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RESEARCH ARTICLE

INCIDENCE ON HUMAN AND ANIMAL HEALTH OF THE FLUVIAL AND TERRESTRIAL MALACOFUNA OF THE MUNICIPALITY OF SANTA CLARA, PROVINCE OF VILLA CLARA, CUBA

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ABSTRACT

The investigation was carried out with the purpose of determining the grade of incidence of the fluvial and terrestrial existent malacofauna in the municipality Santa Clara, in the human health and animal during the period corresponding to the years 2011 -2015. The species of mollusks were identified, so much fluvial and terrestrial existent in the municipality Santa Clara whose identification process, was made in the laboratory of the Provincial Unit of Surveillance and Antivectorial Fights. The obtained data were processed by means of the statistical package Microsoft Office Excel, version 2007 and with the package Statgraphics, to determine the graph of tendency curve. Being evidenced that the species well represented and distributed, as for the fluvial mollusks, they turned out to be: *Tarebia granifera*, *Melanoides tuberculata*, *Corbicula fluminea* and *Physa acuta*; while in the case of the terrestrial ones, they were: *Pratycorella griseola* and *Subulina octana*. A wide proliferation of the vegetation was appreciated in most of the ecosystems where they were carried out the collections, that which possesses direct repercussion in the feeding and ovoposition of the mollusks. The municipality Santa Clara possesses a wide variety of species of mollusks, with medical marked importance, so much terrestrial as fluvial, that which develops the epidemic risk for entities that require of species of mollusks in her cycle of life; therefore, the identified taxons possesses the enough potentialities, as put up intermissions to parasites that affect, so much to the human health as to that of the rest of the animals.

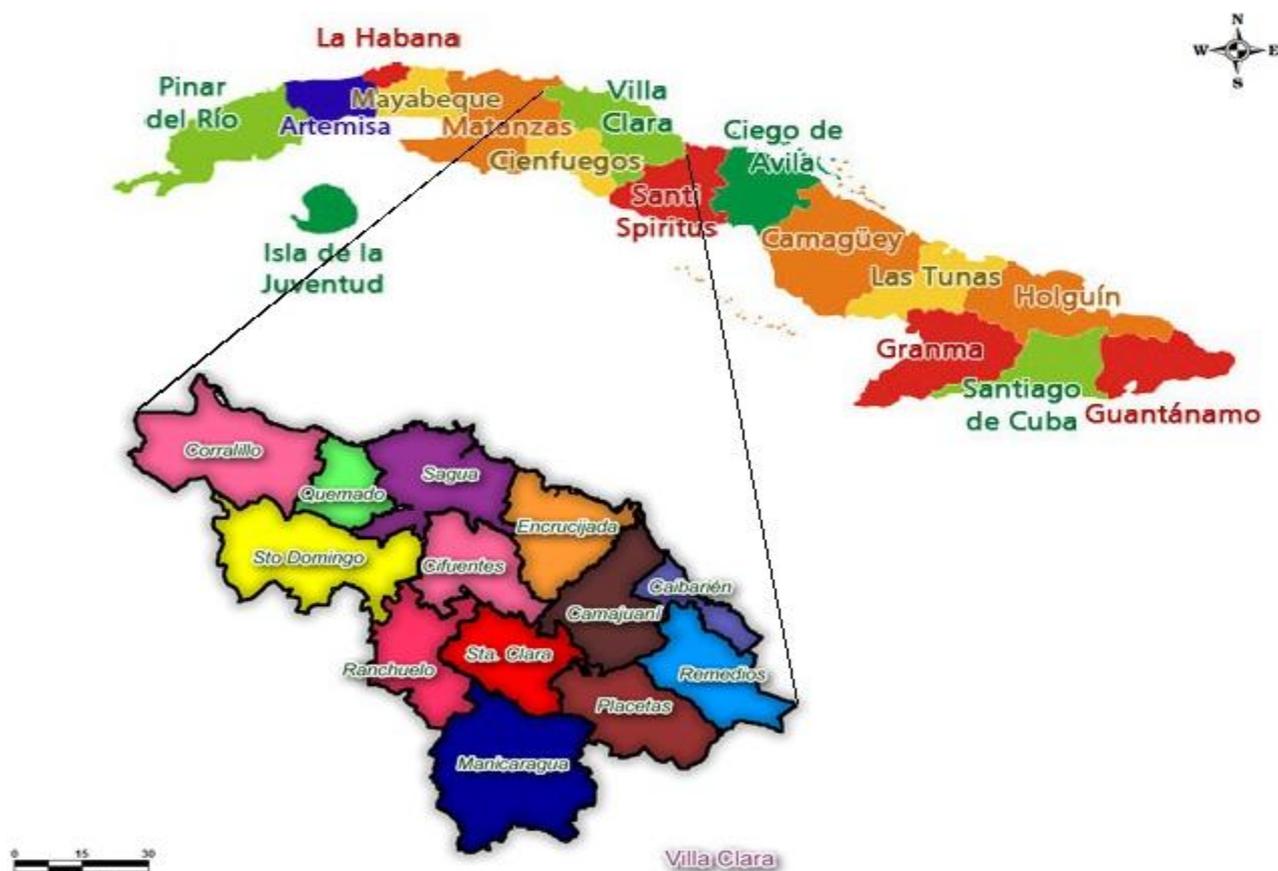
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INTRODUCTION

The Phyla mollusk constitutes the second group of spineless more numerous organisms in species, only overcome by the Arthropods. He/she is considered the existence of approximately 120 000 species in the world, with some 35 000 fossils (Pointier *et al.*, 2005). From the sea, the bivalve ones and gastropod they colonized brackish atmospheres and freshwater; the snails (gastropod) only invaded the terrestrial mean (Darrigran, 2002). The studies have more than enough mollusks they are generally based on the description of species or in the presentation of listings that you/they show in a very synthetic way the wealth that exists in a certain place (Perera, 1996; Pointier *et al.*, 2005). For general rule, the groups more studied in this sense they have been the marine and terrestrial

mollusks, although these studies almost always lack data on their distribution. Nowadays works are not conceived that untie the studies taxonomic of the ecological, and alone with a narrow relationship among them one can have a more complete vision of the characteristics of an area, with regard to the wealth and diversity that it presents in different groups (Vásquez and Cobian, 2014). Studies autoecologies developed in mollusks, they have allowed to observe very complex and varied adaptations, that which has sometimes favored the colonization of atmospheres very fluctuating (Rodríguez *et al.*, 2003). The malacofauna also carries harmful effects, like plagues for the human health and to the livestock, as well as of species invader, several species of mollusks are intermediary host of numerous parasites that affect the man and other animals; they don't still exist in the bovine effective current moments (Iannacone *et al.*, 2013a; Fimia *et al.*, 2014; Vásquez and Cobian, 2014). At the moment the great dispersion, incidence and graveness of many illnesses transmitted by

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Source: Meteorological Provincial Center of Villa Clara.

Figure 1. Political administrative map of Cuba and the province Villa Clara

vectors, provoke a dangerous increase of the same ones in several regions of the world (Iannacone *et al.*, 2013b; Vázquez and Perera, 2010). This situation gets complicated for the existence of whites behavioral and strategic differences he/she doesn't only enter species different vectors, but even in those belonging to oneself gender, hence is not advisable to extrapolate the results of an area to other, because there will possibly be ecologies different and therefore different answers adaptatives from the species to those new conditions (Fimia *et al.*, 2012). In Cuba 1 299 species and 2 139 subspecies of terrestrial mollusks are recognized, being characterized by their microlocalization and high endemic (96%) (Espinosa and Ortea, 1999), although it ascended to 1 393 species, overcoming to other islands of Caribbean (Maceira *et al.*, 2003; Vázquez and Sánchez, 2015), for that that the Cuban territory one of the most important "hotspots" is considered (Cañete *et al.*, 2004; Sarmiento, 2010; Vázquez and Perera, 2010). Among the terrestrial exotic mollusks 52 species have been recognized (Maceira *et al.*, 2003). The studies medical malacology have charged great peak in Cuba, because it is one of the places with more wealth, as for diversity and endemic of mollusks of the world (Cañete *et al.*, 2004; Vázquez and Perera, 2010; Vázquez and Cobian, 2014). The fauna terrestrial malacology of the Cuban archipelago is almost exclusive of him, being different still of neighboring Antilles, as The Spaniard and Jamaica. Among their main characteristics it is, the high diversity in ways taxonomic, mainly goods, species, subspecies and varieties, the abundance of many populations, the marked endemic and the microlocalization of numerous species and subspecies (Rodríguez *et al.*, 2011).

The mollusks freshwater, integrated for bivalve and gastropod, is very diversified groups that occupy very varied (especially, the gastropod) bodies of water in general; some of the species are distributed thoroughly and they invade new relatively quick, while other form habitats they are in restricted places (Naranjo and Oliveira, 2014). The objective of the investigation was guided to determine the level of incidence of the fluvial and terrestrial malacofauna of the municipality Santa Clara, in the human health and animal during the period 2011 -2015.

MATERIALS AND METHODS

Description of the study area

For the realization of the work they were kept in mind the fluvial and terrestrial hatcheries / ecosystems of the municipality Santa Clara, capital of the county Villa Clara (it figures 1), which is located in the central region of the island of Cuba and with geographical limits to the west, with the county Matanzas, to the east, with the county Sancti Spiritus and to the south he/she has geographical limits with the county Cienfuegos. One kept in mind for the investigation, the existent data in the files of the Provincial Unit of Surveillance and Antivectorial (UPVLA) of Villa Fights Clara, where the sheets registrations are conserved, with charts that pick up the whole history taxonomic of the province Villa Clara and their respective municipalities. The investigation embraced the period understood from the year 2011 to the one 2015.

About the sampling

The samplings embraced the fluvial (rivers, streams, lagoons, preys, dam, pools and narrow canyons) ecosystems and organoponic of the areas of health belonging to the five policlinics of the municipality Santa Clara: XX Anniversary, Chiqui Gomez, Marta Abreu, Sacred Clara and Overgrowth. The samples/specimens were gathered by the operatives of the Municipal Department of Vectors that work directly in the Program of Surveillance and Control Malacology. The samplings were carried out bimonthly (it captures for unit of effort) during 15 minutes and in a manual way, by means of a strainer of hand of 1 mm of mesh opening and mango, of two meters of longitude (aquatic reserves); for the terrestrial mollusks soft pincers were used for not to damage the shells of the pulmonary and to diminish the mortality for manipulation. This method was also used for the extraction of the fluvial mollusks of the strainers.

Laboratory work

The collected copies were placed in flasks of 100ml with water unchlorine. After the 24 hours he/she was added to the water a fenobarbital solution to achieve the total relaxation of the specimens. Last the 72 hours you proceeded to the extraction of the soft parts of the copies, taking the shells like museum pieces, with educational ends and taxonomic. With the soft parts, and for mediation of the microscope stereo (MBC -9), they were possible to identify the structures of the reproductive organs and the radul (buccal cavity and teeth). The diagnosis and identification of the collected specimens was carried out in the laboratory of the Provincial Unit of Surveillance and Antivectorial (UPVLA) of Villa Clara, for a specialist in the matter, with the help of malacology key for such ends (Simone, 2006; Vázquez and Cobian, 2014). The analysis of the data was carried out by means of the electronic tabulator Microsoft Office Excel version 2007 and the electronic package Statgraphics, as well as the statistical package SPSS, Version 13, in which the data corresponding to all the carried out samplings were processed (2011 -2015).

RESULTS AND DISCUSSION

Of the 21 species of fluvial mollusks identified in the study, the best represented and distributed they were: *Tarebia granifera*, *Melanoides tuberculata*, *Corbicula fluminea* and *Physa acuta*, continued by *Galba cubensis* and *Pachychilus nigratus* (chart 1), this last, endemic of the municipality Santa Clara. As you he/she can see *Tarebia granifera* it turned out to be the species you prevail yourself in the study, result that it coincides with other investigations carried out in the county Sancti Spiritus and in Villa Clara (Fimia *et al.*, 2010; Fimia *et al.*, 2015), that which demonstrates the ecological high plasticity of the species in question, as well as the high proliferated of the same one, in spite of being an introduced species; the one that even, it has reached so high dispersion grades that it has ended up displacing *P. acuta*, species that years behind, it was considered as the dominant one (Ferrer *et al.*, 1985; Vázquez and Gutiérrez, 2007). According to Perera (1996), the ecosystems fluvial Cubans presents mollusks of the family *Thiaridae*, with a wide radiation, given by their ecological favorable characteristics and their high plasticity phenotypic, aspects these, corroborated years more afternoons

for Pointier *et al.* (2005) and Vázquez and Perera (2010) who predicted from those years, what is happening today in the fluvial ecosystems of the country to *T. granifera*, even, with the species *Melanoides tuberculata*, also introduced and belonging both to the same family. The years where the biggest quantities in copies/specimens were gathered by species, they turned out to be 2011 (22,3%) and 2013 (20,6%), although the differences with the rest of the years, were not very significant. They were identified 14 genus of fluvial mollusks for the municipality Santa Clara, with 21 species, being the families *Thiaridae* and *Lymnaeidae*, those that concentrated the biggest quantities in specimens (3 092), results that they agree with those obtained by Fimia *et al.* (2010) and Fimia *et al.* (2015); in turn, these two families, were the best represented and distributed in the municipality; for that that Subclass *Caenogastropoda* turned out to be the one that concentrated the biggest percent of gathered specimens (6673). To highlight, the case of the family *Planorbidae*, that in spite of being represented by five goods, the total number of copies, alone it was of 123/29,85% (table 2). The presence of a smaller percentage of mollusks put up middlemen, of the families *Lymnaeidae* and *Planorbidae* (fasciolosis and schistosomosis), it could be given, to the pressure that they exercise the dominant species *T. granifera*, *M. tuberculata* and *C. fluminea*, results that they agree with those obtained by Pointier and Jourdane (2000) and Pointier and David (2004), in studies carried out in other towns of Central America and Caribbean.

In connection with the species of terrestrial mollusks identified in the study (table 3), they turned out to be: *Praticorella griseola* (16 995/80,66%), *Subulina octona* (2 928/13,89%) and *Succinea columella* (494/2,3%), the species well represented and distributed, but with differences notables among these, in connection with the quantities of copies for species; for what is *P. griseola*, the represented species of terrestrial, better mollusk and distributed, not alone in the municipality Santa Clara, but, in the whole Villa Clara province; results that they coincide with those obtained by other authors, regarding this species, as much in this county as in Sancti Spiritus (Pérez *et al.*, 2010; García *et al.*, 2012; Fimia *et al.*, 2015). It is necessary to highlight the fact, of how the species *P. griseola* has gone winning specious and representativeness in the terrestrial Cuban ecosystems, since not only it is limited to the agricultural areas (Matamoros, 2014), because it can be found and in populational significant densities, so much in organoponic, orchards and gardens, that which demonstrates, the ecological high plasticity of the species. In the carried out investigation, he/she was proven as the species *S. octona* reached significant values, as for the quantity of copies, relegating *Z. auricoma* (345/1,6%) to the fourth position, when this era one of the two predominant species, so much in the provinces Villa Clara like in Sancti Spiritus, until ago to hardships three or four years behind (Pérez *et al.*, 2010; Fimia *et al.*, 2015). As for the years, they turned out to be the 2014, followed by the 2012 and the 2013, although here, the differences were not so significant. For all the ones analyzed, they turned out to be, Subclass *Prosobranchia* and the order *Stylommatophora*, those that better represented they were in the study. Of all the taxons mentioned previously, alone the selection that is shown in the Table 4 possesses veterinary interest, to be intermediary innkeeper for certain parasitosis;

Table 1. Distribution of the species of fluvial mollusks during the five years study object

Species identified	2011		2012		2013		2014		2015		Total
	N	%	N	%	N	%	N	%	N	%	
<i>P. poeyana</i>	9	12,3	2	2,7	11	15,0	41	56,1	10	13,6	73
<i>P. paludosa</i>	11	20,7	18	33,9	7	13,2	9	16,9	8	15	53
<i>M. cornuar.</i>	2	3,3	8	13,5	5	8,4	26	44	18	30,5	59
<i>P. parvulus</i>	3	27,2	0	0	1	9	5	45,4	2	18,1	11
<i>T. granifera</i>	652	56,7	415	36,1	305	26,5	325	28,3	148	12,8	1845
<i>M. tubercul.</i>	95	21,3	60	13,5	182	40,9	36	8,1	71	15,9	444
<i>P. nigratus</i>	55	21,2	38	14,6	35	13,5	49	18,9	82	31,6	259
<i>G. cubensis</i>	0	0	38	14,0	80	29,6	64	23,7	88	32,5	270
<i>P. columella</i>	21	21,2	37	37,3	19	19,1	7	7,0	15	15,1	99
<i>P. acuta</i>	26	5,9	94	21,6	110	25,3	85	19,5	119	27,4	434
<i>B. pallida</i>	2	12,5	0	0	3	18,7	5	31,1	6	37,5	16
<i>B. helop.</i>	0	0	1	11,1	1	11,1	2	22,2	5	55,5	9
<i>D. anatinum</i>	1	10,0	0	0	2	20,0	5	50,0	2	20,0	10
<i>D. aerugin.</i>	1	16,6	0	0	1	16,6	2	33,3	2	33,3	6
<i>D. cimex</i>	0	0	1	16,6	1	16,6	2	33,3	2	33,3	6
<i>D. lucidum</i>	0	0	2	22,2	0	0	5	55,5	2	22,2	9
<i>H. duryi</i>	0	0	5	12,5	8	20,0	19	47,5	8	20,0	40
<i>H. trivolvis</i>	2	22,2	0	0	1	11,1	4	44,4	2	22,2	9
<i>G. parvus</i>	0	0	1	20,0	1	20,0	2	40,0	1	20,0	5
<i>G. radiata</i>	0	0	0	0	2	15,3	8	61,5	3	23,0	13
<i>C. fluminea</i>	39	8,8	17	3,8	76	17,1	105	23,7	205	46,3	442
Total	919	22,3	737	17,9	851	20,6	806	19,6	799	19,4	4112

Legend: *M. cornuar.*: *Marisa cornuarietis*, *M. tubercul.*: *Melanoides tuberculata*, *B. helop.*: *Biomphalaria helophila*, *D. aerugin.*: *Drepanotrema aeruginosum*.

Source: Provincial Laboratory of Surveillance and Antivectorial Fights (UPVLA) of Villa Clara.

Table 2. Abundance and wealth of species of identified fluvial mollusks of importance veterinary medical. Sata Clara. 2011- 2015

Family	Genus	Species	Total	Status
Subclass Caenogastropoda				
Ampullariidae	<i>Pomacea</i>	<i>P. poeyana</i> (Pilsbry, 1927)	73	E
		<i>P. paludosa</i> (Say, 1829)	53	L
	<i>Marisa</i>	<i>M. cornuarietis</i> (Linné, 1758)	59	I
Hydrobiidae	<i>Pyrgophorus</i>	<i>P. parvulus</i> (Guilding, 1828)	11	L
Thiaridae	<i>Tarebia</i>	<i>T. granifera</i> (Lamarck, 1816)	1845	I
	<i>Melanoides</i>	<i>M. tuberculata</i> (Müller, 1774)	444	I
Pachychilidae	<i>Pachychilus</i>	<i>P. nigratus</i> (Poey, 1858)	259	E
Subclass Heterobranchia				
Lymnaeidae	<i>Galba</i>	<i>G. cubensis</i> (Pfeiffer, 1839)	270	L
	<i>Pseudosuccinea</i>	<i>P. columella</i> (Say, 1817)	99	L
	<i>Physa</i>	<i>P. acuta</i> (Dreparnaud, 1805)**	434	L
Planorbidae	<i>Biomphalaria</i> ***	<i>B. pallida</i> (C.B. Adams, 1846)	16	L
		<i>B. helophila</i> (d'Orbigny, 1835)	9	L
		<i>D. anatinum</i> (d'Orbigny, 1835)	10	L
	<i>Drepanotrema</i>	<i>D. aeruginosum</i> (Morelet, 1851)	6	L
		<i>D. cimex</i> (Moricand, 1839)	6	L
		<i>D. lucidum</i> (Pfeiffer, 1839)	9	L
		<i>H. duryi</i> (Wetherby, 1879)	40	I
	<i>Helisoma</i>	<i>H. trivolvis</i> (Say, 1817)****	9	I
		<i>Gyraulus</i>	<i>G. parvus</i> (Say, 1817)	5
		<i>Gundlachia</i>	<i>G. radiata</i> (Guilding, 1828)	13
Total			14	21

Legend: E = Endemic, I = Introduction, L = Local, * *Pomacea diffusa*=*Pomacea bridgesi*, ** The gender still *Physa* and no *Haitia*, because the filogenia until the momento of the research still have the gender (*Physa*) and until the opposite is not demonstrated, bassaded or sustained in molecular studies, then what we have is *Physa acuta*, *** The three registered species for Cuba of the gender *Biomphalaria* is *B. helophila*, *B. pallida* and *B. havanensis* (this last have as town type, the gutter Ferrer in the county Havana), **** *Helisoma trivolvis* cannot be differentiated of *H. duryi* starting from the shell, alone some.

Source: result of the carried out samplings

Table 3. Distribution of the species of fluvial mollusks during the five years study object

Species identified	2011		2012		2013		2014		2015		Total
	N	%	N	%	N	%	N	%	N	%	
<i>P. griseola</i>	836	4,9	3836	22,5	4313	25,3	5923	34,8	2087	12,2	16995
<i>S. octona</i>	54	1,8	1224	41,8	918	31,3	458	15,6	274	9,3	2928
<i>Z. auricoma</i>	20	5,7	60	17,3	105	30,4	63	18,2	97	28,1	345
<i>V. cubensis</i>	0	0	60	23,8	0	0	110	43,6	82	32,5	252
<i>S. columella</i>	120	24,2	313	63,3	34	6,8	26	5,2	1	0,2	494
<i>J. bicinctia</i>	0	0	2	3,7	16	29,6	14	25,9	22	40,7	54
Total	1030	4,8	5495	26,0	5386	25,5	6594	31,2	2563	12,16	21068

Legend: *P. griseola*: *Praticorella griseola*, *S. octona*: *Subulina octona*, *Z. auricoma*: *Zachrysia auricoma*, *V. cubensis*: *Veronicella cubensis*, *S. columella*: *Succinea columella*, *J. bicinctia*: *Jeanneretia bicinctia*.

Source: Provincial Laboratory of Surveillance and Antivectorial (UPVLA) of Villa Fights Clara.

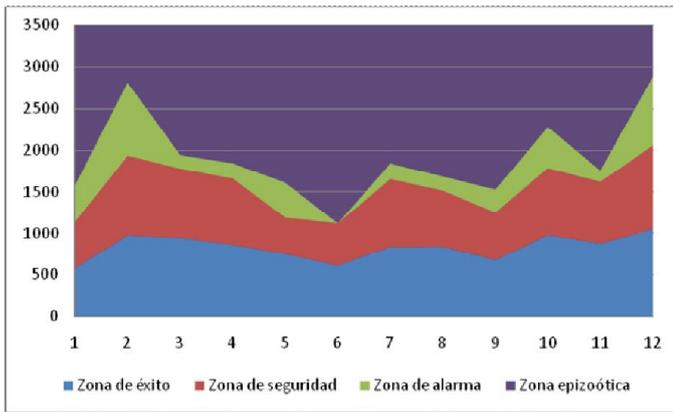


Figure 2. Channel enzootic or channel of the populations' of mollusks habitual behavior in the municipality Santa Clara

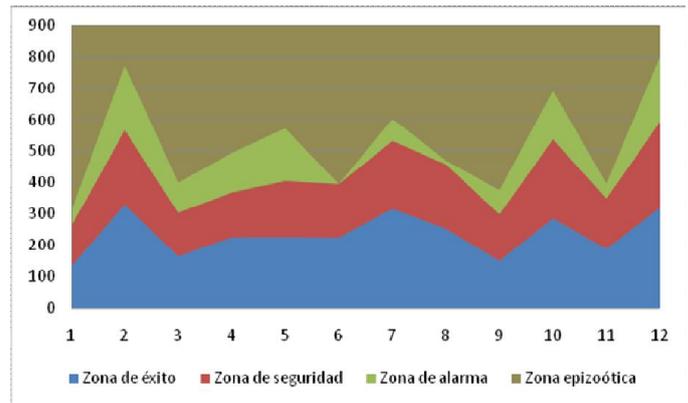


Figure 3. Channel enzootic or channel of habitual behavior for the populations of *Tarebia granifera* in Santa Clara

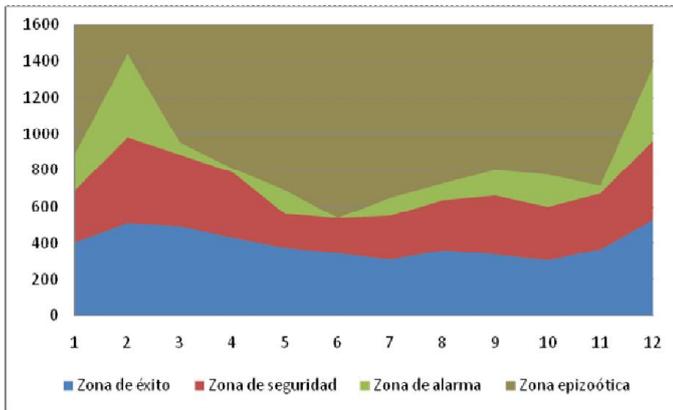


Figure 4. Channel enzootic or channel of the populations' of *Praticorella griseola* habitual behavior

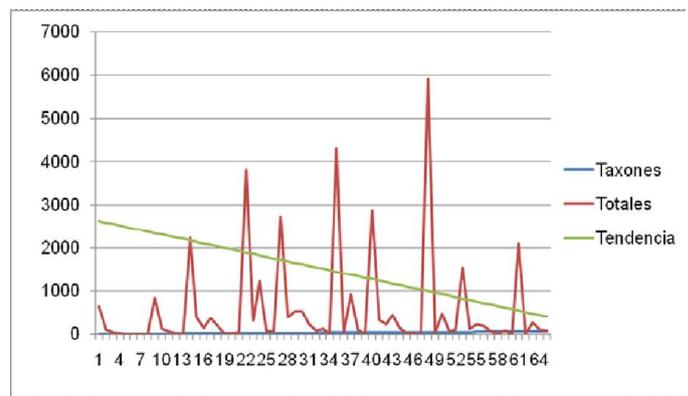


Figure 5. Behavior tendency of the mollusks representative samples among 2011-2015 in the municipality Santa Clara.

for what the figures are not anything worthless, if we keep in mind that in the case of the fluvial taxons, the number of identified species, was of 21 (38, 09%), while that of the terrestrial ones, the figure ascended to six species (50,00%).

Table 4. Mollusks of medical-veterinary interest identified in the municipality Santa Clara

Species	Fluvial	Terrestrial	Entity
<i>C. fluminea</i>	X		Angiostrongilosis
<i>P. poeyana</i>	X		Angiostrongilosis
<i>P. paludosa</i>	X		Angiostrongilosis
<i>P. acuta</i>	X		Dermatitis cercariana
<i>P. columella</i>	X		Fasciolosis
<i>G. cubensis</i>	X		Fasciolosis
<i>B. helophila</i>	X		Esquistosomosis
<i>B. pallida</i>	X		Esquistosomosis
<i>P. griseola</i>		X	Angiostrongilosis
<i>Z. auricoma</i>		X	Angiostrongilosis
<i>S. octona</i>		X	Angiostrongilosis
<i>S. columella</i>		X	Fasciolosis
<i>J. bicinctia</i>		X	Angiostrongilosis

The figure 2 sample the behavior enzootic of the mollusks in the municipality Santa Clara, being appreciated that above the green color, it represents an alarm area for the presence of the mollusks, since starting from this point, it becomes uncontrollable the growth of the populations, what represents a critical point for the appearance of the parasitic illnesses in the municipality, that which coincides in each one of the years with the months of January-March and November-December (Fimia *et al.*, 2016).

The figures 3 and 4 show the enzootic channels of the two species of each ecosystem study (fluvial and terrestrial) object, better represented and distributed, and with the highest values, as for quantity of copies gathered by species in the five years of samplings. By means of seasonal this graphics, we can give pursuit to the alarming values for each one of the species study object and at the same time, of the parasitosis, of which are put up middleman, and for this reason it is that a surveillance constant checking is taken the increase or the populations' malacology decrease, it stops this way to trace strategies of surveillance, monitored and control, better addressed and more effective (Montero *et al.*, 2000; Clausen *et al.*, 2012; Osés *et al.*, 2012). The results expressed in the figure 5 show that although the levels of individuals in the populations stay high, the tendency is to the decrease. This is not due to that the populational densities have diminished, but rather the personnel dedicated to the realization of the samplings malacology, it has been directed almost in their entirety to the campaign against the mosquito *Aedes aegypti*, for what the samplings were carried out with less systematize and technical rigor, for what the prospective results were not achieved. For all the ones analyzed and the obtained results, a great number of species of mollusks, so much fluvial as terrestrial, they are of great interest, due to the high incidence they have in the health medical-veterinary, since these they are those responsible for parasitic illnesses, inside which are, the angiostrongilosis taken place by nematode *Angiostrongylus cantonensis*. It is also, the schistosomosis, tropical parasitosis of more importance in the man after the malaria, taken place

by species of the genus *Schistosoma* and the fasciolosis, taken place by *Fasciola hepatica*, this last entity affects fundamentally to the bovine livestock and caprino and it has been recently considered of medical great importance, because they have been high prevalence in human, mainly in children (Basins, 2004; Brito *et al.*, 2010; Bedoña *et al.*, 2016) and where the losses annual economic averages, for concept of seizure of livers in bovine, swinish and ovine is considerable, so much in our country, like at world level.

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