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# Notes on the biology of the freshwater stingrays *Paratrygon aiereba* (Müller & Henle, 1841) and *Potamotrygon orbignyi* (Castelnau, 1855) (Chondrichthyes: Potamotrygonidae) in the Venezuelan *llanos*

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**Accepted: 25.09.1996**

**Keywords:** *Paratrygon aiereba, Potamotrygon orbignyi,* Potamotrygonidae, freshwater stingrays, Caño Guaritico, *llanos*, Venezuela, biology

**Abstract:**

The ontogenetic development, reproduction, feeding habits and habitat of the stingrays *Paratrygon aiereba* and *Potamotrygon orbignyi* from the Venezuelan *llanos* (Apure river basin) were studied.

According to the ontogenetic development, four stages were considered: fetuses, immatures, sexually maturing and mature individuals. The variation of 12 measurements and their development in relation to disk width are described. *P. aiereba* attained greater size (780 mm DW) and weight (25 kg) than *P. orbignyi* (325 mm DW) and weight (2 kg).

In *P. aiereba* males, sexual maturity is apparently reached at a size larger than 410 mm DW, whereas in *P. orbignyi* sexual maturity is attained at 230 mm DW. Females show signs of sexual maturation at 370 and 185 mm DW in *P. aiereba* and *P. orbignyi* respectively. Pregnancy and littering in both species goes on all year. Births seem to be more frequent during the rainy season. According to our data, the litter size varies between one and two young in each reproductive cycle in both species.

*P. aiereba* is a piscivore even though shrimps are important items in its diet. *P. orbignyi* is essentially an insect feeder.

*P. aiereba* has been observed only in the main channel of the Caño Guaritico (clear water) whereas *P. orbignyi* is usually found in a wide range of habitats and water types.

**Resumen:**

Se estudian diferentes aspectos relacionados con el desarrollo ontogenético, reproducción, hábitos alimenticios y hábitat de las rayas *Paratrygon aiereba* y *Potamotrygon orbignyi* en los *llanos* de Venezuela (cuenca del río Apure).

De acuerdo al desarrollo ontogenético se consideraron cuatro estadios, fetos, inmaduros, en maduración y maduros sexualmente. Se discute la variación de doce medidas corporales a lo largo del desarrollo y su relación con el ancho del disco. *P. aiereba* es la especie que alcanzó la mayor talla (780 mm ancho discal) y peso (25 kg) en relación a *P. orbignyi* (325 mm ancho discal) y peso ( 2 kg).

En *P. aiereba* la talla de madurez sexual debe estar por encima de los 410 mm de ancho discal, mientras que en *P. orbignyi* individuos de 230 mm de ancho discal ya están iniciando la madurez. Las hembras de *P. aiereba* muestran indicios de madurez sexual a partir de 370 mm de ancho discal y *P. orbignyi* a partír de los 185 mm ancho discal. Tanto la gestación como los nacimientos tienen lugar durante todo el año, aunque éstos últimos parecen ser más frecuentes durante las lluvias. El tamaño de la camada varió entre 1 y 2 crías por evento reproductivo en ambas especies.

*P. aiereba* es ictiofaga aunque los camarones representan un item importante de su dieta. *P. orbignyi* consume esencialmente fases inmaduras de insectos acuáticos.

*P. aiereba* ha sido encontrada unicamente en el cauce principal del Caño Guaritico (aguas claras) mientras que *P. orbignyi* se encuentra en todos los hábitats y tipos de agua.

**Zusammenfassung:**

Ontogenese, Reproduktion, Nahrung und Habitat der Stachelrochenarten *Paratrygon aiereba* und *Potamotrygon orbignyi* aus den *llanos* Venezuelas (Apure-Becken) wurden untersucht.

Vier Entwicklungstadien wurden untersucht: Föten, Adoleszente, Subadulte und Adulte. Die Variation von 12 Körpermaßen und ihre Entwicklung in Relation zur Körperscheibenbreite werden beschrieben. *P. aiereba* wird größer (780 mm Breite) und schwerer (25 kg) als *P. orbignyi* (325 mm Breite, 2 kg).

*P. aiereba*-Männchen erreichen die sexuelle Reife

bei mehr als 410 mm Breite, wogegen die Sexualreife bei *P. orbignyi* bei 230 mm Breite einsetzt. Weibchen zeigen Anzeichen sexueller Reife bei 370 und 185 mm Breite *(P. aiereba* und *P. orbignyi* respektive). Trächtige und gebärende Weibchen wurden während des ganzen Jahres gefunden. Geburten scheinen während der Regensaison häufiger zu sein. Nach unseren Daten variieren die Wurfgrößen beider Arten zwischen ein und zwei Jungen pro Reproduktionszyklus.

*P. aiereba* ist piscivor, obwohl auch Garnelen ein wichtiger Nahrungsbestandteil sind. *P. orbignyi* ist hauptsächlich insectivor.

*P. aiereba* wurde nur im Hauptkanal des Caño Guaritico gefunden (klares Wasser), wohingegen *P. orbignyi* in verschiedenen Habitaten und Gewässertypen gefunden wird.

**Riassunto:**

E´ stato compiuto uno studio sviluppo ontogenetico (riproduzione, alimentazione, abitudini ed habitat) delle razze *Paratrygon aiereba* e *Potamotrygon orbignyi* degli *llanos* del Venezuela (bacino del Rio Apure).

Sono state prese in considerazione quattro fasi: feto, immaturo, individuo in fase di maturazione e sessualmente maturo. Vengono descritte le variazioni di 12 parametri corporei ed il loro diverso sviluppo in relazione all´ampiezza del disco. Le maggiori dimensioni sono state registrate in *P. aiereba* (780 mm./diam. e 25 kg./peso) rispetto a *P. orbignyi* (325 mm./diam. e 2 kg./peso).

Apparentemente nei maschi di *P. aiereba* la maturità sessuale non viene raggiunta prima dei 410 mm./diam., mentre in *P. orbignyi* inizia con i 230 mm./diam. In *P. aiereba* e *P. orbignyi* le femmine manifestano i primi segni di maturazione sessuale al raggiungimento dei 370 e 185 mm./diam. rispettivamente. Nelle due specie gravidanza e parto si verificano tutto l´anno, anche se le nascite sembrerebbero più frequenti durante la stagione delle pioggie. Sulla base dei dati in nostro possesso il numero dei nati per ogni parto oscilla in entrambe tra 1 e 2.

*P. aiereba* è prevalentemente piscivoro, anche se i gamberi sono una componente importante della sua dieta, mentre *P. orbignyi* è sostanzialmente insettivoro.

*P. aiereba* è stato osservato solo nel canale principale del Caño Guaritico (acque chiare), mentre *P. orbignyi* è normalmente presente in un´ampia varietà di ambienti acquatici.

**Resumé:**

L'ontogenèse, la reproduction, les comportements alimentaires et l'habitat de deux raies à aiguillon des *llanos* vénézuéliens (bassin du Rio Apure), *Paratrygon aiereba* et *Potamotrygon orbignyi,* sont étudiés.

L'étude de l'ontogenèse porte sur quatre stades de développement: fœtus, juvéniles, subadultes et adultes. La variabilité de 12 mensurations est rapportée relativement au diamètre du disque. *P. aiereba* atteint une taille (780 mm DD) et un poids (25 kg) supérieurs à ceux de *P. orbignyi* (325 mm DD et 2 kg).

Chez *P. aiereba,* les mâles semblent n'atteindre la maturité sexuelle que lorsque leur taille dépasse 410 mm DD alors qu'elle intervient dès 230 mm DD chez *P. orbignyi.* Pour les femelles, les signes de maturité sexuelle apparaissent à 370 et 185 mm DD pour *P. aiereba* et *P. orbignyi* respectivement. Dans les deux espèces, l'état de gravidité est indépendant de la saison. Les naissances semblent plus fréquentes au cours de la saison des pluies. Selon nos informations, la taille des portées varie de un à deux jeunes dans les deux espèces.

*P. aiereba* est piscivore bien que les crevettes représentent une part non négligeable de son alimentation. *P. orbignyi* est essentiellement insectivore.

*P. aiereba* n'a été observée que dans le cours principal du Caño Guaritico (eaux claires) alors que *P. orbignyi* peut être trouvée dans des biotopes et des qualités d'eau très variés.

## Introduction

The freshwater stingrays (family Potamotrygonidae) are classified in 3 genera: The monotypic genera *Paratrygon* Duméril, 1865, and *Plesiotrygon* Rosa, Castello and Thorson,1987, and *Potamotrygon* Garman, 1877, with 18 valid species (Rosa, 1985, Rosa *et al.*, 1987). The stingrays occur in most river systems of South America, except those that drain into the Pacific and into the Atlantic coastal drainages south of the Rio de la Plata. The freshwaters stingrays are apparently absent from the Rio Sao Francisco system in Coastal Brazil (Brooks *et al.*, 1981, Rosa, 1985).

In Venezuela, 5 species have been reported : *Paratrygon aiereba*, (Müller & Henle, 1841); *Potamotrygon orbignyi* (Castelnau, 1855), *P. schroederi* Fernández-Yépez, 1958, *P. yepezi* Castex and Castello, 1970 and *P. motoro* (Natterer, 1841) (Lasso, 1985, López-Corcuera, 1984, Mago, 1970, Rosa, 1985). Citations of *P. brachyura* (Günther, 1880) *P. histrix* (Müller & Henle, 1834), *P. magdalenae* and *P. reticulatus* (Ribeiro, 1907) for Venezuela possibly represent misidentifications or compilations based on the erroneous geographic range (Rosa, 1985).

In spite of their wide distribution, and abundance in some regions of Venezuela, they are not commercially exploited. Additionally their taxonomy and biological aspects are practically unknown. Previous investigations have been published concerning potamotrygonid respiratory function and sensory systems (Achenbach,

1969,1972, Szabo *et al.*, 1972), osmoregulation (Junqueira *et al.*, 1968, Thorson, 1970, Thorson *et al.*, 1967, 1978), reproduction and development (Castex, 1963 a,b, Castex & Maciel, 1965, Taniuchi & Ishihara, 1990, Teshima & Takashita, 1992, Thorson *et al.*, 1983).

Scattered notes are available about the biology of freshwater stingrays in Venezuela (Fernández-Yépez and Espinosa, 1970, Lasso, 1985, López-Corcuera, 1984, Machado-Allison, 1987, Winemiller, 1989, Winemiller and Taphorn, 1989).

This paper reports the results of the research on *Paratrygon aiereba* and *Potamotrygon orbignyi* carried out in the Caño Guaritico (Apure river basin) from 1989 to 1993.

## Study area

Sampling was carried out in the lowland Venezuelan *llanos* in a protected area in Caño Guaritico Basin and Hato El Frio (Apure State) (Fig. 1). Caño Guaritico is located in the upper section of the Apure river basin (Ramia, 1972). In this region, enormous areas of land are flooded to a very shallow depth by rain water as well as by overspill from river flooding (Welcomme, 1985).

The climatology of the area shows two contrasting periods; the dry season, which extends from November to April, and the rainy season, which extends from May to October. These climatic conditions lead to two hydrological periods: low water (December-May) and high water (June-November) (Lasso and Castroviejo, 1992).

According to the classification of Amazonian river waters (Sioli, 1965), the Caño Guaritico has clear water, whereas adjacent flooded areas and streams have white water. Ranges for pH, water temperature, conductivity and water transparency are shown in Table I. Additional data for each site during the study periods are given in Lasso and Castroviejo (1992) and Señaris and Lasso (1993).

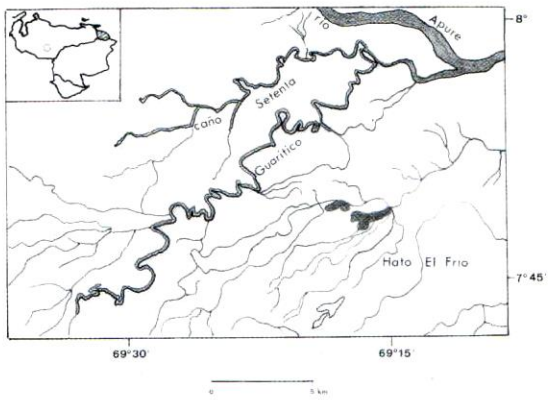


**Fig. 1.** Map of the study area in Apure, showing Caño Guaritico and major streams or *caños*.

## Material and Methods

Approximately 150 stingrays of different species were collected in Caño Guaritico and adjacent flooded areas and streams over a five-year period (1989-1993). Collections were made during both dry and rainy season (low and high water periods).

Stingrays were captured with baited hook and line, gill net, beach seine and trawl net adapted to dugout canoes (López-Rojas *et al.*, 1984, Lasso and Castroviejo, 1992). Additional specimens were bought from fishermen who caught them using traditional harpoons (Fig. 2).

Measurements follow Rosa *et al.* (1987), and we considered the comparative measures of Thorson *et al.* (1983). Measurements over 150 mm were taken to the nearest millimetre with a steel ruler; those under 150 mm were taken to the nearest tenth of a millimetre with dial calipers. All measurements are expressed as proportions (percentages) of disk width and were taken from preserved specimens (ethanol 70%). Disk widths (DW) used only for disk width-weight relationships were taken from freshly caught specimens.

Two basic methods were employed for stomach content analysis, frequency of occurrence (Hyslop, 1980) and total volume (Goulding, 1980). Volumetric measurements were based on total stomach fullness and the relative contribution of each food item. Stomach fullness was estimated on the basis of the following intervals: empty, 10%, 25%, 50%, 75% or 100%.

**Fig. 2.** Fishing by the traditional method (hook and line) in the Caño Guaritico. All photos by authors.

To measure the relative contribution of each food item in a stomach, we first estimated its volume as a percentage of the total food present (Goulding *et al.*, 1988).

Reference specimens are deposited in the following institutions: Museo de Historia Natural La Salle (MHNLS), Caracas, Venezuela and Centro de Estudios Tropicales (CET), Seville, Spain.

## Results and Discussion

### Morphology and development

#### Size

***Paratrygon aiereba*** (Fig. 3)

Twenty males and 18 females were measured fresh (disk width, DW) and weighed in the field. The range of disk width was 125-650 mm and 196-780 mm for males and for females, respectively (Fig. 4). The relation between disk width and weight in both sexes is shown in figures 5 a,b. The largest specimen measured was a female with 780 mm disk width and weighing 25 kg. The maximum size in males was 650 mm DW and 14 kg .

*Paratrygon aiereba* reach the largest size of all the potamotrygonids. Only two other members of this family come near this size: *Plesiotrygon iwamae* (579 mm DW) (Rosa *et al.*, 1987) and *Potamotrygon brachyura* (858 mm DW) (Rosa, 1985). Another unidentified species of *Potamotrygon*, misidentified as *P. histrix*, from the Orinoco drainage can reach 590 mm DW (Lasso, unpublished data). The largest specimen of *P. aiereba* known is a female with 870 mm DW (920 mm DL) (Rosa, 1985).

***Potamotrygon orbignyi*** (Fig. 6)

Of 52 specimens examined, 17 were males and 35 females. The range of disk width for males was 108-290 mm and 107-325 mm for females (Fig. 7). Disk width-weight relationships in both sexes are shown in figures 8 a,b. The largest male measured was 290 mm DW and 1.4 kg. The females were larger with a maximum size of 325 mm DW and 2 kg.

Thorson *et al.* (1983) report a maximum size of approximately 600 mm DW and 13 kg for *Potamotrygon constellata* (=*P. circularis*) and 550 mm DW and 8.5 kg weight for *Potamotrygon motoro*. In a study of *Potamotrygon magdalenae* in Colombia, Teshima and Takeshita (1992) reported a maximum size of 357 mm DW for females and 260 mm DW for males. No weight

**Fig. 3.** *Raya manta* (*Paratrygon aiereba*, adult specimen, 442 mm DW), collected in Caño Guaritico.

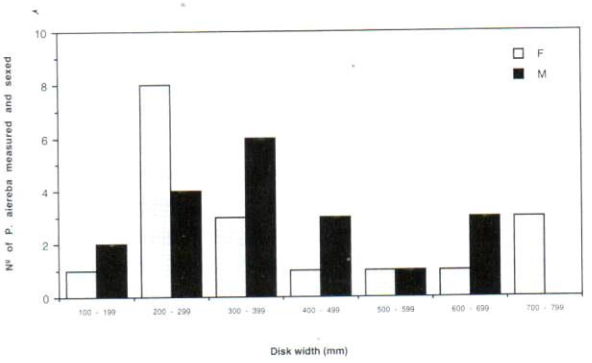


**Fig. 4.** Size frequency, by sex, of *Paratrygon aiereba* that were measured and sexed. N=38 (20 males and 18 females).

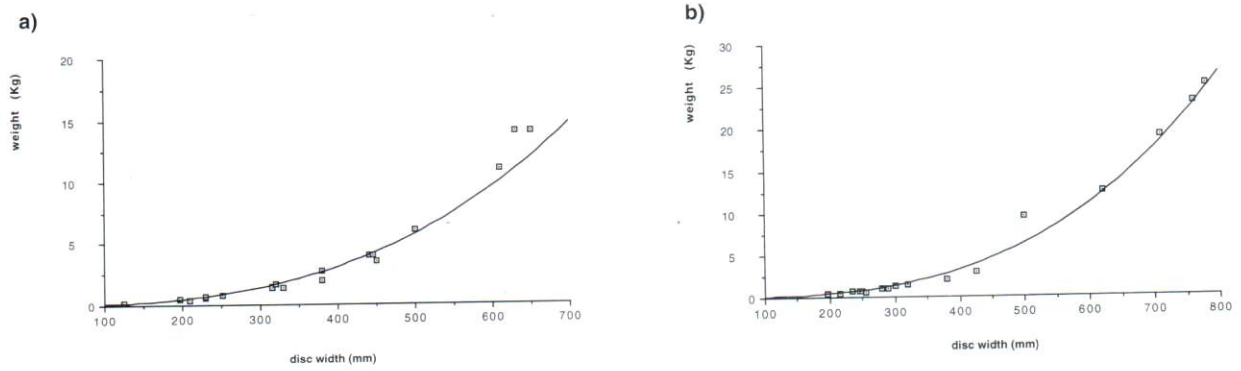


**Fig. 5.** Size/weight relationships in 18 males (a) and 17 females (b) of *Paratrygon aiereba*.

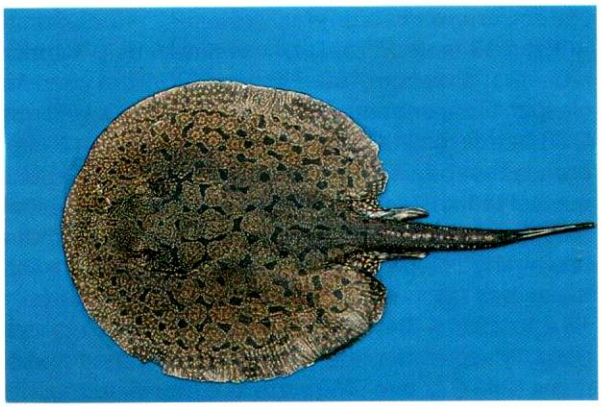

**Fig. 6.** *Raya tigrita* (*Potamotrygon orbignyi* , adult male - 320 mm DW), collected in Caño Macanillal.

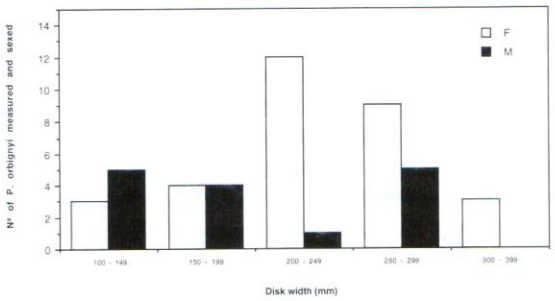


**Fig. 7.** Size frequency, by sex, of *Potamotrygon orbignyi* that were measured and sexed. N=52 (17 males and 35 females).

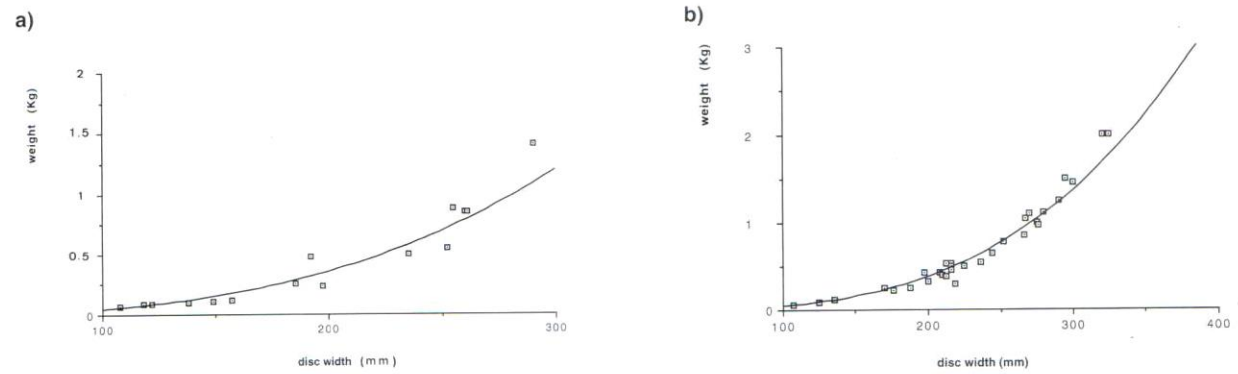


**Fig. 8.** Size/weight relationships in 15 males (a) and 31 females (b) of *Potamotrygon orbignyi.*

data were reported for this species. Additional information relevant to the size of *Potamotrygon* species is compiled by Rosa (1985).

## Body measurements

In order to characterize stingray ontogenetic development and allometric growth, 16 measurements were made on a series of 28 individuals of *Paratrygon aiereba* and 17 of *Potamotrygon orbignyi.* One fetal stage and three post-natal stages (inmature or juvenile, sexually maturing and mature) were considered. The mean of each measurement is expressed as a percentage of the disk width (DW).

### *Paratrygon aiereba*

(125-530 mm DW; 335-746 mm TL)

Some of the proportional measurements (nº 1-7) of the 28 specimens decrease from the fetal stage to sexual maturity. The others (nº 8-16) show little ontogenetic developmental change (Table II). The decrease of the disk length /DW is rather constant at all the different stages, 114% in fetuses, 111.9% in inmature and 103.9% in mature individuals, although two sexually mature females of *P. aiereba* measured in the field (610 and 780 mm DW; 680 and 780 DL) showed an increase of disk length/DW (108.6%). This difference can be explained by individual variation, but a larger series of mature specimens might better characterize this change.

The reduction in relative size (% DW) of disk length and the same tendency in the measurements associated with the growth in length (total length, anterior end to mouth, to orbits and to cloaca, tail from level of posterior margin of disk to insertion of spine) could be associated with the circular shape of *Paratrygon* in the adult stage. Rosa (1985) describes the disk shape of *Paratrygon aiereba* as a nearly circular disk, with disk length 1.0-1.2 times DW in specimens of 108-870 mm range of DW.

### *Potamotrygon orbignyi*

(105-325 mm DW; 225-500 mm TL)

Proportional measurements in almost all the cases did not vary appreciably between the four developmental stages. The most important changes occurred in total length (3) and the distance from the anterior end (disk edge) to orbits (5), which decrease from 215% and 27% in fetuses to 132% and 23% in sexually mature fish, respectively (Table IV).

Thorson *et al.* (1983) report for *P. constellata* (Vaillant,

1880) total length/DW decrease from 391.7% in the youngest fetuses to 175.1% in sexually mature fish . In our case this measure changed from 215.6% in the fetal stage to 167.7 % in sexually mature stingrays. The diameter of spiracles also decreases from 8.2% in fetus to 6.8% in sexually mature individuals, considering that the important change occurs at the initial stages: from fetus to juvenile (from 8.2% to 6.5%). However, the distance from the anterior end of the disk to orbits increases in their study of *P. constellata*, whereas this measurement decreases in *P. orbignyi* .

## Reproduction

### Males

Claspers and sexual maturation:

In freshwater stingrays, the best external and conspicuous sign of sexual maturity in the males is the length of the claspers as a percentage of the disk width (Thorson *et al.*, 1983). Clasper length is measured from the posterior margin of the cloaca to the tip of the clasper (Rosa, 1985) .

### *Paratrygon aiereba*

Of the 20 male *Paratrygon aireba* examined, only 8 were available for clasper measurements, ranging from 125-447 mm DW. The specimens of 125-218 mm DW (fetal) and 250-342 mm DW (postnatal) had characteristic juvenile clasper morphology. Clasper lengths (11.7-30 mm) represent 7.4% to 9.5% of DW. The 447 mm male has a clasper of 63.1 mm (14.1% DW) and is sexually maturing (Fig. 9). Unfortunately claspers of sexually maturing males were not available. Even though is not possible to establish a determinated range, an estimate of the size of sexually maturing males is over 447 mm DW.

Rosa *et al* . (1987) described two male *Plesiotrygon iwamae* (573 and 579 mm DW) with relative clasper lengths of 21.2% and 19.3% DW, respectively.

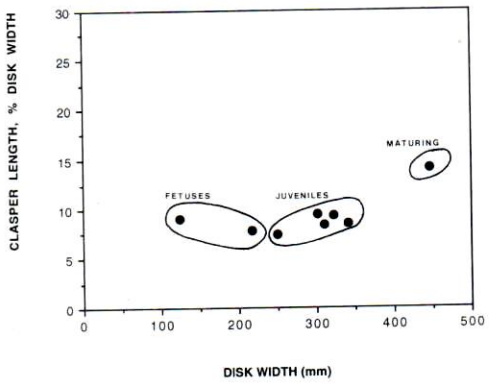


**Fig. 9.** Scattergraph of proportional length of clasper of eight males of *Paratrygon aiereba*.

### *Potamotrygon orbignyi*

Of the 17 male *P. orbignyi* examined, only 9 specimens (ranging from 100-290 mm DW) were used for clasper measurements. Two fetuses (100-106 mm DW) had juvenile clasper morphology (11.3-12 mm) and cannot be separated from the post-natal specimens (116-140 mm DW) with 10-12.6 mm clasper length. Claspers of this group of immature specimens had a range of 8.6-11.9 % DW. The 230-250 mm DW males had claspers 32.6-33.7 mm with a range from 18.2 to 13.5 % DW, indicating that they were at the sexually adolescent stage (Fig. 10). The largest specimens (258-272 mm DW) were sexually maturing with 74.6 and 74 mm clasper length (28.9-27.2 % ). As in other potamotrygonids, the males often mature at somewhat smaller size than females. If we consider the small sample, the maximum size of the species, the variability among individuals and the small difference (28 mm) of the disk width between the two specimens (32.6 and 74.6 mm clasper length), the size at sexual maturity should be near or under 230 mm DW.

Thorson *et al.* (1983) estimated that sexual maturity of males of *P. motoro* takes place between 200-250 mm DW and 320-340 mm DW in *P. constellata*, which in both cases corresponds to more or less the half of the largest size (550-600 mm DW respectively). Males of *P. magdalenae* are estimated to reach maturity between 170 and 190 mm DW (Teshima and Takeshita, 1992).

### Females

Sexual maturity:

Field reproductive information relative to *P. aiereba* and *P. orbignyi* is limited. Detailed observations on the ovary were not made. As reported for *P. motoro* and *P. constellata* (Thorson *et al.*, 1983), only the left ovary is normally present and functional. Seven specimens of *P. aiereba* (250-370 mm DW) were examined, but no evidence of macroscopic ova was found. Ova are

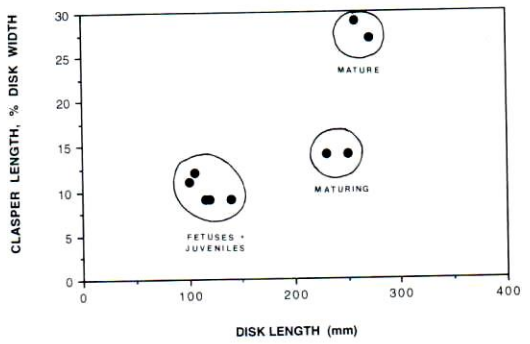


**Fig. 10.** Scattergraph of proportional length of clasper of nine males of *Potamotrygon orbignyi*.

better distinguishable in larger specimens (370 to 530 mm DW) which could indicate the onset of sexual maturity at 370 mm. Females larger than 610 mm DW are fully mature and show reproductive activity.

With regard to *P. orbignyi*, only females from 185 to 290 mm DW showed signs of gonad development. Individuals of 295 mm DW were completely mature, and those larger than this size displayed reproductive activity. Winemiller (1989) considered *P. orbignyi* an extreme case of the life history strategy that corresponds to long generation time (43 months), well-developed parental care, large ova and low fecundity ("equilibrium strategy").

According to Thorson *et al.* (1983), sexual maturity in female *P. motoro* takes place between 240-320 mm DW and from 350 to 450 mm DW in *P. constellata*. Teshima and Takeshita (1992) reported that the females of *P. magdalenae* reach maturity between 170 and 210 mm DW.

**Some reproductive parameters**

At the moment, there is no information about the mating behavior and/or copulation of freshwater stingrays in the field. The only detailed observations come from a captive colony of *P. motoro* (Thorson *et al.*, 1983).

With regard to the pregnancy and littering season, we have recorded fetuses of *P. aiereba* both at the end of the dry season (April) and during the rainy season (June-July). Sexually maturing, mature and pregnant females have also been observed at the end of the dry season. It therefore seems probable that the littering season continues during the rainy season and high water.

Sexually maturing, mature and pregnant *P. orbignyi* females and also fetuses have been observed in the dry season (March). Juveniles have been observed in both seasons, dry (February) and rainy (May to July). As in *P. aiereba*, these observations indicate reproductive activity during the rainy season and high water. The presence of juveniles in the middle of the dry season (February) could be indirect evidence of giving birth at the end of the rainy season and high water the year before. In the same study area, a similar situation was observed in two unidentified species of *Potamotrygon* (Lasso, unpublished data). Based on ten variables related to life history, Winemiller (1989) estimated the duration of the pregnancy season in *P. orbignyi* at 11 months.

Machado-Allison (1987) reported the capture of pregnant females and neonates of *Potamotrygon* sp. during the rainy season, but he did not reject the presence of both of them in other climatic periods.

Thorson *et al.* (1983) reported that the captures of pregnant females of *P. motoro* and *P. constellata* during some years were always between June 15 and July 17, the high water season in the Amazon Basin. Although these authors cannot give conclusive estimates of the gestation or littering seasons of freshwater stingrays in the wild, the onset of breeding activity in captivity of *P. motoro* may be temperature-dependent (low water temperature ). In the Venezuelan *llanos*, it is well known that the beginning of the rainy season and high water are followed by changes in other physico-chemical factors, such as the decrease in the water temperature down to 25 ºC (Machado-Allison, 1987, 1990).

Based on the development of different reproductive features in males and females of *P. magdalenae*, Teshima and Takeshita (1992) suggested that reproductive activity might take place over an extended period of time and that this species may not have a defined reproductive season.

**Litter size**

Only three litters could be accurately counted, one in *Potamotrygon orbignyi* and two in *Paratrygon aiereba* (Table III).

In *P. orbignyi*, litter size was determined by counting intra-uterine fetuses. The only pregnant female (320 mm DW) had one fetus (male 100 mm DW) and seven uterine eggs of different diameters. The other three females had more than five uterine eggs, although ttheir number could not be counted exactly. Winemiller and Taphorn (1989) indicated that *P. orbignyi* almost always has a litter size of two young. Thorson *et al.* (1983) counted 4-11 intra-uterine and aborted young in *P. constellata*, and a mean litter size of 6.3 (range 6-7) in *P. motoro*. Teshima and Takeshita (1992) reported a single embryo develops in each uterus of *P. magdalenae*.

The litter counts of *Paratrygon aiereba* were made from both intra-uterine and aborted specimens. In the first case (female 760 mm DW), we observed one fetus (male 125 mm DW) and two uterine eggs of

**Fig. 11.** Fetus of *Paratrygon aiereba* (female - 230 mm DW) collected in Caño Guaritico.

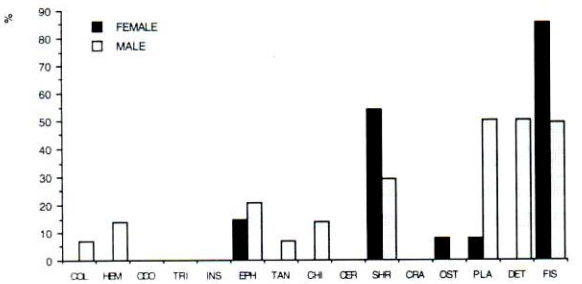


**Fig. 12a.** Stomach content analysis of *Paratrygon aiereba*. Frequency of occurrence method.

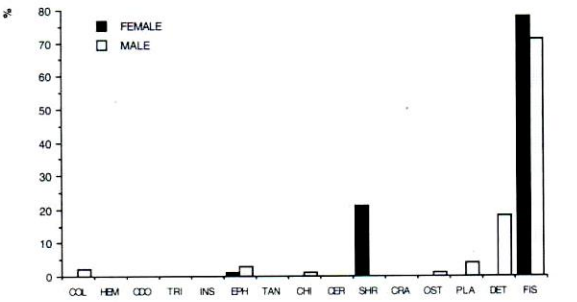


**Fig. 12b.** Stomach content analysis of *Paratrygon aiereba*. Volumetric method.

COL: Coleoptera, HEM: Hemiptera, ODO: Odonata, TRI: Trichoptera, INS: unidentified insects, EPH: Ephemeroptera, TAN: Tanypodinae, CHI: Chironominae, CER: Ceratopogonidae, SHR: shrimp, OST: Ostracoda, PLA: plants, DET: detritus, FIS: fishes.

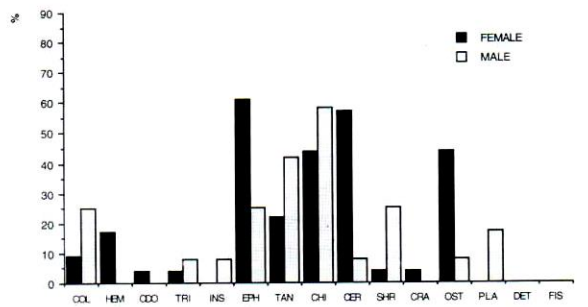


**Fig. 13a.** Stomach contents analysis of *Potamotrygon orbignyi*. Frequency of occurrence method. Abbreviations see Fig. 12.

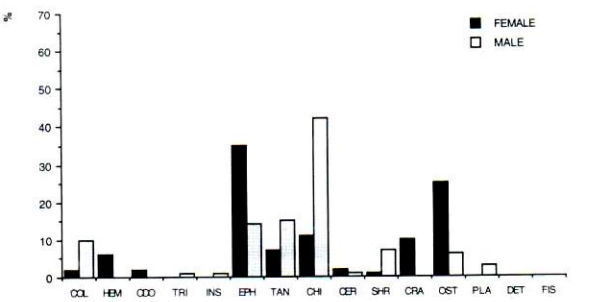


**Fig. 13b.** Stomach contents analysis of *Potamotrygon orbignyi*. Volumetric method. Abbreviations see Fig. 12.

different diameters. The aborted young from a female 620 mm DW were two fetuses (male and female) of similar size (196-197 mm DW). Six more fetuses, ranging 210-239 mm DW, procured by a fisherman, presumably belong to the same mother, but this could not be confirmed (Fig. 11).

## Feeding habits

### *Paratrygon aireba*

Thirty-two stomachs were examined (16 males,16 females) and only one was empty (adult female 780 mm DW). The food was classified in ten categories: Coleoptera, Hemiptera, Ephemeroptera, Tanypodinae, Chironominae, shrimp, Ostracoda, plants, detritus and fishes.

The analysis of the stomach contents, by the method of frequency of occurrence in both sexes, shows that the most important food categories are (male, female): fishes (79%, 85%) and shrimps (28.6%, 53.8%). Males had a higher diet diversity (9 food items) compared to females (5 food items) (Fig. 12a). These results indicate that *Paratrygon aiereba* prefers fishes and shrimps, with fishes as the dominant food.

We arrive at the same conclusion using the volumetric method, even though in this case the invertebrates are less important (Fig. 12b).

The species of fish identified from the stomachs of *P. aiereba* were: *Aphyocharax alburnus*, *Prochilodus mariae*, *Pimelodus blochii* and *Loricariichthys maculatus*. A specimen of *P. mariae* of 325 mm TL was found in the stomach of a female of 760 mm DW. The shrimps were *Macrobrachium amazonicum* and *M. yelskii*.

According to Rosa *et al.* (1987), *P. iwamae* is also piscivorous. Additional stomach contents of unidentified *Potamotrygon* specimens from the Venezuelan *llanos* show that only larger specimens are piscivorous, whereas the smallers ones are insect feeders.

### *Potamotrygon orbignyi*

Forty-six stomachs were examined (15 males, 31 females), 11 of these were empty (3 males, 8 females). Food items were classified in 13 categories: Coleoptera, Hemiptera, Odonata, Trichoptera, Ephemeroptera, Tanypodinae, Chironominae, Ceratopogonidae, shrimps, crabs, Ostracoda, plants and unidentified insects.

**Table I. Physico-chemical data of Caño Guaritico and floodplain streams and lakes.**

| Parameters | Guaritico River | Floodplain | |
|---|---|---|---|
| | | Stream - Swamps | Lakes |
| pH | 6.0 - 7.8 | 6.3 - 6.4 | 6.4 - 7.4 |
| T (°C) | 28 - 32 | 32.0 - 33.5 | 33.0 - 35.0 |
| Conductivity (S $cm^{-1}$) | 19.4 - 21.9 | 20.0 - 40.8 | 20.0 - 80.0 |
| Water transparency (Secchi) (cm) | 20 - 25 | 0 - 4 | 0 - 5 |

**Table II. Morphometric data of 28 preserved specimens of *Paratrygon aiereba*.**

| **Developmental stages** | Fetal | | | Juvenile | | | Sexually maturing | | |
|---|---|---|---|---|---|---|---|---|---|
| **Number of specimens** | 9 | | | 13 | | | 6 | | |
| **Sexes** | 4 male; 5 female | | | 6 males; 7 females | | | 5 males; 1 female | | |
| | Range (mm) | Mean (mm) | % DW | Range (mm) | Mean (mm) | % DW | Range (mm) | Mean (mm) | % DW |
| Disk width (DW) | 125-239 | 207.7 | 100.0 | 250-369 | 304.2 | 100.0 | 380-530 | 451.0 | 100.0 |
| Disk length | 160-269 | 236.7 | 114.0 | 276-418 | 340.5 | 111.9 | 416-529 | 469.0 | 103.9 |
| Total length | 335-586 | 517.9 | 249.3 | 342-661 | 529.5 | 174.0 | 466-746 | 636.6 | 141.1 |
| Anterior end to: | | | | | | | | | |
| mouth | 42.3-79 | 65.0 | 31.3 | 71-115 | 93.6 | 30.8 | 99-140 | 124.2 | 27.5 |
| orbits | 40.8-77 | 64.5 | 31.3 | 71-122 | 93.9 | 30.9 | 109-162 | 134.2 | 29.7 |
| cloaca | 131.1-268 | 199.3 | 96.0 | 176-340 | 263.9 | 86.8 | 324-451 | 379.2 | 84.0 |
| Tail from post. margin of disk to insertion of spine | 19.5-39 | 30.8 | 14.8 | 33-51 | 40.2 | 13.3 | 40-80 | 57.0 | 12.6 |
| width at insertion of spine | 4.2-9.4 | 6.8 | 3.3 | 4.9-12.2 | 7.0 | 2.3 | 7.6-12.5 | 9.8 | 2.2 |
| Horizontal diameter of orbits | 4.2-9.9 | 6.1 | 2.9 | 5.2-11.1 | 7.0 | 2.3 | 4.9-6.8 | 6.1 | 1.4 |
| Horizontal diameter of spiracles | 7.7-12.6 | 10.5 | 5.1 | 10.8-19.9 | 14.1 | 4.6 | 17.1-24.2 | 20.7 | 4.6 |
| Width of mouth | 18.2-25.7 | 23.1 | 11.1 | 24.5-39.9 | 32.3 | 10.6 | 41.1-51.1 | 46.7 | 10.4 |
| Distance between: | | | | | | | | | |
| nares | 11.6-20.1 | 17.3 | 8.3 | 20.0-30.0 | 24.3 | 8.0 | 29.8-42.0 | 34.4 | 7.6 |
| 1st gill slits | 32.8-51.4 | 45.5 | 22.0 | 51.7-89.8 | 67.8 | 22.3 | 83.0-109.0 | 93.6 | 20.8 |
| 5th gill slits | 28.5-43.0 | 37.9 | 18.2 | 46.0-76.5 | 58.1 | 19.1 | 70.0-95.0 | 80.8 | 17.9 |
| orbits | 15.4-28.6 | 23.5 | 11.5 | 24.0-42.7 | 31.8 | 10.5 | 44.6-56.5 | 49.1 | 10.9 |
| spiracles | 26.4-34.6 | 31.9 | 15.4 | 34.6-60.7 | 42.7 | 14.0 | 53.4-67.3 | 59.9 | 13.2 |

**Table III. Data on pregnant females and their litters (*Paratrygon aiereba* and *Potamotrygon orbignyi*).**

| DATE | Disk width of female (mm) | Number and sex of fetuses | Fetal disk width (mm) and number of eggs |
|---|---|---|---|
| *Paratrygon aiereba* | | | |
| 18.4.93 | 760 | 1 male | 125; two uterine eggs (different diameter), no visible development |
| 08.04.94 | 620 | 1 male; 1 female | 196 and 197 |
| *Potamotrygon orbignyi* | | | |
| 06.03.93 | 325 | indeterminate | Uterine eggs only (different diameter), no visible development |
| 06.03.93 | 320 | 1 male | 100; seven uterine eggs (different diameter), no visible development |
| 29.03.93 | 300 | indeterminate | Uterine eggs only (different diameter), no visible development |
| 06.03.93 | 295 | indeterminate | Uterine eggs only (different diameter), no visible development |

**Table IV. Morphometric data on 17 preserved specimens of *Potamotrygon orbignyi*.**

| **Developmental stages** | Fetal | | | Juvenile | | | Sexually maturing | | | Sexually mature | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Number of specimens** | 2 | | | 2 | | | 11 | | | 2 | | |
| **Sexes** | 1 male; 1 female | | | all males | | | 4 males; 7 females | | | all females | | |
| | Range (mm) | Mean (mm) | % DW | Range (mm) | Mean (mm) | % DW | Range (mm) | Mean (mm) | % DW | Range (mm) | Mean (mm) | % DW |
| Disk width (DW) | 105-106 | 105.0 | 100.0 | 140 | 125.3 | 100.0 | 185-290 | 260.7 | 100.0 | 310 | 310.0 | 100.0 |
| Disk length | 115.0 | 115.0 | 109.0 | 120-142 | 129 | 102.9 | 192-315 | 280.7 | 107.7 | 335-340 | 337.5 | 108.9 |
| Total length | 225-230 | 227.5 | 215.6 | 245-265 | 253.3 | 202.2 | 357-523 | 447.2 | 171.5 | 541-500 | 520.5 | 167.7 |
| Anterior end to: | | | | | | | | | | | | |
| mouth | 22.7-23.3 | 23.0 | 21.8 | 25.7-28.2 | 27.5 | 22.0 | 37.8-92 | 55.1 | 21.1 | 56-62 | 59.0 | 19.0 |
| orbits | 27.7-29.3 | 28.5 | 27.0 | 29.6-30 | 31.8 | 25.4 | 45.1-94.7 | 66.7 | 25.6 | 71.1-75 | 73.0 | 23.5 |
| cloaca | 92-94.4 | 93.2 | 88.3 | 102-120 | 108.3 | 86.4 | 157-293 | 231.9 | 89.0 | 280-285 | 282.5 | 91.1 |
| Tail from post. margin of disk to insertion of spine | 38.1-40.3 | 39.2 | 37.0 | 42.6-47.8 | 44.8 | 35.8 | 39.6-132.2 | 96.8 | 37.1 | 120 | 120.0 | 38.7 |
| breadth at insertion of spine | 4.5-5.5 | 5.0 | 4.7 | 4.8-7.7 | 6.2 | 4.9 | 6.5-14.9 | 11.7 | 4.5 | 15-17.3 | 16.1 | 5.2 |
| Horizontal diameter of orbits | 5.9-6.4 | 6.2 | 5.9 | 5.9-6.6 | 6.2 | 4.9 | 4.1-11.6 | 8.8 | 3.4 | 8.2-11.1 | 9.3 | 7.2 |
| Horizontal diameter of spiracles | 7.1-10.2 | 8.7 | 8.2 | 7.6-8.8 | 8.2 | 6.5 | 11.5-19.2 | 15.8 | 6.1 | 19.9-22.5 | 21.2 | 6.8 |
| Width of mouth | 7.9-9.3 | 8.6 | 8.2 | 8.6-10.5 | 9.3 | 7.4 | 10.4-30.3 | 22.6 | 8.7 | 24.9-29.5 | 27.2 | 8.8 |
| Distance between: | | | | | | | | | | | | |
| nares | 7.6-8.7 | 8.2 | 7.8 | 8.6-10.5 | 9.4 | 7.5 | 10.3-24.3 | 18.3 | 7.0 | 24-25.1 | 24.5 | 7.9 |
| 1st gill slits | 26.3-27 | 26.7 | 25.3 | 28-34.6 | 31.3 | 25.0 | 45.4-69.7 | 63.9 | 24.5 | 83.4-86.5 | 84.9 | 27.4 |
| 5th gill slits | 18.1 | 18.1 | 17.2 | 20.7-25 | 23.4 | 18.7 | 31.1-52 | 46.7 | 17.9 | 59.5-61.8 | 60.6 | 19.5 |
| orbits | 15.6-21.3 | 18.5 | 18.0 | 23.4-27 | 25.1 | 20.0 | 31.6-50 | 42.9 | 16.5 | 60-62.8 | 61.4 | 19.8 |
| spiracles | 19.8-19.9 | 19.8 | 18.8 | 23.6-24.5 | 23.9 | 19.1 | 34.2-52.8 | 46.1 | 17.7 | 58.9-61.9 | 60.9 | 19.6 |

*Potamotrygon orbignyi* were primarily insectivorous (Fig. 13a). According to the frequency of occurrence method, the three most important food items were Chironominae (58%), Tanypodinae (42%) and Coleoptera (25%). Females ate mostly Ephemeroptera (61%), Ceratopogonidae (57%), Chironominae and Ostracoda (both 44%). The number of food items was almost the same for both sexes (10 in males, 11 in females). Hemiptera, Odonata and crabs were not present in the stomachs of males.

With the volumetric method the results were quite similar, but the abundance of the most frequent items decreases and the chironomids become the most important item (Fig. 13b).

The species of Ephemeroptera found in the stomachs were as follows in order of abundance: nymphs of *Campsurus* spp., *Astenopus* sp. (Polymitarcidae) and nymphs of *Traverella* sp. (Leptophlebidae).

Larvae of Chironominae, Tanypodinae and Ceratopogonidae (Heleidae) could not be identified to genus level.

Machado-Allison (1987) reported that *Potamotrygon* sp. from the Venezuelan *llanos* feed primarily on shrimps (*Macrobrachium* spp.) and aquatic snails of the genus *Pomacea*.

### Habitat

The *Paratrygon aiereba* were collected exclusively in the main channel of the Caño Guaritico (clear water). This species is apparently more common in the shallower areas and near banks than in the deeper section of the channel.

*Potamotrygon orbignyi* occurs in both white waters and clear waters. Of 42 specimens, 31 (73.8%) were collected in stream-swamps called "inactive *caños*" (Ayarzagüena, 1982), 9 (21.4%) in the Caño Guaritico and 2 (4.8%) in floodplain lakes and artificial lagoons. Lasso and Castroviejo (1992) report *P. orbignyi* and another unidentified species of this genus from the bottom of the Caño Guaritico.

In conclusion, *Paratrygon aiereba* and *Potamotrygon orbignyi* are two common species in the Venezuelan *llanos*. In spite of their medical importance and abundance in other regions of Venezuela, they have not previously been studied. *P. aiereba* reach the largest size and weight of all the potamotrygonids. Like other freshwater stingrays, males of both species often mature at somewhat smaller size than females. Based on development of ovaries, the size of fetal and post-natal stages and at sexual maturity, the reproductive activity may take place over an extended period of time and giving birth seems to be more frequent during the rainy and high water season. *P. aiereba* is piscivorous whereas *P. orbignyi* is essentially an insect feeder.

### ACKNOWLEDGEMENTS

We wish to thank the Asociación Amigos de Doñana (Dr. J. Castroviejo) and Estación Biológica El Frío (Programa Ecodesarrollo de los *llanos* del Orinoco), for the partial support of this project. The Fundación La Salle de Ciencias Naturales, INVEGA and members of the Maldonado's family provided the logistic assistance. The Ministerio de Agricultura y Cría of the Republic of Venezuela provided a permit for the transport of preserved specimens. This study would not have been possible without the field and laboratory assistance of A. Aguirre, C. Señaris, V. Ponte and J. Ayarzagüena. C. Marrero identified the species of aquatic insects. Earlier drafts of this manuscript were reviewed, and valuable suggestions offered by J. Jørgensen, K. Winemiller, C. Granado and A. Machado-Allison. Special appreciation is extended to H. Ishihara for bibliographic information he provided and to the anonymous referee for his comments.

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