

THE MARINE AND BRACKISH-WATER NON-AMPHIPODAN PERACARIDAN CRUSTACEA OF NORFOLK

by

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Résumé

L'auteur présente un inventaire des Tanaïdacés, des Cumacés, des Mysidacés et des Isopodes des eaux marines et saumâtres du Norfolk, avec leurs distributions préférentielles. Deux espèces, *Cancricepon elegans* et *Prodajus ostendensis*, sont nouvelles pour la faune britannique. 27 espèces sont ajoutées aux 28 déjà signalées du Norfolk. Sauf peut-être pour les Epicarides, il semble qu'il n'en reste qu'un petit nombre à ajouter encore.

L'auteur donne des renseignements biologiques sur quelques espèces, ainsi que des figures du quatrième pléopode mâle de *Mysidopsis gibbosa*, à maturité sexuelle plus avancée que chez aucun jusqu'ici.

Introduction

Of the five suborder of Peracarida found in Norfolk, an account (Hamond, 1967) has already been given of the amphipods; the other four orders are dealt with below, including all Norfolk tanaidaceans, mysids, and cumaceans, but of the isopods excluding those found on land (except for the strictly maritime *Ligia*) or in fresh water. The area (Hamond, 1963, 1969) and methods of capture are as for the amphipods; except for the South Race Buoy (mentioned only under *Hemiarthrus abdominalis*, q.v.), "the Buoy" is everywhere intended to denote the Blakeney Overfalls Buoy .

Altogether 55 species are dealt with, which 25 are isopods, 18 mysids, 8 cumaceans and 4 tanaidaceans.

Previous records

Non-amphipodan peracarids have been recorded in Norfolk marine and brackish waters by Metzger (1875), Gurney (1904, 1907, 1923), Tesch (1911, 1912), Omer-Cooper (1917), Hart (1930), Serventy (1934), Gilson & al. (1944), Mistakidis (1957), and Pantin & al. (1960), as well as in the unpublished notes of the late A. H. Patterson (see Hamond, 1971 b) and in the notes or collections of Miss R. M. Barnes (Mrs Race), Drs G. I. Crawford, E. Duffey, E. A. Ellis, and J. Fisher, and Messrs P. G. W. Trett and W. J. Wolston; these unpublished records are

referred to in the text by the initials of the worker concerned. The published records are quoted for each species, with synonyms. A few of the specimens collected by other workers are still housed in NCM (Norwich Castle Museum); my own museum contains specimens of every species found here by me. Of the species found in our area by previous author the only ones I have not seen are *Lamprops*, *Iphinoe*, *Siriella norvegica*, *Gastrosaccus sanctus*, and *Cirolana*, whereas 27 species are recorded from Norfolk waters for the first time in the present paper.

Since the same species tend to be found over and over again throughout the southern North Sea (Tesch, 1911, 1912; Tattersall & Tattersall, 1951; van der Baan & Holthuis, 1969, 1971), it does not seem likely that many more species remain to be found in Norfolk waters except among the comparatively neglected Epicaridea; more than half of all the species found in our area are capable of breeding there (Table 1).

SYSTEMATIC LIST

TANAIDACEA

(identified from Nierstrasz & Stekhoven, 1930 b).

Heterotanaïs gurneyi Norman (1906); Gurney (1907); *Heterotanaïs* sp. (?) Gurney (1904).

All Gurney's records were from East Norfolk; his 1904 specimens were sent to Norman for description, but the NCM contains other specimens found by him in the River Bure on later occasions (Six-mile-House on 25-8-1921; Stokesby, 11-9-1927). I have also found it in East Norfolk (2 among *Cordylophora* in the Waveney at Haddiscoe on 18-5-1966) and in North Norfolk (6 among weed in the northern sluiceway in Cley East Bank, 24-2-1965).

I have not seen any example here of the closely related *H. oerstedii* Krøyer.

Paratanaïs batei Sars.

The only marine tanaid that is at all common in Norfolk waters, where it is confined to the richer kinds of offshore dredgings (type C2; Hamond, 1963 a).

Tanaïssus lilljeborgi (Stebbing).

Two on Morston Strond in a sandy pool at mid-tide level, about half a kilometre E.S.E. of the Freshes Stake, 11-12-1956; nine in 0.6 litres sand, close to the wreck lying off the Firs at Holme-next-the-Sea (about mean low-water level) on 8-8-1967.

Tanaopsis laticaudata Sars.

In the same dredgings as *P. batei*, but much rarer.

CUMACEA

(identified from Fage, 1951)

Cumopsis goodsiri (van **Beneden**).

Common in Blakeney Harbour, plankton, though less so than *Pseudocuma* (q.v.); mainly in April and from August to December.

Bodotria scorpioides (Montagu).

Common in offshore bottom plankton, and occasionally in dredgings; easily recognised by its opaque orange-brown or bright orange colour.

Iphinoe trispinosa (Goodsir). Tesch (1912).

One male at 52°33'N.01°58'E., on 25-9-1904 (Tesch); not seen here since then.

Nannastacus unguiculatus Bate.

Only at D.18, where one large adult male and 19 smaller specimens were taken.

Cumella pygmaea Sars.

Rare in dredgings. The specimens differed from Fage's description (1951) in the following respects, which according to Dr. N.S. Jones (in litt.) are due to immaturity:

1. Pseudorostrum much longer relative to the carapace, straighter, and cocked up at a steeper angle; it is never quite half, and usually only about one-third, the length of the carapace.

2. Dorsal teeth of carapace only 2 or 3, near eyes.

3. The upper anterior edge of the carapace is serrated at the outer side of the pseudorostral base.

4. The telson and uropods are as in *pygmaea*, but the spines are fewer and longer, and alternate with short tooth-like spines.

In the first three respects these specimens approach *C. limicola* Sars.

Lamprops fasciata Sars. Tesch (1912).

A female at 52°48'N.02°25'E. on 9-4-1908, and three females at 53°48'N.01°40'E. on 11-3-1910 (both by Tesch); not seen here since.

Pseudocuma longicornis (Bate).

By far the most numerous cumacean in plankton off the North Norfolk coast and in Blakeney Harbour; sometimes several hundred may be taken in a single ten-minute plankton haul. It occurs in March, April, and from June to December, being most common from July to October.

Diastylis bradyi Norman.

Scarce in plankton, both in the Harbour and offshore, from August to December; the only haul in which it was numerous on 7-10-1963 in the Harbour, when 120 (some of them 8 to 10 mm long) were taken in a ten-minute haul. The usual length is from 4 to 6 mm.

MYSIDACEA

All identifications were made from Tattersall & Tattersall (1951), except for *Paramysis* (from Labat, 1953); the useful paper by Mauchline (1971) appeared only after I had left Norfolk for Australia (April 1968). Specimens personally identified by Dr. Olive Tattersall are marked O.S.T. The most recent survey of mysids in an adjacent area is by van der Baan & Holthuis (1971) who found nine species, all of them known from Norfolk except for *Siriella clausi* and *Anchialina agilis*.

Siriella armata (Milne-Edwards). Tesch (1911).

Widely distributed offshore, but never numerous (Tesch); occasionally in shrimptrawls in Breydon (A.H.P.: det. R. Gurney, 10-8-1921) and off Yarmouth (P.G.W.T. & W.J.W.). An ovigerous female and four other adults at West Runton on 29-7-1961, and four adults trapped in a sandy pool near the "Hjordis" on 6-8-1956. The intestine shows up as a dark crimson or brown line running the whole length of the glassily transparent body.

Siriella jaltensis Czerniavsky. Tesch (1911).

One at "Wodan" station H6 (53°43'N. 00° 33'E.) on 9-2-1907 (Tesch); one (certainly not the var. *brookii*) under rocks near low water at West Runton on 10-8-1957.

Siriella norvegica Sars. Metzger (1875); Tesch (1911).

At P. 107 (Metzger); this is the record quoted by Tattersall & Tattersall (1951, p. 159) as being north-east of Cromer in 17 fathoms. Teach found two specimens with *S. jaltensis* (q.v.) Not seen here since.

Gastrosaccus sanctus (van Beneden). Metzger (1875).

Not seen here since Metzger found it at P. 111.

Gastrosaccus spinifer (Göes).

On the shoreward slope of Blakeney Deeps, from low-water mark at the edge of the sands on the north side of the Point to about two miles offshore, this and *Schistomysis kervillei* are absolutely dominant among the mysids, and are often among the most numerous animals (apart from calanoid copepods) in plankton hauls taken just above the bottom (cf. van der Baan & Holthuis, 1971, who also found that *G. spinifer* and *S. kervillei*

usually occurred together). *G. spinifer* is often carried into Blakeney Harbour on the tide, and is also taken in shrimptrawls off Yarmouth (W.J.W.) and in the Wash.

Leptomysis mediterranea Sars.

Apart from a small one taken in Pit plankton after dark on 4-10-1962, this species appears to be confined to West Runton, where it is not uncommon in little pools near low water from July to October (when it breeds; Table 1). It is dark brown, almost black, and swims horizontally, cruising

TABLE 1.

Monthly records of females which were definitely (x) or doubtfully (?) ovigerous; p = pair in precopula. The total for a month is the sum of x and p.

	J	F	M	A	M	J	J	A	S	O	N	D
<i>Paratanais batei</i>								x	x			
<i>Bodotria scorpioides</i>								x	x	x		
<i>Cumopsis goodsiri</i>									x			
<i>Pseudocuma longicornis</i>			x					x	x	x	x	x
<i>Siriella armata</i>					x	x	x					
<i>Gastrosaccus spinifer</i>						x						
<i>Leptomysis mediterranea</i>							x	x	x	x		x
<i>Mysidopsis gibbosa</i>								x				
<i>Paramysis nouveli</i>							x					
<i>Schistomysis ornata</i>					x		x					
<i>Schistomysis kervillei</i>						x			x	x		
<i>Praunus flexuosus</i>					x	x	x					
<i>Praunus inermis</i>							x					
<i>Mesopodopsis slabberi</i>						x						
<i>Neomysis integer</i>		x					x	x				
<i>Heteromysis formosa</i>								x				
<i>Paragnathia formica</i>								x				
<i>Eurydice pulchra</i>							x					
<i>Idotea granulosa</i>			p	x	p		x	x				x
<i>Idotea viridis</i>				x								
<i>Idotea linearis</i>				?			x			x		
<i>Astacilla longicornis</i>							x					
<i>Janira maculosa</i>							x	x				
<i>Jaera albifrons</i>			x	x				x	x			
<i>Ligia oceanica</i>							x					
<i>Cancericepon elegans</i>										x		
<i>Pleurocrypta galathea</i>									x			
<i>Pleurocrypta porcellanae</i>							x					
<i>Hemiarthrus abdominalis</i>								x				
Total 29 spp.	0	1	3	3	4	5	14	12	8	6	1	3

slowly about with a curiously deliberate and unhurried air. During the rest of the year no specimens have been found anywhere in Norfolk waters; it is possible that the young migrate offshore in November and do not move inshore again until late June or early July, when they are almost mature.

Mysidopsis gibbosa Sars.

One ovigerous female on 15-8-1965, and one male on 12-10-1965, both in bottom plankton near the Buoy. The former agreed well with the description of Tattersall & Tattersall (1951), but the latter was apparently fully adult, and therefore more mature than any seen by them. The two dorsal protuberances found in the female were quite lacking in this male, whose general appearance was more like that of *M. didelphys* (as in Tattersall & Tattersall, fig. 81 A) except that the eyes were more like those of the male of *M. angusta* (as in Tattersall & Tattersall, fig. 86 A). The fourth pleopod of this male is shown in Fig. I, 1 and 2.

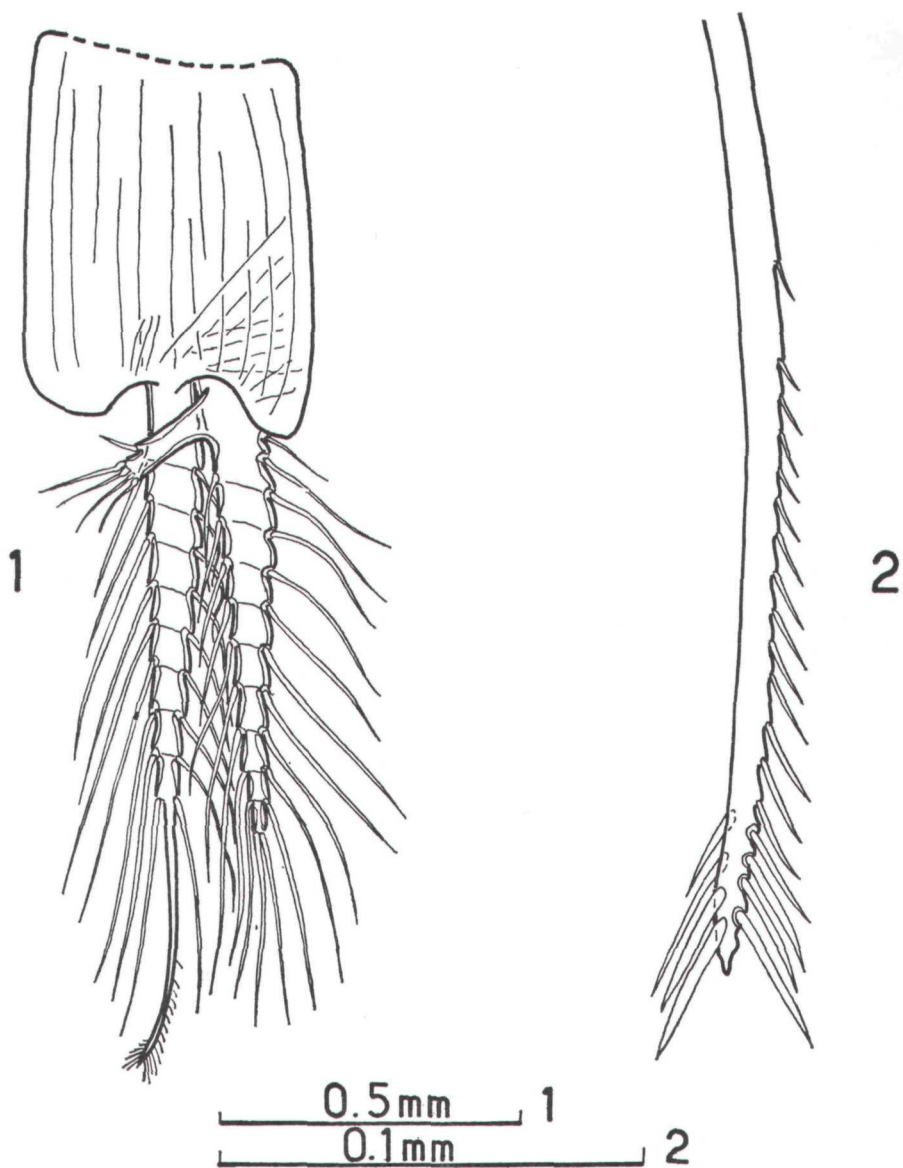


FIG. I
Mysidopsis gibbosa, mature male.

1: posterior view of left fourth pleopod; 2: distal half of terminal exopodal seta of this pleopod.

Hemimysis lamornae (Couch). Tesch (1911).

Always in plankton. One near the bottom, close to the Buoy, on 29-3-1965; the others all in the Pit of Blakeney Harbour. These included one at the surface after dark on 12-4-1963 and the remainder all near the bottom during July 1957 (three on the 19th and an immature female on the 14th). Tesch found two specimens at 53°55'N.00°03'W. on 21-3-1911.

Paramysis sp., possibly *bacescoi* Labat.

A halfgrown specimen in Pit plankton, 17-9-1958. The tarsus of the 8th pereopod is less reduced than Labat makes out, but the numbers of spines on the endopods of the uropods (10 on the right, 11 on the left) and along the sides of the telson (13 on the right, 12 on the left) appear to agree with the numbers given by him (Labat, 1953, p. 14). It is possible, however, that the numbers of spines increase with age, so that when adult this specimen would quite possibly have been identifiable as *P. noveli*; because of this, and since no mature *P. bacescoi* have yet been found here, the presence of *bacescoi* in Norfolk waters must be regarded as doubtful.

Paramysis noveli Labat. ? *Schistomysis helleri* Serventy (1934) ; ? *Paramysis helleri* Pantin & al. (1960).

Pantin and his party did not collect any *Paramysis* themselves, but merely quoted Serventy's record. The Scolt Head record is tentatively referred here to *P. noveli*, which (although scarce) is undoubtedly the usual *Paramysis* of this coast; I have found an ovigerous female trapped in a sandy pool on the outside of the tip of Blakeney Point on 26-7-1956, a badly damaged adult in Pit plankton on 17-12-1962, and a female in plankton near the end of the Point on 29-7-1963.

Schistomysis spiritus (Sars). Tesch (1911).

Tesch found it only off Yarmouth (stations H8 and H8 a), and only in February (1907 and 1908) ; one adult and several halfgrown specimens were taken in a Breydon shrimptrawl on 10-8-1921 (A.H.P.; det. R. Gurney). My own records (all in plankton) include five in the Pit of Blakeney Harbour after dark on 17-9-1958, an adult near the bottom about 2 km north of Blakeney Bar on 1-11-1961, two adults and two smaller ones in approximately the same place on 12-12-1961, and a small one close to the bottom near the Buoy on 14-7-1965.

Schistomysis ornata (Sars). *Mysis inermis* Metzger (1875).

Two ovigerous females at West Runton with *Praunus inermis* (q.v.) (both spp. det. O.S.T.). Off Yarmouth, apart from Metzger's find at P.111 (quoted by Tattersall & Tattersall, p. 372), two adult females (one ovigerous) were taken in a shrimptrawl in Caister Hole, late in May 1961 (W.J.W., det. O.S.T.).

Schistomysis kervillei (Sars). ?*S. ornata* Gilson & al. (1944).

Very common with *Gastrosaccus spinifer* (q.v.) outside Blakeney Point, and also frequently carried into Blakeney Harbour with the tide, whereas I have never seen *S. ornata* in either of these places. Since Scolt Head and Blakeney Point are so very similar faunistically, and only a few kilometres apart, I suspect that Gilson and his colleagues really had *kervillei* before them. Off Yarmouth several specimens were taken in shrimptrawls in June 1961 (P.G.W.T. & W.J.W., det. O.S.T.), including an adult male and an ovigerous female from the Cockle Bank on the 3rd, and an ovigerous female off Caister some days later.

Praunus flexuosus (O. F. Miiller). Serventy (1934); Gilson & al. (1944); ?*Mysis chamaeleon* Patterson (1898); *Macromysis flexuosa* Gurney (1907); *Mysis flexuosa* Hart (1930).

Abundant in the Pit, in Morston Creek, and in Wells Quay alongside the Rocks; in the last-named place it can be seen hovering in swarms in

the lee of boulders, rotten wooden posts, and the blades of *Laminaria saccharina*. It is always present (sometimes in large numbers) in plankton hauls after dark in the lowest reach of Morston Creek, as if it congregated there to intercept the food brought in by the tide; other Crustacea which behave in the same are *Palaemon elegans*, *Bathyporeia sarsi*, and *Eurydice pulchra*. When the tide ebbs, *B. sarsi* and *E. pulchra* burrow in sand in the Pit (just outside the mouth of Morston Creek), while *Palaemon* and *Praunus* hide among algae, either in the mouth of the Creek, or in the Pit (slightly west of the main sandbank, where there is deeper water with algae).

Praunus inermis (Rathke).

Two ovigerous females (det. O.S.T.) among a thick growth of small red and brown algae near extreme low-water mark at West Runton on 11.7.1956.

Mesopodopsis slabberi (van Beneden). *Macropsis slabberi* Gurney (1907).

Hitherto entirely in East Norfolk (in the Rivers Yare and Bure, Gurney, 1907; in Breydon, 10.8.1921, coll. A.H.P., det. R. Gurney). The only North Norfolk record was on 3.6.1966, as the last of the ebb-tide was draining out of Morston Creek, using a plankton net whose mouth (diameter 70 cm) was nearly half exposed as the rim rested on the floor of the Creek. Twenty-two specimens, most of them ovigerous females, were taken in ten minutes, but none during the rest of that ebb-tide either before or afterwards; apparently a small shoal of this species was moving down into the Pit to remain there while the tide was out.

Neomysis integer (Leach). *Mysis vulgaris* Patterson (1898); *Neomysis vulgaris* Gurney (1904, 1907, 1923).

The characteristic mysid of Norfolk brackish waters, being often found in marsh pools and drains, ditches on the landward side of seawalls, and in estuaries. Two exceptional occurrences, intertidally in water of full North Sea salinity, were:

- (a) a large one among algae at Wells Rocks on 9.12.1961; and
- (b) an immense swarm of small specimens (ca. 8 mm long) with a few larger specimens (ca. 12 mm long, and mostly ovigerous) scattered among them, in a sandy pool at the level of high water of neap tides, just under the cliffs at Hunstanton on 15.7.1957. The swarm formed a grey cloud about two metres in diameter in the middle of the pool, which was nowhere more than 15 or 20 cm deep.

Heteromysis formosa S. I. Smith.

Among the rocks at extreme low-water mark, about half a kilometre west of Sheringham Lifeboat House, on 5.8.1962, one specimen was caught by hand and another one was pursued but escaped; when cornered in a little pool these animals were extremely agile and difficult to catch. The captured specimen was a female, of a lovely rose-pink all over, except for the rear edges of the somites which were magenta; the broodpouch contained about ten young.

ISOPODA

(identified from Nierstrasz & Stekhoven, 1930 a, and from other sources as indicated)

Cyathura carinata (Kröyer). Gurney (1907) ; Hart (1930) ; Gilson & al. (1944).

One by the sluices in Stiffkey Freshes (the estuary of the Stiffkey River) on 27.3.1956, and another in Stiffkey Freshes Backwater Creek (ca. 200 m downstream of the sluices) on 3.4.1957. Gurney gives a good figure of it (drawn by Mrs. E.W. Sexton) which appears to have been ignored in the literature, and a careful redescription with excellent figures is given by Cléret (1960). No copepods are yet known to be associated with *C. carinata*, but Bowman (1972) has described a harpacticoid which is associated with the closely allied *C. polita*.

***Gnathia dentata* Sars.**

Rare offshore, in dredgings and whelkpot-rubbish (as for *Paratanais* and *Tanaopsis*).

Paragnathia formica (Hesse). Pantin & al. (1960) ; *Gnathia maxillaris* Gurney (1904, 1907); *Paragnathia halidaii* Omer-Cooper (1917).

This species is characteristic of the more saline parts of estuaries such as Breydon (A.H.P., 10.8.1921, det. R. Gurney as *P. halidaii*) and in the creeks and harbours of North Norfolk from Blakeney westwards. The pranaeae are common in the plankton of Blakeney Harbour and on the skins and fins of fishes in the Pit (mostly on *Gobius minutus* and *Platichthys flesus*, less often on *Pleuronectes limanda*); a young pranaeae was found on a sunfish (*Orthogoriscus mola*) cast ashore on Scott Head in November 1954 (E.D.). The adults tunnel into the steep sides of the creeks in the marshes, forming small caverns in each of which a male and one or more females together undergo their final moult preparatory to mating, and from which the young pranaeae emerge when ready to suck the blood of fishes (Omer-Cooper, 1917; Stoll, 1962); in August 1962 I found several such caverns with adults, about 10 cm below the level of the top of the marsh (covered with "crab-grass", *Halimione portulacoides*) in the side of Bluejacket Creek (a tributary of Morston Creek).

***Cirolana borealis* Lilljeborg.**

One from a shrimp-trawl off Yarmouth on 8.5.1908 (coll. A.H.P., det. W.T. Caiman).

Eurydice pulchra Leach. Hart (1930); Pantin & al. (1960); A.H.P.

This very active species, whose mode of swimming (as Hart remarks) reminds one of a whirligig-beetle, is extremely common in Pit plankton at high tide, but has never been found offshore except for three specimens at D.23 (and, even here, contamination cannot be ruled out, as they may have got into the catch while it was being washed in the entrance to the Harbour (where *E. pulchra* is very common) as soon as I had returned there from the dredging-grounds offshore). As the first of the flood-tide begins

to creep across the sand, shortly after low water, the *Eurydice* can be seen swarming like gnats in the water's edge, which they follow as it moves up the shore. Other species of this genus are known from the North Sea (Wolff, 1966; Jones & Naylor, 1967; van der Baan & Holthuis, 1969), but Dr. D.A. Jones found that all my preserved specimens were definitely *E. pulchra*.

Limnoria lignorum (Rathke).

This is the only species of *Limnoria* found here, as might be expected (Jones, 1963); it is constantly found in the mast-stump of the "Hjördis", the wooden planking of the Strond Pool Dam, and the rotten wooden posts alongside Wells Rocks. It is often accompanied by various folliculinid ciliates (Hamond, 1971 a), the harpacticoid copepod *Harrietella simulans* (not yet at Wells), and the ostracod *Aspidoconcha limnoriae*. Another harpacticoid, *Donsiella limnoriae*, has not yet been found here in spite of being looked for, although it is found with *Limnoria* spp. in several other places (Jones & Krishnaswamy, 1958; Brunei, 1963).

Sphaeroma hookeri Leach.

The only undoubted specimens I have seen were from an almost fresh-water ditch at Burgh Castle on 31.8.1963. This is, strictly speaking, a Suffolk record, but it is included here because similar ditches on the Norfolk side of Breydon will probably prove to contain this species. The *Sphaeroma* found in Breydon itself (22.4.1902, A.H.P., as *S. hookeri*), where the salinity is much higher although still not that of the open sea, were more likely to have been *S. rugicauda*.

Sphaeroma rugicauda Leach. Gurney (1907); Hart (1930); Serventy (1934); Pantin & al. (1960); *S. serratum* Gurney (1907).

Common in the marsh pools and the upper parts of the creeks in the North Norfolk marshes, as well as in brackish ditches, but only occasionally in Blakeney Harbour itself, the most seaward record being of two found among hydroids cast up near the "Hjördis" on 15.4.1957. It also seems to be common in East Norfolk (Gurney, 1904, 1907; P.G.W.T. & W.J.W.), especially around Breydon, but may have been partly confused with the last species.

Idotea baltica (Pallas). *I. tricuspida* Metzger (1875); A.H.P. (in part).

Occasionally at West Runton, especially among *Corallina* where, however, it is greatly outnumbered by the next species. It is sometimes taken in the Yarmouth shrimptrawls (A.H.P., 22.4.1902 and 8.5.1906; two large specimens on 12.11.1962, coll. P.G.W.T., now NCM reg. no. 46.963), but P. 109 (Metzger) is the only record from more than about two km offshore.

Idotea granulosa Rathke. Hart (1930).

Abundant at West Runton, where large numbers (most rather small) may be found among *Corallina*; larger individuals, often in precopula, are more usually found in small numbers under rocks near low-tide mark, in other words further down the shore than *Corallina*. It seems to be rare in the "Hjördis", where Hart found it; two large pairs in precopula were found on 3.5.1959 clinging to *Fucus* in a small pool near the Strond Pool, a few small ones have also been found on Hunstanton Scaup, Wells Rocks, among *Laminaria*-holdfasts in the Threshold, and in plankton in the Pit. At West Runton the ovigerous females are most often found among *Corallina* with the halfgrown specimens.

Idotea viridis (Slabber). Gurney (1904, 1907, 1923) ; Serventy (1934); Gilson & al. (1944); A.H.P.; *I. chelipes* Pantin & al. (1960); *I. tricuspidata* A.H.P. (in part).

In small numbers in Morston Creek, especially near the Quay; in East Norfolk it seems to be common on Breydon (A.H.P., 10.8.1921, det. R. Gurney; E.A.E., 30.3.1929). Patterson's *tricuspidata*, found in a ditch with *Corophium volutator* and *Sphaeroma rugicauda*, was almost certainly *I. viridis*; his marine records of *tricuspidata* were considered above under *baltica*.

***Idotea pelagica* Leach. Hart (1930).**

One small one at D. 49, which was later lost. The *I. pelagica* of Hart may or may not have been this species; I have never found any *Idotea* in the situation that he describes. The record of this species from Salt-house (in pools with *Gammarus* sp., 21.8.1920, A.H.P.) is undoubtedly of *I. viridis*, as are probably the records from Breydon (6.5.1906, A.H.P.) and Lake Lothing (14.8.1909, A.H.P.); the two latter localities are both in East Norfolk, and should be re-examined.

***Idotea linearis* (L.). Hart (1930); A.H.P.**

The adults are found most often among algae and other drifted material on the open sand near the "Hjördis"; they attain their maximum size in July, when all the females have young in their broodpouches. After July these large adults are absent and only the young are to be found, in the above habitat or (rarely) in plankton in the Harbour; the species thus appears to be an annual. Near Yarmouth it is found in shrimptrawls, and in drawnets on the beach (A.H.P.; W.J.W.).

***Astacilla longicornis* (Sowerby).**

Three adult females offshore at different dates:—

- (a) one, ovigerous, in a shrimptrawl at 53° 02'N. 00°30'E. on 18.7.1962;
- (b) one, slightly larger but not ovigerous, at D. 50; and
- (c) one, ovigerous, in a shrimptrawl 1 km N.E. of Caister Water Tower, Yarmouth, on 10.6.1970 (per J.G. Goldsmith).

***Janira maculosa* Leach.**

Rare in dredgings and whelkpots, and also taken at Q. 2 (four adult females); apart from this, all the large adults have been found under rocks near extreme low-water mark at West Runton (2 ovig. females, 1 juvenile female, and 2 adult males on 29.7.1961; 1 adult male and 1 non-sexed juvenile on 10.9.1961) and at East Runton (one very large adult male, 23.5.1959, J.F.).

***Jaera albifrons* Leach. Pantin & al. (1960) ; *J. marina* Gurney (1907) ; Serventy (1934) ; Gilson & al (1944) ; A.H.P.**

Very common among stones and algae in Morston Creek and on the Strand; also found on most other shores, wherever there are algae growing on stones or rocks. It is very scarce in Pit plankton, even in hauls taken at high tide ove grounds where it is abundant. Pantin & al. (1960) did

not collect it themselves, but used the name *albifrons* in quoting Serventy's and Gilson's records of supposed *marina*. *J. albifrons* s. lat. is now divided into several forms (Naylor & Haahtela, 1966) which are distinguishable only in the adult male; in my collection of *Jaera* from all along the North Norfolk coast Professor Naylor found 12 males of *albifrons* s.str. (approaching "syei") and 3 males of *prae-hirsuta*.

***Munna fabricii* Kröyer.**

Three among a surfball of hydroids (Hamond, 1957, p. 318) cast up under Hunstanton Pier on 2.4.1957; otherwise entirely offshore, where it is rare. This is a fragile species, and all my specimens were more or less damaged: however, Dr. R. J. Menzies examined them, and found that they probably were all of this species.

***Ligia oceanica* (L.). Gurney (1904, 1907) ; Hart (1930) ; Serventy (1934) ; Pantin & al. (1960) ; A.H.P.**

Common on Morston Quay, and under the lumps of concrete lying above high-water mark along the side of the seawall above Wells Rocks. Patterson found it in "swarms in piles and timbers by the riverside" at Yarmouth, near which (in a locality called the Muckholes, which I have not been able to trace) he saw it being eaten by starlings (*Sturnus vulgaris*) on 2.6.1891.

***Prodajus ostendensis* Gilson.**

On 11.7.1956, in sand at West Runton between mid-tide level and low-water of neap tides, I found a female of *Gastrosaccus spinifer* with an empty broodpouch and three epicarid larvae fixed to her outer surface. Since the larvae of all North European epicarids look very much alike, it is not possible to be certain that these larvae were in fact of *P. ostendensis*, although this is the only epicarid known to infest *G. spinifer*. In stating that this epicarid is not definitely known from British waters, Tattersall & Tattersall (1951, p. 63) appear to have overlooked the finds off Orford Ness, off Deal, and near the Kentish Knock Lightship and the Varne Lightship (Holthuis, 1950, fig. 6). If the West Runton specimens were indeed *P. ostendensis*, then the distribution of this species shows an interesting resemblance to that of *Margelopsis haeckeli* and *Mitrocomella brownei* (in Hamond, 1963 b); all three are species which are most plentiful off the Dutch and Belgian coasts (cf. also van der Baan & Holthuis, 1969, for *Prodajus*), and for which North Norfolk is near the northwestern limit.

***Cancericepon elegans* (Giard & Bonnier).**

A female, with an attendant male and a large number of larvae on the point of hatching, was found in the left gill-chamber of one out of 17 *Pilumnus hirtellus* at W. 36 (for actual or potential hosts of epicarids, see Hamond, 1971b). The host, a male, was lost soon afterwards, but not before it had been noticed that its pleopods were very much reduced. In colour and general appearance this parasite exactly resembled the original (Giard & Bonnier, 1887, plate 1); its identity, and the fact that this is the first British record of *C. elegans*, were both confirmed by Dr. R. Bourdon.

***Pleurocrypta galathea* (Hesse).**

Four specimens have been found here, all at West Runton in *Galathea squamifera*. The first, on the right of the host, on 6.9.1952, was noted by

Dr. R.B. Pike to resembles very closely that described from Northumberland by him (Pike, 1953) as *P. galathea*. Two more were taken in 24.9.1961 on the left and the right of two different hosts, and the fourth was taken on the left of a host on 5.9.1967.

***Pleurocrypta intermedia* Giard & Bonnier.**

A female on the left of a *Galathea intermedia*, cast up near the "Hjördis" on 11.4.1951.

***Pleurocrypta porcellanae* (Hesse).**

Among eight *Porcellana longicornis* taken in a shrimp-trawl off Yarmouth (52°39'30"N. 01°44'E., 10.7.1960, P.G.W.T.), one contained both a male and a female parasite, and another a male alone; both males had completely segmented abdomina (cf. remarks by Bourdon, 1965). The parasites were determined by Professor J.H. Stock.

***Hemiarthrus abdominalis* (Krøyer). Mistakidis (1957); *Phryxus abdominalis* Metzger (1875); A.H.P.**

Infects ca. 1 per cent of *Pandalus montagui* (Mistakidis; A.H.P.); a female parasite from just south of the South Race Buoy had two attendant males instead of the usual one (Mistakidis). An un-named parasite (referred by A.H.P. to *H. abdominalis*) was found twice on *Thorulus cranchi* in the Yarmouth shrimp-trawls, namely:—

- (a) on one out of six hosts on 4.5.1891; and
- (b) on the only host (whose tail was abnormally attenuated) taken on 12.6.1906.

In the Clyde (Pike, 1960) the larval host of *H. abdominalis* is exclusively *Pseudocalanus elongatus*, which is one of the less common calanoids of Norfolk waters (where epicarid larvae are in any case scarce on calanoids); it would be of interest to know whether larvae of Norfolk *Hemiarthrus* could infect other species of calanoid.

***Athelges paguri* (Rathke).**

A young female with an attendant male at D. 24, and an adult male without a female at D. 26, both on small *Pagurus bernhardus* and on the same day (6.8.1962), are the only specimens I have found here after examining hundreds of pagurids of different species at various times from different places. The effect of this parasite on its host (as in Nielsen, 1970) was not looked for in my material.

***Hemioniscus balani* Bate.**

Crisp (1968, p. 1164 and fig. 2; D.J. Crisp, in litt.) found no *H. balani* between Spurn Head (Yorkshire) and Lowestoft (just inside the Norfolk area), where he found it in *Balanus balanoides* on the sheltered side of the harbour wall in November 1952; in a much larger sample of *B. balanoides* from Hunstanton, at about the same time, he also found no *Hemioniscus*. So far I have not looked for it.

ECOLOGY

The following assignments of species to approximate ecological categories, based on not very numerous data and excluding the epicarids, are not intended to imply that any species is either rigidly confined to, or extends throughout, the habitat (s) under which it is listed; this applies especially to the Norfolk within which the substrata, both intertidally and offshore, are very liable to change from one year to the next (Serventy, 1934; Pantin & al., 1960; Hamond, 1963 a). It is hoped that the rough data given here will act mainly as a collector's guide for those who wish to collect more precise ecological or experimental findings.

1. Salinity preferences.

- a) Terrestrial, above high-water mark of waters of marine salinity.
Ligia.
- b) Fresh-water to moderately brackish water.
Heterotanais ; *Sphaeroma hookeri*.
- c) Slightly brackish to strongly brackish waters. *Idotea viridis*,
Cyathura, *Neomysis*, *Mesopodopsis*.
- d) Moderately brackish to marine waters. *Jaera*, *Paragnathia*,
Sphaeroma rugicauda.
- e) Exclusively marine salinities. All other species.

2. Current preferences, irrespective of salinity.

- a) Still water; in brackish ditches *Neomysis*;
in salt-marsh pools *Sphaeroma rugicauda*.
- b) Slowly flowing water; ditches of very low salinity, *Sphaeroma hookeri*; among *Cordylophora* and small weeds *Heterotanais*; brackish ditches, *Neomysis*; large creeks and estuaries, *Cyathura*, *Mesopodopsis*, *Praunus flexuosus*.
- c) Free-swimming during high tide. *Eurydice*, and any unattached pranzae of *Paragnathia*.

3. Substrate preferences.

- a) Intertidally.
 1. Sand; burrowing in it *Eurydice*, *Tanaissus*; swimming over it *Paramysis nouveli*, *Siriella armata*, and sometimes *Neomysis*;
 2. Mud; tunnelling into hard clay near high-water mark, adult *Paragnathia*; burrowing into soft or somewhat gritty mud at about mid-tide level in the sheltered parts of estuaries, *Cyathura*;

3. Rocks ; clinging to their sides or lower surfaces *Janira*; swimming around them *Leptomysis*, *Heteromysis*;
4. Well-wetted small stones, forming the surface layer of intertidal bound shingle. *Jaera*;
5. Tunnelling in rotten wood *Limnoria*;
6. Algae; clinging among them *Jaera*, *Sphaeroma rugicauda*, *Idotea* spp. except *pelagica*, and at low tide *Praunus* spp. and *Schistomysis ornata*; hovering over them at high tide; *Praunus flexuosus*, some *Neomysis*.

b) Offshore.

1. Over clean or slightly dirty sand, sometimes burrowing in it. Dominant spp. *Gastrosaccus spinifer* and *Schistomysis kervillei*; also *Bodotria*, *Cumopsis*, *Pseudocuma*, *Mysidopsis*, *Schistomysis spiritus*, and possibly *Diastylis*, *Siriella* spp., *Gastrosaccus sanctus*, *Hemimysis*, and *Schistomysis ornata*;
2. Among hydroids. *Astacilla*, *Munna*;
3. Among mixed epifauna and shallow infauna, often including hydroids. *Paratanais*, *Tanaopsis*, *Cumella*, *Nannastacus*, *Gnathia*, *Idotea pelagica*, *Janira*, and (very rarely and perhaps by contamination) *Eurydice*.

4. Breeding seasons (Table 1).

The most noticeable features of this table are:

a) The height of the breeding season, for all species taken together, is in July and August.

b) Tanaids and cumaceans appear to breed only from August to December.

c) Many of the commonest species have the most extended breeding seasons (*Pseudocuma*, *Schistomysis kervillei*, *Neomysis*, *Idotea granulosa*, *Jaera*), but some have a very restricted season; in a few of these (*Leptomysis*, *Janira*, *Paragnathia*, and possibly *Heteromysis*) there is a marked breeding migration, which appears to be lacking in others (*Ligia*, *Idotea linearis*). The very short breeding seasons of *Praunus flexuosus* and *Gastrosaccus spinifer* are somewhat anomalous in view of the abundance of adults of each of these species at almost all times of year.

d) As with most other groups of marine invertebrates, and not surprisingly considering that North Norfolk offshore waters are holothermic, there appears to be no relation between the bathymetric distribution of any species and its breeding season in those waters.

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Summary

The non-amphipodan peracarids of Norfolk marine and brackish waters are listed; short accounts of the distribution of each species, and a classified list of ecological preferences, are also given. Of 55 species all told, 27 are new to Norfolk; *Cancericepon elegans* and *Prodajus ostendensis* are new to the British Isles. Figures are given of the fourth pleopod of a male *Mysidopsis gibbosa* which was more mature than any available to Tattersall & Tattersall (1951).

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