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ABSTRACT

A small collection of unidentified land snails were found in the University of the West Indies Zoology Museum and discovered to be part of a study from 1995 looking at distributional ecology on the Five-Islands Archipelago, north-west Trinidad. The snails were identified and the results of the study were reassessed based on the new information gained.

Key words: Terrestrial molluscs.

BACKGROUND

The University of the West Indies Zoology Museum (UWIZM), based at its St. Augustine Campus, has extensive collections covering a wide variety of animal phyla including over 4000 molluscs. Amongst the molluscs is a small collection of terrestrial snails made by students during a field trip for the 1995 Caribbean Island Ecology class run by Dr. Stanley Temple.

The snails all came from the so-called Five-Islands, which are in fact a group of six islets lying just off the northwestern peninsula of Trinidad.

The students were investigating the distribution of island species in relation to the area of the island and the influence of habitat diversity on species numbers. They surveyed the islands for woody plants, ants, reptiles, land birds and land snails.

Of the organisms studied, the birds and reptiles were easily identified; plants were sent to the National Herbarium, University of the West Indies, and the ants to Mark Dubois of the Illinois Natural History Survey for identification. The snails were merely grouped into morphological types rather than species.

In this paper I identified the snails to species level and then recalculated the relevant statistics from Temple's paper.

METHODS AND RESULTS

Identification of specimens

The specimens each had a handwritten label with the time of day when the sample was collected, the name of the island on which it was found and a capital letter that indicated to which morphological type each specimen had been allocated.

The snails from the study were all identified to species level using a variety of journal papers and books (Guppy 1864, 1866; Smith 1896; Haas 1962; Venmans 1963; Emerson and Jacobson 1976; Auffenberg and Stange 1988). Nine species of snail were identified (see Table 1). The shells are stored in the UWIZM under the accession numbers UWITT.2011.4.1 to .20.

Table 1. Snail species in the study, Five-Islands, north-west Trinidad.

Family	Species
Subulinidae	*Allopeas gracile* (Hutton, 1834)
Subulinidae	*Beckianum beckianum* (L. Pfeiffer, 1846)
Subulinidae	*Allopeas micra* (d'Orbigny, 1835)
Subulinidae	*Subulina octona* (Bruguière, 1792)
Helicinidae	*Helicina dysoni* (L. Pfeiffer, 1849)
Orthalicidae	*Orthalicus undatus* (Bruguière, 1792)
Orthalicidae	*Plekocheilus glaber* (Gmelin, 1791)
Neocyclotidae	*Cyclohidalgoa translucidum trinitense* (Guppy, 1864)
Streptaxidae	*Streptaxis glaber* (L. Pfeiffer, 1849)

Three of the original samples were not found and have been presumed lost. Table 2 shows the species and the island on which they were found. The bottom three rows show the total number of snail species for each island – **A** is the number from the 1996 paper; **B** is the number of newly identified species and; **C** is the number used in the statistical analysis.

Several assumptions were made for the purposes of the statistical analyses. Firstly, it was assumed that for Caledonia Island snail "I" was a different species from all the other snails; as there was only one specimen assigned to this morphological type, it must have been distinctly different from the other specimens. Secondly, it was assumed that for Lenagan Island snail "B" was *Subulina octona* as snail "B" from Caledonia and Nelson Island were both *S. octona*. Thirdly, again for Lenagan Island, it was assumed that snail "E" was either *Beckianum beckianum* or *Allopeas gracile* as that is what the other two snail "E" were, thus although the exact species is not known it was surmised that there is a fourth species of snail for Lenagan Island.

Table 2. Snails found on the Five-Islands, north-west Trinidad during 1995.

Species	Caledonia Island	Nelson Island	Lenagan Island	Pelican Island	Rock Island	Craig Island
Snail "A"	*Subulina octona*	*Subulina octona* + *Allopeas gracile*	*Subulina octona*	*Subulina octona* + *Allopeas micra*	*Subulina octona* + *Beckianum beckianum*	
Snail "B"	*Subulina octona*	*Subulina octona*	Specimen lost			
Snail "C"	*Helicina dysoni*	*Helicina dysoni*	*Helicina dysoni*	*Helicina dysoni*	*Helicina dysoni*	
Snail "D"		*Plekocheilus glaber*				
Snail "E"	*Beckianum beckianum*	*Allopeas gracile*	Specimen lost			
Snail "F"			*Streptaxis glaber*	*Streptaxis glaber*		*Streptaxis glaber*
Snail "G"						*Orthalicus undatus*
Snail "H"	*Cyclohidalgoa translucidum trinitense*					
Snail "I"	Specimen lost					
Total **A**	6	5	5	3	2	2
Total **B**	4	4	3	4	3	2
Total **C**	5	4	4	4	3	2

Statistical analysis

In Temple's paper the two main statistical analyses carried out were the creation of species-area curves for each taxonomic group studied and correlation analyses looking at the relationship between the features on the islands and the number of species found.

The species-area curve was described using the power function equation $S = cA^z$, where S = number of species, A = island area and c and Z are constants that are taxa specific. As the number of snail species, after identification, is different for some of the islands, the equation for snails was recalculated using MS Excel.

In Temple's paper the original values for the equation were calculated as $S = 4.69\ A^{0.271}$, but when I used the original data to check the c and Z values, the values came back as $S = 4.72\ A^{0.309}$. To find the source of this discrepancy I checked back through the paper and noticed that in his Table 2 it says two snails were found on Pelican Island and three on Rock Island which was different from the numbers mentioned in the text which had three snails for Pelican and two for Rock. By checking the specimens, I confirmed that the Table was wrong and the text was correct. It is possible that the information from the table had been used when calculating the equation leading to the error. However, even when this was taken into account the equation still came back as $S = 4.64\ A^{0.290}$, a smaller difference and one that I suspect is due to the different computer programmes used to calculate the equation. Not having access to a 1995 version of SYSTAT, I cannot confirm this but for the purposes of this study I was willing to accept the minor difference.

With the new snail species totals for each island, new values of c and Z were calculated and the results were $S = 4.23\ A^{0.184}$.

In the original paper the correlation analyses for the snails showed that there was a significant positive correlation between the area of the island and the number of snail species and between the number of buildings

and the number of snail species and a significant negative correlation between building cover and the number of snail species. Using the new snail species totals, these correlations were recalculated using MS Excel. Table 3 shows the original figure and the recalculated results. Only two of the three correlations remained significant after the recalculation.

Table 3. Correlations between number of snail species and island features. Only statistically significant correlations (r>0.725, p>0.10) are presented.

Number of Snail Species		
Features of Islands	**Temple's Paper (1996)**	**This Paper**
Area	+0.847	+0.749
Elevation		
Forest Cover		
Grass Cover		
Rock Cover		
Building Cover	-0.823	-0.909
No. of Buildings	+0.863	
Canopy Height		

DISCUSSION

Snail species

The nine species of snails identified are commonly found throughout Trinidad in a variety of habitats and as such their presence on the Five-Islands is not unexpected. They can, however, be split up into two main groups - the five smaller snails mainly from the Subulinidae family and the four larger snails from several different families.

Of the smaller snails several of them, *Subulina octona*, *Allopeas gracile* and *Allopeas micra,* are widespread throughout the tropics and subtropics and are also found as hothouse aliens in several temperate countries. *Beckianum beckianum* is found throughout the West Indies and Central America and *Streptaxis glaber* is found in northern South America and the southern Caribbean. In many cases these snails are recorded as introduced or alien species in the countries in which they are found.

Two of them, *A. gracile* and *Allopeas micra,* were only found on one island each with the former only on the second largest island and the latter only on the third smallest island, whilst *B. beckianum* was found on two islands, the largest one and the second smallest. *S. glaber* was found on three of the smaller islands but not the two larger ones; this is surprising as you might expect to find such a common snail on the larger islands first. Finally, the most widespread snail from this group was *S. octona,* which was found on five of the six islands. This mixed distribution could suggest that this species presence on the other islands is quite likely as they were on both small and large islands but that due to their very small size (often less than 10 mm long) they may have been missed in the sampling process. With all of these small snails I suspect that after further searching they will be found on the majority of the islands.

The larger snails, *Orthalicus undatus*, *Cyclohidalgoa translucidum trinitense* and *Plekocheilus glaber,* are more limited in their distribution. The first may only be found on Trinidad, the second on Trinidad and nearby Venezuela and the last one on Trinidad, Tobago, Grenada, Suriname and Guyana. All three species were represented by a single specimen each thus making it harder to draw conclusions about their distribution on the Five-Islands. *O. undatus*, the largest species in the study, was found only on the smallest island, which is at odds with expectations. However, it should be noted that this specimen was damaged and incomplete and might have been on the island as a result of being carried there by a predator.

The fourth largest snail, *Helicina dysoni,* is a bit of an exception; although it is similarly restricted as far as international distribution goes, it is amongst "the commonest of land shells in Trinidad" according to R.J.L. Guppy (1864). Specimens were found on five of the islands in large numbers.

In the 1995 study, the most mistakes in allocating snails to a morphological distinct type were made in snail groups A, B and E. All the snails in these three groups were from the family Subulinidae and were all of a similar size and shape if sorted by the naked eye. This shows that care should be taken when splitting snails up into morphologically distinct types for similar studies. Although this method can prove useful, some basic knowledge of the anatomy of the target group is essential.

Another contributing factor to the confusion was the fact that the snails in group "B" were actually juvenile *S. octona*. As juvenile snails often have a different number of whorls than the adults, it can be difficult to attribute them to the same species.

Species-area relationships

Temple (1996) stated that the relationship between island area and species diversity has strong theoretical and empirical support. It was also mentioned that the Z value in the species-area equation is usually in the range of 0.2 -0.4. Whilst this was true of the Z value in the 1995 paper, after the new species totals were used to calculate the equation, the Z value came out as 0.184. This is outside of the expected range. In the original study the only

other group that was also outside of the expected range was the ants with a Z value of 0.077. This was explained as possibly being a result of the lack of suitable habitats for the ants on these small, dry islands and that only "super tramp" ant species could successfully colonize such a place. Although the Z value for the snails is nowhere near as low as the Z value for the ants, it is heading in the same direction and as such it could be said that two of the snails at least, *Subulina octona* and *Streptaxis glaber,* are snail "super tramps". *Helicina dysoni* could have been included in this category as it was very widespread in the islands. However, it is not as widespread regionally as the other two snails which could suggest that it does not have the same colonising ability.

Correlations

The changes in the correlations between species numbers and island features after recalculation showed that area was still a significant factor in predicting the number of species and that the percentage of building cover was even more significant than before. The number of buildings on the islands still had a fairly high positive correlation with number of species but was no longer above the statistically significant level. The reason for the island area and building cover on the islands having such an effect on the number of snail species is most likely a result of the range of different habitats available to the snails.

CONCLUSIONS

The original study showed some of the principal theories of island ecology. With the information gained from identifying the snail shells, a more accurate assessment could be made of the ecology of terrestrial molluscs on the Five-Islands. However, working on this paper just generated further questions and a more thorough study of the molluscan biota of Trinidad's islands needs to be undertaken.

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