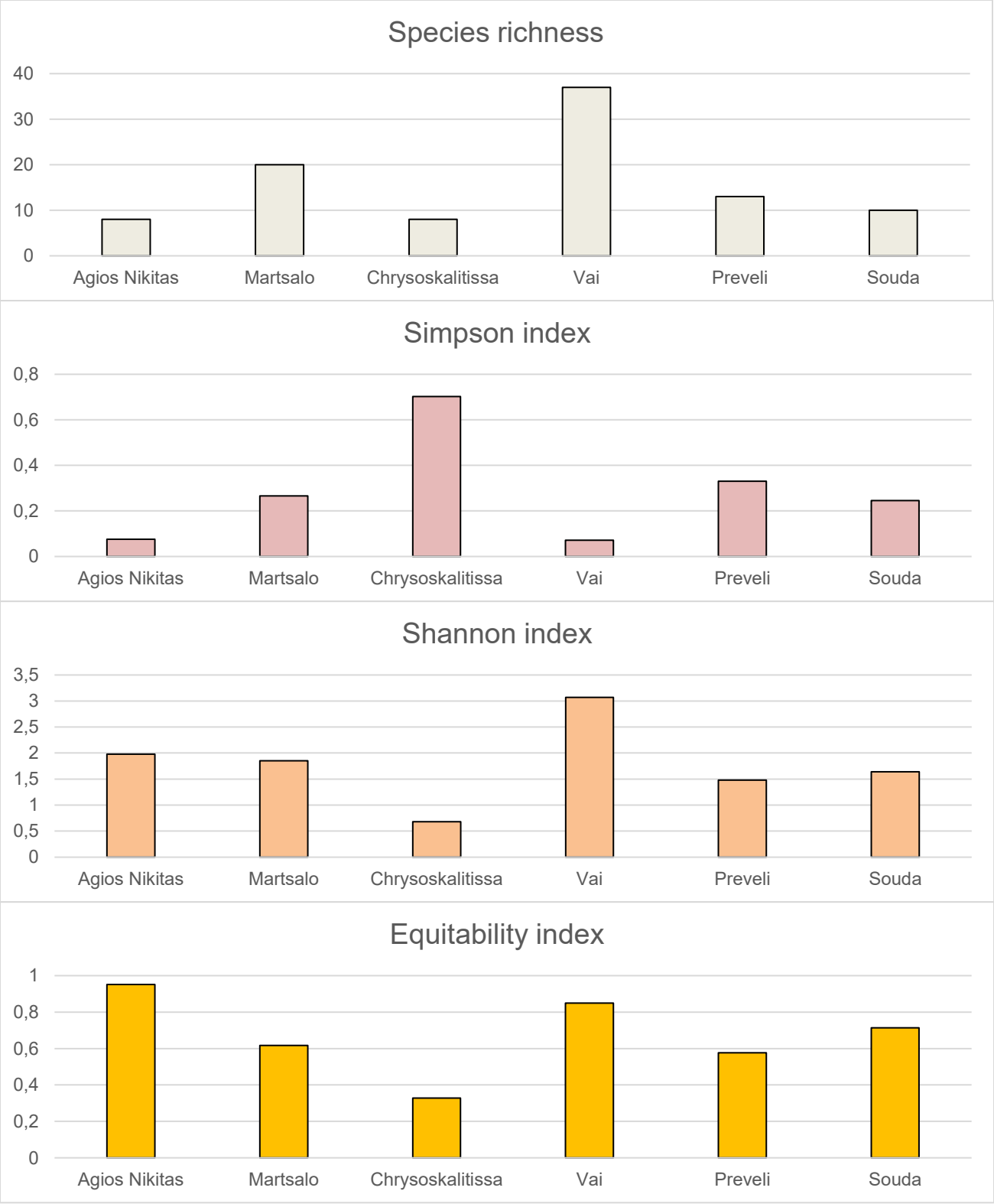
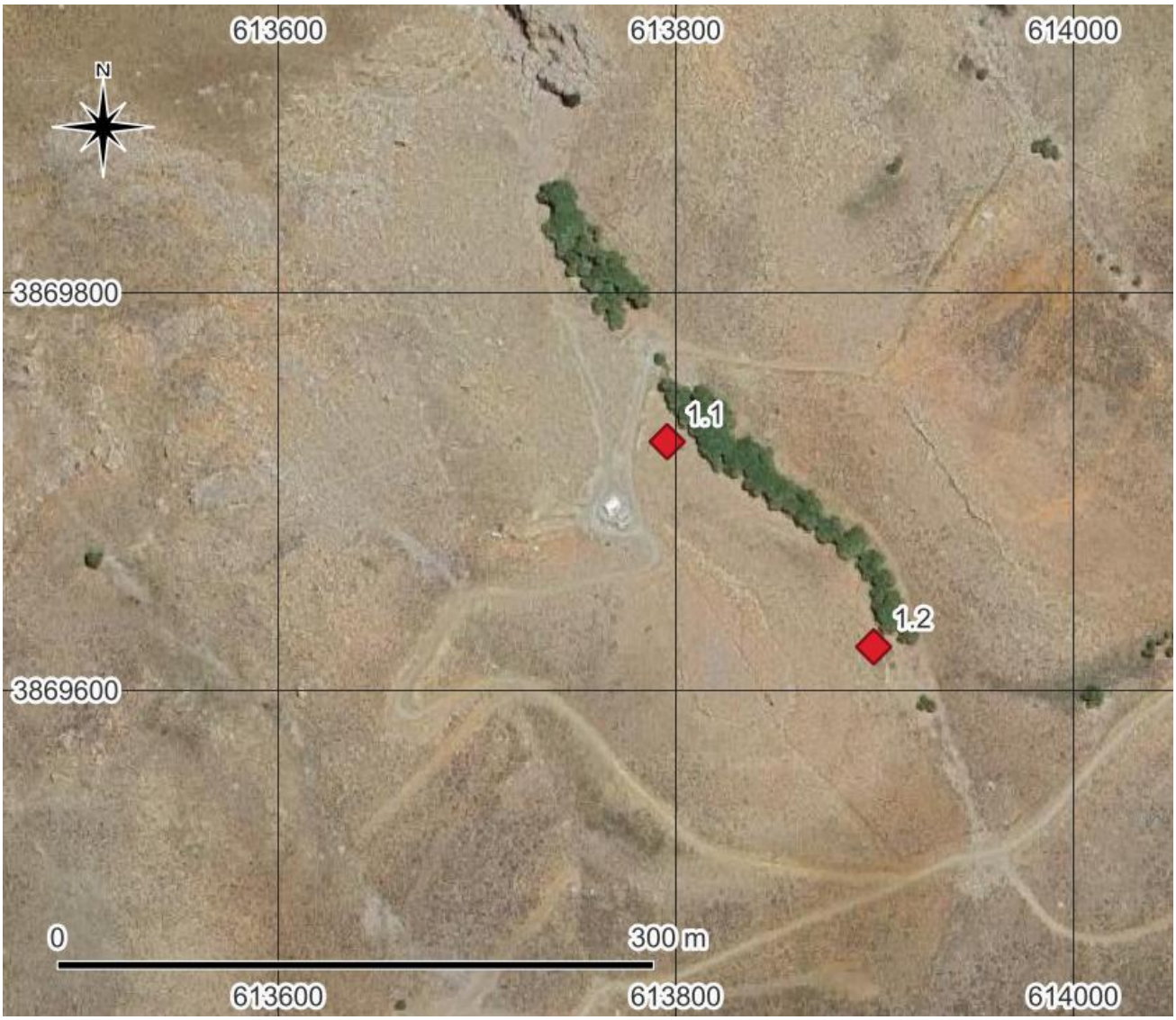


Figure 6 Biodiversity indices per pilot area. The table presents Species Richness, Simpson's Index, Shannon Index (ln), and Equitability Index.

4 ANNEX

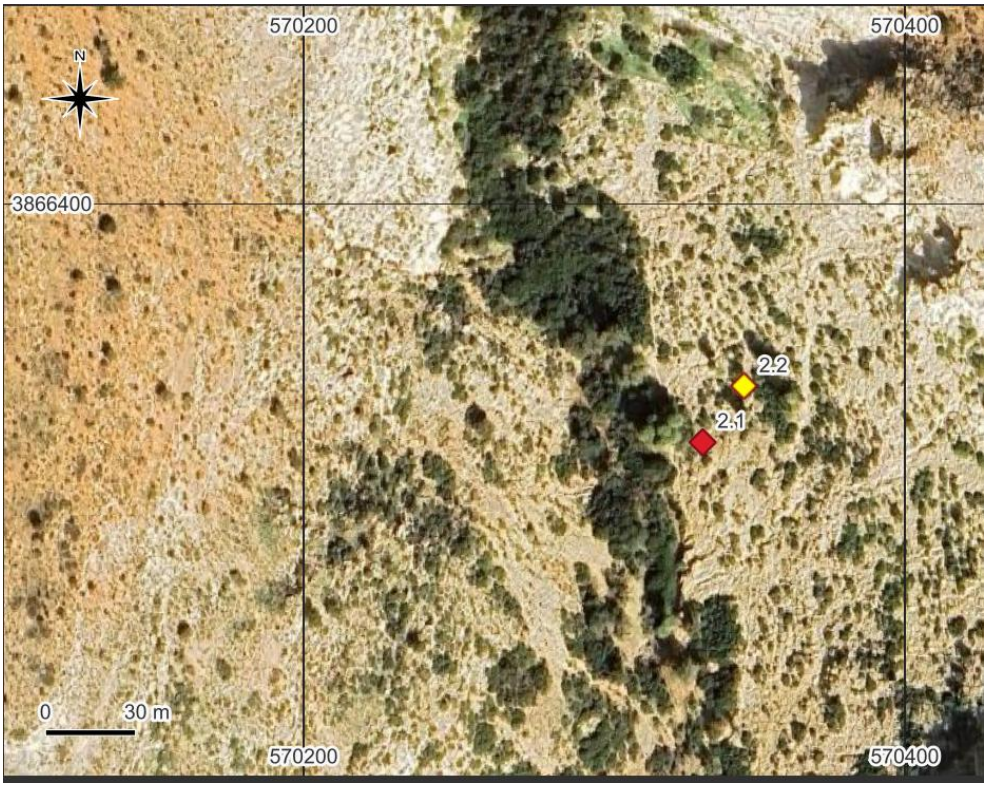
4.1 Agios Nikitas - Heraklion



Map 1 Location of the traps in Agios Nikitas

Image 1 Traps 1.2

4.2 Martsalos - Heraklion



Map 2 Location of the traps in Martsalos

Image 2 Traps 2.1

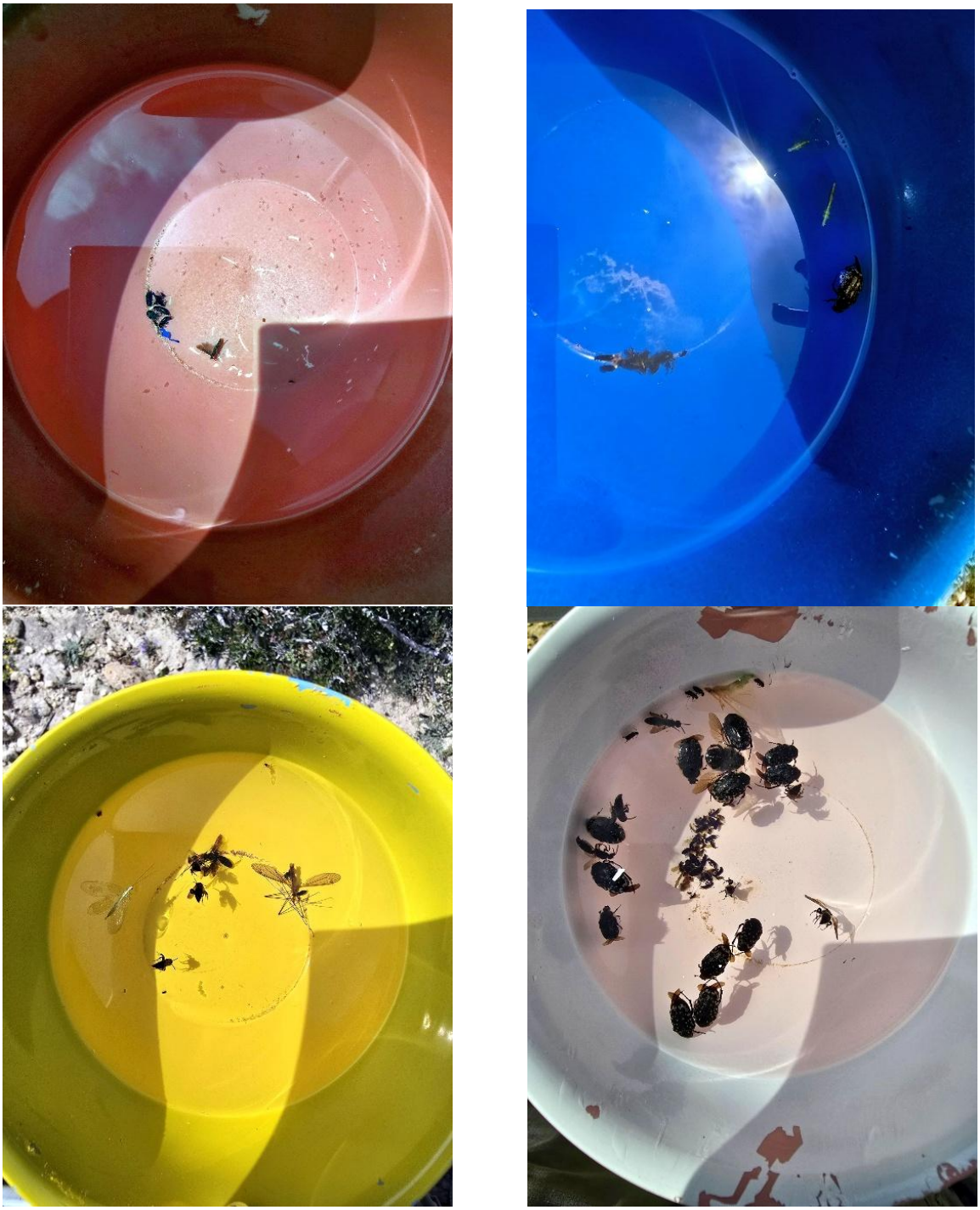


Image 3 Traps 2.2.

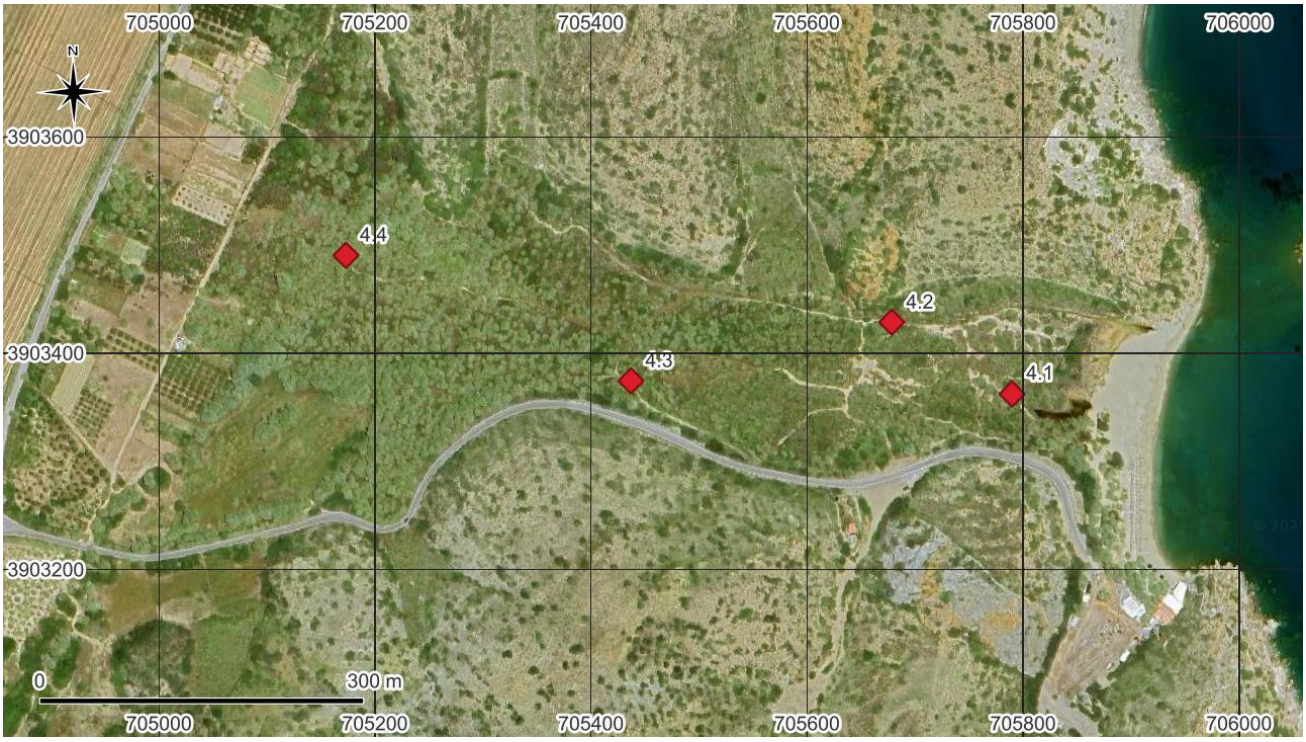
4.3 Chrisoskalitissa - Chania

Map 3 Location of the traps in Chrysoskalitissa Chania

Image 4 Traps 3.1

Image 5 Traps 3.2

4.4 Vai - Lasithi



Map 4 Location of the traps in Vai

Image 6 Traps 4.1

Image 7 Traps 4.2

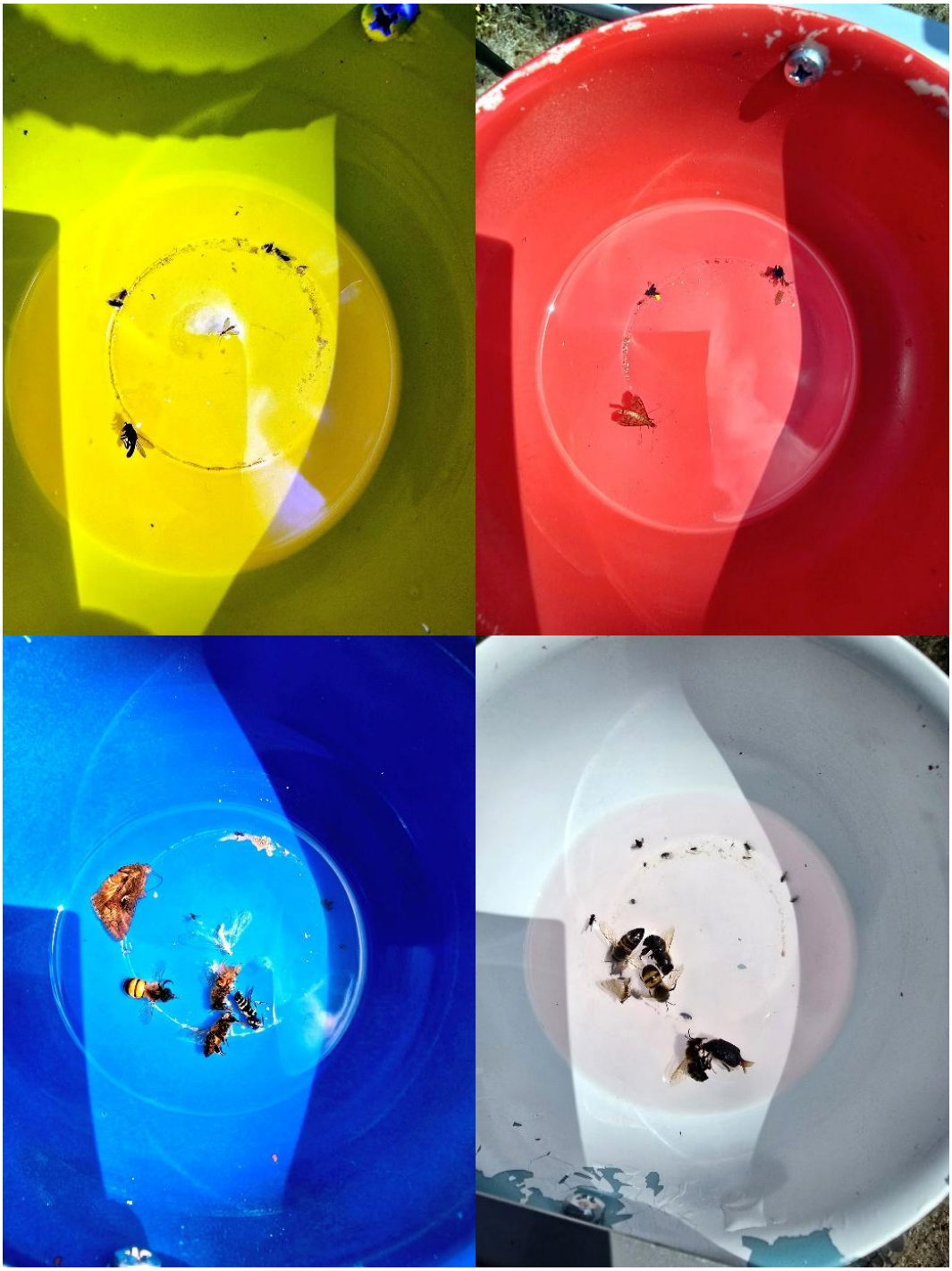
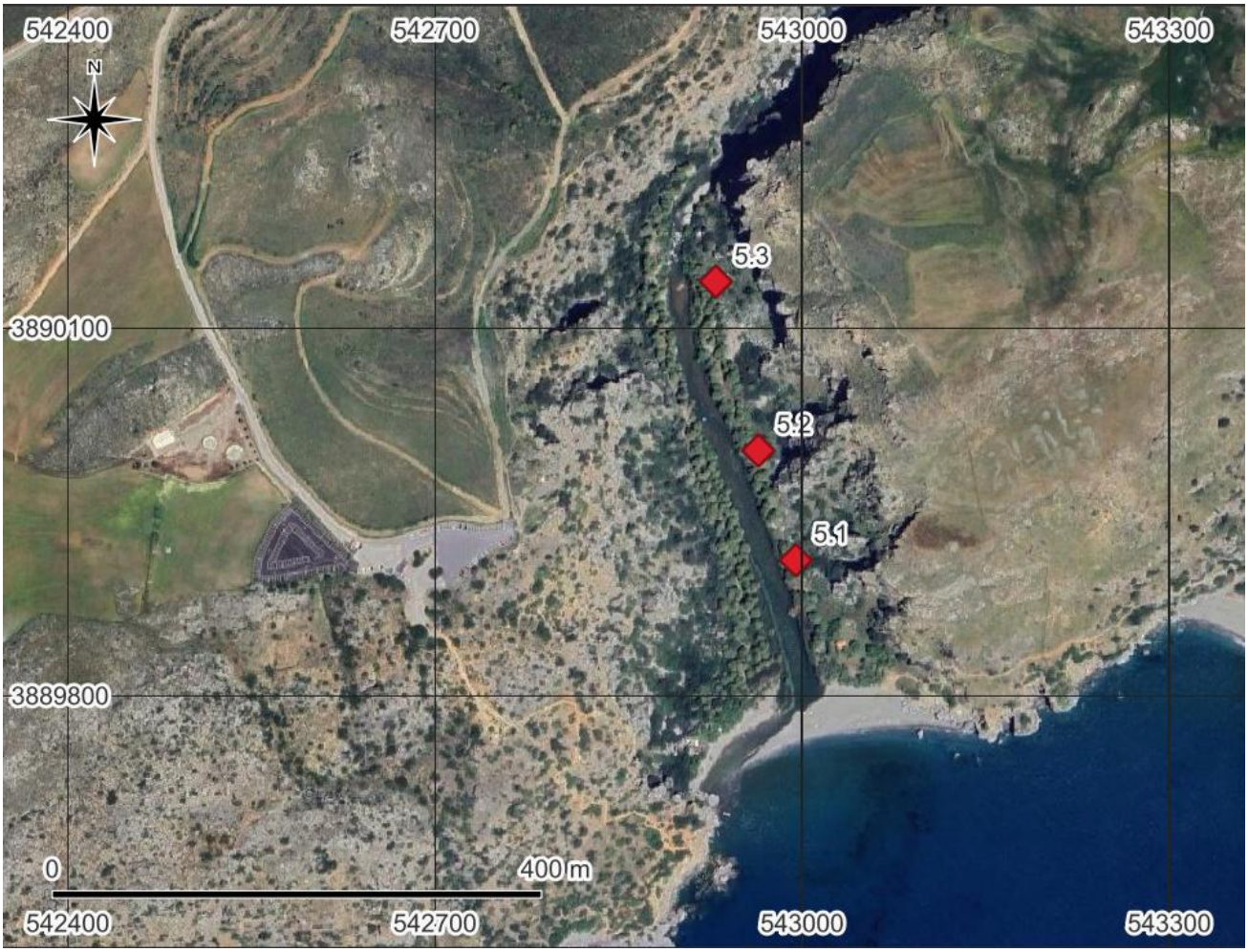


Image 8 Traps 4.3

Image 9 Traps 4.4

4.5 Preveli - Rethymno



Map 5 Location of the traps in Preveli

Image 10 Trap 5.1

Image 11 Trap 5.1

Image 12 Trap 5.2

Image 13 Traps 5.3

Image 14 Trap 5.3

4.6 Souda - Rethymno

Map 6 Location of the traps in Souda

Image 15 Trap 6.1

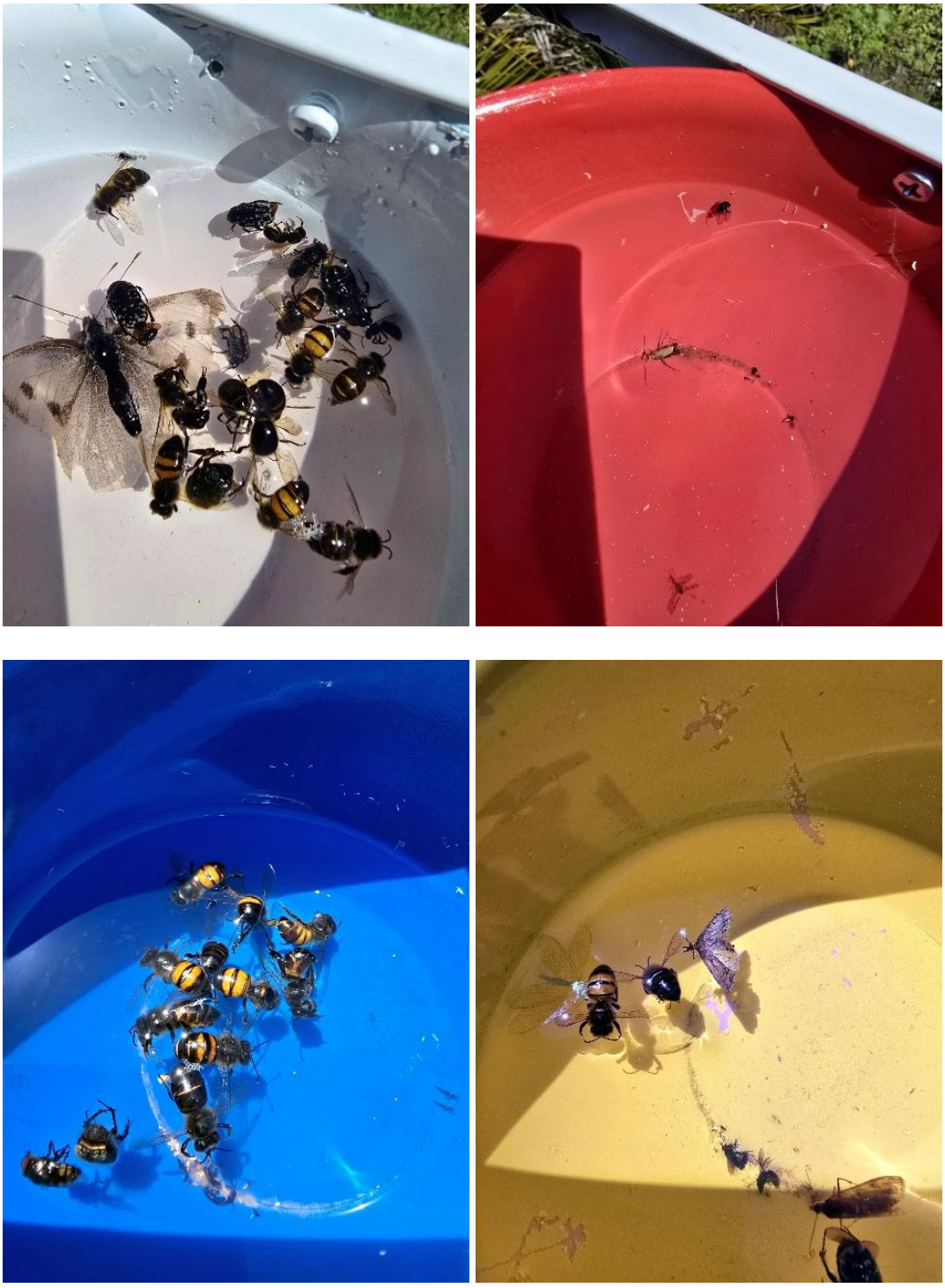


Image 16 Trap 6.1

Image 17 Trap 6.2

Image 18 Trap 6.2

5 REFERENCES

Cabildo de Gran canaria, 2004. Plan Director de Reserva Natural Especial. Reserva Natural Especial de Güi-Güí.. BOC 59/2004, de 25 de marzo: https://ordenacion-espacios-protegidos.idegrancanaria.es/?ucode_enp=C-08_20040325_APDEF

Cabildo de gran canaria, 2011. Plan Especial de Paisaje Protegido. Paisaje Protegido de Fataga. BOC 125/2011, de 27 de junio: https://ordenacion-espacios-protegidos.idegrancanaria.es/?scode_enp=C-27_20110627_APDEF

Cabildo de Gran Canaria, 2022. Plan Insular de Ordenación: https://plan-insular.idegrancanaria.es/?ucode=PIOGC_2022.

Goulson, D. (2019). The insect apocalypse and why it matters. Current Biology, 29(19), R967–R971.

Klein, A. M., Vaissière, B. E., Cane, J. H., Steffan-Dewenter, I., Cunningham, S. A., Kremen, C., & Tscharntke, T. (2007). Importance of pollinators in changing landscapes for world crops. Proceedings of the Royal Society B: Biological Sciences, 274(1608), 303–313.

Ollerton, J., Winfree, R., & Tarrant, S. (2011). How many flowering plants are pollinated by animals? Oikos, 120(3), 321–326.

Russell, J. C., & Kueffer, C. (2019). Island biodiversity in the Anthropocene. Annual Review of Environment and Resources, 44, 31–60.

Sánchez-Bayo, F., & Wyckhuys, K. A. G. (2019). Worldwide decline of the entomofauna: A review of its drivers. Biological Conservation, 232, 8–27.

Wagner, D. L., Grames, E. M., Forister, M. L., Berenbaum, M. R., & Stopak, D. (2021). Insect decline in the Anthropocene: Death by a thousand cuts. Proceedings of the National Academy of Sciences, 118(2), e2023989118.

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