NAUPLIUS, Rio Grande, 2: 75 - 86, 1994.

MORPHOLOGY, ABUNDANCE AND DISTRIBUTION OF LARVAL PHASES OF TWO SERGESTIDS IN THE SOUTHERN BRAZILIAN COAST

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ABSTRACT

Larval phases of two coastal sergestids, *Acetes americanus* and *Peisos petrunkevitchi* were taken from quantitative oblique samples between August 1982 and May 1983 in the region surrounding the mouth of the Patos Lagoon. Morphological features of protozoeae, mysis and megalopa stages were observed and compared with other sergestids and luciferids. Distribution and abundance were analyzed and results showed that larvae of *P. petrunkevitchi* was present during autumn, winter and spring and *A. americanus* in summer and autumn.

Keywords: Decapoda, Sergestidae, larvae, morphology, abundance, distribution.

INTRODUCTION

Free-swimming decapod larvae have adaptive features allowing survival and molt to the next phase in which different requirements are associated with new morphological characters. The larvae are therefore different in appearance from the respective juveniles and adults, even if the juveniles and adults are also pelagics. However the presence of early larval stages (*e.g.* protozoea I of penaeideans) in the water column may indicate recent reproductive activity, and their abundance can reflect the size of the parent stock in the region.

There are many species of pelagic shrimps of the Family Sergestidae known from the Southern Brazilian coast (D'Incao, pers. com.). Among these are two small transparent shrimps *Acetes americanus* Ortmann, 1893 and *Peisos petrunkevitchi* Burkenroad, 1945 which inhabit inshore waters. Both species are a very important link in the trophic chain of coastal systems. *Acetes americanus* is found in tropical and subtropical regions up to 32°S while *P. petrunkevitchi* is limited to subtropical and temperate waters of south-eastern South America up to 44°S.

For *A. americanus* Oshiro (1983) described 6 stages of nauplius, 3 of protozoea and 2 of mysis which were separated from zooplankton samples collected off Brazilian coast. Mallo & Boschi (1982) described briefly four

naupliar stages, five stages of protozoea and just one of mysis of *P. petrunkevitchi* reared under laboratory conditions. Calazans (1992) described 3 stages of protozoea, 2 stages of mysis and one megalopa for both species. These larval stages were taken from zooplankton collected along the southern Brazilian coast.

A number of authors have studied the morphology, abundance and distribution of larval phases of sergestidean shrimps including Brooks (1882), Hasen (1922), Menon (1933), Gurney & Lebour (1940), Subrahmanyam (1971), Omori (1974), Omori and Gluck (1979), Knight & Omori (1982), Paulinose & George (1976), Makarov (1967), Boschi & Scelzo (1969), Price (1979, 1982), Mallo & Cervellini (1988) and Cervellini & Mallo (1991).

In this present study the morphological differences, abundance and distribution of the larval phases of *A. americanus* and *P. petrunkevitchi* in the region surrounding the mouth of the Patos Lagoon are discussed.

MATERIAL AND METHODS

The sampling area (Fig.1) is about 60 nautical miles in length, surrounding the mouth of the Patos Lagoon, with the eastern edge being delimited by the 60m isobath which enclosed an area of approximately 2,900 nautical square miles. This was divided into 17 smaller areas, each 10 nautical miles long and lying between two isobaths, demarcating four depth levels with the number of subareas indicated in parenthesis: 10 and 15m (6), 15 and 20m (6), 20 and 30m (3), and 30m and 60m (2). Each of these areas was again subdivided into 1 nautical mile square and it was from these that the sample positions were chosen randomly for each subarea. The numbers of samples were established as 2 for isobaths of 10 and 20m, 4 for the 20 and 30m, and 6 for the subareas between 30 and 60m, with a possible 48 samples in total during four cruises at different seasons (Tab. 1), using the R/V "Atlântico Sul" (35.9 m) of Rio Grande University. However because of bad weather during the second and third cruises it was only possible to complete 43 stations, and during the final cruise only 24 stations were completed across the whole area.

Table 1 - Dates and numbers of stations per cruise.

	DATE	N° OF STATIONS
Cruise 1 (Winter)	31/08/82 - 04/09/82	48
Cruise 2 (Spring)	17/11/82 - 21/11/82	43
Cruise 3 (Summer)	19/01/83 - 23/01/83	43
Cruise 4 (Autumn)	17/05/83 - 22/05/83	24

At each station zooplankton were collected in oblique hauls from one meter above the bottom to the surface. At stations with a depth of 10 metres or less, double oblique hauls (bringing the net to the surface and letting it down again) were carried out to increase the volume of water filtered. The plankton net was a conventional conical net of 330 μm mesh size, 60 cm mouth diameter and 250 cm length, with a flowmeter centrally mounted in the mouth and a 20 kg hydrodynamic wire depressor. Towing speed was estimated to be between 1.5 and 2.0 m/s and the vessel speed was kept constant at 2 knots. The angle of the towing wire was monitored frequently in order to keep it constant. The appropriate lengths of cable, read from a prepared chart (depth = cable length x cosecant of wire angle), were let out to enable sampling to start at the right depth. Samples were immediately fixed and preserved in 4% buffered formalin.

Using a Nikon MZ10 dissecting microscope, larvae of *A. americanus* and *P. petrunkevitchi* were sorted and removed from the zooplankton samples. The drawings were made using an Olympus BH-2 microscope with Nomarski interference contrast and *camera lucida*. Identification of larval stage and species was possible by comparison with laboratory reared material. Counts were standardised as number per $100m^3$ of filtered water.

Abundance of larvae could varied significantly between individual tows, ranging from absent to extremely abundant (defined below), consequently in

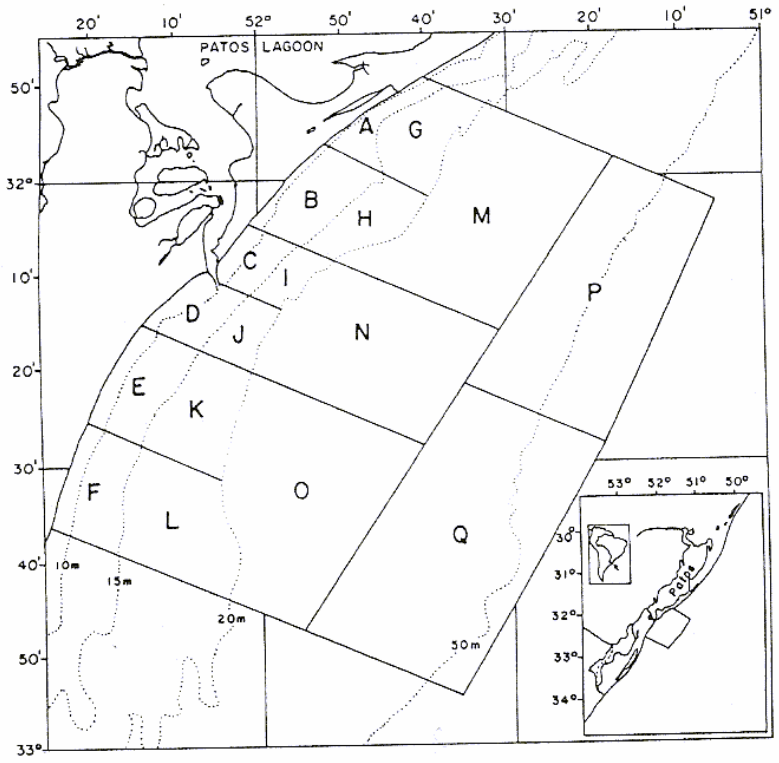

Figure 1. Sampling Area.

order to allow use of particular statistical procedures, this number (x) was compressed by the transformation log(x+1), thereby effecting the variance to be independent of the mean (Sokal and Rohlf, 1981). A three-way analysis of variance (ANOVA) was used to investigate the effect of 1) season; 2) depth; and 3) position of sampling point to the north or south of the lagoon mouth, against larval abundance. Regression analysis was used to assess the effect of temperature, salinity and depth on the abundance of the larvae.

For the distribution maps a geometric progression of base 3 was used to allow a rapid interpretation of the abundance categories contours. The abundance magnitude, established in this way, provide a scale as follows: absent (0); extremely rare (>0-1); very rare (>1-3); rare (>3-9); normal (>9-27); abundant (>27-81); very abundant (>81-243) and extremely abundant (>243-729).

RESULTS

Morphological Aspects

Oshiro (1983) described for *Acetes americanus* 6 naupliar, 3 protozoeal and 2 mysis stages from planktonic samples taken in Paranaguá and Laranjeiras Bays (48°10'W, 25°10' and 48°45'W, 25°35'S). However for the genus *Acetes*, stage numbers of naupliar and mysis phases may vary according to the region. Although the description of Kurata (1970) was based mainly on the morphological external appearance of the larvae it was the size of the larval stages which constitute the major difference between his study and the present account.

The appendages in the mysis phase of *A. americanus* show considerable changes, particularly in the protopod and endopods of mouthparts. These lack specialized setae to collect and triturate food, making these appendages non-functional. Therefore, during this phase the larva may cease feeding and because of it is possible to deduce that the mysis phase does not last longer than 2 or 3 days before transformation to the megalopa. In the megalopa phase all endites used for feeding are functional and well ornamented with setae.

The development pattern of *Peisos petrunkevitchi* after the nauplius phase, is similar to that of other genera of the Sergestidae and consists of 3 protozoeae and 2 mysis stages but in their brief description, Mallo and Boschi (1982) show 5 protozoea stages and only one mysis stage. Environmental conditions during laboratory rearing may explain the occurrence of 5 protozoea stages (instead of the usual 3 stages) and the presence of only one mysis stage. Descriptive aspects of both species were based on samples taken from the plankton rather than laboratory reared material. For this reason the naupliar phase was not included due difficulties to recognize all the stages.

In the protozoea phase, the pattern of development is very similar for *A. americanus* and *P. petrunkevitchi*. This makes differentiation between both genera difficult but not impossible. It is possible to separate them by size (Tab. 2) and some morphological features (Fig. 2). For example the first stage of

Table 2. Average size of each stage of *Acetes americanus* and *Peisos petrunkevitchi*.

	PI	PII	PIII	MI	MII	Dec
A. americanus	0.66	1.07	1.64	1.86	1.94	2.21
P. petrunkevitchi	0.74	1.15	1.84	1.97	2.51	2.79

Acetes bears 3 spinulose spines on the carapace (Fig. 2A) while that of *Peisos* has 3 smooth spines (Fig. 2B). To distinguish the second and third protozoea stages, the differences are the telson (Fig. 2C,D) and the number of segments on the endopod of maxilla, 3 in *Acetes* and 4 in *Peisos*. The major difference between the mysis phase and megalopa of *Acetes* and *Peisos* is the presence/absence of a dorsal spine (Fig. 2E,F) on the fourth and fifth abdominal somites and telson (Fig. 2G,H).

Abundance

All larvae of *Acetes americanus* were taken in plankton samples during summer and autumn. A total mean number of 22.2 larvae per $100m^3$ were caught. There were no significant differences between the abundance of the protozoea (Fig. 3A), and the mysis (Fig. 4A) phase. Further there was no significant correlation between larval abundance with either temperature or salinity. However there were significantly higher ($P<0.01$) peaks of abundance for the protozoea phase during summer which seems indicate an influence of temperature (23^{o}-$25^{o}C$) on spawning activity. In contrast the abundance of the megalopa (Fig. 5A) did show highly significant variation ($P<0.01$) with season being much high during summer.

All larval stages of *Peisos petrunkevitchi* were taken in plankton samples during winter, spring and autumn. A mean total of 10.5 larvae per $100m^3$ were caught. There was a significant difference ($P<0.05$) between the abundance of the protozoea phase and the megalopa collected during the winter, but no such difference during spring and autumn. The abundance of the protozoea phase (Fig. 3B) was the same for winter and autumn, but significantly lower ($P<0.01$) in spring. The abundance of the mysis phase (Fig. 4B) was homogeneous for all seasons, while the megalopa (Fig. 5B) were lower during autumn ($P<0.05$).

Distribution

For the protozoea phase, both species were more abundant ($P<0.05$) at 10 to 15m. The larvae of *A. americanus* showed no differences in distribution to north or south of the lagoon mouth during peak of distribution in the summer. However, in contrast the larvae of *P. petrunkevitchi* were distributed to the south during winter and northern in autumn

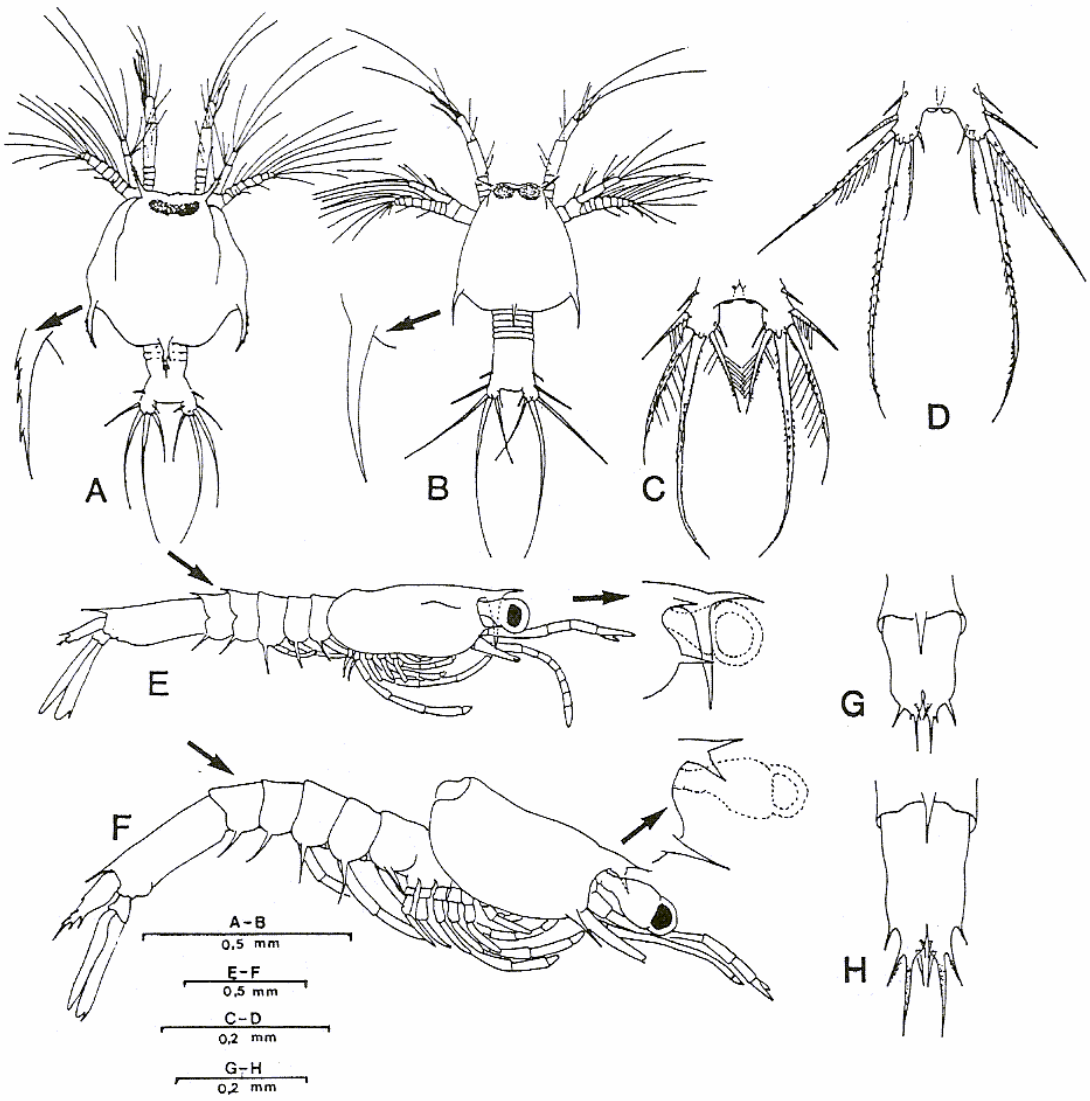

Figure 2. Morphological differences between *Acetes americanus* Ortman, 1867 and *Peisos petrunkevitchi* Burkenroad, 1945. A-B, Protozoea I; C-D, Telson; E-F, Mysis II; G-H, Telson.

In the mysis phase *A. americanus* demonstrated the same pattern of distribution as the protozoea during summer being slightly more abundant to the north of the lagoon mouth. During autumn, distribution was based in the south and near to the coast.

The mysis phase distribution of *P. petrunkevitchi* is complex with no difference in distribution between north and south of the lagoon mouth, but they show tendences to be off shore during the winter and inshore during autumn.

The megalopa of *A. americanus* seem to have the same pattern of distribution as mysis but *P. petrunkevitchi* showed different patterns of distribution between seasons moving seaward during spring and moving closer to the coast line during autumn with no differences between north and south of the lagoon mouth.

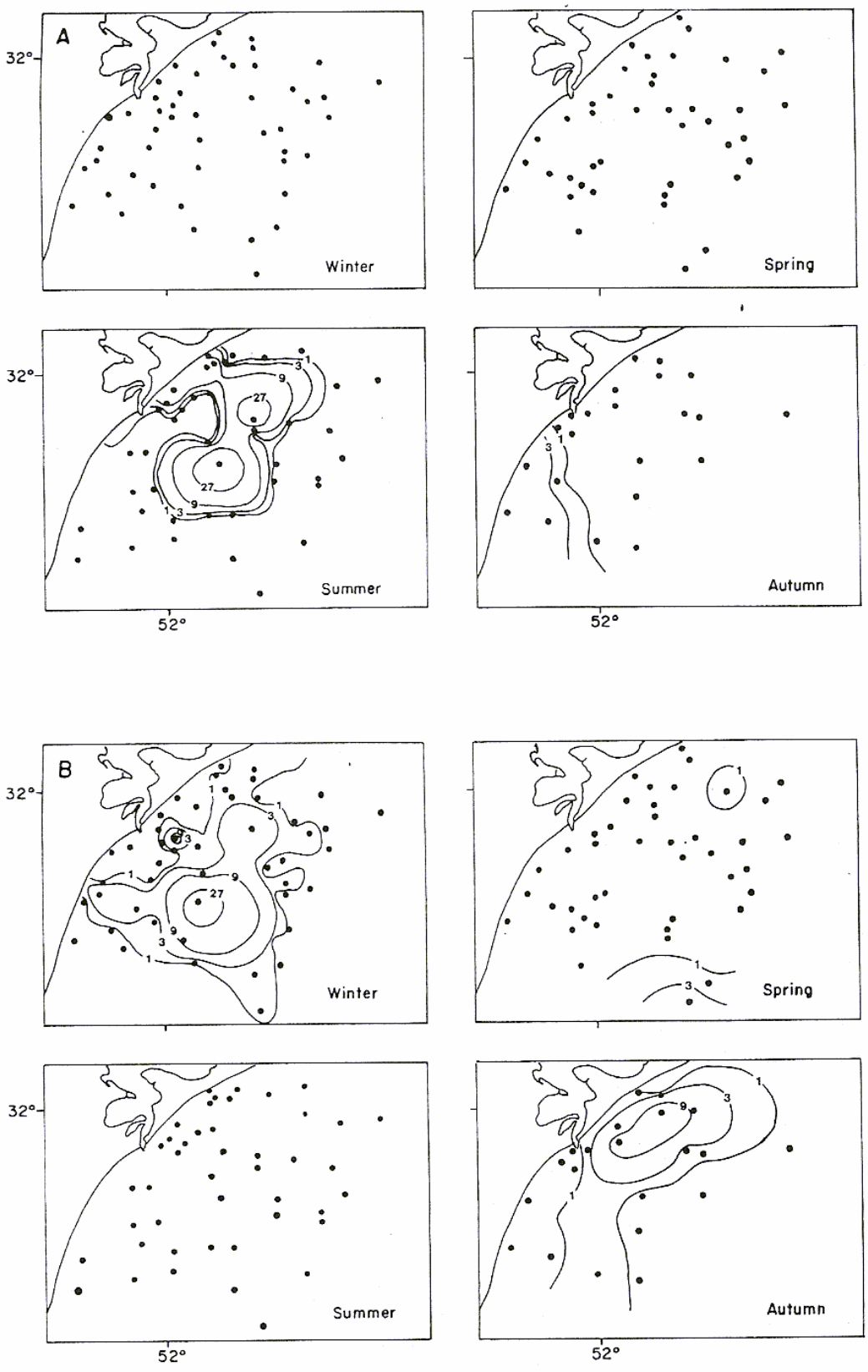

Figure 3. Seasonal distribution of combined protozoeae stages of A-*Acetes americanus* and B-*Peisos petrunkevitchi*

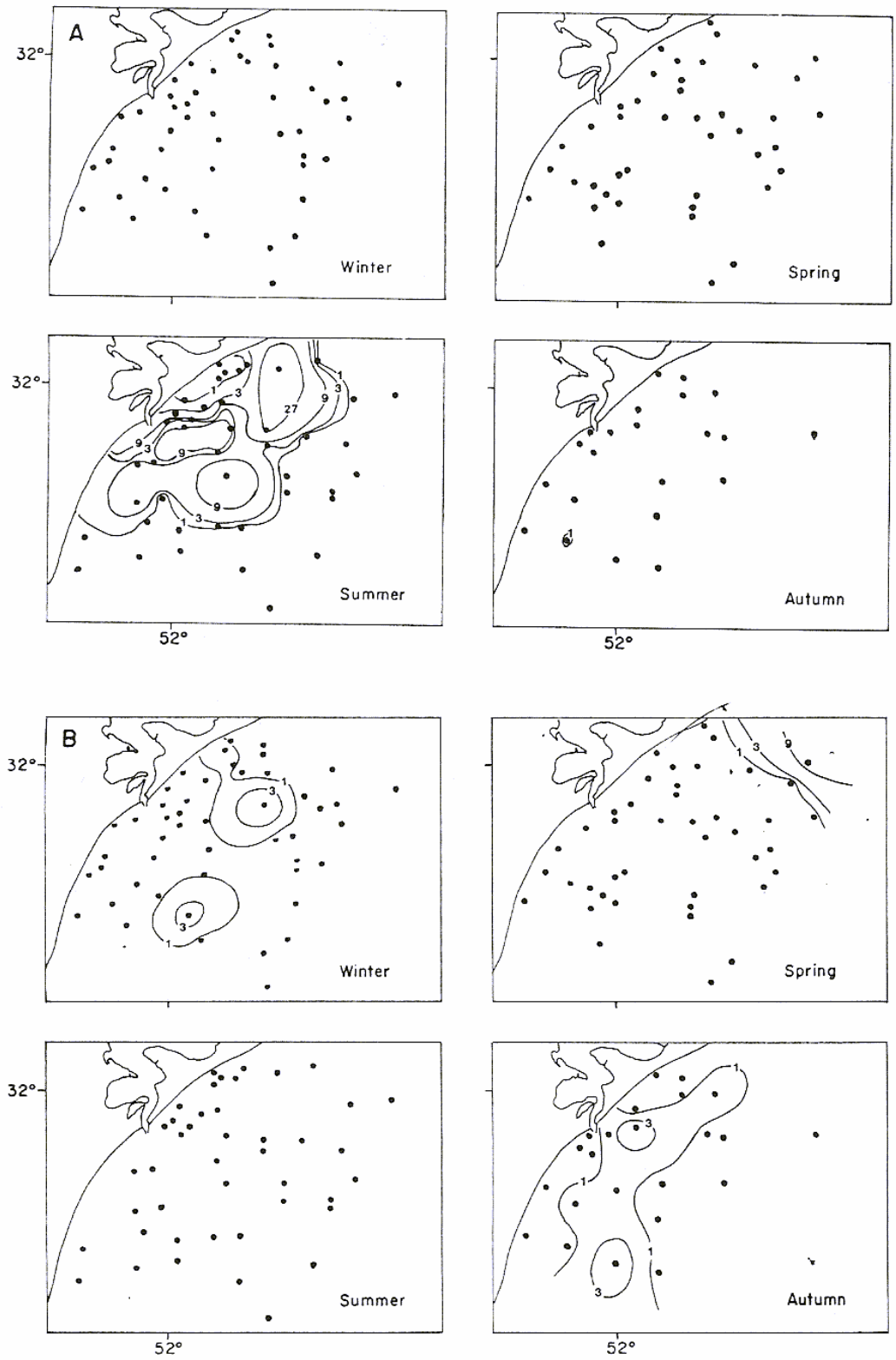

Figure 4. Seasonal distribution of combined mysis stages of A-*Acetes americanus* and B-*Peisos petrunkevitchi*.

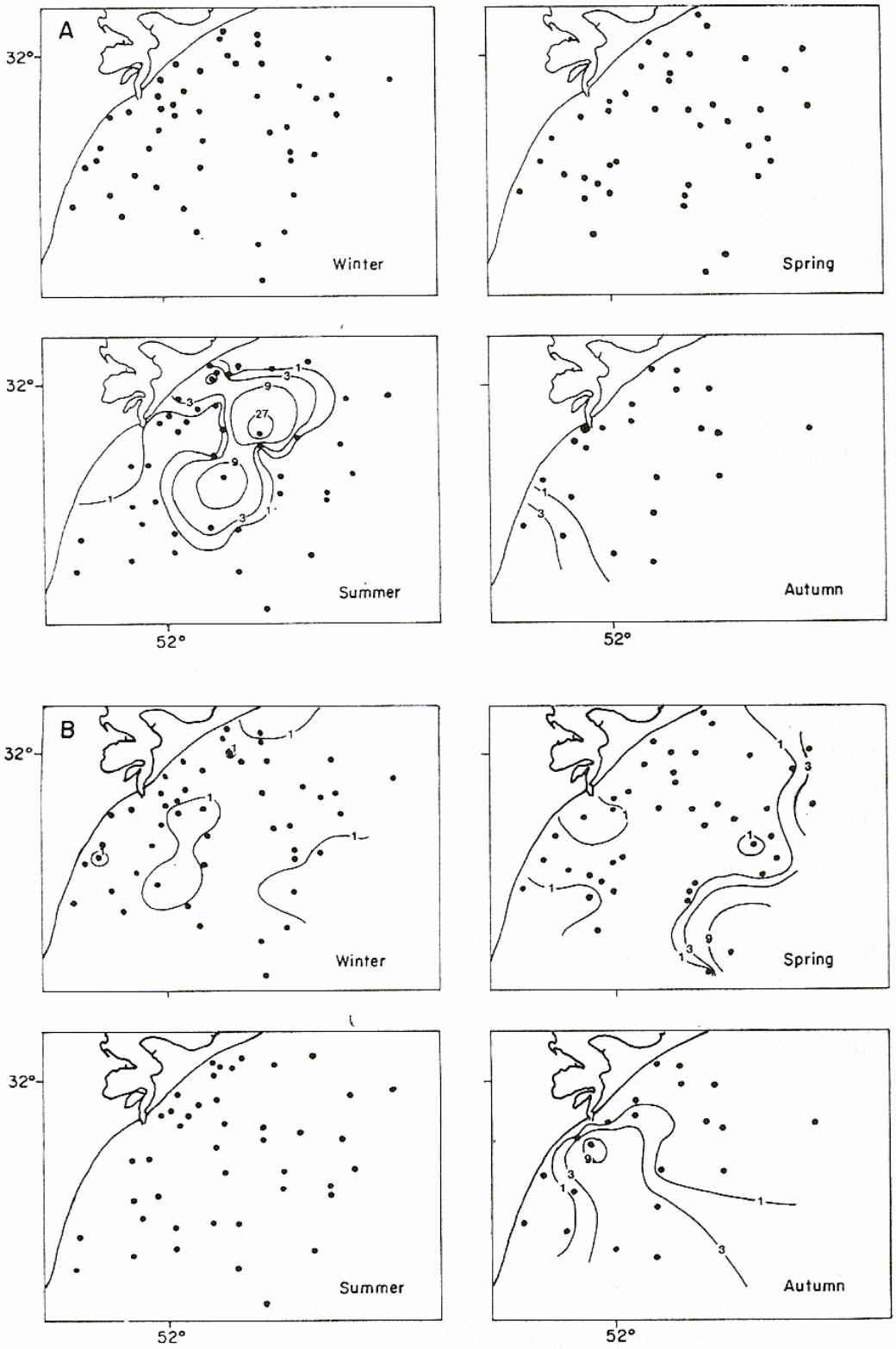

Figure 5. Seasonal distribution of megalopa of A-*Acetes americanus* and B-*Peisos petrunkevitchi*.

DISCUSSION AND CONCLUSIONS

A smooth carapace with only a pair of lateral and a posterior dorsal spines in the protozoea phase together with non-functional mouthparts during the mysis phase, have not been reported for any genera of the Sergestidae other than *Acetes* and *Peisos*. These characteristics suggest a close relationship between these two genera as reported by Burkenroad (1945). Therefore it is possible to distinguish two groups of Sergestidae based on larval development.

Sergestes group. The genera *Sergestes* and *Sergia* have lateral and posterior spines with long spinules at least at the posterior portion during the protozoea phase. The mysis phase of this group bear some spines, smooth or not, on the carapace edge or its surface.

Acetes group. The genera *Acetes* and *Peisos* with lateral and posterior spines smooth (but *Acetes* with small spinules during stage I) of protozoea phase. Mysis without spines on the edge or surface of carapace.

The morphological features of larval stages of *Acetes* and *Peisos* may indicate them as an intermediate group between the Sergestidae and Luciferidae.

The presence of larval stages of *Acetes americanus* along the Southern Brazilian coast and mostly during summer indicates a relationship between spawning activity Brazilian Current flowing south from the north. It is possible that the presence of this species is related with the presence of Tropical Waters in the area during summer having its southern limit of distribution. The abundance of early stages of protozoea in shallow waters (10-15m depths) indicates preference for matures adults for coastal areas.

In comparison *Peisos petrunkevitchi* larvae and/or adults are present in the area all the year around but spawning activity occour mostly during winter, autumn and lesser during spring. This activity indicates the influence of Subantartic Waters from a coastal branch of Malvinas/Falkland Current flowing north from the south in the distribution of this species. Early stages of protozoea indicate a widespread presence of mature adults in the region during winter when the influence of the Subantartic Waters is more notable.

ACKNOWLEDGEMENTS

The author would like to thank the crew of R/V "Atlântico Sul" for their technical support during the survey trips, Mrs. Suelma R. Silveira for much needed help in sorting decapod larvae in the plankton samples and Mr. Paul F. Clark for a critical reading of the manuscript.

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