have been reported from several places outside this distribution range (i.e. Cape Province: West Cape Natures Valley, East London; *vide* material examined). White (1986), however, indicates a more extended distribution range that corresponds well with the known occurrence of *A. munroanum*. No other *Ekebergia* species' have been reported as hosts for *Ceratitis* fruit flies.

ACKNOWLEDGEMENTS

We wish to thank the various museum curators who put material at our disposal, notably: N. Wyatt and I. M. White (BMNH), K. Maes (NMKN); D. Barraclough (NMSA) and M. Mansell (PPRI). B. Bytebier (NMKE), R. Polhill (Kew Gardens, UK). I. M. White and an anonymous referee provided useful information pertaining to aspects discussed in this paper. Thanks are also due to Mrs. N. Van Noppen (Tervuren, Belgium) for the preparation of the artwork and to Dr. U. Dall'Asta (Tervuren, Belgium) for translation of Italian descriptions by Bezzi. This research was partly supported by USAID grant No. PCE-G-00-98-00048-00 to Texas A&M University (in collaboration with ICIPE and the African Fruit Fly Initiative), and by the Fonds voor Wetenschappelijk Onderzoekvlaanderen.

REFERENCES

Beentje, H. 1994. *Kenya trees, shrubs and lianas*. National Museums of Kenya, Nairobi, ix+1-722 pp.

Bezzi, M. 1920. Notes on the Ethiopian fruit-flies of the family Trypaneidae, other than *Dacus*. - III. *Bulletin of Entomological Research* 10: 211-272.

Bezzi, M. 1926. Nuove specie di Tripaneidi (Dipt.) dell' Africa del Sud. *Bollettino del Laboratorio di Zoologia Generale e Agraria della R. Scuola Superiore d'Agricoltura, Portici* 18: 276-300.

Coates Palgrave, K. C. 1983. *Trees of southern Africa*. Struik Publishers, Cape Town, 1-959 pp.

Cogan, B. H. & Munro, H. K. 1980. 40. Family Tephritidae (pp. 518-554). In Crosskey, R. W. (ed). *Catalogue of the Diptera of the Afrotropical Region*. British Museum (Natural History), London, 1-1437 pp.

De Meyer, M. 1996. Revision of the subgenus *Ceratitis* (*Pardalaspis*) Bezzi (Diptera, Tephritidae, Ceratitini). *Systematic Entomology* 21: 15-26.

De Meyer, M. 1998. Revision of the subgenus *Ceratitis* (*Ceratalaspis*) Hancock (Diptera: Tephritidae). *Bulletin of Entomological Research* 88: 257-290.

De Meyer, M. 1999. Phylogeny of the genus *Ceratitis* (Dacinae: Ceratitidini) (pp. 409-428). In Aluja, M. & Norrbom, A. L. (eds). *Fruit flies (Tephritidae): phylogeny and evolution of behavior*. CRC Press, 1-944 pp.

De Meyer, M. 2000. Systematic revision of the subgenus *Ceratitis* MacLeay *s. s.* (Diptera, Tephritidae). *Zoological Journal of the Linnean Society* 128: 439-467.

De Meyer, M. this volume. Distribution patterns and host-plant relationships within the genus *Ceratitis* MacLeay (Diptera, Tephritidae) in Africa. *Cimbebasia* 17.

Hancock D. L. 1987. Notes on some African Ceratitinae (Diptera: Tephritidae), with special reference to the Zimbabwean fauna. *Transactions of the Zimbabwe Scientific Association* 63: 47-57.

Hancock D. L. & White, I. M. 1997. The identity of *Thrixithrum nigrum* (Graham) and some new combinations in *Ceratitis* Macleay (Diptera: Tephritidae). *The Entomologist* 116: 192-197.

Le Pelley, R. H. 1959. *Agricultural insects of East Africa*. East Africa High Commission, Nairobi, x+1-307 pp.

Norrbom, A. L., Carroll, L. E., Thompson, F. C., White, I. M. & Freidberg, A. 1998. Systematic database of names (pp. 65-251). In Thompson, F. C. (ed). *Fruit fly expert identification system and systematic information database*. *Myia* 9, ix+1-524 pp.

Stael, C. 1876. Bidrag till södra Afrikas Orthopter-fauna. *Ofversigt det Vetenskabernes Akademiker Förhandlinger, Stockholm* 33: 29-76.

White, F. 1986. The taxonomy, chorology and reproductive biology of southern African Meliaceae and Ptaeroxylaceae. *Bothalia* 16: 143-168.

Manuscript received April 2001; accepted April 2001.

Inter-tidal Diptera of southwestern Africa (Chironomidae, Canacidae, Chloropidae, Milichiidae, Tethinidae, Ephydridae, Sphaeroceridae, Coelopidae, Sarcophagidae and Anthomyiidae)

Ashley H. Kirk-Spriggs[1], John W. Ismay[2], Michael Ackland[2], Jindrich Roháček[3], Wayne N. Mathis[4], George A. Foster[4], Thomas Pape[5], Peter S. Cranston[6] & Rudolf Meier[7]

[1]Entomology Centre, National Museum of Namibia, P.O. Box 1203, Windhoek, Namibia; e-mail: ashley@natmus.cul.na
[2]Hope Entomological Collections, University Museum of Natural History, South Parks Road, Oxford, UK; e-mail: john.ismay@oum.ox.ac.uk/mackland@btinternet.com
[3]Department of Entomology, Silesian Museum, Masarykova 35, CS-746 46 Opava, Czech Republic; e-mail: szmoptir@iol.cz
[4]Department of Systematic Biology, Smithsonian Institution, Washington, DC 20560-0169, USA; e-mail: mathis.wayne@nmnh.si.edu/gfoster@jouaninc.com
[5]Swedish Museum of Natural History, Postbox 50007, S-104 05 Stockholm, Sweden; e-mail: thomas.pape@nrm.se
[6]Entomology Department, University of California Davis, One Shields Avenue, 95616-8584, Davis, California, USA; e-mail: pscranston@ucdavis.edu
[7]Department of Entomology, Zoological Museum, University of Copenhagen, Universitetsparken 15, DK-2100, Copenhagen, Denmark; e-mail: RMeier@zmuc.ku.dk

This paper presents results from the National Museum of Namibia's Marine-littoral Survey, 1998, which sampled the inter-tidal invertebrate fauna from the Kunene Mouth on the Namibian/Angolan border to Tsitsikamma National Park in the Eastern Cape of South Africa at 69 sampling stations. Taxonomic notes, distribution and biology of species in ten families of Diptera are dealt with from the survey, namely: Chironomidae, Canacidae, Chloropidae, Milichiidae, Tethinidae, Ephydridae, Sphaeroceridae, Coelopidae, Sarcophagidae and Anthomyiidae. Biogeography is discussed in relation to ocean currents (Agulhas Current and Benguela Upwelling System) on the southwestern and southern African coast and to the three recognised coastal provinces. Kelp is found to be the primary producer, and the distribution of marine algae is examined. Within the family Chironomidae, the phylogenetic position of the subfamily Telmatogetoninae is discussed and a key is provided for the afrotropical species of the subfamily. One species, *viz. Telmatogeton minor* (Kieffer) (new to Namibia) is recorded and its biology briefly discussed. A key to the two species of recorded Chloropidae, *viz. Siphunculina* nr. *lurida* (Enderlein) and *Eutropha lindneri* Sabrosky, is provided. Adults of *Eutropha lindneri* were attracted to decomposing Cape Fur Seal *Arctocephalus pusillus* (Schreber) carcasses on the coast, and larvae and puparia were discovered beneath the skin. This is the first record of Chloropidae feeding on mammalian carrion and the carrion-feeding habit in Chloropidae is discussed. Adults of *E. lindneri* were found to be more variable than was formerly thought and the male terminalia are described and figured for the first time. A new species, *Asmeringa namibia* Mathis, sp. nov. (Ephydridae) from Namibia is described and a key to afrotropical *Asmeringa* Becker, incorporating the new species, is presented. Due to taxonomic difficulties the Coelopidae could not be identified to species. Two species of Sarcophagidae were found to be exclusively coastal, *viz. Sarcophaga* (*L.*) *namibia* Reed and *Sarcophaga* (*L.*) *maritima* Engel, where they occur as scavengers, the former having been reared from the carcasses of Cape Fur seals. The species are allopatric, with *S. namibia* occurring along the Namibian and northern South African coast, *S. maritima* being found in South Africa south of 33°08'05"S, 18°00'08"E. A key to separate the two species is presented, with illustrations of the distiphallus of the two species.

A new synonym: *Parathalattisca namibica* Lehrer, 1995 syn. nov. = *Sarcophaga* (*Liosarcophaga*) *namibia* Reed, 1974, is proposed. Three species of Anthomyiidae are recorded from southern Africa, an illustrated key is provided, and the occurrence of the three species is discussed. Two species, *Fucellia capensis* (Schiner, 1868) and *F. maritima* (Haliday) were sampled during the survey, the latter being a new, possibly introduced, species to southern Africa. A new synonym: *Fucellia baltica* Lyneborg, 1965 syn. nov. = *Fucellia capensis* (Schiner, 1868) is proposed. Six species of Canacidae are recorded, *viz. Canace rossii* Canzoneri (new to Namibia), *Dynomiella cala* (Cresson), *D. stuckenbergi* (Wirth), *D. spinosa* Wirth, *Xanthocanace capensis* Wirth, and *Nocticanace cyclura* Mathis & Wirth, 1979, and keys are provided for all afrotropical subfamilies, tribes, genera and species of Canacidae. Four species of Tethinidae are recorded, *viz. Horaismoptera microphthalma* (Bezzi) (new to South Africa), *Afrotethina persimilis* Munari, 1991 (new to South Africa), *A. femoralis* (Munari) (new to Namibia), and *A. stuckenbergi* Munari (new to Namibia) and a key to the four species is given. Eight species of Ephydridae are recorded, *viz. Paralimna* (*P.*) *bicolor* (Macquart), *Asmeringa africana* (Wirth) (new to Namibia), *Atissa ?kairensis* Becker, *Ochthera* (*O.*) *praedatoria* (Loew) (new to Namibia), *Elephantinosoma cogani* Mathis & Deeming (new to Namibia), *Eremotrichom ?meridionale* (Canzoneri & Vienna) (new to Namibia), *Ephydra stuckenbergi* Wirth, and *Haloscatella dichaeta* (Loew) (new to Namibia). Six species of Sphaeroceridae are recorded, *viz. Rachispoda fuscipennis* (Haliday) (new to Namibia), *Thoracochaeta brachystoma* (Stenhammar), *T. pertica* Marshall & Roháček, *T. securis* Marshall & Roháček, *T. falx* Marshall & Roháček, *T. pugillaris* Marshall & Roháček and an illustrated key to species of the southwestern African seaboard provided. One species of Milichiidae, *Desmometopa singaporensis* Kertész (new to Namibia) is recorded.

INTRODUCTION

The southwestern seaboard of Africa has been the subject of a number of specific studies of the ecology of sandy beaches and rocky shorelines (*vide* Bally 1987 for a review of Benguela studies). Key papers for the southwestern Atlantic coastline, from north to south, are: Kensley & Penrith (1973) for southern Angola, Moçamedes (now Namibe); Kensley & Penrith (1980) for False Cape Frio to the Kunene River in Namibia; Tarr *et al.* (1985) for Toscanini, Hoarusib River mouth area and Bosluisbaai (Namibia); Penrith & Kensley (1970a) Rocky Point; Donn & Cockcroft (1989) for Langstrand and Cape Cross (Namibia); Walvis Bay (McLachlan 1985); Lüderitzbucht (Penrith & Kensley 1970b); Bally (1987) summarised information for the South African part of the Benguela coast from Cape Point to the Orange River; the Cape Peninsula (Brown 1971); and Langebaan Lagoon (Day 1959). McLachlan *et al.* (1981) reported on the Indian Ocean coastline from Cape Point to Sordwana, Natal. Brown & Jarman (1978) provide an overview of the biogeography of the southern African coastline. These studies paid only superficial attention to the Hexapoda component of the littoral fauna.

In January 1998, the National Museum of Namibia in collaboration with Zoologisches Museum für Naturkunde, Berlin, instigated a survey of the inter-tidal littoral invertebrate fauna of the southwestern Atlantic and southernmost Indian Ocean coastlines (Benguela system), from the Kunene River mouth on the Namibian/Angolan border to Tsitsikamma National Park in the Eastern Cape of South Africa (*vide* Figures 1-4). The purpose was to examine the hexapod community of the inter-tidal zone (here used to imply the area between low and high tide marks) by taking samples at regular intervals along the coast to ascertain species composition and faunistics. The survey predominantly focused on the fauna associated with kelp on sandy beaches, and for this reason very little of the fauna associated with rocky outcrops was sampled in Namibia. Results regarding the flies (Diptera) are reported here.

Few southern African littoral studies have dealt consistently with insect faunas, especially the variety of dipterous families. Those that do, often contain misidentifications. Of the six taxa listed under 'Diptera' in Bally (1987: 766), for example, three taxa (*Colpometopus basicornis* (Fairmaire, 1895) and the genera *Colpometopus* Abeille de Perrin, 1900, and *Phyllotreta* Stepnes, 1839 (as *Pyllotreta* [sic]), are wrongly placed, all being Coleoptera. Elsewhere, other more specific studies have used Diptera as indicators of habitat change or pollution in maritime habitats (e.g. Englund 2000a, 2000b). Ardö (1957) dealt principally with dipterous families associated with sand dune systems, rather than with the true littoral fauna.

The majority of dipterous species along the Namibian and South African coastlines are associated with kelp, decomposing marine animals, birds, or mammals (A.H. Kirk-Spriggs pers. obs.), with kelp forming a major component in the trophic requirement of many species. From north to south, there is a marked increase in the quantities of kelp distributed along the coastline, being particularly abundant in rocky bays and inlets adjacent to headlands, e.g. Rocky Point, Angra and Guano Bays. In some localities, such as Möwe Bay and Terrace Beach, the kelp is fragmented into short lengths by the action of waves, and this in turn appears to be preferred by some dipterous families, such as the Coelopidae and Sphaeroceridae, but not exclusively so.

Laminaria pallida Greville ex J.Ågårdh (Laminariales: Laminariaceae) is the only kelp species currently known to occur along the Namibian coastline, occurring sympatrically with *Ecklonia maxima* (Osbeck) Papenfuss (Laminariales: Alariaceae) south of the Orange River as far as the Cape of South Africa. A third kelp species, *Macrocystis angustifolia* Bory (Laminariales: Lessoniaceae), is limited to the Cape of South Africa (Branch *et al.* 1994: 316)). Algae of the species *Porphyra capensis* Kuetzing (Bangiales: Bangiaceae) (although not recorded from Namibia (Branch *et al.* 1994: 322)), was observed at several rocky outcrops along the coast (A.H. Kirk-Spriggs pers. obs), and it is probably the dominant species fed upon by inter-tidal larvae.

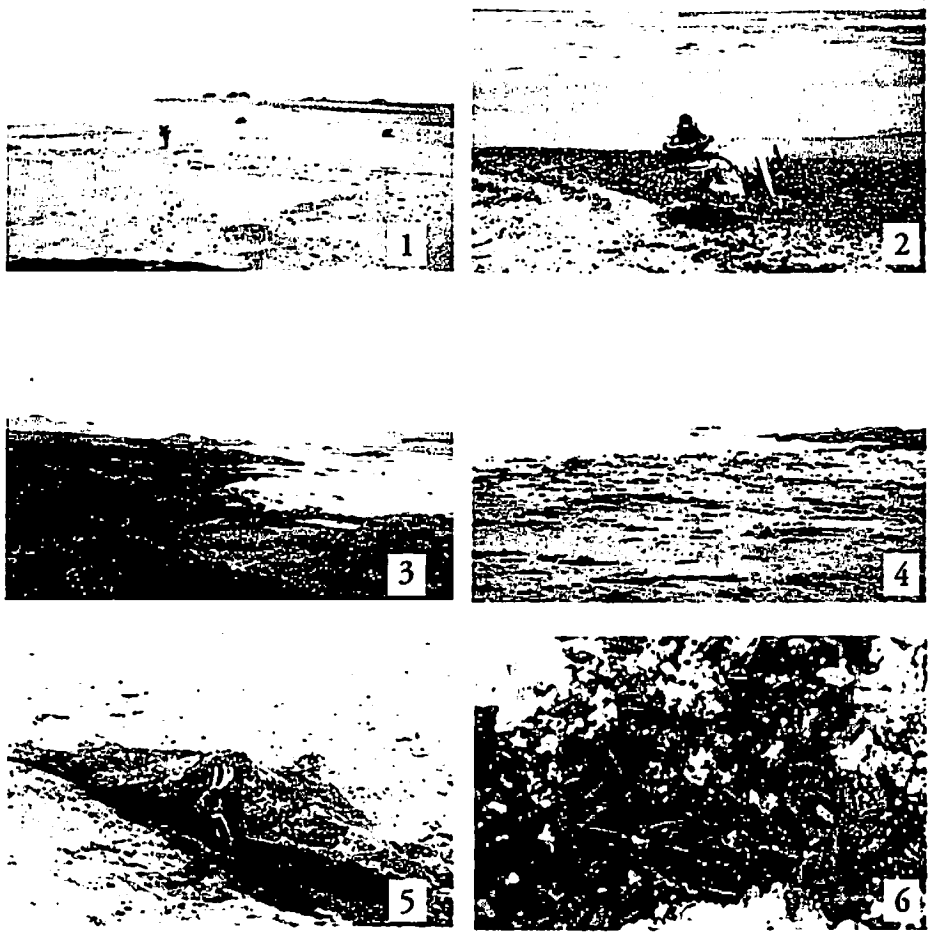
This paper deals with the taxonomy, biology, faunistics and biogeography of the dipterous families: Chironomidae, Canacidae, Chloropidae, Milichiidae, Tethinidae, Ephydridae, Sphaeroceridae, Coelopidae, Sarcophagidae and Anthomyiidae. Dolichopodidae and Empididae collected during the survey are not included as the material was destroyed in transit.

MATERIALS & METHODS

Samples were taken at 69 sampling stations (*vide* Appendix I); 52 in Namibia and 17 in South Africa. Diptera were sampled by use of a fine meshed net, which was either swept over shore debris, or was quickly placed over isolated patches of kelp and the kelp agitated to cause the flies to fly or crawl up into the net. The flies were then removed with an aspirator, killed using ethyl acetate and then micro-pinned into flat trays. Upon return to the laboratory, the flies were staged on 'nu-poly' strips and full data labels added.

Immature stages (larvae) were extracted from partially covered kelp, from the carcasses of seals, and from beneath beds of kelp. Larvae were either preserved in 70% alcohol for further study, or placed on a bed of fine sand to facilitate pupariation. Puparia were then segregated into individual vials until adult flies emerged and these were left for 24 hours to allow for sclerotisation and hardening before being killed and micro-pinned.

Bilaterally symmetrical structures in the new species description are described in the singular. Holotype and paratype label data are quoted as



Figures 1-4. Examples of coastal habitats on the southwest African seaboard. 1, Atlantic coast at Cape Fria, Namibia, is typical of the northern beaches south of the Kunene River, having only isolated clumps of kelp for larval breeding; 2, deep beds of cockle shells and other debris at 17°27'05"S, 11°44'35"E, Namibia, are sampled; 3, Rocky Point, Namibia, which has deep beds of kelp, cockle shells and other debris; 4, Guano beach, near Lüderitz, Namibia, here the accumulations of kelp are much more pronounced (photographs: Barbara Uhlig). Figure 5. Decomposing Cape Fur Seal at Cape Fria, Namibia, the usual larval medium of *Eutropha lindneri* Sabrosky (Chloropidae). Figure 6. Massed puparia of *Eutropha lindneri* Sabrosky (Chloropidae) in sand beneath decomposing Cape Fur Seal at Cape Fria, Namibia (photographs: Eugène Marais).

they appear; a slash (/) indicates the end of a line of print, two slashes (//) signify data on a further label. Significant supplementary or qualifying information is presented in square parentheses when considered necessary.

Abbreviations used in the text: BMNH = The Natural History Museum, London; NMNW = National Museum of Namibia, Windhoek; USNM = National Museum of Natural History, Washington D.C., USA; ZMHU = Zoologisches Museum für Naturkunde der Humboldt-Universität, Berlin.

SYSTEMATICS

For keys to families of Diptera the reader is referred to Barraclough & Londt (1985) and Barraclough (1995). A list of sampling stations in numerical order is provided in Appendix I and the presence or absence of sampled species from all sampling stations in Appendix II.

Chironomidae ('non-biting midges')

The Chironomidae, commonly known as 'non-biting midges', are a group of small to medium-sized Nematocera which superficially resemble mosquitoes. They occur in all zoogeographic regions, with over 5 000 species known worldwide. Over 400 species have been recorded from the Afrotropical Region (Freeman & Cranston 1980: 175), but the Namibian fauna has not been studied in detail. The majority of species have larvae that develop in fresh water ('bloodworms'), but some species inhabit marine environments, usually occurring in the inter-tidal zone (Barraclough & Londt 1985: 292).

Subfamily: Telmatogetoninae Brundin

The subfamily is widespread from sub-Antarctic islands through tropical and temperate coasts as far north as Norway, Japan, Newfoundland and Alaska. Early ideas on the marine midges implied monophyly - in a subfamily Clunioninae or tribe Clunionini of the subfamily Orthocladiinae. This grouping comprised taxa centred on *Clunio* Haliday, 1855, small midges of inter-tidal shores, rock pools and reefs and genera such as *Telmatogeton* Schiner, 1866, and *Thalassomya* Schiner, 1856, larger taxa of wave-swept coastal rocks, or montane Hawai'ian streams. In reality, all that the two groupings had in common was their marine habitat and some reductional features of the adult body. As early as 1960, Strenzke, using Hennig's approach to determine relationships, assessed the *Clunio* grouping to be sister to a clade of Orthocladiinae with terrestrial larvae. Strenzke was, however, less certain about *Telmatogeton* and allies, but recognised it as plesiomorphic and unrelated to *Clunio*, and he dismembered the polyphyletic Clunioninae.

The subsequent history of *Telmatogeton* and allies has been controversial. Brundin (1966) claimed a relationship to the Diamesinae, although he acknowledged all shared states appeared to be plesiomorphies and distinctive features were all highly autapomorphic. In a comprehensive survey of female genitalia of Chironomidae, Sæther (1977) suggested that on these features alone, the taxon deserved family rank as sister to the remaining Chironomidae. In a critique of Sæther's use of symplesiomorphies, autapomorphies and non-parsimonious reasoning, Ashe *et al.* (1987) disputed this, adding that a marine ancestor for the Chironomidae radiation was *prima facie* unlikely. Molecular data (Cranston & Cook unpub.) supports the position espoused by Sæther, although the subfamily may be sister to Aphroteniinae, with both combined as sister to the remaining Chironomidae.

Species of Telmatogetoninae tend to show reductional and autapomorphic characters, and generic descriptions frequently lack phylogenetic justification. At present it is best to consider that there are two genera, *Thalassomya* Schiner and *Telmatogeton* Schiner, the latter including at least *Paraclunio* Kieffer, 1911, *Halirytus* Eaton, 1875, and *Psamathiomyia* Deby, 1889. Worldwide, *Telmatogeton* includes some 20 species, of which

six are found in Hawai'i in the splash zone beside freshwater waterfalls. *Thalassomya* has 9 described species from most temperate-tropical coasts, all living in tubes in similar sites to species of larval *Telmatogeton*, predominantly between high and low tide in green algae such as *Enteromorpha* Link (Ulvaceae). Several species of larval *Telmatogeton* have been observed to interact antagonistically, apparently competing for optimal larval feeding and/or pupation sites with respect to tide level (Robles 1984; Cranston pers. obs.). Telmatogetoninae larvae and pupae can be recognised from keys and descriptions in Cranston (1983, 1986).

IDENTIFICATION KEY TO ADULT AFROTROPICAL TELMATOGETONINAE (after Cranston 1989; Wirth 1947).

1. Acrostichal setae numerous. Tarsomere 5 simple ..... *Thalassomya africana* Edwards
- Acrostichal setae absent. Tarsomere 5 trilobed (*Telmatogeton*) 2
2. Wing length >5 mm; dark, wings smoky brown; body very setose (> 50 scutellars) ..... *Telmatogeton sanctipauli* (Schiner)
- Wing length <4 mm; light brown, wings grey; body weakly setose (*c.* 12 scutellars) ..... *Telmatogeton minor* (Kieffer)

Telmatogeton minor (Kieffer, 1914: 260).

TAXONOMIC NOTES: Two species of *Telmato-geton* Schiner, 1866, occur in the Afrotropical Region. Both species in the genus are confined to the marine inter-tidal zone, where they are encountered as adults actively scurrying over rocks in the splash zone (Cranston 1989: 19). We have been informed (B. Stuckenberg pers. comm.) that the species is frequently encountered on the South African coastline.

DISTRIBUTION: Afrotropical: South Africa (Monille Pt., Cape Town). New to Namibia.

NOTES: During the survey this species was only collected from one locality, where adults were observed walking on marine algae (*Porphyra capensis*) in the splash zone on the wreck of the Kya Maru (sampling station 10). This part of the Namibian coastline has very few rock outcrops, and this, together with the fact that the survey focused chiefly on sandy beaches, probably explains why the species was not sampled elsewhere.

Canacidae ('beach-flies')

The acalyptrate family Canacidae is small and primarily includes shore-inhabiting maritime flies that are better known as 'beach-flies' or 'surf-flies'. Although superficially resembling the Ephydridae, the family Canacidae is probably more closely related to the Tethinidae (Cogan 1980a: 694; Mathis 1992: 1). Larvae develop in and feed upon marine algae on rocks and play a rôle in the recycling of nutrients in coastal areas, and this explains their distribution along the southwestern African seaboard, where 'beach-fly' species are virtually restricted to rocky outcrops or sheltered lagoons (A.H. Kirk-Spriggs pers. obs.). Mathis (1982) and Mathis & Freidberg (1991) reviewed most afrotropical species from Namibia and South Africa, and all afrotropical species then known were included in a recent world catalogue (Mathis 1992).

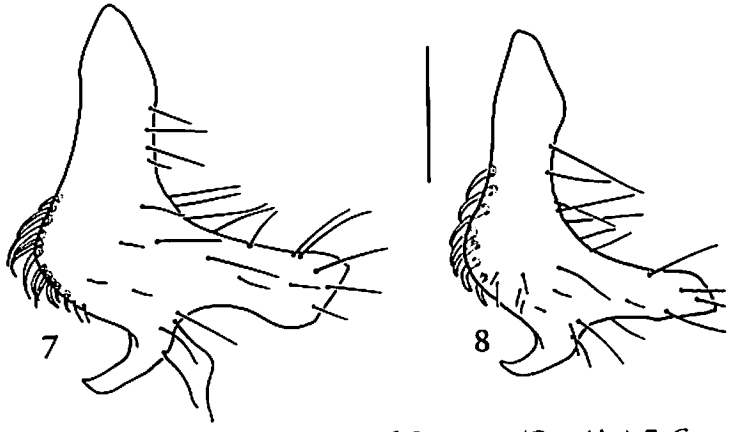
ANNOTATED KEY TO SUBFAMILIES, TRIBES AND GENERA OF AFROTROPICAL CANACIDAE

1. Lateroclinate fronto-orbital setae 3 and katepisternal seta usually present (lacking in the *grisescens* group of *Procanace*); lamella of female terminalia bearing 2 large setae, one apical the other subapical, each rather bluntly rounded (Subfamily Nocticanacinae) 2
- Lateroclinate fronto-orbital setae either 4 or more, or 3 and with katepisternal seta lacking; lamella of female terminalia with 1 large, apical seta, this usually acutely pointed (Subfamily Canacinae) ... 3
2. Intrafrontal setae absent, although anterior $^1/_3$ of frons occasionally bearing scattered setulae ..... *Procanace* Hendel [6 species in the Afrotropical Region]
- One or 2 intrafrontal setae in addition to setulae if any .... *Nocticanace* Malloch [6 species in the Afrotropical Region]
3. Lateroclinate fronto-orbital setae 3; katepisternal seta lacking (Tribe Canacini) .... *Canace* Haliday [3 species in the Afrotropical Region]
- Lateroclinate fronto-orbital setae 4 or more; katepisternal seta sometimes present (Tribe Dynomiellini)..... 4
4. Katepisternal seta present, sometimes pale ..... *Isocanace* Mathis [3 species in the Afrotropical Region]
- Katepisternal seta absent 5
5. Anterior notopleural seta lacking; lateral scutellar setae 1 pair .... *Trichocanace* Wirth [1 species in the Afrotropical Region, *T. sinensis* Wirth, 1951, Madagascar; Mathis 1982: 22]
- Anterior notopleural seta present; lateral scutellar setae 2 pairs 6
6. Vein M with last section arcuate; mesofrons uniformly and densely setulose; fronto-orbital setae 4-6; setae in general pale ..... *Xanthocanace* Hendel [1 species in the Afrotropical Region, *X. capensis* Wirth, 1956, South Africa; Mathis 1982: 24]
- Vein M with last section more or less straight, not distinctly arcuate; mesofrons with bare areas, not densely setulose; fronto-orbital setae 4; setae in general dark coloured .... *Dynomiella* Giordani Soika [4 species in the Afrotropical Region (South Africa and Namibia); Mathis 1982: 9-11]

Subfamily: Canacinae Jones

KEY TO AFROTROPICAL SPECIES OF *CANACE* HALIDAY.

1. Gena with 3-4 large, dorsoclinate setae below eye 2
- Gena with 2 large, dorsoclinate setae below eye .... *Canace zvuv* Mathis & Freidberg
2. Posterior process of surstylus robust, slightly enlarged subapically .... *Canace nasica* (Haliday)
- Posterior process of surstylus generally thinner and gradually becoming narrower toward apex .... *Canace rossii* Canzoneri



Figures 7-8. Posterior surstylar process (lateral aspect) of *Canace* spp. (Canacidae). 7, *Canace nasica* (Haliday); 8, *Canace rossii* Canzoneri. Scale bar = 0.1 mm.

Canace rosii Canzoneri, 1982: 61.
TAXONOMIC NOTES: This species is very similar and closely related to *C. nasica* (Haliday, 1839), and distinguishing between these two species usually requires study of the male terminalia (Figures 7-8).
DISTRIBUTION: Afrotropical: Sierra Leone (Mathis 1992: 4). New to Namibia.
NOTES: Two of the three sites where this species was sampled were isolated rock outcrops with marine algae (*Porphyra capensis*) on the Namibian coastline. The restricted northern distribution of the species (*vide* Appendix II) may indicate a more extensive distribution north of the Kunene River.

KEY TO AFROTROPICAL SPECIES OF *DYNOMIELLA* GIORDANI SOIKA.

1. Setae on lower pleural areas pale and very fine; forefemur lacking anteroventral spine-like setae; midfemur of male with prominent, posteroventral series of black setae 2
- Setae on lower pleural areas black; forefemur bearing anteroventral spine-like setae (except in males of *D. cala*); midfemur of male lacking prominent, posteroventral setae 3
2. Head greatly produced triangularly in front of eyes, mesofrons extended to lunular margin, with a bare medial area between lateral mesofrontal setae and extended entire length; legs with fine white setulae, lacking black setae except for 1-4 on posteroventral surface of forefemur and in male with 8-12 on posteroventral surface of midfemur .... *Dynomiella glauca* (Wirth)
- Head only slightly produced in front of eyes; mesofrons in form of a triangle, extended not more than $^3/_4$ way to lunular margin, medial bare area small; legs with abundant black setae and fine white setulae; midfemur of male with conspicuous posteroventral series of about 15 black seta .... *Dynomiella stuckenbergi* (Wirth)
3. Forefemur of male lacking black anteroventral setae, that of female with 6-8 closely set, slender setae on distal half; smaller species, 2.75 mm or smaller ..... *Dynomiella cala* (Cresson)
- Forefemur of both sexes bearing anteroventrally 4-6 widely spaced, very stout black spine-like setae on distal half; larger species, 3 mm or larger .... *Dynomiella spinosa* (Wirth)

Dynomiella cala (Cresson, 1934: 220).
DISTRIBUTION: Afrotropical: South Africa (Cape) (Cogan 1980a: 694; Mathis 1992: 5).
NOTES: This species was only sampled at West Coast National Park (Langebaan Lagoon). This site differed much from other sampling stations and yielded some unusual species (*vide* section on Anthomyiidae, Discussion, Appendix II). The site was a white sandy sheltered lagoon, with no kelp, but with thick beds of other marine algae along the strand line.

Dynomiella stuckenbergi (Wirth, 1956: 50).
DISTRIBUTION: Afrotropical: Namibia (Walvis Bay) and South Africa (Cape) (Cogan 1980a: 694; Mathis 1992: 5).
NOTES: This species shows no distinct distributional pattern, having been sampled from Sandwich Lagoon mouth and Kuisebmond in Namibia and McDougal's Bay and West Coast National Park in South Africa (*vide* Appendix II). Sites 36 and 51 are, however, brackish lagoons, and this may indicate a preference for this habitat type. Among species of *Dynomiella* that were collected as part of this study, this species occurred at more localities and was more abundant. Although common, care must be taken in identifying this species, as both *D. cala* and *D. spinosa* occurred sympatrically at one site (station 51).

Dynomiella spinosa Wirth, 1956: 51.
DISTRIBUTION: Afrotropical: South Africa (Cape) (Cogan 1980a: 694; Mathis 1992: 5).
NOTES: Only sampled from West Coast National Park (Langebaan Lagoon), *vide D. cala*, above.

Xanthocanace capensis Wirth, 1956: 47.
DISTRIBUTION: Afrotropical: South Africa (Cape) (Cogan 1980a: 694; Mathis 1992: 6).
NOTES: *Xanthocanace* is represented by a single species, *X. capensis*, in the Afrotropical Region, although two other species are found in the southern Palaearctic Region (Egypt, Sinai; Mathis & Freidberg 1982). Between these two rather disjunct localities (the Sinai and South Africa), other species of *Xanthocanace* are likely to occur. During the current survey this species was only sampled from West Coast National Park (Langebaan Lagoon) and Struisbaai in South Africa.

Subfamily: Nocticanacinae Mathis

Nocticanace cyclura Mathis & Wirth, 1979: 791.
DISTRIBUTION: Afrotropical: Madagascar (Mathis 1992: 5). New to South Africa.
NOTES: This species was only sampled from Stilbaai-Wes (site 56), a sandy bay with small beds of seaweed and other debris, and Driftwood Bay, a pebble beach without kelp and with very few dead marine invertebrates or sea grasses along the strand line. The species is probably associated with the Indian Ocean maritime fauna of Africa, but until an extensive survey of the eastern African coast is undertaken this cannot be substantiated.

Chloropidae ('shoot flies')

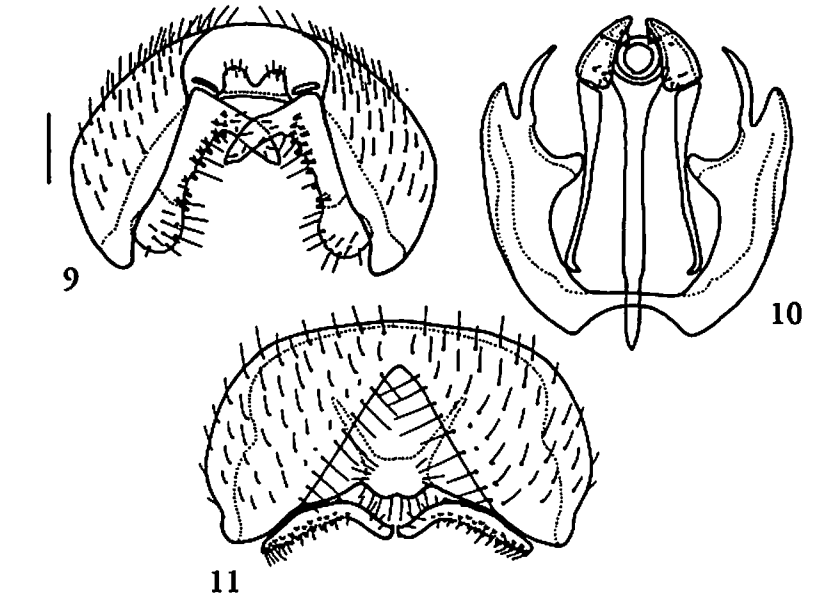
Chloropidae is a large family with one centre of endemism in the Afrotropical Region. They are small to medium sized acalyptrate flies, often distinctly coloured. They lack an anal vein and often have a shining ocellar triangle (Sabrosky 1980a). Larval habits are varied, but many species develop in the shoots of grasses, and for this reason some species are of economic importance as pests of grasses and cereals. A brief review of the family was recently published by Ismay (2000).

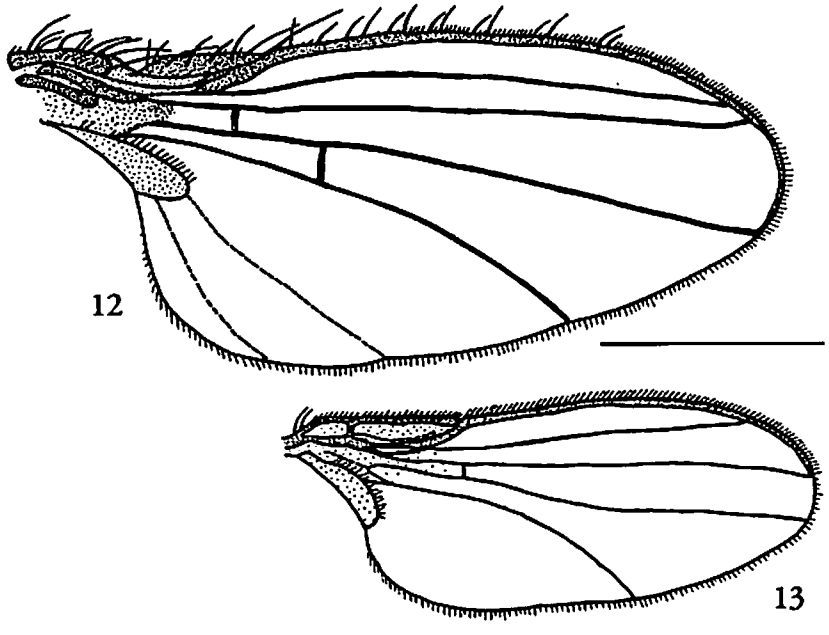
During the course of the coastal survey large giant black chloropids were frequently observed, often in swarms, attracted to freshly washed up carcasses of Cape Fur Seal *Arctocephalus pusillus* (Schreber, 1776) (Carnivora: Otariidae). Further examination found these to represent the genus *Eutropha* Loew, 1866, two species of which (*viz. E. lindneri* Sabrosky, 1972, and *E. obscura* Sabrosky, 1959) are known to occur in the Afrotropical Region (Sabrosky 1980a). The samples were all subsequently found to represent *Eutropha lindneri*. An additional series of *Siphunculina* nr. *lurida* (Enderlein, 1911) was also sampled during the course of the survey, and a key for the identification of the two species is provided below.

KEY TO SPECIES OF CHLOROPIDAE OCCURRING ON THE SOUTHWESTERN AFRICAN SEABOARD.

1. Second costal sector (R_1-$R_{2,3}$) much shorter than the third ($R_{2,3}$-$R_{4,5}$); frons and scutum dull, heavily dusted .... *Siphunculina* nr. *lurida* (Enderlein)
- Second costal sector (R_1-$R_{2,3}$) longer than third ($R_{2,3}$-$R_{4,5}$); frons and scutum undusted, shining .... *Eutropha lindneri* Sabrosky

Eutropha lindneri Sabrosky, 1972: 2.
TAXONOMIC NOTES: Sabrosky (1972) described this species from South Africa and South West Africa (Namibia). *Eutropha lindneri* is most closely related to *E. obscura* Sabrosky, the essential differences were enumerated by Sabrosky (1972). *Eutropha lindneri* has a dark head, shining scutum, smooth, shining anepisternum with dusting on the dorsal margin, tarsi at least partly yellowish and $R_{4,5}$ less strongly curved anteriorly and less divergent from M_1. *Eutropha obscura* has a predominantly yellow head, lateral dusted stripes on the scutum, entirely shining but rugose anepisternum, brown tarsi and $R_{4,5}$ more strongly curved anteriorly and more divergent from M_1. The material examined in this study is all referred to *E. lindneri*, but shows a rather greater variation than is indicated in Sabrosky's (1972) paper. There is a distinction in the head colour between the occiput and the posterior gena up to the vertical line dividing the gena





Figures 9-11. Male genitalia of *Eutropha lindneri* Sabrosky (Chloropidae). 9, epandrium (ventral aspect); 10, epandrium (apical aspect); 11, hypandrium (ventral aspect). Figure 12. *Horaismoptera microphthalma* (Bezzi) (Tethinidae), wing. Figure 13. *Afrotethina persimilis* Munari (Tethinidae), wing. Scale bars: 9-11 = 0.1 mm; 12-13 = 0.2 mm.

and the anterior part of the head. The posterior part is black in all specimens but the anterior part varies from black to dark yellow in both sexes. The tarsi are uniformly brown in some specimens, though not black. Some specimens have a slightly rugose anepisternum. One male specimen (Cape Fria, 21.iii.1998, em[erged] 04.iv.1998) differs from the remainder. It has a bright yellow anterior part of the head, and the scutum is largely rugose, though not dusted. All the material has the venation as figured by Sabrosky (1972) for *E. lindneri* and agrees with the thoracic dusting pattern described for that species. It is, therefore, considered that all the material is *E. lindneri*, but that variation is more extensive than the type series indicated. The original description did not include details of the male genitalia and specimens were dissected to confirm that one species was present. The male genitalia of *E. lindneri* (Figures 9-11) are similar to those of *E. fulvifrons* (Haliday, 1833), the type species of the genus, illustrated by Andersson (1977). The surstylus is in three lobes as in *E. fulvifrons*. The anterior lobe is reduced to a small strip. The middle lobe has an elongate, finger-like extension in both species and in *E. lindneri* the apex has a small papilla at the tip. The basal portion of the middle lobe has fine dentations. The posterior lobe is smaller than in *E. fulvifrons*, nearly circular and flat. The most important difference is the arm of the hypandrium, which has a step-like process at over half its length. This process is absent in *E. fulvifrons*. The postgonite is short, as in *E. fulvifrons* and is apically extended around the base of the aedeagus, as in the genus *Lasiosina* Becker, 1903. The specimen from Cape Fria (*vide supra*) was dissected, and no differences were found in the male genitalia. It was concluded that the material all represents *E. lindneri*. No material of *E. obscura* was available for study.

BIOLOGICAL NOTES: Ferrar (1987) summarised records of the biology of chloropid larvae. In the subfamily Oscinellinae, five genera were recorded as feeding on decayed animal matter. *Anatrichus pygmaeus* Lamb, 1918, was found to be feeding on a dead caterpillar of a rice stem borer in Thailand (Wongsiri *et al.* 1974). *Aphanotrigonum darlingtoniae* (Jones, 1916) larvae were found to scavenge on the insect remains inside pitchers of the California pitcher plant in the USA (Jones 1916). *Cadrema pallida* (Loew, 1866) is known to breed in stranded marine molluscs in Australia (Colless & McAlpine 1970). *Conioscinella hinkleyi* (Malloch, 1915) has been reared from decaying horseshoe crabs in the U.S.A. (Norrbom 1983). *Polyodaspis ruficornis* (Macquart, 1835) has been reported as saprophagous on dead caterpillars (Nartshuk 1972). In the subfamily Chloropinae, *Pachylophus beckeri* Curran, 1828 has been reared from the pupa of a stem borer (Deeming 1974). These records are all from invertebrates, whereas the present record appears to be the first published record from mammalian carrion. No earlier records of the life history of *Eutropha* are known, although most species appear to be associated with the coast. E. P. Nartshuk (pers. comm.) has unpublished records of species of *Siphunculina* Rondani, 1856, and *Tricimba* Lioy, 1864, reared from cat and snake corpses and dead fish.

Adult *Eutropha lindneri* were found to be attracted to decomposing Cape Fur Seals *Arctocephalus pusillus* (Schreber, 1776) (Carnivora: Otariidae) washed up on the coast, and larvae and puparia were discovered in great numbers beneath the skin and in sand beneath carcasses (*vide* Figures 5-6). Adults were also noted as being attracted to sheep's blood on a hessian bag and to decomposing food waste. *Eutropha lindneri* would appear to be predominantly coastal in habits and distribution, but one specimen has been sampled considerably further inland (Gai-Ais spring, 20°46'01"S, 14°01'12"E), swept from marginal grasses of a small desert spring on the gravel plains.

ADDITIONAL MATERIAL EXAMINED: 16♀♀, SKELETON COAST PARK, False Cape Fria, 18°28'18"S, 12°01'61"E, 17.iii.1998, A. H. Kirk-Spriggs, alighting on decomposing cape fur seal *Arctocephalus pusillus* (Schreber) (Otariidae); 3♀♀, SKELETON COAST PARK, Bosluisbaai, 17°22'05"S, 11°45'23"E, 20.iii.1998, A.H. Kirk-Spriggs, attracted to domestic rubbish sack with sheep's blood; 1♂, SKELETON COAST PARK at: 17°32'22"S,

11°44'36"E, 18.iii.1998, A.H. Kirk-Spriggs, ex Cape Fur Seal; 1♂, Lüderitz Dist., Rotkop gate, 26°14'33"S, 15°19'59"E, 01.ix.1998, A.H. Kirk-Spriggs, refuse skip & on windows; 4♂♂, Namibia, KHORIXAS DIST., Gai-Ais Spring, 20°46'01"S, 14°01'12"E, 22.xii.1998, A.H. Kirk-Spriggs, sweeping marginal grasses and sedges.

Siphunculina nr. *lurida* (Enderlein, 1911: 231).
DISTRIBUTION: Afrotropical: South Africa (Sabrosky 1980a: 705).
NOTES: Sampled only at Hermanus in the Western Cape of South Africa, where a series was netted from accumulations of kelp on the upper shore (kelp had been cleared) on a sandy beach.

Milichiidae

Milichiidae is a family of small, usually black, dull or shining acalyprate flies closely allied to the Chloropidae. About 250 extant species are known world-wide, of which 68 species in 12 genera are known from the Afrotropical Region. The Namibian fauna was briefly reviewed recently by Swann (2000), on which these notes are based. Larvae of Milichiidae tend to be saprophagous or coprophagus, but there are many varied life histories within the group, some species being associated with ants and bees, some cavernicolous and some associated with spiders and their webs.

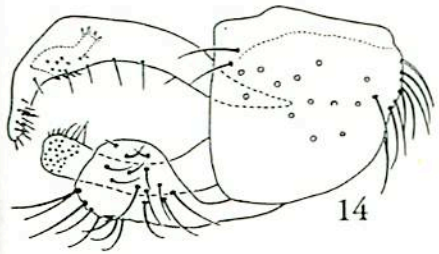
Only one species, *Desmometopa singaporensis* (Kertész), was sampled during the survey. A key to species of *Desmometopa* Loew, 1866, is provided by Sabrosky (1983). Eight additional species are currently known from the Afrotropical Region (Sabrosky 1980b), of which only three, *viz. D. interfrontalis* Sabrosky, 1965, *D. inaurata* Lamb, 1914, and *D. m-nigrum* (Zetterstedt, 1848) are recorded from southern Africa. Adults of *Desmometopa*, including *D. singaporensis*, are recorded as being attracted to human faeces and decayed animal matter. Other species have been observed feeding on juices of prey of predatory insects, and there are some records of species attracted to eyes of humans (Sabrosky 1983). The larvae are mostly recorded as feeding on decayed plant material. There are no specific records for *D. singaporensis* from coastal habitats or from kelp.

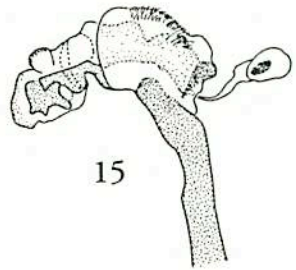
Desmometopa singaporensis (Kertész, 1899: 194).
TAXONOMIC NOTES: There has been confusion over the correct names for species in this species complex, with the present species having been variously named as *D. singaporensis*, *D. palpalis* and *D. tarsalis* (Sabrosky, 1983). Sabrosky (1983) gave a short diagnosis: "Polished pleural spot small, not including an area of mesopleuron; fronto-orbital plates relatively narrow [*vide* Sabrosky 1983]; palpus of male broadly expanded, capitate [Sabrosky 1983: figure 5]".
DISTRIBUTION: Afrotropical: Ivory Coast, Seychelles, South Africa (Transvaal), Uganda. Widespread in the Oriental and Pacific Regions and Neotropical (Brazil) (Sabrosky 1980b: 687). New to Namibia.
NOTES: This species was sampled at Torra Bay (one specimen) from isolated clumps of kelp. The species has a very wide range of life histories. Sabrosky (1983) recorded it from cattle and poultry excrement and cattle manure, from rotten onions, rotten pawpaw stems, decaying stump of papaya tree, pomalo fruit, *Areca catechu* L. (Arecaceae) inflorescences, decaying cabbage, rotten potatoes, decaying banana skins and from a dead cat. The wide distribution is presumably because it has been spread naturally or by human activity.

Tethinidae

Tethinidae is a group of small greyish acalyprate flies found predominantly on seashores or saline/alkaline environments inland, often abundantly, in both temperate and tropical regions of the world (Mathis & Munari 1996: 1; Vockeroth 1987a: 1074). Mathis & Munari (1996: 5-7) provide a key to the world genera of Tethinidae.

On the southwestern Atlantic seaboard, species appear to be associated with decomposing kelp





Figures 14-15. Male genitalia of *Horaismoptera microphthalma* (Bezzi) (Tethinidae). 14, epandrium (lateral aspect); 15, aedeagus (lateral aspect). Scale bar = 1 mm.

and other shoreline debris, being particularly prevalent in the anchor root section of washed up kelp (A.H. Kirk-Spriggs pers. obs.). Very little is known of the biology of the family, even in temperate regions of the world, but it can be assumed that larvae develop within decomposing kelp and probably pupate in the sand beneath. Despite repeated efforts, no larvae or puparia were discovered during the course of the survey.

Two genera of Tethinidae in two subfamilies were recorded during the survey, *viz. Horaismoptera* Hendel, 1907: 238 (one species) and *Afrotethina* Munari, 1986: 44 (three species).

Horaismoptera is represented by three species world-wide, one from the Oriental Region and two afrotropical. The second afrotropical species, *H. vulpina* Hendel, 1907: 240, is recorded from Abd al Kuri, Kenya, Madagascar and from Egypt, Iran, Oman and Yemen in the Palaearctic Region (Mathis & Munari 1996: 8). The species is unlikely to occur along the southwestern African seaboard, but may possibly occur north of the Kunene River.

Munari (1991: 183-184) provides a key to *Afrotethina*. The genus is restricted to the Afrotropical Region, seven species being currently known, four of which occur in southern Africa (*A. brevicostata* Munari: Natal, South Africa; *A. femoralis* (Munari): Cape & Natal, South Africa; *A. persimilis* Munari: Namibia and *A. stuckenbergi* Munari: South Africa (*vide* Mathis & Munari 1996: 11)).

KEY TO GENERA AND SPECIES OF TETHINIDAE OCCURRING ON THE SOUTHWESTERN AFRICAN SEABOARD (after Mathis & Munari 1996; Munari 1991).

1. Costa with irregular prominent spines longer and stronger than adjacent vestiture (Figure 12) .... *Horaismoptera microphthalma* (Bezzi).
- Costa not spinose (Figure 13) (*Afrotethina* Munari, 1986) 2
2. Fore and hind femora pale in male (darker in large specimens), often slightly pale grey dusted; femora entirely pale yellow in female. Hind femur in male swollen, with antero-ventral comb of irregular, bristle-like spines in distal third. Bristles and hairs on body with golden reflections when viewed laterally ..... *Afrotethina femoralis* (Munari)
- Femora mostly dark, grey or bluish grey dusted in both sexes. Hind femur of male not as swollen and without antero-ventral comb of spines in distal third. Bristles and hairs of body without golden reflections 3
3. Acrostical hairs in six rows (between second pair of dorsocentral bristles). Gena not particularly broad; eye subcircular, diameter 1.50-2.16 times genal width .... *Afrotethina stuckenbergi* Munari

Acrostical hairs in four (occasionally five), very broad irregular rows (between second pair of dorsocentral bristles). Gena broad; eye ellipsoidal, transverse, diameter 1.22-1.57 times genal width .... *Afrotethina persimilis* Munari

Subfamily: Horaismopterinae Sabrosky

Horaismoptera microphthalma (Bezzi, 1908:198).
= *Oestroparea grisea* Séguy, 1933: 30.
TAXONOMIC NOTES: For illustrations of the epandrium and aedeagus *vide* Figures 14-15.
DISTRIBUTION: Afrotropical: Namibia (Mathis & Munari 1996: 11). New to South Africa.
NOTES: This species was sampled during the survey from Kuisebmond in Namibia as far south as Gordon's Bay in South Africa (*vide* Appendix II; Discussion). The species appears to be associated with deep beds of kelp on rocky shorelines, rather than isolated clumps of kelp (A.H. Kirk-Spriggs pers. obs.).

Subfamily: Tethininae Hendel

Afrotethina persimilis Munari, 1991: 181.
DISTRIBUTION: Afrotropical: Namibia (Mathis & Munari 1996: 11). New to South Africa.
NOTES: This species was not sampled until site 16 of the survey, sites north of which were represented by *A. stuckenbergi* only (*vide* Appendix II, Discussion). A few individuals were swept from Cape Fur Seal carcasses, 5 km south of Bandom Bay, also netted from wet mud at the edge of the Groen River mouth lagoon.

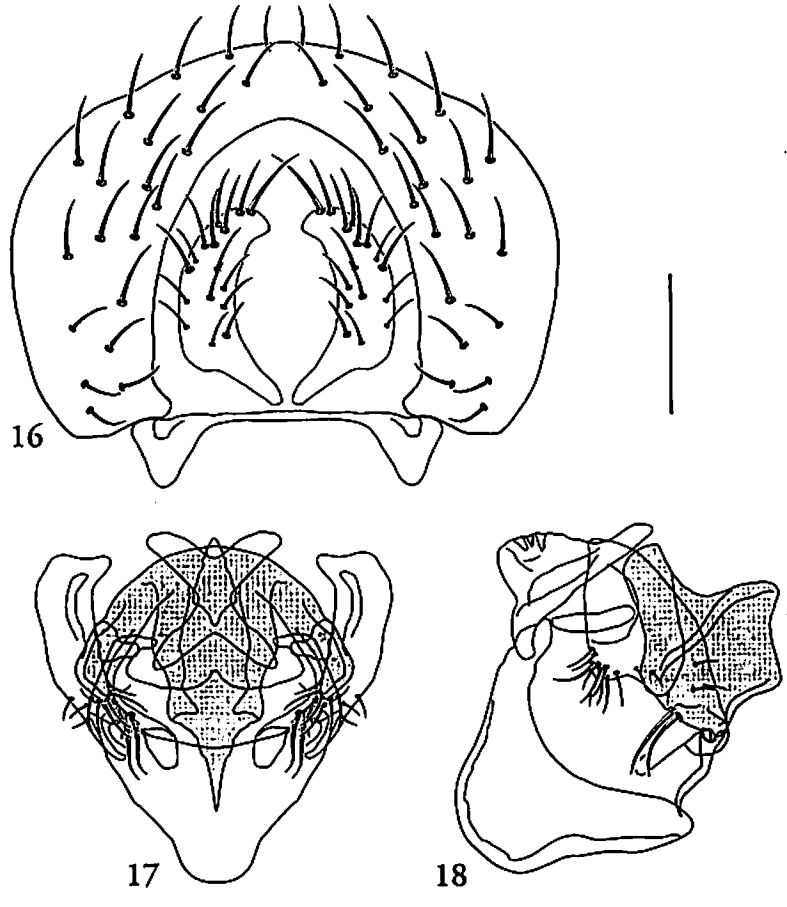
Afrotethina femoralis (Munari, 1981: 94).
DISTRIBUTION: Afrotropical: Madagascar, Seychelles (Aldadra), South Africa (Natal) (Mathis & Munari 1996: 11). New to Namibia.
NOTES: It is interesting to note that in all the sites this species was sampled (Stilbaai-Wes, Groot Brakrivier, Struisbaai & Gordon's Bay), kelp was not present and individuals were sampled from other species of marine algae, both on rocky shores and sandy beaches (*vide* Appendix II, Discussion). It is tempting to infer that the larvae of this species do not develop in kelp, as is assumed for the other species of the genus in southern Africa, but probably develop in other marine algae.

Afrotethina stuckenbergi Munari, 1990: 58.
DISTRIBUTION: Afrotropical: South Africa (Cape) (Mathis & Munari 1996: 11). New to Namibia.
NOTES: While not as abundant as *A. persimilis*, this species is, however, more widely distributed northwards along the Namibian coast as far as the Kunene River mouth, whereas *A. persimilis* makes its first appearance at site 16 (*vide* Appendix II; Discussion).

Ephydridae ('shore flies')

Among acalyprate Diptera, the family Ephydridae, or 'shore flies', is perhaps the most diverse family regarding its adaptive evolution. Although most species are aquatic or semi-aquatic as immatures, feeding as browsers or filter feeders, others are terrestrial, feeding as leaf miners (Foote 1995). Still others are parasitoids in spider eggs and clusters of frog eggs or are saprophagous on stranded snails or carrion and faeces. Many species are adapted to such inhospitable environments as sulphurous hot springs, highly alkaline or saline lakes, and perhaps most notably, exposed pools of crude petroleum. Although most species are beneficial, providing important food to wildlife, some species of *Hydrellia* Robineau-Desvoidy, 1830, damage watercress, rice, barley, and other irrigated cereals with their stem- and leaf-mining habits.

The 'shore flies' are now classified into five subfamilies and include world-wide nearly 1800 species of which over 325 occur in the Afrotropical Region (Mathis & Zatwarnicki 1995). The fauna occurring in coastal marine habitats is comparatively diverse as reflected by the species reported here from Namibia and South Africa that represent three of five subfamilies.



Figures 16-18. Male genitalia of *Paralimna* (*Phaiosterna*) *bicolor* Macquart (Ephydridae). 16, epandrium, cerci and presurstyli (posterior aspect); 17, internal male genitalia (ventral aspect); 18, internal male genitalia (lateral aspect). Scale bar = 0.1 mm.

Subfamily: Hydrelliinae Robineau-Desvoidy
Tribe: Dryxini Zatwarnicki

Paralimna (*Phaiosterna*) *bicolor* (Macquart, 1851: 303).
TAXONOMIC NOTES: A single species of *Phaiosterna*, *P. bicolor*, occurs in the Afrotropical Region (Mathis & Zatwarnicki in press). The other three names that have been used for species in this region (Cogan 1980c) are synonyms or misidentifications. This species is distinguished from congeners, especially those of the subgenus *Phaiosterna*, by the following combination of character states: basal flagellomere lacking fringe of long, whitish setulae along dorsum and dorsal portion of rounded apex; apex of basal flagellomere evenly rounded; mesonotum black, dull to subshiny, with moderately dense grey to brown microtomentum, frequently with conspicuous, longitudinal stripes medially (Figures 16-18).

ing towards research in Namibia. We are also grateful to the editors of *Studia Dipterologica*, A. Stark and F. Menzel (Ampyx-Verlag, Halle (Saale)) for permission to reproduce some illustrations of *Thoracochaeta* recently published in that journal. W. Seeger (Editor: *Stuttgarter Beiträge zur Naturkunde*) kindly gave permission to reproduce an illustration of the distiphallus of *Sarcophaga maritima* (Rohdendorf 1963, figure 15), and A.Z. Lehrer gave permission to reproduce his illustration of the distiphallus of *Parathalattica namibica*, published in *Entomologica, Bari* (Lehrer 1995, figure 3).

REFERENCES

ANDERSSON, H. 1977. Taxonomic and phylogenetic studies on the Chloropidae (Diptera) with special reference to Old World genera. *Entomologica Scandinavica Supplement* 8: 1-200.

ARDO, P. 1957. Studies on the marine shore dune ecosystem with special reference to the dipterous fauna. *Opuscula Entomologica Supplement* 14: 1-225.

ASHE, P., MURRAY, D. A. & REISS, F. 1987. The zoogeographical distribution of Chironomidae. *Annales de Limnologie* 23: 27-60.

BALLY, R. 1987. The ecology of sandy beaches of the Benguela ecosystem (pp. 759-770). In PAYNE, A. I. L., GULLAND, J. A. & BRINK, K. H. (eds). *The Benguela and comparable ecosystems*. South African Journal of Marine Science 5: 1-957 pp.

BARRACLOUGH, D. A. 1995. An illustrated identification key to the acalyprate fly families (Diptera: Schizophora) occurring in southern Africa. *Annals of the Natal Museum* 36: 97-133.

BARRACLOUGH, D. A. & LONDT, J. G. H. 1985. 22 Order Diptera (flies) (pp. 283-321). In SCHOLTZ, C. H. & HOLM, E. (eds). *Insects of southern Africa*. Butterworths, Durban, South Africa, [viii]+1-502 pp.

BOLTON, J. J. & LEVITT, G. J. 1987. The influence of upwelling on the South African west coast seaweeds. *South African Journal of Marine Science* 5: 319-325.

BRANCH, G. M, GRIFFITHS, C. L. BRANCH, M. L. & BECKLEY, L. E. 1994. *Two oceans. A guide to the marine life of southern Africa*. David Philip, Cape Town & Johannesberg, 1-360 pp.

BRODERICK, A. C. & HANCOCK, E. G. 1997. Insect infestation of Mediterranean marine turtle eggs. *Herpetological Review* 28: 190-191.

BROWN, A. C. 1971. The ecology of the sandy beaches of the Cape Peninsula South Africa. Part I: introduction. *Transactions of the Royal Society of South Africa* 39(3): 247-279 + plates III-V.

BROWN, A. C. & JARMAN, N. 1978. 38 Coastal marine habitats (pp. 1239-1277). In WERGER, M. J. A. (ed). *Biogeography and ecology of southern Africa*. Monograph Biologicae Volume 31, Dr W. Junk Publishers, The Hague, Volume 2, 661-1439 pp.

BRUNDIN, L. 1966. Transantarctic relationships and their significance, as evidenced by chironomid midges with a monograph of the subfamilies Podonominae and Aphroteniinae and the austral Heptagyiae. *Kungliga Svenska Vetenskapsakademiens Handlingar* 11: 1-472+30 plates.

COGAN, B. H. 1980a. 79. Family Canacidae (p. 698). In CROSSKEY, R. W. (ed). *Catalogue of the Diptera of the Afrotropical Region*. British Museum (Natural History), London, 1-1437 pp.

COGAN, B. H. 1980b. Superfamily Heleomyzoidea. 55. Family Coelopidae (p. 610). In CROSSKEY, R. W. (ed). *Catalogue of the Diptera of the Afrotropical Region*. British Museum (Natural History), London, 1-1437 pp.

COGAN, B. H. 1980c. 71. Family Ephydridae (pp. 655-669). In CROSSKEY, R. W. (ed). *Catalogue of the Diptera of the Afrotropical Region*. British Museum (Natural History), London, 1-1437 pp.

COLLESS, D. H. & MCALPINE, D. K. 1970. Diptera (flies). Chapter 34 (pp 656-740). In *The insects of Australia. A textbook for students and research workers*. Melbourne University Press, Australia, xiii+1-1029 pp.

COLLIN, J. E. 1930. Some new species of the dipterous genus *Scatella* Dsv. and the differentiation of *Stictoscatella* gen. nov. (Ephydridae). *Entomologist's Monthly Magazine* 66: 133-139.

CRANSTON, P. S. 1983. 3. The larvae of Telmatogetoninae (Diptera: Chironomidae) of the Holarctic Region. *Entomologica Scandinavica Supplement* 19: 17-22.

CRANSTON, P. S. 1986. 3. The pupae of Telmatogetoninae (Diptera: Chironomidae) of the Holarctic Region. *Entomologica Scandinavica Supplement* 28: 13-17.

CRANSTON, P. S. 1989. 3. The adult males of Telmatogetoninae (Diptera: Chironomidae) of the Holarctic Region. *Entomologica Scandinavica Supplement* 34: 17-21.

CROSSKEY, R. W. (ed). 1980. *Catalogue of the Diptera of the Afrotropical Region*. British Museum (Natural History), London, 1-1437 pp.

DAHL, R. G. 1959. Studies on Scandinavian Ephydridae (Diptera: Brachycera). *Opuscula Entomologica, Supplementum* 15: 1-224.

DAY, J. H. 1959. The biology of Langabaan Lagoon: a study of the effect of shelter from wave action. *Transactions of the Royal Society of South Africa* 35(5): 475-547.

DAY, T. H. & Gilburn, A. S. 1997. Sexual selection in seaweed flies. *Advances in the Study of Behavior* 26: 1-57.

DEEMING, J. C. 1974. Notes on immature stages of *Pachylopus beckeri* Curran (Dipt., Chloropidae). *Entomologist's Monthly Magazine* 109: 155-157.

DONN, T. E. Jr. & COCKCROFT, A. C. 1989. Macrofaunal community structure and zonation of two sandy beaches on the central Namibian coast, South West Africa/Namibia. *Madoqua* 16(2): 129-135.

EGGLISHAW, H. J. 1960. The life-history of *Fucellia maritima* (Haliday) (Diptera, Muscidae). *Entomologist* 93: 225-231.

EGGLISHAW, H. J. 1961a. The life-history of *Thoracochaeta zosterae* (Hal.) (Diptera, Sphaeroceridae). *The Entomologist's Monthly Magazine* 96(1960): 124-128.

EGGLISHAW, H. J. 1961b. Mass migrational flight of *Coelopa frigida* (Fabr.) and *Coelopa pilipes* Haliday (Diptera, Coelopidae) and *Thoracochaeta zosterae* (Hal.) (Diptera, Sphaeroceridae). *The Entomologist* 94: 12-18.

ENGLEDOW, H. & BOLTON, J. J. 1992. Environmental tolerances in culture and agar content if *Garcilaria verrucosa* (Hudson) Papenfuss (*Rhodaphyta gigartinales*) from Saldanha Bay. *African Journal of Botany* 58: 263-267.

ENGLEDOW, H., BOLTON, J. J. & STEGENGA, H. 1992. The biogeography of the seaweed flora of Namibia (pp. 117-130). In MSHIGENI, K., BOLTON, J., CRITCHLEY, A. T. & ISAAC, G. E. (eds). *Proceedings of the first international workshop on sustainable seaweed resource development in sub-Saharan Africa*. Windhoek, Namibia, 1-391 pp.

ENGLUND, R. A., ARAKAKI, K., PRESTON, D. J., COLES, S. L. & Eldredge, L. G. 2000a. *Nonindigenous freshwater and estuarine species introductions and their potential to affect sportfishing in the lower stream and estuarine regions of the south and west shores of Oahu, Hawaii*. Final report to Hawaii Department of Land and Natural Resources, Division of Aquatic Resources. Bishop Museum Technical Report 17, viii+1-121 pp.

ENGLUND, R. A., PRESTON, D. J., WOLFF, R., COLES, S. L., ELDREDGE, L. G. & ARAKAKI, K. 2000b. *Biodiversity of freshwater and estuarine communities in lower Pearl Harbor, Oahu, Hawaii with observations on introduced species*. Final Report prepared for the U.S. Navy. Bishop Museum Technical Report 16, x+1-167 pp.

FREMAR, P. 1987. *A guide to the breeding habits and immature stages of Diptera Cyclorrhapha (part 1: text)*. Entomonograph Vol. 8. E.J. Brill/Scandinavia Scientific Press, Leiden, Copenhagen, 7-478 pp.

FOOTE, B. A. 1995. Biology of shore flies. *Annual Review of Entomology* 40: 417-442.

FREEMAN, P. & CRANSTON, P. S. 1980. 11. Family Chironomidae (pp. 175-202). In CROSSKEY, R. W. (ed). *Catalogue of the Diptera of the Afrotropical Region*. British Museum (Natural History), London, 1-1437 pp.

GRIFFITHS, C. L. 1974. *The Gammaridean and caprellid Amphipoda of southern Africa*. Ph.D. dissertation, University of Cape Town [unpaginated] (unpublished).

HARRISON, R. A. 1959. *Acalyprate Diptera of New Zealand*. Wellington Bulletin, New Zealand Department of Scientific & Industrial Research 128, viii+1-382 pp.

HENNIG, W. 1966. 63a. Anthomyiidae, Lieferung 262 (pp. 1-48). In LINDNER, E. (ed). *Die Fliegen der Palaearktischen Region*. Stuttgart: Schweizerbart'sche Verlagsbuchhandlung, lxxviii+1-974 pp.+114 plates.

ISAAC, W. E. 1956. The ecology of *Gracilaria confervoides* (L.) Grev. in South Africa with special reference to its ecology in the Saldanha-Langebaan Lagoon. In *Second International Seaweed Symposium, London*.

ISMAY, J. W. 2000. Chloropidae (Diptera: Chloropoidea) (pp. 269-281). In KIRK-SPRIGGS, A. H. & MARAIS, E. (eds). *Dâures – biodiversity of the Brandberg Massif, Namibia*. Cimbebasia Memoir 9, National Museum of Namibia, Windhoek, 1-389 pp.

JONES, F. M. 1916. Two insect associates of the California pitcherplant, *Darlingtonia californica*. *Entomological News* 27: 385-392.

KENSLEY, B. & PENRITH, M.-L. 1973. The constitution of intertidal fauna of rocky shores of Moçamedes, southern Angola. *Cimbebasia* (A) 2(9): 113-123.

KENSLEY, B. & PENRITH, M.-L. 1980. The constitution of the fauna of rocky intertidal shores of South West Africa. Part III. The north coast from False Cape Frio to the Kunene River. *Cimbebasia* (A) 5(4): 201-214.

KIRK-SPRIGGS, A. H. & PAPE, T. 1998. The distribution of Sarcophagidae related to the biomes of Namibia (pp. 105-106). In ISMAY, J. W. (ed). *Fourth international congress of dipterology 6-13th September 1998, Keble College, Oxford, UK, abstract volume*. Hope Entomological Collections, 1-275 pp. (abstract).

LAWSON, G. W., SIMONS, R. H. & ISAAC, W. E. 1990. The marine algal flora of Namibia: its distribution and affinities. *Bulletin of the British Museum (Natural History) Botany* 20:153-168.

LEHRER, A. Z. 1995. Six new afrotropical species from the subfamily Sarcophaginae (Diptera: Sarcophagidae). *Entomologica, Bari* 29: 5-20 [in French with English abstract].

LINDNER, E. 1974. Zur Kenntnis der Dipterenfauna Südwestafrikas, III (D. Acalyptratae). *Journal of the South West African Scientific Society* 28 (1973-4): 73-77.

LINDNER, E. 1976. Zur Kenntnis der Dipterenfauna Südwestafrikas, VI-VIII (VI. Brachycera Cyclorhapha Calyptratae; VII. Pupiparia; VIII. Nematocera). *Journal of the South West African Scientific Society* 30 (1975-6): 75-82.

LOPES, H. S. DE SOUZA 1982. On *Eumacronychia sternalis* Allen (Diptera, Sarcophagidae) with larvae living on eggs and hatchilings [sic!] of the East Pacific Green Turtle. *Revista brasileira de Biologia* 42(2): 425-429.

LUNDBECK, W. 1901. Diptera groenlandica. *Videnskabelige Meddelelser fra Dansk Naturhistorisk forening. Copenhagen* 1900: 281-316.

LYNEBORG, L. 1965. The *Fucellia maritima*-group in north Europe, with description of a new species (Dipt., Anthomyiidae). *Entomologiske Meddelelser* 34: 19-29.

MARSHALL, S. A. & ROHÁČEK, J. 2000. A world revision of the seaweed fly genus *Thoracochaeta* Duda (Diptera: Sphaeroceridae: Limosininae). Part 1: extra-Holarctic species. *Studia Dipterologica* 7: 259-311.

MATHIS, W. N. 1979. Studies of Ephydrinae (Diptera: Ephydridae), II: phylogeny, classification and zoogeography of the Nearctic *Lamproscatella* Hendel. *Smithsonian Contributions to Zoology* 295: 1-41.

MATHIS, W. N. 1982. Studies of Canacidae (Diptera), I: suprageneric revision of the family, with revision of new tribe Dynomiellini and new genus *Isocanace*. *Smithsonian Contributions to Zoology* 347: 1-29.

MATHIS, W. N. 1986. A revision of the subgenus *Eremotrichoma* Soika of the shore fly genus *Allotrichoma* Becker (Diptera, Ephydridae). *Israel Journal of Entomology* 19: 127-139.

MATHIS, W. N. 1992. World catalog of the beach-fly family Canacidae (Diptera). *Smithsonian Contributions to Zoology* 536: 1-18.

MATHIS, W. N. & FREIDBERG, A. 1982. New beach flies of the genus *Xanthocanace* Hendel, with a review of the species from the western palearctic (Diptera: Canacidae). *Memoirs of the Entomological Society of Washington* 10: 97-104.

MATHIS, W. N. & FREIDBERG, A. 1991. Review of afrotropical beach flies of the tribe Canacini and subfamily Nocticanacinae (Diptera: Canacidae). *Proceedings of the Entomological Society of Washington* 93: 70-85.

MATHIS, W. N. & MUNARI, L. 1996. World catalog of the family Tethinidae (Diptera). *Smithsonian Contributions to Zoology* 584, iv+1-27.

MATHIS, W. N. & ZATWARNICKI, T. 1995. World catalog of shore flies (Diptera: Ephydridae). *Memoirs on Entomology International* 4: 1-423.

MATHIS, W. N. & ZATWARNICKI, T. 2001. A phylogenetic study of the tribe Dryxini Zatwarnicki (Diptera: Ephydridae). *Smithsonian Contribution to Zoology*. In press.

MCALPINE, D. K. 1991. Review of the Australian kelp flies (Diptera: Coelopidae). *Systematic Entomology* 16: 29-84.

MCGOWAN, A., BRODERICK, A. C., DEEMING, J. C., GODLEY, B. J. & HANCOCK, E. G. 2001. Dipteran infestation of loggerhead (*Caretta caretta*) and green (*Chelonia mydas*) sea turtle nests in northern Cyprus. *Journal of Natural History* 35: 573-581.

MCKILLUP, S. C., MCKILLUP, R. V. & PAPE, T. 2000. Flies that are parasitoids of a marine snail: the larviposition behaviour and life cycles of *Sarcophaga megafilosia* and *Sarcophaga meiofilosia*. *Hydrobiologia* 439: 141-149.

MCLACHLAN, A. 1985. The ecology of two sandy beaches near Walvis Bay. *Madoqua* 14(2): 155-163.

MCLACHLAN, A., WOOLDRIDGE, T. & DYE, A. H. 1981. The ecology of sandy beaches in southern Africa. *South African Journal of Zoology* 16(4): 219-231.

MOLLOY, F. J. 1998. The seaweed resources of Namibia (pp. 409-412). In CRITCHLEY, A. T., OHNO, M., LARGO, D. B. & GILLESPIE, R. D. (eds). *Seaweed resources of the world*. Japan International Cooperation Agency, Yokosuka, Japan.

MOLLOY, F. J. 1990. Utilized and potentially utilizable seaweeds on the Namibian coast: biogeography and accessibility. *Hydrobiologia* 204/205: 293-299.

MOLLOY, F. J. & BOLTON, J. J. 1995. Distribution, biomass and production of *Gracilaria* in Lüderitz Bay, Namibia. *Journal of Applied Phycology* 7: 381-392.

MOLLOY, F. J. & BOLTON, J. J. 1996. The effect of season and depth on the growth of *Gracilaria gracilis* at Lüderitz, Namibia. *Botanica Marina* 39: 407-413.

MUNARI, L. 1991. Contribution to the knowledge of afrotropical Tethinidae. VI A new species of *Afrotethina* Munari, 1986 from Namibia, with a key to the species of the genus and new records of Tethinidae (Diptera) from the Afrotropical Region. *Annals of the Natal Museum* 32: 179-185.

NARTSHUK, E. P. 1972. Predatism and parasitism in the evolution of chloropid flies (Diptera, Chloropidae). *Zoologicheskii zhurnal* 51: 1342-1352. [In Russian with English summary].

NORRBOM, A. L. 1983. Four acalyprate Diptera reared from dead horseshoe crabs. *Entomological News* 94: 117-121.

OLDROYD, H. 1954. The seaweed fly nuisance. *Discovery* 15: 198-202.

OLDROYD, H. 1958. Diptera-Cyclorrhapha from Gough Island, South Atlantic. *Proceedings of the Royal Entomological Society of London* (A) 33: 76-80.

PAPE, T., MCKILLUP, S .C. & MCKILLUP, R. V. 2000. Two new species of *Sarcophaga* (*Sarcorohdendorfia*) Baranov (Diptera: Sarcophagidae), predators on *Littoraria filosa* (Sowerby) (Gastropoda: Littorinidae). *Australian Journal of Entomology* 39: 236-240.

PENRITH, M.-L. & KENSLEY, B. 1970a. The constitution of the fauna of rocky intertidal shores of South West Africa. Part II. Rocky point. *Cimbebasia* (A) 1(10): 243-268.

PENRITH, M.-L. & KENSLEY, B. 1970b. The constitution of the fauna of the intertidal fauna of rocky shores of South West Africa. Part I. Lüderitzbucht. *Cimbebasia* (A) 1(9): 191-239.

POSNAR, G. O. Jr. 1977. Observations on the kelp fly *Coelopa pandazeei* Cresson in southern California (Coelopidae: Diptera). *Pan-Pacific Entomology* 53(2): 81-86.

PRETTICK, G. 1979. The feeding ecology of curlew sandpipers *Calidris ferruginea* in the South-Western Cape, South Africa. Ph.D. dissertation, University of Cape Town, ii+1-156 pp.+viii (unpublished).

PRINGLE, C. 1984. Coincidence of agonistic larval behavior, uniform dispersion and unusual pupal morphology in a genus of marine midges (Diptera: Chironomidae). *Journal of Natural History* 18: 897-904.

ROHÁČEK, J. 1991. A monograph of *Leptocera* (*Rachispoda* Lioy) of the West Palaearctic area (Diptera, Sphaeroceridae). *Folia Sleszkého zemského Muzea, Opava* (A) 40: 97-288.

ROHÁČEK, J. 1998. 3.43. Family Sphaeroceridae (pp. 463-499). In PAPP, L. & DARVAS, B. (eds). *Contributions to a manual of palaearctic Diptera. Vol. 3., Higher Brachycera*. Science Herald, Budapest, 1-880 pp.

SCHLEDENDORF, B. B. 1963. Über das System der Sarcophaginen der äthiopischen Fauna. *Stuttgarter Beiträge zur Naturkunde* 124: 1-22.

SMITHERS, C. W. 1972. A synopsis of the genus *Eutropha* Loew, with a new African species. *Stuttgarter Beiträge zur Naturkunde* 251: 1-7.

SMITHERS, C. W. 1980a. 80. Family Chloropidae (pp. 695-716). In CROSSKEY, R. W. (ed). *Catalogue of the Diptera of the Afrotropical Region*. British Museum (Natural History), London, 1-1437 pp.

SABROSKY, C. W. 1980b. 75. Family Milichiidae (pp. 686-689). In CROSSKEY, R. W. (ed). *Catalogue of the Diptera of the Afrotropical Region*. British Museum (Natural History), London, 1-1437 pp.

SABROSKY, C. W. 1983. A synopsis of the world species of *Desmometopa* Loew (Diptera, Milichiidae). *Contributions of the American Entomological Institute* 19(8): 1-69.

SAETHER, O. A. 1977. Female genitalia in Chironomidae and other Nematocera: morphology, phylogenies, keys. *Bulletin of the Fisheries Research Board of Canada* 197: 1-204.

SCHINER, I. R. 1866. Bericht über die von der Weltumseglungsreise der k. Fregatte Novara mitgebrachten Dipteren. *Verhandlungen der Zoologisch-botanischen Gesellschaft in Wien* 16: 927-934

SCHINER, I. R. 1868. Diptera. In *Reise der österreichischen Fregatte Novara um die Erde in den Jahren 1857, 1858, 1859, unter den Befehlen des Commodore B. von Wüllerstorf-Urbair*. Zoologischer Theil 2, 1(B), vi+1-388 pp. Wien.

STEIN, P. 1908. Zoologische und anthropologische Ergebnisse einer Forschungsreise im westlichen und zentralen Südafrika ausgeführt in den Jahren 1903-1905 mit Unterstützung der Kgl. Preussischen Akademie der Wissenschaften zu Berlin von Dr. Leonhard Schultze, Professor der Erdkunde an der Universität Jena. Erster Band: Systematik und Tiergeographie. IV. Insecta (Erste Serie). D. Diptera. 4. Anthomyiidae. *Denkschriften der Medizinisch-Naturwissenschaftlichen Gesellschaft zu Jena* 13(1): 171-174.

STEIN, P. 1910. Zur Kenntnis der Gattung *Fucellia* Rob. Desv. *Wiener Entomologische Zeitung* 29(1): 11-27.

STEIN, P. 1919. Die Anthomyidengattungen der Welt, analytisch bearbeitet, nebst einem kritisch-systematischen Verzeichnis aller außereuropäischen Arten. *Archiv für Naturgeschichte* (A) 83(1) (1917): 85-178.

STENTON-DOZEY, J. & GRIFFITHS, C. L. 1980. Growth, consumption and respiration by larvae of the kelp-fly *Fucellia capensis* (Diptera: Anthomyiidae). *South African Journal of Zoology* 15(4): 280-283.

STEPHENSON, T. A. 1948. The constitution of the intertidal fauna and flora of South Africa. III. *Annals of the Natal Museum* 11: 207-324.

STRENZKE, K. 1960. Metamorphose und Verwandtschaftsbeziehungen der Gattung *Clunio* Hal. (Dipt.). *Suomalaisen Eläin-ja Kasvitieteellisen Seuran Vanamon Tiedonannot* 22: 1-30.

SWANN, J. E. 2000. Milichiidae (Diptera: Carnoidea) (pp. 265-268). In KIRK-SPRIGGS, A. H. & MARAIS, E. (eds). *Dâures – biodiversity of the Brandberg Massif, Namibia*. Cimbebasia Memoir 9, National Museum of Namibia, Windhoek, 1-389 pp.

TARR, J. G., GRIFFITHS, C. L. & BAILY, R. 1985. The ecology of three sandy beaches on the Skeleton Coast of South West Africa. *Madoqua* 14(3): 295-304.

VENKATRAMAN, T. V. 1936. The biology of the shore-fly *Sarcophila cinerea* Fabricius (Diptera: Metopiidae). *Records of the Indian Museum* 38: 367-372, 1 pl.

VOCKEROTH, J. R. 1987a. Tethinidae (pp. 1073-1078). In McALPINE, J. F. (ed). *Manual of nearctic Diptera*. Volume 2, Research Branch Agriculture Canada, Monograph 28, vi+675-1332.

VOCKEROTH, J. R. 1987b. Coelopidae (pp. 919-922). In McALPINE, J. F. (ed). *Manual of nearctic Diptera*. Volume 2, Research Branch Agriculture Canada, Monograph 28, vi+675-1332.

WIRTH, W. W. 1947. A review of the genus *Telmatogeton* Schiner. with descriptions of three new Hawaiian species (Diptera: Tendipedidae). *Proceedings of the Hawaiian Entomological Society* 13: 145-91.

WIRTH, W. W. 1960. Chapter XIX. Diptera (Brachycera) Canaceidae and Ephydridae (pp. 390-396). In HANSTRÖM, B., BRINCK, P. & RUDEBECK, G. (eds). *South African animal life. Results of the Lund University Expedition in 1950-1951*, 7, Almqvist & Wiksell, Stockholm, [iv]+9-488 pp.

WIRTH, W. W. 1975. A revision of the brine flies of the genus *Ephydra* of the Old World (Diptera: Ephydridae). *Entomologica Scandinavica* 6: 11-44.

WONGSIRI, T., NAVAVICHIT, S., NILPANIT, P., YANO, K. & YASUMATSU, K. 1974. Remarks on two noteworthy dipterous predators of the larvae of stalk borers including *Chilo polychrysus* (Meyrick) in S.E. Asia. *Mushi* 47: 111-117.

ZETTERSTEDT, J. W. 1845. *Diptera Scandinaviae deposita et descripta [part]*. Lundae [= Lund], 4: 1218-1738.

Manuscript received September 2001; accepted October 2001.

Appendix I. Summary of sampling stations from the National Museum of Namibia's Marine-littoral Survey of the southwest African seaboard (Namibia & South Africa). Unless otherwise stated, material collected by A.H. Kirk-Spriggs.

00 - Namibia: Kunene River mouth, 17°15'58"S, 11°46'50"E, 18.iii.1998. Debris, principally cockle shells, pelican feathers & crab shells on Kunene bar.
01 - Namibia: at: 17°17'22"S, 11°45'17"E, 19.iii.1998. Debris & kelp.
02 - Namibia: at: 17°18'22"S, 11°45'17"E, 19.iii.1998. Debris & kelp.
03 - Namibia: at: 17°21'13"S, 11°45'21"E, 19.iii.1998. Isolated clumps of kelp.
04 - Namibia: at: 17°27'05"S, 11°44'35"E, 20.iii.1998. Debris, principally cockle shells, dead crabs & other debris.
05 - Namibia: at: 17°32'28"S, 11°44'35"E, 20.iii.1998. Ooze from decomposing cape fur seal.
05a - Namibia: Angolan truck, 17°33'54"S, 11°44'14"E, 18.iii.1998. Isolated clumps of kelp.
06 - Namibia: at: 17°41'40"S, 11°45'44"E, 20.iii.1998. Isolated clumps of kelp.
07 - Namibia: at: 17°47'27"S, 11°46'25"E, 20.iii.1998. Isolated clumps of kelp.
09 - Namibia: wreck of Kya Maru, 18°06'59"S, 11°50'55"E, 20.iii.1998. Isolated clumps of kelp.
10 - Namibia: wreck of Kya Maru, 18°06'09"S, 11°51'13"E, 20.iii.1998. Marine algae on wreck.
11 - Namibia: at: 18°15'44"S, 11°57'30"E, 20.iii.1998. Isolated clumps of kelp.
13 - Namibia: Cape Fria, 18°25'58"S, 12°00'16"E, 21.iii.1998. Isolated clumps of kelp/debris.
14 - Namibia: at: 18°29'29"S, 12°10'55"E, 21.iii.1998. Isolated clumps of kelp/debris.
15 - Namibia: at: 18°36'28"S, 12°10'05"E, 21.iii.1998. Isolated clumps of kelp/debris.
16 - Namibia: at: 18°44'35"S, 12°19'47"E, 21.iii.1998. Isolated clumps of kelp/debris.
17 - Namibia: at: 18°50'02"S, 12°23'17"E, 21.iii.1998. Marine algae on exposed rocks.
18 - Namibia: at: 18°55'03"S, 12°27'38"E, 21.iii.1998. Isolated clumps of kelp/debris.
19 - Namibia: Rocky Point, 18°59'38"S, 12°28'35"E, 22.iii.1998. Deep beds of kelp, prolific mussel shells and other debris.
20 - Namibia: Hoarusib River mouth, 19°04'19"S, 12°33'21"E, 22.iii.1998. Isolated clumps of kelp/debris.
21 - Namibia: Ventura bomber wreck, 19°08'23"S, 12°36'16"E, 22.iii.1998. Isolated clumps of kelp/debris.
22 - Namibia: Möwe Bay, 19°21'51"S, 12°42'29"E, 22.iii.1998. Isolated clumps of kelp & deep beds of debris.
24 - Namibia: at: 19°38'54"S, 12°51'29"E, 23.iii.1998. Deep beds of kelp on pebble beach.
25 - Namibia: at: 19°52'33"S, 12°58'20"E, 23.iii.1998. Isolated clumps of kelp/debris.
26 - Namibia: Terrace Bay, 20°00'05"S, 13°02'09"E, 23.iii.1998. Deep beds of wave broken kelp on pebble beach.
27 - Namibia: Harold's Bay, 20°10'31"S, 13°09'47"E, 23.iii.1998. Isolated clumps of kelp.
28 - Namibia: Torra Bay, 20°19'08"S, 13°14'24"E, 23.iii.1998. Isolated clumps of kelp.
29 - Namibia: Koigab River mouth, 20°28'54"S, 13°15'59"E, 23.iii.1998. Isolated clumps of kelp.
30 - Namibia: Toscanni Bay, 20°45'38"S, 13°22'49"E, 24.iii.1998. Isolated clumps of kelp.
31 - Namibia: Huab River mouth, 20°55'16"S, 13°27'25"E, 24.iii.1998. Isolated clumps of kelp/debris.
32 - Namibia: Ugab River mouth, 21°10'35"S, 13°37'01"E, 24.iii.1998. Isolated clumps of kelp/debris.

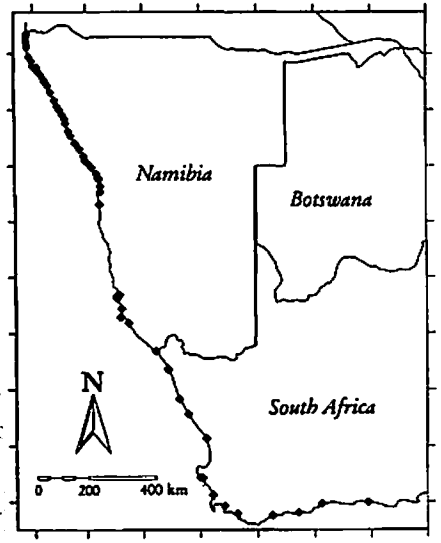


Figure 81. Mapped sampling stations from the National Museum of Namibia's Marine-littoral Survey 1998 (losengers).

33 - Namibia: 5 km S Bandom Bay, 21°23'21"S, 13°46'38"E, 24.iii.1998. Decomposing cape fur seal.
34 - Namibia: Horingbaai, 21°38'41"S, 13°55'18"E, 24.iii.1998. Isolated clumps of kelp/debris.
35 - Namibia: Cape Cross, 21°47'22"S, 13°58'21"E, 24.iii.1998. Seal colony.
36 - Namibia: Sandwich Lagoon, 23°22'11"S, 14°29'08"E, 25.iii.1998. Isolated clumps of sea grass Sandwich Lagoon.
37 - Namibia: Kuisebmond, Walvis Bay, 22°55'19"S, 14°31'19"E, 25.iii.1998. Shoreline debris, principally dead marine invertebrates & sea grass.
38 - Namibia: 2 km S Swakopmund, 22°42'36"S, 14°31'31"E, 25.iii.1998. Deep beds of kelp on rocky beach.
39 - Namibia: at: 22°28'30"S, 14°28'00"E, 25.iii.1998. Isolated clumps of kelp/debris.
40 - Namibia: Grosse Bucht, 26°44'09"S, 15°05'45"E, 27.iii.1998. Deep beds of kelp on sandy beach.
41 - Namibia: Guano Bay, 26°38'45"S, 15°05'34"E, 27.iii.1998. Deep beds of kelp on sandy beach.
42 - Namibia: Angra Bay, 26°36'26"S, 15°10'42"E, 27.iii.1998. Deep beds of kelp on rocky beach.
44 - South Africa: McDougall's Bay, 29°17'10"S, 16°52'39"E, 01.iv.1998. Single clumps of kelp on rocky beach.
45 - South Africa: Port Nolloth, 29°15'09"S, 16°51'58"E, 01.iv.1998. Layers of kelp between rocky outcrops.
46 - South Africa: Hondeklip Bay, 30°19'00"S, 17°16'24"E, 02.iv.1998. Deep beds & single clumps of kelp on sandy beach with rocky outcrops.
47 - South Africa: Groen River mouth, 30°51'20"S, 17°34'51"E, 02.iv.1998. Cockle shell debris & single clumps of kelp on rocky inlet.
48 - South Africa: Groen River mouth lagoon, 30°51'20"S, 17°34'51"E, 02.iv.1998. Wet mud at lagoon edge & kelp on sandy beach.
49 - South Africa: Papendorp, 31°43'05"S, 18°12'23"E, 03.iv.1998. Single clumps of kelp, sea grass & other debris on sandy beach.
50 - South Africa: Lambert's Bay, 31°43'05"S, 18°12'23"E, 03.iv.1998. Isolated clumps of kelp on rocky beach with sandy coves.
51 - South Africa: Langebaan Lagoon, 33°08'19"S, 18°05'03"E, 04.iv.1998. Shoreline sea grass & other debris on white sandy beach (no kelp).
52 - South Africa: Tsaarsbank, 33°08'05"S, 18°00'08"E, 04.iv.1998. Abundant kelp & rocky outcrops with algae & rock pools on sandy beach.
54 - South Africa: 2 km S of Melkbosstrand, 33°45'02"S, 18°26'29"E, 05.iv.1998. Abundant kelp & from small rocky outcrops with algae.
55 - South Africa: Koppie Alleen, 34°28'32"S, 20°30'22"E, 06.iv.1998. Single clump of sea grass (no kelp). Sandy beach edged by sand dunes.
56 - South Africa: Stilbaai-Wes, 34°23'01"S, 21°25'24"E, 07.iv.1998. Selective beds of seaweed (no kelp) & other debris on sandy beach.
57 - South Africa: Groot Brakrivier, 34°03'23"S, 22°14'10"E, 07.iv.1998. Patches of sea grass (no kelp) & other debris on sandy beach.
58 - South Africa: Driftwood Bay, 34°51'17"S, 23°53'22"E, 08.iv.1998. Pebble beach with no kelp and very few marine invertebrates.
59 - South Africa: Struisbaai, 34°01'17"S, 23°53'22"E, 09.iv.1998. Patches of sea grass (no kelp) & other debris on sandy beach.
60 - South Africa: Hermanus, 34°24'49"S, 19°17'16"E, 09.iv.1998. Accumulations of kelp on upper shore (kelp cleared) on sandy beach.
61 - South Africa: Gordon's Bay, 34°08'25"S, 18°51'01"E, 10.iv.1998. Rocky shoreline, some kelp, but chiefly other species of seaweeds.
62 - Namibia: Oranjemund at: 28°37'16"S, 16°26'08"E, 25.viii.1998. Sandy beach with isolated clumps of kelp and cockle debris.
63 - Namibia: Prinzen Bucht at: 27°06'32"S, 15°15'04"E, 03.ix.1998. Sandy beach with single patches of kelp and other debris, principally cockles, bordered by rocky outcrops with algae.
64 - Namibia: Van Reenenbaai at: 27°24'19"S, 15°12'42"E, 03.ix.1998. Sandy beach with patches of kelp & other debris, chiefly cockles. Rocky outcrops with some algae to southern end.
65 - Namibia: False Plum Pudding at: 27°36'20"S, 15°29'59"E, 03.ix.1998. Sandy bay with accumulated debris, mainly cockles & sea grasses with isolated patches of kelp.
66 - Namibia: Mile 72, 21°52'34"S, 14°04'06"E, 21.x.1998. Sandy beach with much kelp & other debris.
67 - Namibia: 5 km N Henties Bay, 22°02'59"S, 14°13'03"E, 21.x.1998. Narrow sandy beach, flanked by dunes, thin strips of kelp & some debris.
68 - Namibia: Mile 33, 22°16'00"S, 14°22'53"E, 21.x.1998. Wide sandy beach with kelp & other debris.
69 - Namibia: at: 22°23'34"S, 14°26'23"E, 21.x.1998. Sandy beach with abundant kelp.

Appendix II. Presence or absence of Diptera from sampling stations in the National Museum of Namibia's Marine-littoral Survey 1998. Sampling stations in order from north to south/southeast. No flies were sampled as stations 23 and 53 and these are omitted, as are stations 08 (feather lice only) and 12 (pitfall traps only). Stations 05 and 33 only comprise material from Cape Fur Seal carcasses and 10 only from marine algae on the wreck of the Kya Maru. For a detailed list of sampling station data *vide* Appendix I.

Dipterous species/genera	Sampling stations 1998																	
	00	01	02	03	04	05	05a	06	07	10	09	11	13	14	15	16	17	18	19
Telmatogeton minor										+									
Canace rossii																	+		+
Dynomiella cala																			
Dynomiella stuckenbergi																			
Dynomiella spinosa																			
Xanthocanace capensis																			
Nocticanace cyclura																			
Eutropha lindneri	+	+			+	+			+				+						
Siphunculina nr. lurida																			
Desmometopa singaporensis																			
Horaismoptera microphthalma																+		+	
Afrotethina persimilis																			
Afrotethina femoralis																			
Afrotethina stuckenbergi	+	+	+	+	+	+	+	+	+		+	+	+	+	+	+			
Paralimna (P.) bicolor																			
Asmeringa namibia sp. nov.																			
Asmeringa africana	+																		
Atissa ?kairensis																			
Ochthera (O.) praedatoria																			
Elephantinosoma cogani	+																		
Eremotrichoma ?meridionale	+																		
Ephydra stuckenbergi																			
Haloscatella dichaeta																			
Rachispoda fuscipennis																			
Thoracochaeta brachystoma																			
Thoracochaeta pertica																			
Thoracochaeta securis																			
Thoracochaeta falx																			
Thoracochaeta pugillaris																			
Coelopa spp.																			
Sarcophaga (L.) namibia													+						+
Sarcophaga (L.) maritima																			
Fucellia capensis	+	+		+	+		+		+		+	+	+	+	+	+		+	+
Fucellia maritima																			
Total number of species	6	3	1	2	3	2	2	1	3	1	2	2	4	2	2	3	1	2	3

Appendix II cont. Presence or absence of Diptera from sampling stations in the National Museum of Namibia's Marine-littoral Survey 1998. Sampling stations in order from north to south/southeast. No flies were sampled as stations 23 and 53 and these are omitted, as are stations 08 (feather lice only) and 12 (pitfall traps only). Stations 05 and 33 only comprise material from Cape Fur Seal carcasses and 10 only from marine algae on the wreck of the Kya Maru. For a detailed list of sampling station data *vide* Appendix I.

Dipterous species/genera	Sampling stations 1998																	
	20	21	22	24	25	26	27	28	29	30	31	32	33	34	35	66	67	68	39
Telmatogeton minor																			
Canace rossii			+																
Dynomiella cala																			
Dynomiella stuckenbergi																			
Dynomiella spinosa																			
Xanthocanace capensis																			
Nocticanace cyclura																			
Eutropha lindneri										+	+			+	+	+			
Siphunculina nr. lurida																			
Desmometopa singaporensis								+											
Horaismoptera microphthalma																+		+	+
Afrotethina persimilis	+	+	+		+		+	+	+	+	+	+	+	+		+	+	+	+
Afrotethina femoralis																			
Afrotethina stuckenbergi	+						+			+	+	+	+						+
Paralimna (P.) bicolor			+																+
Asmeringa namibia sp. nov.																			
Asmeringa africana																			
Atissa ?kairensis												+							
Ochthera (O.) praedatoria																			
Elephantinosoma cogani																			
Eremotrichoma ?meridionale																			
Ephydra stuckenbergi			+																
Haloscatella dichaeta																			
Rachispoda fuscipennis			+																
Thoracochaeta brachystoma																			
Thoracochaeta pertica																			
Thoracochaeta securis		+	+		+	+	+	+	+	+									
Thoracochaeta falx																			
Thoracochaeta pugillaris																			
Coelopa spp.				+															
Sarcophaga (L.) namibia	+	+		+		+	+	+		+	+				+				
Sarcophaga (L.) maritima																			
Fucellia capensis	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+
Fucellia maritima																			
Total number of species	4	4	7	3	3	3	5	5	3	6	5	4	3	3	2	4	3	4	5