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Flora and fauna of an inner-city waste-land in Rotterdam, The Netherlands

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An inventory is presented of the flora and fauna of an urban waste-land that had laid fallow during 14 months. The plants, gastropods, spiders, insects, isopods, centipedes and millipedes of this area, the Rijndam site, were sampled on 8 May 1993. Several rare or threatened species were encountered: the plant *Atropa bella-donna*, the aquatic beetle *Coelambus nigrolineatus*, the slug *Milax (Tandonia) sowerbyi*, and the centipede *Chaetechelyne vesuviana*. These taxa, and the biological diversity of the site, suggest that urban waste-lands may play an important role in urban biodiversity. More study is needed as so far little is known of the urban ecosystem in The Netherlands.

Flora en fauna van een braakliggend terrein in de binnenstad van Rotterdam - De resultaten van een inventarisatie van flora en fauna van een braakliggend bouwterrein in de Rotterdamse binnenstad worden gepresenteerd. Het terrein had gedurende 14 maanden braak gelegen en werd op 8 mei 1993 onderzocht. Enkele zeldzame en/of bedreigde soorten werden aangetroffen: de wolfskers *Atropa bella-donna*, de waterkever *Coelambus nigrolineatus*, de naaktslak *Milax (Tandonia) sowerbyi*, en de duizendpoot *Chaetechelyne vesuviana*. Deze soorten zowel als de gevonden biologische diversiteit vormen een indicatie voor het grote belang van dergelijke terreinen voor de stedelijke biodiversiteit. Er is meer onderzoek vereist, omdat onze kennis van het stedelijk ecosysteem tekort schiet.

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INTRODUCTION

Within the urban context of the city of Rotterdam a thorough knowledge of the flora and fauna (the biodiversity) is lacking. This hampers the evaluation of policy measures and of the management of the outdoor area. Without a proper knowledge of the presence of plant and animal species, of their distribution in the urban environment, and of the factors affecting their presence (or absence) and their distribution, it is impossible to make reference to past situations. What should observations be compared to? What is the biological reference level? Even such seemingly simple political remarks as 'we should have more nature in the city', or 'the city must be greener' imply the presence of a reference situation with which to compare.

For these reasons there is – at least in Rotterdam – the strongly felt need for fundamental scientific research into the distribution of organisms in the urban environment. To put it simply: 'what lives where and why is that so?'. Distribution maps of plant and animal species too often show blank spots on the places where cities are located. This is not surprising. Distribution maps such as the ones existing in the Netherlands are normally the result of the work of volunteer naturalists. Naturalists have a tendency to investigate outside the urban realm, in (semi)natural or rural landscapes such as heaths, forests, dunes, or meadows, rather than on the rooftop of the local supermarket.

Figure 1 The Rijndam waste-land site in February 1993, seen from the southeast from a neighbouring rooftop. [photo: C.W. Moeliker]

Considering the need for thorough investigations in the urban area, a group of volunteer naturalists of the Natural History Museum Rotterdam (hereafter NMR) executed a one-day inventory of a proposed building site situated at the edge of the city centre. The results show that there is much to be discovered in the urban environment, and also that such areas have a large biological potential. An enlarged version of this report in the Dutch language is to be found in Reumer & Van Muijen (1996).

A hospital existed, until March 1992, somewhat hidden behind other buildings at the corner of the Westersingel and the Westzeedijk in Rotterdam. The hospital buildings were then demolished to make way for a new medical rehabilitation centre, the so-called Rijndam Centre. The building site laid fallow from March 1992 until June 1993 when building activities started. Already in the fall of 1992 a luxuriant vegetation became evident, also suggesting the presence of an exuberant fauna. The idea ripened to investigate the site, preferably as shortly as possible before the onset of the building activities. This inventory took place on 8 May 1993, although some preliminary activities took place in the weeks before that date.

Aim of the study

The goal of the inventory was twofold. In the first place we wanted to investigate the biological richness and the biological potentials of the site. This inventory might serve as a pilot-study for further and more large-scale inventories within the urban realm. In the second place we wanted to know whether or not such small waste-land areas can be of any importance in the urban ecosystem and whether it could be possible to formulate recommendations for urban planning and maintenance policies. Since it was clear from the start that the onset of the construction of the Rijndam Centre would completely erase the biotope, material has not only been identified on the spot, but it has also been collected for the museum. This allows us to verify identifications in the future.

THE SITE

The Rijndam waste-land area measured approximately 140 x 100 metres. Figure 1 shows an 'aerial photograph', taken in a northwesterly direction from the rooftop of a neighbouring building. The site was bordered at the northern edge by old gardens, at the eastern side by some buildings and the pavements between them, at the southern edge by a high fence, and at the

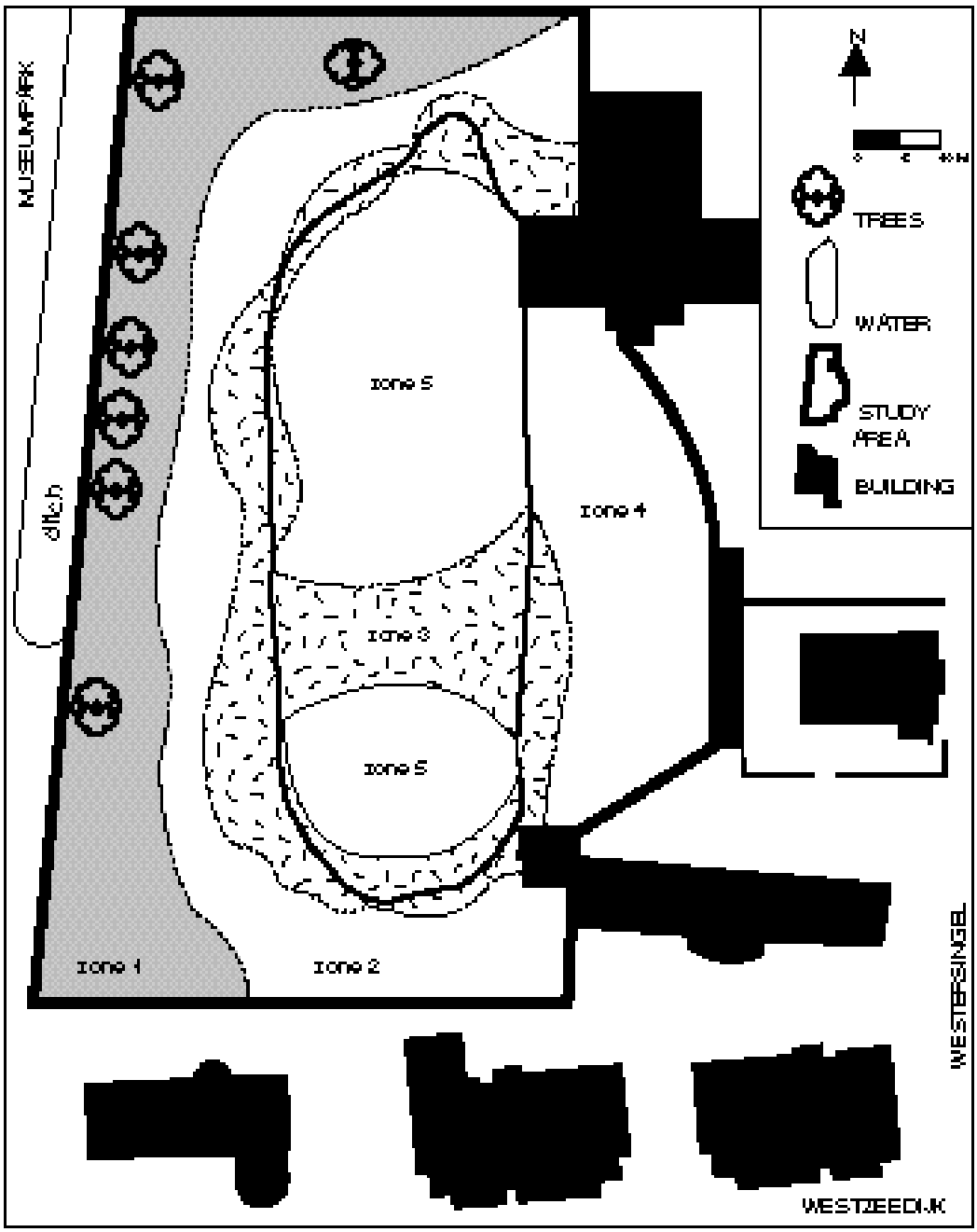

Figure 2 Map of the Rijndam waste-land site, showing the outline of the study area, locations of buildings and the ecological zonation. [map graphics: Jaap van Leeuwen Design]

western edge by a ditch. Some high trees provided shade at the western side. The site was relatively hilly; this proved important for an ecological differentiation. Heaps of demolition rubble and sand were situated next to a large pond. The water in this pond was more than 1 metre deep at places, and crystal clear. The small hills and the pond created a differentiation in biotopes that may be called unique for a demolition/building site. These are normally rather flat. The eastern part of the site consisted of such rubble hills and was not shaded, while

the western part was lower and in the shade. The site was thus divided into several different zones (Fig. 2):

Zone 1 was the westernmost zone, formed by remnants of the former gardens of the hospital. It had a rather wooded character due to the presence of high trees along the ditch and of bushes and shrubs in the northwestern corner.

Zone 2 ran parallel to zone 1, it was rather barren apart from a low grass cover. A path had formed at places, and during the fallow period a trench had been dug through it in order to accomodate some cable or pipe. The southern part of the site also belonged to zone 2.

Zone 3 was the transitional zone between the grassy zone 2 and the open pond. It was thus much wetter, resembling a marsh at places.

Zone 4 was the higher and somewhat hilly part between, and surrounding, the buildings at the eastern part of the site. Due to its higher position and the absence of trees this zone was exposed to direct sunlight.

Zone 5 was the pond. It must have originated after the pit where the demolished hospital was located got filled with either ground-water and/or stagnant rainwater.

Unfortunately we did not manage to take samples of the water for chemical analysis. Conclusions concerning its quality can therefore not be drawn, although the presence of a rich fauna and of a dense Charophyte vegetation may indicate the relatively good quality of the water.

MATERIAL AND METHODS

The zonation was taken into consideration as much as needed during the sampling activities; for each observation and/or sampled specimen the zone was noted. A few days in advance we placed 28 pitfall-traps in all zones (except zone 5). These traps were made of empty Spontin grenadine syrup cans with the upper side removed; they had been placed into the soil with a soil-drill. A small amount of formaldehyde-solution was added to the traps in order to preserve the animals fallen into it. The results of the individual pitfall-traps are here not further dealt with, but these results are available on request.

Flora and fauna from zone 5 (the pond) were collected by means of a small inflatable raft holding one person provided with nets and pots. We also used a wading suit. All animal samples were preserved at the site in 70% ethanol and are stored in the collections of the Natural History Museum Rotterdam. The plants were dried in the days following May 8 and are now incorporated in the herbarium of the museum. All material may be studied on request.

It will be evident that not all animal or plant groups could be incorporated in this study. We especially investigated the vascular plants, mosses, algae, isopods, spiders, millepedes, Coleoptera (beetles), Lepidoptera (butterflies) and some other insect groups. This implies that other important groups are not dealt with, such as Acari (mites), the worms (including nematodes), most Diptera (flies, mosquitoes) and other insect groups, as well as vertebrates (birds, mammals) and planctonic life from the pond. Although perhaps regrettable, not all groups could be sampled within one day, and the aim of this investigation was only to obtain an impression of the site, not a thorough inventory. The tables present an overview over the species in the groups investigated. As said, no distinction as to zones has been made (except for the plants) and more detailed information can be obtained through the authors.

RESULTS

Plants

A total of 147 vascular plant species was found (Table 1). If we realise that the total Dutch flora contains about 1400 species, this figure means that some 10% of these species were found on the small Rijndam waste-land. In retrospect, zone 1 appears to be inadequately sampled. Furthermore, the sampling took place rather early in the flowering season. The total number of plant species should therefore have been somewhat higher than 147.

Some species warrant a few more words. The Deadly Nightshade, *Atropa bella-donna*, is a very rare species in the Netherlands; it figures on the so-called Red List (category 1: extremely threatened). The species is found more often in the vicinity of the Rijndam site. It is known from the Schoonoord Park (c. 300 m distance), from the garden of the Faculty of Medicine of Erasmus University next to the Natural History Museum (at c. 200 m distance) and from a few spots around the museum itself. Another interesting species is the Sea Aster (*Aster tripolium*).

Table 1 Vascular plants from the Rijndam waste-land site.
The plants are arranged in alphabetical order. In addition it is indicated from which zones the plants were found: (1,2,4) means that the species was found in zones 1, 2 and 4.

A. VASCULAR PLANTS
Acer negundo var. *californicum* (2)
Acer pseudoplatanus (2,4)
Aegopodium podagraria (1)
Aesculus hippocastaneum (1,2)
Agrostis canina (4)
Agrostis stolonifera (3,4)
Alisma plantago-aquatica (3)
Allium schoenoprasum (1)
Alnus glutinosa (2)
Alopecurus pratensis (4)
Anthirrhinum majus (4)
Anthriscus sylvestris (4)
Arabidopsis thaliana (4)
Arrhenatherum elatius (4)
Artemisia vulgaris (4)
Aster tripolium (3)
Atropa bella-donna (4)
Bellis perennis (2,4)
Betula pendula (4)
Brassica napus (4)
Buddleja davidii (2,4)
Calystegia sepium (1,3)
Capsella bursa-pastoris (4)
Cardamine flexuosa (3)
Cardamine hirsuta (4)
Cardamine pratensis (1,2)
Carduus crispus (2)
Carex hirta (3,4)
Carum carvi (4)
Cerastium fontanum ssp. *vulgare* (2,4)
Cerastium glomeratum (4)
Chelidonium majus (1)
Chenopodium album (2)
Cirsium arvense (1,2,4)
Cirsium vulgare (4)
Clematis vitalba (2)
Coronopus squamatus (4)
Dactylis glomerata (2)
Daucus carota (4)
Deutzia scabra (1)
Dianthus spec. (4)
Diplotaxis tenuifolia (4)
Epilobium hirsutum (2,4)
Epilobium montanum (4)
Erigeron canadensis (4)
Erodium cicutarium ssp. *cicutarium* (4)
Erophila verna (4)
Eupatorium cannabinum (4)
Festuca rubra (4)
Fraxinus excelsior (4)
Fumaria officinalis (4)
Geranium molle (4)
Glechoma hederacea (1,2,4)
Hedera helix (1)
Holcus lanatus (4)
Hypericum perforatum (4)
Juncus articulatus (3,4)
Juncus conglomeratus (4)
Juncus effusus (3,4)
Juncus inflexus (3,4)
Laburnum anagyroides (2)
Lamium album (4)
Lamium purpureum (4)
Lapsana communis (4)
Linaria vulgaris (4)
Lolium perenne (4)
Lotus corniculatus ssp. *corniculatus* (4)
Malva spec. (4)
Matricaria dicoidea (4)
Matricaria maritima (4)
Medicago lupulina (4)
Melilotus altissima (2,4)
Mentha spec. *(4)*
Oxalis fontana (2)
Papaver rhoeas (4)
Petasites hybridus (1)
Phragmites australis (3,4)
Plantago lanceolata (4)
Plantago major ssp. *pleiosperma* (3,4)
Poa annua (4)
Poa pratensis (4)
Poa trivialis (4)
Polygonum cuspidatum (2)
Polygonum lapathifolium (1,2,3)
Populus simonii c.v. *fastigiata* (4)
Potamogeton crispus (5)
Potentilla indica (1,3,4)
Potentilla supina (4)
Prunella vulgaris (1,4)
Prunus avium (1)
Quercus petraea (4)

Quercus robur (2,4)
Ranunculus acris (2,4)
Ranunculus repens (2,4)
Ranunculus sceleratus (2,4)
Ribes sanguineum (4)
Rosa multiflora (2)
Rosa pimpinellifolia c.v. (4)
Rubus fruticosus (1)
Rubus idaeus (4)
Rumex crispus (4)
Rumex maritimus (3,4)
Rumex obtusifolius (3,4)
Rumex x pratensis (3,4)
Sagina procumbens (4)
Salix alba x S. fragilis (3)
Salix cinerea (3,4)
Sambucus nigra (1,4)
Scirpus lacustris ssp. *lacustris* (3)
Scirpus maritimus (3)
Scrophularia nodosa (2)
Sedum telephium c.v. (1)
Senecio jacobaea (4)
Senecio vulgaris (2,4)
Silene dioica (1)
Sinapis arvensis (4)
Sisymbrium officinale (4)
Sisymbrium orientale (4)
Solanum dulcamara (1,3,4)
Solanum nigrum (4)
Sonchus arvensis (4)
Sonchus asper (4)
Stellaria media (4)
Stellaria pallida (4)
Tanacetum parthenium (2)
Tanacetum vulgare (1)
Taraxacum officinale (1,2,4)
Trifolium diffusum (4)
Trifolium dubium (4)
Trifolium pratense (4)
Trifolium repens (4)
Tussilago farfara (3,4)
Typha latifolia (5)
Ulmus glabra (4)
Urtica dioica (1,4)
Valerianella locusta (4)
Verbascum densiflorum (4)
Verbascum thapsus (1)
Veronica arvensis (4)
Veronica filiformis (1,2)
Veronica serpyllifolia (1)
Vicia cracca (4)
Viola odorata (1)
Viola tricolor c.v. *hortensis* (3,4)
Vulpia myuros (4)
Weigelia japonica (1)
Zannichellia palustris ssp. *palustris* (5)

B. MOSSES
Amblystegium serpens (2)
Anisothecium schreberianum (2)
Barbula convoluta (2)
Barbula unguiculata (2)
Didymodon fallax (2)
Funaria hygrometrica (2)
Marchantia polymorpha (2)

C. ALGAE
Chara vulgaris var. *vulgaris* (5)
Cladophora glomerata / fracta (5)

The species is found more often in the urban environment. It normally grows in the coastal area as it requires a certain salinity. The use of slightly saline sand in civic works (such as road construction or building site amelioration) provides the circumstances for the species to grow in non-coastal areas.

Some interesting plant species were found in the pond (zone 5): the Curled Pondweed (*Potamogeton crispus*) and the Horned Pondweed (*Zannichellia palustris* ssp. *palustris*), in addition to a Charophyte identified as *Chara vulgaris* var. *vulgaris*. These three aquatic taxa are not especially rare, but it is quite remarkable how quickly these plants reached the Rijndam site. Yet another alga was found in the pond, a filiform species identified as *Cladophora glomerata* or *Cladophora fracta*.

Snails and slugs (Gastropoda)

Eleven gastropod species were found on the Rijndam site (see Table 2): eight terrestrial species and three aquatic ones. The terrestrial species are indicative for a moist environment with strong human influence. The number of slugs is relatively high: five out of the eight terrestrial taxa are slugs. These were identified

Table 2 The Gastropoda from the Rijndam waste-land site.

A. TERRESTRIAL SNAILS AND SLUGS
Discus rotundatus (Müller, 1774): one specimen
Oxychilus (Oxychilus) draparnaudi (Beck, 1837): many
Aegopinella nitidula (Draparnaud, 1805): one specimen
Arion (Kobeltia) distinctus Mabille, 1868: five specimens
Milax (Tandonia) sowerbyi (Ferussac, 1823): three specimens
Limax (Limax) maximus Linnaeus, 1758: one juvenile specimen
Deroceras (Deroceras) laeve (Müller, 1774): one specimen
Deroceras (Agriolimax) reticulatum (Müller, 1774): many

B. AQUATIC SPECIES
Galba truncatula (Müller, 1774)
Radix peregra (Müller, 1774)
Physa acuta Draparnaud, 1805

by the colour, the from and characters of the sole. Except for one species all slugs are abundant in the Netherlands. The exception is *Milax sowerbyi*, a slug that is only known from west central Holland, and there mostly from places that are under direct human influence, such as gardens or waste-heaps. Within the country the species was reported from the cities of Schiedam, Amsterdam, Leiden, Haarlem and Brielle (Gittenberger *et al.* 1984); it is typical for the urban environment. The three aquatic gastropod species, of which only few specimens were found, are characteristic for eutrophic and often stagnant water.

Spiders (Araneae)
Table 3 gives a complete inventory of the observed spiders. It came as a surprise that no less than 38 species were collected, some 6% of all species known from the Netherlands. They belong to 10 different families, while a total of 30 families exists in the country. It may thus be stated that the Rijndam site harboured a rich spider fauna.

Twenty-one out of the 38 spider species (55%) belonged to one single family, the Lyniphiidae. This might appear a high percentage, but this family comprises 36% of all Dutch spider species. Lyniphiidae are typical colonists; they are small spiders and most species are known to spread by means of a silk thread blowing in the wind (the so-called ballooning). By this means they can easily reach new localities and it thus comes as no surprise that this group is well represented in the Rijndam fauna. It needs to be mentioned that ten of the lyniphiid spider species are represented by only one specimen; this emphazises the pioneer character of the fauna.

The next best represented family is the Lycosidae, with four species (11%). Members of this family do not build webs, but hunt their prey while running and jumping over the soil. They are active diurnally, contrary to most other spiders. This might explain their relative abundance in the sample, while – on the other hand – typical nocturnal groups such as the Dysderidae (represented by two juveniles), the Clubionidae (represented by one species, *Clubiona terrestris*, and the Gnaphosidae, are either much rarer or were not found at all.

The families Agelenidae and Tetragnathidae are next in row: both families are represented by three species (8%). The Agelenidae are most probably survivors from the former edifices, the Tetragnathidae are typical outdoor spiders. The rest of the species may also be divided into these two categories. *Amaurobius ferox* and *Segestria senoculata* are doubtlessly remainders of the former hospital fauna (i.e. from the indoor ecosystem), while *Araneus* spec. en *Anelosimus vitatus* are considered to be immigrants.

Insects (Insecta)
Roughly one quarter of all known living animal species are beetles (Coleoptera). 4144 beetle species have been reported from The Netherlands (Van Nieukerken & Van Loon 1995), we found 42 of these on the Rijndam site. In addition to the beetles we found five butterflies (Lepidoptera), four aquatic bugs (Hemiptera), eleven hoverflies (Syrphidae), and one earwig (Dermaptera). Table 4 provides an inventory of the Rijndam Insecta.

All insects mentioned are abundant to very

Table 3 Spiders (Araneae) from the Rijndam waste-land site.
The families and the species within the families are alphabetically ordered. Also indicated is the number of specimens found and whether the specimens are male, female or juvenile. The abbreviation (1m,2f,3j) means one male, two females and three juveniles.

family AGELENIDAE
Agelena labyrinthica (Clerck, 1757) (1j)
Tegenaria atrica C.L.Koch, 1843 (1f)
Tegenaria larva Simon, 1875 (4f)
family AMAUROBIDAE
Amaurobius ferox (Walckenaer, 1825) (2f)
family ARGIOPIDAE
Araneus spec. (1j)
family CLUBIONIDAE
Clubiona terrestris Westring, 1862 (1m,2j)
family DYSDERIDAE
Dysdera spec. (1j)
Harpactea spec. (1j)
family LINYPHIIDAE
Araeoncus humilis (Blackwall, 1841) (2f)
Bathiphantus gracilis Blackwall, 1841 (4m,3f,1j)
Centromerus dilutus (O.P.Cambridge, 1875) (1m)
Diplocephalus picinus (Blackwall, 1841) (1m)
Diplostyla concolor (Wider, 1834) (1f)
Erigone arctica White, 1852 (4m,1f)
Erigone atra Blackwall, 1841 (5m,1f)
Erigone dentipalpis Wider, 1834 (10m,3f)
Gnathonarium dentatum Wider, 1834 (1m)
Gongylidiellum latebricola (O.P.Cam., 1871) (1m)
Gongylidium rufipes Sundevall, 1829 (1m)
Lepthyphantes tenuis (Blackwall, 1852) (1f,1j)
Linyphia hortensis Sundevall, 1829 (2f,2j)
Milleriana inerrans (O.P.Cambridge, 1884) (1m)
Oedothorax apicatus (Blackwall, 1850) (1m,1f)
Oedothorax fuscus Blackwall, 1834 (5m,30f)
Oedothorax restusus (Westring, 1851) (1m,2f)
Poeciloneta globosa (Wider, 1834) (1m)
Porrhomma pygmacum (Blackwall, 1834) (1f)
Raebothorax paetulis (O.P.Cambridge, 1875) (1m)
Silometopus elegans (O.P.Cambridge, 1872) (1m)
family LYCOSIDAE
Pardosa amantata (Clerck, 1757) (2m,3f,3j)
Pardosa monticola (Clerck, 1757) (2m)
Pardosa pullata (Clerck, 1757) (1m)
Pirata piraticus (Clerck, 1757) (4m,4f,5j)
family SEGESTRIIDAE
Segestria senoculata (Linnaeus, 1758) (2f)
family TETRAGNATHIDAE
Pachygnatha clercki Sundevall, 1830 (5m,5f,1j)
Pachygnatha degeeri Sundevall, 1830 (7m,2f,1j)
Tetragnatha spec. (1j)
family THERIDIIDAE
Anelosimus vitatus (C.L.Koch, 1836) (1m)

abundant in The Netherlands. There is, however, one interesting exception to this: the aquatic beetle *Coelambus nigrolineatus* (Fig. 3). This is a pioneering species that typically occurs in 'new' water-bodies in which no balanced fauna has yet developed. It is thus not surprising that we found the species in the newly formed pond on the Rijndam site, but because the species is known from only few localities in The Netherlands, it is certainly a rare curiosity.

Sow-bugs, centipedes and millepedes

Sow-bugs (Isopoda) are Crustaceans requiring a high humidity as far as they are terrestrial. We found six species on the Rijndam site, both aquatic and terrestrial ones; there are no rare taxa involved (see Table 5). Centipedes (Chilopoda) and millepedes (Diplopoda) are represented by ten species (see Table 5): one millepede and nine centipedes. Within one exception all species are known from quite many localities in the country. The one exception is the centipede species *Chaetechelyne vesuviana*, which was so far known from one locality only: Domburg (province of Zeeland, Jeekel 1977). This species now has its second Dutch occurrence in Rotterdam.

CONCLUSIONS

Although the inventory of the Rijndam waste-land site is of a rather limited character, the conclusion can be drawn that a large biological diversity had developed within a 14-month period of time. Much of the material found is indicative of a pioneer phase. Many of the pioneer species would diminish in numbers, or even disappear, if the fallow period would extend over more years. The urban ecosystem is,

Table 4 Insects from the Rijndam waste-land site.

A. BEETLES (COLEOPTERA)

The beetles from the Rijndam site have also been collected on days other than 8 May 1993. In this table it is indicated on which day the sampling took place. Species marked (*) were sampled on 20 April 1993; those marked (+) on 4 May 1993; and those marked (o) were collected on 8 May 1993. The order in the table is alphabetical.

family CARABIDAE
Acupalpus flavicollis Strm (o)
Agonum dorsale Pont. (o)
Agonum marginatum L. (o)
Agonum moestum Dft. (o)
Agonum muelleri Herbst (o)
Agonum ruficornum Goeze (o)
Amara aenea Degeer (o)
Amara similata Gyll. (o)
Anisodactylus binotatus F. (o)
Bembidion tetracolum Say (o)
Bembidion varium Ol. (o)
Chlaenius vestitus Paykull (o)
Clivina collaris Herbst (o)
Elaphrus riparius L. (o)
Harpalus aeneus F. (o)
Harpalus griseus Panzer (o)
Harpalus pubescens Muller (o)
Leistus ferrugineus L. (o)
Loricera pilicornis F. (o)
Nebria brevicollis F. (o)
Notiphilus biguttatus F. (o)
Pterostichus strenuus Panzer (o)
Stenolophus mixtus Herbst (o)
Stenolophus teutonus Schrk (o)

family COCCINELLIDAE
Adalia bipunctata L. (o)
Anisosticta novemdecipunctata L. (o)
Coccinella septempunctata L. (o)

family DYTISCIDAE
Agabus spec., larva (*)
Coelambus nigrolineatus (Steven) (*+)
Colymbetes fuscus (L.), larva (*+)
Dytiscus marginalis L., larva (+)
Hydroglyphus pusillus (F.) (*+)
Hydroporus ? spec., larva (*)
Hygrotus versicolor (Schaller) (o)
Hyphydrus ovatus (L.) (+o)
Laccophilus minutus (L.) (*+o)
Rhantus suturalis (MacLeay) (*)

family HYDROPHILIDAE
Anacaena limbata (F.) (o)
Helophorus flavipes F. (+)
Helophorus minutus F. (o)
Helophorus obscurus Mulsant (o)
Laccobius minutus (L.) (*+o)

B. EARWIGS (DERMAPTERA)
Forficula auriculata L.

C. FLIES AND MOSQUITOES (DIPTERA)
family SYRPHIDAE
Epistrophe eligans Harr.
Helophilus pendulus L.
Melanostoma scalare Fabr.
Metasyrphus luniger Mg.
Myatropa florea L.
Neoascia podagrica Fabr.
Platycheirus peltatus Mg.
Platycheirus scutatus Mg.
Sphaerophoria rueppellii Wied.
Syrphus ribessi L.
Syrphus vitripennis Mg.

D. BUGS AND RELATED GROUPS (HEMIPTERA)
HETEROPTERA AQUATICA
Nepa cinerea L.
Notonecta viridis Delcourt
Sigara striata (L.)
HYDROMETRIDAE
Hydrometra stagnorum L.

E. BUTTERFLIES (LEPIDOPTERA)
Artogeia napi L.
Artogeia rapae L.
Celastrina argiolus L.
Platyptilia calodactyla
Timandra griseata Pet.

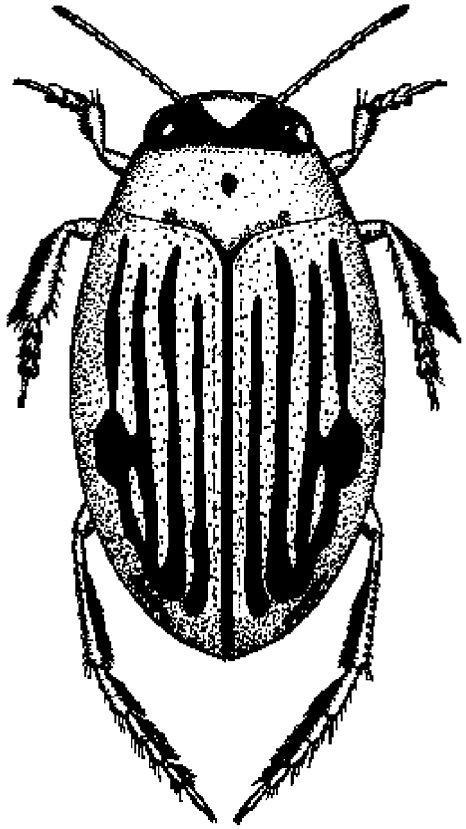

Figure 3 The aquatic beetle *Coelambus nigrolineatus* (STEVEN), a pioneering species, found at the Rijndam waste-land site. [illustration: Bernhard J. van Vondel]

among other features, characterized by the the fact that, as a result of the unavoidable dynamics, pioneer stages or typically dynamic groups of species are permanently present. Waste-lands can play an important role in this process. The taxonomic lists presented here, and the numbers of encountered specimens are quite self-explaining, but the few rare taxa are worth mentioning.
Among the plants this applies to *Atropa belladonna*, which is a rare and threatened species. The aquatic beetle *Coelambus nigrolineatus*, the slug *Milax* (*Tandonia*) *sowerbyi*, and the centipede *Chaetechelyne vesuviana* are without doubt interesting encounters. They show that even such short-lived waste-lands in the middle of a big city can act as important aspects of Dutch nature. This now is an interesting conclusion, which in its turn leads us to two further considerations.

Tabel 5. Listing of the centipedes (Chilopoda), millipedes (Diplopoda) and sow-bugs (Isopoda) from the Rijndam waste-land site.

A. CHILOPODA
Chaetechelyne vesuviana (Newport)
Cryptops hortensis Leach
Haplophilus subterraneus (F.)
Lithobius crassipes Koch
Lithobius forficatus (L.)
Lithobius melanops Newport
Lithobius microps Meinert
Necrophloeophagus longicornis (Leach)

B. DIPLOPODA
Blaniulus guttulatus (F.)

C. ISOPODA
Armadillidium vulgare (Latreille, 1802)
Asellus aquaticus L., 1758
Asellus meridianus L., 1758
Oniscus asellus L., 1758
Philoscia muscorum (Scopoli, 1763)
Porcellio spinicornis Say, 1818

In the first place, the city – contrary to 'natural' areas such as forests, heaths and dunes – is an unpopular place for (amateur) naturalists to go to. That does not seem justified. The large floral and faunal diversity encountered on the Rijndam site shows us that there is much to be discovered in the urban environment. The rarities found might indicate an insufficient knowledge of the urban ecosystem, rather than the specific unicity of the Rijndam site. We therefore would like to promote the city as a biological research area. Within the Rotterdam context this consideration will be translated into research proposals for the years to come. The Rijndam inventory is thus considered a pilot-study that will be extended to other localities in the city.

In the second place we propose that inner-city waste-lands should be treated with more respect, as they could contribute substantially to

the biodiversity in The Netherlands, or Western Europe for that matter. This seems a contradiction-in-terms: inner-city waste-lands inevitably get built over after a while. This should not be prevented from happening; on the contrary, pioneer floras and faunas are qualitate qua short-lived, also in real nature. We propose to consider the total stock of inner-city waste-lands as one single biotope. This inevitably is a biotope that continuously changes its place: it is a 'hopping ecosystem'. Individual waste-lands serve as sources from which flora and fauna can spread to other such places. With this consideration in mind, the management of inner-city waste-lands should be done thoughtfully. This will often be very easy: just surrounding the site with fences and doing nothing further. Even such seemingly well-meant measures as flattening the soil and sowing weeds should be avoided.

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