

ORGAN WEIGHTS OF NON-CAPTIVE PORPOISE (*STENELLA* SPP.)WILLIAM F. PERRIN¹ AND EDWARD L. ROBERTS²

ABSTRACT: Weights of heart, lungs, liver, kidney, and spleen of 68 eastern Pacific spotted porpoise (*Stenella graffmani*) and 14 eastern Pacific spinner porpoise (*S. cf. S. longirostris*) are presented and related to total body weight. Values of Huxley's growth coefficient α are presented. Adult female spotted porpoise have on the average smaller spleens than adult males; a hypothesis of suppression of antibody production in pregnant females is suggested.

Information on organ weights and on other aspects of the anatomy of non-captive cetaceans is valuable for 3 reasons: 1) to establish norms that may be used in evaluation of the post-mortem condition of animals that die in captivity, 2) to further understanding of the physiology and overall biology of these animals, which is so radically different from that of terrestrial mammals, and 3) to provide comparative data for use in the systematics of the group.

Odontocete cetaceans for which various organ weights have previously been reported include *Phocoena phocoena*, *Tursiops truncatus*, *Lagenorhynchus acutus*, *Delphinus delphis*, *Grampus griseus*, *Delphinapterus leucas*, *Physeter catodon* (Slijper, 1959); *Globicephala melaena* (Cowan, 1966); and, very recently, *Inia geoffrensis* (Pilleri and Gehr, 1969b), and *Stenella styx* [= *S. coeruleoalba* (*vide* Mitchell, 1970)] (Gehr and Pilleri, 1969a). Layne (1965) reported weights of heart, lungs, liver, and kidneys for 1 specimen of *Stenella longirostris*. We report here weights of several organs for 68 eastern Pacific spotted porpoise, *Stenella graffmani* (Lönnerberg, 1934), and 14 eastern Pacific spinner porpoise, *Stenella cf. S. longirostris* (Gray, 1828). Specimens of the spotted *Stenella plagiodon* and *S. attenuata*, both very

similar to the eastern Pacific spotted porpoise, have been or are on exhibit or held captive for research purposes at various institutions on the southeast coast of North America and in Hawaii, respectively. Specimens of *Stenella roseiventris*, very similar to the eastern Pacific spinner porpoise, are currently held by aquaria in Hawaii.

METHODS

The specimens examined were all from the eastern tropical Pacific (Table 1). They were part of a large series of animals gathered for extensive studies of external morphometrics, osteology, parasites, and reproduction, which will be reported elsewhere. The porpoise were captured and killed accidentally during the course of commercial tuna seining operations, such as described by Perrin, 1969. The animals were placed in refrigerated holds along with the tuna and upon return to port were kept in freezers at -18° C until they could be dissected. Before dissection, the specimens

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TABLE 1. Collection data.

Date	Locality	Number of specimens		
		<i>Stenella graffmani</i>	<i>Stenella cf. S. longirostris</i>	Number of schools
9 Apr. 1968	12°51' N/93°18' W	36	4	1
12 Apr. 1968	7°11' N/90°32' W	29	2	1
26-27 Mar. 1969	7°47'-8° N/106°36'-106°50' W	3	4	?
28 Apr. 1969	7°40'-8° N/107° W		2	?
5 Apr. 1969	8° N/109°45' W		2	1
	Total	68	14	

TABLE 2. Total length, total weight, and organ weights of 68 specimens of *Stenella graffmani* and 14 specimens of *S. cf. S. longirostris*.

Specimen (field no.)/U. S. Nat. Mus. No. (skeleton)	Sex	Total length (cm)	Total weight (kg)	Heart (gm)	Lungs (gm)	Liver (gm)	Kidneys		Spleen (gm)
							Left (gm)	Right (gm)	
<i>Stenella graffmani</i>									
CV 259/395276	M	168	44.6	—	—	1000	(—409—)		43
CV 260/395277	F	175	58.2	—	—	1767	326	312	48
CV 261/395278	F	166	46.8	—	—	1283	182	205	44
CV 262/395279	F	165	43.2	—	—	1065	193	182	44
CV 263/395328	M	176	49.5	—	—	1259	235	251	51
CV 264/395329	M	172	50.0	—	—	1137	247	306	53
CV 265/395330	M	195	76.7	—	—	1727	326	353	54
CV 266/395331	M	168	47.2	—	—	1011	178	199	32
CV 267/395332	M	179	61.7	—	—	1398	246	234	39
CV 268/395333†	F	190	76.3	—	—	1480	250	240	46
CV 269/395334	F	184	59.9	—	—	1476	217	209	31
CV 270/395336†	F	182	70.8	—	—	1304	298	319	36
CV 271/395337	F	182	58.2	—	—	1467	245	251	35
CV 272/395338†	F	185	72.7	—	—	1394	242	—	16
CV 273/395339	M	163	47.2	—	—	1000	220	233	85
CV 274/395385	M	178	53.2	253	—	1153	232	208	24
CV 275/395386	M	157	42.2	230	—	1087	200	247	84
CV 276/395387	M	158	50.0	211	—	1274	216	201	45
CV 277/395388	F	182	59.9	291	—	1396	284	300	38
CV 278/395389	M	163	44.1	207	—	1237	190	199	62
CV 279/395390	M	218	84.0	311	—	1892	477	485	36
CV 280/395391	M	203	82.7	311	—	1961	406	429	46
CV 281/395392	F	174	43.2	214	—	1280	220	227	60
CV 282/395393	F	174	44.1	179	—	1052	207	199	32
CV 283/395394	M	202	79.9	308	—	2195	484	480	50
CV 284/395395†	F	193	71.3	250	—	1371	309	290	30
CV 286/395397	M	165	47.7	199	—	1112	190	233	100
CV 287/395417	M	173	53.6	261	—	1325	260	296	60
CV 289/395594	M	177	48.6	226	1576	1219	227	243	44
CV 290/395595	F	163	40.4	184	1270	924	166	183	27
CV 291/395596	F	193	63.6	293	—	1847	340	323	21
CV 292/395597	M	189	75.8	289	2275	1704	354	380	50
CV 293/395598	M	200	62.2	274	2129	1281	291	316	65
CV 295/395526	F	139	29.1	152	994	528	91	104	19
CV 296/395527	M	129	23.6	—	907	517	86	91	33
CV 297/395528	F	143	26.8	129	824	470	88	100	30
CV 298/395529	M	154	40.4	210	1323	1124	155	189	47
CV 300/395530	M	144	31.8	169	1019	647	114	121	38
CV 303/395532	M	143	29.5	141	1075	532	112	113	34
CV 304/395535	M	86	6.8	52	382	135	35	35	6
CV 305/395458	F	78	5.0	40	185	109	28	27	1
CV 306/395459	M	91	7.2	54	264	122	40	—	6
CV 307/395460	F	80	5.5	43	254	122	32	35	6
CV 308/395461	F	79	5.5	38	232	101	27	30	5
CV 309/395466	F	188	56.7	236	2078	1798	281	330	26
CV 310/395463	M	180	58.2	264	1642	1360	220	241	48
CV 311/395464	M	200	69.9	286	2090	1869	389	406	47
CV 312/395465	F	164	44.1	211	1317	1087	233	198	42
CV 313/395462	M	160	41.8	182	1291	999	177	179	62
CV 314/395467	F	184	55.4	284	1789	1600	284	290	20
CV 315/395468	M	162	43.6	227	1354	1139	193	190	35

TABLE 2. (Continued)

Specimen (field no.)/U. S. Nat. Mus. No. (skeleton)	Sex	Total length (cm)	Total weight (kg)	Heart (gm)	Lungs (gm)	Liver (gm)	Kidneys		Spleen (gm)
							Left (gm)	Right (gm)	
CV 316/395603	M	168	45.0	211	1457	1013	187	209	60
CV 317/395604	M	138	25.9	147	887	614	121	117	34
CV 318/395605	F	144	29.6	160	1047	684	115	114	39
CV 319/395606	F	168	46.8	204	1681	974	200	222	72
CV 320/395607	M	167	46.3	210	1672	1132	205	217	76
CV 321/395608	M	153	34.6	175	1304	774	130	140	34
CV 322/395609	F	142	26.3	119	853	528	102	110	26
CV 323/395610	M	162	46.8	201	1700	1076	191	190	33
CV 324/395611	F	136	25.4	126	959	523	82	94	11
CV 325/395612	M	135	29.5	153	1090	608	94	108	43
CV 326/395613 ¹	M	86	6.6	42	246	104	33	31	3
CV 327/395614 ²	F	81	5.9	44	245	84	29	30	3
CV 328/395615 ³	M	74	3.4	29	156	62	21	28	2
CV 329/395616 ⁴	F	81	5.7	—	—	—	26	26	4
PQ 01/395617	M	198	—	301	—	1234	231	247	42
PQ 02/395618	M	170	—	170	—	657	161	149	27
PQ 04/395410	F	168	—	219	—	995	197	176	27
<i>Stenella cf. S. longirostris</i>									
CV 285/395369	F	177	44.5	230	—	936	150	158	15
CV 288/395593	F	173	43.5	220	—	832	(—300—)	—	23
CV 294/395526	F	149	33.6	204	1112	855	116	137	43
CV 299/395531	M	119	18.6	114	631	368	58	69	14
CV 301/395533	F	140	26.3	135	812	542	73	88	16
CV 302/395534	M	118	18.1	97	599	367	60	63	29
PQ 03/395409	F	157	39.5	225	—	832	128	128	22
PQ 05/395411	F	168	46.7	196	—	971	147	164	13
PQ 06/395412 [†]	F	173	51.3	245	—	776	125	136	21
PQ 07/395413	F	176	52.2	191	—	871	145	144	—
PQ 08/395414	M	173	50.3	240	—	972	152	147	20
PQ 09/395599	M	173	59.0	272	—	997	192	201	31
PQ 10/395600	F	109	18.1	97	—	323	55	58	22
PQ 11/395601	F	105	13.2	72	—	282	46	51	10

[†] Individual was pregnant.

¹ Fetus from CV 270/395336.

² Fetus from CV 268/395333.

³ Fetus from CV 272/395338.

⁴ Fetus from CV 284/395395.

were weighed on platform scales, accurate to the nearest pound. The weights were converted to kilogram equivalents for use here. Some dehydration may have taken place during the storage periods, which ranged from 5 days to 14 months. When each specimen was dissected, the heart, lungs, liver, kidneys, and spleen were excised, placed in plastic bags, and refrozen. The sample size is not the same for all the organs, as these data were gathered incidentally to the primary purposes of the dissections, and some organs were not removed when time was short for other procedures. Later, the organs were thawed and weighed on a beam balance, accurate to the nearest

gram. Four of the female specimens of *S. graffmani* collected on April 9, 1958 were gravid with near-term fetuses, and the organs of these fetuses were included in the sample. Degree of sexual development was determined by histological examination of gonads. Complete skeletons of all the specimens are in the U. S. National Museum, Washington, D. C., and museum numbers are given in table 2.

The taxonomy of the spotted and spinner porpoises is confused (Perrin and Hunter, 1972), and the use here of *Stenella graffmani* and *S. longirostris* is provisional pending the results of studies underway by Perrin and others.

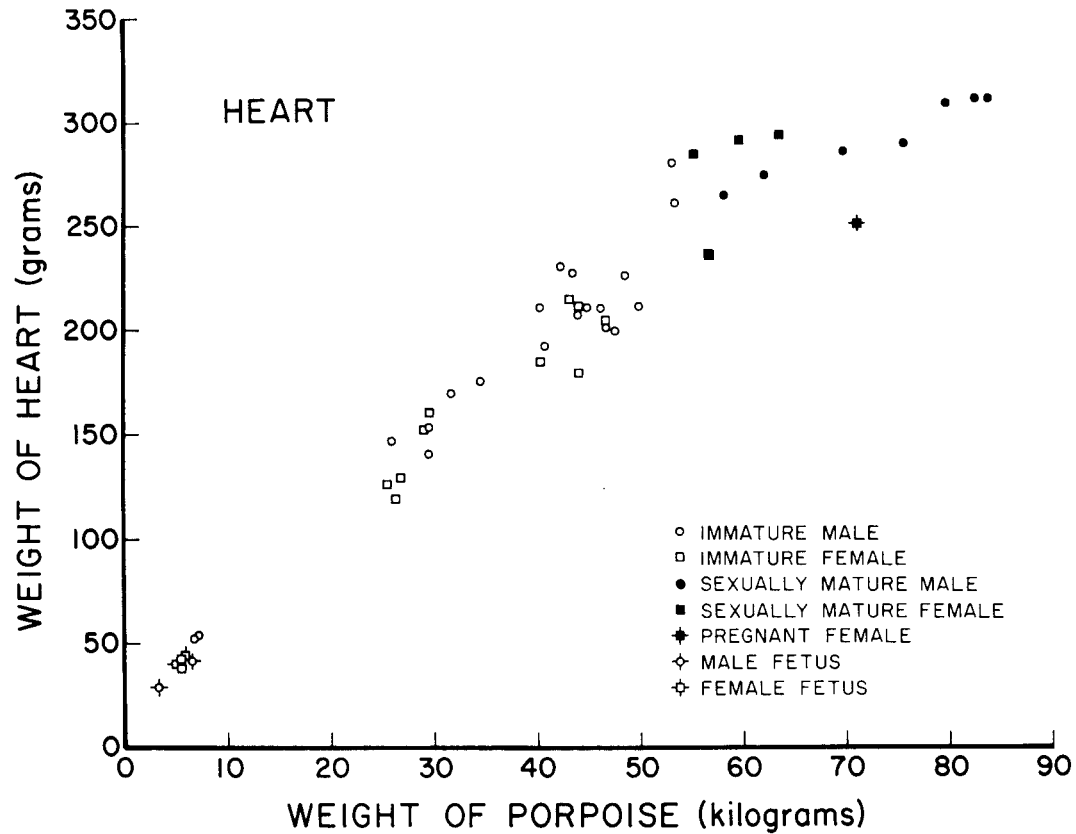


Figure 1. *Stenella graffmani*. Weight of heart relative to total body weight for 29 males and 19 females.

RESULTS

The data are presented in table 2. Scatter plots of organ weight on total weight are presented in figures 1-6 and 8-10. Where sample sizes were adequately large, the data were fitted to the equation $\text{Log } Y = a + b \text{ Log } X$ by the least squares method, where Y = organ weight in grams, X = total weight in grams, and b = Huxley's (1932) "growth coefficient" α . For the cases where correlation was statistically significant (at $P = 0.05$), the estimates of a and b are presented in table 3. Data for the pregnant females were not included in the regression analyses.

Heart

S. graffmani (Fig. 1). The hearts of 11 sexually mature adults (ranging from 180-218 cm total length and from 55.5-84.0 kg) weighed from 236-311 gm and from 0.37-0.51% (average: 0.43%) of total body weight. As is evident in figure 1, the relative weight of the heart decreases during development; the average relative weight for 28 calves and sexually immature subadults (ranging from 126-178 cm total length and from 25.4-53.6 kg total weight) was 0.48% (range: 0.41-0.57%) and for 8 infants and fetuses was 0.75% (range: 0.63-0.86%).

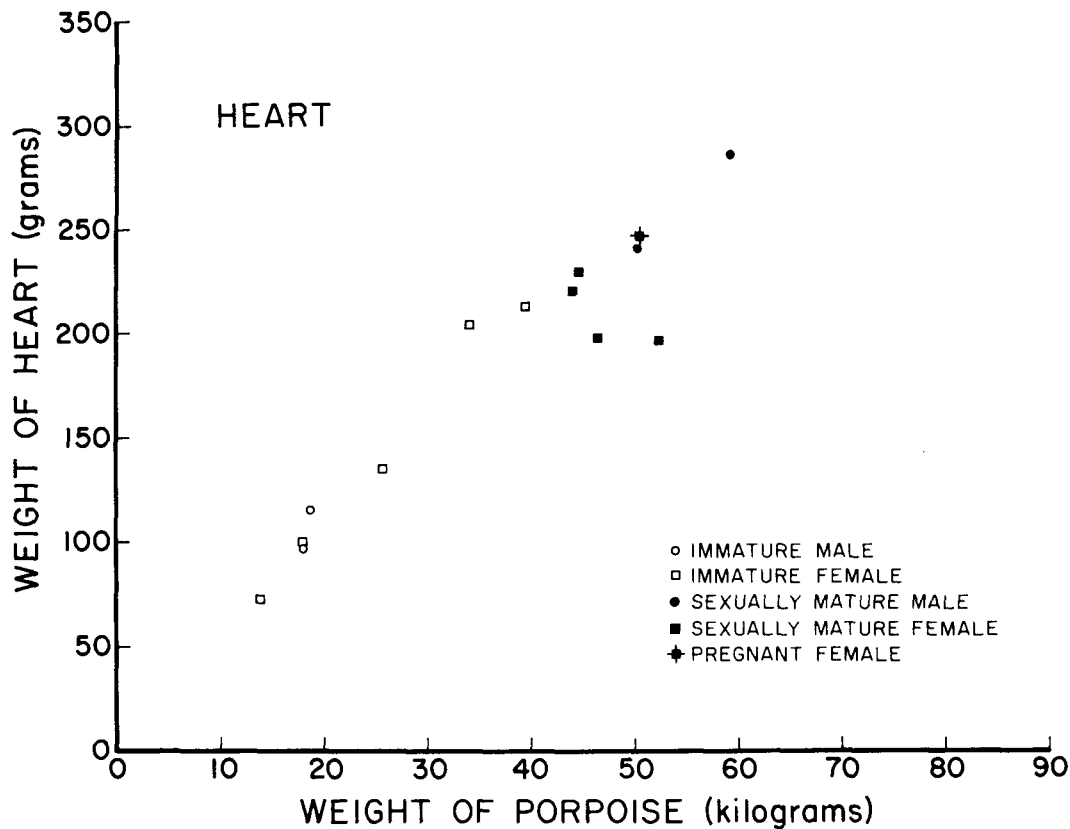


Figure 2. *Stenella* cf. *S. longirostris*. Weight of heart relative to total body weight for 4 males and 10 females.

TABLE 3. Log-log regression analyses of relationships between organ weights and total body weight in *S. graffmani* and *S. cf. S. longirostris*.

	a ¹	b ¹	r ¹	Sample size
<i>S. graffmani</i>				
Heart	-1.25	0.769	0.948	47
Lungs	-0.92	0.880	0.990	35
Liver	-2.18	1.114	0.922	59
Kidneys	-1.87	0.965	0.977	57
Spleen:				
males	-3.07	1.010	0.874	36
females	-3.40	1.057	0.885	24
<i>S. cf. S. longirostris</i>				
Heart	-1.48	0.820	0.962	13
Lungs	-1.25	0.947	0.991	4
Liver	0.01	0.608	0.536	13
Kidneys	-1.91	0.940	0.986	13

¹ Values of a, b, and correlation coefficient r in linear regression equation $\text{Log } Y = a + b \text{ Log } X$, where Y = organ weight and X = total body weight, in gms.

S. longirostris (Fig. 2). The hearts of 6 sexually mature adults (ranging from 168–177 cm total length and from 43.5–59.0 kg total weight) weighed from 191–272 gm and from 0.37–0.52% (average: 0.46%) of total body weight. The data are insufficient to determine whether relative weight of the heart decreases during development in this species.

Lungs

S. graffmani (Fig. 3). The combined weight of both lungs of 6 adults (from 180–200 cm total length and from 55.4–75.8 kg total weight) ranged from 1642–2275 gm and from 2.82–3.66% (average: 3.19%) of total weight.

S. longirostris (Fig. 3). The lungs of 4 individuals, all calves and subadults (from 118–149 cm total length and from 18.1–33.6 kg total weight) weighed from 599–1112 gm and from 3.09–3.39% (average: 3.28%) of total weight.

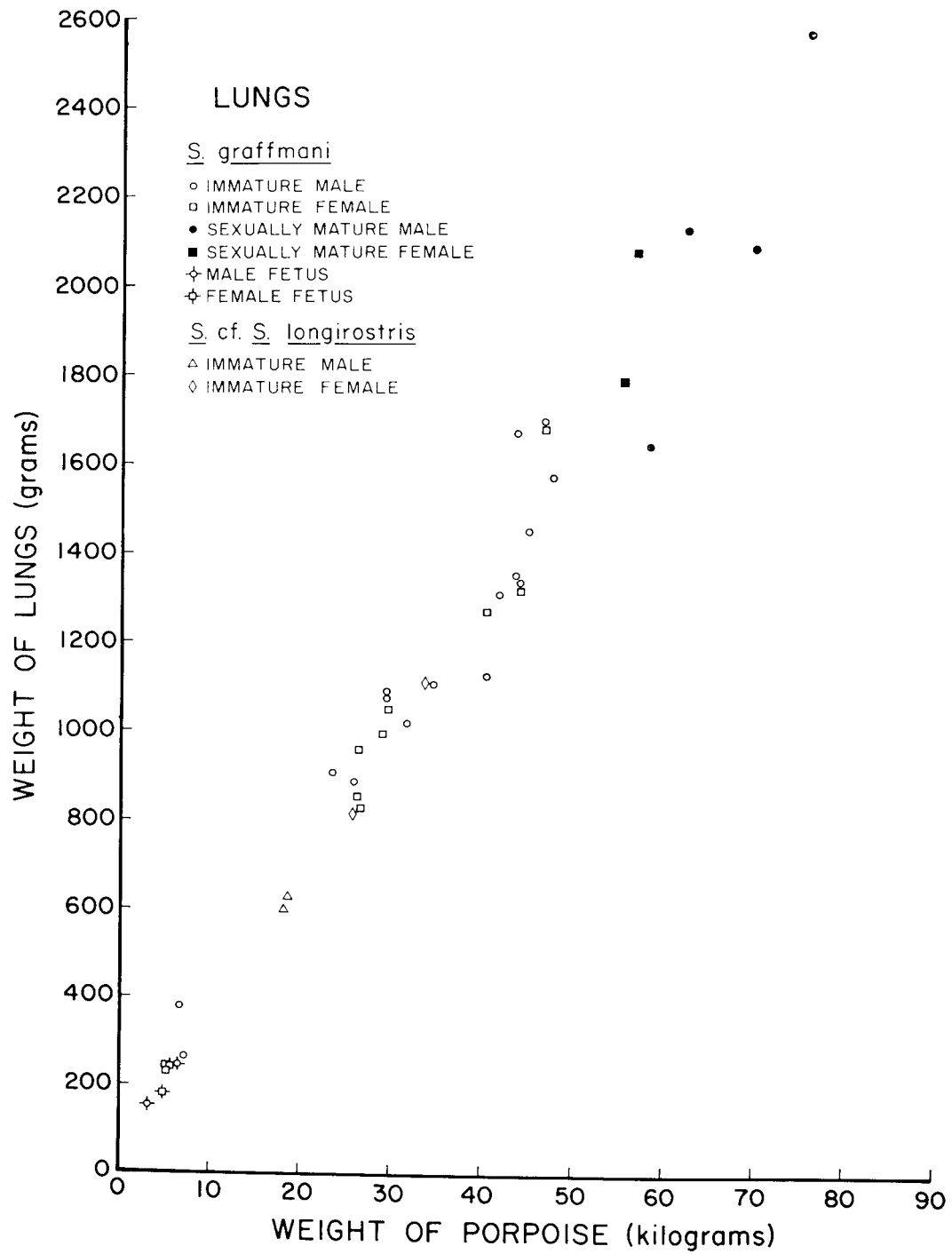


Figure 3. *Stenella graffmani*. Weight of lungs relative to total body weight for 22 males and 15 females. *Stenella cf. S. longirostris*. Weight of lungs relative to total body weight for 2 males and 2 females.

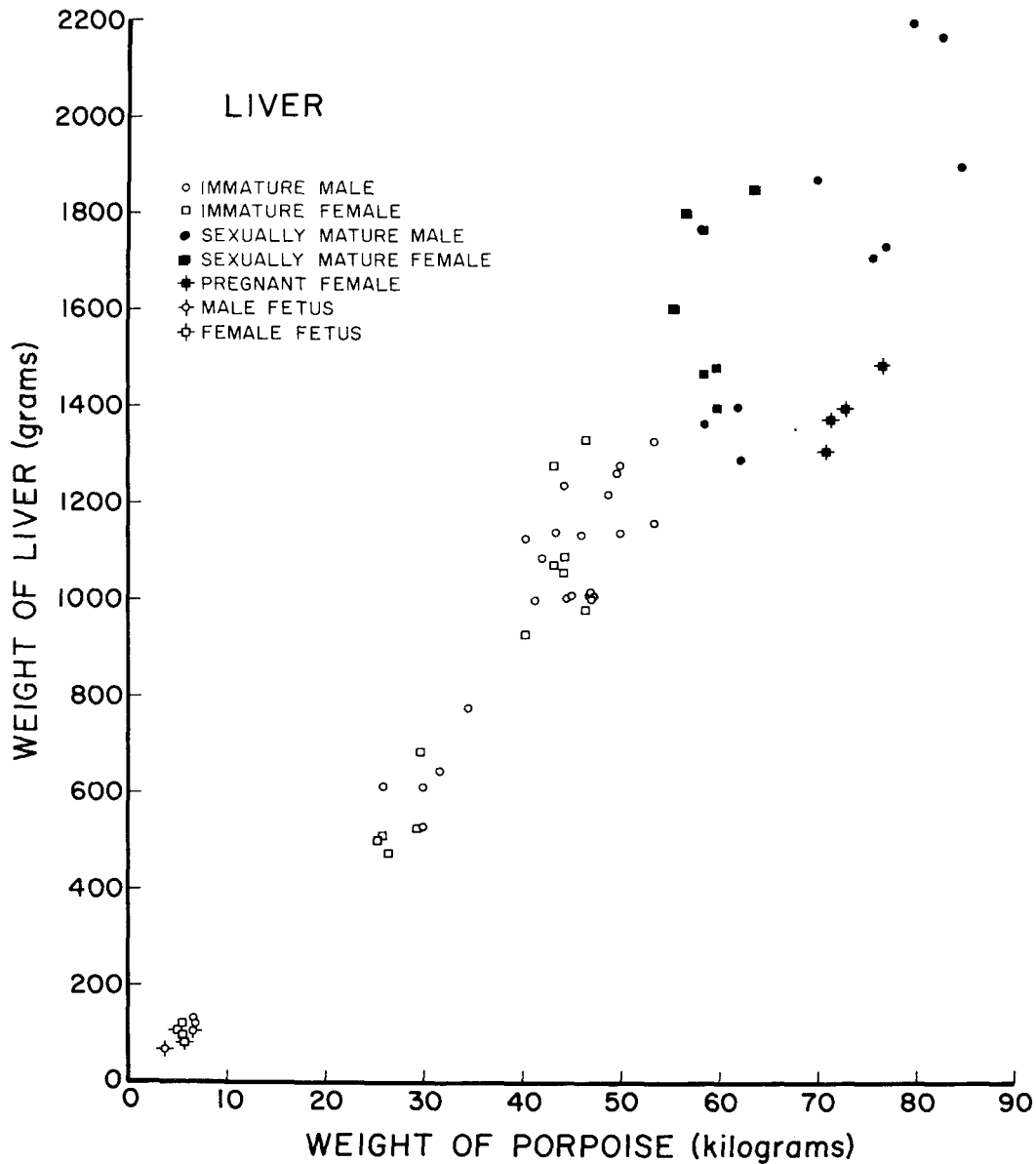


Figure 4. *Stenella graffmani*. Weight of liver in 36 males and 27 females.

Liver

S. graffmani (Fig. 4). The livers of 16 adults (from 175–218 cm total length and from 55.4–84.0 kg total weight) weighed from 1281–2195 gm and from 2.06–3.17% (average: 2.53%) of total weight. Relative weight of the liver appears

to increase early in development (average for 8 fetuses and infants was 1.84%, range: 1.42–2.22%) and remain nearly constant thereafter.

S. longirostris (Fig. 5). The livers of 6 adults (168–177 cm total length and 43.5–59.0 kg total weight) weighed from 832–997 gm and from 1.67–2.10% (average: 1.90%) of total weight. Adults

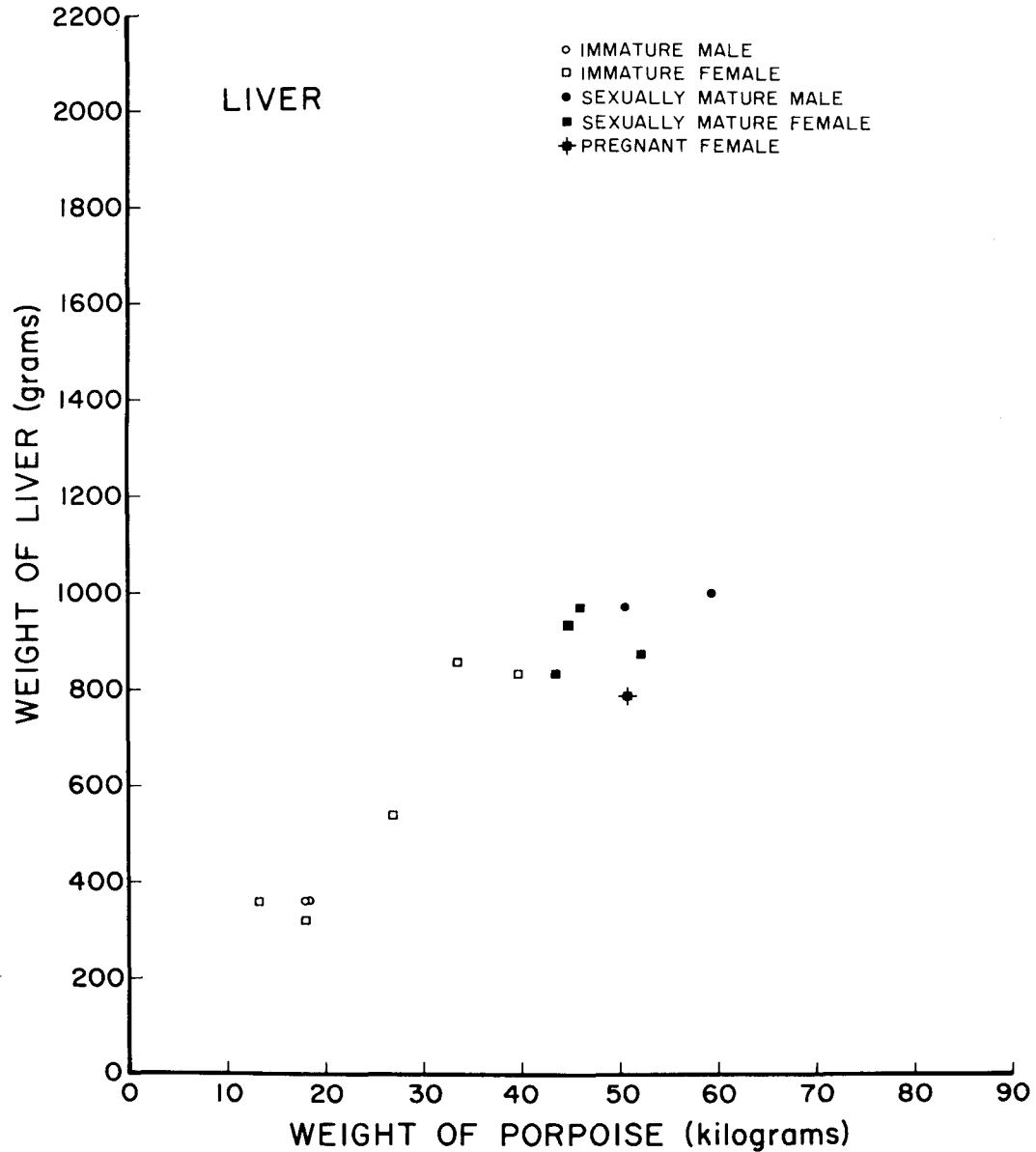


Figure 5. *Stenella* cf. *S. longirostris*. Weight of liver relative to total body weight for 4 males and 10 females.

of this species have smaller livers than subadults of *S. graffmani*; the livers of 21 calves and subadults of *S. graffmani* ranging from 43.2–53.6 kg total weight weighed from 974–1457 gm and from 2.08–3.00% (average: 2.42%) of total weight.

Kidneys

S. graffmani (Fig. 6). The relative weight of the kidneys drops from a high at birth to a low in calves and subadults and then increases again to a secondary high in adults. The kidneys of 8

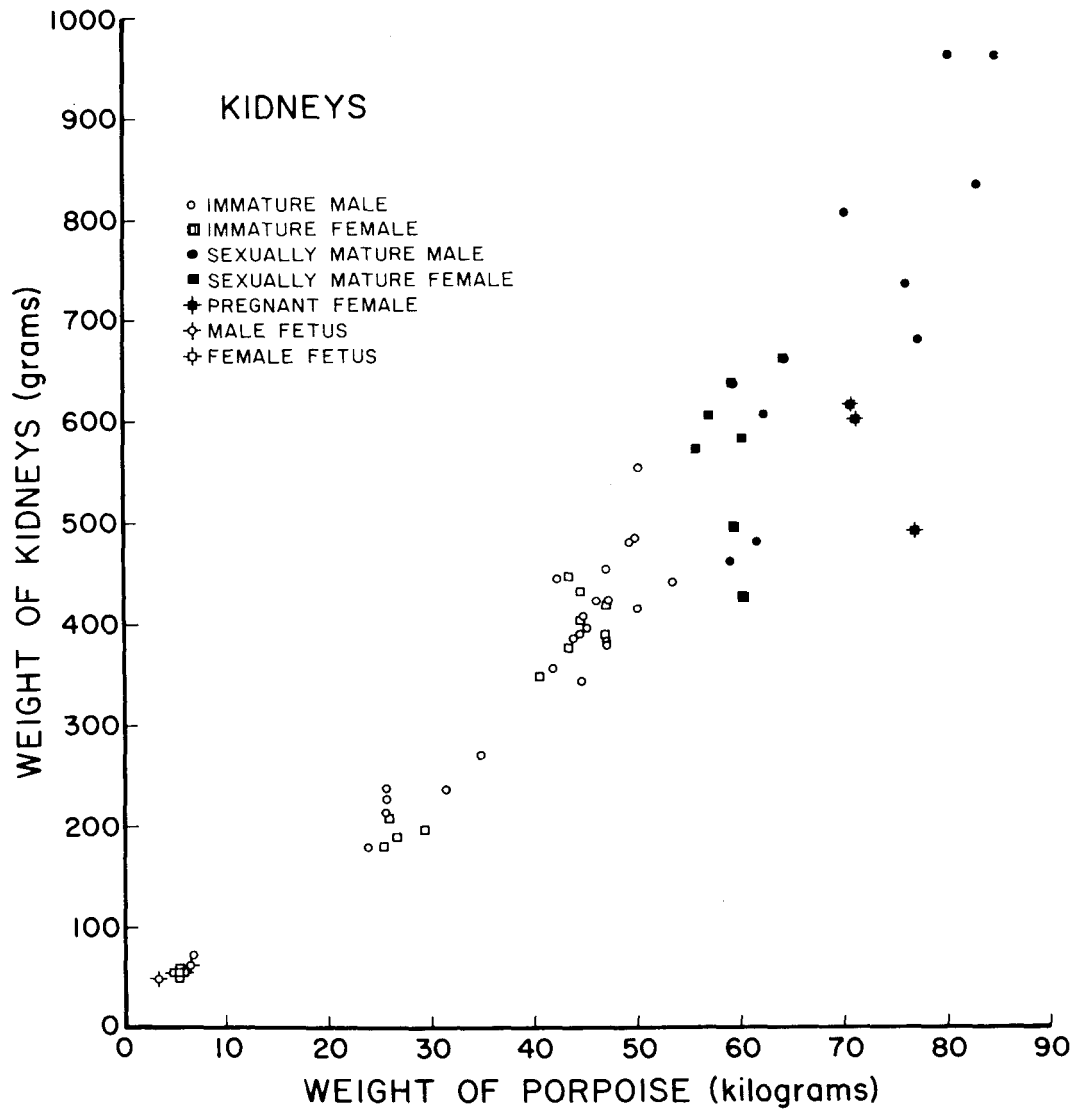


Figure 6. *Stenella graffmani*. Combined weight of kidneys relative to total body weight for 35 males and 27 females.

neonatal and near-term fetuses (74–86 cm total length and 3.4–6.8 kg total weight) ranged from 49–70 gm (average: 59 gm) and from 0.91–1.44% (average: 1.09%) of total weight. The kidneys of 31 calves and subadults (129–178 cm total length and 23.6–53.2 kg total weight) ranged

from 129–178 gm and from 0.67–1.11% (average: 0.84%) of total weight, and those of 15 adults (175–218 cm total length and 55.4–84.0 kg total weight) ranged from 426–968 gm and from 0.78–1.20% (average: 0.98%) of total weight. The animal is asymmetrical with respect to weight of

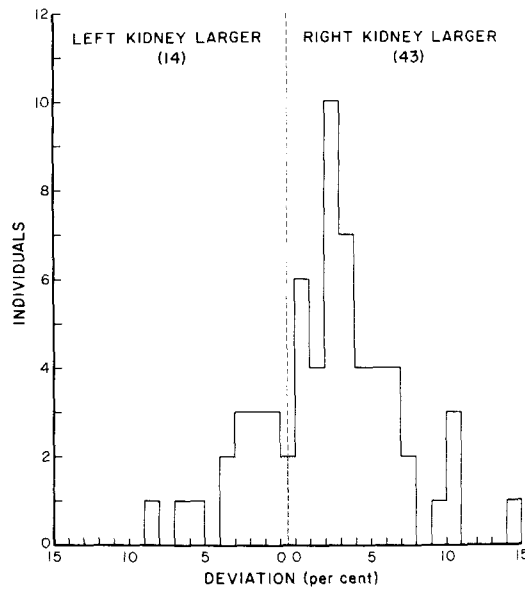


Figure 7. *Stenella graffmani*. Frequency distribution of percent deviation of weight of largest kidney from average weight of both kidneys, for 59 individuals.

kidneys (Fig. 7); the right kidney on the average is 2–4% heavier than would be expected were symmetry to prevail.

S. longirostris (Fig. 8). The kidneys of 6 adults (168–177 cm total length and 43.5–59.0 kg total weight) weighed from 289–393 gm and from 0.55–0.69% (average: 0.65%) of total weight. This species also exhibits dextral asymmetry; of 12 sets of kidneys weighed, in 9 the right kidney was heavier, in 2 the left was heavier, and in 1 set both kidneys weighed the same.

Spleen

S. graffmani (Fig. 9). We infer from the scatter plot of weight of spleen on total weight that the spleen increases in size both absolutely and relatively during development to a peak in subadulthood, then rapidly decreases in size, again both absolutely and relatively, to a relative low during adulthood. The spleens of 10 neonatals and near-term fetuses averaged 4 gm (0.07%) in weight, those of 11 calves (129–153 cm total length and 23.6–34.6 kg total weight) ranged from 11–43 gm (average: 31 gm) and from 0.04–0.15% (average: 0.11%) of total weight,

and those of 25 subadults (154–178 cm total length and 40.4–53.6 kg total weight) ranged from 24–100 gm (average: 53 gm) and from 0.05–0.21% (average: 0.12%) of total weight—the variance was greatest for this group, but the spleens of 16 adults (175–218 cm total length and 55.4–84.0 kg total weight) weighed only 20–65 gm (average: 41 gm) and from 0.03–0.10% (average: 0.06%) of total weight. There is also an apparent sexual dimorphism in weight of the spleen in adults; the spleens of 9 adult males weighed 36–65 gm (average: 48 gm) and 0.04–0.10% (average: 0.06%) of total weight, while those of 7 non-pregnant adult females weighed only 20–48 gm (average: 31 gm, the same as for the calves) and from 0.03–0.08% (average: 0.05%, less than for the infants and fetuses). The smallest adult spleen (16 gm or 0.02% of total weight) was possessed by a pregnant female (near-term).

S. longirostris (Fig. 10). As is the case for the liver and the kidneys, the adults of this species possess smaller spleens than do subadults of comparable size of *S. graffmani*. The spleens of 5 adults weighed 13–31 gm (average: 30 gm) and from 0.03–0.05% (average: 0.04%) of total weight. The data conform to the pattern noted above for *S. graffmani* of decreased absolute weight of spleen in adulthood but are insufficient in number to warrant conclusions.

DISCUSSION

The value of the growth coefficient b , the ratio of the rate of increase of organ weight to the rate of increase of total body weight, for heart weight obtained here for *S. graffmani* (0.769) is lower than those obtained by Pilleri (1969) for *S. coeruleoalba* (1.014), *Delphinus delphis* (0.806), and *Phocoena phocoena* (1.055). That of *S. longirostris* (0.820) falls between those for *D. delphis* and *S. coeruleoalba*. The value of the growth coefficient for lung weight appears to be inversely related to maximum body weight. Of the 3 species of *Stenella*, the smallest, *S. longirostris*, has the highest coefficient (0.947), and the largest, *S. coeruleoalba* has the lowest (0.684)—Pilleri, 1969. The value of b for *S. graffmani* is intermediate (0.880). The value of b for liver weight for *S. longirostris* (0.608) is close to that obtained for *S. coeruleoalba* (0.684) by Pilleri, but that for *S. graffmani* (1.114) is considerably

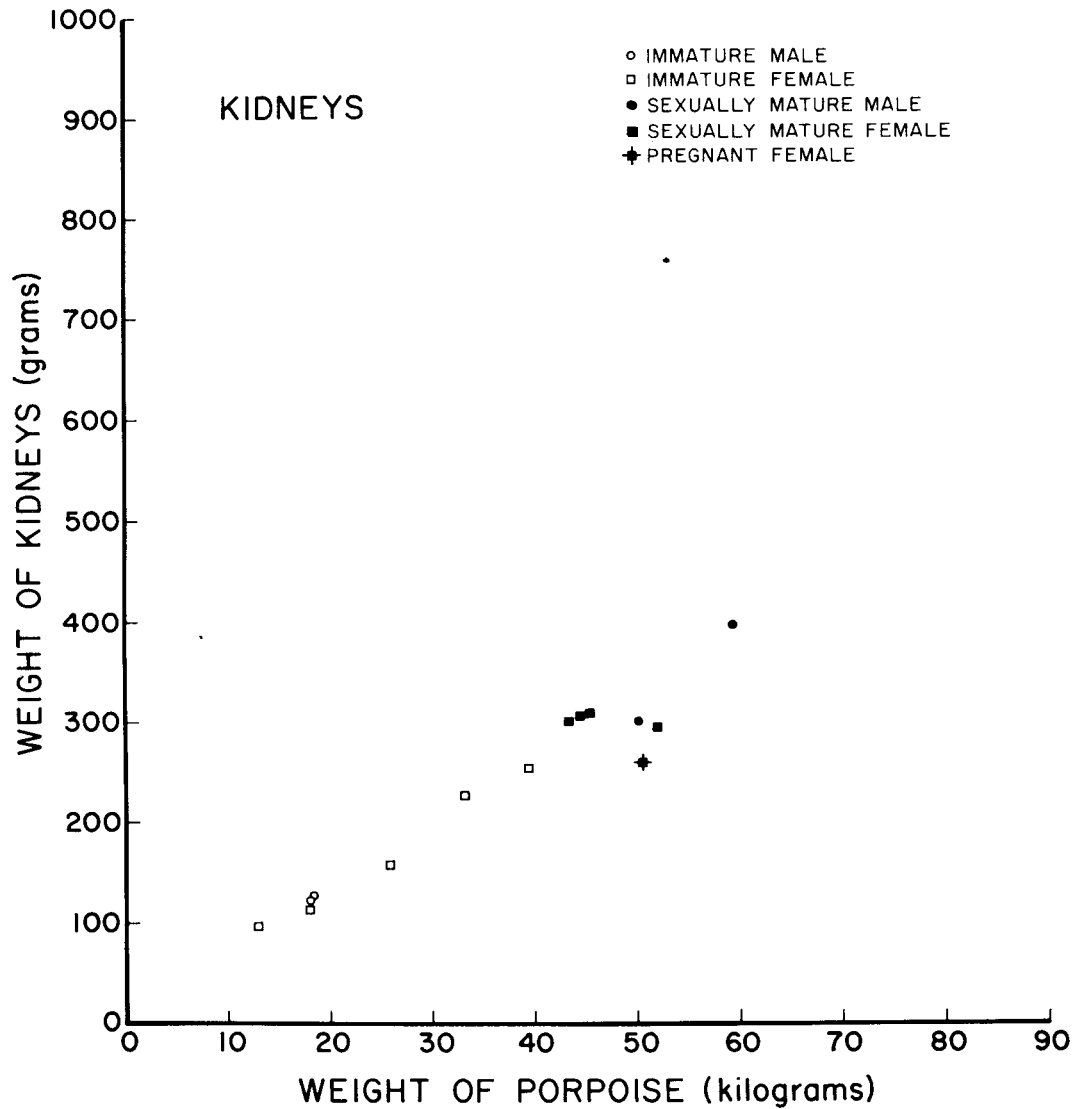


Figure 8. *Stenella* cf. *S. longirostris*. Weight of kidneys relative to total body weight for 4 males and 9 females.

higher. The values of b for kidney weight for both species dealt with here (0.965 and 0.940) are lower than those obtained by Pilleri for *S. coeruleoalba* (0.977) and *D. delphis* (1.089).

Pilleri's (1969) value of b for *Phocoena phocoena* (0.685) is very much lower than those for the 4 delphinids (*sensu stricto*).

The odontocete spleen has a relatively large

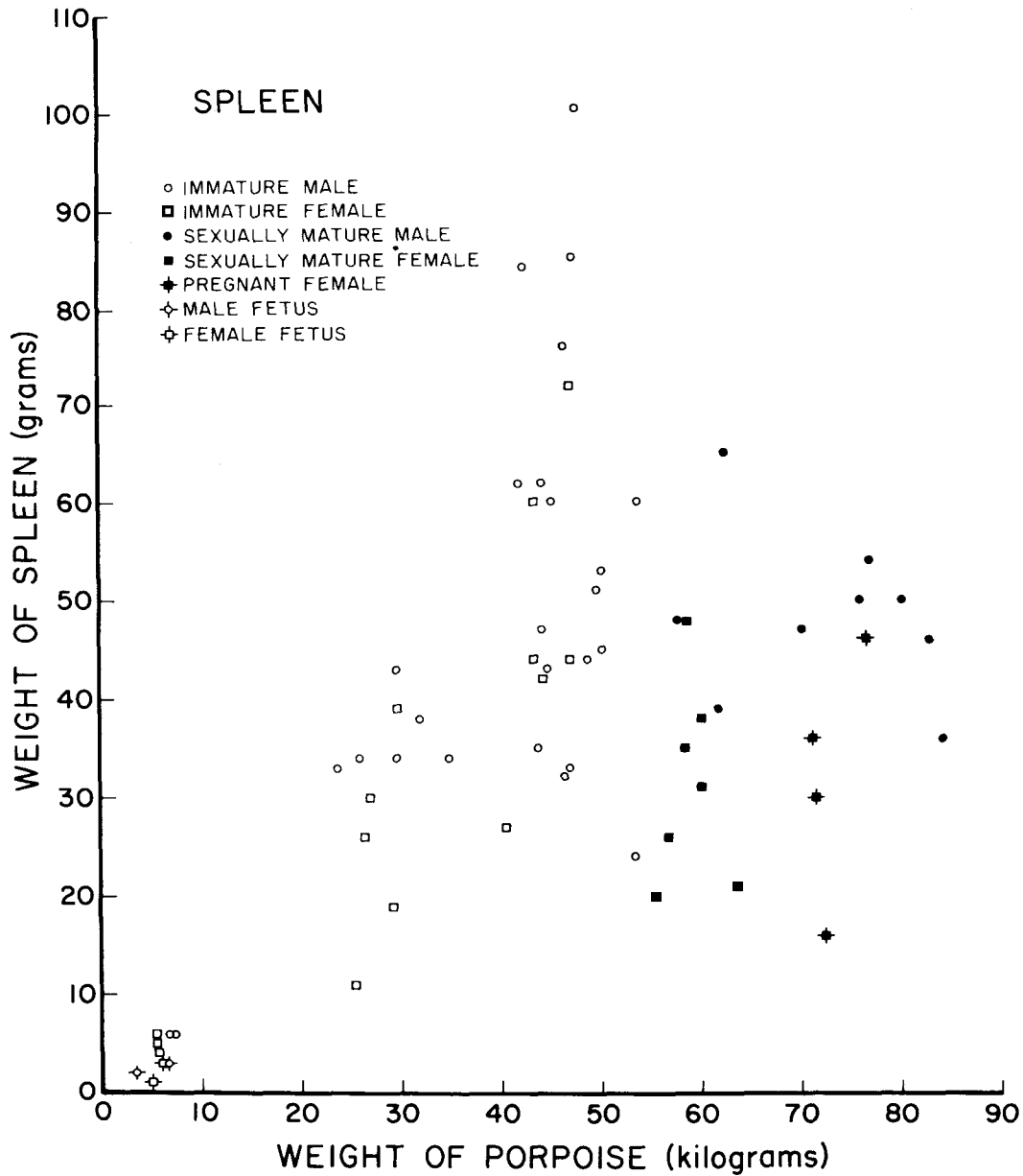


Figure 9. *Stenella graffmani*. Weight of spleen relative to total weight for 37 males and 28 females.

number of lymph nodules (white spleen pulp) (Pilleri, 1969). A major function of the lymphatic tissue of the spleen is the production of antibodies (Jubb and Kennedy, 1963). We offer here the tentative hypothesis that smaller relative spleen size for adult females of *S. graffmani* (Fig. 8) is

tied functionally to suppression of antibody production during pregnancy to eliminate the possibility of rejection of the fetus. Obviously histological investigation of splenic change during pregnancy will be necessary if this hypothesis is to be critically examined.

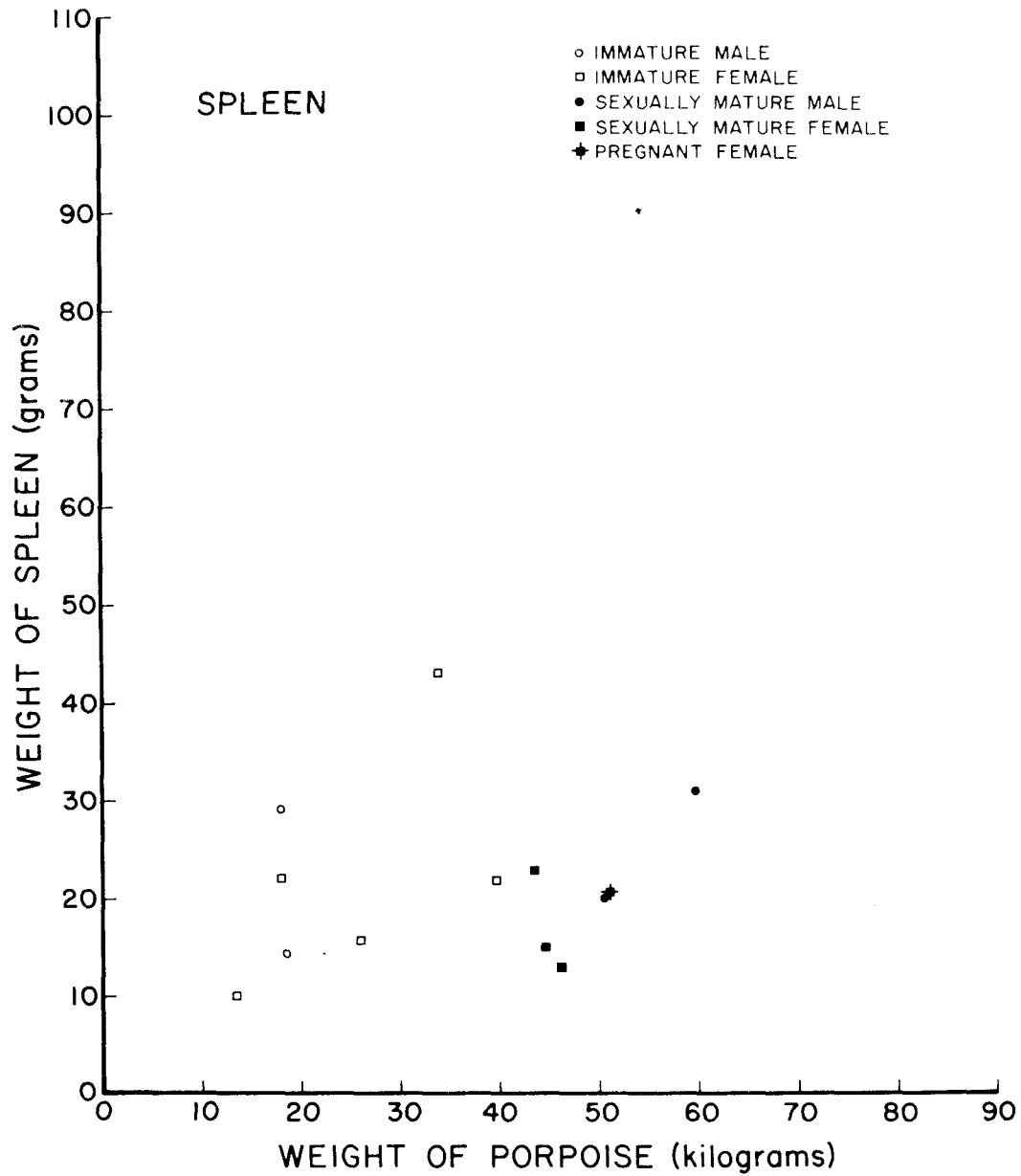


Figure 10. *Stenella* cf. *S. longirostris*. Weight of spleen relative to total weight for 4 males and 9 females.

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