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NOTES ON THE
HEMIPTERA, COLEOPTERA, DIPTERA AND
OTHER INVERTEBRATES OF THE BURREN, CO. CLARE AND
INISHMORE, ARAN ISLANDS.

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ABSTRACT

Habitats are described and the species of aquatic and semi-aquatic Heteroptera recorded from them are discussed. Emphasis is placed on their known ecological preferences and the use of corixids as lake-type indicators. Appendices are included listing other insects collected from the Burren and Inishmore Island.

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Acknowledgments.

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INTRODUCTION.

Tansley (1939) defined the Burren as an area of Carboniferous Limestone extensively developed with an oceanic climate, heavy rainfall, high relative humidity and subject to very strong winds. The British Ecological Society define the Burren geographically as follows:— the northern part of Co. Clare: the northern boundary is Galway Bay, the western boundary the Atlantic: the S.W. boundary roughly follows a line through Corofin, Kilfenora, Lisdoonvarna and thence to the coast: the S.E. and E. boundaries follow an arbitrary line N.E. from Corofin to Gort and then to the sea at a point about three miles west of Kinvarra.

The area was visited twice, first during the last fortnight of May, 1959, when only aquatic and semi-aquatic Heteroptera and aquatic Coleoptera were collected. The second visit was in September, 1960, when part of the time was spent on Inishmore Island. During the second visit all invertebrate groups possible were collected, see appendices.

LIST OF THE AQUATIC AND SEMI-AQUATIC HETEROPTERA
COLLECTED FROM THE BURREN HABITATS.

HYDROMETRIDAE

Hydrometra stagnorum (L).

GERRIDAE

Gerris thoracicus Schummel

„ *lacustris* (L.)

Gerris odontogaster (Zett.)

„ *argentatus* Schummel

Limnoporus rufoscutellatus (Latrielle)

VELIIDAE

Velia caprai Tamanini

Microvelia reticulata (Burm.)

SALDIDAE

Salda littoralis (L.)

Saldula saltatoria (L.)

Chartoscirta cincta (H.-S.)

CORIXIDAE

Corixa punctata (Illger)

„ *affinis* Leach

„ *panzeri* (Fieb.)

- Sigara (Sigara) dorsalis* (Leach)
 „ (*Retrocorixa*) *semistriata* (Fieb.)
 „ (*Vermicorixa*) *lateralis* (Leach)
 „ „ *concinna* (Fieb.)
 „ „ *nigrolineata* (Fieb.)
 „ (*Subsigara*) *scotti* (Fieb.)
 „ „ *fossarum* (Leach)
 „ „ *falleni* (Fieb.)
 „ „ *distincta* (Fieb.)
 „ „ *fallenoidea* (Hungf.)
Hesperocorixa castanea (Thoms.)
 „ *moesta* (Fieb.)
 „ *linnei* (Fieb.)
 „ *sahlbergi* (Fieb.)
Callicorixa praeusta (Fieb.)
Arctocorixa germari (Fieb.)
Cymatia bondsdorffi (C. Sahlberg)

NEPIDAE

Nepa cinerea L.

NOTONECTIDAE

Notonecta glauca L.

„ *obliqua* Gallen

LIST AND DESCRIPTIONS OF THE HABITATS SAMPLED

Some indication of the type of vegetation present is given, but no detailed lists of the plants were compiled.

LAKE INCHQUIN This habitat is not strictly in the Burren. The western side of the lake is bordered by Carboniferous shales and sandstones. The river Fergus, which flows through the lake, issues from a subterranean channel in the limestone about two miles to the north-west. The lake is roughly triangular in shape, the southern and western shores, each about nine-tenths of a mile long, are fairly straight. The north-eastern shore, which is more sinuous, measures more than a mile.

Locus a. Rocky shore under Clifden Hill, depth of water variable, 9"–36"; rocks covered with algae; substrate hard, stony with vegetable detritus and branches of trees, part of the shore overhung with trees; vegetation sparse, *Phragmites*, small clumps of *Elodea canadensis*. National Grid Reference Number (hereafter abbreviated to N.G.R.N.) R 26 90. Sampled 16 v.1959 and 22.ix 1960

Locus b. Adjoining locus a. bay with extensive *Phragmites* bed, water muddy and shallow. N.G.R.N. R 26 90. Sampled 16 v.1959.

Locus c. Open bay with small submerged limestone rocks along margins; water shallow, 6"-9"; substrate silty mud; occasional *Phragmites*, *Glyceria* and *Juncus*. N.G.R.N. R 27.5 89.5. Sampled 23.v.1959 and 23.ix.1960.

Locus d. Exposed shore-line with large limestone rocks along margins; substrate hard, covered with a layer of sandy silt; water shallow, depth 12"-18"; occasional *Phragmites*, some submergent vegetation also present. N.G.R.N. R 27.5 89. Sampled 23.v.1959 and 23.ix.1960.

LAKE GEORGE. Peripheral Burren lake on limestone; shape rather elongate, axis, N.E.-S.W. The part sampled was about four-fifths of a mile long. The greatest width of lake is about one-fifth of a mile.

Locus a. Sheltered bay at the S.W. end; substrate hard, covered with a layer of sandy silt; water shallow, 3"-24" deep, slightly cloudy; scattered limestone rocks covered with filamentous algae; outer margin of locus with a thick stand of *Phragmites*; habitat polluted daily by cattle. N.G.R.N. R 33.5 90.5. Sampled 25.v.1959 and 26.ix.1960.

Locus b. Exposed lake-shore parallel with the road; water shallow, 3"-12" deep; substrate hard with a thin layer of silt; large rocks along margins covered with filamentous algae; no higher plants present. N.G.R.N. R 33.5 90.5. Sampled 26.ix.1960

LAKE SHANDANGAN. Rectangular limestone lake, about one-third of a mile long along each margin.

Locus Sampled. Exposed shore-line with large rocks along margins; water shallow, 3"-24" deep, very clear; substrate hard, covered with a layer of vegetable detritus, mostly *Juncus* stems; vegetation strongly emergent, *Phragmites*, *Juncus*, *Cladium*, *Glyceria* and *Carex*. N.G.R.N. R 30 91. Sampled 21.v.1959 and 23.ix.1960.

LOUGH BUNNY. Peripheral Burren lake on limestone; shape elongate, axis, N.E.-S.W; eastern shore with striking limestone pavement; vegetation confined to the sheltered bays and inlets; greatest length of habitat about one and a half miles; greatest width about half a mile.

Locus a. Submerged limestone pavement with sparse algal growth; some grasses growing in fissures of rock; water shallow, shelving very gradually, very clear; depth collected from, 6"-24".

Locus b. Sheltered bay midway along eastern margin where drainage ditch enters habitat; Water shallow, 12" 24", brown in colour; substrate with much vegetable detritus, mostly *Juncus* stems covering comminuted shells and greyish black gravel. Adjoining this locus the margins of the lake were undercut; water very deep, about 6'-8'; bottom covered with comminuted shells; vegetation along ditch mostly *Juncus*, some *Carex* and *Glyceria*. N.G.R.N. R 38 97.5. Sampled 19.v.1959 and 25.ix.1960.

LAKE MURREE. Finnavarra, small peripheral Burren limestone lake, very close to the sea shore; shape very roughly triangular, greatest length nearly half a mile along western shore, greatest width just over one-fifth of a mile. Locus sampled on landward side by road, N.G.R.N. M 25.5 10.5. Habitat with many small limestone rocks embedded in lake and covered with a thick layer of vegetable detritus and greyish ooze; water shallow, up to 18", very opaque; locus heavily polluted by cattle and sea birds; marginal vegetation, *Elodea canadensis*, *Glyceria*, *Mentha*, *Lemna*, *Nasturtium* and *Juncus*, large stands of *Phragmites* slightly offshore. Sampled 29.ix.1960.

LAKE CALLAUN-LAKE ATTEDAUN. Two large peripheral Burren limestone lakes. Habitat sampled; stream joining the former with the latter where it passes under the road from Corofin to Gort. N.G.R.N. R 30.5 89.5. The stream where sampled was about 8' wide; greatest depth about 24"; numerous large stones and small limestone rocks in stream; substrate hard and sandy, with banks of elevated silty vegetable detritus; current slow; habitat polluted by cattle; vegetation, *Elodea canadensis*, *Potamogeton*, *Sagittaria*, *Rumex*, *Glyceria*, *Carex*, *Juncus*, *Nasturtium* and *Ranunculus*. Sampled 25-26.v.1959 and 29.ix.1960.

MISCELLANEOUS HABITATS

LAKE ALEENAUN. In May 1959 this lake almost completely dried out during the long period without rain. In September 1960 the lake was full again: water shallow, up to 18", clear; substrate, submerged limestone pavement; vegetation, mostly grasses. N.G.R.N. R 25 95.5. Sampled 24.ix.1960.

RIVER FERGUS. Swift river, bottom stony. Habitat sampled; small dammed pool fed by river; water clear, depth 2"-3"; vegetation, *Elodea canadensis*, *Carex* and *Juncus*. N.G.R.N. R 26 92. Sampled 16.v.1959.

RINNAMONNA STREAM. Small sluggish stream; width about 10', depth up to 24"; substrate stony, with coarse gravel; margins of stream with large moss-covered limestone rocks; vegetation, *Elodea canadensis*, *Glyceria*, *Juncus*, *Mentha* and *Potamogeton*. N.G.R.N. R 29.5 94. Sampled 24.ix.1960.

LEMANEAGH CASTLE. Well cut in rock, sampled 17.v.1959. N.G.R.N. R 23.5 93.5.

CATTLE TROUGH IN LEMANEAGH CASTLE GROUNDS. Trough about 12' long, 3' 6" deep and 3' wide; water opaque; bottom of trough covered with a deep layer of greyish ooze, habitat very sheltered; no apparent macroscopic vegetation. N.G.R.N. R 23.5 93.5. Sampled 24.ix.1960.

SLIEVE ELVA. Small sheltered pool; depth 12"-30"; substrate silty, with dead leaves; vegetation, *Juncus* and *Glyceria*. Slieve Elva is composed of shales and flagstones overlying the limestone. N.G.R.N. M 14.5 005. Sampled 20.v.1959.

Sigara concinna was the dominant corixid in L. Murree. The association between *S. concinna*, *C. praeusta*, *S. lateralis* and *C. punctata* has been found before. A comparison between the conditions described in Lansbury (1959), Pearce & Walton (1939) and L. Murree shows certain similarities. Briefly the Hertfordshire habitat (Lansbury 1959) was 65 yards long and about 35 yards wide, exposed and polluted by cattle; vegetation mostly grasses, *Callitriche* and clumps of *Juncus effusus*; substrate hard fine gravel covered with vegetable detritus and fine silt; water at margins 3"–12" deep and opaque. Pearce & Walton (1939) "SH. 14, pond by roadside at Warren Farm, St. Leonard's-on-Sea about 40 × 20 yards, gradually shelving to about 2 ft. in depth; bottom of flinty gravel and a little debris; very little vegetation, *Juncus*".

Comparison of corixid fauna of each habitat in descending order of numerical abundance.

L. MURREE	HERTFORDSHIRE	SH. 14.
<i>S. concinna</i>	<i>S. concinna</i>	<i>S. concinna</i>
<i>S. lateralis</i>	<i>C. punctata</i>	<i>S. lateralis</i>
<i>C. praeusta</i>	<i>S. lateralis</i>	
<i>C. punctata</i>	<i>C. praeusta</i>	

Macan (1954) considers *S. concinna* and *C. praeusta* to be 'lake and river species' and *S. lateralis* and *C. punctata* to be 'pond species'. He has found a highly significant association between *S. concinna* and the two pond species and a slightly less significant association between *S. concinna* and *C. praeusta*. Walton (1943) found *S. concinna* fairly commonly in the Yeo Reservoir, Blagdon, N. Somerset, a calcareous habitat. The locus where *S. concinna* was commonest is described as "*Scirpus*, Moss Mud'. Other corixids present were *A. germari*, *C. praeusta*, *S. falleni* and *S. dorsalis*. There appears to be no common ecological denominator between these habitats. Most of the habitats described where *S. concinna* has been found in any numbers are near the sea and therefore almost certainly have a higher than average salinity; or inland, usually polluted by cattle and with sandy or stony substrate.

Sigara dorsalis is common in L. Inchiquin (Table 1) and the Rinnamonna Stream (Table 3) and to a lesser extent in L. Bunny (Table 2). In the Burren generally *S. dorsalis* appears to have been replaced by *S. distincta*. In L. Inchiquin, *S. dorsalis* had a highly significant association with all the common species of corixid collected: the associations correlating with those of Macan (1954). *S. dorsalis* appears on the whole to be scarce in the Irish loughs (Macan 1954a). Crisp (Crisp & Heal 1958) found very few specimens in the oligotrophic-dystrophic habitats of western Galway. It is generally accepted that *S. dorsalis* is most common in habitats where the amount of organic matter in solution is low being in its turn replaced as this increases, see page 94 by *S. distincta* or *S. falleni*.

Sigara falleni is scarce in the Burren (Table 2). It is found only in small numbers in L. George, **locus a** around the periphery of the polluted area. Macan (1954) states that *S. falleni* occurs frequently with *S. dorsalis*. The ecological relationship between these two species is obscure. It would appear that *S. falleni* is a calcicole species which is likely to be found where conditions are not stagnant and there is some deposition of organic matter on the bottom.

Cymatia bonsdorffi. As already indicated this species has a highly significant association with *S. distincta* and *C. praeusta*. In L. Inchiquin, **Locus d**, where it was common, large numbers were observed on 23.v.1959 in copula. Walton (1943) thought it likely that two generations a year occurred in N. Somerset. This may be so in L. Inchiquin although no teneral adults nor the distinctive larvae were collected in September 1960. The behaviour of this corixid is very characteristic. The adults were observed to spend most of the time anchored to the rocks, only occasionally swimming. The *Sigara* species were constantly active, swimming and sieving along the bottom of the lake. Macan (1949) in a study of the marginal fauna of Blelham Lake near L. Windermere (Lake District) found an association of corixids fairly similar to that of L. Inchiquin. However, in the former *S. fossarum* was the dominant species whereas in L. Inchiquin this species was rare (Table 1). Macan (1949) found that the distribution of *C. bonsdorffi* was correlated with the presence of vertical faces of *Carex elata*. By comparison, in L. Windermere, where the reed beds are few and small with little *C. elata*, *C. bonsdorffi* was also scarce. The significance of these observations is that *C. bonsdorffi* is generally associated with vertical faces of either vegetation or, as in L. Inchiquin, submerged rocks. Sometimes *C. bonsdorffi* is found in rivers which receive organic matter from external sources (Macan 1956). In **Locus a** of L. Inchiquin, *C. bonsdorffi* was rarely taken although conditions would seem ideal. Possibly the shade cast by the overhanging trees might be a significant factor with a species which is primarily a predacious one. The association of vertical faces of vegetation has also been described for *C. coleoptrata* (Fabr.), Lansbury (1956).

Corixa panzeri. This rare species, found mainly in L. Inchiquin, has a very significant association with *S. dorsalis* (Macan 1954). It is almost invariably associated with the deeper parts of lakes.

Sigara fossarum. This species is usually found most commonly in sheltered habitats where undissolved vegetable detritus has been able to accumulate and therefore its distribution may be taken broadly as an indication of the accretion of organic matter. As Macan (1949) found a significant association between *S. fossarum* and the reed beds in Blelham Lake its absence from **Locus b** of L. Inchiquin is unexpected. In L. George, **Locus a**, it was moderately common; but possibly, if collections had been made from amongst the *Phragmites* beds forming the outer margin of the locus, larger numbers might have been collected.

Sigara scotti is unexpectedly common in some of the lakes (Table 2). The ecological status of this corixid in the Burren is rather obscure. Macan (1954) regards *S. scotti* as an oligotrophic-dystrophic species, typical of lime-deficient habitats. The occurrence of *S. scotti* with *S. distincta* and *S. fossarum* in flowing water (the stream joining L. Callaun to L. Attedaun) is most unusual. In L. George, **Locus a** it would appear that the ecological conditions are rather complex as both *S. fossarum* and *S. scotti* were common and *S. distincta* the dominant corixid. Macan (1954) in a survey of one hundred and seventeen habitats in Great Britain only recorded *S. scotti* and *S. fossarum* from the same habitat twice. Macan (1956) states that *S. scotti* is common in a few big reed beds growing on highly organic substrate in some rich lakes in the Lake District. The presence of the *Phragmites* in L. George **Locus a** may be the factor common to these two corixids. It is obvious from Tables 1 and 2 that these two species are closely associated in the Burren lakes. In L. Inchiquin (Table 1) *S. fossarum* is very scarce and no *S. scotti* were collected.

Sigara fallenoidea is a circumpolar species not found elsewhere in the British Isles than Ireland (Jaczewski 1960). It is comparatively uncommon in L. Inchiquin and rare in L. George. Macan (1954a) found it commonly in several stations on Lough Arrow, L. Ree and L. Gill where it was associated with *A. germari* in two stations. The greatest number (60 specimens) were collected from L. Ree, where there was no significant association with any other corixids. Macan (1954a) describes the station as "stony bottom behind reed bed". It would appear that *S. fallenoidea* may be more common in calcareous lakes with sandy bottoms and not much organic matter. Macan (1954a) gives figures that indicate *S. fallenoidea* is an alkaline lake species found in water between 12"–36" deep. There is also some association between this corixid and *Phragmites* (Macan 1954a). Walton (1936) recorded the following species as being associated with *S. fallenoidea**; *S. dorsalis*, *S. nigrolineata*, *S. fossarum*, *S. distincta*, *S. semistriata*, *C. praeusta*, *A. germari* and *C. bonsdorffi*. Unfortunately he (Walton 1936) did not indicate which of these species were common.

Sigara semistriata is not very common in the Burren lakes. In L. Bunny all the specimens were collected from the ditch. In L. George all the specimens were from **Locus a**. In Ireland (Macan 1954a) found *S. semistriata* associated with *S. distincta* in a "bay with *C. elata* and *Schoenoplectus lacustris* on mud". Macan (1954) discusses at length all the previous records of this species, and considers that "*S. semistriata* appears to be a species of small shallow collections of water, mainly alkaline peat". From its associations in L. Bunny, *S. semistriata* appears to prefer somewhat calcareous conditions with a relatively high deposition of organic matter. Macan (1962) has also shown

* Originally described as *Sigara pearcei* Walton (1936). China (1956) synonymised *S. pearcei* with *S. fallenoidea* (Hungf.)

that *S. semistriata* has positive associations with lake species and possibly with higher than average salinity. Macan (private communication) considers that it is likely that the Atlantic gales would bring a lot of salt into the Burren lakes.

Arctocorisa germari is certainly more common than the records show. Crisp (1962) says that in the Pennines *A. germari* is found in large relatively deep habitats with rocky surfaces and inorganic bottoms. Some of the Burren lakes come within this rather broad definition. Teneral adults were collected in September, 1960 from all the lakes where *A. germari* occurred. There appears to be a more than casual association with *S. concinna*. Macan (1957) found in Scotland that *A. germari* was dominant in L. Skene with *S. concinna* and *C. praeusta* relatively common.

Corixa punctata is rare in the Burren. Its presence in L. Murree confirms Macan's (1954) placing of this species in the "productive pond group".

All the British species of *Hesperocorixa* were recorded from the Burren (Tables 2 and 3), none very commonly. *H. linnei* was the commonest, being associated with *S. semistriata* in L. Bunny, **Locus b**. No collections were made from the reed beds in the lakes so that *H. linnei* was probably far more common than the records show. *H. moesta* is usually found in small grassy ponds, (Lansbury 1953, 1957). *H. sahlbergi* is typical of stagnant habitats with much decomposing vegetable matter, i.e. dead leaves. *H. castanea* is found most abundantly in lime-deficient habitats, Macan (1954). It is not a species which would be expected to be common in the Burren lakes. This species has a highly significant association with *S. scotti*, Macan (1954). It seems likely that *S. scotti* has a wider toleration of conditions than *H. castanea*. It is presumed that on Slieve Elva (Table 3) where *H. castanea* was collected that conditions might be lime-deficient, if this is so, the absence of *S. scotti* is puzzling.

Sigara lateralis and *Sigara nigrolineata*. Both species are regarded as "productive pond group" species. Therefore the occurrence of *S. lateralis* in L. Murree requires no comment. *S. nigrolineata* was only found in small numbers other than on Inishmore Island. It is probable that the many corixid nymphs found in the cattle trough at Lemaneagh Castle (Table 3) are referable to *S. nigrolineata*.

Corixa affinis, a relatively rare species, is frequently associated with a rather high salinity. It is probable that *C. affinis* is confined in the Burren to the smaller productive habitats with a high salinity. It is considered that the absence of *C. affinis* from L. Murree is very significant in this respect. Walton (1943) found *C. affinis* most commonly in "Slightly saline, grassy, clay bottomed ponds of clear water". Lansbury (1957) describes similar habitats.

Two species of *Notonecta* were found in the Burren.

	Inchiquin	Bunny	Shandangan	George	Callaun	Murree
<i>N. glauca</i>	2 ♀ + n.	6 ♂ 9 ♀	8 ♂ 7 ♀ + n	3 ♂ 3 ♀	11 ♂ 4 ♀	2 ♂
<i>N. obliqua</i>		1 ♀				
	Rinnamonna stream					
<i>N. glauca</i>	1 ♂	1 ♀				

Five species of *Gerridae* were collected (Table 4).

Gerris lacustris was common on some lakes. Only one sample was collected from each habitat. Most of the brachypterous specimens were collected from small habitats other than the stream joining L. Callaun-L. Attedaun.

Gerris odontogaster was very common on L. Murree, but scarce elsewhere.

Gerris thoracicus. This species is typical of dew and cattle ponds. It is also associated with brackish habitats (Brinkhurst, 1959).

Gerris argentatus is found, not very commonly, on L. George, amongst emergent vegetation. Brinkhurst (1959) comments on the association between this species and *Phragmites*. There may be an association with calcareous lakes. *G. argentatus* has been found fairly commonly amongst *Phragmites* in the lake in the grounds of Blenheim Palace, Oxon. This lake is very calcareous.

Limnoporou rufoscutellatus is a very rare gerrid in the British Isles. The status of the Co. Clare record is discussed by Lansbury (1961) and Sutcliffe (1962).

Hydrometra stagnorum is very common in the reed bed of L. Inchiquin, **Locus b**, but is not recorded from the other Burren lakes, although it probably does occur amongst the emergent vegetation there.

Nepa cinerea is not very common (Table 4.)

Two species of *Saldidae* were found about the margins of L. Inchiquin, *Salda littoralis*, adults and nymphs in late May, 1959; *Saldula saltatoria*, nymphs but no adults in large numbers in late May, 1959. A single male of *Chartoscirta cincta* was found on the margins of L. Shandangan. These three species of *Saldidae* are the most common of those occurring in the British Isles.

Two species of *Veliidae* were recorded, neither very common (Table 4).

V OBSERVATIONS ON SOME OF THE BURREN LAKES.

Macan (1955) has shown that within very broad limits corixids can be utilised as lake-type indicators, particularly for shallow lakes. The corixid fauna of the Burren lakes sampled is very diverse, indicating a wide variety of ecological conditions. The ecology of the lakes is very complex and until there has been an investigation of the drift geology, a survey of the influence of the surrounding cultivated land and a detailed chemical analysis of the water of the lakes, it will be very difficult to correlate the ecology of the corixids in the Burren with what is known about them elsewhere. It was anticipated that the lakes would have been very calcareous. Some of the corixids collected however, are not typical of calcareous habitats, i.e. *S. scotti* and to a lesser extent *S. distincta*. The so-called calciphile species, i.e. *S. falleni* were uncommon. Macan (1954a) found the ecological relationship between certain species of corixids, i.e. *S. distincta*, and the Irish calcareous loughs sampled obscure. Corbel (1957) states that the water of the Burren risings and rivers is very calcareous. If the Burren lakes are calcareous, then the relative abundance of *S. scotti* and *S. distincta* is rather puzzling. Lousley (1950 p 205) found a very complex situation regarding the Burren flora and wrote, "The showy flowers are found where a thin layer of soil has accumulated over the rock. A depth of only a couple of inches can lead to the formation of a peat-like soil in this humid district, and under such conditions calcifuges can thrive side by side with calcicoles." With the exception of L. George and L. Callaun-L. Attedaun none of the Burren lakes have very much in common with each other. The lakes sampled can be classified in rather an elementary fashion from the corixids recorded from each habitat. This classification is related to the known habitat preferences over the British Isles and, by reference, to the extensive literature on the ecology of the aquatic Heteroptera.

GROUP I

Lake Shandangan was the poorest lake, both numerically and faunistically, as regards the potential breeding species of Corixidae. The number of extraneous species recorded is very high (Table 2). L. Shandangan is virtually a "closed lake", very exposed with stony and rocky margins, in places with bare patches of limestone. The exception was the locus sampled. This had a certain amount of emergent vegetation. There was vegetable detritus on the bottom and the water was very shallow. Collections made from other parts of the lake produced no water-bugs of any kind. It is likely that only two species of corixid, *S. scotti* and *S. distincta*, were breeding in the lake. In September 1960 no immature corixids were found, the most abundant water-bugs being immature gerrids. The indications are that this lake is base poor.

GROUP II

Lake George, and Lake Callaun—Lake Attedaun. These lakes form a straggling series of large, indented lakes. Vegetation was much more abundant than in L. Shandangan, and much larger populations of corixids were present (Table 2). The ecology of L. George, **Locus a** is very complex. Two groups of corixids are present *S. scotti* and *S. distincta* are typical of base poor conditions; *S. falleni* and *S. fossarum* are more typical of lime-rich conditions. *C. bonsdorffi* can be considered in relative isolation in the lakes. This species is predacious whereas all the others collected in large numbers are more or less detritus feeders and phytophagous. *C. bonsdorffi* forms an important constituent of the corixid population of L. George and L. Inchiquin, two habitats which have very little else in common. It would appear that if there is some degree of pollution and accretion of organic matter with thick stands of vegetation or rock faces in lakes, then *C. bonsdorffi* is likely to occur in numbers irrespective, within limits, of the chemical make-up of the water. This in turn would cause a very high number of significant associations with other species of corixids.

From the relative abundance of *S. scotti* and *S. distincta* it seems that, with the development of the vegetation and the accumulation of organic matter, base poor conditions, culminating in bog as postulated by Macan (1954), will result. However, the presence of *S. fossarum* and *S. falleni* indicates that this may not be so.

GROUP III

Lough Bunny, lies along the same axis as the Group II lakes. It is a very exposed lake with the margins mostly limestone pavement. In **Locus b** conditions were very sheltered and probably lime-rich. *S. distincta* was very scarce (Table 2) and *S. semistriata* was probably associated with what is likely to be alkaline peat conditions. L. Bunny as a whole is probably base poor with some parts distinctly richer and likely to develop into patches of fen.

GROUP IV

Lake Inchiquin, has received the most detailed study of all the lakes (Table 1) This habitat receives part of its inflow, over Carboniferous shales and sandstones, from the south and west. It is not possible with any certainty to assess the significance of this factor. The river Fergus flows through the lake. The corixid fauna differs greatly from all the other lakes, compare Table 1 with Table 2. A notable absentee being *S. scotti*. On the evidence of the teneral specimens found in September 1960, at least six out of the eight species of corixids recorded breed in the lake. It seems reasonable to assume that *C. bonsdorffi* also breeds, see page 96. The low number of *A. germari* collected suggests that this species is mainly confined to the deeper parts of the lake from which I was unable to collect.

GROUP V

Lake Murree, was the most productive lake sampled in the Burren. The corixid fauna indicates that this habitat is of the eutrophic type. Important differences between this lake and the others was the very high level of pollution from cattle and sea-birds and the close proximity to the sea. All these factors would increase the organic matter and salts of the lake. This lake is the most highly evolved of the Burren habitats sampled as this is shown by the highly developed vegetation present and the thick layer of ooze and vegetable detritus on the bottom. L. Murree is strongly reminiscent of the small euryhaline habitats associated with *Sigara stagnalis* (Leach) (Lansbury, 1954) although on a much larger scale.

All the Burren lakes, with a localised exception in L. Bunny adjacent to **Locus b**, appear to have moderately shallow margins shelving gradually to the deeper parts of the lakes. The lakes are liable to considerable fluctuations in the water level. In May 1959 during a long dry period all the habitats studied decreased in size considerably.

APPENDIX A

LISTS OF AQUATIC AND SEMI-AQUATIC HETEROPTERA
RECORDED FROM INISHMORE WITH NOTES ON HABITATS.

Water trough near Kilmurvey. Tank built of stone and cement with an extensive slope on the north side for the collection of rain water; tank about 10' × 2'6"; water about 30" deep, clear with no vegetation.

Sigara nigrolineata 2♂, 5♀, Sampled 16. ix. 1960.

Kilmurvey, small spring-fed sheltered pool. Water very shallow with small limestone rocks; pool very grassy, not very much clear water; substrate covered with vegetable detritus.

S. nigrolineata 2♀; *Gerris thoracicus* 3♂, 11♀; *Salda littoralis* 1♀; *Gammarus duebeni* (Lillj) very abundant. Sampled 16.ix.1960.

Crescent shaped rock pool midway between Kilmurvey and Kilonan. Pool about 15' × 3' 5"; water about 2' deep, clear; bottom covered with vegetable detritus and a thin layer of silt; vegetation very sparse, clumps of *Juncus* and *Glyceria*.

Corixa affinis 14♂, 10♀, *S. nigrolineata* 12♂, 16♀, *G. thoracicus* 2♂; *Velia caprai* immature Sampled 17.ix.1960.

The water tanks of Inishmore Island appear to be a type of habitat peculiar to this group of islands. They can almost certainly be regarded as permanent because of the high rainfall which these islands have. The spring fed pool at Kilmurvey is a very highly evolved habitat, there being very little open water. Very large numbers of *G. thoracicus* were present. The specimens appeared to be slightly larger than usual and with the connexivum

very bright orange, the coloration being very apparent when alive. The rock pool contained a very large fauna of water insects and shows a remarkable similarity to that at Lemaneagh. The principal differences between this pool and the cattle trough at Lemaneagh are that the latter had a thick layer of ooze and the water was completely opaque. The distribution of *S. nigrolineata* in the Burren and on Inishmore is very obviously that of small shallow habitats as suggested by Macan (1954).

APPENDIX B.

LISTS OF THE HEMIPTERA, DIPTERA, ORTHOPTERA AND OTHER GROUPS COLLECTED FROM ALL LOCALITIES DURING THE PERIOD 15TH-29TH SEPTEMBER 1960.

Habitats: *Killinaboy* covers the area around the village and extending towards Roughan House, N.G.R.N. R 27 91.5. *Roughan House* refers specifically to the east-facing fields, above and below the house, having outcrops of rock and hazel and hawthorn scrub, N.G.R.N. R 26 92.5. *Finnavarra* refers to the margins of L. Murree. *Kilmurvey* refers to the area around the village of Kilmurvey, Inishmore Island, including the spring fed pool. N.G.R.N. L 82.5 10.

LIST OF HEMIPTERA

PENTATOMIDAE

Palomena prasina (L.), very abundant around Killinaboy on bracken, bramble and hazel scrub; very large numbers of 3rd and 4th instar larvae present; not very common around Kilmurvey.

Dolycoris baccarum (L.), nearly as common as *P. prasina* on bracken and hazel scrub; only a few larvae found; one adult found on *Potentilla fruticosa* (L.) near Killinaboy; not very common around Kilmurvey.

ACANTHOSOMATIDAE

Acanthosoma haemorrhoidale (L.), one adult found on hazel at Killinaboy, another found in L. Bunny.

LYGAEIDAE

Stygnocoris rusticus (Fallen) 1 ♀ Roughan House.

„ *pedestris* (Fallen), common on *P. fruticosa* near Killinaboy, one pair in-copula, 20.ix.1960.

NABIDAE

Himacerus mirmicoides (Costa), one larva found at Kilmurvey; four adults on bracken around Roughan House.

Dolichonabis limbatus (Dahlbohm), fairly common in long grass around Roughan House.

Nabis rugosus (L.), abundant on all vegetation around Killinaboy.

CIMICIDAE

Anthocoris nemorum (L.), common everywhere.

MIRIDAE

Plagiognathus arbustorum (Fabr.), 1 ♀ on nettle, Kilmurvey.

„ *chrysanthemi* (Wolff), 1 ♀ Roughan House.

Orthotylus ericetorum (Fallen), 1 ♀ on *P. fruticosa* near Killinaboy.

Lygus rugulipennis Poppius, Roughan House and on nettle at Finnavarra.

Lygocoris pabulinus (L.), common on nettle at Kilmurvey.

„ *contaminatus* (Fallen), 1 ♀ on nettle at Kilmurvey

„ *spinoli* (Meyer-Dür), 1 ♀ Roughan House.

Adelphocoris lineolatus (Goeze), common around Roughan House.

Phytocoris varipes Boheman, not very common on bracken around Roughan House.

Pantilius tunicatus (Fabr.), 1 ♀ teneral from hazel, Roughan House.

Stenodema laevigatum (L.), common on grasses around Roughan House and Kilmurvey.

Stenodema holsatum (Fabr.), 1 ♂, 1 ♀ Roughan House.

CICADELLIDAE

Evacanthus interruptus (L.), Roughan House.

Aphrodes bicinctus (Schrank), common around Kilmurvey and Roughan House.

Deltocephalus pulicarius (Fallen), Roughan House.

Euscelis plebjus (Fallen), Roughan House and Kilmurvey.

Streptanus sordidus (Zett.), Roughan House.

Cicadula sp. (perhaps *quadrinotata* (Fabr.), ♀ ♀ Roughan House and Kilmurvey.

Macrosteles sp. (*sexnotatus* group), ♀ Kilmurvey.

Cicadella aurata (L.), Roughan House.

„ *urticae* (Fabr.), Roughan House.

DELPHACIDAE

Stenocranus minutus (Fabr.), Roughan House.

CIXIIDAE

Cixius (*Ceratocixius*) *simplex* Herrich-Schaeffer?, 1 ♀ on *P. fruticosa* near Killinaboy

LIST OF DIPTERA

ANISOPIDIDAE

Anisopus punctatus (Fabr.), taken at Ivy and Fuschia at Kilmurvey, also at Roughan House.

TABANIDAE

Haematopota pluvialis (L.), Roughan House.

EMPIDIDAE

Hemerodromia praecatoria (Fallen) 2♀ taken at Ivy and Fuschia Kilmurvey.

Tachydromia notata (Mg.), taken at Ivy, Kilmurvey

„ *minuta* (Mg.), taken at Ivy, Kilmurvey.

Ocydromia glabricula (Fallen), Roughan House.

Lonchoptera lutea Panzer, taken at Ivy, Kilmurvey; also at Roughan House.

Lonchoptera furcata (Fallen), taken at Ivy, Kilmurvey.

SYRPHIDAE

Eristalis pertinax (Scop.), Common at Ivy, Kilmurvey; also at Killinaboy and Roughan House.

Eristalis tenax (L.), taken at Ivy, Kilmurvey; also at Killinaboy and Roughan House.

Eristalis arbustorum (L.), Killinaboy.

Syrphus balteatus (Degeer), common at Ivy, Kilmurvey.

„ *ribesii* (L.), taken at Ivy, Kilmurvey.

„ *vitripennis* (Mg.), common at Ivy, Kilmurvey.

Syrpitta pipiens (L.), taken at Ivy, Kilmurvey.

Helophilus pendulus (L.), taken at Ivy, Kilmurvey; also at Killinaboy and Roughan House.

Rhingia campestris (Mg.), Killinaboy.

Platycheirus albimanus (Fabr.), Kilmurvey.

„ *manicatus* (Mg.), taken at Ivy, Kilmurvey.

Melanostoma mellinum (L.), Killinaboy and Roughan House.

Cheilosa intonsa (Lw.), Killinaboy and Roughan House.

CONOPIDAE

Sicus ferrugineus (L.), Roughan House, first record for Co. Clare, (vide Smith 1961).

DRYOMYZIDAE

Neuroctena anilis (Fallen), Killinaboy and Roughan House.

OPOMYZIDAE

Opomyza germinationis (L.), taken at Ivy and Fuchsias, Kilmurvey; also at Killinaboy and Roughan House.

SCIOMYZIDAE

Trypetoptera punctulata (Scop.), Roughan House.

COELOPIDAE

Orygma luctuosa (Mg.), Kilmurvey.

CALLIPHORIDAE

Calliphora erythrocephala (Mg.), Roughan House
 ,, *vomitorea* (L.), very common at Kilmurvey.
Pollenia rudis (L.), Roughan House.
 ,, *vespillo* (Fabr.), Roughan House.

TACHINIDAE

Siphona geniculata (Degeer), swept from Fuschia, Kilmurvey.

MUSCIDAE

Mesembrina meridiana (L.), taken at Ivy, Kilmurvey.
Mydaea urbana (Mg.), Roughan House.
Coenosia tricolor (Zett.), taken at Ivy, Kilmurvey.
 ,, *tigrina* (Fabr.), taken at Ivy, Kilmurvey, also at Roughan House.
Orthellia cornicina (Fabr.), Roughan House.
 ,, *caesarion* (Mg.), taken at Ivy, Kilmurvey; also at Roughan House.
Polietes lardaria (Fallen), taken at Ivy, Kilmurvey.
Morellia simplex (Lw.), taken at Ivy, Kilmurvey.
 ,, *hortorum* (Fallen), taken at Ivy, Kilmurvey.
Phaonia variegata (Mg.), Roughan House.
Helina impuncta (Fallen), Roughan House.
Hebecnema umbratica (Mg.), swept from Fuchsias, Kilmurvey; also at Roughan House.
Fannia canicularis (L.), Roughan House.
Azelia macquarti (Staeg.), swept from Fuchsias, Kilmurvey.
Hylemyia variata (Fallen), swept from Fuchsias, Kilmurvey.
 ,, *nigrimana* (Mg.), or *H. strigosa* (Fabr.), Roughan House.
 References to the Irish Diptera given at the end of the paper.

LIST OF ORTHOPTERA

All the Orthoptera found in the Burren were ACRIDIDAE.
Omocestus viridulus (L.), common in the field around Roughan House, one also found by the margins of L. Bunny.

- Chorthippus brunneus* (Thunberg), common in the fields around Roughan House, fairly common around margins of L. Bunny and L. Shandangan.
- Chorthippus albomarginatus* (Degeer) 1♂ and 2♀ found along the margins of L. Bunny. This is the first record of this species for Ireland from a definite locality, Ragge (1963).
- Myrmeleotettix maculatus* (Thunberg), three specimens found by margins of L. Shandangan; one found at Kilmurvey.
- The four species recorded from Co. Clare are all new county records.

MISCELLANEOUS RECORDS OF INSECTS AND OTHER GROUPS

- Forficula auricularia* (L.), (Dermaptera), common everywhere.
- Sympetrum striolatum* (Charp.); (Odonata), common around Killinaboy and Roughan House; a few specimens seen around the Kilmurvey pool.
- Orthetrum coerulescens* (Fabr.); (Odonata). Sight record only; pair seen in-tandem by the margins of L. Bunny.
- ISOPODS (woodlice)
- Oniscus asellus* (L.), Kilmurvey and Roughan House.
- Porcellio scaber* (Lat.), Kilmurvey and Roughan House.
- Philoscia muscorum* (Scop.), Kilmurvey and Roughan House.

APPENDIX C.

LIST OF THE COLEOPTERA COLLECTED FROM ALL LOCALITIES DURING 1959 AND 1960.

HALIPLIDAE

- Haliphus lineatocollis* (Marsham), L. George and Slieve Elva.
- „ *confinis* Stephens, L. Inchiquin.
- „ *ruficollis* (Degeer), L. Inchiquin and L. Callaun.
- „ *immaculatus* Gerhardt, very abundant in L. Inchiquin, L. Bunny, L. Shandangan and the Rinnamonna stream.
- Haliphus flavicollis* Sturm, L. Inchiquin.
- „ *variegatus* Sturm, L. Bunny.
- „ *obliquus* (Fabr.), L. Shandangan..

DYTISCIDAE

- Noterus capricornis* (Herbst.), (nec. F.B.B. 1940) L. Inchiquin, very common in L. George.
- Noterus clavicornis* (Degree), L. Inchiquin, L. Shandangan and L. Murree.
- Laccophilus hyalinus* (Degeer), L. Inchiquin.
- „ *minutus* (L.), L. Inchiquin and L. Shandangan.
- Hyphydrus ovatus* (L.), L. Inchiquin, L. Callaun, L. Shandangan and the Rinnamonna stream.

Hygrotus (s. str.) *inaequalis* (Fabr.), very abundant in L. Inchiquin, fairly common in L. Bunny, L. George, L. Shandangan and L. Murree.

Hygrotus (s. str.) *quinque-lineatus* (Schaller), abundant in L. Inchiquin, common in L. George and L. Callaun.

Hygrotus (*Coelambus*) *novemlineatus* (Stephens), L. Inchiquin, L. Bunny and L. Shandangan.

Deronectes depressus (Fabr.), River Fergus.

„ *assimilis* (Paykull), Rinnamonna stream and L. Callaun.

„ *elegans* (Panzer), L. Inchiquin and L. Bunny.

Hydroporus (*Graptodytes*) *pictus* (Fabr.), L. Inchiquin and L. Callaun.

Hydroporus (*Scarodytes*) *lineatus* (Fabr.), abundant in L. Bunny. Fairly common in L. Inchiquin, L. George and L. Callaun.

Hydroporus (*Stictonotus*) *lepidus* (Olivier), Slieve Elva, common in rock pool, Inishmore.

Hydroporus (*Saphrodytes*) *dorsalis* (Fabr.), L. Bunny.

Hydroporus (s. str.) *palustris* (L.), very abundant in L. Inchiquin, L. Bunny, L. Shandangan, Rinnamonna stream, also found in small numbers in L. Alleenaun, L. Murree, Lemaneagh cattle trough and the rock pool, Inishmore.

Hydroporus (s. str.) *erythrocephalus* (L.), L. Bunny, L. Alleenaun, Lemaneagh cattle trough and the rock pool, Inishmore.

Hydroporus (s. str.) *pubescens* (Gyllenhal), L. Bunny and Rinnamonna stream.

Agabus nebulosus (Forster), common in L. Murree, L. Alleenaun and the rock pool, Inishmore. The specimens from Inishmore are much paler than those from the mainland.

Agabus bipustulatus (L.), L. Shandangan, Rinnamonna stream very common in Lemaneagh cattle trough, L. Alleenaun and the rock pool, Inishmore.

Ilybius fuliginosus (Fabr.), L. Inchiquin, L. George, L. Murree and L. Alleenaun.

Rantus exsolentus (Forster,) L. Bunny.

Dytiscus marginalis L., Slieve Elva.

„ *semisulcatus* Muller, Rinnamonna stream.

GYRINIDAE

Gyrinus marinus Gyllenhal, L. Inchiquin and L. Bunny.

„ *natator substriatus* Stephens, L. Bunny, L. George, Slieve Elva, Turlough and Lemaneagh cattle trough.

Orectochilus villosus (Ml.), L. George.

HYDROPHILIDAE

Helophorus minutus minutus (Fabr.), L. Inchiquin, L. Bunny and L. George.

Helophorus brevipalpis (Bedel), L. Bunny, L. George, L. Shandangan and the Rinnamonna stream.

Anacaena limbata (Fabr.), L. Bunny.

Laccobius minutus (L.), L. Inchiquin.

„ *biguttatus* Gerhardt, L. Inchiquin, L. Shandangan, L. Bunny, L. Murree, rock pool and spring fed pool, Kilmurvey, Inishmore.

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Species	<i>S. distincta</i>	<i>S. fallenoides</i>	<i>S. dorsalis</i>	<i>S. fossarum</i>	<i>C. bondorff</i>	<i>C. praenata</i>	<i>A. germani</i>	<i>C. panzeri</i>
Locus								
<i>Locus a</i> no cattle or sewerage pollution	26 : 31 20 : 17*	1 : 3 18 : 18*	1 : 0 53 : 28*	1 : 0	1 . 1 1 : 2	6 : 17 70 : 50*	1 : 1	12 : 3
<i>Locus b</i> no cattle or sewerage pollution, reed bed	9 : 24		0 . 1	0 : 1	13 . 30	7 : 9	0 : 1	
<i>Locus c</i> cattle and sewerage pollution	1 : 9 4 : 1		3 . 4 25 : 34*	0 . 1	1 . 2 8 : 8	4 . 6 62 . 45*	1 : 0 2 : 1*	1 : 0 3 : 8
<i>Locus d</i> cattle pollution no sewerage	8 : 36 3 : 5		15 : 36 0 : 2	1 . 0 0 : 1	63 : 83 13 : 23	8 . 31 45 . 19	1 : 4	1 : 12 6 . 12*

Table 1 showing the distribution of the Corixidae in Lake Inchuquin in each locus. The figures on the left hand side of the colon are the number of males collected; on the right, the number of females collected. The upper figure for each locus is the number collected in May, 1959, the lower figure for September 1960. Where marked with an asterisk indicates that part of the population were general.

species habitat	Murree	Shan- dangan	Callaun	George A	George B	Bunny A	Bunny B
<i>S. lateralis</i>	24 : 6						
<i>S. concinna</i>	109 : 43*						
<i>S. distincta</i>	2 . 1*	2 : 1 14 : 12	4 : 5 85 : 151	27 : 33 58 : 78	: 5	3 : 3 : 2	
<i>S. fallenoudea</i>				1 : 2 1 :			
<i>S. scotti</i>		. 2 31 . 28	19 : 16 5 : 14	8 : 35 13 : 54			7 . 8 1 : 3
<i>S. fossarum</i>		1 . 1 1 1	: 24 35 : 25	: 4 35 : 25	: 1		1 :
<i>S. falleni</i>				7 : 6 8 : 10			
<i>S. semistriata</i>			2 : 3	8 : 12			: 4 20 : 39
<i>S. nigrolineata</i>							2 : 4 : 1
<i>S. dorsalis</i>			2 :	1 : 2		12 : 6	1 : 1 5 : 3
<i>H. linnei</i>		: 2	1 :	: 3 2 : 2			7 : 4
<i>H. moesta</i>		: 2					1 :
<i>C. praeusta</i>	15 : 9*			1 :			. 1
<i>C. bonsdorffi</i>		2 : 1 1 : 1	3 : 10	3 : 9 52 : 50	1 :	: 1 : 1	
<i>C. punctata</i>	6 : 13	1 :					
<i>C. panzeri</i>				1 :	1 :	2 : 1	
<i>A. germari</i>	5 : *					2 : 3*	: 2 : 1

TABLE 2—Lists of Corixidae recorded in 1959 and 1960, upper figures in boxes representing 1959 collections, lower figure 1960 collection. Numbers on left hand side of colon are males, right hand side females. Where marked with an asterisk indicates that part of the population were teneral.

Species	Habitat				
	Lake Aleenau	Rinnamonna Stream	Lemaneagh cattle trough	Turlough	Slieve Elva
<i>S. dorsalis</i>		20♂ 29♀		1♀	
<i>S. nigrolineata</i>			2♂ 2♀ + N.		2♂ 6♀
<i>S. lateralis</i>	1♀				
<i>S. scotti</i>		4♂ 6♀			
<i>H. sahlbergi</i>					1♀
<i>H. castanea</i>					1♂ 1♀
<i>H. linnei</i>		1♂			
<i>C. affinis</i>			2♂ 12♀		
<i>C. punctata</i>	1♂ 1♀				

TABLE 3 showing distribution of Corixidae in the miscellaneous habitats.
N = Nymphs.

TABLE 4 showing distribution of Gerridae, Velidae, Hydrometridae and Nepidae.

<i>G. lacustris</i> m b	7♂ 3♀ 5♂ 1♀	3♀ 2♂ 2♀	Inchiquin	Bunny	George	Callan	Murree	Shandangan	Lem. c/w.	R. Bergus	Sieve Elva	Turlough
<i>G. odontogaster</i> m b	1♂ 1♀	3♀	3♀	1♀		1♀ 3♂ 1♀	13♂ 11♀ 1♂ 1♀	1♂ 1♀		3♂ 1♀	3♂ 3♀	1♂ 1♀
<i>G. thoracicus</i> m							2♂					
<i>G. argentatus</i> m					4♂ 5♀							
<i>L. rufoscutellatus</i> m								1♀				
<i>V. capraii</i> b								1♀	2♂ 3♀ n		3♂ 12♀	
<i>M. reticulata</i> b			1♀				2♀	1♂ 1♀				
<i>H. stagnorum</i>			7♂ 12♀									
<i>N. cinerea</i>			1n					1 ad.				

abbreviations used:— m = macropterous, b = brachypterous, n = nymph.
Lem. c/h = Lemanagh cattle trough, Lem. c/w = Lemanagh Castle Well, ad = adult.