COMMUNITY STRUCTURE OF PARASITIC HELMINTHS OF BIRDS OF THE GENUS LARUS FROM MAR DEL PLATA, ARGENTINA

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PARASITES
HELMINTHS
COMMUNITY STRUCTURES
LARUS SPP.

ABSTRACT. – Community structure of parasite helminths of *L. dominicanus* (Lichtenstein, 1823), *L. maculipennis* (Lichtenstein, 1823) and *L. cirrocephalus* (Vieillot, 1818) were studied. Species richness of the three helminthological communities was composed by 11 species (4 digenean, 5 cestodes and 2 nematodes). The nematode *Pectinospirura argentata* (Wehr, 1933) was the central species of the helminthological community of *L. dominicanus* and the digenean *Tanaisia (Tanaisia) fedtschenkoi* Skrjabin, 1924 of *L. maculipennis* and *L. cirrocephalus* respectively. The similitude between helminthological communities of *L. dominicanus-L. maculipennis* was 62.54 %; between *L. dominicanus-L. cirrocephalus* it was 61.54 %, and between *L. maculipennis-L. cirrocephalus*: 61.54 %. In *L. dominicanus* all associations between intestinal species were significative with the exception of *Alcataenia dominicana* Spasskaja, 1971– *Paricterotaenia porosa* (Rudolphi, 1810); *Stephanoprora denticulata* (Rudolphi, 1802) Odhner, 1911-*Tetrabothrius argentinus* (Szidat, 1964) and *T. argentinus-Paricterotaenia porosa* were significative in *L. maculipennis* and *L. cirrocephalus* respectively. Two site shifting cases were observed between *Tetrabothrius argentinus-Paricterotaenia porosa* and *T. argentinus-Alcataenia dominicana.*

PARASITES
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STRUCTURE DES COMMUNAUTÉS
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RÉSUMÉ. – Les communautés d'Helminthes de *Larus dominicanus* (Lichtenstein, 1823), *L. maculipennis* (Lichtenstein, 1823) et *L. cirrocephalus* (Vieillot, 1818) ont été étudiées. La richesse spécifique est de 11 espèces (4 Digènes, 5 Cestodes et 2 Nématodes). Le Nématode *Pectinospirura argentata* Wehr, 1933 est l'espèce centrale dans la communauté helminthologique de *L. dominicanus* et le Digène *Tanaisia (Tanaisia) fedtschenkoi* Skrjabin, 1924 celle des communautés helminthologiques de *L. cirrocephalus* et *L. maculipennis*. Les similitudes entre les communautés helminthologiques de *L. dominicanus-L. maculipennis, L. dominicanus-L. cirrocephalus* et *L. maculipennis-L. cirrocephalus* sont de 62.54 %, 61.54 % et 61.54 % respectivement. Les associations d'espèces intestinales chez *L. dominicanus* sont significatives sauf celle d'*Alcataenia dominicana* Kolotilova, 1971-*Paricterotaenia porosa* (Rudolphi, 1810). Les associations *Stephanoprora denticulata* (Rudolphi, 1802) Odhner, 1911-*Tetrabothrius argentinus* (Szidat, 1964) et *T. argentinus-P. porosa* sont significatives chez *L. maculipennis* et *L. cirrocephalus* respectivement. Deux changements de site ont été observés entre *T. argentinus-P. porosa* et *T. argentinus-A. dominicana.*

INTRODUCTION

Birds of the family Laridae are one of the components in the coastal fauna of the argentine Sea. They have been frequently studied, in particular those belonging to the genus *Larus* Linné (Magno 1971, Canevari *et al.* 1991, Lizurume *et al.* 1995). The genus in question is represented in Argentina by six species (Canevari *et al.* 1991) among which are *Larus dominicanus* (Lichstenstein, 1823); *L. maculipennis* (Lichstenstein, 1823) and *L. cirrocephalus* (Vieillot, 1818). Although these three seagull species are inshore coastal species, they go upriver and may be found in pools and wetlands. These birds have a highly varied diet, eating insects, small invertebrates and fishes which may come from inland water bodies, marine coasts, rural areas, debris collected near the sea, and eggs of other species of marine birds. Therefore, they are considered as secondary and tertiary predators in the food web. The previous statement suggests that the study of bird parasites contributes to assess the state of the marine ecosystem, among others. Still, although in the North Hemisphere there are papers about helminth parasites of several *Larus* species focused on systematics and ecology (Bakke 1972, 1985, Hoberg 1996, Galaktionov 1996) in the South Hemisphere only fauna inventories carried out by Torres *et al* (1982, 1983, 1991, 1992) for Chile and only systematic information (Szidat 1964, Cremonte & Navone 1998) for Argentina are known. Therefore, the goals of this work are: 1) determining the parasitic community structure of *Larus dominicanus*, *L. maculipennis* and *L. cirrocephalus* at the inshore coastal region of Mar del Plata; 2) calculating by means of the species richness of the three helminth communities the degree of likeness between them; 3) establishing the existence of areal associations between gut species and those appearing frequently together; and 4) study gut helminth distribution with the aim of estimating species *site* occupation percents and detecting possible cases of shifting.

MATERIAL AND METHODS

Between 1995-1998, 44 specimens of seagulls of the genus *Larus* were caught in the outskirts of Mar del Plata city (38º05'S – 57º38'W), General Pueyrredón District, Buenos Aires Province. Nine of these birds belong to the *L. dominicanus* species, 26 to *L. maculipennis* and 9 to *L. cirrocephalus*. After describing the composition of the helminthological fauna by means of the study of systematics (Labriola & Suriano, in press) of collected parasites, total percent of general parasitosis, total percent of seagulls infected with one or more helminth species and parasitosis percent for each helminth group (considering digeneans, cestodes and nematodes as groups) were calculated. For each helminth species found in each host species, prevalence, mean intensity, parasite frequency or dominance, and abundance were estimated, according to Margolis *et al.* 1982 and Bush *et al.* 1997. Helminth community structures for each studied seagull species were established according to Esch *et al*. 1990. Species frequencies higher than 45 % were considered as central species; species with frequencies between 10 %-45 % were considered as secondary species and species with frequencies lower than 10 % were considered as satellite species. Sorensen similitude coefficient (Morales y Pino 1987) were estimated as a function of species richness of each of the three helminth communities with the aim of expressing the degree of likeness between community pairs in a percentual scale. The Fager Affinity Index (Morales y Pino 1987) and a t-test to evaluate its significance level were used to establish the existence of a real association between gut species frequently associated, independently of its abundances. This index was chosen according to the criterion stated by Combes (1983) in the sense that in low prevalence cases, as presently occurs and as frequently found on analyzing helminths parasitic on wildlife, it is convenient to use association indices not including double absences, because they are very common. *Site* occupation percents were estimated to assess helminth species distribution along the guts of seagulls and to detect possible shiftings. For this purpose, the gut was divided in five sections: Duodenum I, Duodenum II, Ileum I, Ileum II and Rectum. For cestodes, the chosen site was defined as the area of scolex attachment according to Bakke (1985).

RESULTS

Percent of parasitism of host seagulls was high. Of all birds examined (44) 84.90 % had parasite helminths (81.77 % in *Larus maculipennis* and 88.89 % in *L. dominicanus* and *L. cirrocephalus* respectively). *Larus dominicanus* was parasitized by up to 6 different helminth species simultaneously, with higher percent of parasitism with 3 species (37.50 %). In *L. maculipennis* the highest percent of parasitism was found with a single species (47.62 %) and in *L. cirrocephalus* with one and two species (37.50 % in both cases) (Table I A). In all three species of studied seagull percent of parasitism found was higher for cestodes with similar values: 87.50 % in *L. dominicanus* and *L. cirrocephalus* and 85.71 % in *L. maculipennis* (Table I A).

Regarding prevalence estimates in *L. dominicanus* highest values corresponded to *Stephanoprora denticulata*, *Tetrabothrius argentinus* and *Alcataenia dominicana* (55.56 % in all three cases) (Fig. 1). In *L. maculipennis* and *L. cirrocephalus* the highest prevalence value was estimated for the cestode *P. porasa* (65.39 % and 55.56 %, respectively) (Fig. 1).

Highest mean intensity values were found for the nematode *P. argentata* (138) in *L. dominicanus* and for the digenean *T. fedtschenkoi* in *L. maculipennis* and *L. cirrocephalus* (56.43 and 24, respectively) (Fig. 2).

In *L. dominicanus* the nematode *P. argentata* (F=47.59 %) turned out to be the central species, the cestode *A. dominicana* (F=16.55 %) and the digenean *S. denticulata* (F=13.45 %) the secondary species, and 5 satellite species: *T. argentinus* (F=8.97 %), *Skrjabinoclava* sp. (F=6.21 %), *Microsomacanthus shetlandicus* Cielecka & Zdzitowiecki, 1981 (F=5.17 %), *Beaverostomum brachhyrhynchus* Gupta, 1963 (F=1.38 %) and *P. porosa* (F=0.69 %) (fig. 3). In *L. maculipennis*, the central species was the digenean (*T. fedtschenkoi*) (F=79.19 %), the secondary species the cestode *P. porosa* (F=14.43 %) and 6 satellite species: *Psilochasmus oxyurus* (Creplin, 1825) Lühe, 1909 (F=3.14 %), *Wardium paucispinosum* Labriola & Suriano, 2000 (F=1.60 %), *S. denticulata*, *T. argentinus* and *M. shetlandicus* (F=0.40, respectively) and *B. brachyrhynchus* (F=0.20 %) (Fig. 3). In

Table I. – A, Parasitism percentages in function of the helminth parasite species number for each group of host species. B, Fager affinity indices contingence tables. * Significant values with 5 % error.

Table I

A-

	L. dominicanus (n=9)	*L. maculipennis* (n=26)	*L. cirrocephalus* (n=9)	Total (n=44)
Without parasites	11,11%	19,23%	11,11%	15,91%
1 helminth species	12,50%	47,62%	37,50%	37,84%
2 helminth species	25%	33,33%	37,50%	32,43%
3 helminth species	37,50%	14,29%	25%	21,62%
4 helminth species	12,50%	0%	0%	2,70%
5 helminth species	0%	0%	0%	0%
6 helminth species	12,50%	0%	0%	2,70%

	L. dominicanus (n=8)	*L. maculipennis* (n=21)	*L. cirrocephalus* (n=8)	Total (n=37)
Parasitized with digeneans	62,50%	42,86%	50%	48,65%
Parasitized with cestodes	87,50%	85,71%	87,50%	86,49%
Parasitized with nematodes	12,50%	0%	0%	12,50%

B-

Larus dominicanus

	S.denticulata	*T. argentinus*	*P.porosa*	*A. dominicana*
S. denticulata	1	0.80*	0.67*	0.67*
T. argentinus		1	0.57*	0.44*
P. porosa			1	0.33
A. dominicana				1

Larus maculipennis

	S.denticulata	*T. argentinus*	*P. porosa*
S. denticulata	1	0	0.12*
T. argentinus		1	0.22
P.porosa			1

Larus cirrocephalus

	S.denticulata	*T. argentinus*	*P.porosa*	*A. dominicana*
S. denticulata	1	0	0.29	0.5
T. argentinus		1	0.67*	0
P. porosa			1	0
A. dominicana				1

* significant value with 5% error

L. cirrocephalus the *central species* was *T. fedtschenkoi* (F=68.57 %), the same as in the *L. maculipennis* helminthological community. *Secondary species* were represented by the cestode *P. porosa* (F=16.19 %) and by the digenean *S. denticulata* (F=10.48 %). *Satellite species* were *T. argentinus* (F=2.86 %) and *A. dominicana* (F=1,90 %) (Fig. 3).

In *L. dominicanus* the helminth with the higher abundance was *P. argentata* (15.33), while for *L. maculipennis* and *L. cirrocephalus* it was represented by *T. fedtschenkoi* (15.19 and 8, respectively) (Fig. 4).

Species richness of parasitic helminths present in all three gull species was 11 species: 8 in *L. dominicanus* and *L. maculipennis* and 5 in *L. cirrocephalus*. Helminth species common to all three communities were three: *S. denticulata*, *T. argentinus* and *P. porosa*. *B. brachyrhynchus* and *M. shetlandicus* were found in *L. dominicanus* and *L. maculipennis* but were absent in *L. cirrocephalus*. *A. dominicanus* was shared by *L. dominicanus* and *L. cirrocephalus*, and *T. fedtschenkoi* by *L. maculipennis* and *L. cirrocephalus*. *P. oxyurus* and *W. paucispinosum* were collected only in *L. maculipennis*; *P. argentata* and *Skrjabonoclava* sp. were only collected in *L. dominicanus*.

According to the Sorensen Similitude Coefficient obtained, the *L. dominicanus* and *L. maculipennis* communities were the most similar (62.50 %), followed by *L. dominicanus-L. cirrocephalus* and *L. maculipennis-L. cirrocephalus* (61.54 %) respectively. The Fager Indices values are shown in Table I B. For *L. dominicanus*, affinity indices were significative (=0.05) for all pairs of species, with the exception of *A. dominicana-A. argentina* (0.33). In *L. maculipennis*, the Fager Index was significative for the species pair *S. denticulata-T. argentinus* (0.12). For *L. cirrocephalus* the only significative value of the Fager index was *T. argentinus-A. argentinus* (0.67) (=0.05) (Table I B).

Regarding helminth species distribution along the gut in host species studied, *Psilochasmus oxyurus* was distributed in Duodenum II and Ileum I; *Stephanoprora denticulata* in Duodenum I, Ileum I, Ileum II and rectum and *Beaverostomum brachyrhynchus* was only present at Ileum II. *Tetrabothrius argentinus, Paricterotaenia porosa* and *Alcataenia dominicana* were distributed along all the gut. *M. shetlandicus* was found at Duodenum I, Duodenum II and Ileum I and *Wardium paucispinosum* was collected from Ileum I and II. (Fig. 5). With regard to *site shifting*, when *T. argentinus* is alone, it inhabits all the gut (genera-

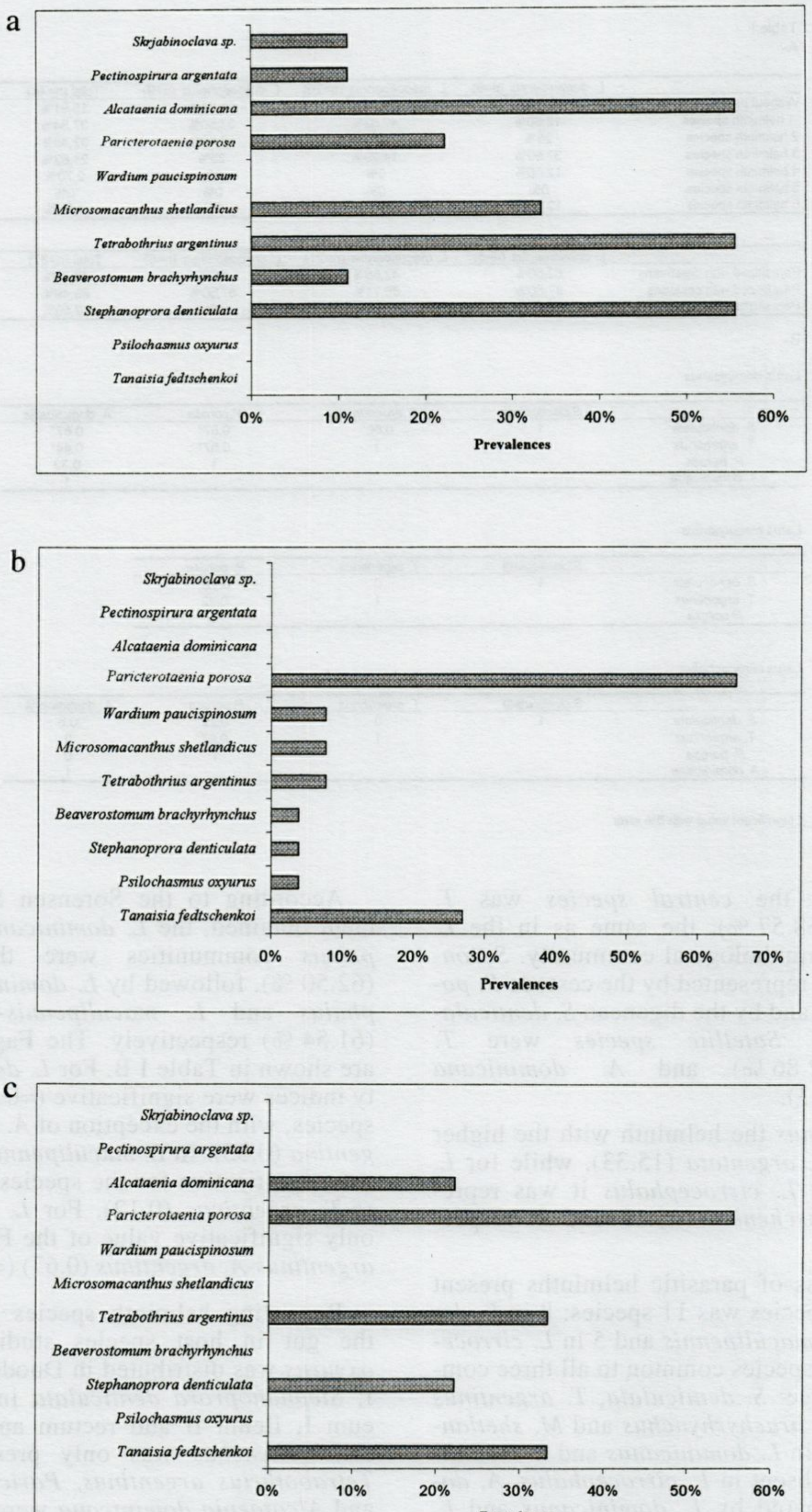
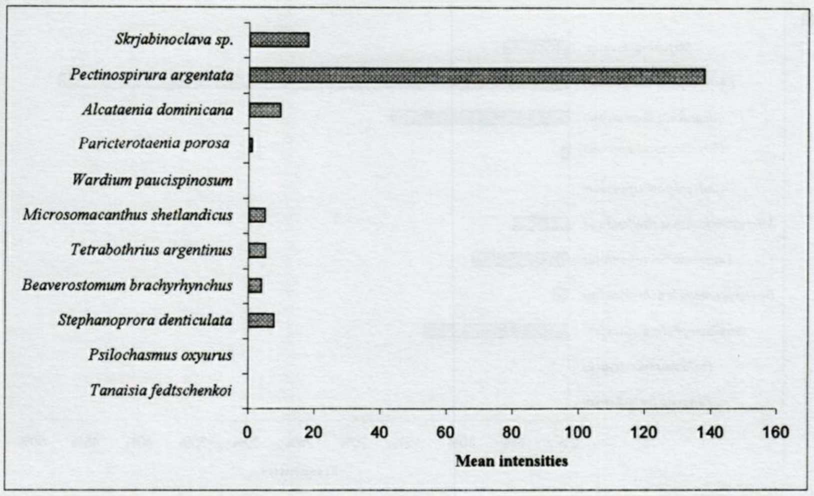
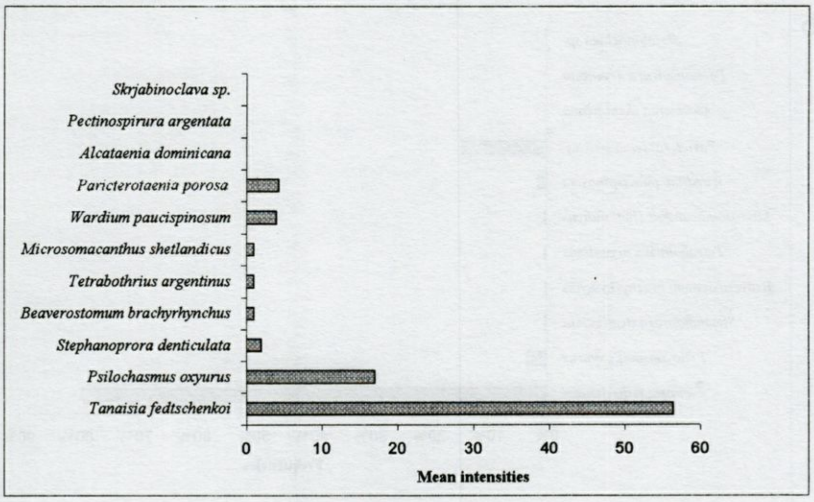


Fig. 1. – Parasite helminth prevalence in: a, *Larus dominicanus*; b, *L. maculipennis*; c, *L. cirrocephalus*.

a



b



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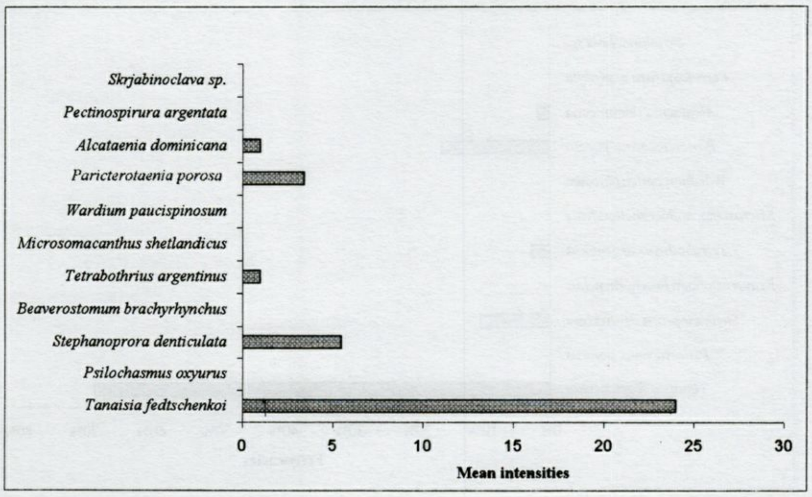
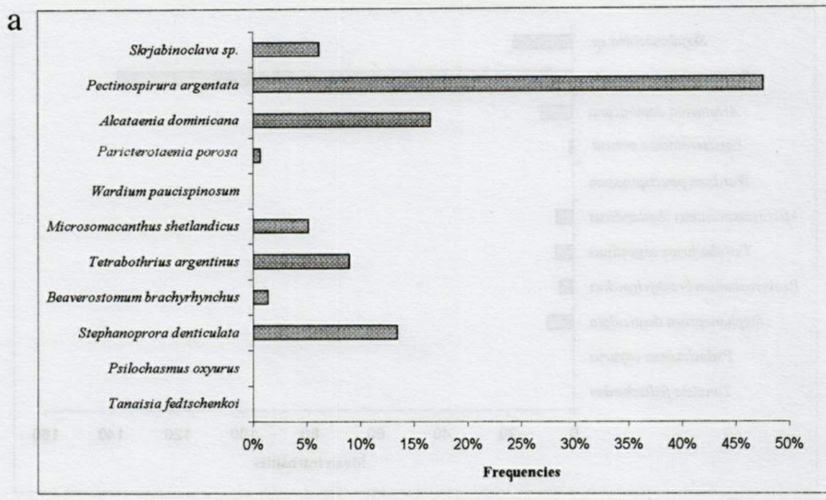
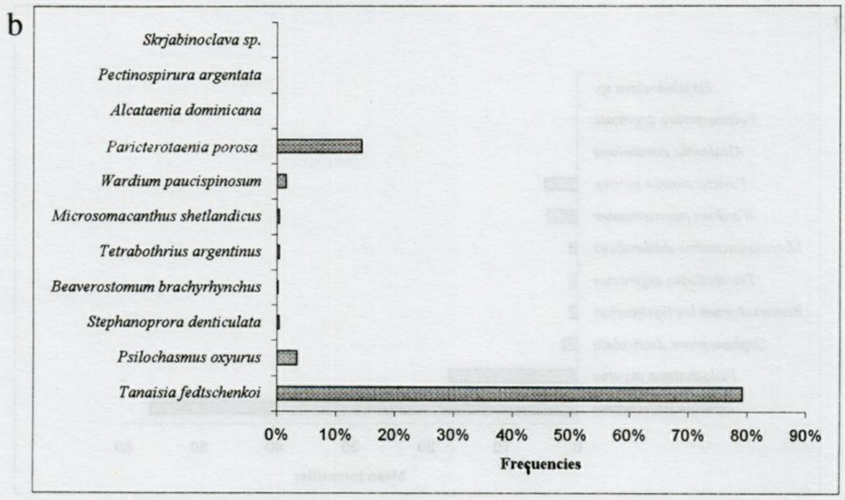


Fig. 2. – Parasite helminth mean intensities in: a, *Larus dominicanus;* b, *L. maculipennis;* c, *L. cirrocephalus.*





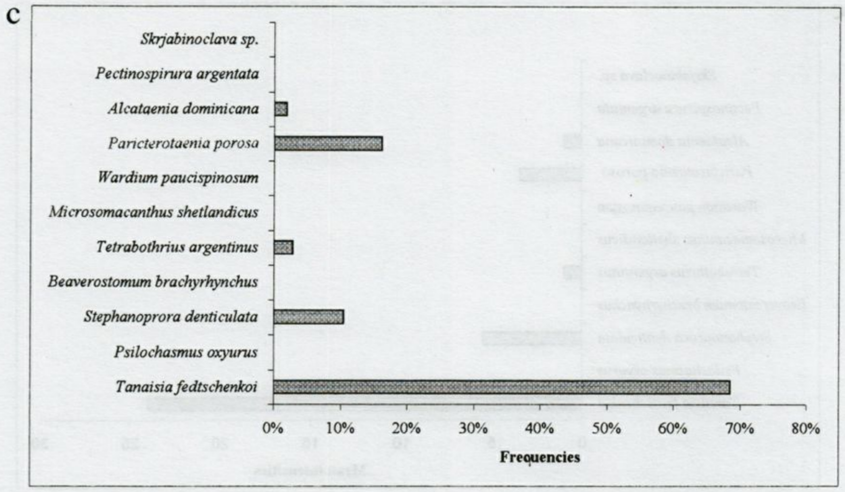


Fig. 3. – Parasite helminth frequencies in: a, *Larus dominicanus*; b, *L. maculipennis*; c, *L. cirrocephalus*.

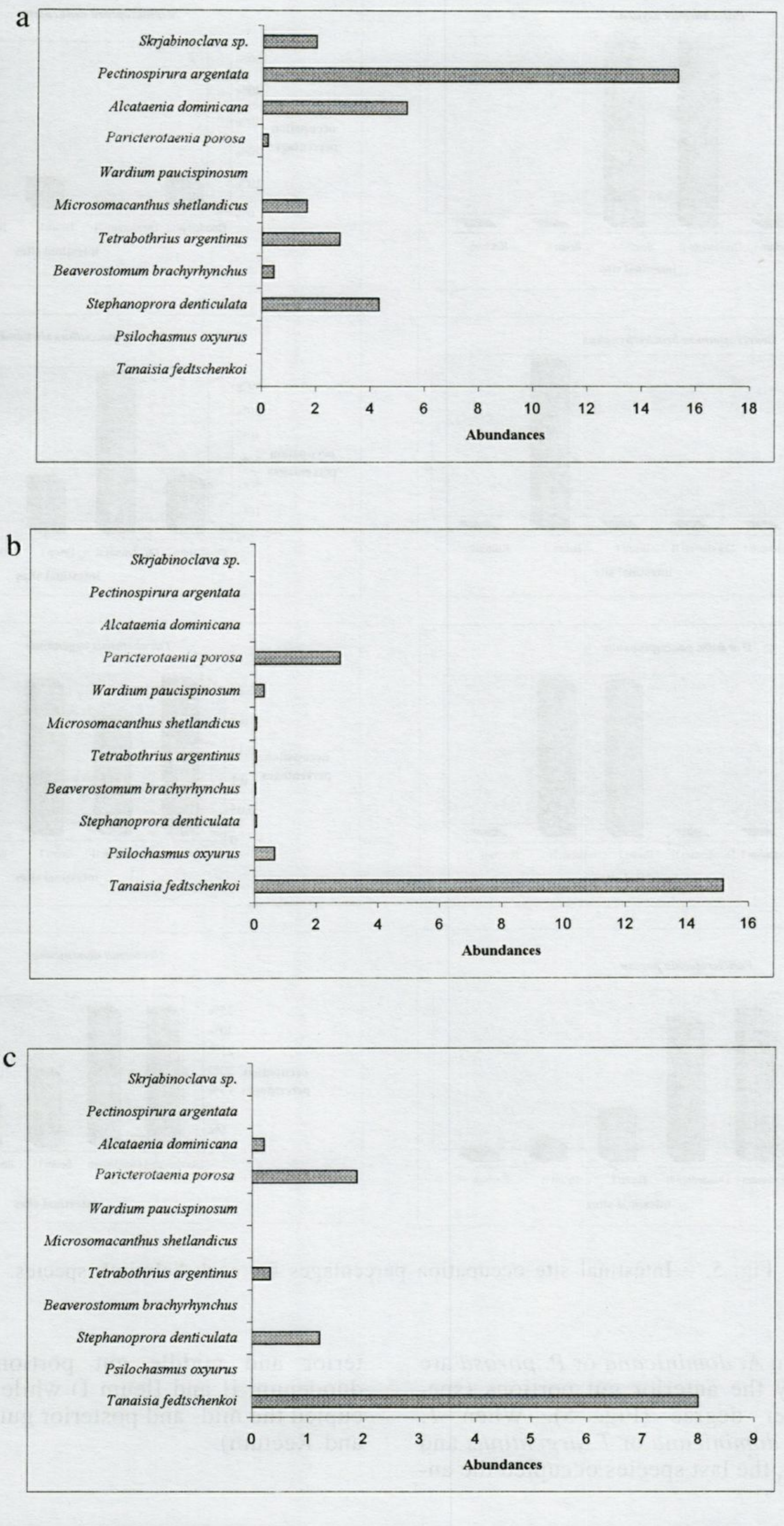


Fig. 4. – Parasite helminth abundances in: a, *Larus dominicanus*; b, *L. maculipennis*; c, *L. cirrocephalus*.

Figure 5

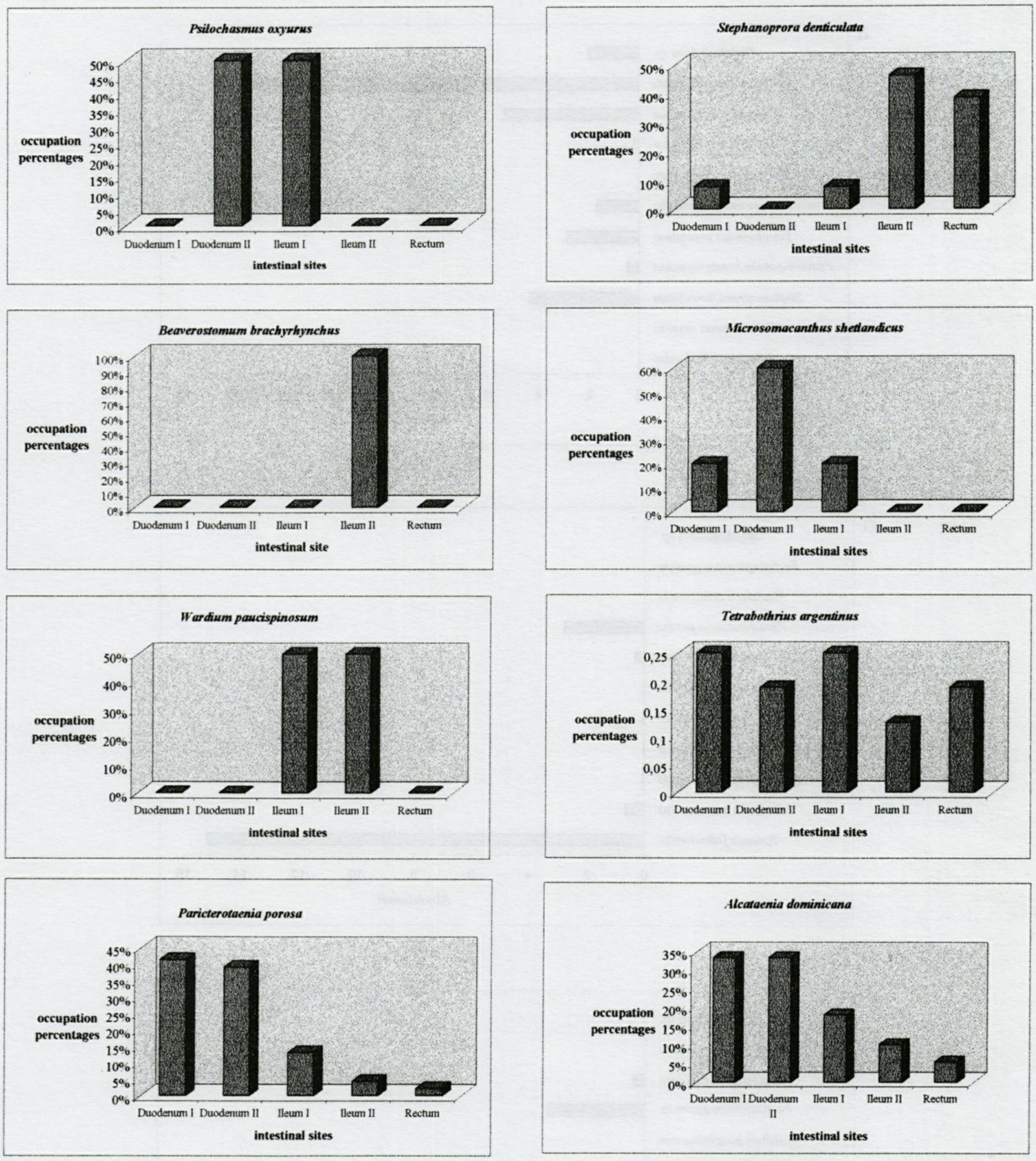


Fig. 5. – Intestinal site occupation percentages for each helminth species.

list) (Fig. 5). When *A. dominicana* or *P. porosa* are alone they occupy the anterior gut portions (specialists) in higher degree (Fig. 5). When *T. argentinus* and *A. dominicana* or *T. argentinus* and *P. porosa* cooccur, the last species occupied the anterior and middle gut portions (Duodenum I, duodenum II and Ileum I) while *T. argentinus* occupied the mid- and posterior gut (Ileum I, Ileum II and Rectum).

DISCUSSION

All three gull species considered have similar feeding habits, being associated in their feeding areas. However, it is necessary to take into account host feeding habits and areas and life cycles of their parasites to be able to explain the presence of the helminths found in each avian species and the composition of their helminthological community as well. This in turn allows inferring each bird's higher or lower association with marine, freshwater or terrestrial environment. With regard to digenean species found in all three communities as a whole, they were: *Tanaisia fedtschenkoi*, *Beaverostomum brachyrhynchus, Stephanoprora denticulata* and *Psilochasmus oxyurus*. Not all life cycles of all these species are known, but there are papers (Szidat 1957, Wisniewski 1958, Pojmanska *et al.* 1984), reporting that their intermediate hosts are freshwater gasteropods and that *S. denticulata* and probably *B. brachyrhynchus* have as secondary or paratenic host a freshwater fish. That indicates, in principle, that all three bird species caught freshwater prey. However, the structure of their respective helminthological communities (*T. fedtschenkoi* is the central species of the *L. maculipennis* and *L. cirrocephalus* helminthological communities but is not represented in *L. dominicanus* helminthological community, where the digenean *S. denticulata* is the secondary species) allows to infer that *L. dominicanus* eats preferentially fishes, while *L. cirrocephalus* and *L. maculipennis* eat mainly molluscs. Regarding the cestodes *Alcataenia dominicana*, *Paricterotaenia porosa, Wardium paucispinosum*, *Microsomacanthus shetlandicus* and *Tetrabothrius argentinus* are present in all three communities as a whole. Two common cestodes species were *T. argentinus* and *P. porosa*. *W. paucispinosum* was not present in *L. maculipennis*; *A. dominicana* in *L. cirrocephalus* and *W. paucispinosum* and *M. shetlandicus* in *L. cirrocephalus*. Although knowledge on life cycles of these cestodes is scarce, it is known that the life cycles of dilepidids involves a marine inshore crustacean as the only intermediate host (Jarecka *et al.* 1984, Galaktionov 1996, Hoberg 1996) while marine or freshwater copepods, ostracods or gammarids are the intermediate hosts of the majority of himenolepidid species parasites of aquatic birds. The tetrabothridean life cycle includes two intermediate hosts: a planktonic crustacean and a marine fish or cephalopod (Hoberg 1989, 1996, Galaktionov 1996). Nematode species present were *Pectinospirura argentata* and *Skrjabinoclava* sp. Although the life cycle of *P. argentata* has not been elucidated yet, nematodes of the Acuariidae family parasiting aquatic hosts develop in the hemocoel of marine crustaceans up to their third larval stage (Wong *et al.* 1989). Of all three gull species studied, only *L. dominicanus* was parasited by both aforementioned nematode species. All facts mentioned on life cycles of all helminths found apart from the table on parasite presence-absence suggest that though all host birds have similar feeding habits and their feeding areas sometimes overlap, *L. maculipennis* and *L. cirrocephalus* are preferably associated to the freshwater environments. On the other hand, in the community structure of *L. dominicanus* parasites, the central species (*P. argentata* and *Skrjabinoclava* sp) have a marine-related life cycle. On the other hand, digeneans whose life cycle involves freswater molluscs are absent from the aformentioned helminthological community. This suggests that *L. dominicanus* is the host species more closely associated to the marine environment and that, on the other hand, it feeds on larger prey than *L. maculipennis* and *L. cirrocephalus* (fishes and molluscs).

Two cases of site shifting were observed: that of *Tetrabothrius argentinus-P. porosa* and that of *T. argentinus-Alcataenia domincana*. In both cases *T. argentinus* shifted to the posterior gut portions in the presence of specimens from one of the two other species.

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