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Faunal Remains Associated with Late Saladoïd and Post-Saladoïd Occupations at Anse à la Gourde, Guadeloupe, West Indies: Preliminary Results

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ABSTRACT: The study of the large faunal assemblage recovered from the Saladoïd (400-600 A.D.) and Troumassoïd (800-1400 A.D.) occupation levels in a trench at the site of Anse à la Gourde, Guadeloupe, permitted an evaluation not only of the richness and diversity of the faunal spectrum, but also of the ecosystems exploited and the techniques of capture, based on the taxonomic list and the size estimates for snappers (Lutjanidae), grunts (Haemulidae), and parrotfishes (Scaridae). The large sample size also permitted a statistical analysis of the data obtained from each archaeological layer. These analyses indicated significant changes in the exploitation of the animal resources through time.

KEY WORDS: ZOOARCHAEOLOGY, GUADELOUPE, WEST INDIES, FISH, GRUNT, SNAPPER, PARROTFISH, HAEMULIDAE, LUTJANIDAE, SCARIDAE

RESUMEN: La capas saladoïdes tardías (400 – 600 A.C.) y troumassoïdes (800 – 1 400 A.C.) del sondeo realizado en el sitio Anse à la Gourde, Guadeloupe, permitió caracterizar tanto el espectro de fauna (gracias a los índices de riqueza y de diversidad), así como los ecosistemas explotados y las técnicas de captura utilizadas (gracias al conjunto faunístico específico y a la talla de ciertos peces: Haemulidae, Lutjanidae y Scaridae). La gran cantidad de huesos permitió también testar estadísticamente las informaciones obtenidas sobre cada capa arqueológica. Gracias a estos análisis se pudo observar que ciertas mutaciones eran significativas.

PALABRAS CLAVE: ARQUEOZOOLOGÍA, GUADELOUPE, PEQUEÑAS ANTILLAS, PEZ, HAEMULIDAE, LUTJANIDAE, SCARIDAE

RÉSUMÉ: Les couches saladoïdes tardives (400 – 600 ap. J.-C.) et troumassoïdes (800 - 1400 ap. J.-C.) d'un sondage du site l'Anse à la Gourde ont livré un abondant matériel faunique. L'étude de ces restes a permis d'une part, de caractériser la richesse et la diversité du spectre de faune, et d'autre part, de reconstituer les écosystèmes exploités et les techniques de capture (au travers de la liste taxonomique et par l'estimation de la taille de trois familles de poissons: Haemulidae, Lutjanidae et Scaridae). La grande quantité d'ossements a permis d'étayer statistiquement les informations obtenues sur chaque couche archéologique. Ces approches indiquent quelques variations significatives de l'exploitation des ressources animales dans le temps.

MOTS CLEFS: ARCHEOZOOLOGIE, GUADELOUPE, PETITES ANTILLES, POISSON, GORETTE, VIVANEAU, POISSON-PERROQUET, HAEMULIDAE, LUTJANIDAE, SCARIDAE

INTRODUCTION

The importance of marine resources in the pre-Columbian Caribbean is suggested by the island environment and substantiated by several zooarchaeological studies (Wing, 1977, 1989, 1994, 1995; Wing & Scudder, 1983; deFrance, 1988; Carlson, 1995; Keegan, 1997). Analyses of faunal assemblages from various sites in the Lesser Antilles provide data on the subsistence patterns and on the environments that were exploited by the pre-Columbian Amerindians (Rouse, 1989a; Watters & Rouse, 1989; Watters, 1998). Guadeloupe is an island for which we have a small amount of data. The site of Anse à la Gourde in Grande-Terre provides a long chronological sequence with large refuse areas. Based on one refuse area, this zooarchaeological study was undertaken to investigate the nature of both marine and terrestrial exploitation in a chronological perspective (molluscs have been excluded from this study). The large faunal samples from successive levels of the site provide an understanding of the prehistoric economy, the prehistoric fisheries and the long term effects of fishing on the natural resources.

This article deals with the preliminary results from the material recovered during the 1997-1998 excavations. Although we are still in the process of studying the new data recovered during the 1999-2000 excavations, the initial results confirm the main interpretations discussed here.

MATERIAL AND METHODS

Anse à la Gourde is one of the major village sites located along the eastern coast of Grande-Terre in Guadeloupe (Figures 1, 2). It occupies 4.5 hectares (Figure 3). The coastal strip is a refuse area and the remains of house posts, burials and fireplaces are located inland from the shore. A trench through the large refuse area indicated a deeply stratified unit (Z64S93C01), corresponding to an Amerindian Ceramic period occupation from 400 to 1400 A.D. (Rouse, 1989b, 1992, 1995; Delpuech *et al.*, 1997). This last unit was selected for analysis because it is very rich in well preserved faunal remains (vertebrates, crabs, and urchins) and it covers all the occupation periods.

The trench measuring 1 x 1 square meter was excavated in 10 cm arbitrary levels. The material from this unit was water sieved through a 2.8 mm gauge screen. The stratigraphy reveals nine successive occupations (Figure 4). The analysis of the ceramics reveals that occupation levels III, IV, VI, IX, X, and XVIII are of the late Saladoïd period, ranging from 400 to 600 A.D. Occupation levels XX, XXI, XXIII, and XXIV are different phases of the Troumassoïd period, ranging from 800 to 1400 A.D. (Delpuech *et al.*, 1997). In order to point out differences between samples, the data is grouped into five phases: Saladoïd 1 (S1 = levels III, IV and VI), Saladoïd 2 (S2 = IX, X, XVIII), Post-Saladoïd 1 (PS1 = XX and XXI), Post-Saladoïd 2 (PS2 = XXIII), and Post-Saladoïd 3 (PS3 = XXIV).

Spectrum of taxa

The faunal remains were sorted and identified to their lowest taxonomic levels using comparative collections at the following institutions: the Florida Museum of Natural History in Gainesville; The *Laboratoire d'Anatomie Comparée* of the *Muséum National d'Histoire Naturelle* in Paris; The Laboratory of Zooarchaeology of the *Centre de Recherches Archéologiques* in Valbonne; and the specimens collected by the author in 1997, which are now at the *Service Régional de l'Archéologie de Guadeloupe*.

The number of identified specimens (NISP), the minimum number of individuals calculated by paired elements (MNI), and the weight of the remains (in grams) were quantified for each taxon in each level. Each of these methods of quantification has its own advantage (see Chaplin, 1971; Ducos, 1975; Poplin, 1976a, 1976b, 1977; Grayson, 1984; Lyman, 1994). Comparisons were made between samples using both NISP and MNI.

An understanding of subsistence during antiquity, at least concerning the flesh meat portion of the diet, is based on the identified taxa and their relative abundances in each period. One dietary aspect is diversity, which can be measured by calculating the taxonomic richness, according to the size of samples. In order to check the reliability of samples in relation to their size, a rarefaction curve was constructed by plotting MNI on the x axis and the number of taxa (S) on the y axis. Richness was also estimated by applying the Margaleff index (dI) (1958, cited by Bobrowski & Ball, 1989) to the samples from each level. This index was calculated using the formula $dI = (S-1)/(Log_e N)$ where S is the number of species and N is the total NISP for each level. Diversity and homogeneity were estimated using the Simpson Reciprocity index (H'), calculated using the formula $H' = 1/\sum pi^2$, where pi = ni/N, ni = NISP per taxon, and N = total NISP for the sample (Grayson, 1984). In order to evaluate the differences between the samples, Chi^2 square tests of NISP across species were carried out (the MNI of some species was too small to be used in a Chi^2 test).

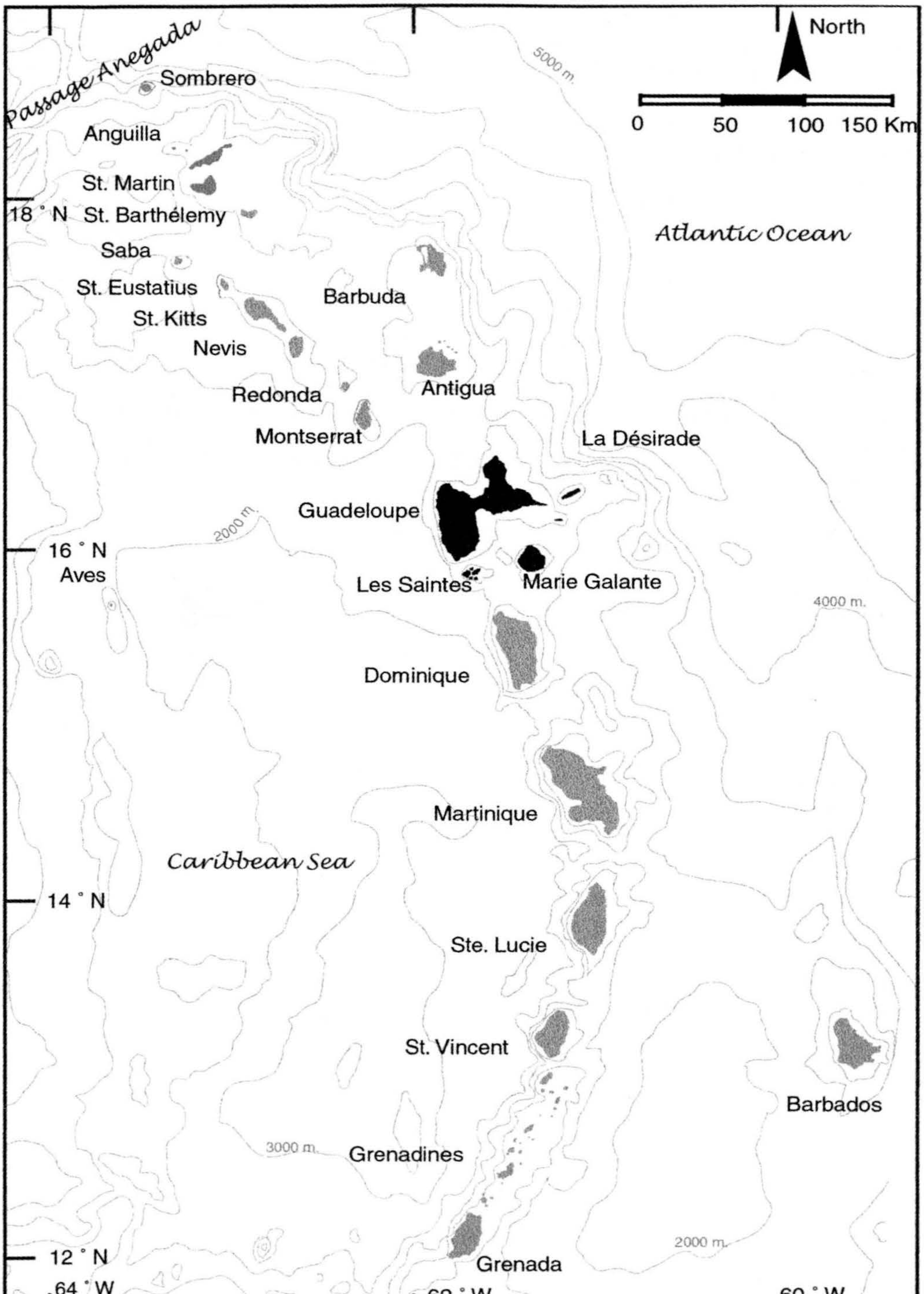

FIGURE 1

Map of the West Indies.

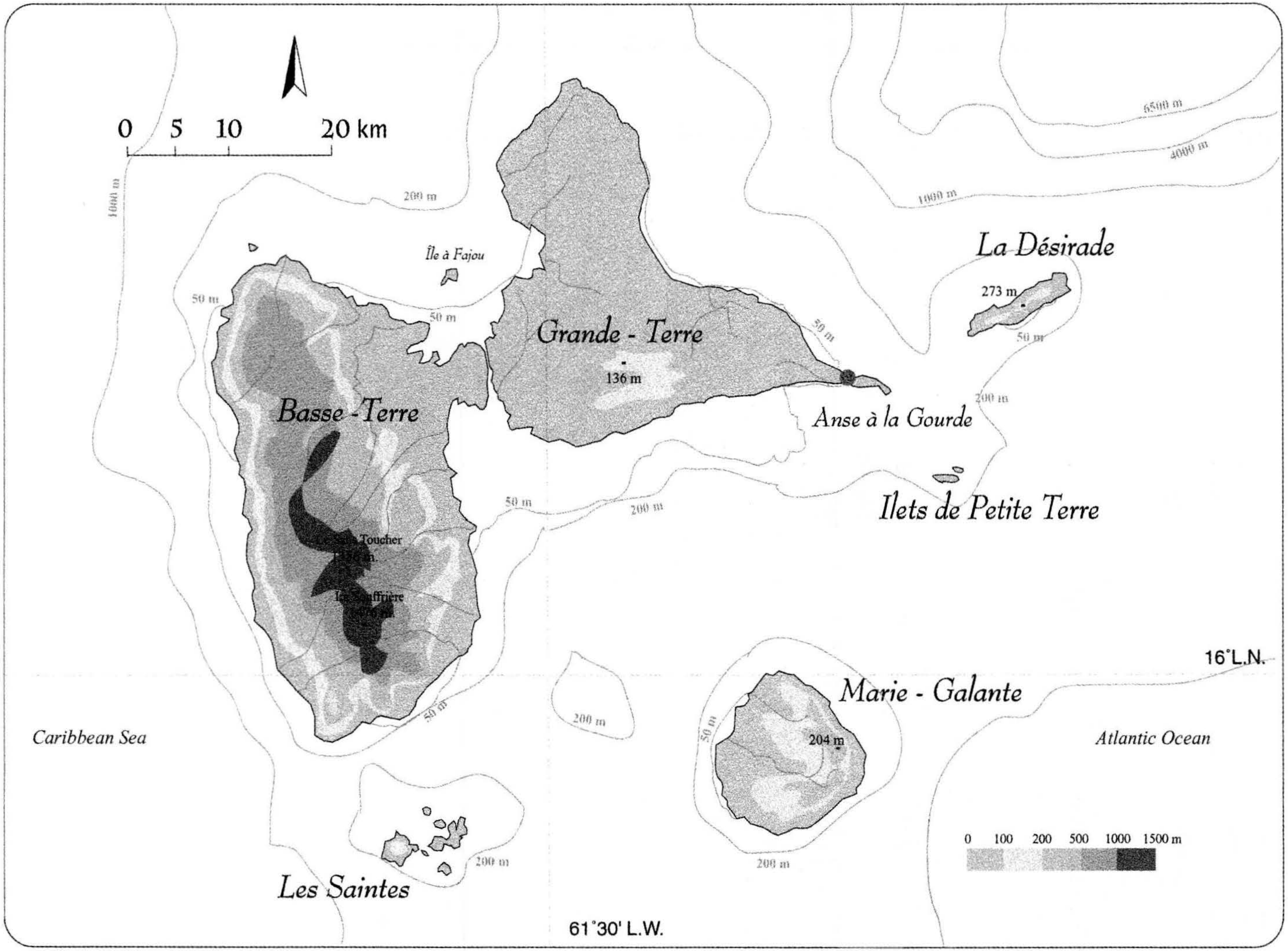

FIGURE 2
Location of Anse à la Gourde in Guadeloupe.

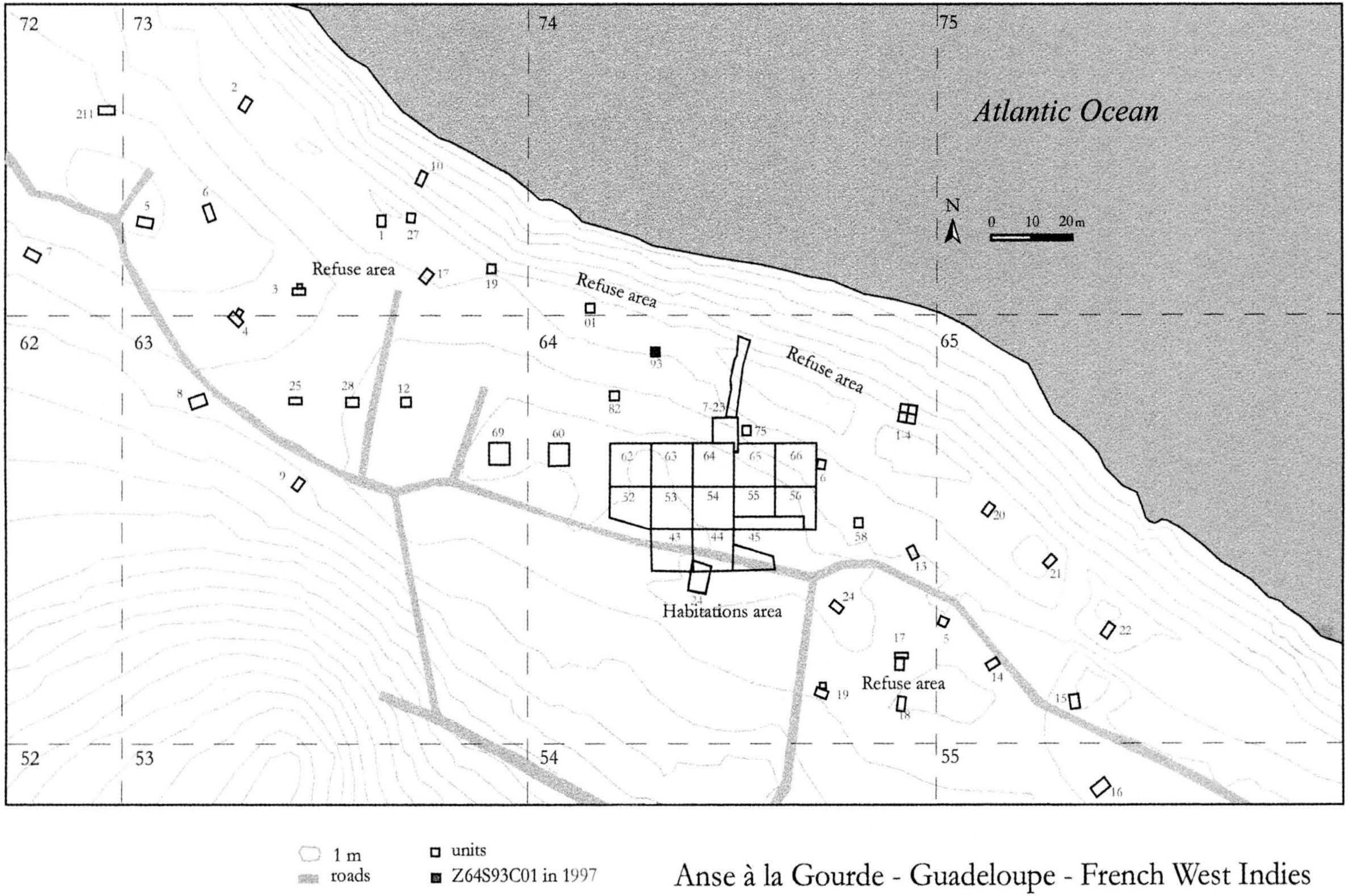

FIGURE 3

Location of unit Z64S93C01 at Anse à la Gourde.

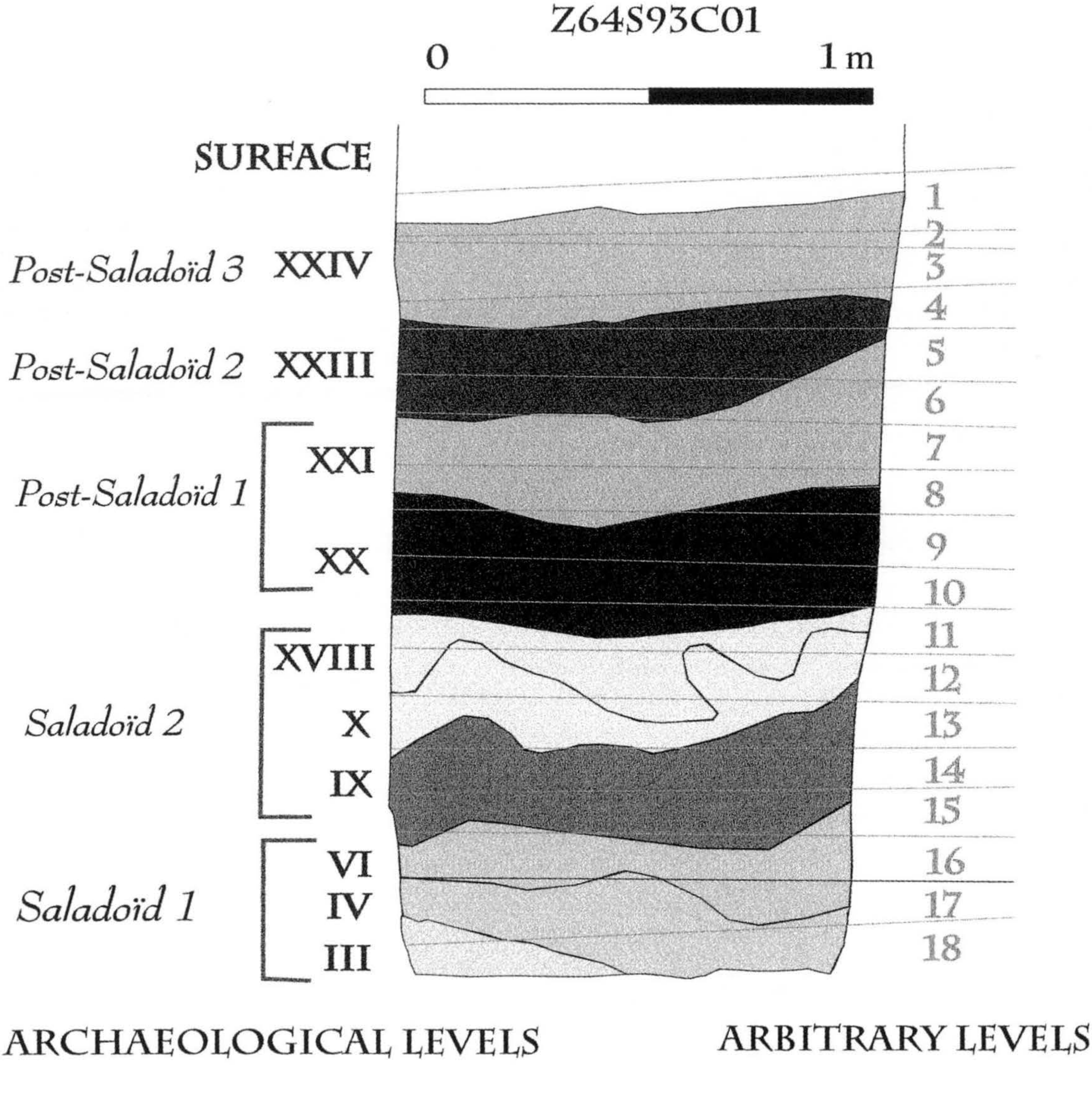

FIGURE 4
Arbitrary levels and archaeological level of unit Z64S93C01 at Anse à la Gourde.

Body size reconstruction

The sizes of fish from archaeological sites illustrate both the different ecosystems where the animals were probably caught, as well as the techniques used to catch them. There are many ways of estimating body size (live weight or standard length) based upon different measurements of fresh fish skeletal parts (Casteel, 1974, 1978; Desse, Desse-Berset & Rocheteau, 1987, 1989, 1996; Wheeler & Jones, 1989; Leach & Boocock, 1993, 1995; Béarez, 1995; Leach *et al.*, 1996a, 1996b, 1996c). For some Caribbean taxa, body weights are estimated using the first vertebrae width or otolith length (Reitz & Cordier, 1983; Adams, 1985; Reitz *et al.*, 1987; Reitz & Wing, 1999). Correlations between the body weight or length and otolith length or vertebral width did not seem to provide accurate estimates of weight for some taxa in this study (correlation coefficients were too small). As a result, various regression lines were fitted and equations were calculated for the different skeletal parts of the most common taxa from the samples, i.e., grunts (Haemulidae), snappers (Lutjanidae) and parrot-fishes (Scaridae). The comparative specimens used in producing the equations belong to the Greater and Lesser Antilles, and Florida. The "least squares method" was applied to determine the metrical relationship between live standard lengths and various measurements of skull elements (examples in Figure 5). As illustrated by the example of the *Sparisoma* standard length for all the taxa and skeletal parts (Figure 6), the standard error of the estimates was smaller for the power curve, than for the linear, the exponential, and the logarithmic curves. Consequently, the power curve was chosen to estimate the length of the archaeological specimens.

Equations were calculated at the level of species, genus and family when correlations were significant, as recommended by Desse & Desse-Berset (1996a, 1996b) (examples at the level of genus in Appendix 1).

Before choosing measurements for analysis, the random nature of the processes of destruction indicated by the distruibution of body parts was verified for each sample of unit Z93S64C01, as suggested by Leach & Boocock (1994:73; 1995:27). All measurements are in millimetres and all weights are in grams. Details of the basic statistics of these formulas will be published elsewhere.

RESULTS AND INTERPRETATIONS

The taphonomic study concluded that all bones were dissociated and partly broken, and that all parts of the skeleton were present. The majority of bones were well-preserved, although some of them showed evidence of erosion possibly due to exposure to acidic conditions or weathering. None of the bones exhibited evidence of cut marks, gnaw marks or burning. Because their bones were also dissociated and broken, mammals such as dogs (*Canis familiaris*), agoutis (*Dasyprocta* cf. *leporina*), and rice rats (Oryzomyini) were probably eaten, though no evidence of butchery or cooking was present on their bones. These taxa are common in Lesser Antillean sites and they were undoubtedly consumed (Wing, 1995; Wing & Wing, 1995). The animal bones regularly thrown into a refuse area near the habitation during the occupations, were not disturbed by animals and survived the attacks from sand, sea, and weather elements, etc.

Richness, diversity and faunal assemblage

A total of 191,978 fragments were identified, at least by class, with 22,287 crab and sea urchin fragments, 27,864 fishes, 1,414 reptiles, 273 birds, and 4,199 mammal remains. These represent a minimum of 3,842 individuals (MNI). A total of 46 families (89 species) of vertebrates, crustacean, and sea urchins were identified (Table 1, Appendix 2).

Crustaceans and sea urchins were represented by seven families and 20 species (Table 1, Appendix 2). The land crabs (Gecarcinidae) and the land hermit crabs (Coenobitidae) were the most abundant. The fishes belong to 26 families and 55 species, of which the doctor-fishes (Acanthuridae), jacks (Carangidae), trigger-fishes (Balistidae), and parrot-fishes (Scaridae) were the most abundant. Among the reptiles, sea turtles (Cheloniidae) and iguanas (Iguanidae) were the most frequent taxa. Pigeons and doves (Columbidae) predominated among the birds. Rice rats (Cricetidae tribe Oryzomyini) and agoutis (Dasyproctidae) were the most abundant mammals.

From the bottom to the top of the stratigraphy, we observed a strong increase in the relative abundance of fish remains until the late Saladöid level (S2), and a slight decline after the Post-Saladöid

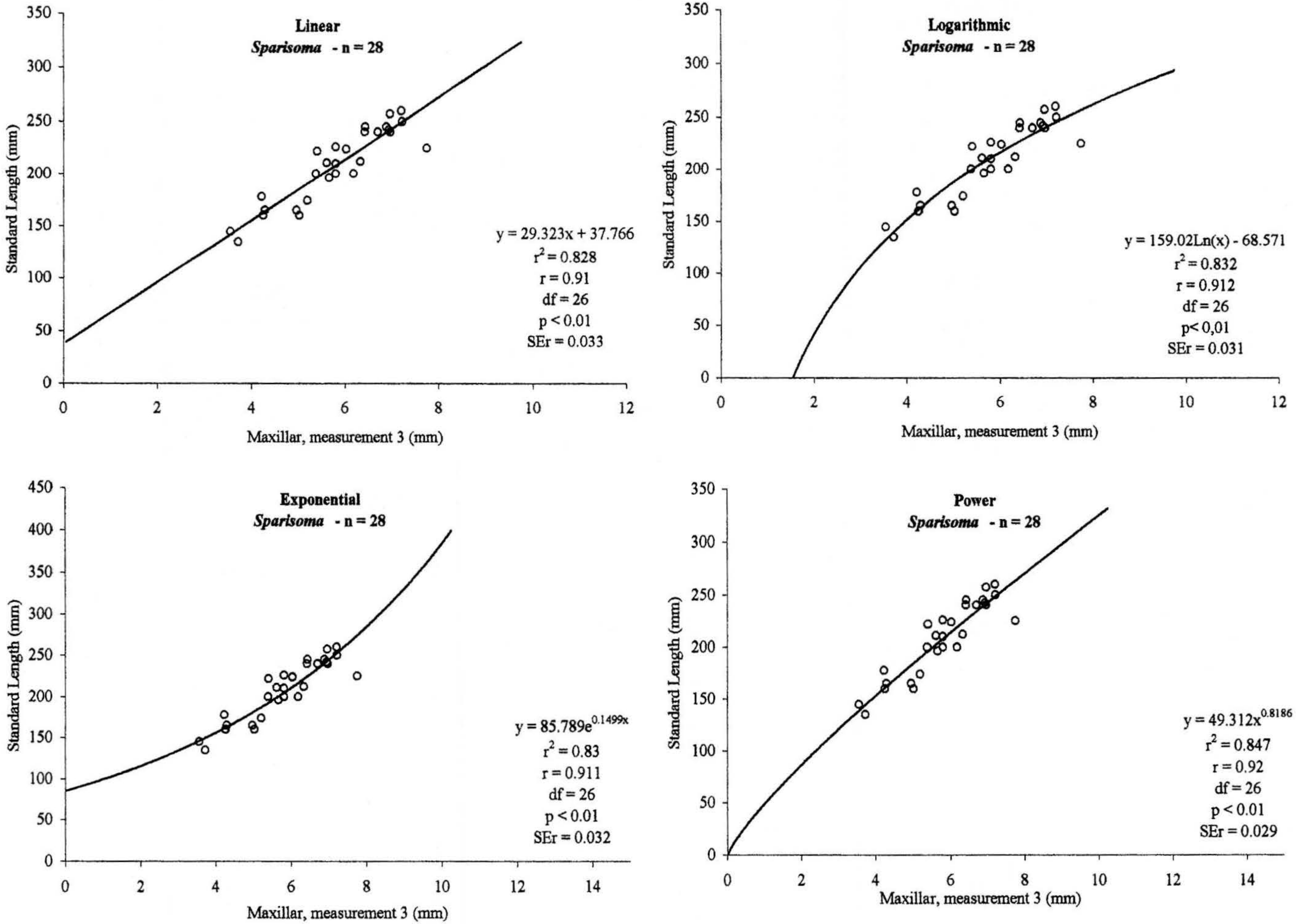

FIGURE 5

Examples of the best-fit curves (for *Sparisoma*).

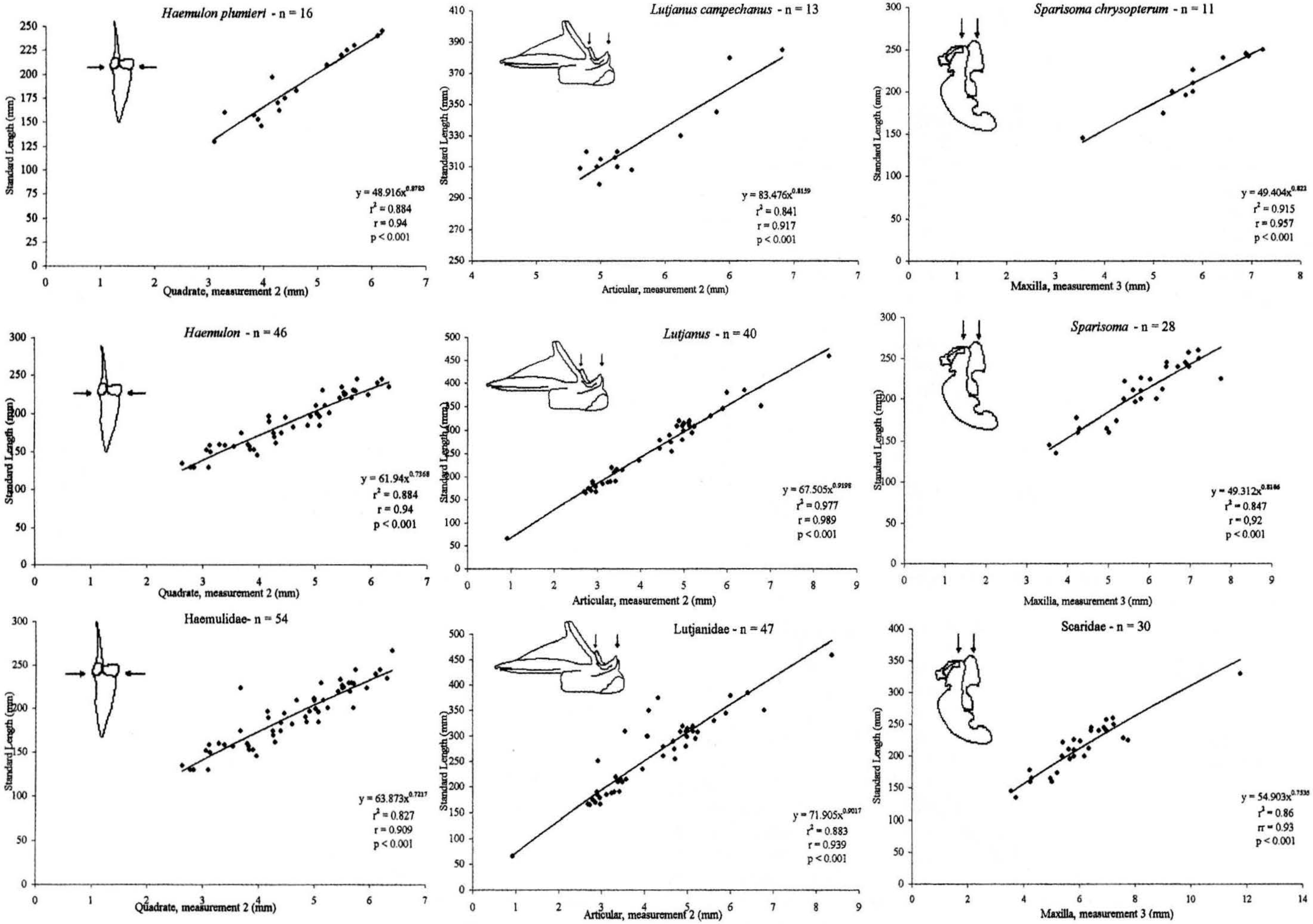

FIGURE 6

Examples of allometric regressions for the estimation of the Standard Length at the rank of species, genus and family from the same measurement.

Haemulon

measurements		y =	a	x	b	r^2	r	df	SEr	t	p
premaxilla	M1	y =	96.38	x	0.6022	0.785	0.886	44	0.032	27.99	< 0.01
premaxilla	M2	y =	26.878	x	0.7397	0.846	0.920	44	0.023	40.42	< 0.01
premaxilla	M3	y =	62.165	x	0.7433	0.790	0.889	44	0.031	28.69	< 0.01
maxilla	M1	y =	83.642	x	0.6549	0.862	0.928	44	0.020	45.59	< 0.01
maxilla	M2	y =	53.729	x	0.6343	0.847	0.920	44	0.023	40.80	< 0.01
maxilla	M3	y =	61.996	x	0.6082	0.820	0.905	44	0.027	34.04	< 0.01
dentary	M1	y =	110.32	x	0.4968	0.725	0.851	44	0.041	20.97	< 0.01
dentary	M2	y =	90.535	x	0.5695	0.786	0.886	44	0.032	28.02	< 0.01
articular	M1	y =	84.159	x	0.6566	0.796	0.892	44	0.030	29.66	< 0.01
articular	M2	y =	82.677	x	0.7093	0.805	0.897	44	0.029	31.15	< 0.01
quadrate	M1	y =	61.94	x	0.7368	0.884	0.940	44	0.017	55.12	< 0.01
quadrate	M2	y =	113.59	x	0.661	0.764	0.874	44	0.035	25.10	< 0.01
hyomandibula	M1	y =	27.776	x	0.8623	0.844	0.919	44	0.023	39.89	< 0.01
parasphenoïd	M1	y =	83.593	x	0.6657	0.697	0.835	43	0.045	18.48	< 0.01
vomer	M1	y =	42.194	x	0.765	0.853	0.924	44	0.022	42.64	< 0.01
neurocrane	M1	y =	77.754	x	0.5705	0.824	0.908	43	0.026	34.60	< 0.01
neurocrane	M2	y =	79.442	x	0.6035	0.891	0.944	43	0.016	57.81	< 0.01
neurocrane	M3	y =	50.383	x	0.7085	0.878	0.937	44	0.018	52.05	< 0.01
otolith	M1	y =	11.292	x	1.2613	0.745	0.863	43	0.038	22.70	< 0.01
otolith	M2	y =	24.258	x	1.0925	0.536	0.732	43	0.069	10.57	< 0.01
first vertebra	M1	y =	75.298	x	0.6033	0.877	0.936	43	0.018	51.07	< 0.01
first vertebra	M2	y =	82.841	x	0.5977	0.877	0.936	43	0.018	51.03	< 0.01
first vertebra	M3	y =	86.005	x	0.6287	0.762	0.873	41	0.036	24.06	< 0.01
vertebra 2-20	M1	y =	81.637	x	0.6422	0.848	0.921	159	0.012	77.04	< 0.01
vertebra 2-20	M2	y =	77.712	x	0.6422	0.893	0.945	159	0.008	111.51	< 0.01
vertebra 2-20	M3	y =	51.767	x	0.67	0.804	0.897	160	0.015	58.36	< 0.01
Total Length	TL	y =	1.4902	x	0.8878	0.930	0.964	44	0.010	93.72	< 0.01
Weight	W	y =	46.622	x	0.2712	0.922	0.960	44	0.012	83.49	< 0.01

p < 0.01 = significant correlation

Lutjanus

measurements		y =	a	x	b	r^2	r	df	SEr	t	p
premaxilla	M1	y =	89.884	x	0.9731	0.899	0.948	38	0.016	59.62	< 0.01
premaxilla	M2	y =	25.391	x	0.9903	0.958	0.979	38	0.007	148.84	< 0.01
premaxilla	M3	y =	33.388	x	1.0405	0.937	0.968	38	0.010	97.34	< 0.01
maxilla	M1	y =	92.583	x	0.9136	0.831	0.911	38	0.027	34.07	< 0.01
maxilla	M2	y =	28.540	x	1.0616	0.964	0.982	38	0.006	172,00	< 0.01
maxilla	M3	y =	33.308	x	1.0587	0.965	0.982	38	0.006	175.47	< 0.01
dentary	M1	y =	110.690	x	0.9122	0.836	0.914	38	0.026	35.24	< 0.01
dentary	M2	y =	42.770	x	0.987	0.931	0.965	38	0.011	87.91	< 0.01
articular	M1	y =	48.725	x	0.98	0.910	0.954	38	0.014	67.04	< 0.01
articular	M2	y =	68.031	x	0.9155	0.979	0.989	38	0.003	295.15	< 0.01
quadrate	M1	y =	53.244	x	0.9449	0.961	0.98	37	0.006	157.39	< 0.01
quadrate	M2	y =	102.38	x	0.9243	0.892	0.944	37	0.017	54.51	< 0.01
hyomandibula	M1	y =	19.196	x	0.9909	0.980	0.99	37	0.003	312.27	< 0.01
vomer	M1	y =	19.511	x	1.098	0.966	0.983	37	0.005	178.92	< 0.01
otolith	M1	y =	65.601	x	0.5394	0.496	0.704	19	0.110	6.40	< 0.01
otolith	M2	y =	63.522	x	0.7035	0.666	0.816	19	0.073	11.21	< 0.01
first vertebra	M1	y =	54.385	x	0.8806	0.946	0.972	36	0.009	109.98	< 0.01
first vertebra	M2	y =	62.246	x	0.8774	0.931	0.965	36	0.011	85.69	< 0.01
first vertebra	M3	y =	68.514	x	0.8367	0.944	0.972	35	0.009	105.34	< 0.01
vertebra 2-20	M1	y =	57.034	x	0.8734	0.939	0.969	138	0.005	188.60	< 0.01
vertebra 2-20	M2	y =	58.126	x	0.8405	0.958	0.979	138	0.004	275.74	< 0.01
vertebra 2-20	M3	y =	40.985	x	0.9348	0.937	0.968	138	0.005	181.21	< 0.01
Total Length	TL	y =	0.7151	x	1.018	0.993	0.997	38	0.001	913.43	< 0.01
Weight	W	y =	39.819	x	0.3022	0.980	0.99	38	0.003	319.50	< 0.01

Sparisoma

measurements		y =	a	x	b	r^2	r	df	SEr	t	p
premaxilla	M1	y =	80.028	x	0.4263	0.542	0.736	26	0.087	8.50	< 0.01
premaxilla	M2	y =	52.556	x	0.536	0.780	0.883	26	0.042	21.21	< 0.01
premaxilla	M3	y =	85.048	x	0.8047	0.614	0.784	26	0.073	10.76	< 0.01
maxilla	M3	y =	82.179	x	0.8348	0.717	0.847	26	0.053	15.85	< 0.01
maxilla	M4	y =	65.798	x	0.7515	0.767	0.876	26	0.044	19.90	< 0.01
maxilla	M5	y =	49.312	x	0.8186	0.850	0.92	26	0.029	31.72	< 0.01
dentary	M3	y =	42.130	x	0.6595	0.564	0.751	26	0.082	9.11	< 0.01
dentary	M4	y =	39.874	x	0.6221	0.721	0.849	26	0.053	16.12	< 0.01
articular	M3	y =	116.810	x	0.6712	0.753	0.868	26	0.047	18.62	< 0.01
articular	M4	y =	93.485	x	0.7674	0.558	0.747	26	0.084	8.94	< 0.01
quadrate	M3	y =	79.341	x	0.8021	0.543	0.737	26	0.086	8.53	< 0.01
quadrate	M4	y =	162.680	x	0.6243	0.750	0.866	26	0.047	18.36	< 0.01
hyomandibula	M1	y =	25.650	x	0.9019	0.841	0.917	26	0.030	30.6	< 0.01
upper pharyngeal	M1	y =	146.990	x	0.6416	0.638	0.798	26	0.068	11.66	< 0.01
upper pharyngeal	M2	y =	100.800	x	0.7077	0.761	0.872	26	0.045	19.31	< 0.01
upper pharyngeal	M3	y =	75.602	x	0.5923	0.661	0.813	26	0.064	12.69	< 0.01
lower pharyngeal	M1	y =	43.287	x	0.6257	0.689	0.830	26	0.059	14.10	< 0.01
lower pharyngeal	M2	y =	58.973	x	0.5176	0.544	0.737	26	0.086	8.55	< 0.01
lower pharyngeal	M3	y =	92.909	x	0.6417	0.685	0.828	26	0.060	13.91	< 0.01
cleithra	M1	y =	100.900	x	0.7848	0.658	0.811	25	0.066	12.33	< 0.01
cleithra	M2	y =	54.042	x	0.8395	0.730	0.854	25	0.052	16.44	< 0.01
cleithra	M3	y =	121.000	x	0.6593	0.506	0.711	25	0.095	7.49	< 0.01
parasphenoïd	M5	y =	47.986	x	0.743	0.822	0.906	26	0.034	26.89	< 0.01
parasphenoïd	M6	y =	31.814	x	0.8278	0.807	0.898	26	0.036	24.63	< 0.01
otolith	M1	y =	172.07	x	0.0834	0.011	0.107	13	0.255	0.42	> 0.10
otolith	M2	y =	262.98	x	-0.3661	0.049	0.222	13	0.245	0.90	> 0.10
neurocrane	M1	y =	71.106	x	0.6501	0.846	0.920	26	0.029	31.51	< 0.01
neurocrane	M2	y =	77.119	x	0.6955	0.794	0.891	26	0.039	22.88	< 0.01
neurocrane	M3	y =	57.032	x	0.7056	0.811	0.900	26	0.036	25.15	< 0.01
first vertebra	M1	y =	61.016	x	0.772	0.877	0.936	24	0.024	38.65	< 0.01
first vertebra	M2	y =	88.920	x	0.6584	0.858	0.926	25	0.027	33.90	< 0.01
first vertebra	M3	y =	97.697	x	0.6266	0.771	0.878	21	0.048	18.43	< 0.01
vomer	M1	y =	100.99	x	0.589	0.549	0.741	26	0.085	8.69	< 0.01
vertebra 2-20	M1	y =	73.728	x	0.7582	0.846	0.920	88	0.016	56.50	< 0.01
vertebra 2-20	M2	y =	70.706	x	0.7232	0.878	0.937	88	0.013	73.12	< 0.01
vertebra 2-20	M3	y =	38.503	x	0.9358	0.803	0.896	88	0.021	43.15	< 0.01
Total Length	TL	y =	1.185	x	0.9309	0.913	0.955	26	0,021	57.84	< 0.01
Weight	W	y =	38.366	x	0.298	0.883	0.940	26	0.022	42.54	< 0.01

APPENDIX 1

Power equations calculated for estimations of Standard Length and basic statistics.

Class	Family	NISP	Weight (g.)	MNI	% NISP	% Weight	% MNI
Invertebrata	Palinuridae	187	12.5	8	0.8	1.3	0.3
	Coenobitidae	9 947	367.8	1 756	44.6	38.3	72.7
	Portunidae	33	1.0	2	0.2	0.1	0.1
	Xanthidae	998	88.2	16	4.5	9.2	0.7
	Gecarcinidae	5 032	325.0	573	22.6	33.8	23.7
	Ocypodidae	27	1.2	7	0.1	0.1	0.3
	Echinoidea	6 063	165.6	52	27.2	17.2	2.2
	7	22 287	961.3	2 414	100	100	100
Pisces	Carcharhinidae	8	0.6	2	0	0	0.2
	Dasyatidae	12	0.6	3	0	0	0.2
	Elopidae	6	0.6	2	0	0	0.2
	Albulidae	23	1.0	4	0.1	0.1	0.3
	Muraenidae	27	1.0	3	0.1	0.1	0.2
	Clupeidae	2 282	12.1	95	8.2	1.1	7.1
	Belonidae	759	24.0	26	2.7	2.2	1.9
	Holocentridae	679	18.3	76	2.4	1.7	5.6
	Centropomidae	69	5.1	5	0.3	0.5	0.4
	Serranidae	620	76.1	31	2.2	6.9	2.3
	Priacanthidae	1	0	1	0	0	0.1
	Carangidae	5 467	172.6	204	19.6	15.6	15.1
	Lutjanidae	1 334	95.0	53	4.8	8.6	3.9
	Haemulidae	1 915	58.3	200	6.9	5.3	14.8
	Sparidae	26	3.7	2	0.1	0.3	0.2
	Sciaenidae	62	2.1	11	0.2	0.2	0.8
	Kyphosidae	13	0.2	2	0.1	0	0.2
	Pomacanthidae	1	0	1	0	0	0
	Sphyrenidae	41	1.7	4	0.2	0.1	0.3
	Labridae	1 123	39.0	41	4.0	3.5	3.0
	Scaridae	2 934	279.4	221	10.5	25.3	16.4
	Acanthuridae	6 153	211.1	297	22.1	19.1	22.0
	Scombridae	406	54.5	9	1.5	4.9	0.7
	Balistidae	3 842	48.2	50	13.8	4.4	3.7
	Ostraciidae	24	0.5	3	0.1	0	0.2
	Diodontidae	37	1.1	3	0.1	0.1	0.2
	26	27 864	1106.8	1 349	100	100	100
Amphibia	Anura	2	0.1	1	0.2	0	5.3
Reptilia	Cheloniidae	902	125.5	2	63.8	88.4	10.5
	Iguanidae	388	14.9	8	27.4	10.5	42.1
	Lacertilia	122	1.5	8	8.6	1.1	42.1
	4	1 414	142.0	19	100	100	100
Aves	cf. Procellariidae	15	0.8	2	5.5	11.6	13.3
	cf. Anatidae	8	0.6	1	2.9	9.8	6.7
	cf. Laridae	1	0.1	1	0.4	1.2	6.7
	cf. Columbidae	246	5.1	10	90.1	77.1	66.6
	cf. Mimidae	3	0	1	1.1	0.3	6.7
	5	273	6.6	15	100	100	100
Mammalia	Chiroptères	74	1.3	9	1.8	0.7	20.0
	Canidae	34	3.3	2	0.8	1.9	4.5
	Oryzomyine	2 798	92.6	28	66.6	53.7	62.2
	Dasyproctidae	1 293	75.4	6	30.8	43.7	13.3
	4	4 199	172.6	45	100	100	100
Total	46	56 037	2389.3	3 842			

TABLE 1

NISP, Weight, MNI, and S by family and class for the unit as a whole.

Class	Family	Species	English name	French name	Ecosystem
Crustacea	Palinuridae	*cf. Panulirus sp.*	lobster	langouste épineuse	reef
	Coenobitidae	*Coenobita clypeatus*	hermit crab	bernard-l'hermite terrestre	terrestrial
	Portunidae	*cf. Callinectes sp.*	blue crab	crabe cancroïde bleu	reef
	Xanthidae	*cf. Carpillius corallinus*	coral crab	crabe corallien	reef
		sp. 1	sea crab	crabe de mer	reef
		sp. 2	sea crab	crabe de mer	reef
		sp. 3	sea crab	crabe de mer	reef
		sp. 4	sea crab	crabe de mer	reef
		sp. 5	sea crab	crabe de mer	reef
	Gecarcinidae	*cf. Cardisoma guanhumi*	great land crab	crabe terrestre	terrestrial
		cf. Gecarcinus ruricola	black, blue or mountain crab	crabe terrestre	terrestrial
		cf. Gecarcinus lateralis	black land crab	crabe terrestre	terrestrial
	Ocypodidae	*Ocypode quadrata*	sand crab	crabe blanc	terrestrial
		Uca sp. 1	fiddler crab	crabe violoniste	terrestrial
		Uca sp. 2	fiddler crab	crabe violoniste	terrestrial
		Uca sp. 3	fiddler crab	crabe violoniste	terrestrial
		Uca sp. 4	fiddler crab	crabe violoniste	terrestrial
		Uca sp. 5	fiddler crab	crabe violoniste	terrestrial
Echinoidea	Echinometridae	*Echinometra sp.*	rock-boring urchin	oursin lie-de-vin	reef
	Echinidae		variegated urchin	oursin commun	reef
Pisces	Carcharhinidae		sharks	requins	reef
	Dasyatidae	*cf. Dasyatis americana*	southern stingray	pastenague américaine	estuarine
		cf. Aetobatis narinari	spotted eagle ray	ange de mer	estuarine
	Elopidae	*Elops saurus*	mulets	mulets	estuarine
	Albulidae	*Albula vulpes*	bonefish	baramme	estuarine
	Murenidae	*cf. Echnida catenata*	chain moray	murène à gueule pavée	reef
		Gymnothorax sp.	moray	murène	reef
	cf. Clupeidae	*cf. Engraulidae, or cf. Atherinidae*	herring/sardine/anchovy	pisquette	estuarine
	Belonidae	*Tylosurus crocodilus*	houndfish	orphie de terre	estuarine
		cf. Platybelone argalus	keeled needlfish	orphie de canal	estuarine
		cf. Strongilura timucu	Timucu needlefish	aiguillette timucu	estuarine
	Holocentridae	*cf. Holocentrus sp.*	squirrelfish	cardinal	reef
		cf. Sargocentron sp.	squirrelfish	cardinal	reef
	Centropomidae	*Centropomus cf. undecimalis*	snook	brochet de mer	estuarine
	Serranidae	*Epinephelinae*	grouper	mérou, vieille	reef
		cf. Epinephelus sp.	grouper	mérou, vieille	reef
		cf. Epinephelus adscencionis	rock hind	waliwa	reef
		cf. Cephalopholis fulva	coney	tanche	reef
	Priacanthidae	*cf. Priacanthus cruentatus*	glasseye	soleil batard	reef
	Carangidae	*Decapterus sp.*	mackerel scad	coulirou de canal	reef
		Caranx sp.	jack	carangue	reef
		Caranx ruber	bar jack	carangue franche	reef
		Caranx hippos	crevalle jack	carangue grasse	reef
	Lutjanidae	*Lutjanus sp.*	snapper	vivaneau	reef
		Lutjanus buccanella	blackfin snapper	vivaneau oreilles noires	reef
		Lutjanus purpureus	red snapper	vivaneau rouge	reef
		Lutjanus vivanus	silk snapper	vivaneau franc	reef
		Ocyurus chrysurus	yellowtail snapper	colas	reef
	Haemulidae	*Anisostremus sp.*	margate	lippu	reef
		Haemulon sp.	grunt	gorette	reef
	Sparidae	*cf. Calamus pennatulata*	pluma	daubenet plume	estuarine
		cf. Calamus sp.	porgy	gueule ferrée	estuarine
		cf. Archosargus rhomboidalis	sea bream	rondeau des pâturages	estuarine
	Sciaenidae	*cf. Equetus acuminatus*	cubbyu	monsieur l'abbé	estuarine
		cf. Equetus lanceolatus	jackknife fish	monsieur l'abbé	estuarine
		Equetus sp.	drum	monsieur l'abbé	estuarine
	Kyphosidae	*Kyphosus sectatrix*	bermuda chub	agouti	reef
	Pomacanthidae	*cf. Holacanthus sp.*	rock beauty	ange des Caraïbes	reef
	Sphyraenidae	*Sphyraena barracuda*	great barracuda	barracuda	reef
		Sphyraena sp.	southern sennet	bambokio	reef
	Labridae	*Bodianus rufus*	spanish rufus	capitaine de roche	reef
		Halichoeres sp.	wrasse	girelle	reef
	Scaridae	*Scarus sp.*	parrotfish	chat	reef
		Sparisoma sp.	parrotfish	chat	reef
		Sparisoma chrysopterum	redtail parrotfish	perroquet queue rouge	reef
		Sparisoma viride	stoplight parrotfish	chat	reef
		Sparisoma aurofrenatum	redband parrotfish	perroquet à bandes rouges	reef
		Sparisoma rubiprinne	yellowtail parrotfish	perroquet queue jaune	reef
	Acanthuridae	*Acanthurus sp.*	dostorfish	surgien	reef
	Scombridae	*Euthynnus sp.*	little tuny	bonite	pelagic
		Thunus cf. albacares	yellowfin tuna	thon ailes jaunes	pelagic
	Balistidae	*cf. Balistes vetula*	queen triggerfish	bourse blanche	reef
	Ostraciidae	*cf. Lactophrys sp.*	smooth trunkfish	coffre mouton	estuarine
	Diodontidae	*Chilomycterus sp.*	burrfish	diodon	reef
		Diodon cf. hystrix	porcupinefish	diodon de roche	reef
Amphibia	cf. Leptodactylidae	cf. Leptodactylus fallax	frogs	grenouilles	terrestrial
Reptiles	Cheloniidae		sea turtle	tortue marine	pelagic, terrestrial
		cf. Chelonia mydas	green turtle	chélonée franche	pelagic, terrestrial
	Iguanidae	*Iguana sp.*	West Indies iguana or green iguana	iguane des Petites Antilles ou iguane vert	terrestrial
	Lacertilia cf. Teiidae	cf. Ameiva cineracea	ameiva	ameive de Guadeloupe	terrestrial
Aves	cf. Procellariidae	*Puffinus sp.*	shearwater	puffin	terrestrial
	cf. Anatidae	*Anas sp.*	duk, teal	canard, sarcelle	terrestrial
	cf. Laridae	*cf. Larus sp.*	gull	mouette	terrestrial
	Columbidae	*Zenaida cf. aurita*	dove	tourterelle	terrestrial
	cf. Mimidae	*cf. Margarops sp.*	trasher	grive fine, grosse grive	terrestrial
Mammalia	Chiroptera		bat	chauve-souris	terrestrial
	Canidae	*Canis familiaris*	domestic dog	chien domestique	terrestrial
	Oryzomyine	*Megalomys cf. desmarestii*	rice rat	rat pilori	terrestrial
	Dasyproctidae	*cf. Dasyprocta leporina*	agouti	agouti	terrestrial
Number of taxa		**89**			

APPENDIX 2

Faunal spectrum and ecosystems of the whole assemblage Z64S93C01.

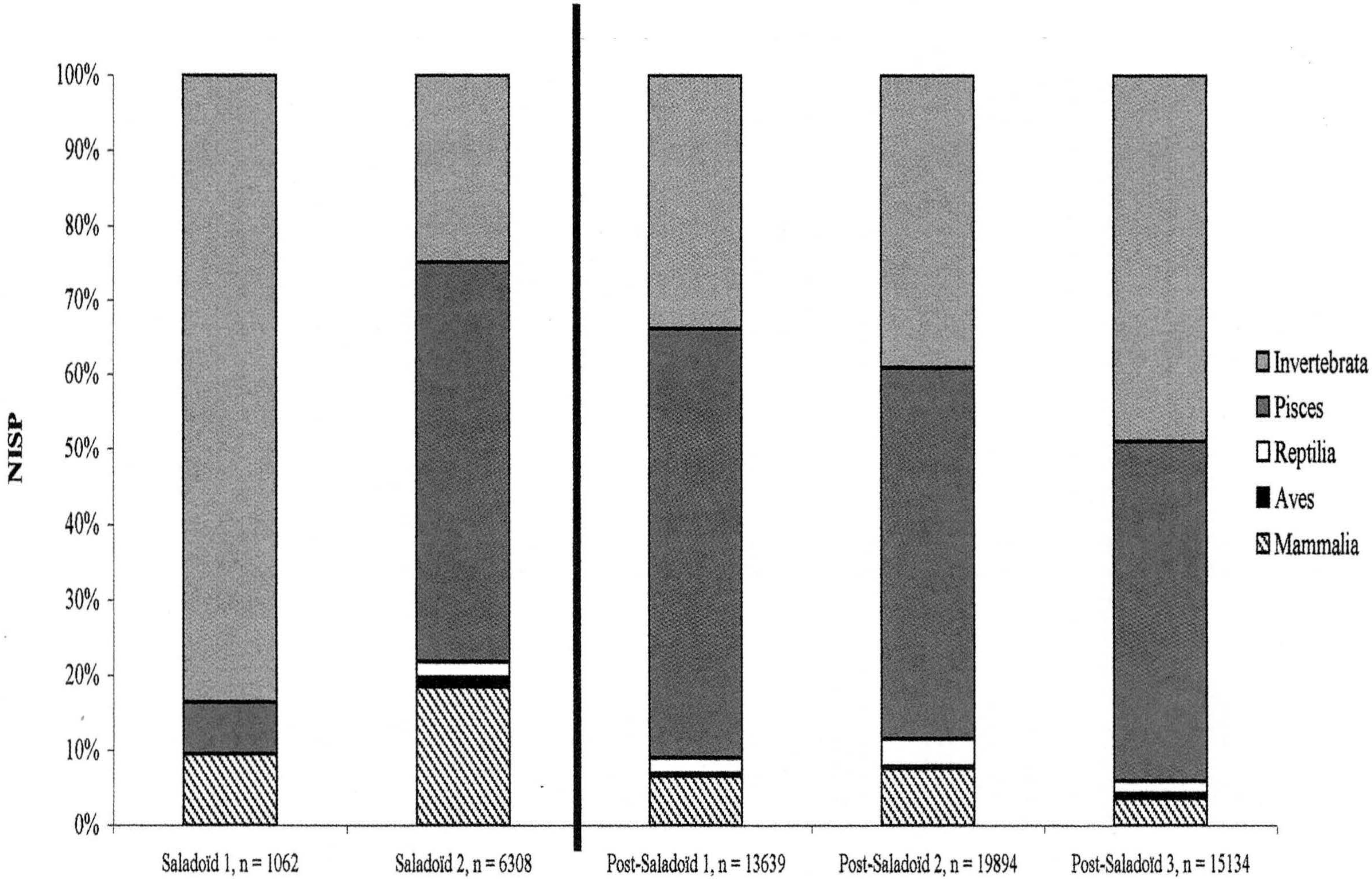

FIGURE 7

Faunal classes by archaeological level (percentage of the NISP).

level (PS1) (Figure 7). Conversely, crustaceans and sea urchins showed a decrease between levels S1 and S2, then a slight increase in level PS3. Mammals were most abundant in the late Saladoïd level (S2). Dogs were absent from the Saladoïd and the third Post-Saladoïd levels (Appendix 3). The NISP of agoutis increased progressively from S1, but decreased between PS2 and PS3. Remains of rice rats increased between S1 and S2, and between PS1 and PS2, but decreased between S2 and PS1 and between PS2 and PS3. Birds and reptiles were scarce throughout the levels. In conclusion, the global spectrum changed among the levels: mammals were abundant towards level S2 and well represented among levels PS1 and PS2. Fish decreased, while crabs and urchins increased from level S2 until level PS3. It seems that each occupation had a distinctive faunal selection.

The rarefaction curve (Figure 8) indicates that the sample from level S1 was not large enough to reflect species richness, nor to reflect the proportions of the rarest species. The samples from levels S2, PS1, PS2 and PS3 were close to the asymptote of this curve and included common as well as rare taxa. They were considered to be an adequate representation of the population being studied. The samples from levels S1, S2, and PS1 included respectively 25, 53, and 72 taxa, but PS2 and PS3 contained 67 and 66 taxa, although they are the largest samples.

The richness index for the whole sequence was 8.1, but differences can be seen between levels in Figure 9. The richness for S2, PS2, and PS3 reached values between 5.9 and 6.8, while PS1 had a higher index of 7.5. These results indicate that Saladoïd 2, Post-Saladoïd 2 and 3 lacked of some of the rarer taxa present in the first Post-Saladoïd deposit. According to Grayson (1984), the higher the value of the richness index, the richer the spectrum, thus the broader the exploitation of resources. Consequently, the inhabitants of Post-Saladoïd 1 had a broader exploitation subsistence than those of Saladoïd 2, Post-Saladoïd 2, or 3.

The diversity index for the whole sequence was 11.3, but differences were also observed between levels. The S2 and PS1 had high diversity indices (12.3 and 12.9, respectively), while PS2 and PS3 had small indices (11.4 and 7.8, respectively) (Figure 9). The diversity index represents the number of equally common species; the higher the values, the more evenly distributed the NISP is across species (Grayson, 1984: 160). Thus, the more the acquisition of the resources is diversified, the more equal the distribution between the samples. A faunal sample with both high richness and diversity suggests a generalised subsistence (Leonard & Jones, 1989).

Figure 10 showing the 20 most abundant families, based on NISP, illustrates this phenomenon. According to the decreasing relative frequencies, the most important taxa of the whole assemblage were land hermit crabs (Coenobitidae), doctor-fishes (Acanthuridae), sea urchins (Echinoidea), jacks (Carangidae), land crabs (Gecarcinidae), trigger-fishes (Balistidae), parrot-fishes (Scaridae), and rice rats (Oryzomyini), anchovies (Clupeidae) and grunts (Haemulidae). The rice rats predominated in the late Saladoïd level, with jacks, land hermit crabs, and land crabs. A terrestrial animal (either a rice rat, a land hermit crab, or a land crab) appeared among the three most important taxa of each level. Sea urchins were among the three most important taxa of the most recent three levels. Fish, especially jacks and doctor-fishes were abundant, jacks particularly in the earlier levels and doctor-fishes in the later deposits. These lists illustrate the natural importance of animals that are typically found on land and in the sea around Grande-Terre.

In conclusion, a strategy of selection based on a small number of dominant species was found in Post-Saladoïd 3. However, Post-Saladoïd 1 had both high richness and diversity indices, and its spectrum of taxa illustrated a generalised subsistence, with a large spectrum and equally distributed species. Saladoïd 2 was apparently impoverished, but had a high diversity index and its spectrum illustrated equally distributed species. Post-Saladoïd 2 had a high richness index, but a low diversity index, and its spectrum illustrated a specialisation with few taxa, but accompanied by a large quantity of species.

Comparisons of the distributions were undertaken in chronocultural stages, and statistically tested pairwise (Chi^2). Differences between the assemblages were all significant (Table 2). Hermit crabs, rice rats, urchins, jacks, and doctor-fishes were the taxa that created the differences between levels S2, and PS1, PS2 and PS3. Land crabs, hermit crabs, rice rats, jacks, sea turtles, herrings, and trigger-fishes created the differences between levels PS1, PS2 and PS3. Land crabs, hermit crabs, rice rats, sea turtles, and agoutis created the differences between levels PS2 and PS3. Without those taxa, the differences between the levels would

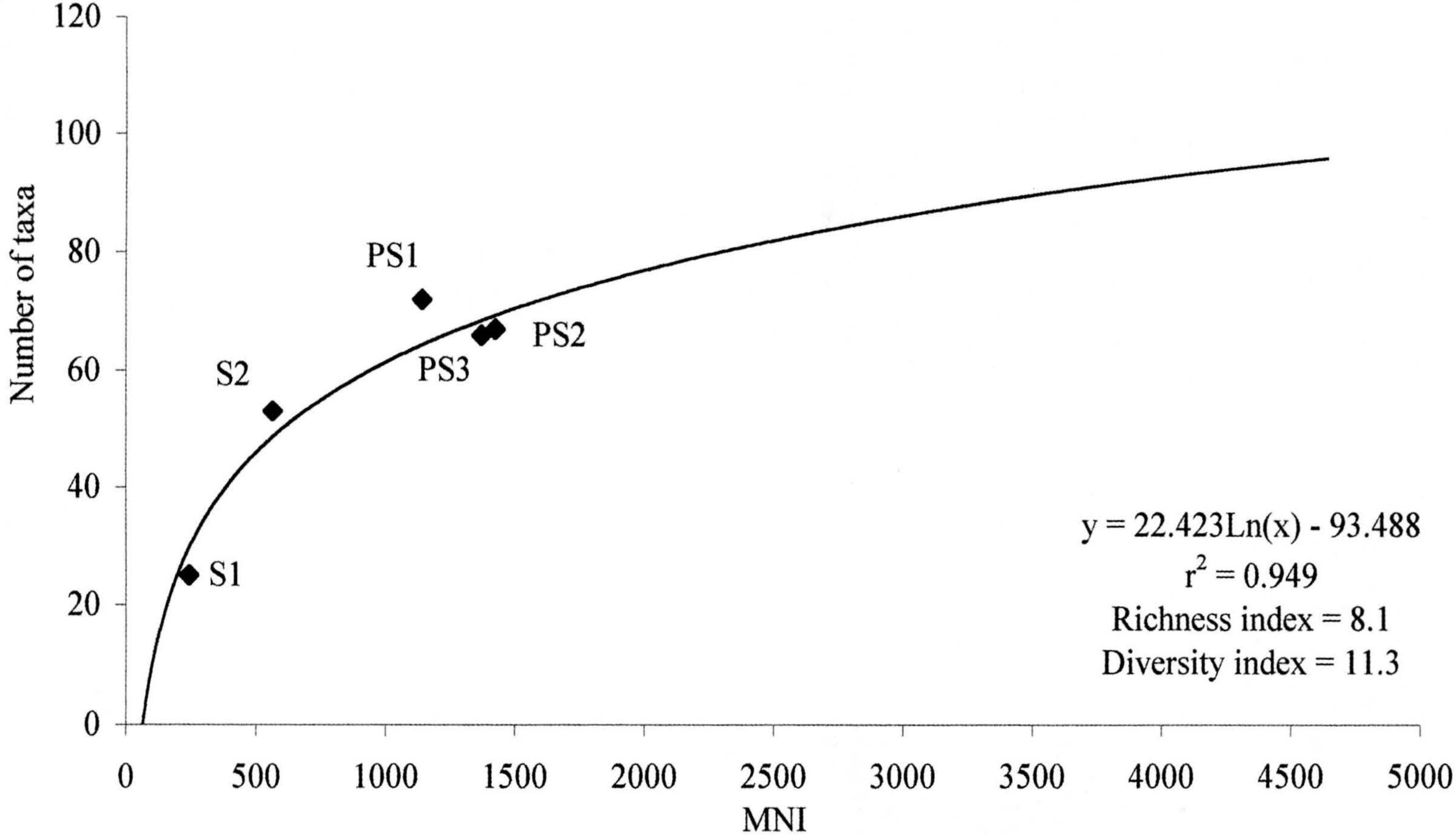

FIGURE 8

Richness curve (number of taxa and MNI) by archaeological level (PS = Post-Saladoïd, S = Saladoïd).

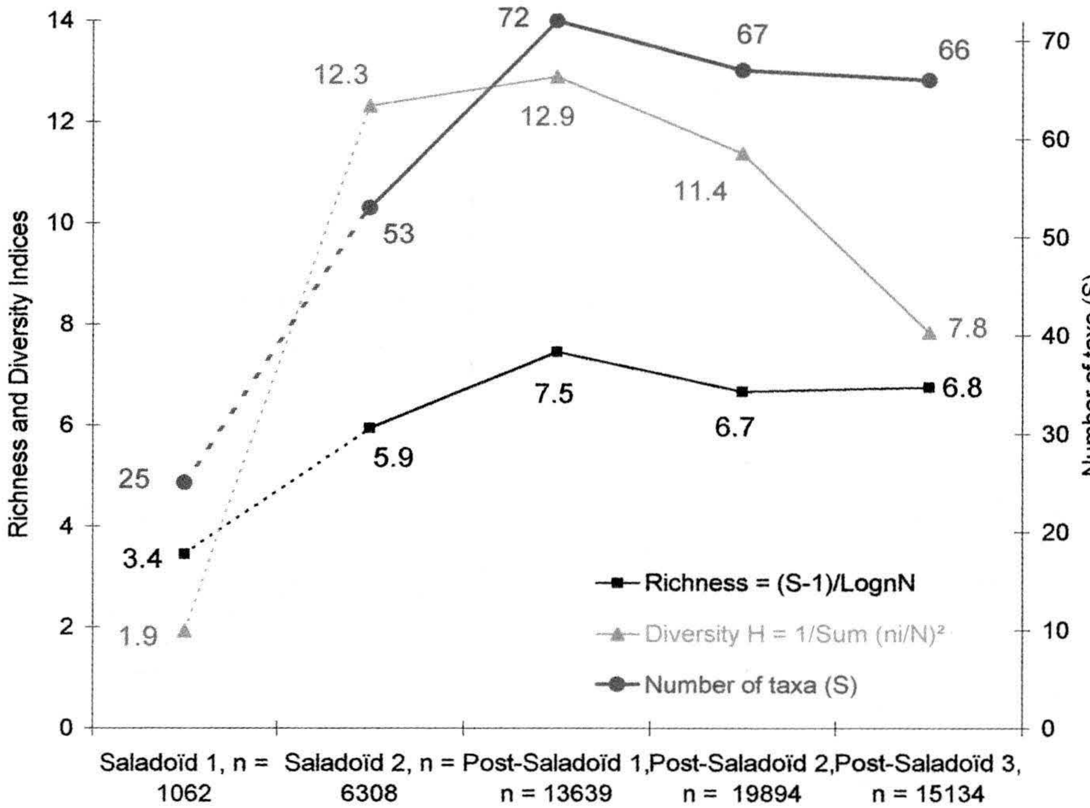

FIGURE 9
Richness and diversity indices, and number of taxa by archaeological level.

have been rendered insignificant. In conclusion, terrestrial crabs and mammals, sea turtles and some reef fishes (like doctor-fishes, jacks or triggerfishes) were not exploited in the same proportions throughout each period. The Post-Saladoïd 3 seems to have had a specialised economy, and although Saladoïd 2, Post-Saladoïd 1 and 2 had generalised economies, the inhabitants selected different species during each occupation.

Fish sizes

The results of the length estimates for fish are presented in Table 3 and Figure 11. Details of the basic statistics of the 3,951 measurements will be presented the author's PhD dissertation.

According to the Agostino test (Chenorkian, 1996), none of the size class distributions of grunts (Haemulidae) were normal (Table 4). Most individuals were between 120 and 160 mm long and few small individuals gave a slight skew toward the small size classes (Figure 11). The smallest individual was 52 mm, and the largest was 317 mm length (Table 3). The general mean length was 147 mm. However, the maximum, minimum and mean were slightly different in each level. For example, maximal lengths varied between 251 mm (PS1) and 317 mm (PS3); minimal lengths varied between 52 mm (PS1) and 73 mm (PS3); and mean lengths vary between 145.7 mm (PS1) and 148.9 mm (PS3). However, shapes of the size class distributions of grunts seem generally similar through time.

The PS1 and PS2 size class distributions of snappers (Lutjanidae) had normal distributions (Table 4), while S1+S2 and PS3 did not have a normal distribution, although they resembled normal curves for size with a few large individuals giving the curve a slight skew toward the large size (Figure 11). The smallest individual was 59 mm and the largest 824 mm long (Table 3). The mean was 207 mm long. Maximum lengths varied from 401 mm (PS2) to 824 mm (PS3); minimal lengths varied from 59 mm (PS1) to 82 mm (PS2); and mean lengths varied from 201 mm (PS2) to 215

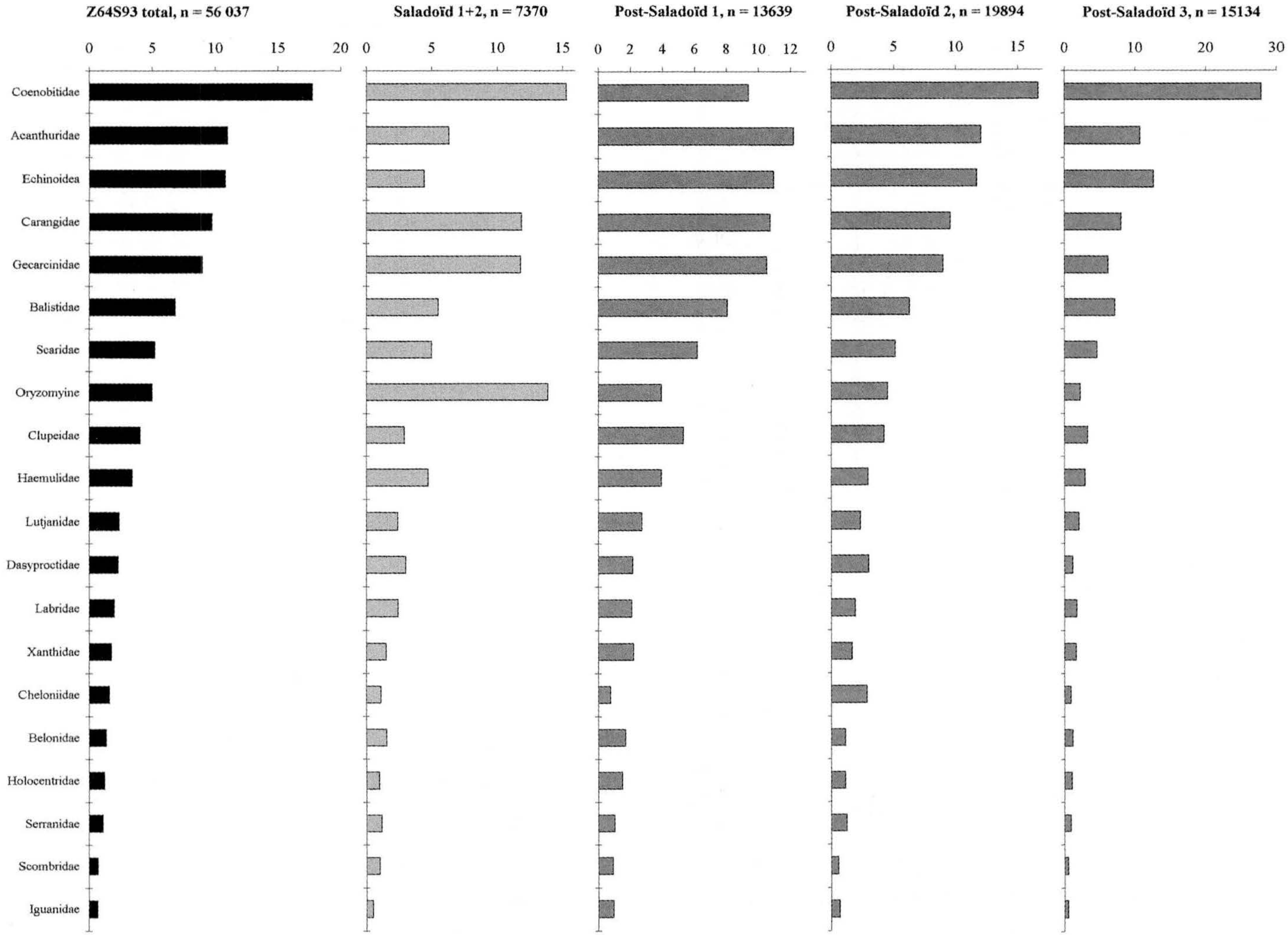

FIGURE 10
Diversity distribution by archaeological level (percentage of NISP).

Chi² tests

df = 26	Post-Saladoïd 1	Post-Saladoïd 2	Post-Saladoïd 3	Levels
chi square value	1251.89	1856.73	3097.32	**Saladoïd 2**
risk of error	< 0.001	< 0.001	< 0.001	
main contributions	Oryzomyini Echinoidea Acanthuridae Coenobitidae Carangidae	Coenobitidae Oryzomyini Echinoidea Acanthuridae Carangidae	Coenobitidae Oryzomyini Echinoidea Carangidae Acanthuridae	
chi square value		784.12	1883.67	**Post-Saladoïd 1**
risk of error		< 0.001	< 0.001	
main contributions		Coenobitidae Carangidae Cheloniidae Balistidae Gecarcinidae	Coenobitidae Gecarcinidae Carangidae Clupeidae Oryzomyini	
chi square value			1161.00	**Post-Saladoïd 2**
risk of error			< 0.001	
main contributions			Coenobitidae Gecarcinidae Oryzomyini Dasyproctidae Cheloniidae	

TABLE 2

Chi² values on the NISP by taxon, significance, and taxa providing the highest contributions to the value.

mm (PS3). The size class distributions of snappers slightly changed through time. In S1+S2 and PS3, most of individuals were between 150 and 275 mm long, while in PS1 and PS2, most of individuals were between 125 and 250 mm long.

All of the size class distributions of parrot-fishes (Scaridae) formed a normal distribution (Table 4). The smallest individual was 65 mm long and the largest 567 mm (Table 3). The mean length was 218 mm. Maximum length varied from 463 mm (PS1) to 567 mm (S1+2); minimal lengths varied from 65 mm (PS1) to 105 mm (S1+2); and mean lengths varied from 212 mm (S1+2) to 222 mm (PS1). The size class distributions of parrot-fishes also changed slightly through time. Most individuals of S1+S2 were between 150 and 200 mm long. Most individuals of PS1 were between 200 and 250 mm long. PS2 showed relatively equal proportions in each size class between 125 and 275 mm long, while PS3 resembled normal curves for size with a few large individuals.

Most fish were intermediate in size. Few juveniles and few large adults were caught, and a large quantity of individuals were of intermediate size. This effect suggests a technique of selection of the intermediate sizes. The natural populations of grunts, snappers and parrot-fishes have higher mean values and larger ranges than these archaeological populations: the standard lengths of grunts from the reference collection of modern fish are between 130 and 267 mm, the snappers are between 66 and 460 mm, and parrotfishes are between 135 and 260 mm; thus the estimated lengths of archaeological fish beyond this range should be interpreted with great caution.

The pairwise Chi² tests showed that the differences between samples were not significant for grunts and parrot-fishes (Table 5). For snappers, significant differences appeared between PS1 and S2 and between PS2 and PS3 (Table 5). However, the distribution of snappers during PS1 and PS2 were not significantly different.

The sizes of the fish did not decrease nor increase through time, and if the curves are globally homogeneous throughout the levels, selections must have been made on the size of the fishes

Haemulon	number of individuals	mean	maximum	minimum	standard deviation
Natural population (Fisher, 1978)		*198.00*	*171.42*	*229.63*	*14.32*
Reference collection	*54*	*192.30*	*267.00*	*130.00*	*34.41*
Saladoïd 1 + 2	330	145.82	282.53	60.73	30.78
Post-Saladoïd 1	519	145.70	251.34	52.62	30.89
Post-Saladoïd 2	625	146.76	299.09	67.15	30.03
Post-Saladoïd 3	431	148.91	317.51	73.27	32.59
Total	**1905**	**146.80**	**317.51**	**52.62**	**31.01**

Lutjanus	number of individuals	mean	maximum	minimum	standard deviation
Natural population (Fisher, 1978)		*385.99*	*224.39*	*797.01*	*73.65*
Reference collection	*47*	*264.17*	*460.00*	*66.00*	*75.83*
Saladoïd 1 + 2	155	209.87	544.74	78.59	64.51
Post-Saladoïd 1	340	205.30	562.05	62.26	71.65
Post-Saladoïd 2	376	201.38	401.83	82.03	57.55
Post-Saladoïd 3	278	215.42	824.12	59.76	66.11
Total	**1149**	**207.08**	**824.12**	**59.76**	**65.20**

Sparisoma	number of individuals	mean	maximum	minimum	standard deviation
Natural population (Fisher, 1978)		*471.49*	*1628.49*	*231.41*	*157.6*
Reference collection	*28*	*208.11*	*260.00*	*135.00*	*35.32*
Saladoïd 1 + 2	144	212.26	566.77	105.94	58.88
Post-Saladoïd 1	252	222.00	463.92	65.33	63.31
Post-Saladoïd 2	288	215.87	489.55	104.61	63.82
Post-Saladoïd 3	213	218.55	467.81	69.10	66.38
Total	**897**	**217.65**	**566.77**	**65.33**	**63.63**

TABLE 3

Basic statistics of the estimated standard length by archaeological level for three fish taxa.

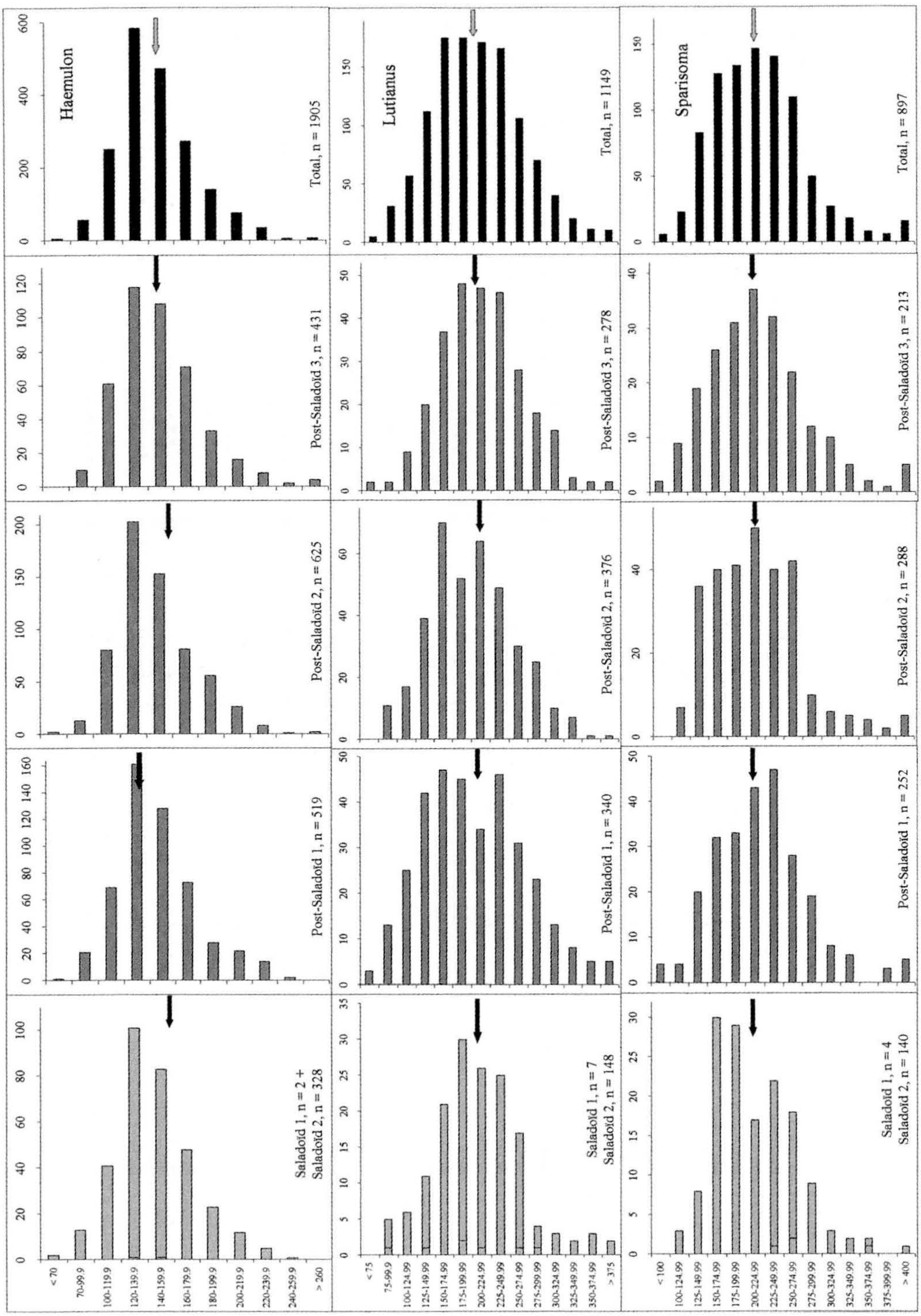

FIGURE 11

Curves of estimated standard length for *Haemulon*, *Lutjanus*, and *Sparisoma* by archaeological level.

Agostino tests of Normality
Ho = normal distribution at the confidence level of 0.05

		Saladoïd	Post-Saladoïd 1	Post-Saladoïd 2	Post-Saladoïd 3
Haemulon	**Statistic U**	922434.00	2292547.09	3222772.55	1645544.81
	Statistic D	0,28	0.276	0,27	0,27
	Statistic Q	**-4,23**	**-5.16**	**-6.13**	**-7.11**
	Number of Measurements	330	519	625	431
	Standard error	30,84	30.92	30.05	32.63
	Signification	**Ho rejected**	**Ho rejected**	**Ho rejected**	**Ho rejected**
Lutjanus	**Statistic U**	407977.55	2308092.51	2300570.19	1277765.85
	Statistic D	0.26	0.28	0.28	.25
	Statistic Q	**-7.84**	**-2.11**	**0.41**	**-17.79**
	Number of Measurements	155	340	376	278
	Standard error	64.72	71.76	57.63	66.22
	Signification	**Ho rejected**	**Ho accepted**	**Ho accepted**	**Ho rejected**
Sparisoma	**Statistic U**	317631.24	1097306.83	1421151.24	827623.80
	Statistic D	0.26	0.27	0.27	0.27
	Statistic Q	**-8.78**	**-4.86**	**-7.73**	**-3.54**
	Number of Measurements	144	252	288	213
	Standard error	59.08	63.44	63.94	66.53
	Signification	**Ho rejected**	**Ho rejected**	**Ho rejected**	**Ho rejected**

TABLE 4

Agostino test values and significance of the normality of the estimated length distributions.

Chi² tests

Haemulon

df = 8	Post-Saladoïd 1	Post-Saladoïd 2	Post-Saladoïd 3	Levels
Chi square value risk of error, p difference	2.71 0.95 ns	5.21 0.74 ns	5.70 0.68 ns	**Saladoïd**
Chi square value risk of error, p difference		11.40 0.18 ns	10.27 0.25 ns	**Post-Saladoïd 1**
Chi square value risk of error, p difference			8.46 0.39 ns	**Post-Saladoïd 2**

Lutjanus

df = 11	Post-Saladoïd 1	Post-Saladoïd 2	Post-Saladoïd 3	Levels
Chi square value risk of error, p difference	18.12 0.08 ns	16.89 0.11 ns	8.95 0.63 ns	**Saladoïd**
Chi square value risk of error, p difference		20.99 0.03 significant	25.59 0.007 significant	**Post-Saladoïd 1**
Chi square value risk of error, p difference			14.67 0.20 ns	**Post-Saladoïd 2**

Sparisoma

df = 10	Post-Saladoïd 1	Post-Saladoïd 2	Post-Saladoïd 3	Levels
Chi square value risk of error, p difference	11.78 0.30 ns	14.51 0.15 ns	14.01 0.17 ns	**Saladoïd**
Chi square value risk of error, p difference		11.58 0.31 ns	3.85 0.95 ns	**Post-Saladoïd 1**
Chi square value risk of error, p difference			10.24 0.42 ns	**Post-Saladoïd 2**

TABLE 5

Chi² values on the estimated lengths and significance for the main fish taxa.

during the Saladoïd and the first two Post-Saladoïd levels. The absence of the smallest specimens could be linked to the use of pots, tramails (large pots), nets, bottom trawls, or hooks and lines, which are good techniques for selecting the biggest fish. Only the specimens in the last Post-Saladoïd level resembled a normal curve, suggesting a selection over the natural range of the species. The large range of size of the samples suggests the simultaneous use of diverse fishing techniques, with nets, pots, hooks and lines, spears, bows, poisons, trawls, etc. This result corroborates our observation concerning the richness and diversity indices, that is, a generalised subsistence during the last Post-Saladoïd occupation.

Selected ecosystems and fishing techniques

The reconstruction of the selected ecosystems have been based on the ecological preference of the species and the size profiles of the faunal sample (Appendix 2).

The species represented on this site could all have been procured from adjacent environments (Figure 12). Most of the fish are primarily reef fish, such as trunkfish, porcupinefish, doctor-fish, parrotfish, triggerfish, grunt, squirrelfish, and small grouper. Throughout the Post-Saladoïd levels (from PS1 until PS3), there was a decline in the use of animals typically found on land, such as rice rats and agoutis. Moreover, beginning in the first Post-Saladoïd period, there was also a decrease of the exploitation of fish from the rocky substrate in inshore water and a corresponding increase in the use of coral reef species, particularly doctor-fishes, parrotfishes, and triggerfishes. As suggested by the insignificant number of small and juvenile fishes, there was no overexploitation of the natural ecosystems.

The geological, geographic, edaphic, and climatic characteristics of the Grande-Terre area produce a mosaic of conditions which sustains a diverse animal life. In particular, the varied marine ecosystems are determined by the nature of the lagoon, the island shelf, and the banks. The present location of the site is on a white-sand beach one kilometre long on the Atlantic Ocean. It is separated from the island of La Désirade by swift ocean currents. A coral barrier reef protects the lagoon, and the beach vegetation is xerophytic. A salt pond is located around La Pointe des Châteaux to the east and a mangrove forest is situated in the Grand-Cul-de-Sac Marin to the west.

The fishing techniques in use today in Guadeloupe are adapted to the sea bottoms, period of the year, species and size of fish. Reef fish are caught from a small boat with hoop nets, pots, or traps, during the whole year, but especially from May to December, because of the rain and hurricane season. Small fish and juveniles are caught with cast nets and lines from the beach in shallow waters, lagoons, or mangrove canals, where they are used to feeding and sheltering. For example, grunts less than 122 mm long (standard length) are juveniles that hide in coral reefs during the day and feed in the shallow waters near the shore, and on the seagrass beds at night (Wing, pers. comm.). The bottom fish, such as large grouper or snapper, are caught with tramails all year round, except from December to February, when the currents are unfavorable. The permanent pelagic fishes, such as anchovies, needlefish, houndfish, little tuny, mackerel scad, and barracuda, are caught during the whole year with surface hooks and lines, seines, or casting nets. The seasonal pelagic species, such as mackerel and tuna, are caught by dragnet fishing from January to June in inshore waters, or in the swift currents flowing between Guadeloupe and La Désirade, from large boats (Aubin-Roy, 1968; Odum, 1971; Hurault, 1972; Wing, 1977, 1994; Bonniol, 1979, 1981; Wing & Reitz, 1982; Béarez, 1995). Although these fishing techniques are employed today, they could have not been used by the pre-Columbian inhabitants of the Caribbean, because some of these techniques were introduced by Europeans, Africans or Asians (seines, cast nets, tramails and pots). However, similar techniques such as reed curtains could have been used. In fact, Amerindians from French Guyana (Galibis) used to close the estuary with a reed curtains during high tide. When the tide ebbed, fishes and crabs that tried to reach the sea remained prisoners. At least, at the beginning of European colonisation, Amerindians had a very high level of navigation technology, using large pirogues to travel from the Guyanas to the Caribbean islands.

Thus, one of the explanations for the diverse fauna is that the wide variety of ecosystems near the site were exploited and that numerous and diverse fishing techniques were probably used.

CONCLUSIONS

The archaeological faunal assemblage from Anse à la Gourde provided information about the

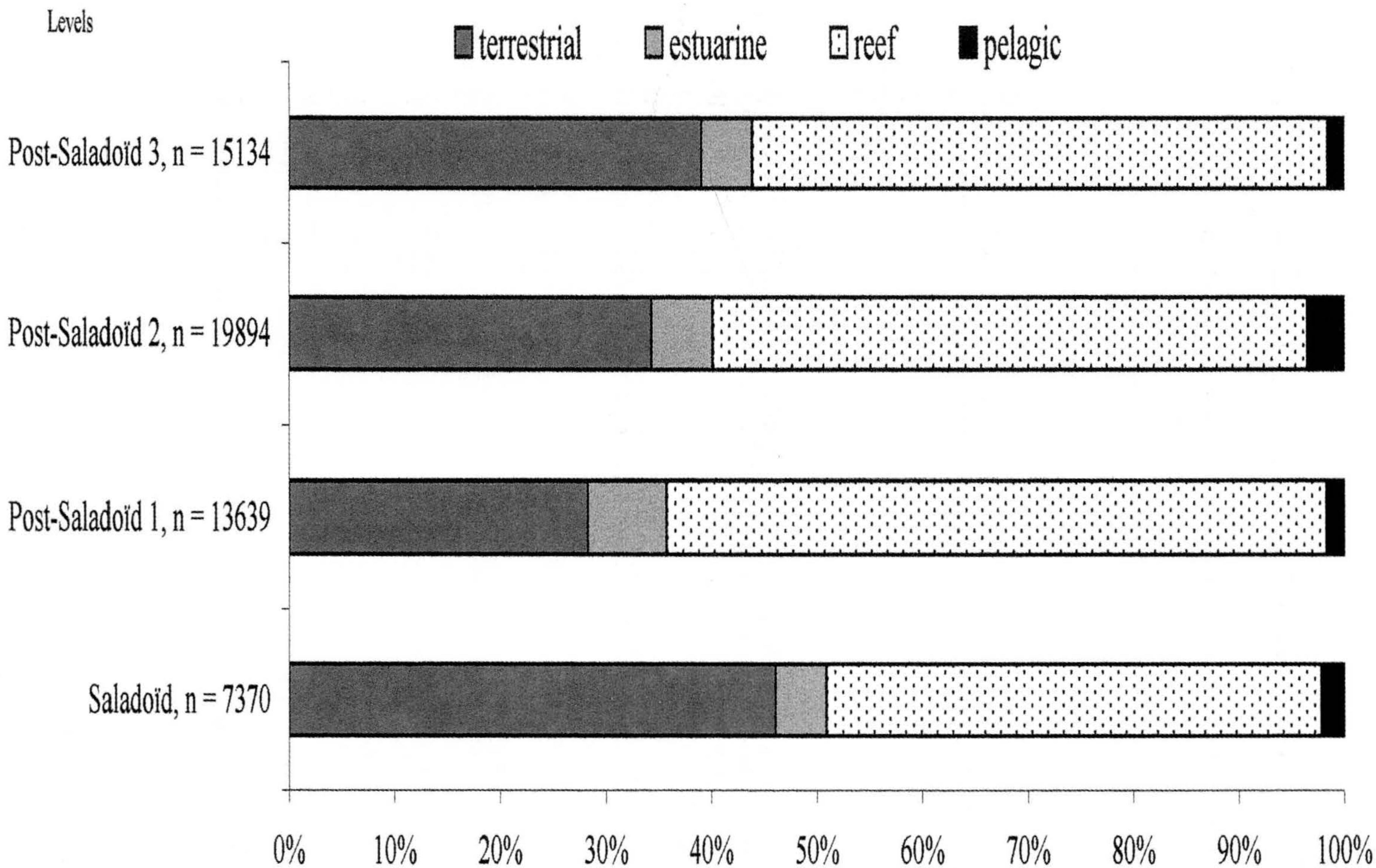

FIGURE 12

Selected ecosystems by archaeological level.

Families	Saladoïd 1			Saladoïd 2			Post-Saladoïd 1			Post-Saladoïd 2			Post-Saladoïd 3			TOTAL		
	NR	Weight	NMI	NR	Weight	NMI	NR	Weight	NMI	NR	Weight	NMI	NR	Weight	NMI	NR	Weight	NMI
Palinuridae	5	0.15	1	21	1.08	4	52	4.01	7	27	1.95	2	82	5.3	3	187	12.49	8
Coenobitidae	748	23.38	156	380	13.32	67	1281	62.46	245	3312	122.69	567	4226	145.84	836	9947	367.69	1756
Portunidae							33	1.01	3							33	1.01	2
Xanthidae				113	11.41	10	299	26.55	16	335	30.88	20	251	19.38	3	998	88.22	16
Gecarcinidae	131	5.14	62	738	49.85	84	1434	111.52	216	1787	105.25	216	942	53.28	120	5032	325.04	573
Ocypodidae							25	0.92	8				2	0.27	2	27	1.19	7
Echinoidea	4	0.11	1	323	8.46	8	1493	47.47	21	2327	58.62	23	1916	50.95	18	6063	165.61	52
Carcharhinidae				4	0.29	4	2	0.12	2				2	0.2	1	8	0.61	2
Dasyatidae				3	0.17	2	2	0.21	2	6	0.17	2	1	0.01	1	12	0.56	3
Elopidae				2	0.2	2				4	0.44	2				6	0.64	2
Albulidae				1	0.03	1	3	0.15	2	11	0.47	4	8	0.35	2	23	1,00	4
Muraenidae				1	0.01	1	10	0.43	7	10	0.26	2	6	0.26	2	27	0.96	3
Clupeidae				215	1.36	21	724	3.24	42	839	4.56	46	504	2.97	29	2282	12.13	95
Belonidae	3	0.06	1	111	4.51	14	232	6.46	20	231	7.74	16	182	5.22	8	759	23.99	26
Holocentridae				74	2.16	14	205	5.18	22	232	6.53	22	168	4.47	9	679	18.34	76
Centropomidae				15	0.68	6	10	0.66	4	26	2.01	5	18	1.73	5	69	5.08	5
Serranidae	3	0.64	1	83	5.8	14	141	15.46	26	253	18.87	25	140	35.28	17	620	76.05	31
Priacanthidae										1	0.01	1				1	0.01	1
Carangidae	18	0.67	4	857	25.62	56	1465	45.8	72	1905	41.74	97	1222	58.72	60	5467	172.55	204
Lutjanidae	7	0.88	2	171	12.36	28	370	27.71	31	473	27.56	29	313	26.5	18	1334	95.01	53
Haemulidae	2	0.04	1	348	10.65	60	539	14.4	70	580	19.65	72	446	13.51	41	1915	58.25	200
Sparidae				2	0.11	2	15	2.22	5	3	0.15	1	6	1.23	2	26	3.71	2
Sciaenidae				5	0.47	4	27	0.41	9	22	0.92	9	8	0.26	4	62	2.06	11
Kyphosidae				1	0.02	1				3	0.12	2	9	0.1	2	13	0.24	2
Pomacanthidae							1	0.02	1							1	0.02	1
Sphyraenidae				4	0.2	1	14	0.49	5	14	0.62	6	9	0.42	3	41	1.73	4
Labridae	3	0.09	1	176	5.56	19	285	8.60	30	387	12.48	26	272	12.26	16	1123	38.99	41
Scaridae	7	0.69	2	362	34.91	47	844	84.22	83	1019	69.69	86	702	89.97	60	2934	279.48	221
Acanthuridae	5	0.26	1	460	15.72	25	1663	61.44	96	2399	76.65	98	1626	57.13	61	6153	211.2	297
Scombridae	9	0.76	2	67	13.43	7	125	13.81	13	120	8.91	7	85	17.57	4	406	54.48	9
Balistidae	17	0.25	1	390	5.83	11	1099	13.25	18	1249	14.97	12	1087	13.85	12	3842	48.15	50
Ostraciidae							8	0.29	3	13	0.16	2	3	0.04	1	24	0.49	3
Diodontidae				1	0.1	1	19	0.29	5	8	0.2	1	9	0.52	2	37	1.11	3
Anura							2	0.03	1							2	0.03	1
Cheloniidae				83	34.77	5	105	19.62	6	568	32.21	3	146	38.93	3	902	125.53	2
Iguanidae				37	1.71	6	132	4.63	7	139	4.43	6	80	4.14	4	388	14.91	8
Lacertilia				14	0.34	4	47	0.36	10	34	0.33	6	27	0.51	6	122	1.54	8
Procellariidae				9	0.34	1							6	0.42	1	15	0.76	2
Anatidae				3	0.41	1							5	0.23	1	8	0.64	1
Laridae							1	0.08	1							1	0.08	1
Columbidae				68	1.45	6	44	1.01	6	59	1.48	6	75	1.11	4	246	5.05	10
Mimidae										1	0.01	1	2	0.01	1	3	0.02	1
Chiroptera	3	0.09	1	17	0.19	2	29	0.56	3	2	0.11	1	23	0.32	2	74	1.27	9
Canidae							27	2.58	2	7	0.7	1				34	3.28	2
Oryzomyini	85	2.01	6	938	34.35	17	538	16.71	12	894	24.31	14	343	15.29	8	2798	92.67	28
Dasyproctidae	12	0.62	1	211	13.05	6	294	15.56	7	594	33.54	5	182	12.65	3	1293	75.42	6
Total identified	**1062**	**35.84**	**244**	**6308**	**310.92**	**562**	**13639**	**619.94**	**1139**	**19894**	**731.19**	**1444**	**15134**	**691.2**	**1375**	**56037**	**2389.29**	**3842**
Unidentified																		
Crustaceans	337	5.56		1892	48.91		8325	234.62		4774	142.3		2814	66.48		18142	497.87	
Osteichthyes	201	3.39		13538	211.9		35468	517.54		41691	668.3		25650	453.32		116548	1854.45	
Mammalia				316	5.46		435	8.55		311	5.75		189	6.41		1251	26.17	
Total unidentified	538	0,00		15746	0,00		44228	0,00		46776	0,00		28653	0,00		135941	0,00	
Total	**1600**	**44.79**	**244**	**22054**	**577.19**	**562**	**57867**	**1380.65**	**1139**	**66670**	**1547.74**	**1444**	**43787**	**1217.41**	**1375**	**191978**	**4767.78**	**3842**

APPENDIX 3

NISP, Weight, MNI, and S by family for each archaeological level.

animals that were used for food during the prehistoric occupation of the site.

Although the same complex of common species appeared throughout the excavation of unit Z64S93C01, a shift in the predominant species was observed. Hermit crabs, rice rats, urchins, jacks, and doctor-fishes predominatde in the Saladoïd deposits. Land crabs, hermit crabs, rice rats, jacks, sea turtles, herrings, and trigger-fishes predominated in the Post-Saladoïd levels. An analysis of the remains did not indicate overexploitation of these animals but rather a shift toward a greater dependence upon marine resources during Post-Saladoïd periods.

In general, grunts, snappers and parrotfishes had adults lengths, with few small and large individuals. Selections must have been made on the size of fish during both Saladoïd levels and the first two Post-Saladoïd levels. Only the last Post-Saladoïd level suggested a selection over the natural range of the species.

Based on the ecological context in which the species are usually found, it is clear that a great variety of different ecosystems was exploited. These included the tropical forests, dry lands, sand beaches, salt ponds, shallow inshore waters, rocky substrates, coral reefs, estuaries, mangroves, and pelagic waters. Catching animals from such varied habitats would naturally result in a diverse faunal assemblage.

The fauna from unit Z64S93C01 as a whole is rich and diverse, particularly in the second Saladoïd and the first Post-Saladoïd deposits. This suggests a more generalised subsistence during these periods. The second and third Post-Saladoïd periods were still rich, but less diversified. This suggests a more specialised subsistence economy, mainly during the Post-Saladoïd 3. The decrease in diversity could be linked to a less extensive use of the wider ecosystems and a more intensive use of the immediate vicinity, namely coral reefs and the lagoon.

The size characteristics, species characteristics, and the natural environment of the encountered species suggest that a variety of different techniques were used to catch them.

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