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. Telmatogoton 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 33º08'05"S, 18º00'08"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 cycleta M athis & Wirth, 1979, and keys are provided for all afrotropical subfamilies, tribes, genera and species of Canacidae. Four species of Tethinidae are recorded, viz. Horaismoptera microphthalmia (Bezzi) (new to South Africa), Afrorheta persimilis M unari, 1991 (new to South Africa), A. fenoralsis (M unari) (new to Namibia), and A. stuckenbergi M unari (new to Namibia) and a key to the four species is given. Eight species of Ephydridae are recorded, viz. Paralimna (P.) bicolor (M acquart), Asmeringa africana (Wirth) (new to Namibia), Atisa ?kairensis Becker, O chthra (O.) praedatoria (Loew) (new to Namibia), Elephantinosoma cognati M athis & D eming (new to Namibia), Eremitridiophy Meridionale (Canzoneri & Vienna) (new to Namibia), Ephydra stuckenbergi Wirth, and Haloscatella dicaeta (Loew) (new to Namibia). Six species of Sphaeroceridae are recorded, viz. Rachispoda fuscipennis (Haliday) (new to Namibia), Thoracochaeta brachystoma (Stenhammar), T. pertica M arshall & Röhácek, T. securis M arshall & Röhácek, T. falx M arshall & Röhácek, T. pugilis M arshall & Röhácek and an illustrated key to species of the southwestern African seaboard provided. One species of M iliidae, 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, M ogambe (now N amibia); Kensley & Penrith (1980) for False Cape Friio to the Kunene River in N amibia; Tarr et al. (1985) for Toscanini, H oarusib River mouth area and B osluisbaai (N amibia); Penrith & K ensley (1970a) R ocky P oint; D onn & C ockcroft (1989) for Langstrand and C ape C ross (N amibia); W alvis B ay (M cLachlan 1985); L üderitzbucht (Penrith & K ensley 1970b); B ally (1987) summarised information for the South African part of the Benguela coast from C ape C oin to the O range R iver; the C ape P eninsula (B rown 1971); and L angebaan Lagoon (D a y 1959). M cLachlan et al. (1981) reported on the Indian O cean coastline from C ape P oint to S ordwana, N atal. B rown & J arman (1978) provide an overview of the biogeography of the southern African coastline. These studies paid only superficial attention to the H exapoda component of the littoral fauna.

In January 1998, the N ational M useum of N amibia in collaboration with Zoológisches M useum für N aturkunde, Berlin, instigated a survey of the inter-tidal littoral invertebrate fauna of the southwestern Atlantic and southernmost Indian Ocean coastlines (B enguela system), from the Kunene River mouth on the Namibian/An golian border to T sitsikamma N ational P ark in the E astern C ape of S outh A frica (vide Figures 1-4). T he 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. T he survey predominantly focused on the fauna associated with kelp on sandy beaches, and for this reason very little of the fauna asso-
ciated 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.Ågarðh (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, Tenthredinidae, 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 17º27'05"S, 11º44'35"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.


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: Telmatogotoninae 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 Telmatogoton Schiner, 1866, and Halirytus Eaton, 1875, larger taxa of wave-swept coastal rocks, or montane Hawaiian 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 Telmatogoton and allies, but recognised it as plesiomorphic and unrelated to Clunio, and he dismembered the polyphyletic Clunioninae.

The subsequent history of Telmatogoton 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 Sather'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 Sather, although the subfamily may be sister to Aphroteniinae, with both combined as sister to the remaining Chironomidae.

Species of Telmatogotoninae 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, Halirytus Schiner and Telmatogoton Schiner, the latter including at least Paradunio Kieffer, 1911, Halirytus Eaton, 1875, and Pamathomyia Deby, 1889. Worldwide, Telmatogoton 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 Telmatogenon, predominantly between high and low tide in green algae such as Enteromorpha Link (Ulvaceae). Several species of larval Telmatogenon 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.). Telmatogenoninae larvae and pupae can be recognised from keys and descriptions in Cranston (1983, 1986).

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

1. Acrostichal setae numerous. Tarsomere 5 simple
   - Acrostichal setae absent. Tarsomere 5 tri-lobed (Telmatogenon) 

2. Wing length >5 mm; dark, wings smoky brown; body very setose (>50 scutellars)
   - Wing length <4 mm; light brown, wings grey; body weakly setose (c. 12 scutellars)

Telmatogenon minor (Kieffer, 1914: 260).

**Taxonomic Notes:** Two species of Telmatogenon 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 (Monaille 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 role 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. Laterocline 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
   - Laterocline fronto-orbital setae either 4 or more, 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 1/4 of frons occasionally bearing scattered setulae ............... Procanace H ended [6 species in the Afrotopical 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; meso- frons with bare areas; not 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; meso- frons 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: Canicinae 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 ................................. Canacezvuv Mathis & Freidberg

2. Posterior process of surstylus robust, slightly enlarged subapically ............................... Dynomiella Haliday

- Posterior process of surstylus generally thinner and gradually becoming narrower toward apex ........................ Canacerossi 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 rossi** 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 cala* (Cresson)

   - Head only slightly produced in front of eyes; mesofrons in form of a triangle, extended not more than 1/2 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

   - 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 Kuixbmond in Namibia and McDougall’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 Palearctic 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 matt black chloropids were frequently observed, often in swarms, attracted to freshly washed up carcases 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 (R₁-R₂+₃) much shorter than the third (R₂+₃-R₄+₅); frons and scutum dull, heavily dusted .......... *Siphunculina nr. lurida* (Enderlein)
   - Second costal sector (R₁-R₂+₃) longer than third (R₂+₃-R₄+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 R₄+₅ less strongly curved anteriorly and less divergent from M₁. *Eutropha obscura* has a predominantly yellow head, lateral dusted stripes on the scutum, entirely shining but rugose anepisternum, brown tarsi and R₄+₅ more strongly curved anteriorly and more divergent from M₁. 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 microphthalmia (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, emerged) at 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 Anderson (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 Osciellinae, five genera were recorded as feeding on decayed animal matter. Anatrichus pygaeus 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). Coniosinella hinkleyi (Malloch, 1915) has been reared from decaying horseshoe crabs in the U.S.A. (Norrbom 1983). Polydapsis ruficornis (M acquart, 1835) has been reported as saprophagous on dead caterpillars (Nartshuk 1972). In the subfamily Chloropinae, Pachyplus 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 Tridenma Lloy, 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:** 1699, 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); 399, 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; 100, Skeleton Coast Park at 17°32'22"S,

Siphunculina nr. lurida (Enderlein, 1911: 231).


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 worldwide, 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 coprophagous, 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].”


NOTES: This species was sampled at Torra Bay (one specimen) from isolated clumps of kelp. This 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.
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 Palearctic 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)

<table>
<thead>
<tr>
<th>1. Costa with irregular prominent spines longer and stronger than adjacent vestiture (Figure 12)</th>
<th>Horaismoptera microphthalma (Bezzi).</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Costa not spinose (Figure 13) (Afrotethina Munari, 1986)</td>
<td>Afrotethina femoralis (Munari)</td>
</tr>
<tr>
<td>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</td>
<td>Afrotethina femoralis (Munari)</td>
</tr>
<tr>
<td>- 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</td>
<td>Afrotethina stuckenbergi Munari</td>
</tr>
<tr>
<td>3. Acrostical hairs in six rows (between second pair of dorso-central bristles). Genal not particularly broad; eye subcircular, diameter 1.50-2.16 times genal width</td>
<td>Afrotethina stickenbergi Munari</td>
</tr>
</tbody>
</table>
- Acrostical hairs in four (occasionally five), very broad irregular rows (between second pair of dorso-central bristles). Gena broad; eye ellipsoidal, transverse, diameter 1.22-1.57 times genal width ........................................ Afrotethina persimilis Munari

Subfamily: Horaismopterinae Sabrosky


Taxonomic Notes: For illustrations of the epandrium and aedeagus vide Figures 14-15.


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


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 Hydrelia Robineau-Desvoidy, 1830, damage watercress, rice, barley, and other irrigated cereals with their stem- and leaf-mining habits.

Afrotethina femoralis (Munari, 1981: 94).


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.


Distribution: Afrotropical; South Africa (Cape) (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; South Africa (Cape) (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.


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Afrotethina femoralis (Munari, 1981: 94).

Distribution: Afrotropical; South Africa (Cape) (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.
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 microomentum, frequently with conspicuous, longitudinal stripes medially (Figures 16-18).

NOTES: During the survey, this species was only sampled at Möwe Bay from isolated clumps of kelp and deep beds of debris on the shoreline.

Tribe: Atissini Cresson

KEY TO AFROTROPICAL SPECIES OF ASMERINGA BECKER.

1. Antenna, especially basal flagellomere, and tibiae mostly reddish yellow (Senegal) ............ Asmeringa senegalensis Canzoneri
   - Antenna and tibiae mostly black ............ 2

2. Antennal bases narrowly separated, distance between subequal to width of pedicel; antennal grooves shallow; oral margin distinctly sinuous; oral margin with distinct facial emargination (Maldive Islands) ............ Asmeringa ligabuei Canzoneri
   - Antennal bases widely separated by nearly twice width of pedicel; antennal grooves deep; oral margin nearly straight .......... 3

3. Setae generally black ................................... Asmeringa namibia Mathis, sp. nov.
   - Setae generally white .............................. 4

4. Vein M ratio 0.42 (circum-M mediterranea) .................................. Asmeringa inermis Becker
   - Vein M ratio 0.57 or larger (South Africa) .................................. Asmeringa africana (Wirth)

Asmeringa namibia Mathis, sp. nov.

Figures 19-20


Asmeringa namibia W.N. Mathis [red]. The holotype is double mounted (minuten in a rectangular block of plastic foam) and is in excellent condition (NMNW # T642). Twelve paratypes (8♂♂ 4♀♀) bear the same locality data as the holotype (NMNW type series # T642, USNM). Other paratypes (1♂ 2♀♀) "N etted from isolated / clumps of kelp / on shoreline // Namibia: SWAKOPMUND / DIST. at: 22°28'30"S / 14°28'00"E 25 iii 1998 / A.H. Kirk-Spriggs / Sampling station 39 // National M useum of Namibia marine littoral survey, 1998 [blue] // PARATYPE Asmeringa namibia Mathis [blue] (NMNW type series # T642, USNM).

DESCRIPTION: This species is distinguished from congeners by the following combination of character states: small to moderately small shore flies, body length 1.70-2.30 mm; generally densely grey to dark grey microtomentose; setae and setulae generally black.

Head: Cephalic setae generally poorly developed; frontal setae lacking, setulae greatly reduced, sparse, inconspicuous; no apparent ocellar setae; fronto-orbital setulae very small, moderately numerous; outer and inner vertical setae greatly reduced but usually evident, outer vertical setae sometimes not evident. Frons with vertex and extended ocellar triangle light brownish grey, anterolateral areas mostly grey; ocellar triangle equilateral or with distance between posterior ocelli slightly less than between either posterior ocellus and anterior ocellus. Antenna dark, especially basal flagellomere; antenna inserted in deep antennal groove; antennal bases widely separated, interval between 1.5-2 x width of pedicel. Eye broadly and irregularly oval, oriented at oblique angle, conspicuously setulose. Genae high, gena-to-eye ratio 0.56-0.87. Oral margin very shallowly sinuous in lateral view with posterior 1/3 shallowly angled dorsally anteriorly and anterior 1/3 shallowly angled ventrally; clypeus mostly concealed.

Thorax: Mesonotum mostly light brownish grey, slightly greyer laterally. Thoracic setae black,
moderately developed; presutural seta barely evident; prescutellar acrostichal setae, posterior-most dorsocentral seta and 2 scutellar setae although reduced evident; acrostichal setulae in 2 rows, barely evident.

Wing: Faintly milky white; rather bluntly rounded apically; costal vein ratio 0.63; M vein ratio 0.61.

Legs: Femora and tibiae mostly greyish, concolorous; tarsi pale, yellowish.

Abdomen: Male terminalia (Figures 19-20): presurstyli (surstylus) fused as a large posteromedial process, length much shorter than postsurstylus; lateral margins slightly tapered medially toward apex, ventral apex bluntly and broadly truncate, bearing a seta ventrolaterally; postsurstylus (clasper) straight, comparatively narrow, parallel sided throughout most of length in posterior view, apex in lateral view angulate, turned anteriorly at perpendicular angle to general plane of postsurstylus; aedeagus short, about $1/2$, length
of posturstylus, length in posterior view about 2.5 x width, in lateral view tapered gradually to pointed apex.

**distribution:** Afrotropical: Namibia (Swakopmund).

**etymology:** The specific epithet, namibia, is a noun in apposition and refers to the country where this species is found.

**notes:** This species is halophilous, like other species of Asmeringa, occurring primarily on maritime beaches in the Old World where organic debris has accumulated (vide Appendix II).

Asmeringa africana (Wirth, 1956: 389).

**taxonomic notes:** This species is distinguished from congeners by the following combination of characters: small shore flies, body length 1.30-1.60 mm; setae and setulae generally white.

Head: Cephalic setae generally poorly developed; frontal setae lacking, setulae greatly reduced, sparse, inconspicuous; no apparent ocellar setae; fronto-orbital setulae very small, moderately numerous; outer vertical seta either lacking or greatly reduced; inner vertical seta much reduced but evident. Frons with vertex and extended ocellar triangle light brownish grey, anterolateral areas mostly grey. Antenna dark, especially basal flagellomere; antenna inserted in deep antenal grooves; antennal bases widely separated, interval subequal to twice width of pedicel. Gena moderately high, gena-to-eye ratio 0.55. Oral margin very shallowly angulate, in lateral view with posterior 2/3 shallowly angled dorsally anteriorly and anterior 1/3, shallowly angled ventrally; clypeus mostly concealed. Thorax: Mesonotum mostly light brownish grey, slightly greyer laterally. Thoracic setae moderately developed; presutural seta barely evident; prescutellar acrostichal setae, posteriormost dorsocentral seta and 1 scutellar seta moderately well developed, conspicuous; apical scutellar seta either lacking or missing. Femora and tibiae mostly greyish, concolorous; tarsi pale, yellowish. Wing bluntly rounded apically; costal vein ratio 0.60; M vein ratio 0.57. Abdomen: Male terminalia (Figures 21-22): fused presurstylus (medial triangular process) nearly as long as posturstylus; posturstylus (clasper) comparatively wide, not tapered toward apices, distinctly sinuous in lateral view; aedeagus short, about 1/2 length of posturstylus.

**distribution:** Afrotropical: South Africa (Cape Province) (Mathis & Zatwarnicki 1995: 54). New to Namibia.

**notes:** During the survey, specimens were sampled from shoreline debris, isolated patches of kelp and from the wet mud at the edge of a saline lagoon (vide Appendix II).

Atissa ?kairensis Becker, 1903: 162.

**taxonomic notes:** The identification of this species is tentative, as determinations in this genus are based primarily on structures of the male terminalia, and only females have been sampled from Namibia.

**distribution:** Afrotropical: Cape Verde Islands, Kenya, Sierra Leone, Sudan, Palaeartic: Algeria, Canary Islands, Egypt (Mathis & Zatwarnicki 1995: 55). New to Namibia.

**notes:** Only sampled at the mouth of Ugab River (netted from isolated clumps of kelp/debris). The species is very probably associated with the river itself, rather than being strictly coastal.

Subfamily: Gymnomyzinae Latreille

Tribe: Ochtherini Dahl

Ochthera (Ochthera) praedatoria (Loew, 1862:14).

**taxonomic notes:** This species is distinguished from congeners by the following combination of character states: clypeus wide, apex rounded; face uniformly brassy microtomentose; palpus yellow; mesonotal setae not greatly enlarged; and bases of apical scutellar setae separated by half distance between basal and apical pairs. Wirth (1960: 395-396) published the most recent key to the afrotropical species of Ochthera Latreille, 1802.

Figures 23-24. Male genitalia of Elephantinosoma cogani Mathis & Deeming (Ephydridae). 23, epandrium, cerci and presurstyli (lateral aspect); 24, same (posterior aspect). Scale bar = 0.1 mm.

NOTES: The single female was collected on a pebble beach (without kelp) at Tsitsikamma National Park. This species may be more closely associated with the Indian Ocean maritime fauna.

Tribe: Hecamedini Mathis


Taxonomic Notes: This species is distinguished from E. chnumi Becker, 1903, by the following combination of characters: shape of epandrium, especially the ventral margin, more sharply pointed (Figures 23-24); abdominal tergites 3-5 more shiny than E. chnumi and with a more silvery grey sheen than E. chnumi.


NOTES: This species is associated with the banks of the Kunene River, rather than being strictly littoral, but as the sample was taken approximately 1/2 km from the coast the species is included for completeness.
SAMPLING STATION: Namibia: SKELETON COAST PARK, Kunene River mouth, 17°15'97"S, 11°46'83"E, 17-18.iii.1998, A.H. Kirk-Spriggs. Sweeping marginal grasses and reeds on floodplane. (23♂♂, 11♀♀). This species is listed under sample station 00 in Appendix II.


TAXONOMIC NOTES: The nomenclatural status of this species remains unresolved, as the holotype and paratype of E. meridionale are females, and the species of Eremotrichoma Giordani Soika, 1956, are distinguished primarily by structures of the male terminalia. These structures of the only male specimen were dissected and are unlike those of the other species for which males are known (Mathis 1986).


NOTES: Only sampled from the banks of the Kunene River, vide E. cogani, above.

Subfamily: Ephydrinae Zetterstedt
Tribe: Ephydrini Zetterstedt

Ephydra stuckenbergi Wirth, 1975: 37.

TAXONOMIC NOTES: This species is distinguished from congeners, especially species of the riparia group, by the following combination of character states (extracted from Wirth 1975): moderately large species, ca. 4 mm; body generally greenish brown, dark olive dorsally with metallic lustre on mesonotum; mesotrons shiny, metallic violaceous; ventral parts paler brown to greyish microtomentose; acrostichal setulae in 4-5, irregular rows, setulae moderately coarse and erect; scutellum convex, moderately long; katepisternum of female bearing posterior row of longer, bristle-like setulae; legs yellowish, apical tarsomers brownish; tarsal claws not much more than half length of 5th tarsomere; 5th tergite of male 1.3 x length of 4th; ventrolateral processes short, stout (stouter than in E. flavipes (M acquart, 1843); aedeagus bearing a strongly developed, recurved basal process, a wrinkled membranous glans attached to anterior side of straight, distal portion; gonite short and wide, with a distinctive hook or pointed process; surstylus usually with distinct longitudinal carina.


NOTES: During the survey, this species was only sampled at Möwe Bay from deep beds of debris on the shoreline. Elsewhere in Namibia, this species has been collected from 'tidal pools' and 'seawater pools' (Wirth 1975: 37).

Tribe: Scatellini Wirth & Stone

Haloscatella dichaeta (Loew, 1860: 40).

TAXONOMIC NOTES: No external characters are known to distinguish this species from H. muria (Mathis, 1979), which is known only from North America and the Caribbean and which has a longer surstylus that is more narrowly produced and shallowly bifurcate apically; a narrower aedeagal apodeme; and a wider aedeagus.

DISTRIBUTION: Afrotropical: South Africa (Northern Cape). Palaearctic: Algeria, Austria, Belgium, Bulgaria, Canary Islands, China (Tibet), Czech Republic, Denmark, Egypt, Finland, France, Germany, Great Britain, Hungary, Israel, Italy, M acedonia, M orocco, N etherlands, Poland, Romania, Russia, Sweden, Switzerland, Tunisia (Mathis & Zatwarnicki 1995: 255). New to Namibia.

NOTES: This species is the only known congener of Haloscatella Mathis, 1979, from the Old World, and its occurrence in South Africa may represent an introduction. Elsewhere in the Old World it is widespread in Western Europe, including the countries bordering the Mediterranean Sea. Dahl (1959) reported this species as halophilous in habitat preference and that in Sweden it is a distinctly maritime species. Dahl's findings corroborate Collin's records (1930).
from the British Isles, where *H. dichaeta* was found to have an exclusively coastal distribution. During the current survey this species was only sampled at the mouth of the Groan River from wet mud at the margin of a saline lagoon.

**Sphaeroceridae ('lesser dung flies')**

The Sphaeroceridae is a relatively large acalyprate family of world-wide distribution. Virtually all known species (both adults and larvae) are saprophagous and develop as microbial grazers in various decaying matter of plant and animal origin (vide Rohácek 1998). A number of species belong to opportunistic polysaprophages of r-strategy type which are able to colonise almost every habitat with at least a small supply of rotting substrate. Some of these species have become cosmopolitan in distribution. On the other hand, there are also specialists restricted to particular kinds of substrate (e.g. rotting wood debris, grass, moss, dung, carrion) or habitat-niche (burrows of animals, nests of social insects, caves, buried dung or carrion, etc.).

Littoral algal wrack belongs to one of these special substrates and niches. It hosts a very distinctive community of halophilous flies, including a few specialised groups of Sphaeroceridae (subfamily Limosoinae only), viz. genera *Thoracochaeta* Duda, 1919 (world-wide but mainly in temperate zones), and *Archicollinella* Duda, 1925 (South America only), whose rapidly developing maggots (vide Egglishaw 1961a) feed on bacteria accelerating the decomposition process of the seaweed. *Thoracochaeta* species can often occur in vast numbers in accumulated shore-line kelp, and adults are able to form swarms being dispersed by both passive and active migration to freshly deposited algal piles (vide Egglishaw 1961a). Besides these specialists, the kelp could also host several other Limosinae, e.g. some halophilous species of *Rachispoda* Lloy, 1864, normally associated with salty shoreline mud, or habitat-tolerant polysaprophagous species such as *Pullimosina heteroneura* (Haliday, 1836). Five species of *Thoracochaeta* and one of *Rachispoda*, were recognised during the survey, those of *Thoracochaeta* having already been recorded by Marshall & Rohácek (2000). The community of *Thoracochaeta* species is highly characteristic on the southwestern African seaboard, as only *Thoracochaeta brachystoma* (Stenhammar, 1855) is a widespread (now almost cosmopolitan) species, while four other recorded species were described from this area and form together a distinctive *T. securis* group which has no known relative in other biogeographic regions (vide Marshall & Rohácek 2000).

**KEY TO GENERA AND SPECIES OF SPHAEROCERIDAE OCCURRING ON THE SOUTHWESTERN AFRICAN SEABOARD (partly after Marshall & Rohácek 2000).**

1. Scutellum (Figure 31) besides 6 (3 pairs) of long marginal scutellar setae with some small marginal setulae and with several setulae also on disc (including a pair of longer setae). Mid basitarsus with strong ventral seta and mid tibia dorsally with more and stronger setae (Figures 26 & 27). Male genitalia (Figures 25 & 32), female sternites (Figures 28-30)..............

   - *Rachispoda fuscipennis* (Haliday)

2. Mid tibia of both sexes (Figure 35) ventrally with only 4 (2 pairs) of marginal setae. Mid basitarsus without strong ventral seta and mid tibia dorsally with less and weaker setae (Figures 34 & 35) (T horacochaeta Duda) ................. 2

   - *Thoracochaeta brachystoma* (Stenhammar)

   - Male mid tibia (Figure 48) ventrally with a distal double row of short spines terminated by 1 short ventroapical seta; female mid tibia (Figure 47) with only
ventral setae apically curved like a pruning-knife. Female tergite 7 large, heavily sclerotised and posteromedially deeply incised, tergite 8 very shortened and transverse, tergite 10 only sparsely, finely pubescent on disc (Figure 56); sternite 8 larger (Figure 57), with distinctive medial keel (South Africa) .......................... 5

Thoracochaeta falx Marshall & Roháček

- Second costal sector as long as or longer than third costal sector; mid tibia with proximal posterodorsal seta situated more distally than adjacent anterodorsal seta. Surstylus (Figure 58) with posterior lobe slender; phallopodeme long and aedeagus short and broader (Figure 55). Female sternites 6 and 7 with medially undivided pigmentation (Figure 59); sternite 8 larger, with central dark spot and sternite 10 (Figure 59) less projecting posteromedially (Namibia) .............................

Thoracochaeta pertica Marshall & Roháček

Second costal sector shorter than third costal sector (Figure 39); mid tibia with anterodorsal and posterodorsal setae on the same level. Surstylus (Figure 40) with dilated, axe-shaped posterior lobe; phallopodeme shorter and aedeagus long and slender. Female sternites 6 and 7 with pigmentation divided medially to form two spots; sternite 8 smaller, with central pale area and posteromedially with a pair of dark denticles (Figure 43); sternite 10 broader and with a narrow anteromedial lobe (Namibia, South Africa) ..............................

Thoracochaeta securis Marshall & Roháček

- Second costal sector only 1.15-1.25 x as long as third costal sector. Surstylus (Figure 40) posterovernally more angular and with a tuft of much shorter setae; postgonite Rachispoda fuscipennis (Haliday, 1833: 178).

**Distribution:** Sub-cosmopolitan. Afrotropical records are scarce and in need of verification: Democratic Republic of the Congo (as Zaire), Madagascar, Suquatra I., [Democratic] Yemen, Sainte Hélène I., Saudi Arabia (vide Roháček 1991: 231). New to Namibia.

**Notes:** Only one female was collected during the survey (Namibia: Skeleton Coast Park, Möwe Bay), netted from isolated clumps of kelp
Figures 25-32. Rachispoda fuscipennis (Haliday) (Sphaeroceridae). 25, male genitalia (lateral aspect); 26, female mid tibia (dorsal aspect); 27, female mid tibia anteriorly; 28, female 7th sternite; 29, female 8th sternite; 30, female 10th sternite; 31, scutellum (dorsal aspect); 32, surstylus (lateral aspect). Abbreviations: ep = epandrium.
Figures 33-39. Thoracochaeta brachystoma (Stenhammar) (Sphaeroceridae). 33, wing; 34, male mid tibia (dorsal aspect); 35, male mid tibia anteriorly; 36, medial part of male 5th sternite; 37, male 5th sternite; 38, female postabdomen (dorsal aspect). Figure 39. Thoracochaeta securis Marshall & Rohácek, wing. Abbreviations: A1 = anal vein; ce = cercus; Cs1, Cs2, Cs3 = 1st, 2nd, 3rd costal sector; CuA1 = cubitus; dm = discal medial cell; dm-cu = discal medial-cubital (= posterior) cross-vein; M = media; R2+3 = 2nd branch of radius; R4+5 = 3rd branch of radius; r-m = radial-medial (= anterior) cross-vein; T6, T7, T8, T10 = tergites.
Figures 40-44. Thoracochaeta securis Marshall & Roháček (Sphaeroceridae). 40, male genitalia (lateral aspect); 41, male 5th sternite; 42, female postabdomen (dorsal aspect); 43, female postabdomen (ventral aspect); 44, male antenna (lateral aspect). Abbreviations: ce = cercus; dp = distiphallus; ep = epandrium; hy = hypandrium; pg = postgonite; pha = phallapodeme; ss = surstylus.
Figures 45-50. Thoracochaeta pugillaris Marshall & Roháček. 45, male abdomen (lateral aspect); 46, female postabdomen (dorsal aspect); 47, female mid tibia anteriorly; 48, male mid tibia anteriorly; 49, male antenna (lateral aspect); 50, male surstylus (lateral aspect). Abbreviations: ce = cercus; S = sternite; T = tergite.
Figures 51, 52, 54. *Thoracochaeta falx* Marshall & Rohácek. 51, male 5th sternite; 52, male genitalia (lateral aspect); 30, aedeagal complex (lateral aspect). Figure 53. *Thoracochaeta pugillaris* Marshall & Rohácek, male postgonite (lateral aspect). Figure 55. *Thoracochaeta pertica* Marshall & Rohácek, aedeagal complex (lateral aspect).
and deep beds of debris on shore-line. Rachispoda fusci pennis is a halophilous fly, normally associated with saline mud both on seashores and in inland salty lakes. It can, however, form synanthropic populations restricted to certain food-processing plants with a supply of saline substrates suitable for larval development (salted skins, brine for soaking cheeses etc. - vide Rohácek 1991: 230, 278).

Thoracochaeta brachystoma (Stenhammar, 1855: 393).
**DISTRIBUTION:** Throughout the world, common in temperate areas, more rare in the tropics. Reliable afrotropical records are scarce: Cameroon, Ghana, Seychelles, [South] Yemen, South Africa, Tristan da Cunha (Marshall & Rohácek 2000: 272).

**NOTES:** Only two males were collected in South Africa (Western Cape, Stillbaai-Wes), both from selective beds of seaweed (no kelp) and other debris on sandy beach (vide Appendix II).

**DISTRIBUTION:** Afrotropical: Namibia (Marshall & Rohácek 2000: 302).
**NOTES:** Only known from the type locality (False Plum Pudding). Specimens were netted from accumulated debris, mainly cockles and sea grasses on a sandy beach.

**DISTRIBUTION:** Afrotropical: Namibia and South Africa (Marshall & Rohácek 2000: 299).

**NOTES:** This is the most abundant species of the genus Thoracochaeta occurring on the Namibian and western South African coastline, from the Ventura bomber wreck, as far south as Hermanus in South Africa (vide Appendix II). Specimens were netted from a range of coastal habitats including rocky shores, pebble beaches with accumulated wave-broken kelp and sandy beaches with isolated patches of kelp.

**DISTRIBUTION:** Afrotropical: South Africa (Marshall & Rohácek 2000: 306).

**NOTES:** Only known from the type locality (Stilbaai-Wes). Specimens were netted from selective beds of marine algae (not kelp) and other debris on a sandy beach.

**DISTRIBUTION:** Afrotropical: Namibia and South Africa (Marshall & Rohácek 2000: 305).

**NOTES:** This species appears to be restricted to southern Namibia and the northern Cape of South Africa. Specimens were sampled from large clumps of kelp on rocky shorelines (South Africa) and from kelp on a sandy beach (Namibia).

**Coelopidae**

The Coelopidae is a relatively small family of usually medium-sized bristly acalyprate flies, which occur in coastal habitats where they are obligate breeders in decaying brown algae. Adults in Coelopa usually exhibit a great range of body size. The corresponding morphological variability is responsible for the large number of synonyms for widespread species such as Coelopa frigida (Fabricius, 1805). The ease with which the flies can be bred under laboratory conditions has spawned a large number of genetic and behavioural studies (Day & Gilburn 1997). Under favourable conditions, some coelopid species can build enormous populations, which can become a nuisance to tourists (Oldroyd 1954; Poinar 1977) and occasionally to city dwellers. Although most diverse in Australia, New Zealand (McAlpine 1991) and the Subantarctic Islands (e.g. Harrison 1959; Vockeroth 1987b), the 29 known species occur in all biogeographic regions, with the notable exception of the Neotropics.
Genus: Coelopa Meigen, 1830.
The afrotropical species of Coelopa are in need of taxonomic revision and for this reason it is impossible to identify taxa from this survey to the species level. Records provided here are, therefore, for Coelopa spp.

**Taxonomic Notes:** The morphological variability of Coelopa and the apparently long overlooked description of Coelopa ursina (vide infra) make it likely that some of the species listed in the afrotropical catalogue (Cogan 1980b) are in fact synonyms. This question can only be addressed by a global revision of Coelopa.

**Distribution:** Four species names in the genus Coelopa are listed in Cogan (1980b: 610), namely: C. aequatorialis Bezzi, 1892, C. africana Malloch, 1933, C. alluaudi Séguy, 1914 and C. dasypoda Bezzi, 1908. At least one additional species has been described from the ‘Cape Good Hope’ C. ursina Wiedemann, 1824. Three of these names apply to species from southern Africa: C. ursina, C. africana and C. dasypoda, the first two mentioned being recorded from South Africa and the last mentioned from Namibia and South Africa.

**Notes:** Specimens of the genus Coelopa were first sampled at 19°38′54″S, 12°51′29″E on the Namibian coast, from deep beds of wave-broken kelp. Elsewhere on the Namibian and South African coast, species appear to be principally associated with deep beds of accumulated kelp on sandy beaches and rocky bays (vide Appendix II).

Figures 60-61. Distiphallus (left lateral aspect) of Sarcophaga spp. (Sarcophagidae). 60, Sarcophaga maritima Engel; 61, Sarcophaga namibia Reed, [60 from Rohdendorf (1963), 61 from Lehrer (1995, as P. namibia Lehrer), reproduced with permission].
Sarcophagidae ('flesh flies')

The 'flesh fly' family Sarcophagidae is divided in three subfamilies (Sarcophaginae, Miltogramminae and Paramacronychiinae), all of which occur in southern Africa and the species represent an important component of the dipterous fauna of the region (Kirk-Spriggs & Pape 1998: 105). They have varied biology, but species of the Sarcophaginae generally develop in decomposing invertebrates or vertebrates, or as parasites in snails and insects (vide Ferrar 1987). Species identifications within this subfamily are most reliably done on characters of the male genitalia, but small external differences often occur, e.g., in the degree of white hairs on the gena and in the setosity of thorax, legs, wing veins and abdomen.

Few species of Sarcophagidae occur on sea beaches and even fewer are narrowly restricted to such habitats, but some noteworthy examples may be mentioned. Sea turtle nests are prone to sarcophagid scavengers (Broderick & Hancock 1997; McGowan et al. 2001) and even to specialised predators (Lopes 1982). Sarcophaga alba (Schiner, 1868) breeds in dead fish and crabs on sea beaches in the Oriental Region (Venkatraman 1936), and Peckia gulo (Fabricius, 1805) may be a specialised scavenger on dead semiterrestrial crabs in coastal areas of the Neotropical Region (Mendez & Pape unpubl.).

Two Australian species of Sarcophaga (Sarcorhodendorph Baranov) were recently discovered parasitising marine snails above the high-water mark in Queensland mangroves, Australia (Mckillup et al. 2000; Pape et al. 2000). Two species of the cosmopolitan genus Sarcophaga M. elgen, 1826 (sensu lato), occur as coastal scavengers along the southwestern and southern coast of Africa, namely S. namibia Reed, 1974, and the aptly named S. maritima Engel, 1925. The former was previously only known from Namibia (Walvis Bay) and the latter from South Africa (Pape 1996). A single specimen of a third species, Sarcophaga (Barcaea) inaequalis Austen, 1909, was collected at Tsitsikamma National Park (Driftwood Bay, 34°51'17"S, 23°53'22"E), but this locality was adjacent to coastal forest, and the species is not ordinarily a coastal scavenger, for which reason the species is not included in the following key.

Most specimens sampled during the survey were netted either from isolated clumps of kelp, or when alighting on other shoreline debris. Both species appear to share the same biology, feeding principally in the carcasses of decomposing Cape Fur Seals, and probably in other vertebrate carcasses periodically washed up on the shoreline, e.g. whales, fish, sharks, turtles. Puparia were sampled from beneath piles of decomposing kelp at Agate beach (vide Appendix I & II), but there were many seal pup carcasses intermixed, and these puparia probably represent larvae which had left carcasses for pupariation. It appears that larvae of both S. maritima and S. namibia are found in cadavers, from which they migrate into the kelp at maturity in order to pupariate. As such they will have to stand high salinity, but not true submersion unless the cadaver is flushed regularly. Larvae and puparia of S. namibia were collected from carcasses and reared from four separate sampling stations along the Namibian coast (sites 13, 30, 31, 40). Larvae of S. maritima were not obtained.

Interestingly, there appears to be no cross-over in the distribution of the two species. Sarcophaga namibia occurs from Cape Fria (18°25'58"S, 12°00'16"E) on the Namibian coast to Lambert's Bay (31°43'05"S, 18°12'23"E) south of the Orange River in South Africa. Sarcophaga maritima occurs from the West Coast National Park (Langbaan Lagoon, 33°08'19"S, 18°05'03"E) to Tsitsikamma National Park (Driftwood Bay, 34°51'17"S, 23°53'22"E) and probably beyond, unless the influence of the warm currents of the Indian Ocean determines distribution.
KEY TO SPECIES OF SARCOPHAGA OCCURRING ON THE SOUTHWESTERN AFRICAN SEABOARD.

1. Gena with black setae only, white setae restricted to postgena; male sternites 3-4 sparsely setose and with anterior and central parts largely bare; male sternite 5 with small and inconspicuous window; male cercus undulating; distiphallus with trough-like depression at base of juxta; harpes about equi-broad and usually leaving ample space to lateral styli and vesica; lateral styli long and reaching beyond juxtal tip. Distiphallus (Figure 60) .................... Sarcophaga maritima Engel

- Gena with a few white setae posteriorly along genal suture (gena-postgena boundary often difficult to find); male sternites 3-4 almost entirely setose, or with at most anterior 0.2 bare; male sternite 5 with very large, triangular 'window' on disc; male cercus almost straight; distiphallus with rounded posterior part, appearing almost globular; harpes broadening distally and filling out the space between lateral styli and vesica; lateral styli not reaching beyond juxtal tip. Distiphallus (Figure 61) ...................... Sarcophaga namibia Reed

DISTRIBUTION: Afrotropical: Namibia, New to South Africa (Cape Province).

Sarcophaga (Liosarcophaga) maritima Engel, 1925: 328.
DISTRIBUTION: Afrotropical: South Africa (Cape Province).

**Anthomyiidae**

There are approximately 1500 described species of Anthomyiidae world-wide, and the total number of species is probably in excess of 2000. The majority of these species occur in the Northern Hemisphere, with greatest diversity in mountains and in the boreal to sub-arctic zones.

The Afrotropical fauna at present numbers about 60 species. The genus Fucellia Robineau-Desvoidy, 1842, occurs world-wide, and the majority of the 18 described species are found in coastal saline areas; one species in northern Scandinavia is found on the shores of inland lakes.

Three species of the genus Fucellia occur along the southwest and southern coasts of Africa. Only two species have been previously recorded from the Afrotropical Region: *F. capensis* (Schiner), which appears to be indigenous to southern Africa, and *F. tergina* (Zetterstedt) which is widespread in the Palaearctic, Nearctic and Neotropical Regions (Hennig 1966; Lyneborg 1965).

It has probably been introduced into southern Africa. *Fucellia tergina* was first recorded from the African mainland (Namibia: Walvis Bay) by Lindner (1974: 76) and subsequently from Swakopmund (Namibia) (Lindner 1976: 75). A further species, *F. maritima* (Haliday) was sampled during the present survey at Langebaan Lagoon, West Coast National Park, South Africa. This is a new record for South Africa; previous records of *F. maritima* from various islands in the Indian and Atlantic oceans probably refer to *F. tergina*, the two species having been confused previously.

According to Ferrar (1987: 70) species of *Fucellia* breed in heaps of seaweed washed up on beaches. But there are reports that the larvae have been found in Phragmites Adanson (Poaceae) debris, in peas, animal and plant material in the early stages of decomposition, and in living snails (for references vide Hennig 1966). Hennig also quotes a note in The Natural History Museum, London (BM NH) "This fly (tergina) attacks the spawn of the caplin on beaches in Newfound-land."
KEY TO SOUTHERN AFRICAN SPECIES OF FUCELLIA ROBINEAU-DESVOIDY

1. Prementum of proboscis short and wide in lateral view, subcircular. Genae wide, between 0.74 and 0.84 times eye height (Figure 65). Scutum with more numerous accessory setulae and hairs, especially between presutural acrostichal rows and on anterior margin. c*: swelling at base of hind femur ventrally evenly rounded on distal margin, with short irregular setulae (Figure 66). c* genitalia: cercal plate in lateral view medially swollen and lateral arms of cercal plate wider dorsally and converging (Figures 62 & 63); postgonite much wider apically than at base (Figure 64) .......................................................... Fucellia capensis (Schiner)

- Prementum of proboscis 2-3 times longer than wide in lateral view. Genae narrower, between 0.38 and 0.7 times eye height (Figure 71). Scutum with less numerous accessory setulae and hairs, presutural acrostichal rows with only a few scattered hairs, or none. c* genitalia: lateral arms of cercal plate narrow dorsally and more widely separated (Figures 68 & 74); postgonite apically pointed, hook-like (Figures 70 & 76) ....... Fucellia maritima (Haliday) -

2. c*: genae wider, between 0.56 and 0.7 times eye height (Figure 71). A few setulose hairs present between presutural acrostichal rows. c*: Swelling at base of hind femur ventrally excavated on distal margin so that the swelling is undercut (Figure 72). c* genitalia: cercal plate in lateral view flat, apex not projected caudally; surstylus with a larger projection medially on inner margin (Figures 68 & 69) .......................................................... Fucellia tergina (Zetterstedt)

- c*: genae narrower, between 0.38 and 0.5 times eye height. No setulose hairs present between presutural acrostichal rows, or at most a single hair c*: swelling at base of hind femur ventrally not excavated on distal margin (Figure 77) (similar to F. capensis but with a row of longer setulae). c* genitalia: cercal plate strongly projecting caudally in lateral view; surstylus with only a small incision medially on inner margin (Figures 74 & 75) .......................................................... Fucellia setulosa Stein, 1908: 172. Synonymy after Stein 1919.

= Fucellia baltica Lyneborg, 1965: 20. syn nov.

TAXONOMIC NOTES: The synonymy of Fucellia baltica Lyneborg requires some explanation. Lyneborg based his description and figures on four male specimens that were found in Stein's collection in Zoologisches Museum für Naturkunde der Humboldt-Universität, Berlin (ZMHU) under the name 'Fucellia maritima Haliday'. The labels on the holotype and paratypes were "Pommern / Treptow a.d. R / Prof. P. Stein S." At the time of the description F. baltica was only known from the original locality. Hennig (1966: 9) listed an additional specimen from Genthin (central Germany); this specimen is also in the ZMHU. Stein (1808) described F. setulosa from Itschabo [Ichabo] Island, Namibia. So there could have been specimens of F. capensis in his collection. The description, figures of the genitalia and key characters for F. baltica leave little doubt that it is the same species as F. capensis. Whether this species really occurs in Europe, or whether there was some mistake in labelling specimens of Fucellia from Africa in Stein's collection is not clear, as Enderlein sometimes incorrectly labelled material in Stein's collection (A.C. Pont pers. comm.). It should be noted that the type locality of F. baltica is not immediately on the coast (though on the River Rega) and that Genthin is in central Germany.

DISTRIBUTION: Afrotropical: Namibia; South Africa.

NOTES: This species is the most abundant and widely distributed Fucellia sp. on the coast of Namibia and South Africa. It was present at 54
Figures 62-67. Fucellia capensis (Schiner) (Anthomyiidae) **♂**. 62, cercal plate and surstylus (caudal aspect); 63, cercal plate & surstylus (lateral aspect); 64, Postgonite; 65, head (lateral aspect) (palpi and proboscis omitted); 66, base of hind femur (lateral aspect); 67, base of hind femur (ventral aspect). Scale bar = 0.1 mm (genitalia only).
Figures 68-73. Fucellia maritima (Haliday) (Anthomyiidae) of. 68, cercal plate & surstylus (caudal aspect); 69, cercal plate & surstylus (lateral aspect); 70, postgonite; 71, head (lateral aspect) (palpi & proboscis omitted); 72, base of hind femur (lateral aspect); 73, base of hind femur (ventral aspect). Scale bar = 0.1 mm (genitalia only).
Figures 74-78. Fucellia tergina (Zetterstedt) (Anthomyiidae) ♂. 74, cercal plate & surstylus (caudal aspect); 75, cercal plate & surstylus (lateral aspect); 76, postgonite; 77, base of hind femur (lateral aspect); 78, base of hind femur (ventral aspect). Scale bar = 0.1 mm (genitalia only).
of the 69 Sampling Stations (vide Appendix II). Larvae were found to develop in decomposing kelp, partially buried on the upper beach.

\textit{Fucellia tergina} (Zetterstedt, 1845: 1960).
"\textit{Fucellia maritima} (Haliday)" of Oldroyd (1958: 79).
\textit{Fucellia tergina} (Zetterstedt) of Lindner (1974: 76).
\textbf{DISTRIBUTION:} Palaearctic, Nearctic and Neotropical Regions. Afrotropical: South Africa (Cape, Natal).
\textbf{NOTES:} This species, with an almost world-wide distribution, has probably been introduced into southern Africa. The earliest specimen examined (by M. Ackland), was collected by F. Zumpt in 1949 (Cape: Muizenberg, 25.xi.1949, 1\(^{\circ}\) (in BMNH)).

\textbf{SAMPLING STATION:} Not sampled during this survey.

\textit{Fucellia maritima} (Haliday, 1838).
\textbf{TAXONOMIC NOTES:} This species has often been confused with \textit{F. tergina} (as \textit{intermedia}).
\textbf{DISTRIBUTION:} Palaearctic (Europe). New to South Africa. According to Lyneborg (1965) this species has not been recorded outside Europe, all published records of \textit{F. maritima} (where they were checked) being \textit{F. tergina}. As in the latter species, \textit{F. maritima} has probably been introduced into southern Africa.

\textbf{NOTES:} Only sampled from Langebaan Lagoon (vide Discussion), West Coast National Park, from the margins of a sheltered saline lagoon. Interestingly, the species was netted from shoreline algae and other debris on a white sandy beach, but with no kelp.

\textbf{DISCUSSION}

This survey largely concentrated on Hexapoda associated with sandy beaches. The Namibian coastline is relatively poorly endowed with small inter-tidal rocky outcrops; these interspersed with long stretches of sandy beach (Kensley & Penrith 1980: 202). Travelling south from the Kunene River mouth on the Namibia/Angola border, to Cape Fria, the coastline is predominantly sandy, with the main outcrops further south being at Cape Fria, False Cape Fria, Rocky Point and Möwe Bay. The coast becomes increasingly rocky as one travels further south along the Namibian/South African west and south coast, being particularly so at the Cape Peninsula and beyond (Brown 1971; Penrith & Kensley 1970a; 1970b; McLachlan et al. 1981).

Kelp is one of the major macrobenthic primary producers in the near shore region of southern Africa (Bolton & Levitt 1987: 319) and for this reason is central to the food requirements and biology of many sublittoral amphipods, isopods and hexapods, not least among which are the Diptera. The current survey recorded 33 species of Diptera in 10 families (Coelopa spp. are counted as one), of which 21 species are either associated with kelp or can be assumed to have larvae which develop in marine algae. For 9 species of Ephydridae the feeding and breeding associations are unclear, and the remaining three species (Sarcophagidae, Chloropidae) either breed in coastal debris or in the carcasses of seals and other marine vertebrates (A.H. Kirk-Spriggs pers. obs). Clearly then, the distribution of kelp on the southwestern African seaboard has broad implications for the distribution and biogeography of the dipterous fauna and is, therefore, discussed in some detail below.

The distribution of marine algae, of which kelp forms a major component, is chiefly affected by the temperature regime of the sea, which is dependent not only on latitude, but also on prevailing currents (Brown & Jarman 1978: 1241). The coastal waters of southern Africa are dominated by two current systems. The warm Agulhas Current, which originates from the South Equatorial Current of the Indian Ocean, passes north of Madagascar and then follows the eastern coast (southwards and southwest) along the coastline, prior to turning back on itself south of the Cape Peninsula. At this point a mixing zone occurs, as the warm Agulhas Current meets the cold Benguela Upwelling System, which originates largely at the sub-tropical convergence from
Atlantic central water, reinforced by the circum-Antarctic West Wind Drift (Brown & Jarman 1978: 1243).

Based on a study of 205 common species, Bolton & Levitt (1987) defined the West Coast seaweed province to extend from Cape Agulhas to the region around the Namibian/Angolan border. Although very little was formerly published on the seaweeds of the Namibian coast, several important papers have been published recently (vide Bolton & Levitt 1987; Engledow et al. 1992; Lawson et al. 1990; Molloy 1998, 1990; Molloy & Bolton 1995, 1996). The Namibian flora is shown to be related to the flora of the Western Cape of South Africa, with a decline in species richness from south to north (Lawson et al. 1990). Although sea temperatures along the South African south coast vary little, they vary greatly in the Benguela Upwelling System, and such variations also occur in the nutrient regime and the degree of light intensity (Bolton & Levitt 1987: 322). These factors effect seasonal growth of kelp, and in both, Laminaria pallida and Ecklonia maxima, new growth is determined by increased day length and light intensity (Bolton & Levitt 1987).

Of the larger shore flies, the most abundant and frequently sampled species during the survey was the anthomyiid Fucellia capensis, which was sampled in 54 sampling stations (vide Appendix II). The species was found to be abundant on all forms of kelp: isolated clumps, wave cut sections and deep beds, both on rocky and sandy beaches throughout the southwestern African coastline. Egglishaw (1960) described the biology of one Northern Hemisphere species F. maritima and noted that flies were also attracted to dead fish and crabs, rotting apples and excrement in Britain, but there is some confusion as to the identity of the species concerned (vide Hennig 1966). There are no Egglshaw Fucellia specimens held in the BM NH. Harold Oldroyd named the material as F. maritima, but did not retain specimens for the BM NH collection. As Oldroyd at this time named other Fucellia material as F. maritima, which are actually F. tergina, there is no certainty that the larvae etc. in Egglishaw's work represent F. maritima at all, the odds are that they were F. tergina (A.C. Pont pers. comm.). Hennig (1966) discussed taxonomic difficulties within the genus and provided further notes on biology. Stenton-Dozey & Griffiths (1980) studied the growth, rate of consumption and respiration of Fucellia capensis larvae under laboratory conditions using cultures obtained from Kommetjie, Cape Peninsula. They found that kelp flies are rapid feeders, consuming 1.8 times their dry mass in kelp per day. They found the lifecycle to typically extend over a 22-28 day period and suggested that this is linked to the lunar cycle, the flies laying eggs on kelp deposited high on the shoreline and maturing prior to highwater spring 28 days later. This fits with results from the present survey, where larvae were located in partially buried kelp situated at high tide (A.H. Kirk-Spriggs pers. obs.). Stenton-Dozey & Griffiths (1980) conclude that although larvae of F. capensis are less significant consumers of drift kelp than kelp-inhabiting amphipods or isopods, they promote decay of wrack beds, possibly by the transfer of micro-organisms, hence speeding up the process of decomposition. Larvae are also the favoured food of many shore-wading birds, and their rôle as food to wading birds should not be underestimated. Fly larvae form a high-energy, readily accessible food resource for birds, such as the Curlew Sandpiper Calidris ferruginea (Pontoppidan, 1763) (Charadriidae), and in this case the birds were found to fulfil their food requirements more rapidly by feeding on fly larvae than by taking other invertebrates in nearby wetlands (Puttick 1979).

Cape Fur Seals also form an important food component on the coast, principally for the two coastal species of Sarcophagidae, viz. Sarcophaga maritima, S. namibia and the chloropid Eutropha lindneri. The Cape Fur Seal is the only seal endemic to southern Africa, occurring from about 18°S off the Namibian coastline to 26°E on the southern African east coast. Approximately 75% of the Namibian fur seal population is found at the two main colonies of Cape Cross (21°47'S,
13°57'E) in the Central Coastal Region and Atlas Bay (26°51'S, 15°09'E) /Wolf Bay (26°48'S, 15°08'E) near Lüderitz (N. Mukapuli pers. comm.).

Early pup mortality is a feature of the population dynamics of the Cape Fur Seal, and the highest pup mortality experienced by a cohort usually occurs in the first few months of life. Typically some 25% of pups die between birth (mid-November to the end of December) and the 15th of January each year (N. Mukapuli pers. comm.).

The seal mortalities observed during 1998 were probably part of these phenomena because no mass mortality was reported during this period. Pup production in 1998 was 80% of the 1993 figure, which was regarded as peak year. Seal mass mortalities were recorded in 1994 and 1999. Both these events were a result of abnormal environmental conditions characterised by a slackening of the southwest winds, a subsequent reduction in upwelling intensity and the intrusion of oxygen-poor water from the north. Reduced primary production in turn results in low prey availability for most marine organisms in the food chain, including top predators such as the fur seal. Clearly events such as those mentioned above would affect fly populations in coastal areas (N. Mukapuli pers. comm.).

A number of sampling stations are of particular interest faunistically. Chief among these is the Saldanha-Langebaan Lagoon system, which comprises a warm almost landlocked body of water, harbouring a biota of great richness, diversity and productivity, with many species not otherwise recorded from the west coast, many being typical of the south coast warm temperate region (Brown & Jarman 1978). Day (1959) undertook a 12-year study of the biology of Langebaan Lagoon and the effects of shelter on the composition of the fauna. He lists 475 species of animals from the Saldanha-Langebaan Lagoon system and notes that more south coast species occur further into the Lagoon. For the Diptera he lists (p. 494, 498, 537) only the family Ephydridae and the canacid Xanthocanace capensis. He concludes that the warm waters and sheltered nature of the lagoon were the key influencing factors of the distinct fauna. As far as the Diptera are concerned, there is certainly a fauna endemic, or virtually so, to the more sheltered parts of the Lagoon. Interestingly, four of the six species of Canacidae recorded during the survey occurred there. Two of these, Dynomiella cala and D. spinosa, were only recorded at Langebaan Lagoon, while Xanthocanace capensis was only sampled at one further site (Struisbaai), this being a strong indication that the last named species is normally associated with the warm temperate south coast fauna. All three are recorded from the Cape and so may be indicative of the south coast warm temperate region (vide supra), while Fuellia maritima was only recorded at Langebaan Lagoon and may represent an introduction. There may, however, be an additional reason for such a difference in the constituent Diptera fauna of the lagoon. Day (1959) notes that the two kelp species Laminaria pallida and Ecklonia maxima occur on rocky shores in Saldanha, but not in the sheltered Langebaan Lagoon itself, where the more typical estuarine species of algae Zostera capensis Setchell (Zosteraceae) and Gracilaria gracilis (Stackhouse) Steentoft L.M. Irwin & Farnham (Gracilariaceae) [as G. confervoidea (L.) Grev.] (vide Engledow & Bolton 1992; Isaac 1956) occur. Fragments of Gracilaria and Zostera make up the major component of the drift line trophic resource for the Diptera fauna and appears to harbour a different fly community from shore-washed kelp (A.H. Kirk-Spriggs per. obs.).

Brown & Jarman (1978) discuss the marine biogeography of southern Africa. They note that distribution of marine associated organisms is largely dependent on the modes of life of the particular organisms concerned. The coast of southern Africa has been divided into three provinces: (1) an East Coast Province, from Mozambique to Port St. Johns the Natal coast (tropical and sub-tropical species); (2) a South Coast Province, from Port St. Johns to the vicinity of Cape point (warm temperate species); and (3) a
West Coast Province, from Cape Point in the south to beyond Walvis Bay in the north (cold-loving species) (Brown & Jarman 1978). Stephenson (1948), based on studies of intertidal fauna of rocky shores, found a more or less distinct break in the fauna in the region of Cape Point, and this hypothesis was supported by Griffiths (1974) based on a study of Amphipoda. Brown & Jarman (1978); note, however, that the number of sandy-beach species is considerably smaller than for rocky shores, thus making analysis of sandy-beach inhabiting species more problematic, especially as over much of the Cape Peninsula sandy beaches are more or less confined to sheltered bays.

When the coastal inter-tidal Diptera are examined as a whole (vide Appendix III), there is an increase in the number of species southwards and eastwards (samples 00-19: 2.4 \( n=19 \); samples 20-37: 4.3 \( n=22 \); samples 36-54: 4.2 \( n=18 \); samples 61-58: 4.4 \( n=7 \)). This can be explained by the rarity of kelp on the northern coast of Namibia, the marked increase in washed-up kelp in rocky bays south of Swakopmund and in rocky bays east of the Cape Peninsula, in combination with the effects of ocean currents discussed above. Sites at which seven or more species were sampled are: Möwe Bay, Kuisebmond, Grosse Bucht, McDougall’s Bay, Tsaarsbank, Stilbaai-Wes and Struisbaai. All had deep accumulations of either wave-cut sections (Möwe Bay) or deep beds of kelp (all except Kuisebmond at Walvis Bay, which also had a lagoon element to the constituent fauna).

If the more abundant and widely sampled genera are examined, some distinct biogeographical patterns are evident. This is particularly true if the distribution of the two littoral scavenger species of Sarcophagidae, viz. Sarcophaga namibia and S. maritima, is examined (vide Figure 79). The former species was sampled from...
Cape Fria on the Namibian coast to Lambert's Bay in South Africa, after which it is promptly and entirely replaced by the latter species at Tsaarsbank. Both species feed on the same resource, but are clearly separated geographically, for reasons we are currently unable to understand.

The distribution of the endemic afrotropical genus Afrotethina does, however, cast some light on biogeographic affinities (Figure 80). Afrotethina stuckenbergi has a broken distribution occurring from the Kunene River mouth to east of the Cape Peninsula. The species occurs allopatrically from the Kunene River mouth to 18°36′28″S, 12°10′05″E on the Namibian coast, after which it occurs sympatrically with a second species of the genus, A. persimilis, this latter species then occurring southwards and eastwards as far as Struisbaai. A third species of the genus, A. femoralis, only appears at Gordon’s Bay and was sampled east as far as Struisbaai.

If the distribution of the three sampled species is compared to the three recognised marine provinces (vide supra), the following conclusions may be drawn. Afrotethina stuckenbergi occurs in two distinct provinces, the semi-tropical coast northwards from Sandwich Lagoon, and the warm, temperate South Coast Province. Afrotethina persimilis is clearly more widely distributed after its first appearance on the northern Namibian coastline. The species appears to shy away from the more northern tropical or semi-tropical area, but otherwise occurs in both the West and South Coast Provinces. Afrotethina femoralis, on the other hand, appears to prefer the warm temperate waters of the South Coast Province. The three species occur sympatrically at only two sites sampled during the survey, Gordon’s Bay and Struisbaai. A fourth southern African species, A. brevicostata Munari, known from Natal (Mathis & Munari 1996) but not recorded during the survey, is probably tropical/subtropical and occurs in the East Coast Province, but further surveys of the southern and eastern coasts are required before this can be said for certain.

CONCLUSIONS

The current survey has significantly increased our knowledge of the inter-tidal Diptera of the southwestern African seaboard. Further surveys are required especially further east (the southern African coast) and north into the East Coast Marine Province, before a clear picture of the biogeography of coastal species can be ascertained. The majority of inter-tidal dipteran species were found to be associated with kelp and other marine algae or with decomposing vertebrates. Kelp is therefore a crucial part of the ecology of the inter-tidal zone, both as breeding grounds for flies and for wading birds that feed on fly larvae. Langebaan Lagoon proved of particular interest, and a more thorough study of the Diptera of this unique and varied habitat is certainly warranted.

ACKNOWLEDGEMENTS

Permission to conduct research in Namibia was granted by G. C. Craig, H. Kolberg and D. Kotzee (Ministry of Environment & Tourism, Namibia). Staff from that Ministry at Möwe Bay (J. Paterson, A. Engelbrecht and J. Meeser), together with W. Versfeld (Etosha Ecological Institute) kindly assisted us in the field. Permits to collect specimens were made available by O. M. von Kaschke, A. Fortuin, P. Nel and A. Lieberking (West Coast National Park), B. Swanepoel and L. Jalving (De Hoop National Park), C. Pieterse, C. Erasmus and J. Allen (Tsitsikamma National Park) (all South Africa). Also thanked are M. H. Knight (National Parks Board), G. Liebenberg (Cape Nature Conservation) and A. Mecinski (Cape Metropolitan Council) (all South Africa) for their assistance with access and permits. N. Mukapuli (Marine Resource Section, Ministry of Environment) provided valuable information on Cape Fur Seals in Namibia, and B. Curtis (Namibian Tree Atlas Project, Windhoek) kindly provided information on botanical names used in this paper. Brian Stuckenberg (Natal Museum, Pietermaritzburg, South Africa) provided information on coastal Chironomidae. Special thanks go to Eugène M arais (National Museum of Namibia, Windhoek) (who also provided some of the photographs used in this paper), and to Barbara and Manfred Uhlig (Zoologisches Museum für Naturkunde der Humboldt-Universität, Berlin, Germany) for their great kindness and help during a most enjoyable survey. This study was partly supported by grant No. 206/00/0236 of the Grant Agency of the Czech Republic (studies on Sphaeroceridae by J. Roháček). The first author acknowledges Mary Ndopu for her assistance in preparing the paper and the Percy Sladen Memorial Fund for part fund-
REFERENCES


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

40 - Namibia: Grosse Bucht, 26º48’09”S, 15º05’45”E, 27.iii.1998. Deep beds of kelp on sandy beach.
41 - Namibia: Guano Bay, 26º38’45”S, 15º05’35”E, 27.iii.1998. Deep beds of kelp on sandy beach.
44 - South Africa: Gordon’s Bay, 34º08’25”S, 18º00’08”E, 02.iv.1998. Deep beds of kelp on sandy beach.
45 - South Africa: 2 km S of Melkbosstrand, 33º45’02”S, 18º26’29”E, 05.iv.1998. Abundant kelp & from small rocky outcrops with algae.
46 - South Africa: Cape Cross, 34º24’49”S, 19º17’16”E, 07.iv.1998. Selective beds of seaweed (no kelp) & other debris on sandy beach.
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.
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.
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