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Amsterdam Expeditions to the West Indian Islands, Report 36*

THE GENUS *STRANDESIA* AND OTHER CYPRICERCINI (CRUSTACEA, OSTRACODA) IN THE WEST INDIES

PART II. CARAPACE LENGTH, ECOLOGY, AND DISTRIBUTION OF TWO *STRANDESIA* SPECIES

by

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SUMMARY

The distribution and ecology of two species of *Strandesia*, *S. longula* Broodbakker, 1983, and *S. stocki* Broodbakker, 1983, are discussed. Both species are very common in Haiti, and *S. longula* is also common in the Bahamas. Both are found on some of the Lesser Antilles, and therefore they are assumed to have a much wider distribution.

The two species are mostly found in fresh water, but they can tolerate chlorinities up to 3500 mg/l. No preferences concerning other factors could be found. Both species live in wells, pools, and in the underflow of running waters.

Differences in carapace length of different populations could not be correlated with any environmental factor measured. These length differences do not appear to be determined genetically. It is most probable that differences in carapace length are caused by combined environmental factors, like food abundance, pollution, and factors of water chemistry other than chlorinity, as postulated for the genera *Heterocypris* and *Hemicypris*.

RÉSUMÉ

On discute la distribution et l'écologie de deux espèces de *Strandesia*, *S. longula* Broodbakker, 1983, et *S. stocki* Broodbakker, 1983. Ces deux espèces sont fort communes à Haïti, et *S. longula* est commune aussi aux Bahamas. Les deux ont été trouvées sur certaines des Petites Antilles, et on suppose que leur distribution est beaucoup plus vaste.

Elles ont été trouvées surtout en eau douce, mais peuvent tolérer des taux de chlorinité atteignant 3500 mg/l. On n'a pas pu trouver des préférences vis-à-vis d'autres facteurs. Les deux espèces vivent dans les puits, dans le sous-écoulement de cours d'eau, et dans des pièces d'eau stagnante.

Les différences dans la longueur de la carapace des différentes populations n'ont pas pu être corrélées avec l'un ou l'autre des facteurs du milieu, et elles ne semblent pas être génétiquement déterminées. Il est fort probable que ces différences sont en relation avec une combinaison de facteurs, tels que l'abondance de la nourriture, la pollution, et des facteurs hydrochimiques autre que la chlorinité — ce qui avait déjà été postulé pour les genres *Heterocypris* et *Hemicypris*.

1. INTRODUCTION

The present article forms the second part of a study on the tribe Cypricercini. The first part (Broodbakker, 1983c) dealt with the genus *Strandesia*, of which seven new species and one new subspecies were described and discussed.

The two most common species, *Strandesia longula* and *S. stocki*, were only described and taxonomically discussed. The present paper deals with the ecology and distribution of these two species and the differences in carapace length between animals of different samples.

2. MATERIAL AND METHODS

Most of the samples studied have been collected by the Amsterdam Expeditions to the West Indian Islands (1973-1982), and the expeditions of Dr. P. Wagenaar Hummelinck to many Caribbean islands (1936-1973). The two

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samples from Cuba have been collected by Dr. St. Negrea and Dr. T. Orghidan, in 1969 and 1970. For further details about most samples, the reader is referred to Stock (1979) and Wagenaar Hummelinck (1940a-b, 1953, 1981). The samples of the Amsterdam Expeditions and of Dr. P. Wagenaar Hummelinck are abbreviated in the sequel as S and WH, respectively. All material is deposited in the Zoölogisch Museum, Amsterdam (ZMA).

Carapace length was measured with a ruler on a sheet of white paper, on which the animals were projected by way of a camera lucida and a Reichert Diapan microscope.

Goodness of fit was computed for frequency distributions arranged by a single criterion of classification. Frequency distributions were calculated for samples containing *S. longula* and/or *S. stocki*, in different classes of the environmental factors (chlorinity, water depth, water table, light conditions, and type of soil). Expected frequencies were calculated in the same way as done for *Heterocypris* (cf. Broodbakker, 1983a). The same types and classes as in that paper were used.

Instead of chi-square tests, *G*-tests were performed, because the *G*-test has a theoretical advantage over the former, and is computationally simpler (Sokal & Rohlf, 1981: 704). Critical values for the *G*-test can be found in a chi-square table, the distribution of *G* approximates the chi-square distribution.

The tests were performed for samples from Haiti, since only from this island enough samples with both *Strandesia* species were available.

3. DIFFERENCES IN CARAPACE LENGTH
(Table I; appendices I-II)

There is more variation in carapace length between populations of *S. longula* than between populations of *S. stocki*. Mean carapace length in Haiti ranges from 1.21 to 1.55 mm for *S. longula*, and from 0.77 to 0.91 mm for *S. stocki*. The variation in mean carapace length between the different populations is also larger for *S. longula* than for *S. stocki*, being 1.32 ± 0.09 mm ($n = 13$) and 0.83 ± 0.03 mm ($n = 26$), respectively.

The variation is not correlated with the geographical position of the stations. In the Département de l'Ouest of Haiti, small as well as large specimens of *S. longula* are found in open wells of low chlorinity. In the Département du Nord the largest and smallest sized populations of *S. stocki* were found (appendix I).

A correlation with chlorinity is not found either. The smallest as well as the largest specimens of *S. longula* were found at low chlorinities.

The largest sized population of *S. stocki* was found at a high chlorinity (S 78/236: 3320 mg/l), but other large-sized populations were found at low as well as at high chlorinities (e.g.: S 78/205, S 78/235, S 79/599; appendix I).

In the few covered wells in which the animals were found in large numbers, they were not distinctly smaller or larger than animals from open habitats.

In the Bahamas only *S. longula* was encountered. Most populations from these islands have smaller carapaces than the populations from Haiti. Mean carapace length on Crooked Island ranges from 1.17 to 1.21 mm, and on San Salvador two populations with mean carapace lengths of 1.15 and 1.22 mm were found. Only on Eleuthera four larger sized populations were found, ranging in mean length from 1.28 to 1.33 mm (appendix II).

This means that in general *S. longula* is smaller in the Bahamas, but that the mean carapace lengths still have overlap with those found in Haiti. As in Haiti, carapace length is not dependent on chlorinity or the light conditions in the wells. Small as well as large animals were found under all conditions.

The populations found on St. Martin, St. Eustatius and the Virgin Islands (table I; appendix II) range from 1.19 to 1.33 mm in mean length.

The populations from Curaçao are relatively large, ranging from 1.39 to 1.53 mm in mean length. Populations from the same stations taken at different dates had approximately the same length, but the differences in carapace size between animals of the stations WH 75 and WH 82 are very large (table I). The populations from Bonaire and La Désirade have an intermediate mean length.

Conclusions. — No correlations could be found between carapace length and chlorinity or geographic location. Carapace lengths of animals sampled in open and covered habitats were not consistently different either.

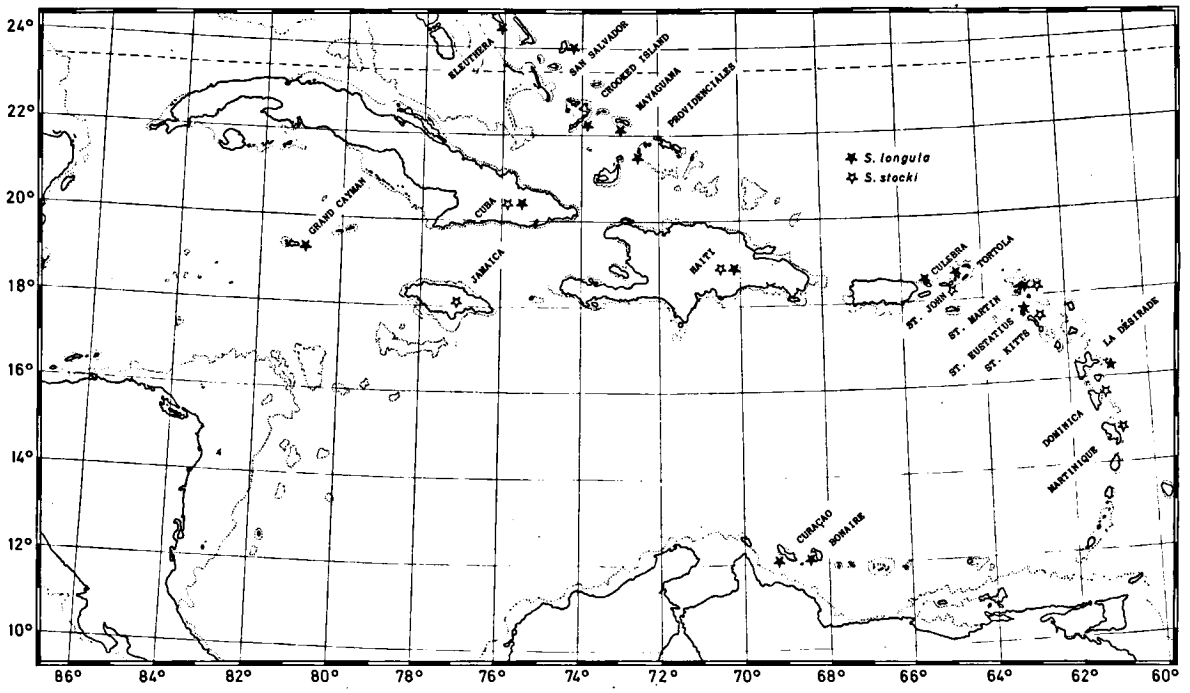

Fig. 1. Map of the Caribbean, showing (dotted) the 200 m line being the edge of the continental shelf. The distribution of *Strandesia longula* and *S. stocki* is indicated.

These results confirm the conclusions found in Broodbakker (1983a-b) for the genera *Heterocypris* and *Hemicypris*. It is most probable that differences in size are caused by combined environmental factors, like food abundance, pollution, and factors of water chemistry other than chlorinity. A comprehensive discussion of aspects concerning the cause of these size differences is provided by Broodbakker (1983a). It seems improbable that the size differences are caused by genetic factors.

4. DISTRIBUTION AND ECOLOGY

Geographical distribution (fig. 1; table I; appendices I-II)

S. longula and *S. stocki* are very common species in Haiti. Since only wells, springs and river interstitia were sampled, it is not clear if the species are also common in pools, ponds, and other epigean habitats.

S. longula is also common in the Bahamas, in contrast to *S. stocki*, which was never found on these islands. Both species live in Cuba, but they were encountered only in epigean habitats and not in the caves sampled by Dr. L. Botosaneanu and Dr. T. Orghidan. Since only few epigean samples were available, and no samples from wells, it is possible that the species is much more common on this island.

S. longula was found in two samples from Grand Cayman, and *S. stocki* in one sample from Jamaica. Since only few ostracod samples from these islands were obtained, the two species may be more common here too. Neither of the species was found in Puerto Rico, but only six ostracod samples were available from this island.

The distribution of the two species in the Virgin Islands and the Lesser Antilles is very scattered. *S. stocki* was found in five islands only, in one sample of each island (fig. 1). These stations are listed in part I of this paper (Broodbakker, 1983c: 339). *S. longula* was encountered in epigean samples on Curaçao, in a pool-like well on Bonaire and on St. Martin, and in a spring on La Désirade (table I). It was

TABLE I

Station list with environmental data and data on carapace length of samples yielding *S. longula*, collected on the Lesser Antilles by Dr. P. Wagenaar Hummelinck, and in Cuba by Drs. T. Orghidan & St. Negrea.

Island Station or collector	Locality type of habitat	Date	Dimensions length × width × depth (m)	Soil; bottom substrate; vegetation; colour; chlorinity (mg/l)	*N* of specimens	Carapace length (mm): mean length ± S.D. (*n*) (length range)
CURAÇAO						
WH 70	Tanki Koenoekoe Hatoen, Hato pool-like well	15-X-1936	10 × 5 × 1	coral-limestone & weathered soil; clayish mud; much; strong; 690	6	— —
WH 75	Tanki Mamaya, Hato pool-like well	06-X-1936	40 × 20 × 2	coral-limestone & shale; mud; much; clear; 450	190	1.40 ± 0.03 (69) (1.31 to 1.46)
WH 75a	Tanki Mamaya, Hato pool-like well	11-X-1936	50 × 25 × 2	coral-limestone & shale; mud; much; clear; 380	250	1.39 ± 0.03 (64) (1.31 to 1.45)
WH 78	Tanki Monpos, Hato pool-like well	11-X-1936	20 × 15 × 1.5	coral-limestone, shale & sand- stone; mud; much; strong; 310	8	— —
WH 82a	Pos Europa, Dokterstuin pool-like well	11-II-1949	2 × 8 × 0.2	diabase & rock detritus; mud; some; slight; 210	48	1.53 ± 0.02 (36) (1.48 to 1.61)
WH 82b	Pos Europa, Dokterstuin pool-like well	22-X-1968	2 × 3 × 0.2	diabase & rock detritus; mud; some; slight; 830	5	— (1.50 to 1.55)
BONAIRE						
WH 54	Pos Baka Chikitoe, Kralendijk pool-like well	14-IX-1936	1.5 × 1 × 0.3	coral-limestone & diabase; clayish mud; no; slight; 500	23	1.30 ± 0.03 (19) (1.25 to 1.36)
LA DÉSIRADE						
WH 741	Grande Source, Baie Mahault spring	24-I-1964	0.5 × 0.5 × 0.5	loamy soil; concrete, rock debris and mud; some; 495	500	1.38 ± 0.03 (84) (1.25 to 1.44)
ST. MARTIN						
WH 533	Yard well of Heyligers, Colom- bier valley; pool-like well	20-V-1949	1.5 × 1.5 × 1.5	weathered rock; debris & mud; much; clear; 160	5	— —
J. J. Jongsma	Reared from dried mud from Slob of Welgelegen, N.W. of Philipsburg	III-1983	—	mud	15	1.33 ± 0.03 (15) (1.28 to 1.38)
CUBA						
T. Orghidan	Ariguanobo; pool ?	4-XII-1970	—	—	12	1.35 ± 0.03 (8) (1.27 to 1.39)
St. Negrea	Bottom substrate of Rio San Vicente, near Vinales, Sierra de los Organos, Prov. Pinar del Rio	6-VI-1969	—	—	14	1.40 ± 0.02 (8) (1.37 to 1.42)

also found in wells on St. Martin, St. Eustatius, Tortola and Culebra (appendix II).

I succeeded in rearing both species from dried mud from St. Martin, this in contrast to the fact that *S. stocki* was only found in 1 and *S. longula* in 3 out of 31 stations sampled on this island. It is therefore highly probable that the two species are more widely distributed, and present on most, if not all, Antillean islands. *S. longula* has the widest distribution, being also common in the Bahamas, while *S. stocki* seems to reach its northernmost distribution in Cuba and Haiti.

Chlorinity (table I; appendices I-II)

S. longula was encountered mostly at low chlorinities, of less than 400 mg/l in Haiti, but also in samples with chlorinities up to 2815 mg/l in the Bahamas.

Likewise, *S. stocki* was mostly found at low chlorinities, of less than 300 mg/l, but once at a chlorinity of 3320 mg/l (S 78/236), and three times at chlorinities reaching from 760 up to 1320 mg/l (S 78/231-234-235). The samples from the other islands where *S. stocki* was sparsely found, were from stations with chlorinities of 320 mg/l or less.

Both species seem to be real freshwater species that are able to tolerate chlorinities up to 3000 or 3500 mg/l, but are mostly found at much lower chlorinities.

Light conditions (table I; appendices I-II)

In Haiti only one sample containing more than 10 specimens of *S. longula* was collected from a covered well. However, in the Bahamas, especially on Eleuthera, many samples originated from covered wells. Of the wells yielding ostracods in Haiti, only 19% was covered, while the percentage of samples with (mostly few) specimens of *S. longula* was also 19%. This means that *S. longula* does not specifically avoid covered wells in Haiti. It looks as if *S. stocki* is found more frequently in covered wells, but the higher percentage of samples from covered wells in Haiti (28%) is not statistically significant ($G = 1.96$).

Water depth and table

No statistically significant differences were found for either of the species concerning the water depth and table of the wells sampled in Haiti. *S. stocki* was found relatively more often in waters deeper than 1.2 m ($G = 1.04$; $\chi^2_{.05[1]} = 3.84$), and in wells with a water table lower than 2 m ($G = 5.80$; $\chi^2_{.05[2]} = 5.99$), but these differences are not significant.

Soil

The type of soil was not registered for most samples, although for the samples from Haiti it could be determined which samples came from alluvial soils and which from limestone surroundings. But often no other data were available. Both species were found in both soil types.

Accompanying fauna (tables II-IV)

In table II the number and percentages of wells in Haiti containing one or more of the listed animal groups are given. Furthermore, the number and percentages of wells containing *S. longula* or *S. stocki*, as well as one or more of the animal groups, are listed. The same procedure was performed for the wells from Mayaguana, Crooked Island, San Salvador Island and Eleuthera, for *S. longula* (table IV). These four Bahamas were chosen solely, because *S. longula* was common in these islands only.

For each animal group a *G*-test was performed, to discover if it was significantly found more or less often with either of the *Strandesia* species, than should be expected from their overall distribution in the wells of these islands yielding ostracods. Most percentages calculated were about the same as those expected from the overall distribution. *S. longula* was found significantly less with Oligochaeta in the Bahamas, but not in Haiti. In Haiti, *S. longula* was found considerably less in the presence of hadziid amphipods (table II; the difference is significant at better than 5% level). Stock (1983) postulates that hadziid amphipods predate on smaller Crustacea, which could mean that they also predate on *S. longula*. However, no such significant relationship was

TABLE II

Number of samples, with percentages and *G*-values, from wells in Haiti, yielding *S. longula* or *S. stocki*, or other faunal elements.

Accompanying fauna	In all wells ($n = 97$)	In wells with *S. longula* ($n = 33$)	*G*	In wells with *S. stocki* ($n = 38$)	*G*
Cyclopidae	81 (84%)	24 (73%)	2.41	30 (79%)	0.54
Oligochaeta	55 (57%)	18 (55%)	0.06	18 (47%)	1.33
Insecta	49 (51%)	16 (48%)	0.05	17 (45%)	0.51
Gastropoda	36 (37%)	10 (30%)	0.68	12 (32%)	0.51
Thermosbaenacea	26 (27%)	9 (27%)	0.00	10 (26%)	0.05
Cladocera/Phyllopoda	20 (21%)	3 (9%)	3.22	6 (16%)	0.58
Hadziid amphipods	18 (19%)	2 (6%)	4.37*	6 (16%)	0.20

TABLE III

Number of samples, with percentage and *G*-values, from wells in Haiti, yielding *S. longula* or *S. stocki*, or other Ostracoda.

Accompanying Ostracoda	In all wells ($n = 98$)	In wells with *S. longula* ($n = 33$)	*G*	In wells with *S. stocki* ($n = 39$)	*G*
Cypretta sp.	39 (40%)	22 (67%)	9.70**	13 (33%)	0.57
S. stocki	39 (40%)	17 (52%)	1.85	— —	—
S. longula	33 (34%)	— —	—	17 (44%)	1.65
Stenocypris major (Baird, 1859)	19 (19%)	9 (27%)	1.20	12 (31%)	2.87
Chlamydotheca unispinosa	37 (38%)	6 (18%)	6.00*	12 (31%)	0.83
Cypridopsis sp.	7 (7%)	2 (6%)	—	2 (5%)	—
Physocypria sp.	12 (12%)	1 (3%)	3.60	1 (3%)	4.83*
Neocypridopsis inaudita	2 (2%)	2 (6%)	—	1 (3%)	—
Pseudocandona antilliana	5 (5%)	1 (3%)	—	— —	—

TABLE IV

Number of samples, with percentages and *G*-values, from wells in Mayaguana, Crooked Island, San Salvador Island and Eleuthera, yielding *S. longula* or other faunal elements.

Accompanying fauna	In all wells ($n = 61$)	In wells with *S. longula* ($n = 37$)	*G*	Accompanying Ostracoda	In all wells ($n = 62$)	In wells with *S. longula* ($n = 37$)	*G*
Insecta	36 (59%)	27 (73%)	3.14	*Cypridopsis* sp.	35 (56%)	22 (60%)	0.14
Cyclopidae	31 (51%)	22 (59%)	1.11	*Physocypria* sp.	31 (50%)	14 (38%)	2.21
Oligochaeta	15 (25%)	4 (11%)	4.50*	*Cypretta* sp.	15 (24%)	9 (24%)	0.00
Gastropoda (except for *Pyrgophorus*)	14 (23%)	8 (22%)	0.04	*Neocypridopsis inaudita*	14 (23%)	2 (5%)	8.31**
Pyrgophorus	14 (23%)	8 (22%)	0.04	No other species	— —	7	—
Amphipoda	14 (23%)	9 (24%)	0.04				
Hyalella sp.	14 (23%)	10 (27%)	0.33				
Cladocera	6 (10%)	3 (8%)	—				

* Significant at better than 5% level (one-tailed).

** Significant at better than 1% level (one-tailed).

found for the co-occurrence of *S. stocki* and hadziid amphipods, which could contradict this supposition.

The same procedure as with the animal groups was followed for the wells in Haiti in which *S. longula* and *S. stocki* were accompanied by other ostracod species (table III), and for *S. longula* in the wells of the four Bahamas chosen (table IV). In this procedure more differences in the animal associations were found.

S. longula is found relatively often together with *Cypretta* sp., and relatively less often with *Chlamydotheca unispinosa* (Baird, 1862), in Haiti. However, this was not the case in the Bahamas. In the islands Mayaguana, Crooked Island, San Salvador and Eleuthera, it was found only slightly more often with *Cypretta* sp., but not significantly so, and less often with *Neocypridopsis inaudita* (Furtos, 1936), a species which was not found in Haiti (table IV). *Chlamydotheca unispinosa* was present in only two ostracod samples from the Bahamas. *S. longula* was not found relatively more or less often with any of the other ostracod species in Haiti and the Bahamas.

S. stocki was found in Haiti only once with *Physocypria* sp., like *S. longula.* The other species were not found significantly more or less often with *S. stocki* in Haiti.

S. longula and *S. stocki* were found somewhat more often in each other's presence than would be expected if they were distributed at random. This means that there certainly is no indication of competition between the two species. Both species are often found together in the same well, and in most of the wells of Haiti they are accompanied by one or more of the other species of ostracods.

Conclusions. — *S. longula* is a common species in the wells of Haiti, but also in the wells of most of the Bahamas. It was also encountered in some epigean samples from Cuba, Curaçao, Bonaire, and La Désirade, and in some wells on Grand Cayman, Tortola, Culebra, St. Martin and St. Eustatius.

S. stocki is most common in Haiti, was never found in the Bahamas, twice in Cuba, and only once on Jamaica, St. Martin, St. Kitts, St. John, Dominica and Martinique.

Both species could be raised from dried mud. It is therefore probable that they have a much wider distribution than is presently known. Both species were encountered on limestone as well as on alluvial deposits (often sand), mostly at low chlorinities (less than 400 mg/l), but they can tolerate chlorinities up to 3500 mg/l. No other preferences could be found. Both species live in pools, wells and river interstitia. In Haiti they were often found together and with other species of ostracods in the same sample. *S. longula* was found significantly more often with *Cypretta* sp. in Haiti, but not in the Bahamas, and less often with *Chlamydotheca unispinosa* in Haiti, and with *Neocypridopsis inaudita* in the Bahamas. *S. stocki* was found significantly less often with *Physocypria* sp., but this conclusion is based on few samples.

Both species were accompanied by a specific fauna. *S. longula* was found significantly less often with hadziid amphipods in Haiti, which could be the result of predation by the latter. However, this is in contrast to the fact that *S. stocki* was not found significantly less in the company of hadziid amphipods.

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APPENDIX I

Station list with environmental data and data on carapace length of samples containing *S. longula* and/or *S. stocki*, taken in wells in Haiti, by the Amsterdam Expeditions to the West Indian Islands.

Département (date) Station no.	Locality	Latitude Longitude	Environmental data; chlorinity (mg/l)	*Strandesia longula* *N* of specimens	*Strandesia longula* mean length ± S.D. (*n*) (length range) (mm)	*Strandesia stocki* *N* of specimens	*Strandesia stocki* mean length ± S.D. (*n*) (length range) (mm)
Dépt. de l'Ouest (4 and 5-V-1978)							
S 78/197	E. of Croix-des-Missions	18°35'38"N 72°16'55"W	dug hole in sand; 40	180	1.32 ± 0.03 (41) (1.28 to 1.37)	—	—
S 78/198	Just S. of S 78/197	18°35'36"N 72°16'53"W	open, cement edge; 80	15	1.32 ± 0.03 (7) (1.26 to 1.36)	—	—
S 78/199	Just W. of S 78/198	18°35'36"N 72°16'53"W	covered; 100	5	—	33	0.81 ± 0.02 (16) (0.78 to 0.84)
S 78/200	S. side of road N 102	18°35'59"N 72°16'12"W	covered	1	—	10	—
S 78/201	Slightly S.W. of S 78/200	18°35'57"N 72°16'14"W	open, in sand, clean; 10	—	—	6	—
S 78/205 /206	Between Gressin and Léogane	18°32'27"N 72°33'50"W	open, in stone and black soil; 40	260	1.55 ± 0.05 (81) (1.47 to 1.69)	33	0.86 ± 0.02 (26) (0.82 to 0.90)
Ditto: Croix-des-Missions (9 and 10-XI-1979)							
S 79/529	Brook Balisaille, where it cuts the road Ganthier-Croix-des-Bouquets	18°32'40"N 72°05'37"W	fast running, gravel,much moving sand; 36	—	—	18	0.81 ± 0.03 (18) (0.78 to 0.85)
S 79/534	Well of Marcel Georges, in Fleuriot	18°34'24"N 72°15'42"W	dug in accretion of land, covered; 47	—	—	1	—
S 79/536	Well of Thérèse Celamy, Groureau, Cazeau	18°35'03"N 72°16'23"W	open, dug in accretion of land; 18	—	—	5	—
S 79/538	Well of Macelon Saint Germain, in Carrefour Marin (Furgy = Fourgu)	18°36'15"N 72°17'03"W	open; 230	4	—	—	—
S 79/539	Well of Gérard Gélan, in Marin	18°36'31"N 72°17'31"W	open, primitive; 310	30	1.27 ± 0.03 (24) (1.21 to 1.28)	—	—
S 79/540	Well of Mrs. Antagras, Mifroh, 150 m from 539	18°36'31"N 72°17'31"W	open, primitive; 67	2	—	—	—
S 79/541	Verdier Edouard's well, in Gibert	18°36'45"N 72°18'11"W	open, dug in muddy ground; 57	—	—	23	0.85 ± 0.01 (21) (0.82 to 0.87)
Dépt. du Sud-Est (Cayes-Jacmel) (5-V-1978)							
S 78/213	Cayes-Jacmel, N. side of road	18°13'54"N 72°23'50"W	open, clean; 40	1	—	—	—
S 78/214	Just W. of Marigot, S. side of road	18°14'07"N 72°20'24"W	open; 240	60	1.31 ± 0.03 (50) (1.26 to 1.34)	—	—
S 78/215	Hamlet Raymond, Puits Conseil Communautaire	18°13'30"N 72°25'36"W	covered, fairly clean; 30	4	—	1	—
S 78/216	Jacmel, house of Dr. Abel Gousse	18°14'31"N 72°32'04"W	covered, neglected; 50	3	—	—	—
Ditto: (13-XI-1979)							
S 79/547	Well of Mrs. André Pascal, at Massac	18°13'58"N 72°22'50"W	open, primitive; 38	10	—	—	—
S 79/549	Well of Emile Magloire, at Ti Mouillage	18°14'01"N 72°22'26"W	open; 70	85	1.21 ± 0.04 (31) (1.14 to 1.28)	—	—
S 79/550	Well of André Jules, at Massac	18°13'58"N 72°22'50"W	dug in the mud; 59	2	—	—	—
S 79/551	Massac, well opposite of 550	18°13'58"N 72°22'50"W	open; 51	27	1.24 ± 0.03 (16) (1.20 to 1.30)	—	—
Ditto: Marigot (16-XI-1979)							
S 79/560	Well of Jacques Simein, at Marigot	18°13'51"N 72°18'52"W	open, walled-in to the bottom, clean; 31	1	—	60	0.78 ± 0.02 (29) (0.76 to 0.81)
S 79/561	Well of Vetirie Lapierre, at Marigot	18°13'51"N 72°18'52"W	open, walled-in, clean; 34	4	—	—	—

APPENDIX I (continued)

Département (date) Station no.	Locality	Latitude Longitude	Environmental data; chlorinity (mg/l)	*Strandesia longula*		*Strandesia stocki*	
				N of specimens	mean length ± S.D. (*n*) (length range) (mm)	*N* of specimens	mean length ± S.D. (*n*) (length range) (mm)
S 79/562	Agricultural well Sévrin, at Marigot	18°13'48"N 72°19'16"W	open, walled-in to the bottom, clean; 150	33	1.28 ± 0.03 (14) (1.23 to 1.33)	7	—
S 79/564	Well of Ferilys Byssaints, at Marigot	18°13'48"N 72°19'16"W	open, neglected, sand and debris; 26	8	—	3	—
S 79/565	Well of the Rectory, at Marigot	18°14'01"N 72°19'33"W	covered; walled-in to the bottom; 280	1	—	1	—
S 79/566	Well opposite the barracks, at Marigot	18°13'51"N 72°19'43"W	open, walled-in to the bottom; 90	1	—	32	0.82 ± 0.02 (23) (0.78 to 0.84)
S 79/567	Well of Lucius René, at Marigot (W.)	18°13'51"N 72°19'43"W	open, completely walled-in, clean; 68	21	—	15	— (0.81 to 0.86)(6)
S 79/568	Well in a park, at Marigot (W.)	18°13'51"N 71°19'43"W	open; 61	22	— (1.10 to 1.22)	400	0.79 ± 0.02 (45) (0.76 to 0.82)
Dépt. de l'Artibonite (8-V-1978)							
S 78/231	Passe Reine (N.E. of Gonaïves)	19°30'29"N 72°32'38"W	covered, clean, in alluvial deposits; 840	—	—	30	0.80 ± 0.02 (22) (0.78 to 0.84)
S 78/242	Just E.S.E. of Gonaïves, S. side of road D 100	19°26'28"N 72°40'57"W	open, with windpump; 150	—	—	7	—
Ditto: (21, 22 and 24-XI-1979)							
S 79/591	Well Frank Mezidor, S. of Saint-Marc	19°05'29"N 72°42'04"W	covered, muddy, in sand; 45	—	—	6	—
S 79/592	Well Tubérisse Surpris, at Saint-Marc	19°05'29"N 72°42'04"W	covered, in sand; 24	—	—	47	0.83 ± 0.02 (47) (0.77 to 0.86)
S 79/597	Well "Portail des Guêpes", at Saint-Marc	19°07'23"N 72°41'44"W	open, made in limestone; 230	—	—	52	0.85 ± 0.02 (39) (0.82 to 0.89)
S 79/599	Well of the Night Club, N. of Saint-Marc	19°07'23"N 72°41'44"W	open, walled-in to the bottom; 180	—	—	75	0.86 ± 0.02 (45) (0.79 to 0.90)
S 79/600	Well of Maître Graviel Martel, N. of Saint-Marc	19°07'23"N 72°41'44"W	open, partly walled-in; 66	—	—	220	lost
S 79/617	Well near market of Arcahaie	18°46'08"N 72°30'44"W	open, troubled water; 145	180	1.28 ± 0.05 (91) (1.17 to 1.14)	—	—
S 79/618	Well of Luc Pierre, at Arcahaie, Rue Abbé Andelin	18°46'08"N 72°30'44"W	open, walled-in till water level, clean; 100	2	—	—	—
S 79/620	Well of Boss Raoul Bélizaire, at Arcahaie (district Cortade)	—	open, made in sand, clean; 17	—	—	12	0.84 ± 0.02 (10) (0.79 to 0.87)
Dépt. du Centre (28-XI-1979)							
S 79/630	"Source Tête Nègre", E. of Mirebalais (road to Lascehobas)	18°49'40"N 72°05'06"W	spring interstitia, water almost stagnant; 23	—	—	10	— (0.83 to 0.86)(7)
Dépt. de Grande Anse (2 and 5-XII-1979)							
S 79/647	Well of Anacius François, at Gomier	18°36'15"N 74°04'10"W	walled-in to water level, clear; 125	—	—	20	0.82 ± 0.02 (16) (0.79 to 0.85)
S 79/658	Limnocrene spring, at Beaucalin	18°35'36"N 74°11'57"W	not karstified; 18	52	1.31 ± 0.03 (26) (1.25 to 1.37)	4	—
Dépt. du Nord (9 and 10-V-1978)							
S 78/234	Plage Diquoi (N.W. of Cap Haïtien)	19°46'50"N 72°14'43"W	open, clean, foot of cliff; 760	4	—	12	—
S 78/235	Slightly S.W. of S 78/234	19°46'34"N 72°14'39"W	water colour gray, in limestone rock; 1320	1	—	10	0.86 ± 0.02 (9) (0.83 to 0.89)
S 78/236	N. E. of Cormier-Plage 60 m from the sea	19°46'13"N 72°14'51"W	open, H_2S, in alluvial plain; 3320	—	—	10	0.91 ± 0.02 (10) (0.89 to 0.94)
S 78/237	Village of Lombard (just E. of Limbé), S. side of road D 100	19°41'57"N 72°22'28"W	open, filamentous algae; 160	—	—	53	0.77 ± 0.01 (29) (0.76 to 0.79)

APPENDIX I (continued)

Département (date) Station no.	Locality	Latitude Longitude	Environmental data; chlorinity (mg/l)	*Strandesia longula* *N* of specimens	*Strandesia longula* mean length ± S.D. (*n*) (length range) (mm)	*Strandesia stocki* *N* of specimens	*Strandesia stocki* mean length ± S.D. (*n*) (length range) (mm)
S 78/239	Limbé, S. side of road D 100	19°42'05"N 72°23'53"W	open; 100	—	—	48	0.82 ± 0.04 (18) (0.78 to 0.89)
S 78/240	Near S 78/239	as S 78/239	covered; 240	—	—	200	0.80 ± 0.02 (35) (0.78 to 0.83)
Ditto: S.E. of Milot (10-XII-1979)							
S 79/676	Well of Raphael Saint-frère at Bénard	ca.19°38'N ca.72°12'W	walled-in to the middle, grey sediment; 385	11	1.34 ± 0.02 (11) (1.30 to 1.36)	1	—
S 79/677	Well of Verne Exalus at Barrière Battant	19°37'13"N 72°11'01"W	walled-in to the bottom; 64	120	1.39 ± 0.05 (56) (1.33 to 1.55)	125	0.83 ± 0.02 (50) (0.81 to 0.89)
S 79/678	Well of "Deshommes Salvant", at Tassy	ca.19°36'N ca.72°12'W	covered, walled-in to water level; 31	18	1.38 ± 0.04 (10) (1.33 to 1.46)	32	0.81 ± 0.03 (32) (0.77 to 0.85)
S 79/679	Well of Narcius Etienne, at Brossard	ca.19°36'N ca.72°12'W	abandoned; 60	3	—	20	0.82 ± 0.02 (16) (0.79 to 0.85)
S 79/680	Public well at Lécurie (Milot)	ca.19°36'N ca.72°12'W	walled-in to the bottom, much sediment; 45	1	—	—	—
Ditto: E. of Limbé (10 and 11-XII-1979)							
S 79/681	Well of Mrs. Elitesse Jeanlouis, at Lombard	19°42'23"N 72°23'08"W	walled-in to the bottom; 69	—	—	250	0.83 ± 0.02 (53) (0.81 to 0.85)
S 79/682	Well of Mrs. Gaspard Caséix, at Lombard	19°42'23"N 72°23'08"W	walled-in to the bottom; 100	—	—	45	0.82 ± 0.02 (24) (0.79 to 0.85)
S 79/683	Well of Francéis, at Limbé	19°42'14"N 72°23'55"W	open, walled-in to the water level, dirty; 32	—	—	10	0.82 ± 0.03 (10) (0.79 to 0.87)
S 79/688	Well Mézardié (in hamlet Moulin de Limbé)	19°42'14"N 72°23'55"W	walled-in, very dirty; 12	—	—	85	0.84 ± 0.02 (57) (0.81 to 0.89)
S 79/689	The Rectory at Limbé	19°42'14"N 72°23'55"W	covered, clean, sandy bottom, electr. pump; 14	—	—	10	0.85 ± 0.03 (10) (0.81 to 0.87)

Appendix II

Station list with environmental data and data on carapace length of samples containing *S. longula*, taken on the Lesser Antilles, Grand Cayman, Providenciales, and the Bahamas, by the Amsterdam Expeditions to the West Indian Islands.

Island Station	Locality	Latitude Longitude	Environmental data	Chlorinity (mg/l)	*N* of specimens	Carapace (mm): mean length ± S.D. (*n*) (length range)
ST. MARTIN						
S 76/41	Anse des Pères, French side, well (18-VI-1976)	18°05'03"N 63°04'46"W	partly covered; round	500	38	1.29 ± 0.02 (38) (1.25 to 1.35)
S 82/142	Jones Gut, between Orléans and Cul de Sac; pool (29-I-1982)	18°05'10"N 63°01'36"W	pool in bed of dry torrent	—	8	— (1.37 to 1.44)
ST. EUSTATIUS (19-VI-1976)						
S 76/44	Schotsenhoek; well with ruined windpump	17°29'06"N 62°58'58"W	round, covered	—	17	1.20 ± 0.04 (14) (1.13 to 1.26)
S 76/49	Rooi (= gully) Spouts, near Zeelandia; well	17°30'11"N 62°58'39"W	open, rather clean	450	38	1.29 ± 0.04 (23) (1.23 to 1.37)
TORTOLA (25 and 26-IV-1978)						
S 78/139	Chapel Hill; well with troughs	18°26'30"N 64°33'25"W	open, fairly clean	880	1	—
S 78/151	Long Bay Point; well near the sea	18°23'57"N 64°41'11"W	open, clean	—	58	1.22 ± 0.04 (42) (1.18 to 1.29)
S 78/152	E.N.E. of Havers, N. side of road; well near ruined farm	18°23'54"N 64°38'22"W	partly covered	920	12	1.19 ± 0.05 (12) (1.15 to 1.33)
CULEBRA (2-V-1978)						
S 78/189	Puerto del Manglar; overshadowed well	18°18'41"N 65°15'42"W	open, round	1390	6	— (1.28 to 1.33)
GRAND CAYMAN (27-X-1979)						
S 79/55	Old Bush, well	19°22'22"N 81°24'17"W	open shaft in limestone	20	21	1.31 ± 0.04 (19) (1.23 to 1.37)
S 79/56	Old Bush, Mrs. Prince's well	19°22'35"N 81°24'19"W	covered, in coral rock (with brooklet)	17	1	—
PROVIDENCIALES (16-XI-1979)						
S 79/149	Pasture well, East	21°47'11"N 72°15'43"W	open	2815	56	1.20 ± 0.04 (27) (1.15 to 1.29)
MAYAGUANA (11-XI-1979)						
S 79/121	Abraham Bay, Mr. C. Brooks well	22°22'14"N 72°57'52"W	cut in rock, with square opening	1120	1	—
S 79/122	Abraham Bay, John McIntosh's well	22°22'12"N 72°57'53"W	open, cut in rock	140	1	—
S 79/129	Betsy Bay windpump, Commissioner Pyrform, 2 wells	22°24'49"N 73°07'35"W	small openings; in swamp (rain)land	150	1	—
S 79/132	Lower Pirate Well, Samuel Collie's well	22°25'45"N 73°05'45"W	open, water not clear	1150	1	—
S 79/133	Eva Collie's well	22°25'46"N 73°05'47"W	half covered	2110	5	—
S 79/134	Lower Pirate Well, public well	22°25'48"N 73°05'49"W	square opening on oval hole	1045	1	—
S 79/135	Lower Pirate Well, Ebanozar Johnson's well	22°25'44"N 73°05'33"W	open, oval opening	2680	1	—

APPENDIX II (continued)

Island Station	Locality	Latitude Longitude	Environmental data	Chlorinity (mg/l)	*N* of specimens	Carapace (mm): mean length ± S.D. (*n*) (length range)
CROOKED ISLAND (27 and 28-XI-1979)						
S 79/192	Moss Town, well W. of main road	22°48'27"N 74°15'25"W	open	310	4	—
S 79/194	Cripple Hill, well	22°47'55"N 74°14'35"W	open	235	28	1.17 ± 0.04 (14) (1.12 to 1.23)
S 79/195	Fair Field, well	22°47'14"N 74°13'39"W	open	420	73	1.19 ± 0.03 (20) (1.12 to 1.23)
S 79/196	Timber Hill, well	22°46'21"N 74°12'15"W	covered, with square opening	490	22	1.21 ± 0.06 (11) (1.10 to 1.29)
S 79/197	Cabbage Hill, public well	22°45'52"N 74°13'13"W	covered, square opening, hand pump	130	2	—
S 79/198	Cabbage Hill, Johnny Hill section, well	22°45'56"N 74°13'28"W	circular, with oblong opening	155	15	1.18 ± 0.03 (11) (1.12 to 1.23)
S 79/199	Cabbage Hill (South), well	22°45'46"N 74°13'21"W	covered, square opening	45	5	—
S 79/202	Boats' well	22°45'29"N 74°11'51"W	covered, square opening	200	5	— (1.10 to 1.14)
S 79/203	Mayors Cay, public well	22°43'50"N 74°09'25"W	covered, oblong opening	180	2	—
S 79/210	True Blue (East), well	22°43'45"N 74°03'21"W	open, oblong opening	215	10	1.19 ± 0.06 (9) (1.10 to 1.26)
SAN SALVADOR (23 and 24-XI-1979)						
S 79/183	United Estates Settlement, well	24°06'20"N 74°27'09"W	open	545	3	—
S 79/184	Hannah Bay, near Club Short Stop, well	24°06'40"N 74°27'08"W	open well, ruined pump	90	2	—
S 79/187	Public well, S. of Bonefish Bay	24°04'26"N 74°31'44"W	open	45	51	1.15 ± 0.04 (13) (1.11 to 1.22)
S 79/189	Olympic Flame, Monument well	24°00'44"N 74°31'35"W	covered, square opening	60	14	—
S 79/190	Sugar Loaf Settlement, well	24°00'03"N 74°31'49"W	open, square opening	140	35	1.22 ± 0.03 (24) (1.17 to 1.27)
S 79/191	Sandy Point Estate, W. of the Queens Highroad, well	23°57'23"N 74°32'49"W	open, square opening	220	6	—
ELEUTHERA (8 and 9-XI-1979)						
S 79/96	Rock Sound International Airport, N. side of W. end, well	24°53'37"N 76°10'36"W	covered with concrete, square entrance	1200	73	1.21 ± 0.03 (55) (1.17 to 1.30)
S 79/98	John Millars (village), S. of John Millars Road, well	24°41'07"N 76°12'08"W	open well, on the bank of larger pool	105	18	1.21 ± 0.04 (15) (1.15 to 1.28)
S 79/99	N. side of Bannerman Town, in front of Town School, well	24°38'22"N 76°10'21"W	covered, square entrance, rubbish	460	62	1.28 ± 0.06 (44) (1.18 to 1.38)
S 79/100	The Village, two wells on T-crossing, S. boundary of village	24°42'48"N 76°12'58"W	half covered, on kind of natural cleft	40	110	1.33 ± 0.04 (44) (1.20 to 1.42)
S 79/101	Foxhill, W. of road near house under construction, well	24°43'12"N 76°13'06"W	open	230	35	1.32 ± 0.03 (27) (1.23 to 1.37)
S 79/102	Waterford Settlement, near house, well	24°03'47"N 76°14'02"W	covered, square entrance	310	2	—

APPENDIX II (continued)

Island Station	Locality	Latitude Longitude	Environmental data	Chlorinity (mg/l)	*N* of specimens	Carapace (mm): mean length ± S.D. (*n*) (length range)
S 79/107	Savannah, George Clark's well	25°04′36″N 76°07′37″W	covered	—	1	—
S 79/108	Just S. of S 79/107, well	25°04′35″N 76°07′37″W	covered, small open hole	485	6	—
S 79/111	The Bluff, Roderick Pedican's well	25°29′19″N 76°44′47″W	covered	70	16	—
S 79/113	The Bluff, close to the Pier, well	25°29′22″N 76°44′49″W	covered, oblong opening	135	7	—
S 79/114	The Bluff, House the Hiltons, well	25°29′22″N 76°44′48″W	covered, oblong opening	60	20	1.31 ± 0.05 (19) (1.23 to 1.39)
S 79/115	Sweedy Kelly's well, The Bluff	25°29′27″N 76°44′40″W	covered, square opening	35	10	1.24 ± 0.04 (10) (1.17 to 1.28)
S 79/117	N. of George Town, well	25°23′39″N 76°33′30″W	open, square opening	530	36	1.23 ± 0.03 (28) (1.20 to 1.30)
S 79/118	Savannah Sound, Saint Fleur's well	25°04′13″N 76°07′42″W	covered	1750	2	—
S 79/120	Savannah Sound (S.E.), grassland, well	25°04′44″N 76°07′40″W	square opening, rubbish	305	5	—