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PATTERNS OF TEMPORAL DISTRIBUTION TN THE METAZOAN PARASITOLOGY

OF THE WHITE MULLET, MUGIL CURENA IN JOYUDA LAGOON

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198

---Page Break---

Introtuction

"he inportance of ecological studies in fish paracite opilatione has been increased ty the developmentof aquaculture prograns with fresiwater and murine fetes, Artificial culture conditions enhance the tranuniasion Of cone parasitic species anc usually reduces the natunal defense nechanlems of the hosts against parasitic infections.

Fhowledge abcut Fish-parasite interactions in their natural ecosyctem Provides useful baseline information for aquaculture research, The present study was conducted to provide such baseline information in a fish vikich has jotential for aquaculture, The specific objectives in this study were:

3. To study the temporal distritution and intensity of infection by

JRetazoan parasites in the vhite millet (igi} curena) occurring Sn doyuda? Lagoen-

2. To examine the influence, that changes in the external environ-

ent, have on the parasitic fauna of the white millet.

2+ To determine the effect that spasning and possible migrations

of the fish have on its parasitic camposition.

4+ To add some ecological and biological information about the white

mlet.

?To evaluate the role of Joyuda Lagoon in the life cycle of the

white mullet.

Recent studies have approached sone ecological aspects of fish pare

?site populations in natural ecocystens. However, most of this work has

been done in sub-tropical and tenperate areas. Neckal (1966) reported

seasonal variations of parasites fren the cod in coastal usters of Nona.

Overstreet (1968) calculated significant correlations between monthly rans

of tomperatures,salinity and size of the fish with mean nunbers of parusites

infecting the inshore Lizardfish, Smodus factens, from an estuarine cal

4n South Florida. Roxshall (1874) found a regular annual cycle ot abuwance

§in the ectoparasitic copepod Lepeophtheirus pectoralis, from a populat len of

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vaice in Yorkshire. Rawson (1976) reported seascnal abundance of mono-venetic trematodes in the bluegill, Lepomis macrechirus, in a reservoir in Alabana. Other studies denonstrate that differences in the habitat

?and geographic location are more important than seasonal variables in 1 panasitic composition of some fishes (Stwoeder 1970, Dowgiallo 1973).

1n addition of providing baseline parasitological information about Mui2 cmena, this study is directed to test the hypothesis that seasonally elated factors in Joyuia Lagoon such as salinity variations dictate the Tattam of atundance in the ectoparasitic fauna of its host.

MATERIALS AND METHODS

?The study area

Joyuda Lagoon (Figure 1) is a coastal brackish water systen locate? cn the souttwester: coast of Puerto Rico. The lagoon i approxiinately 1.6lon long and 0.8hm wide, covering an area of 121 hectares. A conepic-uous band of the red mangrove, Ehizochora mangle, bordere the lagoon.

?There is also sone develomnent of the black mangrove, Avicenia nitida, and white mangrove, Laguncularia racemosa, on the westem section. Water xchange between the lagoon and the cea ccoure along @ stall channel bor dared by mangrove which opens seaward into a sendy patch area of turtle grass with soattered coral growth. The average satter depth of the Laucen is 1.3m, with a macimm depth of approxinately 4m. The hotton substrate is composed of soft md sedinents and organic detritus, mainly derived ?from the mangroves.

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Sampling procedures

Nonthdy samples of ten mullet from Joyuda Lagoon ware examined for metazoan yarasites during the period of February 1979 through April 1980. Most of the collections were made wiht monofilament and nylon bottem gil.

nets. The nets were set at sunset and recovered at dain. Fish were placed ?in individual plastic bags and taken directly to the laboratory for exam ination, The tine lapse between the collection of samples and the paraci- tological examinations never exceeded a 16 hour period.

Salinity, temarature and dissolved oxygen measurments were obtained every month at five stations in the lagoon. These data were recorded cn sampling days at the tine of setting the nets.

latoratory procedures

?Tre fish samples wore taken directly fem the field to the laboratory facilities at CER, All fish were weighed and measured (ctandard length) and the gonads were renoved from the fish and weighed.

Parasitological examinations were linited to metazoan (multicellular) species and included the body surface, gills and alinentary tract of the fish. GILL arches were rengved and placed in separute dishes. thabers and species of parasites present were recorded for each gill arch. An incision was made on the right side of each fish and the different ongans Separated and placed in petri dishes. Each ongan was studied as a utole nit for metazoan parasites. A saline solution was added to the dishes to ?void drying and facilitate the exmination. Obeervatiions and sepanatcn Of parusites were made with a dissecting microscope. A description of the ?ethods used for relaxation, fixation and preservation of parasites are discussed elsewhere (e. g. Garcia, 1981).

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Statistical analysis

?The incidence percuntage and intensity of infection by the @!fferent pausitic cpecies were noted as monthly values for the 15 month period. Incidence parcentages represent the proportion cf fishes infected by a Paruicular parasite, Intensity of infection was oxpressed as mean number of tarasited per fish and the total munber of individuals of a parasitic species and the total runber of millet exanined in a month. A logarithmic ?Tarsfomaticn (ee;g ND was applied to the monthly values of intensity of infection. Prevalence represents the presence of a parasite in a nonthly sample. Sinple and multiple regression analysis between the tenperatiwe anc salinity means and the intensity of infection values wore caleclated far every opecies. The correlation coefficients were obtained fren: a program of an Apple II computer, which also calculated the standard carer of estimate,

Hossitie interrelations between parasitic groups were tested for

significance in 2 x 2 contingency tables. The exact probabilities wen

calculated ly the forma Po=(AtB) ! (CHD) ! (ac) t (BHD) as suggested by:

?Tate and Clelland (1987) for snall N values of less than 40 and expected frequencies of lero than 5.

hata cn the stage of sexual maturity were chtained by using an index

?of ronad development. This index is 2 nurerical relationship between the

weight of the fish and the weight of both ovaries. It is expressed as.

G.I. = wx 100

a

lihere G.I. = Gonad Index

w= Weight of both ovaries in grams

W = Weight of fish in grans

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?The relative abundance of white millet in Joyuda Lagoon was: expressed

© 4 proportion between the nunber of individuals of white millet and the

?total collection of fishes in the month, following standard collection

procedures.

RESULTS AND DISCUSSION

' cal paraicters

Salinity - The average salinity in Joyuda Lagoon for the period

between February 1979 and April 1980 was 19.9 ppt. Monthly mean values ranged between @ minima of 12.0 ppt in October 1972 to @ maxim of 30.0

vot in Ajei2 1960. Figure IT presents the monthly fluctuations in salinity

Sumer months (ay-Cetober) averaged lower

8.6) while the winter period (ovenber-Aprit) presented

uring the study per:

salinity values

a higher average value (R=20.8).

Monthly mean values indicate that the salinity pattem in the lagcon ?is unstable and that moderate variability oan occur in short time intervals of less than one month. Salinity is mostly determined by the anount of Precipitation and runoff, the tenperature and wind effect on evaporation and the intrusion of sea water during high tides.

?Temperature - The average water temperature was 27.7°C, Monthly mean values ranged between a macimm of 30.0°C in May and July 2979 and a

inimm of 24.°C in February 1980. Figure IIT precents the monthly

variation in mean tenperature values. The average water texperature was

higher during the sumer months (May-October) with 7=28.0°C as compared

?to the winter months (Novenber-April) with ¥227.0°C, The gradual decrease

of water temperature started in September and reached its lowest point ty

February. ?The pattem of water temperature is affected by air tenpereture

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FIGURE 11, Monthly means and range of salinity at Joyuda

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Seomuse of the shallow nature of the lagoon and relativily stagnant con-

ition of the water. Short tem variatien in water temperature nay ccour

38 result of heavy precipitation and the drain of cold freshwater fren

the mnof! of adjacent mountains.

Dissolved Guzen - The content of aiesolved axygen in the water ranged

fram 7 ppm 3n March 1980 and 7.2 ppm in Apri and December 1990, Aithough

Poderute variation occurred cn a nenthly basis, the sumer period registered

@ rather stable ccntent of 0, in the water ss cenpared to the winter renths in which the degree of variation from month to nenth was high (see Figure TN). TE we account for the tenperuture and salinity effect on the afferent crpected levels of 0, saturation, the variation in the monthly percentages Of 0p satwrution mist be related to biological prosésses ccourring in the lagoon. Table I presents the monthly values of the percentages of 07 saturation.

Relative abundance of white rullet in Joyuda Lagoon,

?The relative abundance of white millet in monthly samples indicated @ peak in February 1979 with 818 of the total capture in a sanple size of 193 individuals. Another high value was recorded in September 2979 with 32% in a sample size of 49 individuals. Figure V presents the monthly variation in relative abundance of white millet. ?he sudden decrease in abundance of white millet after Fetruary tends to support the theery of an offshore spawning migration of this fish, as has been already suggested by ?Andersen (1957), Yoore (4974) and Yanez-Arencibia (1976). Index of gonad maturity (see Table 1) indicated that 80% of the mullet examined in February 1978 had an advanced stage of gonad development. In March 197%, all the individuals examined were mature. The following monthe presentod. ?Some mature individuals in the collections until Septenber, in which re:

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Means and range of dissolved oxygen walues ot

Soyuda Lagoon.

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FIGURE V. Relative abundance of Mugil curena in monthly samples at

Joyuda Lagoon, with confidence limits to the 954.

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TAME Te Monty means of salinity(*/,.), cemperature (°C), dissolved

oxyesn_content (orm) and $c! p's. saturation at Jove

Indox of gonad development in Mucil curema,

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Individuals were found to be semually mature. The peak of adult vite

mullet in Septenter with reduced gonad development may be incicative of

2 retum, in part, of the white mllet population after the spamming had

?taken: place in offshore waters. The overlapping data for the mnths of

February and March 2980, are not significant in this matter tecause the

individuals examined were not adult fishes (see Figure VI). ?The low

value: in relative abundance after October 1979 ray be indicative of te

dotrinental eff

ct of hurricanes David and Frederick in Septenber 1979,

or te over-tishing of the adult millet population in the lagoon during

thei

perio: of pre-spasning in February and March 1979 by local and

comercial fisherven,

Host ~ parasite interactions

Sik species of metazoan parasites vere found to infect the vite

mullet during the study period at Joyuda Lagoon. Temporal pattems of incidunce percentages mot be interpreted with caution due to small sample size numbers. The Acanthocephalian parasite, Flonidosentis elen-

-batus (Wactado - Filho, 1981) which is an internal parasite, localized aluays in the intestine of the fish, was present at least once in every nonthly sample. Tloridosentis clongetus registered @ peak of incidence? in ontiity collections of March 1972, and then in ?wounber 197%, January aed March 1980. Figure VIZ presente the monthly fluctuations in incidence

Percentages for this species. The pattem of incidence percentages do: not scam to be directly determined by any extemal factor related to tl« water quality of the lagoon. The fact that F. clongatus is transite?! ly an intemediary host is indicative of the apparent availability of is Intermediate host throughout most of the year in the lagoon. Rurther ©tud-

4ies cn the Life cycle of this parasite mist be assessed before any conclusive

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THGURE VE. Scandard length distributes: of Moat in ronthly.

ssples at Joyeda Lagoon.

FIGURE VIT. Monthly ineidence percentaze of Floridosenti:

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Statements can Le divin atout the short term variability in che incidence

Pereontages of th'e species.

?Mo menogencen trematodes were found parasitizing the gill flane

Of the white millet in Joyuda Lagoon, Feeudohalotrema mysilinus Harps

186t oresented peaks in incidence peroentages in Tebruary and March 18), and then in March and April 1980. This monogenean parasite was absent trom Aurust to Cctober 1979, Nevertheless, it appeared with roderately high incidence percentayes throughout the study, especially during the winter yeriod (Fipwe VIII). iow salinities, or perhaps the sudden Gecreace in salinity from Auzust to September, continuing into October 1078, could have caused the abscnce of this parasite éuring, these months. Metanicrocotylea macracantha Alexander 195, another monogenetic ?remitode which infects the pil] filaments peaked in Nevenber 1279, and Mare: 1380, and was aloo common in July and Septenber 1979 and February 1800, Metaricrocotyles macrecantha can withstand short tine salinity variations and was present in September 1979 (sec Figure IX) uhen sali-nity reached its lowest point during the study (approx. 12 ppt). ?The

Presence of thir nonogenetic trenatode in the white mullet was first ited in May 1978, but continued to appear in the rest of the study. This stronly surgests that the parasite either entered the lagcon after @ send ?bar formation opened in Aprii-tay with early spancd adult feniles, er with Juver-iie mitiet which were probably new recruitmunts in the Lagoon. heve~ver, aiter Hay, the short term variations of incidence en the lout may he related to other factors, either environmental, biolopieal or both

?Mince species of copepocs of different genera were found on the w ite mullet. Erpasilus Iizae Kryer 1864,shich occurred only in the pitt mente of the fish wes morw abundant in February 1978, Tt prevailed wh!

Marci 1979 ané then disappeared until October 1979 reaching another hiy'!

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?incidence value during January 1980 (see Figure X). Although E. Lizae oo-curred (uring the winter period, its incidence in the vite milet seen to be more related to the migratory pattern of the adult fish than to searonally related Hydrological conditions. Brgasilus lizae survived in

2 wide vange of temperature and salinity variations in Jeyuda Lagoon. Its absence after March 1879 could be due to the migration of adult millet to offshors waters. /As a consequence of this mignaton, the individuals ?examined during the reraining summer months, did not possess this parasite becauce they were new recruitments composed mostly of juvenile fish. With the next! immigration of adult millet after Septenber 1979, the parasite

decane again a repular component of the parasitic population of the millet in Joyuta Lagoon.

?The parasitic copepod, Lemmavenicus longiventris Wilson 1917, was found Partially enbedded in the fins and body surface of the white millet. Tts revalcnce and incidence percentages show a clear peak during sumer with consistently high incidence percentages for the months of July, August and September 1979 (see Figure XI). After a lag period of two months, the Parasite appeared again in the collections, reaching another peak during March 1980. The pattem of occurrence of this parasitic species is again Indicative of the different populations of mullet which were sampled during ?the study period. The parasite first appeared in monthly collections from June 1979, one month after the migration of the fich, and then showed reduce incidence percentages in Octeber 1973, probably as a result of non-infected ?adult mullet examined in that particular monthly cample. Apparently, ater being introduced by new recruitment into the lagoon during the sumer peried, ?the parasite adapted well to the strongly variable hydrological conditions 4in the lagoon and persisted in the samples despite a change of 17 ppt in salinity between October 1979 and April 1960,

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PIGURE X. Monthly incidence percenteze of Ergastus

FIGURE XI. Monthly incidence percentaze of Lernaeenicus longiventris.

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Bemploctus concinms Wileon 1811, ocomred nostly in the mucus of the branchiosteral cavity with occasional presence in the brenchiostegal fila nnento. Bowlochus concinnus appeared in nine out of fifteen monthly Samples, bu! did not how any distinct peak of abundance based on reascn~ able cumple size runbere. Its low abundance during the nainy period in surmer (soe Figure XIT) fram August to Geteber 1979 may be indicative of Yow tozerance to the sudden salinity decrease associated to hurricanes David und Prednich.

?able TIT presents the monthly dioteitution of infection intensity by parasitic species of Hs cuwna, The monogenean trenatode of the gill

Filanents £. mgiJinus was the most abundant parasite with a mean number of pamsites per fish of 85, The acanthocephalan F. elongatus had a

rnean nunter of parasites per fish of 2.2 and was precent in 938 of the

onthiy collections. None of the parasitic species were observed in

epizootic conditions. The copepod L. longiventriis was observed to cause

moderate lesions in the caudal fin of the fish hosts as it occurs deeply

exbeued in 2

pelvic and caudal fin tissues.

teractions between itic species

Five syecies of external paranites and one endoparasit« were present

in wiste millet at different tine periods throulout the su

The rev

alenat of these sjecier in the white mullet is presented in Table 1V. 1

was clierved that ectoparasites which occupied simile nicrchabitate within

p euch ac Hetamicrocctyiea macraoantha an Dngasilus Liza, di¢ rot

?occur together in any of the fishes examined. Figure XIII evidences tis the £8

similarity in

cite selectivity of both species on the branchiostegal arcs

of the white midlet, Table V details the presence-absence display of both

syecies in monthly samples. The distribution of those species in monthly

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FIGURE X11. S-thly incidence perconteze of Bomoloehus consi

FIGURE X112. zistribution of individuals of Exgasitus 1izae and

microcotylea macracentha in the brachiostegel arcs

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TABLE IV

Mecchly prevalence of parasitic species in the white mullet from Joyuda

Lagoon, luring the period between February 1979 and April

~ SP 1. Sp2___sp3sp4@ spss

Fa + - + +

Sp. 2 - Metanicrocotylea nacracantha

Sp. 3 - Bono!

> Brgasiive 14s:

Sp. 5 - Lernacenicus longiventris

?

thus coneinnus

= Floridosentis elongatus

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TAKE V. Contingency table representing the neestive interspecific

association between M. macracantha an B. lizas a 6

3| ~

2 2

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Probability of association by chazce (p) = 0.017

Contingency table representing the potitive interspecific

association between P. mugilinus and E. concinaus.

Pseudchaliot rena mogilin

Bonolochus cocinnus

Probability of association by chance (p) = 0.002

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samples indionte « significant negative association (p#0.017). Possibly one of these species ir excluding the other for food and/or space. ?The Presenc: of one siscies or the other in their fish host may be dictated either Ly water yuslity related factore and their adaptations to with-stand environment... stress op to actual compet:

?ion and consequent exclusion by one speci or the other.

?

accociat ion between Fueuichatiotrene mugiimis and Borolocius

concinnas also ©

populations. In

parasites (cce

wjeets poesitle interactions between different parasitic

?case, @ positive association resulted between both

?ate V7), the probability of association was highly expose

to sinilar envirornental conditions, as both are parasitic in the branchios-

tegai cavity, however, cach species occupied different niches or microha-

bitats within the fish. Bomolocus coneimus was alvays found in the mous layer of the branchiostegal flap, vile Pseudchaliotrena mugitnus was

aiveys parasitic in the gill {ilanents. Different food and epace reguire-

nants can permit Loth species to co-exist together inthe host.

Hlenidosentie elonatus, an acanthocephalian worm, was the only

internal parasite otserved and it prevailed consistently in monthly san

Ples. The presence of other cndoparasites in the alinentary trect is prob-

ably Linited by the lack of intemediate hosts such as mollucks, which are

rare in Joywa Lagoon. The Possibility of aanpetitive exclusion by the

ecanthocephalian is contradicted by the presence of digenetic trematodes

which occur aleng with F. elongatus in collections of millet exanined in

la Parguera, Puerto Rico (Willians, E. Hy unpubl. Data).

?The consistent pattems of association between parasites constitu:

evidence that their tenporal occurence is real and not an artifact of

sampling variability, The aspect of conpetition song parasitic species

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has been extensively discussed by Halvarsen (1°76) ané constitutes a

Significant phenomenon in the ecoleyy of parasites.

?imple and multiple regression analysie between ronthly means of temperature and salinity and the intensity of infecticn by parasitic species were non-significant at the 0.05 level. Evidently, most ecto- Parasitic cpcoies in the white millet withstand some degree of variaticn An Salinity and temperature (see Tables VIZ, VIII, and D0). Consequently, ?the coread of points in both sides of the regression Lines result in high starcand error and low correlation coefficients. Deteminictic effects ©f Igdrologica) paraneters on the parasitic conposition of the white mullet were observed for abrupt si

inity variations in August through October 1978. Most species of extemal parasites presented lav incidence or were absent uring this period. ?The effect of stort term variation is probably mere inportant in determining the prevalence of sane parasitic species than sea sonaliy related variations which are gradually experienced ty extemal paras sitic fauna has elso adapted to variable salinities. Tt is possible that Such acute and short term salinity variations may indice a threshold responee on sone species of parasites in the white millet.

conctusrons

The hypothesis that ectoparasitic species in the white mllet (hysil mem) display, a diotritution pattem which is seasonally related to

Salinity variations in Joyuda Lagoon, was not evident in the present

stuly. However, two ectoparasitic species, Ronolochus concinnus and

Pecwlohaliotrena mupilinus were apparently affected by the suiden drop

Jn salinity during the rainy season. The range of tolerance observed Ly

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dnaly: 5c cf simple linsar regression betueen =cnthty means of

palin. -y and? intenatty of parasitigatian by neceseay mess oy

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TABLE VII:. Analysis of simple linear regression between conthly means of

fenperature and intensity of parasitization by metacous parec ites

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parasitic sjucies to temperature and salinity variations is indicative of

?the alartations that theve Parasites have developed in onder to withstand

Sinilar enviromental gradients to which the host is adapted.

?The mignatcry behavion of adult miblets to offshore waters and their eventual retin *9 the lagoon accounts for much of the variability observed in the tistrituticn of sme parasitic species.

Negative interspecific interactions between parasitic species occured Detweer: populations which occupy similar microhabitats within the host. ion was significant for the copeped, rgasilus Iizae, trenatode, Metanicrocotyles nacracantha, ?Their actual ?compert:tion and sutual exclusion may explain the short-term variations that

This type of aser

and the nenogenet

?these opecies present in their distribution pattems.

Voyuda lagoon is a detritus-based ecosysten which provides high food availability and protection for juvenile and adult white millet. ?The Population proportion of adult white millet is higher during the winter Period pricr to their peak of semal maturity. This fact suyests that ?the mullet concentrate in the lagoon in ender to feed extensively and storage enough eneryy for their spawning migraticn. Joyuda Lagoon may also function as shelter to juvenile and adult white mullet during perisds

?of high wave eneney and low food availability in the coast.

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LITERATURE CITED

Aederson, Ul. We: Early development, spamming, crowth and occurence of the

silver millet (Mugil) along, the South Atlantic coast of the

\nited States. ?Fishery Bulletin. No. §7 (19): J9)uiu,?tes7"

Soxshall, Cc. A.: *The population dynamics of L es is

(Mulier):" seasonal variation in abundange st ape oes SES

sitology. 69: 31971. 1974,

Dowpiallo, Ms J.: Variation of metazoan parasites of the french grunt,

Jaemtion avolineatun (Denarest) (Osteiehtayes: Panaaee dey by

sabitat type and seanen sith an analysis ct competition sect joe

sites. Waster Thesis, Department of Marin Sciences, GU neyo,

iene Rlaos 1575.

1 Ty Rui Alpuncs aspectos ecolépicos de 1a cammnidad de peces en

ja lamuna Joyuda, San duan, Puerto Rico, i981. (in reso) 186i,
[v0 Sirporio del Departanento de Recursos Hiaturales de PR,

Malvercen, 0.: Nevative interaction among parasites. In: Faolegical Aspects of Parasitology, C. R. Kennedy (ed.). North-Hollane Publishing 0b., Ansterdan. p.? 95-11, 1976.

Neyer, He Bidrag ti2 kundskab om snyltekrebsene naturhistoriches tids-Serift. 241-2): 75-320. Tee.

Machado-PSdho, D. A.: Uma nova éspecie do Atactorhynchus Van-heave, 1935." (Acanthocephala, hyachidae).? Revita Brazileim de Biologia 11: 2H. Tse

Meskal, F. Ho: Seasonal fluctuations in the population of two comon frematode species from the stomach of the cod. Sarcia. 260 "19-20, 1966.

Moore, RH: General Bicloyy, distribution and relative abundance of thugda cura ara Mygil cetbalur cn the Sovth Tenas coset Rented Bitions an Marine Selene Ger Gulvase none?

Overcmrect, F. Mi: Parasites of the inshore Livardfish Sodus foetens, from South Florida, including a description of a nex rems GP cestoda. Bulletin of Marine Science. 182): uuscu6S. "1966.

Rawson, MN. V.: Population biology of parasiter of striped millet, ?Hust cophalus L. I. Monogenea, ?Journal of Fisheries Biology. Sr 165-194. 976,

Schroeder, Ecology of the intestinal trematodes of the srapper, Lutjanus griseus. Near lower matacimbe key, Florida, with Adgceription of a new species. Studies in tropical Cceanogreph. Number 10, 151-273." 1976.

---Page Break---

Tate, M. Wand R. C. Cleland: Nonparmetnic and shortcut statistics.

Interstate Printers and Publishers Inc. Illinois! 72-76, 158).

Yanez-Arancibia, 4.: Observaciones sobre $2 curgpe Valenaiernes en

freas naturelés de crisnza, México: fact, creci

TEey Telacicnes ecolégicas. Anales Centro Ciencias del Mary? Limos

teria. Universidad Auténana de México, 3(1): 92-124. 1976,

---Page Break---

---Page Break---