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BRIEF NOTE

CORTEX OF THE SUPRARENAL (ADRENAL) GLAND OF *PHOCA VITULINA RICHARDI*[1]

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Cuvier (1805) was apparently the first to comment on seal adrenals. He thought these adrenals to be the smallest of any mammal, but as Elliot and Tuckett (1906) suggest, Cuvier was probably misled by comparing the adrenal of the seal to the large kidney. Ridgway (1972) noted that the adrenal glands of seals are similar to those of other mammals, the major variations occurring in the amount of connective tissue present and degree of surface lobulation. The present analysis of the harbor seal (*Phoca vitulina richardi*) adrenal cortex extends beyond the gross description of these organs and examines the microscopic structure of the gland.

The adrenals were obtained from seals collected in British Columbia, Canada (fig. 1) by Dr. Michael A. Bigg. The age, weight and length of each animal was determined (tables 1 and 2). Representative portions of the adrenal gland from 32 (16 male, 16 female) animals were fixed in neutral formalin buffered with seawater. The tissues were embedded in paraffin, 4 micrometer sagittal sections cut, and sections stained with hematoxylin and eosin and azan reagents (Gurr 1953). The sections were used to determine:

(1) relationship of cortex to medulla
(2) cortical zonular pattern
(3) employing the eyepiece micrometer, percentage of cortical volume of zona glomerulosa, zona fasciculata and zona reticularis
(4) arrangement of the connective tissue stroma.

In both males and females, the medulla shape conformed to that of the entire gland (*e.g.* spheroid, oval, etc.), and the amount of medullary material was small when compared with the cortex. In the medulla of adult specimens, in addition to the typical medullary cells, cortical islands of zona reticularis cells containing heavy deposits of lipid were present (fig. 2). In comparison, in juvenile specimens many isolated groups of cortical cells were found adjacent to the medullary vein.

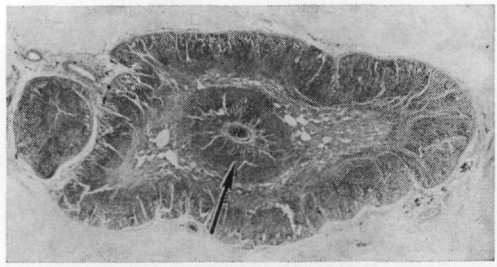

FIGURE 2. Cortical island (arrow) of zona reticularis cells in the medulla of the male adult gland. 2.6×.

The average cortical volume for each zone from all animals was approximately: (a) zona glomerulosa, 50.31%; (b) zona fasciculata, 31.25%; and (c) zona reticularis, 18.44%. There was some variation in thickness of the 3 zones in different specimens (tables 1 and 2); this variation may have been due to the functional state of the gland. Zona glomerulosa cells

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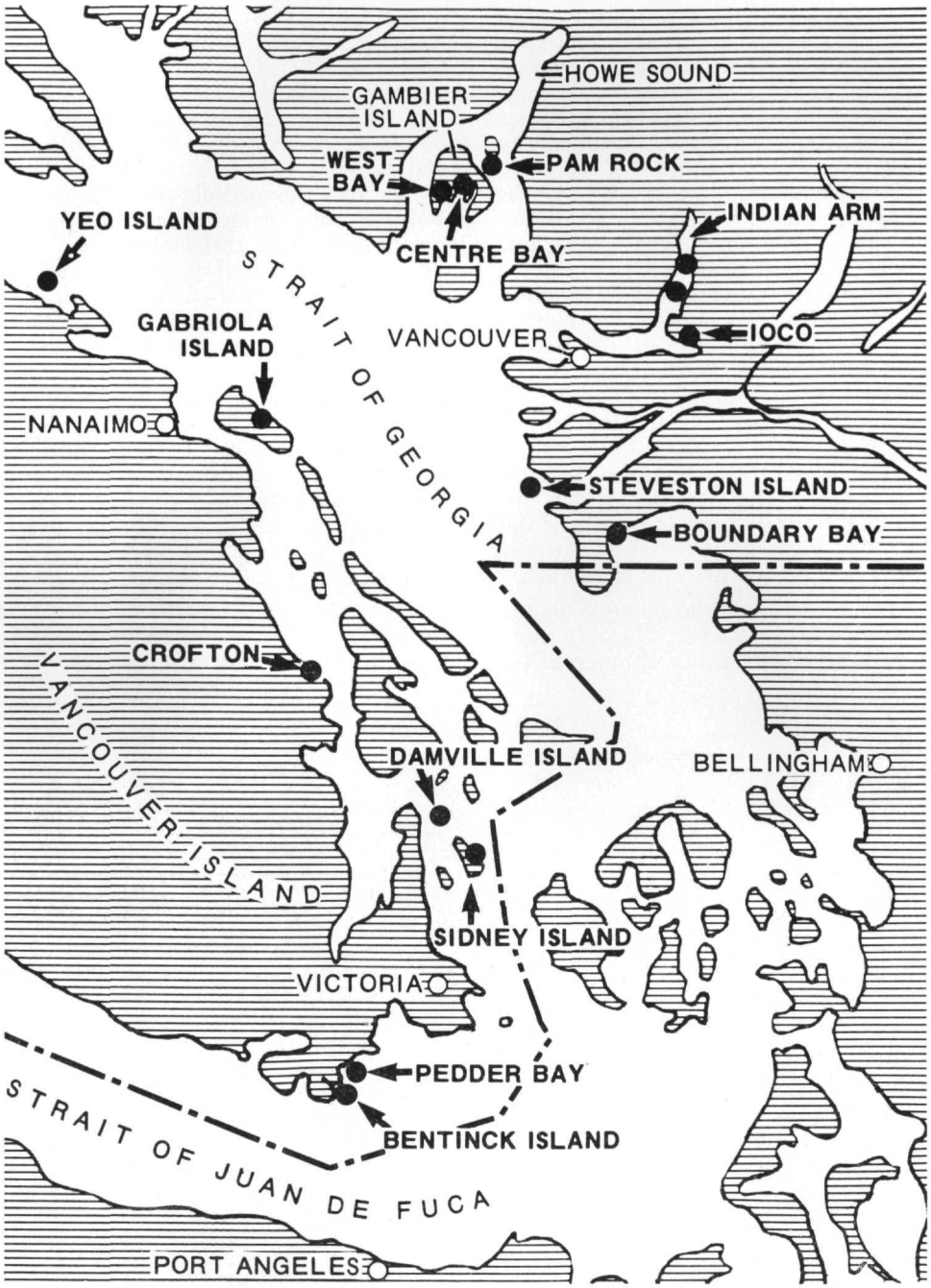

FIGURE 1. Geographic features of British Columbia coastline. Seals were obtained between 1964–67 at locations shown by black dots on map.

in the juvenile gland possessed eosinophilic cytoplasm, while in the adult female adrenal, a distinct increase in cytoplasmic basophilia occurred. The zona fasciculata and zona reticularis occurred as anastomosing eosinophilic cords composed of small cells containing numerous lipid droplets. Thus, it was difficult to distinguish between these two zones in the juvenile gland. In the adult, the zona fasciculata consisted of large, columnar-shaped cells organized into long fascicles. These adult cells contained larger and more numerous lipid droplets. The adult zona reticularis cells retained their juvenile appearance. Moreover, cells of both the zona fasciculata and zona reticularis demonstrated eosinophilic cytoplasm at all ages. There was no evidence of a transient-zone in the cortex of the juvenile gland, although connective tissue between the cortex and medulla could be interpreted as a remnant of this zone. No granular material was seen in cortical cells of any animals examined.

In the juvenile and adult male glands, the capsule was relatively thick (5 mm), but became considerably thinner in the adult female (2.3 mm). In both juvenile and adult specimens, the capsule contained islands of cells in transitional stages between capsular and glomerular cells (fig. 3). The adrenals of all the animals displayed lobulation and folding; this characteristic was particularly predominate in the adult male. In all the glands, connective tissue trabeculae extended into the medulla from the capsule. Folds of zona glomerulosa commonly accompanied these trabeculae and formed arcs which resulted in some specimens having an adrenal pole composed of capsular and glomerular elements. In the adult male, extensions of connective tissue trabeculae formed an incomplete inner connective tissue capsule between cortex and medulla. Fewer connective tissue trabeculae occurred in the adult, giving the gland a somewhat less lobulated appearance.

In the present study of the adrenal gland of *Phoca v. r.*, the amount of medullary material is small when compared to the cortex of this animal and to the cortex of other mammals (Sucheston *et al* 1978). The average cortical volume

TABLE 1

Comparison of Age, Weight, and Length of Female Harbor Seals as Related to Their Adrenal Glands.

Age (yrs)	Wt. (Kg)	Length (cm)	Adrenal Gland measurement (cm)		% Total cortical volume*		
			long. dia.	thickness	Z.G.	Z.F.	Z.R.
0–1	19.10	93.75	0.9	0.3	45	30	25
	20.90	101.25	1.1	0.5	47	34	19
	24.95	96.25	1.0	0.4	48	32	20
	24.95	98.75	1.0	0.3	57	29	14
	27.22	143.37	1.6	0.5	52	26	22
	27.22	145.00	1.1	0.5	42	34	24
	28.58	103.12	1.0	0.6	43	32	25
	29.90	120.00	1.2	0.3	71	16	13
1–2	25.41	120.00	1.2	0.5	52	35	13
	29.50	116.87	1.3	0.6	68	23	9
	29.52	113.12	1.2	0.5	48	35	17
2–3	31.82	119.43	1.2	0.7	47	38	15
	35.00	124.37	1.5	0.4	43	36	21
3–4	—	—	—	—	—	—	—
4–5	—	—	—	—	—	—	—
5–6	—	—	—	—	—	—	—
6–7	60.00	137.51	1.0	0.4	57	28	15
7–8	—	—	—	—	—	—	—
8–9	—	—	—	—	—	—	—
9–10	42.31	138.75	1.4	0.8	47	38	15
10–15	—	—	—	—	—	—	—
15–20	52.23	143.12	1.5	0.9	45	34	21

*Z.G. = Zona glomerulosa. Z.F. = Zona fasciculata. Z.R. = Zona reticularis.

TABLE 2

Comparison of Age, Weight and Length of Male Harbor Seals as Related to Their Adrenal Glands.

Age (yrs)	Wt. (Kg)	Length (cm)	Adrenal Gland measurement (cm)		% Total cortical volume*		
			long. dia.	thickness	Z.G.	Z.F.	Z.R.
0–1	17.22	100.62	1.0	0.5	61	22	17
	22.70	97.54	0.9	0.4	64	22	14
	25.00	105.00	1.2	0.4	41	32	27
1–2	28.63	117.55	1.0	0.6	61	24	15
	32.33	120.00	1.3	0.4	44	41	15
2–3	40.04	129.37	1.6	0.6	59	35	6
3–4	49.91	131.25	1.5	0.7	40	33	27
4–5	55.85	140.00	1.6	0.6	41	35	24
5–6	72.61	152.55	1.7	0.7	50	40	10
	74.81	165.00	1.5	0.5	44	37	19
	81.66	152.52	1.3	0.6	50	40	10
	89.00	160.00	1.5	0.8	49	35	16
6–7	82.61	157.50	1.6	0.5	44	43	13
7–8	59.90	143.37	1.4	0.7	59	29	12
	77.11	152.33	1.7	0.6	50	25	25
8–9	—	—	—	—	—	—	—
9–10	90.74	165.00	1.9	0.7	48	40	12
10–15	—	—	—	—	—	—	—
15–20	—	—	—	—	—	—	—

*Z.G. = Zona glomerulosa. Z.F. = Zona fasciculata. Z.R. = Zona reticularis.

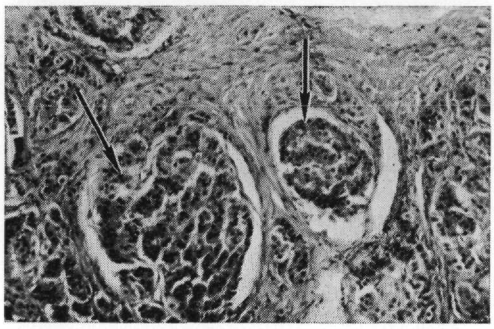

FIGURE 3. Outer connective tissue capsule containing cell islands (arrows) in transitional stages between capsular and glomular cells. Adult female. 13×.

for the zona glomerulosa is approximately half the total cortex. Similar findings of a well-developed zona glomerulosa have been reported by Deane and Greep (1946) and Scheffer (1958). They state that the size of the zona glomerulosa in the seal adrenal is related to certain aspects of electrolyte balance that occurs in marine mammals. The presence of granular material in the zona glomerulosa was also noted by these authors, while in our study cortical cells were devoid of granules. The presence of an irregular connective tissue capsule between the cortex and medulla may be interpreted as a remnant of the transient-zone, which has been shown to be present in various mammals (Sucheston and Cannon 1968). The lobulation and folding of the cortex produced by the arrangement of the connective tissue stroma is of a similar type as occurs in the adrenal gland of some monotremes (Deane and Greep 1946, Scheffer 1958).

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