Senckenbergiana maritima | 38 | (2) | 131–135 | Frankfurt am Main 30.12.2008

First stages of arthropod colonisation of a sand bank island in the German Wadden Sea

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With 4 Figures, 2 Tables, 1 Appendix

Abstract

[Niedringhaus, R. & Lieckweg, T. (2008): First stages of arthropod colonisation of a sand bank island in the German Wadden Sea. – Senckenbergiana maritima, **38** (2): 131–135, 4 Figs., 2 Tabs., 1 App., Frankfurt am Main]

In 2007, we surveyed the arthropod fauna of Kachelotplate, a newly emerging sandbar west of Juist Island, southern North Sea. Sampling methods involved pitfall traps, coloured pan traps, targeted searches as well as sampling for predetermined time intervals by means of a pooter and sweep nets. The survey yielded a total of 46 species, including 21 species of beetles, 10 species of flies, 8 hymenopterid species, 5 species of spiders and 2 species of bugs. More than half of the species were recorded from embryonic dune sites. The arthropod assemblage of the driftline was mostly composed of beetles.

Based on their known habitat requirements, 22 species appear capable of permanent establishment on Kachelotplate. However, the storm surge events in 2007 have prevented most of these species from establishing permanent populations. Immediately after the floods, the sandbar was recolonised by anemochoric or anemohydrochoric dispersal.

In order to achieve a more comprehensive picture of the primary colonisation process during the formation of the island and to determine fluctuations in numbers and composition of the species assemblages, a long-term field study over several years is required.

Introduction

Islands are particularly suited for analysing distribution patterns of species assemblages and their dynamics in space and time. Important factors such as size, isolation and age of development are easily determined. Islands are often "more simple" in structure and their communities of organisms are more easily to survey.

It was not until the sixties of the last century when islands were brought to the attention of ecologists by the "equilibrium theory of insular biogeography" of Robert MacArthur and Edward Wilson (1963, 1967). Their concept, which seeks to explain species numbers of organismic assemblages by the parameters size and degree of isolation of an island in first place, provoked lively debate and extensive conceptual advances that have precipitated in a plethora of publications to the present day (for reviews see Connor & McCoy 1979, Williamson 1981).

The chain of East Frisian dune islands situated off the central European mainland offer all advantages as study sites: The islands emerged independently from the mainland, so that all organisms had – and still have – to immigrate. The islands share many features, but do also differ in size, degree of isolation, landscape structure as well as age and state of development. The islands show a characteristic set of well distinguishable habitats on a small scale which themselves can be viewed as "islands", due to their mosaic-like distribution ("habitat patches").

Numerous studies have been published over the last 30 years involving various arthropod groups of the old East Frisian Islands, i.e. those islands that are more than 3.000 years old (see the compilations of Bröring et al. 1993 and Niedringhaus et al. 2008), and of the islands of Memmert and Mellum (Haeseler & Meyer 1988) that were formed as recently as 120 years ago. These studies have exemplified the effects upon colonisation success both of habitat-related factors (area size, isolation, habitat diversity) and of organism-related factors (dispersal potential, body size, hibernation and diapause, generation cycle, habitat/food specialisation).

However, for several species colonisation success or failure

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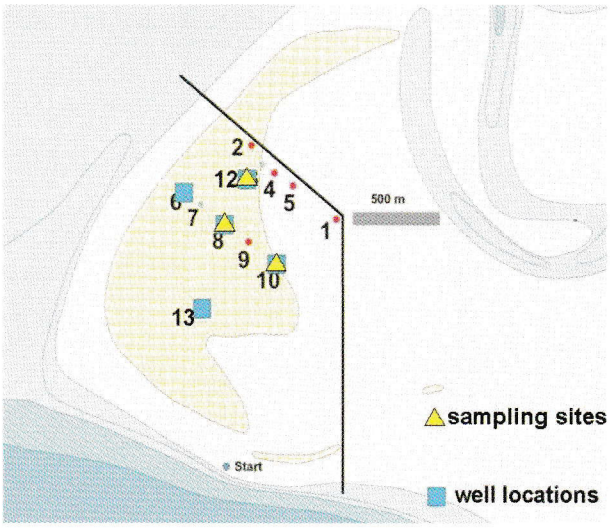

Fig. 1: Location of sampling sites (coloured pans and barber traps) on Kachelotplate sandbar.

could not be linked to any of these factors (NIEDRINGHAUS 2002) and so hitherto unknown parameters or chance phenomena have been considered to play a role in the colonisation process.

Especially with respect to assessing the potential impact of chance phenomena, the study of an ongoing primary colonisation process as presented in this paper is of particular importance.

Materials and methods

Site description

The Kachelotplate sandbar (Fig. 1) is situated in the eastern part of the chain of East Frisian Islands (southern North Sea). Its precise location is three kilometres west of the uninhabited island of Memmert and about five kilometres southwest of the island of Juist from which it is separated by the Haaksgat channel. The area between Kachelotplate and Memmert Islands falls dry at low tide. The distance to the nearest mainland coast is about 18 kilometres.

In 2007, the highest elevation points of the sandbar were about 1.5 metres above mean high water level. Mean tidal ranges are between 2.4 m and 2.7 m. The sediment consists of quartz sand. Microbial stabilisation due to biofilms comprising benthic diatoms and cyanobacteria is a local phenomenon of the upper intertidal and lower supratidal zones only. In spring 2007, the crests of the sandbar were covered by primary dunes with sand couch (*Elymus farctus* ssp. *boreoatlanticus*) and sometimes lyme grass (*Leymus arenarius*). Later in the year, these dunes were almost entirely washed away by storm surge events, but recovered quickly afterwards.

The initial dunes are inhabited by a limited number of plant species. Storm tides intermittently flood the entire sandbar, thus causing erosion in the central part of the sandbar and reducing the dunes. Salt concentration in the saturated zone is about half of the concentration of the surrounding seawater. The presence of brackish groundwater in the sandbar is likely due to infiltration of precipitation.

Sampling methods

Three standard sampling methods were used in the recording of the arthropod fauna:

1. Pitfall traps: Three plastic tubes of 100 centimetres in length and 10 centimetres in diameter, each provided with three bored holes three centimetres below the upper rim for draining excess water after inundations and filled with concentrated salt solution as trapping fluid, were buried into the ground flush with the top rim of the trap at the highest elevation sites of the sandbar. The traps stayed in place from 22 May to 13 August 2007.
2. Coloured pan traps: The set of traps consisted of three customary plastic buckets in red, yellow, and blue, with each bucket furnished with a funnel inside it, filled with concentrated salt solution as trapping fluid and provided with a three-dimensional cross made of acrylic glass and mounted on top of the rim (Fig. 2). The set of traps was placed at the highest elevation site of the sandbar to stay in place from 22 May to 13 August 2007. The combination of coloured pan trap (providing a visual attractant) and "windshield trap" (acrylic glass sheets) were designed to attract and trap winged insects as well as floating arthropods (e.g., spiders), as these inadvertently collide with the acrylic windows.
3. Time-interval collecting and targeted searches by means of a pooter and sweep nets: One collecting bout of 15 minutes each was conducted in four preselected sections of the driftline and at four primary dune sites on 22 May and again on 18 June, 16 July and 13 August 2007.

Fig. 2: Design of the coloured pan trap modified by the addition of an acrylic "windshield trap" (see text for further explanation).

Comparison of methods: Of the three sampling methods employed, the **pitfall traps** yielded no appreciable results in terms of numbers and diversity of arthropods captured (Figs 3 and 4). The catch was a total of four specimens belonging to two species of spiders and one species of beetle. This poor performance was due to the traps being covered by sand and flooded with water particularly in the beginning of the field study.

With respect to the **coloured pan traps**, the yellow bucket proved to be most attractive to arthropods with 16 specimens out of 10 species captured, whereas the red bucket was least effective with only three specimens out of two species. Overall, the set of coloured pan traps yielded a total of 33 specimens out of 17 species. However, the performance of the traps was impeded by the action of sand and water which resulted in series of catches being partly or completely lost. Proper functioning of the traps was largely maintained only after the buckets had been mounted on metal tripods 60 centimetres high (from 18 June onwards). Even during the storm surge event of 26 June 2007 the traps did not suffer particular damage, despite the water level above ground level attained more than one metre.

The best trapping results were obtained by **time-interval collecting**. This method yielded a total of 149 specimens out of 36 species which amounts to 80 percent of all specimens captured and 78 percent of all species recorded in this study. The targeted searches of the driftline and sheltered primary dune habitats were particularly successful with respect to beetles and hymenopterids, despite bad weather conditions during most of the four sampling days.

Results

Composition of the arthropod assemblage

The present survey yielded a total of 217 specimens out of 62 arthropod species (see Appendix), with 31 specimens out of 16 species recovered dead from the driftline. 186 specimens were caught alive. 140 of these specimens were identified to species-level, the remainder individuals – mostly flies – to genus or family. The total number of arthropod species recorded from Kachelotplate sandbar is 46, including 21 species of beetles, 10 species of flies, 8 hymenopterid species (6 species of ants, two species of ichneumon wasps), 5 species of spiders and 2 species of bugs (Table 1).

Table 1: Numbers of arthropod species recorded alive from Kachelotplate sandbar between May and August 2007.

Arthropod group	Number of species	Number of specimens
spiders	5	12
bugs	2	2
beetles	21	81
hymenopterids	8	38
flies	10	53
total	46	186

Spatial distribution

Most species were recorded from and around embryonic dunes (Table 2). These highest elevation sites contained more than half of the species (N = 29) and most of these (N = 21) were found only here. The arthropod assemblage of the driftline was mostly composed of beetles (N = 15), including 8 species of ground beetles. The only arthropod species recorded from the intertidal sand flats (and sometimes in large numbers) was *Cillenus lateralis*, a ground beetle typical of this habitat type.

Table 2: Numbers of arthropod species and specimens recorded (alive) from Kachelotplate according to main habitat type.

Arthropod group	Number of species and specimens recorded from					
	intertidal sandflat		driftline		embryonic dunes	
spiders			1	2	5	10
bugs					2	2
beetles	1	30	15	44	6	7
hymenoptera			4	10	7	28
flies			4	27	9	26
total	1		24	83	29	73

Discussion

As is widely known, a one-year survey of the arthropod fauna will not give a precise representation of its diversity and abundance. Furthermore, allowance has to be made for the technical problems with the traps in the beginning of the field study. Hence, it seems save to assume that the 46 species recorded alive during the present survey do not represent the complete spectrum of arthropod species of Kachelotplate.

22 species are specialists of intertidal sandflats, driftline or dune habitats. With regard to habitat availability, these species should be capable to establish themselves successfully. However, the storm surge events in 2007 have prevented most of them from establishing permanent populations, including two species of bugs, 14 species of beetles, three species of ants and three species of flies.

Trigonotylus psammaecolor bugs are restricted to primary and secondary dune habitats where they occur on *Elymus* and *Ammophila*, *Lygus maritimus* bugs are found on various halophytes (*Cakile maritima* on Kachelotplate sandbar). Being widely distributed and sometimes common on the East Frisian Islands (Bröring 2008), both species can repeatedly recolonise the sandbar through displacement from Memmert or Juist Islands.

The beetle component is dominated by ground beetles which were recorded with 45 individuals out of 8 species. This figure should be seen against the background that the fauna of ground beetles currently recorded from the East Frisian Islands comprises 214 species (Plaisier & Stumpe 2008). Particularly numerous is *Cillenus lateralis*, a specialist of the littoral sandflats. Both its larvae and adults can readily survive periods of inundation in air-filled spaces in the sand, under logs or stones. The remainder, although being halobiontic species

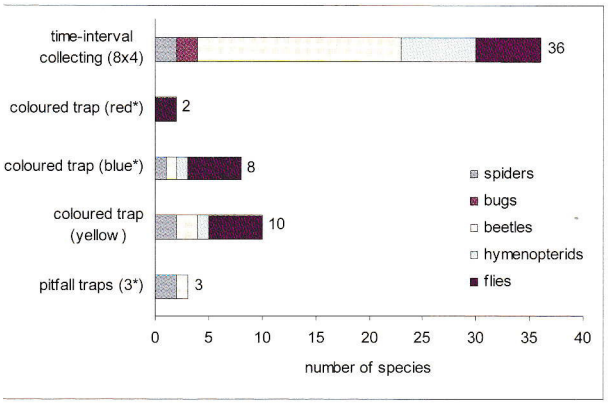

Fig. 3: Numbers of arthropod species obtained from the different sampling methods employed (*trap performance impeded by the action of sand and water).

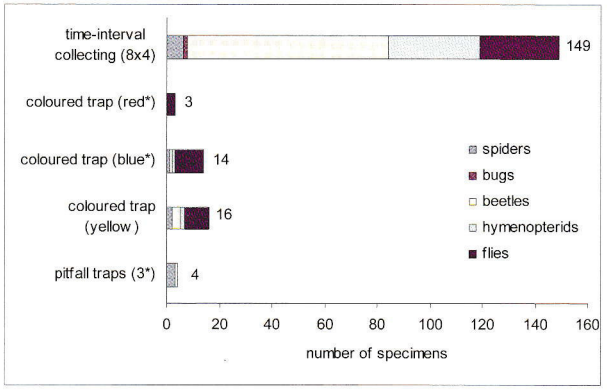

Fig. 4: Numbers of specimens obtained from the different sampling methods employed (*trap performance impeded by the action of sand and water).

that can tolerate ordinary floods, are most likely washed away during a storm flood event as experienced during the study period. However, the sandbar is recolonised immediately afterwards by anemochoric or anemohydrochoric dispersal from the neighbouring islands. Fast colonisation by ground beetles in particular of a newly formed island has already been documented by Topp (1988) in the case of Hoher Knechtsand, a sandbar that emerged in the late 1950s in the eastern part of the Weser estuary. All species of ground beetles recorded from Kachelotplate were also found on Knechtsand, along with numerous other immigrant species; however, only 17 species were classified as – at least temporarily – successful colonists. This comparatively large number is due to the rapid formation of wide dune areas on Knechtsand.

The second most abundant group of beetles of Kachelotplate are rove beetles (Staphylinidae), with 19 specimens out of three species recorded. Two of these species belong to the large genus *Bledius*, which is represented with 20 species on the East Frisian Islands (Rose 2008). Several of these staphylinids live in self-dug, sometimes extensive burrows on coastal shores. Hence, both species recorded from Kachelotplate are expected to readily survive storm flood events.

The three species of ants found on Kachelotplate have previously been recorded from all East Frisian Islands and are abundant in places (Haeseler 2008). Only males and females on their mating flights were seen but no workers, suggesting that colonies had not been founded yet. However, resettlements from neighbouring islands are possible any time.

The recording of flies from Kachelotplate is still incomplete. Several species of the families Canacidae, Coelopidae, Helcomyzidae and Tethinidae are known from the East Frisian Islands (von Tschirnhaus 2008) which predominantly live among beach-cast algae (see Remmert 1960). Of these only a single species, *Rhicnoessa grisea*, has been identified from Kachelotplate. Members of fly families other than above are also expected to occur on Kachelotplate (see ibid.).

Similar studies into the primary colonisation by arthropods of newly formed or young islands (Topp 1975, 1979, 1988) have shown that the species assemblages are subject to qualitative and quantitative changes. This is also expected to occur on Kachelotplate, especially in view of the ongoing processes of colonisation and recolonisation after storm flood events. In order to separate colonisation patterns and habitat occupancy from chance effects, a long-term field study over several years is required.

Acknowledgements

The authors wish to thank the following for assistance with the identification of specimens: Oliver-David Finch (Oldenburg; Araneae), Volker Haeseler (Oldenburg; Hymenoptera), Heiner Krummen (Oldenburg, parts of Coleoptera), Armin Rose (Wardenburg; Coleoptera: Staphylinidae) and Michael von Tschirnhaus (Bielefeld; Diptera).

The study was financially supported by the Ministry for Science and Culture of Lower Saxony.

References

Bröring, U. (2008): Die terrestrischen Wanzen der Ostfriesischen Inseln (Heteroptera). – In: Niedringhaus, R., Haeseler, V. and Janiesch, P. (Hrsg.): Die Flora und Fauna der Ostfriesischen Inseln. – Schr.R. Nationalpark Nieders. Wattenmeer **11**: 155–164.

Bröring, U., Dahmen, R., Haeseler, V., Lemm, R. von, Niedringhaus, R. and Schultz, W. (1993): Dokumentation der Daten zur Flora und Fauna terrestrischer Systeme im niedersächsischen Wattenmeer. – Ber. Ökosystemforschung Wattenmeer, **2** (1): 1–119; **2** (2): 1–207.

Connor, E.F. & McCoy, E.D. (1979): The statistics and biology of the species-area relationship. – Am. Nat., **113**: 791–833.

Haeseler, V. (2008): Ameisen, Wespen und Bienen der Ostfriesischen Inseln (Hymenoptera: Aculeata). – In: Niedringhaus, R., Haeseler, V., Janiesch, P. (Hrsg.): Die Flora und Fauna der Ostfriesischen Inseln. – Schr.R. Nationalpark Nieders. Wattenmeer **11**: 299–312.

MacArthur, R. & Wilson, E.O. (1963): An equilibrium theory of insular zoogeography. – Evolution, 17: 373–387.

MacArthur, R. & Wilson, E.O. (1967): The theory of island biogeography. New York.

Meyer, K.O., Haeseler, V. (Eds.) (1988): Zoologische Beiträge zur Besiedlung der jungen Düneninseln Memmert und Mellum. – Drosera '88: 1–369.

Niedringhaus, R., Haeseler, V. & Janiesch, P. (Hrsg.): Die Flora und Fauna der Ostfriesischen Inseln. Artenverzeichnisse und Auswertungen zur Biodiversität. – Schr.R. Nationalpark Nieders. Wattenmeer, **11**: 470 pp.

Plaisier, F. & Stumpe, C. (2008): Zur Besiedlung der Ostfriesischen Inseln durch Sandlaufkäfer und Laufkäfer (Coleoptera: Cicindelidae et Carabidae). – In: Niedringhaus, R., Haeseler, V. and Janiesch, P. (Hrsg.): Die Flora und Fauna der Ostfriesischen Inseln. – Schr.R. Nationalpark Nieders. Wattenmeer, 11: 197–208.

Remmert, H. (1960): Der Strandanwurf als Lebensraum. Z. Morph. Ökol. Tiere, **48**: 461–516.

Topp, W. (1975): Zur Besiedlung einer neu entstehenden Insel. Untersuchungen am ‚Hohen Knechtsand'. Zool. Jb. Syst., **102**: 215–240.

Topp, W. (1979): Insekten der Watten und Strände des ‚Hohen Knechtsandes'. – Beitr. Naturk. Niedersachsens, **32**: 106–112.

Topp, W. (1988): Besiedlung einer neu entstandenen Insel durch Laufkäfer (Col., Carabidae). Zool. Jb. Syst., **115**: 329–361.

Tschirnhaus, M. von (2008): Die acalyptraten Fliegen der Ostfriesischen Inseln (Diptera: Schizophora, „Acalyptratae"). Kritisches Artenverzeichnis anhand von Literaturdaten, Neufunden und unter Mitarbeit von Fachkollegen. – In: Niedringhaus, R., Haeseler, V. and Janiesch, P. (Hrsg.): Die Flora und Fauna der Ostfriesischen Inseln. – Schr.R. Nationalpark Nieders. Wattenmeer, **11**: 373–390.

Manuscript received: 06 May 2008
Revised Version accepted: 31 October 2008

Appendix

List of arthropods recorded from Kachelotplate in 2007

		specimens	biotope on KP 1)	method 2)	date (2007)	habitat/remarks
Araneae	**True spiders**					
Gnaphosidae gen. spec. (juvenile)	Gnaphosidae	1 alive	ED	PT	07/16	
Erigone atra Blackwall, 1841	Linyphiidae	8 alive	DL; ED	PT, CTy, TC	06/18, 07/16, 08/13	eurytopic
Oedothorax fuscus (Blackwell, 18349	Linyphiidae	1 alive	ED	CTb	06/18	eurytopic
Synageles venator (Lucas, 1836)	Salticidae	1 alive	ED	CTy	06/18	eurytopic
Tetragnathidae gen. spec. (juvenile)	Tetragnathidae	1 alive	ED	TC	08/13	
Psocoptera	**Psocids**					
Psocoptera gen. spec.	Psocoptera - Psocids	1 dead	DL	TC	07/16	
Heteroptera	**True Bugs**					
Trigonotylus psammaecolor Reuter, 1885	Miridae - capsid bugs	1 alive	ED	TC	06/18	coastal area
Lygus maritimus (Wagner, 1949)	Miridae - capsid bugs	1 alive	ED	TC	07/16	coastal area
Auchenorrhyncha	**Leafhoppers**					
Aphrophora alni (Fallen, 1805)	Aphrophoridae - spittle bugs	1 dead	DL	TC	07/16	trees, shrubs
Cercopis vulnerata Rossi, 1807	Cercopidae - spittle bugs	1 dead	DL	TC	06/18	eurytopic
Coleoptera	**Beetles**					
Protapion fulvipes (Fourcroy, 1785)	Apionidae - straight-snouted weevils	1 dead	DL	TC	05/22	ubiquist
Agonum sexpunctatum (Linnaeus, 1758)	Carabidae - ground beetles	1 dead	DL	TC	05/22	eurytopic
Amara aenea (De Geer, 1774)	Carabidae - ground beetles	2 alive	DL	TC	05/22	coastal area
Amara familiaris (Duftschmid, 1812)	Carabidae - ground beetles	3 alive	DL	TC	05/22	coastal area
Bembidion aeneum Germar, 1824	Carabidae - ground beetles	1 alive	DL	TC	06/18	salt marshes
Bembidion minimum (Fabricius, 1792)	Carabidae - ground beetles	1 alive	DL	TC	05/22	salt marshes
Cillenus lateralis (Leach, 1819)	Carabidae - ground beetles	30 alive	sand flat	TC	05/22	only sand flats
Dicheirotrichus gustavii Crotch, 1871	Carabidae - ground beetles	5 alive	DL	TC	06/18	salt marshes
Dyschirius arenarius Stephens, 1828	Carabidae - ground beetles	1 alive	DL	TC	06/18	dunes
Pogonus chalceus (Marsham, 1802)	Carabidae - ground beetles	2 alive	DL	TC	06/18	salt marshes
Pterostichus nigrita (Paykull, 1790)	Carabidae - ground beetles	1 alive	DL	TC	05/22	eurytopic
Agelastica alni (Linnaeus, 1758)	Chrysomelidae - leaf beetles	1 dead	DL	TC	05/22	eurytopic
Altica oleracea (Linneaus, 1758)	Chrysomelidae - leaf beetles	2 dead/alive	DL; ED	TC	08/13	eurytopic
Cassida vittata Villiger, 1789	Chrysomelidae - leaf beetles	1 dead	DL	TC	07/16	eurytopic
Leptinotarsa decemlineata (Say, 1824)	Chrysomelidae - leaf beetles	3 dead	DL	TC	05/22, 07/16	"Colorado beetle"
Oulema melanopus (Linnaeus, 1758)	Chrysomelidae - leaf beetles	1 dead	DL	TC	07/16	eurytopic
Chrysolina staphylaea (Linnaeus, 1758)	Chrysomelidae - leaf beetles	1 alive	DL	TC	05/22	eurytopic
Coccinella sepempunctata Linnaeus, 1758	Coccinellidae - ladybirds	8 alive	DL	TC	05/22, 07/16, 08/13	ubiquist
Coccinella undecimpunctata Linnaeus, 1758	Coccinellidae - ladybirds	1 alive	ED	CTb	06/18, 07/16	dunes
Halyza sedecimguttata (Linnaeus, 1758)	Coccinellidae - ladybirds	1 dead	DL	TC	08/13	forests
Otiorhynchus frisius Schneider 1896	Curculionidae - true weevils	1 alive	DL	TC	05/22	salt marshes
Hterocerus flexuosus Stephens, 1828	Heteroceridae	1 alive	DL	TC	07/16	drift line
Anthocomus coccineus (Schaller, 1783)	Malachidae	1 alive	ED	TC	07/16	reed fields
Phyllopertha horticola (Linnaeus, 1758)	Scarabaeidae - scarabs	1 dead	DL	TC	05/22	eurytopic
Bledius spectabilis ssp. frisicus Lohse, 1978	Staphylinidae - rove beetles	1 alive	DL	TC	05/22	coastal area
Bledius subniger Schneider, 1898	Staphylinidae - rove beetles	17 alive	DL; ED	Cty, TC	05/22, 07/16	coastal area
Cafius xantholoma (Gravenhorst, 1806)	Staphylinidae - rove beetles	1 alive	DL	TC	06/18	drift line
Philonthus carbonarius (Gravenhorst, 1802)	Staphylinidae - rove beetles	1 alive	ED	CTy	07/16	eurytopic
Philonthus cognatus Stephens, 1832	Staphylinidae - rove beetles	1 alive	ED	TC	06/18	eurytopic
Hymenoptera	**Hymenopterids**					
Andrena spec.	Apidae - Bees	2 dead	DL	TC	05/22	
Lasius umbratus (Nylander, 1846)	Formicidae - Ants	1 alive	ED	CTb	08/13	eurytopic
Lasius fuliginosus (Latreille, 1798)	Formicidae - Ants	4 alive	DL, ED	Cty, TC	07/16	forests
Myrmica ruginodis Nylander, 1846	Formicidae - Ants	2 alive	ED	TC	08/13	forests
Lasius niger (Linnaeus, 1758)	Formicidae - Ants	18 alive	DL, ED	TC	07/16	coastal area
Lasius mixtus (Nylander, 1846)	Formicidae - Ants	1 alive	DL	TC	07/16	coastal area
Myrmica scabrinodis Nylander, 1846	Formicidae - Ants	10 alive	DL, ED	TC	08/13	coastal area
Ichneumonidae gen.1 spec.1	Ichneumonidae - ichneumon flies	1 alive	ED	TC	07/16	
Ichneumonidae gen.2 spec.1	Ichneumonidae - ichneumon flies	1 alive	ED	TC	08/13	
Proctotrupidae gen. spec.	Proctotrupidae (parasitic hymenoptera)	1 dead	DL	TC	07/16	
Athalia rosae (Linnaeus, 1758)	Symphyta - sawflies	2 dead	DL	TC	07/16	eurytopic
Symphyta gen. spec.	Symphyta - sawflies	1 dead	DL	TC	06/18	
Vespula vulgaris (Linnaeus, 1758)	Vespidae - social wasps	3 dead	DL	TC	05/22	eurytopic
Diptera	**True Flies**					
Anthomyiidae gen.1 spec.1	Anthomyiidae	3 alive	ED	CTb	06/18	
Anthomyiidae gen.2 spec.1	Anthomyiidae	18 alive	DL; ED	CTb,r,y; TC	06/18, 07/16	
Anthomyiidae gen.3 spec.1	Anthomyiidae	2 alive	ED	CTy	07/16	
Dolichopodidae gen. spec.	Dolichopodidae - long-legged flies	14 alive	DL, ED	CTb; TC	06/18, 07/16	coastal area
Muscidae gen. spec.	Muscidae - house-flies	1 alive	ED	CTb	06/18	
Tetanops myopina Fallen, 1820	Otitidae	7 alive	ED	CTr,y; TC	06/18, 07/16	coastal area
Phoridae gen. spec.	Phoridae	1 alive	DL	TC	08/13	
Sciaridae gen. spec	Sciaridae	1 alive	ED	CTy	07/16	
Syrphidae gen. spec.	Syrphidae - hover-flies	10 alive/8 dead	DL; ED	Cty; TC	05/22, 08/16	
Rhicnoessa grisea (Fallen, 1823)	Tethinidae	4 alive	ED	CTb; TC	08/16, 07/16	coastal area

1) biotope on Kachelot plate: DL = driftline; ED = embryonic dunes
2) sampling method: PT = pitfall trap; CT = coloured trap (blue, yellow, red); TC = time-intervall collecting