# DISTRIBUTION OF THE DECAPODS BRACHYURA AND ANOMURA (EXCLUDING PAGURIDEA) OF THE CRYPTOFAUNA IN THE REEFS NEAR TULEAR

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This study of the distribution of the Decapods Brachyura and Anomura (excluding Paguridea) is a part of a broader work about the whole cryptofauna of the reef flats of Tuléar. The Great Reef of Tuléar, two zones of which were studied in detail, is the principal field of my investigations. Some samples were also extracted from the reefs of Sarodrano, Nosy Tafara, and Songoritelo (map 1).

Cryptofauna consists in all the small fauna of mobile invertebrates which shelter in the little holes on the organic tracts of the reef flats; these holes are 0.5mm to 5 centimeters in diameter. The cryptofauna was extracted from the blocks of hard hollowed-out substrate, the volume of which is $1dm^3$. This volume of $1dm^3$ has been defined as the minimum in which it is possible to obtain almost all the species present in the biota studied (Clausade, 1970 ). For every station studied, 5 samples of $1dm^3$ have been extracted.

Altogether 34 stations, which represent $170dm^3$ of hollowed-out substrate containing cavities, subsequently broken into pieces, yielded 84 species of Brachyura and Anomura. The determination of these species has been confirmed by Mr. Serène. Those which appeared particularly interesting from a systematic point of view formed the subject of a separate paper (Peyrot-Clausade and Serène 1976).

The areas studied on the Great Reef are shown in map 1. In the northern area (here called Sector 1), 9 stations have been studied. Fig. 1 shows their localities (for clarification of terminology, refer to *Téthys* suppl. 2, 1972). In the area situated in the center of the Great Reef (Sector 2) at the place named Antseteky, 12 stations have been studied (fig. 2): 4 in the outer reef flat, 3 in the boulder tract and 5 in the inner reef flat. Samples have been studied on the other reef flats where some formations have appeared new in relation to those of the Great Reef.

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The reef flat of Sarodrano is subjected to the alluvial deposits of the river Onilahy, rich in clay particles in suspension. Moreover, it is situated in an unstable zone and is tilting more and more towards the open sea (J. Picard, personal information). The different formations present on this reef, in order to stay at the degree of dampness which is suitable to them, counterbalance this tilting by an upper growth or elevation. Thus, the little Vermetus *Dendropoma* sp., which form only simple veneerings at the base of the blocks of the boulder tract of the Great Reef, forms at Sarodrano thick pads rich in cavities, on the upper part of the blocks. For this reason, I have studied two kinds of samples in this zone: the first among the blocks of the boulder tract, the second among the *Dendropoma* sp. formations. At the back of the reef flat, micro-atolls are present. Five samples have been taken at the base of these formations which are widely covered with Algae and rich in sandy particles.

The reef of Songoritelo results from the junction of two initial shields (J. Picard, personal communication). The boulder tract, present on the old shields, is absent from this junction zone. This zone is used as an out-fall through which the water of the channel situated between the reef and the Mangrove flows out at ebb-tide. This sea water, rich in sandy earthy particles coming from the river Fiherenana, promotes colonization and growth of the Sabellariids *Idanthyrsus pennatus*. Between this area of *Idanthyrsus* and the boulder tract are found layered Melobesiae formations. They are calcareous Algae, more or less intermingled, and creating interstices partially filled up by sand. It is in this zone that the boulder tract later forms, when the reef has reached a certain degree of evolution. Seven sations have been studied at Songoritelo: two on the outer reef flat (one on the spur upper platform, one on the outer moat rich in Algae) and two others around the outer creeks (on the edge and towards the back among madreporarian coral colonies covered by Zoantharian colonies). The last third are distributed in the following manner: one in the boulder tract,one in the *Idanthyrsus* formations and the last one in the layered Melobesiae.

Nosy Tafara can be distinguished from other reefs by its boulder tract which is a boulder-rampart.

At each station, the abundance and average dominance of the species present have been determined and is shown in table 1.* From this table, I have constructed tables 2, 3, 4 in which is recorded the dominance of the different Brachyura and Anomura families, for each station.

Figs. 3 and 4 show in the two sectors of the Great Reef, the evolution of the settlements from the spur upper platform to the blocks of sea grass bed basins. The population of each station is represented by a circle in which each family is represented by an arc in a direct ratio to its average dominance.

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*Table 1 not reproduced here, available from author.

## POPULATION OF THE OUTER REEF FLATS

For this study, I deal with 60 samples from 12 stations: 8 from the outer reef flats: 2 from Sector 1, 4 from Sector 2, and 2 from Songoritelo (fig. 5). The last 4 come from the flat around the outer creeks of Sector 1 and Songoritelo. For all the outer stations, the total populations vary from 209 for the settlement of the station of the glacis in Sector 1 to 47 in the station on the edge of the outer creek in this same Sector. The average population is 17.8 individuals for $1dm^3$ of hollowed-out substrate; the number of species varies considerably: 4 in the station of the spur upper platform in Sector 2, and 24 for the one in the glacis of Sector 1.

The Sector 2 shows an increase in the diversity of species of Brachyura as we move away from the front of the reef. The number of species varies from 4 to 19. Indeed, in station 12, 97% of the settlement belong to the single sub-family of Chlorodinae and are *Liocarpilodes integerrimus* (Dana 1852) 71%, *Pilodius paumotensis* (Stimpson 1858) 18%, and *Chlorodiella laevissima* (Dana 1852) 8%. *Daira perlata* constitutes the remaining 3%.

In the next station (no. 13), ten species have been collected. The Xanthidae family still represents 85%, the dominant species are *Chlorodiella laevissima* and *Pilodius paumotensis*. *Liocarpilodes integerrimus* is absent but I find *Liomera rugata* (H. Milne Edwards 1834) and *Zozymus aeneus* (Linné 1758) that will be found again in the next two stations. This is true also, for the two species of Anomura *Pisidia delagoae* (Barnard 1955) and *Pachycheles penicillatus* (Heller 1862).

Station 14, established on the outer moat, contains 13 species but they are not abundant. Indeed, in the $5dm^3$, I number only 58 individuals. Among Xanthidae, *Liocarpilodes integerrimus* and *Pilodius paumotensis* are not very abundant. The dominant species is still *Chlorodiella laevissima*, and near the species already mentioned, I collected *Pilumnus purpureus* (A. Milne Edwards 1873), the dominance of which will increase twofold in the next station as will the Pilumninae ind. The Porcellanids are also enriched by a new species: *Petrolisthes lamarckii* (Leach 1820). I note for the first time the presence of Portunidae with *Thalamita* at a juvenile stage.

Station 15 is on the outer reef flat just in front of the boulder tract, in an area of layered Melobesiae; 19 species or 101 individuals were collected. Porcellanidae (with essentially *Petrolisthes lamarckii*) have an increasing dominance at the expense of Xanthidae. In this last family the two more abundant species are *Chlorodiella laevissima* and *Actaeodes tomentosus* (H. Milne Edwards 1839). I note an increase of *Liomera rugata* and a complete disappearance of *Liocarpilodes integerrimus* and *Pilodius paumotensis*. Portunidae are represented by *Thalamita gloriensis* (Crosnier 1962) and Grapsidae by some individuals of *Pachygrapsus minutus* (A. Milne Edwards 1873).

If I compare the population of the stations of the outer reef flat of Antseteky (Sector 2) with that of the station of the outer reef flat

of Sector 1, I see a real similitude of settlement between the station 14-15 and the stations 1-2. Thus, in station 11 on the spur upper platform, I found 133 individuals belonging to 17 species. In station 2, on the reef glacis rich in Algae *Turbinaria,* there are 24 species and 209 individuals. Twelve species are common to these two stations but their dominances vary. *Liocarpilodes integerrimus* (16%) and *Pilodius paumotensis* (18%) are dominant in station 1, whereas *Pilumnus purpureus* (23%) is more abundant in the 2nd station. In this last station, I find also *Liomera rugata* and *Actaeodes tomentosus*. Three species are collected solely on the outer reef flat of Sector 11. They are: *Actumnus elegans* (de Mann 1888), *Domecia glabra* (Alcock 1899) and *Pachycheles garciaensis* (Ward 1942).

The settlement of the outer reef flat of Songoritelo appears quite different from those previously studied. Indeed, the diversity is more important in the station of the spur upper platform than in that realized on the outer moat. Contrary to previous recordings, the abundance and average dominance of *Liocarpilodes integerrimus* also increase in the inner station. *Chlorodiella cytherea* (Dana 1852) and *C. laevissima* are abundant, but *Pilodius paumotensis* and *Pilumnus purpureus* are completely absent.

The station around the outer creeks have settlements which resemble more closely those of the outer reef flat stations. Indeed, at Songoritelo, Xanthidae represent in the two stations more than 96% of the individuals collected. Chlorodinae are the most abundant with essentially the three following species: *Liocarpilodes integerrimus*, *Chlorodiella cytherea* and *C. laevissima*. In sector 1, Xanthidae constitute only 70-78% of the settlement of these stations around the creeks. The outer station contains: Dromiacea, Oxyrhyncha, Grapsidae and Porcellanidae, the inner one has no Grapsidae nor Dromiacea but 8% of Portunidae.

All the settlements of the outer reef flat show a certain homogeneity, despite some variations. Among Xanthidae, Chlorodinae dominates with three species more particularly abundant: *Liocarpilodes integerrimus, Pilodius paumotensis* and *Chlorodiella laevissima*. Fig. 6 shows the dominance of these species in the different stations of the outer reef flats. Although the extension of *Chlorodiella laevissima* is not limited to the outer reef flats, the dominance increase from the outer station to the inner one and is non-existant in the boulder tracts. At Antseteky, after a peak of dominance in the dead madreporian colonies, it is clear that this species diminishes in importance up to the boulder tract. The dominance of *Pilodius paumotensis* diminishes regularly as we move from the front to the back of these outer reef flats.

*Liocarpilodes integerrimus,* is, of these three, the most abundant species. It is seen on fig. 6 that in all the biota studied, its abundance and its dominance decrease towards the back of the outer flat, except on the reef of Songoritelo. On this reef, the dominance of *Liocarpilodes integerrimus* is lower on the outer station that in the inner one (although its value is similar to that recorded on the other

outer stations); but on the inner station (situated on the outer moat) the value of dominance is greater than on homologous stations (about twice as great as that on homologous stations). An explanation of this abundance can be found in the fact that, the front of this reef being in a phase of very fast growth, the outer moat is not very old. This outer moat is very rich in burrowing organisms (small sipunculids). The size of the network and of cavities is very well suited to the *Liocarpilodes integerrimus* which are very small individuals. This area is between two phases of colonisation: the first colonisation characterizes zones exposed to the beating of the waves (at present in the outer station, on the spur upper platform) and the second characterizes a well degraded substrate (found in Sector 1 of the Great Reef of Tuléar, in the zone rich in Algae Turbinaria). Among the "no carpilodea", *Liomera rugata* seems also to characterize quite well the settlement of the outer reef flats. This species is absent from the biota the most exposed to the beating of the waves. *Zozymus aeneus* (Zozymoidea) is never abundant, but is present in almost all the stations studied. *Pilumnus purpureus* and *Actumnus elegans* are also linked to this zone of the reef. They are still more abundant in the calmer biota. Among the Anomura, I find essentially Porcellanidae with *Pachycheles natalensis* (Krauss 1843), *Petrolisthes lamarkii*, *P. penicillatus*, *Pachycheles garciaensis* and *P. pisoides* (Heller 1865). The last third are solely recorded on the outer reef flats.

A problem is posed by the Oxyrhyncha. Some of them are known to live in the thallus of Algae but *Acanthonyx quadridentatus* (Krauss 1843) alone is limited to the biota very rich in Algae, thus species is not included in the cryptofauna.

## POPULATION OF THE BOULDER TRACTS AND OF THEIR BIOTA SUBSTITUTES

As has been seen in the first part of this paper, the structure of the boulder tracts varies on the reef flats; the various stations were established according to these variations in structure. So, in Sector 1, samples were collected on the crags. In Sector 2, over and above the station identical to that of Sector 1, two others have been established: one in the gravel tail and the other in the filtering dike. On the reef of Songoritelo, I have three stations: one on the crags, one on the *Idanthyrsus* formations and the last in the layered Melobesiae. On the Sarodrano reef flat, I studied the settlement of the crags and of the little Vermetus *Dendropoma* sp. formations. At Nosy Tafara, one station is in the gravel sheet at the back of the boulder rampart.

All these stations in the boulder tracts are qualitatively poor. From 4 to 13 species are found. The two stations on the crags of the Great Reef have very similar settlement. Grapsidae are dominant (56 and 44%) with only two species: *Pachygrapsus minutus* (A. Milne Edwards 1873) and *Nanosesarma minutum* (De Mann 1887). Among Xanthidae, I find *Zozymodes xanthoides* (Krauss 1843) *Actaeodes tomentosus*, *Eriphia scabricula* (Dana 1852) and *Pilumnopeus trispinosus* (Sakai 1965). This last species represents from 16 to 18% of the settlement.

Porcellanidae, with only one species — *Petrolisthes lamarckii* — constitute 5 to 9% of the individuals present. The station on the filtering dike differs from those of the crags by a considerable decrease in Grapsidae and increase in Xanthidae (*Pilumnopeus trispinosus* 32% and *Actaeodes tomentosus* 24, 5%) and in Porcellanidae (*Petrolisthes lamarckii* 17%). On the gravel tail, 71% of the settlement is constituted by Porcellanidae (still *Petrolisthes lamarckii*). *Pachygrapsus minutus* constitutes only 1% of the individuals collected on this station. *Chlorodiella cytherea* is, of Xanthidae, the most abundant species (15%). If I compare this settlement to that of the gravel sheet of Nosy Tafara, I see that they are quite identical. On this station, *Petrolisthes lamarckii* represents 67% of the population, *Chlorodiella cytherea* 22%, *Pachygrapsus minutus* 6% and *Pilumnopeus trispinosus* 4%.

On the reef of Songoritelo, the crags have settlements similar to those of the crags of the Great Reef, yet with a greater diversity of species. Some species come from settlement of the outer flat (*Pilodius paumotensis, Liomera rugata, Liocarpilodes integerrimus*) and some species come from the inner reef flat such as *Pilodius spinipes* (Heller 1861). None of them have a high dominance. In these crags, Grapsidae are represented only by *Pachygrapsus minutus* 27%. *Nanosesarma minutum* (de Mann 1887) is absent. It has been senn supra that at Songoritelo, in absence of the boulder tract, we find *Idanthyrsus* formations and layered Melobesiae. These formations have very different populations. In the cavities between the tubes of the *Idanthyrsus pennatus,* Grapsidae are very abundant and constitutes 49% of the individuals collected. Porcellanidae are less abundant: *Petrolisthes lamarckii* does not reach 5,5% of settlement.

The population of layered Melobesiae differs by the very feeble proportion of Grapsidae (1,4%), the presence of Portunidae (14%) and of Ocypodidae-*Macrophtalmus boscii* Audouin(et Savigny) 1825 7%. Xanthidae family is the most important (68% of the individuals) with essentially three species: *Chlorodiella cytherea, Actaeodes tomentosus* and *Pilodius areolatus* (H. Milne Edwards 1834).

The last two series of samples are those of the boulder tract of Sarodrano, among the crags and the formations of little *Dendropoma* sp. In these two stations, the most abundant species is *Pilumnopeus trispinosus* which constitutes 54% of the settlement of the first and 87% of the second. The crags of the boulder tract are characterized by the absence of *Pachygrapsus minutus* and by the quite important number of *Macrophtalmus boscii*.

Among the boulder tracts, four species have an important part in the settlement. They are: *Pachygrapsus minutus, Nanosesarma minutum, Pilumnopeus trispinosus* and *Petrolisthes lamarckii*. In examining the first three species, I note that *Pachygrapsus minutus* is a very mobile species whereas *Nanosesarma minutum* and *Pilumnopeus trispinosus* are more or less non-mobile. The study of table 1 shows that *Nanosesarma minutum* is present only on the Great Reef and more abundant in the biota in the highest part of the mid coast-level. Its abundance

decreases in the filtering dike which is lower. In the same three stations, *Pilumnopeus trispinosus* has an opposite behaviour and is more abundant in the filtering dike. When this species reaches its maximum of dominance in the stations of the reef of Sarodrano, I see the diminution and absence of *Pachygrapsus minutus*. I think that this absence can be explained by the salinity of the sea-water around Sarodrano reef being often very feeble, owing to the river Onilahy. On the hard substrate on the coast Plante (1964) did not find this *Pachygrapsus* where it would normally be collected, and it is also absent from the hard substrate of the mangrove. In the absence of *Pachygrapsus minutus*, *Pilumnopeus trispinosus*, which is no doubt more resistant to the variations of salinity, inhabit all the little cavities. Porcellanidae — *Petrolisthes lamarckii* — have an abundance and dominance which increase as we move from the crags to the gravel sheet or tail of the boulder tracts, this species goes deep into the chips of dead Madreporian as the sea-water level gets lower, and so protects itself from drying up at low tide. Apart from *Pilumnopeus* already cited, I find also *Actaeodes tomentosus* in all the stations. *Zozymodes xanthoides* is only collected on the crags.

## POPULATION OF THE INNER REEF FLATS

It has been possible to study these settlements by means of the eleven stations (five in every Sector of the Great Reef) and one in the zone of micro-atolls of the reef of Sarodrano. The average number of individuals collected in $1dm^3$ of hollowed-out substrate is about 16. However, if I suppress the two series of samples from the branched Melobesiae which constitute a special biota by the abundance of very little cavities between the thallus of these calcareous Algae, there are only 10 individuals per $dm^3$ in the other biota. The number of species is situated between 6 and 19 and reaches 23 in the branched Melobesiae. All the families found on the outer reef flats and on the boulder tracts are represented in this part of the reef flats, but it seems that Xanthidae are more abundant. Anomura, particularly Galatheidae, play in some biota a very important in the inner reef flats and particularly with the species *Macrophtalmus boscii*, in the compact reef flat in the two sectors studied. This species is also found abundantly in the blocks of the sea-grass bed basins of Sector 2. Among Xanthidae, the two most important sub-families are Actaeinae and Chlorodinae. In the first sub-family, *Actaeodes tomentosus* in the dominant species. It has its maximum abundance in the branched Melobesiae, but they are chiefly individuals at a juvenile stage. *Actaea cavipes* (Dana 1852) is also frequent but not very abundant in Sector 2. In Chlorodinae sub-family, *Chlorodiella cytherea*, *C. laevissima* and *C. barbata* and *Pilodius spinipes* are the most abundant. The last two species are only recorded on the inner reef flats and have their maximum average dominance among the branched Melobesiae. The "no carpilodea" are also represented by some species gathered only in the inner reef flats. They are: *Liomera bella* (Dana 1852), *L. cinctimana* (White 1857), *L. semigranosa* (de Mann 1888) and *L. monticulosa* (H. Milne Edwards 1873). Among Anomura, one can notice a gradual replacement of Porcellanidae by Galatheidae, as we

move off the boulder tracts towards the sea-grass bed basins. The most abundant Porcellanids are: *Pisidia delagoae*(Barnard 1955) which reach their maximum in the branched Melobesiae. Galatheidae are represented by several species. The most frequent is *Galathea humilis*(Nobili 1905) which is present in 7 of the eleven stations studied, the maximum dominance is recorded in the micro-atolls of Sarodrano. *Galathea affinis*(Ortmann 1892)is the species dominating in the biota of the blocks in the sea-grass bed basins of Sector 1. *Galathea platycheles* (Miyake 1933),like many other species, reaches its maximum dominance in the branched Melobesiae.

This study of the population on the different reef flats allow us to make certain inferences about the distribution of the families even of some species of brachyura and Anomura. The Dromiacea are represented by only one species in these samples; it is *Dynomene hispida*(Desmarest 1825)exclusively found on the outer reef flats. It is also on the outer reef flats that the majority of Oxyrhyncha are recorded: *Menaethiops natalensis*(Barnard 1955),*Hyastenus aff. elongatus*(Ortmann 1893),*Daira perlata, Elamena matthei* (Desmarest 1825) and more particularly among the places rich in Algae. Among Portunidae, *Thalamita gloriensis* is the only species determined. The three biota in which it is the most abundant are, in an increasing order: the layered Melobesiae of the outer reef flats of Sector 2, the madreporian colonies on the edge of the outer creeks of Sector 1 and layered Melobesiae of the reef of Songoritelo where it represents 13.7% of the settlement. In almost all the stations, juvenile forms of *Thalamita* have been collected, and above all on the spur upper platform of the outer reef flat of Songoritelo. Xanthidae family is the most important qualitatively and quantitatively of all the families of Brachyura in these cavities.

(a) no Carpiloidea

*Liomera rugata* seems to be particularly well adapted to the outer reef flats just behind the spur upper platform, the other species of *Liomera — L. bella, L. monticulosa, L. semigranosa, L. cinctimana,* all came from the inner reef flats and more especially from the branched Melobesiae.

(b) Zozymoidea

Five species belong to this group: *Zozymus aeneus, Zozymoides xanthoides, Atergatis aff. subdentatus*(de Mann 1835), *Platypodia cristata* (A. Milne Edwards 1865) and *Platypodia anaglypta* (Heller 1861). The first species of this list, which is found above all in the outer reef flat biota, like *Zozymoides xanthoides* settled only on the boulder tracts, are the most abundant.

(c) Xanthoidea

The five species of this group are never abundant. The best represented is *Leptodius nudipes* (Dana 1851) which come from the gravel

tail of the boulder tract of Sector 2.

(d) Galenoidea

Actaeinae and Chlorodinae are the most frequent and abundant.

(1) Actaeinae includes 9 species:
*Actaea quadriareolata* which come from the boulder tract is not abundant. Excluding *Actaea consobrina* and *aff. Pseudoliomera varialosa* (Borradaile 1902), which are only samples on the outer reef flats, the other species are collected in the different biota. The most abundant is *Actaeodes tomentosus* which is found at all the stages of growth from a few mm to several centimeters, in all the stations, the branched Melobesiae having in their cavities an important concentration of juvenile forms.

(2) Chlorodinae are, with 12 species, the richest group. It has been seen that *Liocarpilodes integerrimus* and *Pilodius paumotensis* are quite localized exclusively on the outer reef flats. On the other hand *Liocarpilodes armiger* has been collected only in the inner reef flats. The most abundantly represented genus in all the reef flat formations, except on the boulder tracts, is the genus *Chlorodiella* with three species. *Chlorodiella laevissima* although present in all the stations, dominates especially on the outer reef flats where it can represent up to 56% of the settlement (such as in the Zoantharian zone of Songoritelo creek) *Chlorodiella cytherea* is the one of these three species which resist best to drying-up, for it is the one collected in the gravel tail and sheet. *Chlorodiella barbata*, never sampled on the outer reef flats, is abundant on the inner reef flats and particularly among the branched Melobesiae. In the Chlorodinae, the genus *Pilodius* is also well represented. With *Pilodius paumotensis* collected in the outer reef flats, Pilodius areolatus present in the inner reef flats and reaching its maximum abundance in the *Idanthyrsus* formations and the layered Melobesiae, there is also *Pilodius spinipes* which plays an important role in the settlements of the biota of the inner reef flats and more especially in the blocks in the sea-grass-bed basins and reef flat with scattered coral growth. *Pilodius pugil* Dana 1852 is nowhere abundant. Among the *Phymodius*, only one species — *Phymodius ungulatus* (H. Milne Edwards 1834) is quite well represented in the inner reef flats. *Paretisus globulus* (Ward 1933), not abundant, is collected in 4 different biota.

(e) Cymoidea

*Eriphia scabricula* seems to characterize the settlement of the boulder tracts.

(f) In the Hyperomista, only the Pilumnidae are abundant.

*Domecia glabra* (Alcock 1899), on the spur upper platform is the only Mennipinae collected. Among the Piluminae, only two species have been determined: *Pilumnus purpureus* and *Actumnus elegans*. Both occupy only the cavities in the outer reef flats. The extension of *Actumnus elegans* is however limited to Sector 1. *Pilumnopeus trispinosus* is

among the Heteropanopeidea, the most abundant species. If some rare individuals are on the outer reef flats, it reaches very high dominance on the boulder tracts particularly in the reef of Sarodrano on the Vermetus *Dendropoma* sp. where there are 18 individuals per $dm^3$. *Lybia leptochelis* (Zehntner 1894) is essentially present in the inner reef flats, but always in very feeble number.

Ocypodidae family is represented by one species — *Macrophtalmus boscii* — which is particularly abundant in the inner reef flats, in calm biota where colloidal suspension can form a deposit in which this species makes its hole. This *Macrophtalmus* is also recorded in the boulder tract of Sarodrano, where as we have seen the water of the river Onilahy covers the reef.

Grapsidae. *Pachygrapsus minutus* is the most abundant of this family. It occupies all levels of the mid-coast level and takes shelter in the highest part of the reef constituted by the boulder tracts. As it is a very mobile species, at low tide, it moves away and so can be collected in the biota surrounding the boulder tracts. In the absence of boulder tracts at Songoritelo the highest biota is the *Idanthyrsus* formations where the *Pachygrapsus* are abundant. The samples realized at Sarodrano show that this species does not like fresh water, but reappears when the degree of salinity increases (as at Nosy Tafara). *Nanosesarma minutum* lives at the high part of the mid coast-level and is collected only on the Great Reef.

Anomura

Two families are abundant in the cryptofauna: Galatheidae and Porcellanidae.

(a) Porcellanidae family, is, with 11 species, the most important. A succession of species is clearly found moving from the front to the back of reef flats. *Petrolisthes penicillatus* is strictly localized on the outer reef flats, as are *Pachycheles garciaensis*, *P. pisoides* and *P. natalensis*. *Petrolisthes lamarckii*, which is found also on the outer reef flats, reaches its maximum dominance in the boulder tracts and particularly in the gravel tail and sheet where it constitutes 67% of the settlement. *Pisidia delagoae* is recorded on all the reef formations and more abundantly in the inner reef flats. It is also in that zone that *Polyonix triungulatus* (Zehntner 1894) and *P. aff. maccullochi* (Haig 1965) are found.

(b) Galatheidae. Six species are collected essentially in the inner reef flats, and their dominance increases as we move from the boulder tracts to the sea grass bed basins. The most two abundant species are *Galathea humilis* and *G. affinis*. The 1st is frequent on the whole of the Great Reef, and very abundant in the micro-atolls of Sarodrano; the 2nd dominates the settlement of the blocks in the sea grass bed basins in Sector 1 representing more than half of the local cryptofauna.

From this study, some settlement appear quite typical of certain reef zones. Thus, for a stabilized reef, it is possible to define an outer reef settlement which increases in diversity as we move away from the breaking waves. In the outer stations, *Dynomena hispida*, *Liocarpilodes integerrimus*, *Pilodius paumotensis*, *Actumnus elegans*, *Pilumnus purpureus* and *Petrolisthes penicillatus* are sampled. *Liomera rugata*, *Zozymus aeneus* are added to the species already cited in calmer zones. In the boulder tract, it can be said that the classic population of the crags is composed of: *Pachygrapsus minutus*, *Zozymodes xanthoides*, *Eriphia scabricula*, *Petrolisthes lamarckii* and *Pilumnopeus trispinosus*. This last species increases very much when, because of the weak salinity of the sea water, *Pachygrapsus minutus* disappears almost completely. In the gravel zone, *Petrolisthes lamarckii* and *Chlorodiella cytherea* are the dominating species. In the inner reef flats, *Pilodius spinipes*, *Chlorodiella barbata*, *Actaeodes tomentosus*, *Galathea humilis* play an important part in the populations. It is in this zone that the highest density of individuals per $dm^3$ is found among the branched Melobesiae which are also quantitatively very rich.

## REFERENCES


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# Tables

Table 2. Outer Reef-Flats

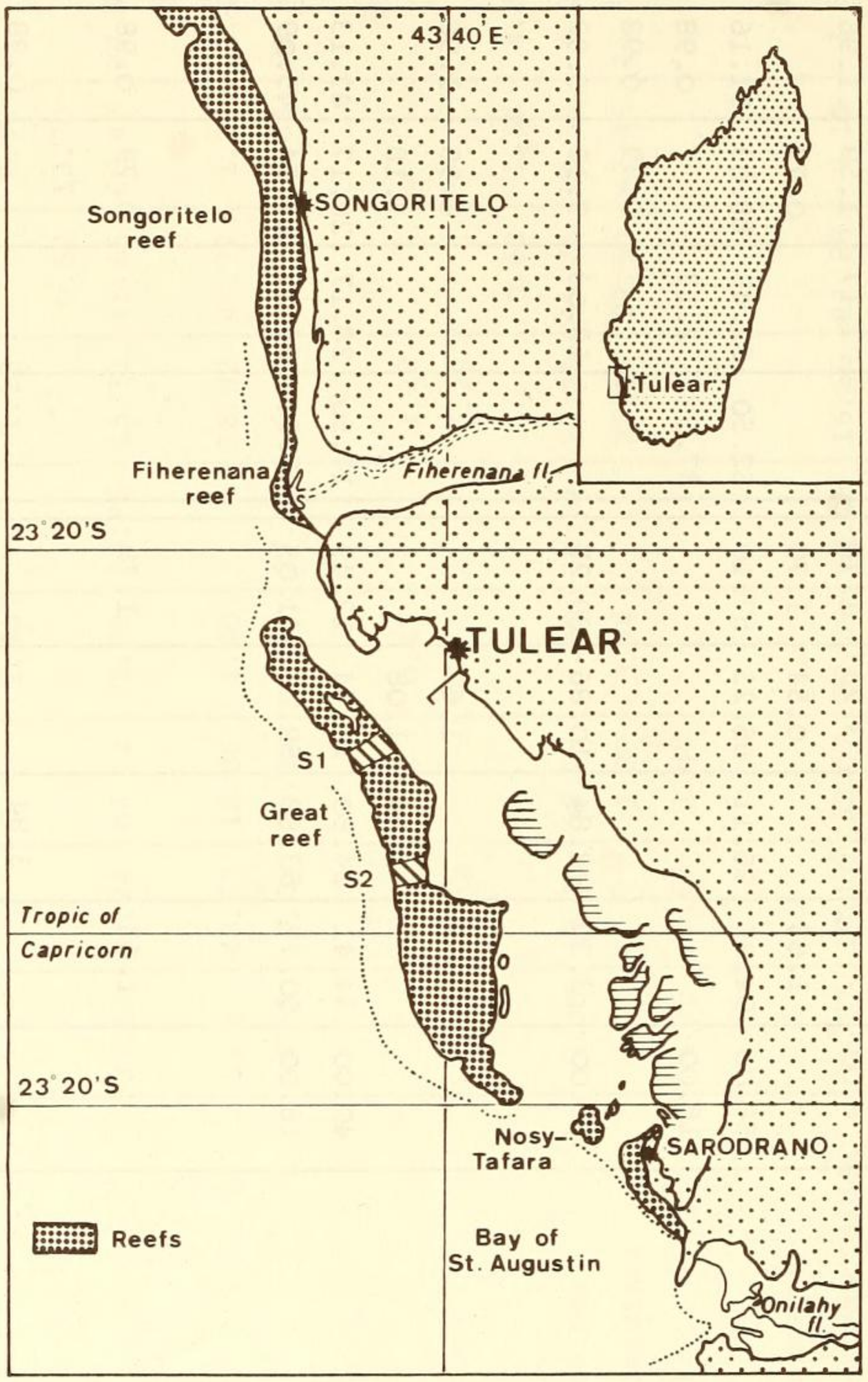
| STATIONS | | 1 | 2 | 10 | 11 | 12 | 13 | 14 | 15 | 27 | 28 | 29 | 30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of individuals | | 133 | 207 | 47 | 97 | 77 | 60 | 55 | 101 | 63 | 76 | 78 | 58 |
| Number of species | | 17 | 24 | 13 | 19 | 4 | 10 | 13 | 19 | 13 | 9 | 11 | 7 |
| Dromiacea | | 3.00 | 0.96 | 2.12 | | | 8.23 | | | 1.51 | 3.94 | | |
| Oxystomata | | | | | | | | | | | | | |
| Oxyrhyncha | | 2.25 | 9.47 | 6.38 | 4.12 | 2.59 | | 7.12 | 2.97 | 7.57 | 1.31 | | |
| Brachyryncha: | Portunidae | 0.75 | 3.82 | | 8.24 | | | 5.4 | 5.94 | 10.60 | | 1.28 | 3.45 |
| | Xanthidae | 78.91 | 67.22 | 78.68 | 70.07 | 97.32 | 84.96 | 70.63 | 63.36 | 77.25 | 88.13 | 97.38 | 96.50 |
| | Ocypodidae | | | | | | | | | | | | |
| | Grapsidae | | | 10.63 | | | | | 1.98 | 1.51 | 2.63 | | |
| Anomura | | 15.03 | 17.69 | 2.12 | 16.48 | | 6.66 | 12.32 | 25.74 | 1.51 | 3.94 | | |
| Xanthidae | | | | | | | | | | | | | |
| Hyperolissa | No Carpiloida | 0.75 | 4.79 | | 1.03 | | 5.00 | 1.72 | 6.95 | 1.51 | | | 1.72 |
| | Zozymoida | | 0.96 | 2.12 | | | 1.66 | 1.72 | 0.99 | | 1.31 | | |
| | Galenoida - Actaeinae | 15.03 | 5.26 | 12.76 | 20.62 | | 3.33 | 6.88 | 14.85 | 9.09 | 5.26 | 7.68 | 15.51 |
| | Chlorodinae | 41.34 | 29.18 | 59.56 | 40.12 | 97.32 | 74.97 | 41.36 | 27.76 | 66.64 | 81.57 | 88.42 | 79.31 |
| | Cymoida | 0.75 | | | | | | | | | | | |
| | Lyboida | | | | | | | | | | | | |
| Hyperomista | Menippinae | 0.75 | | | | | | | | | | | |
| | Pilumninae - Pilumnoida | 15.78 | 24.17 | | 8.24 | | | 15.51 | 11.88 | | | 1.28 | |
| | Heteropanopoida | | 2.87 | 2.12 | | | | 1.72 | | | | | |
| | Trapezinae | 4.51 | | | | | | | | | | | |
| | Carcinoplacinae | | | | | | | | 1.98 | | | | |
| Anomura | Galatheidae | | | | 1.03 | | 1.66 | | 0.99 | | | | |
| | Porcellanidae | 15.03 | 17.69 | 2.12 | 15.45 | | 4.99 | 11.45 | 24.75 | 1.51 | 3.94 | | |

Table 3. Boulder Tracts

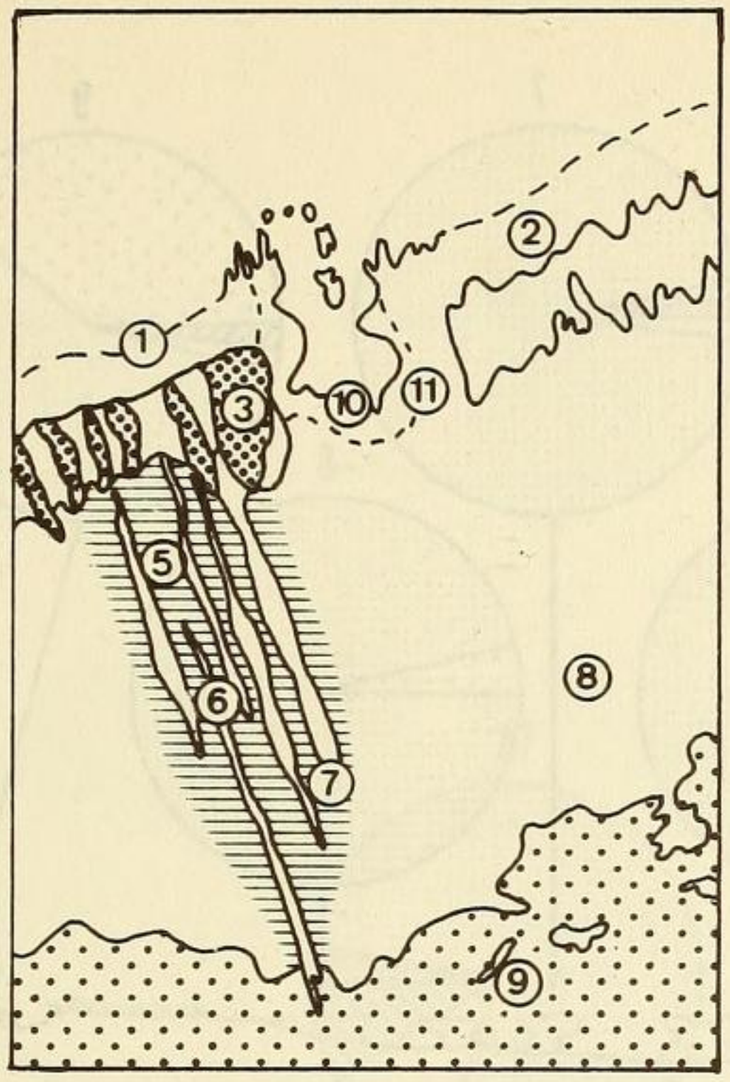
| STATIONS | 3 | 16 | 22 | 24 | 25 | 32 | 33 | 34 | 38 | 41 |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of individuals | 43 | 55 | 53 | 107 | 37 | 78 | 80 | 36 | 141 | 46 |
| Number of species | 7 | 8 | 8 | 9 | 6 | 12 | 12 | 13 | 6 | 4 |
| Dromiacea | | | | | | | | | | |
| Oxystomata | | | | | 2.70 | | | | | |
| Oxyrhyncha | | | | 1.40 | | 1.28 | | 2.72 | | |
| Brachyrhyncha-Portunidae | | | | | | | 0.62 | 13.70 | | |
| Xanthidae | 39.52 | 47.24 | 64.12 | 92.99 | 64.86 | 65.33 | 46.66 | 68.47 | 27.59 | 26.09 |
| Ocypodidae | | | | | | | | | | |
| Grapsidae | 55.80 | 43.63 | 18.86 | 1.40 | | 26.92 | 49.37 | 1.36 | 1.41 | 6.52 |
| Anomura | 4.65 | 9.09 | 16.98 | 4.21 | 27.01 | 6.41 | 3.75 | 6.84 | 70.92 | 67.40 |
| Xanthidae | | | | | | | | | | |
| Hyperolissa No Carpiloida | | | | 0.47 | | 1.28 | | | | |
| Zozymoida | 9.30 | 9.08 | | | | 1.28 | | | | |
| Xanthoida | | | | | | | 0.63 | 1.36 | 4.22 | |
| Galenoida-Actaeinae | 9.30 | 16.36 | 28.29 | 1.40 | 10.81 | 23.06 | 11.26 | 20.55 | 4.22 | |
| Chlorodinae | | | 1.88 | 3.74 | | 23.06 | 22.50 | 42.46 | 15.59 | 21.73 |
| Cymoida | 4.35 | 3.63 | 1.88 | | | | | | | |
| Hyperomista Menippinae | | | | | | | | | | |
| Pilumninae - Pilumnoida | | | | | | | | | | |
| Heteropanopeidea | 16.27 | 18.17 | 32.07 | 87.39 | 54.05 | 16.66 | 11.88 | 4.10 | 3.54 | 4.35 |
| Trapezinae | | | | | | | | | | |
| Carcinoplacinae | | | | | | | | | | |
| Anomura - Galatheidae | | | | | | | | | | |
| Porcellanidae | 4.65 | 9.09 | 16.98 | 4.21 | 27.02 | 6.41 | 3.75 | 6.84 | 70.92 | 67.40 |

Table 4. Inner Reef Flats

| STATIONS | | 5 | 7 | 8 | 6 | 9 | 17 | 18 | 19 | 20 | 21 | 26 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of individuals | | 25 | 61 | 32 | 184 | 56 | 40 | 46 | 259 | 102 | 45 | 44 |
| Number of species | | 9 | 14 | 8 | 23 | 11 | 7 | 12 | 23 | 19 | 8 | 6 |
| Dromiacea | | | | | | | | | | | | |
| Oxystomata | | | | | | | | | | | | |
| Oxyrhyncha | | 8.00 | | | 3.25 | 1.78 | | 2.17 | 1.59 | 1.96 | | 9.09 |
| Brachyrynchia: | Portunidae | | 1.63 | | 0.54 | 1.78 | | | 0.79 | | | |
| | Xanthidae | 56.00 | 94.96 | 96.11 | 85.25 | 57.10 | 62.50 | 82.48 | 88.03 | 91.16 | 88.85 | 52.25 |
| | Ocypodidae | 16.00 | | | | | 37.5 | 2.17 | | 0.98 | 11.11 | |
| | Grapsidae | | | | | | | | 0.39 | 0.98 | | |
| Galatheidae | | 20.00 | 3.26 | 3.84 | 10.86 | 39.27 | | 13.03 | 9.12 | 3.92 | | 38.63 |
| Xanthidae | | | | | | | | | | | | |
| non Carpiloida | | | 1.63 | | 1.62 | | | | 1.96 | 1.96 | | |
| Zozymoida | | | | 3.84 | 1.08 | | | | 1.18 | | | |
| Xanthoida | | | | | | | | | | | | |
| Galenoida: | Actaeinae | 40.00 | 34.41 | 34.60 | 20.64 | 12.49 | 17.50 | 28.17 | 28.17 | 43.13 | 13.32 | 34.08 |
| | Chlorodinae | 16.00 | 50.77 | 53.83 | 59.21 | 41.05 | 42.50 | 54.31 | 55.54 | 45.09 | 75.53 | 15.90 |
| Cymoida | | | | | | | | | | | | |
| Menippinae | | | | | | | | | | | | |
| Pilumninae I | | | 1.63 | | | 1.78 | | | 0.79 | 0.98 | | 2.27 |
| Heteropanopeida | | | | | | | | | | | | |
| Lyboida | | | | 3.84 | | | | | | 0.98 | | |
| Trapezinae | | | 4.91 | | | 1.78 | | | | | | |
| Carcinoplacinae | | | 1.63 | | 1.08 | | 2.50 | | 0.39 | | | |
| Galatheidae: | Galathea | | 1.63 | 3.84 | 8.69 | 39.27 | | 19.03 | 3.96 | 2.94 | | 38.63 |
| Procellanidae | | 20.00 | 1.63 | | 2.17 | | | | 5.16 | 0.98 | | |




Map 1: The coral reef in the vicinity of Tuléar.




① Spur upper platform

② Glacis

③ Boulder tract

⑤ Compact reef flat

⑥ Branched melobesiae

⑦ Reef flat with coral alignements and sandy couloirs

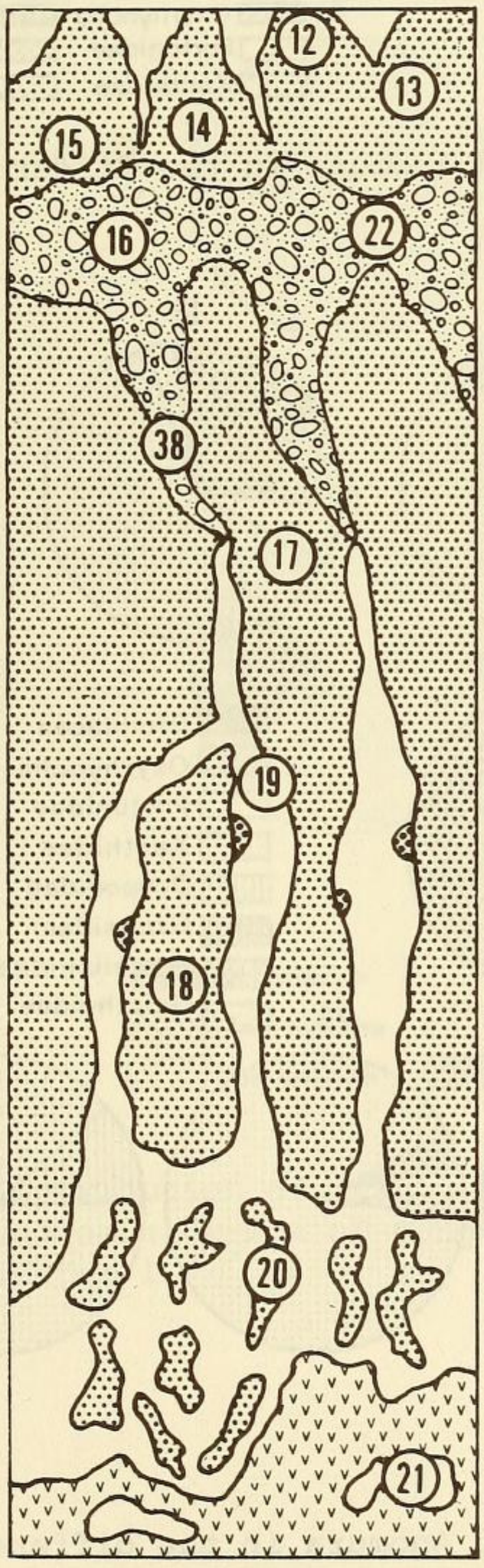
⑧ Reef flat with scattered coral growth

⑨ Sea-grass-bed basin

⑩ Outer creek

⑪ Zoantharian zone

Fig. 1: Localities of the stations in Sector 1.




OUTER REEF FLAT

12 Spur upper platform

13 Outer moat

14 Glacis

15 Layered melobesiae

BOULDER TRACT

16 Crag

22 Filtering dike

38 Gravel tail

INNER REEF FLAT

17 Compact reef flat

18 Reef flat with coral alignments and sandy couloirs

19 Branched melobesiae

20 Reef flat with scattered coral growth

21 Sea-grass-bed basin

Fig. 2: Localities of the stations in Sector 2.

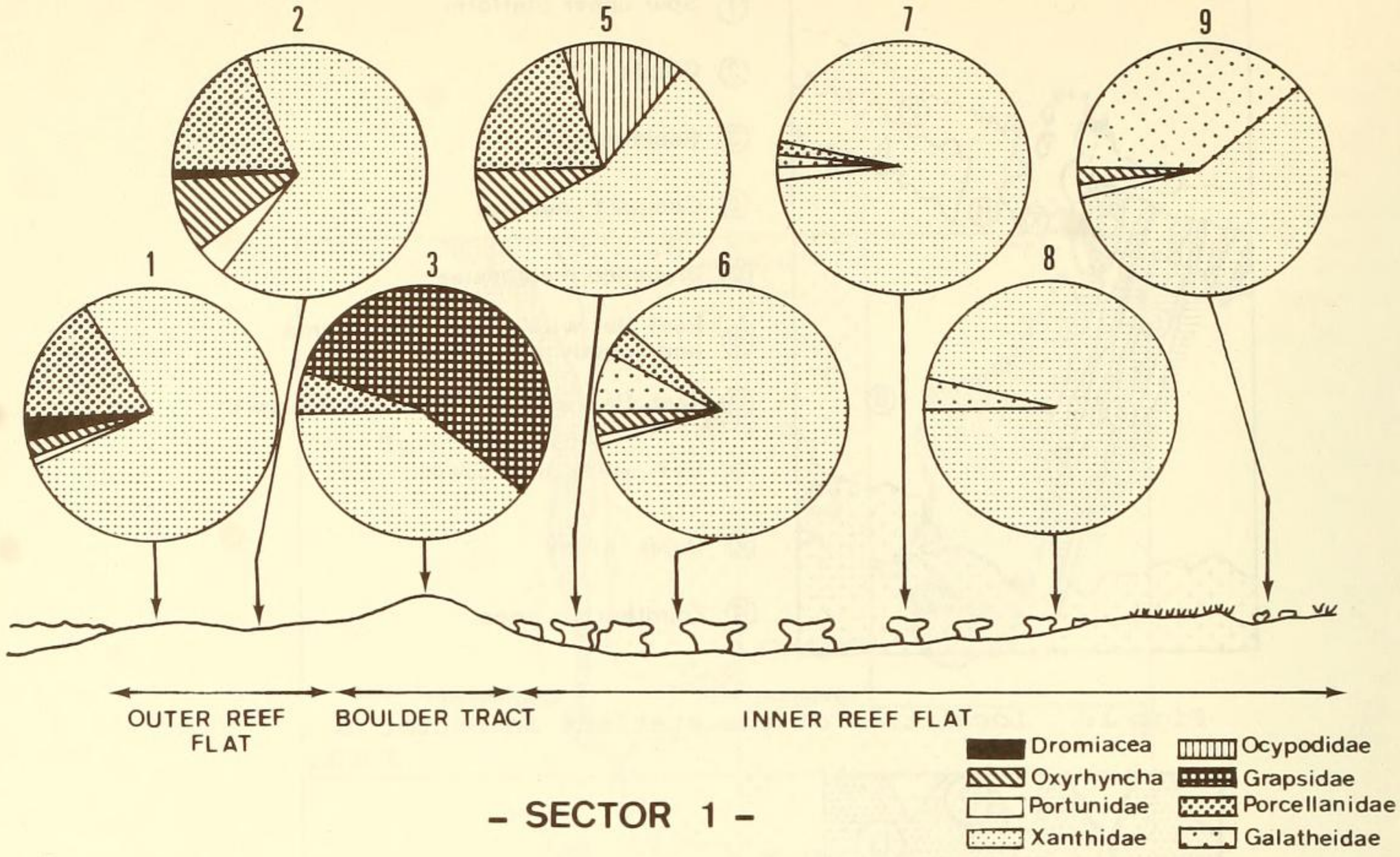



Fig. 3: Distribution of Brachyura and Anomura in the different stations in Sector 1.

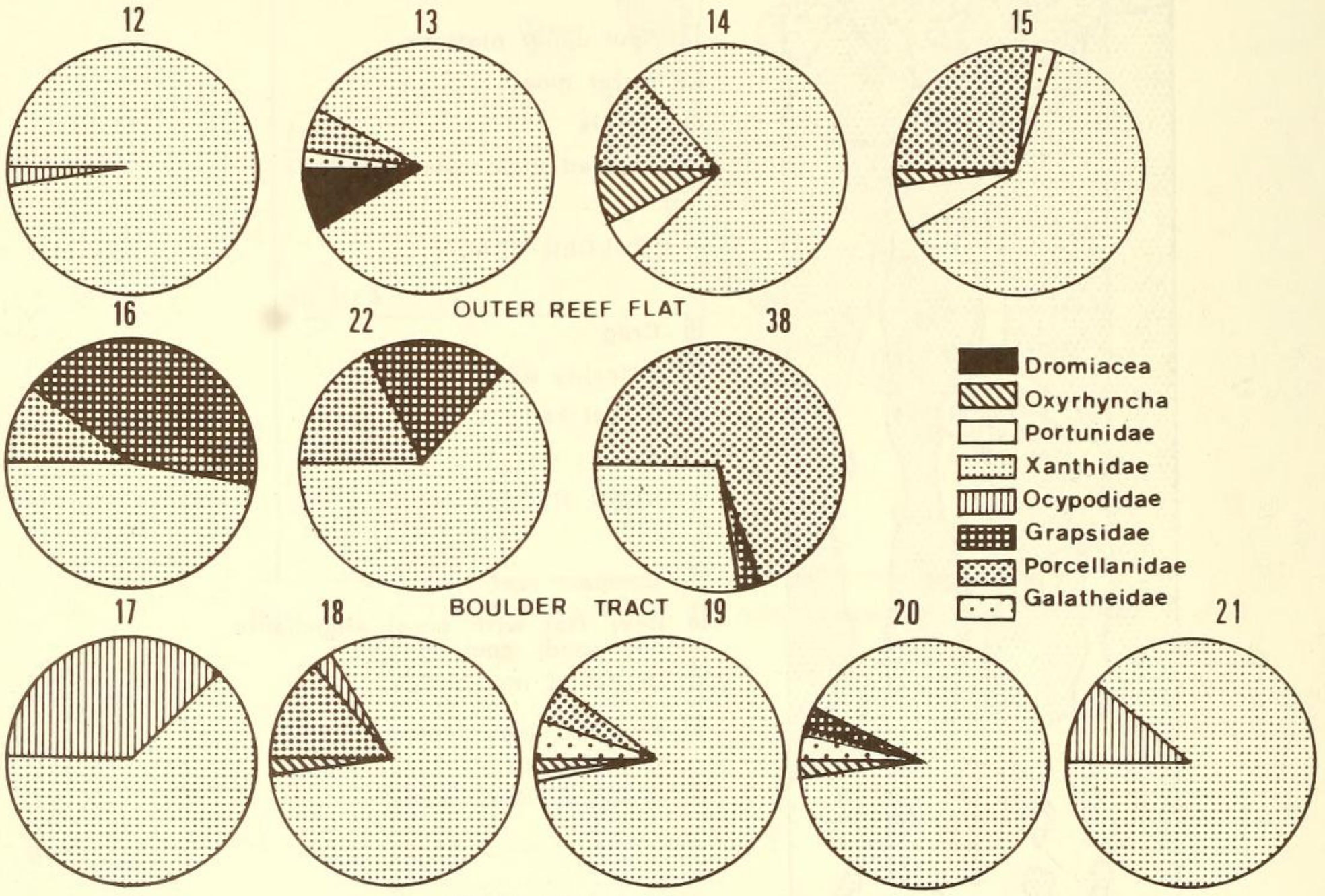



Fig. 4: Distribution of Brachyura and Anomura in the different stations in Sector 2.

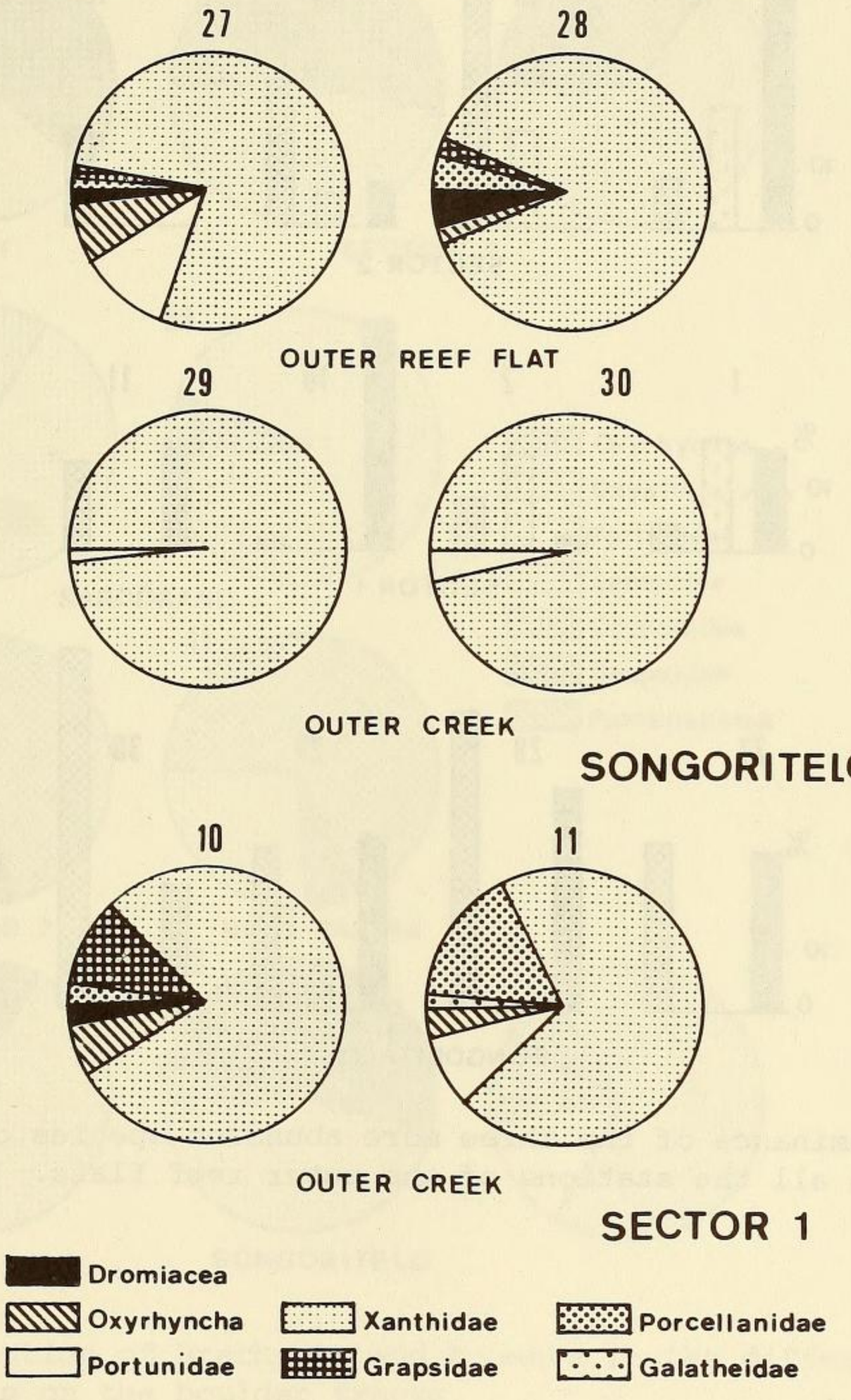



Fig. 5: Distribution of Brachyura and Anomura in the outer reef flat and outer creek of Songoritelo and of outer creek of Sector 1.

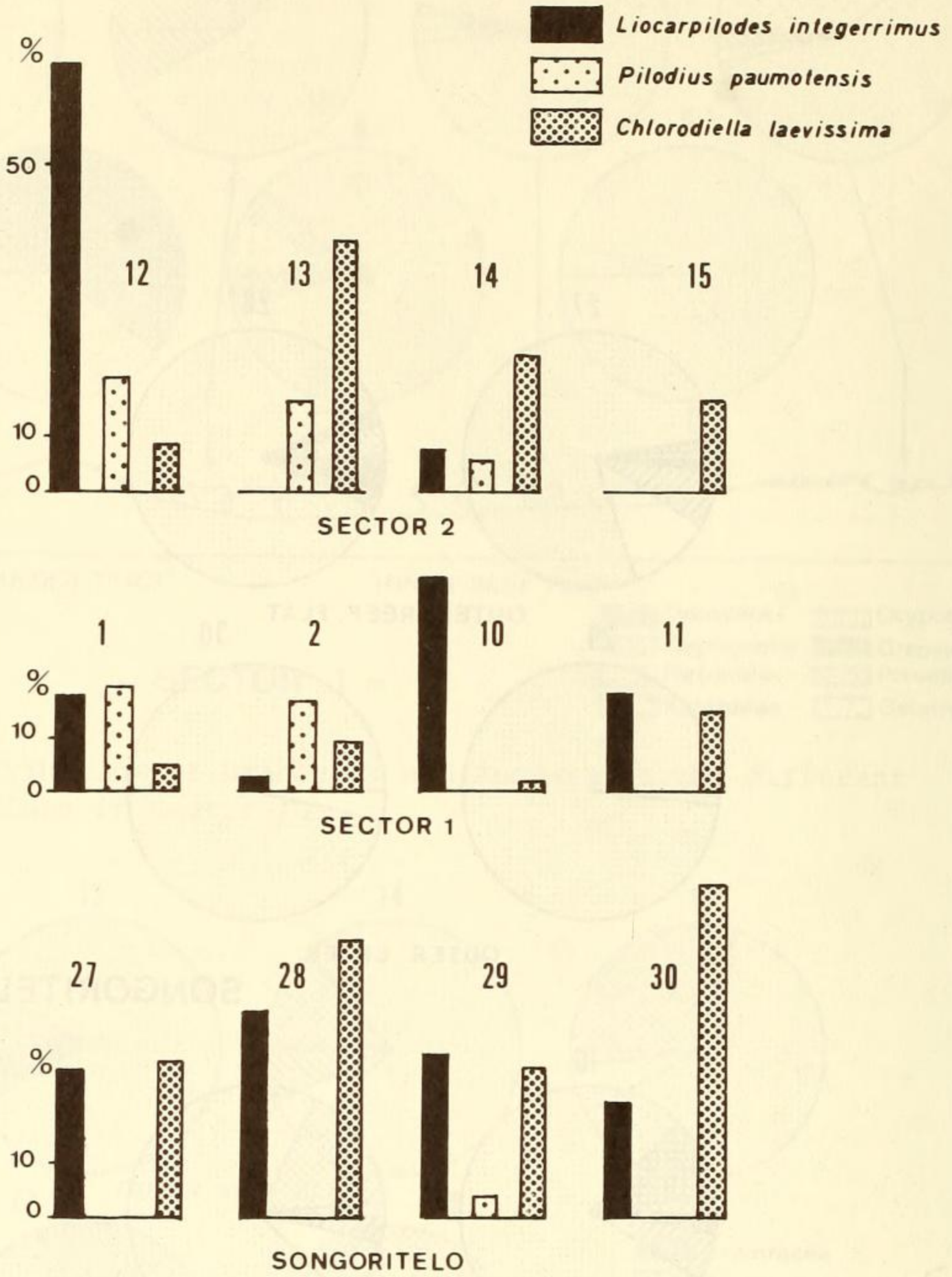



Fig. 6: Dominance of the three more abundant species of Chlorodinae in all the stations of the outer reef flats.

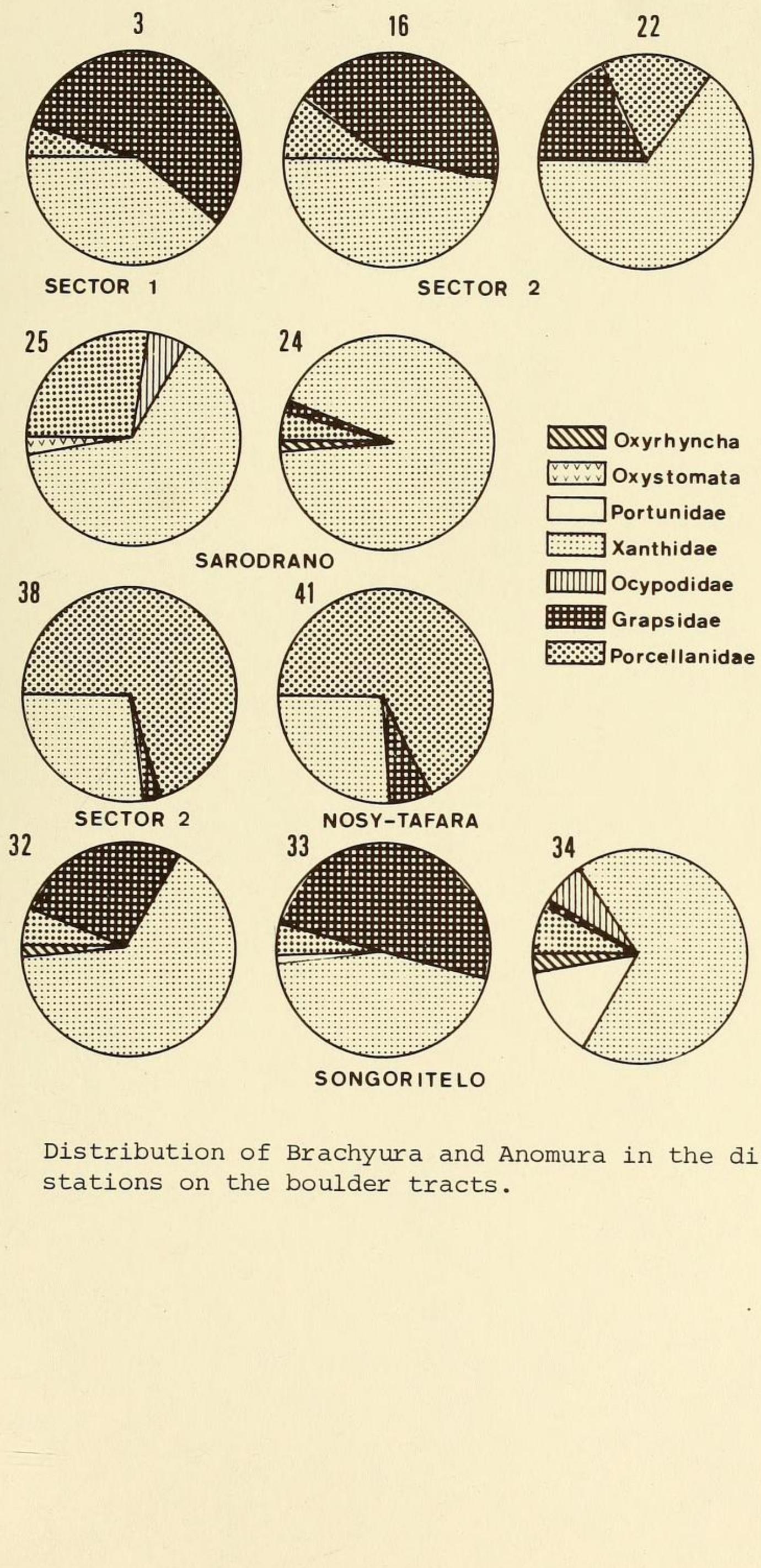



Fig. 7: Distribution of Brachyura and Anomura in the different stations on the boulder tracts.