

#### Early June

Fishing was done in the Flanders Bay area (A) off Calf Island (60' depth) and off Black Ledge and Stave Island (both 30' depth). Fishing was tried in (B) off Hancock Pt. and Dram Island, but with very little success. About 80% of the few fish caught in these places were females.

#### Late June - early July

Trawls were put down on the open side of Calf and Stave Islands (Area C); 95% were males. Females were available in Stave Island Harbor (Area D). Fishing in Bar Harbor area (Area E) was attempted; only a few males were caught there.

#### Late July - mid-August

Males became plentiful in Area C and on both sides of Ironbound Island (Area F). Females were still being caught in Flanders Bay (Area A).

#### Between August 15 - 25

Females were no longer available in Area A. In Area C however, both males and females were caught in equal amounts. Fishing in Bar Harbor improved and mostly males were caught.

#### August 26

Many females were caught in Flanders Bay (Area A).

These data show a differential movement between the sexes. Large mature females approached the coast first, in early June and formed the bulk of the inshore catch throughout June to late August. Mature males moved into coastal waters later, but remained in separate shoals, generally further offshore than the females.

Migration in unisexual shoals appears to be common in the spiny dogfish and has been reported for populations off the eastern seaboard of Canada and for populations in Europe (Templeman, Res. Bull. Div. Fish. Res., Newfoundland., 15:1944; Holden, Fishery Invest. London, II. 24:1967). In view of a projected fishery for the spiny dogfish in Maine, it would be of interest to have a detailed analysis of their migratory behaviour.

#### DETERMINATION OF THE SHORT CIRCUIT CURRENT IN THE RECTAL GLAND OF THE DOGFISH (*Squalus acanthius*) AND THE EFFECTS OF THEOPHYLLINE, DB CYCLIC AMP, AND GLUCOSE

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The isolated perfused rectal gland of the dogfish has been shown to secrete sodium chloride at a slow rate that can be accelerated by the addition of substances that increase the cyclic AMP content of the gland. It is also known that the lumen of the main secretory duct of the gland is electrically negative with respect to the blood. Here we report observations on placing the gland as a membrane in a two compartment chamber prepared ad hoc for the rectal gland, and on detecting potential differences and short circuit currents compatible with previous observations on the perfused gland. The action of the chloride transport inhibitor - furosemide - is also reported here.

Spiny dogfish, *Squalus acanthias*, of either sex, weighing 2-5 kg were taken by hook and line from Frenchman Bay, Maine, and maintained in livecars in a fasted state until sacrificed. Following segmental transection of the spinal cord, rectal glands were removed via an abdominal incision and placed in ice cold Ringer. Both ends of the gland were then sectioned and a longitudinal section extending from the central duct to the surface of the gland along the anterior and posterior branches of the rectal gland artery was then performed. The gland was then rolled open exposing the central duct and mounted in the chamber. Both sides of the tissue were bathed with a solution having the following composition (mmoles/liter): Na 280; K 6; Mg 3; Ca 2.5; Cl 290; phosphate 1; sulfate 0.5; bicarbonate 8; urea 350; glucose 5.

The results are presented in Figure 1 and in Table 1. The gland was kept at open circuit until a very low electrical potential (below 1 mV) remained stable, then it was stimulated with a solution containing theophylline and Db cyclic AMP. The potential then increased for 2 to 3 hours to a steady value of about 6 mV, which is at the order of magnitude of the potential found in the perfused gland. At this point the potential was dropped to 0 and the short circuit current developed by the gland was recorded continuously while the potential difference was measured by opening the circuit for 2-5 seconds at irregular intervals.

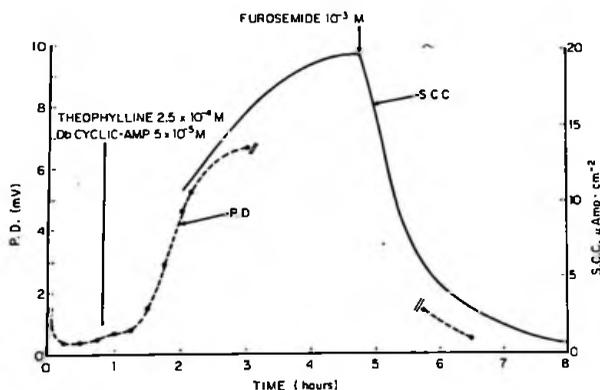


Figure 1 shows a typical experiment where the stimulatory action of theophylline and Db cyclic AMP can be observed, as well as the development of the short circuit current and the inhibitory effect of furosemide upon it. The action of furosemide was irreversible.

Previous attempts to detect the electrical properties of this gland mounted as a flat sheet after sectioning along the main secretory duct indicated a very low potential difference and a high electrical resistance (Hogben, MDIBL Bulletin, Vol. 14). With the aid of the

TABLE 1: ELECTRICAL PROPERTIES AND ACTION OF THEOPHYLLINE AND DB-CYCLIC AMP ON THE ISOLATED, SHORT CIRCUITED RECTAL GLAND OF THE DOGFISH (SQUALUS ACANTHIAS)

A: Ringers containing 10 mM Glucose

	P.D. (mV)			S.C.C. $\mu\text{amp. cm}^{-2}$		
	N	MEAN	% CHANGE	N	MEAN	% CHANGE
Control	10	0.8 $\pm$ 0.1	-	-	-	-
After stimulation with Theophylline $2.5 \times 10^{-4}\text{M}$ and Db-Cyclic AMP $5 \times 10^{-5}\text{M}$	10	5.7 $\pm$ 0.7	+910*	8	16.0** $\pm$ 3.3	-
After inhibition with Furosemide $10^{-3}\text{M}$	6	1.4 $\pm$ 0.6	- 74*	6	2.6 $\pm$ 1.1	- 72**

B: Ringers containing 1 mM Glucose

	P.D. (mV)			S.C.C. $\mu\text{amp. cm}^{-2}$		
	N	MEAN	% CHANGE	N	MEAN	% CHANGE
Control	8	0.8 $\pm$ 0.3	-	-	-	-
After stimulation with Theophylline $2.5 \times 10^{-4}\text{M}$ and Db-Cyclic AMP $5 \times 10^{-5}\text{M}$	6	2.8 $\pm$ 0.9	+105*	6	6.6** $\pm$ 0.8	-

\* Calculated from the average difference

\*\* S.C.C. before stimulation was not measured because the action of the stimulants was followed for their effect on the Potential Difference and only then the preparations were short-circuited. In general, with a 0.8 mV average, the values for S.C.C. at rest were extremely small.

stimulatory agents we have managed to increase the potential difference to the level found in the perfused gland, to short circuit it, and then to study some of its electrical properties.

The presence of at least 5 mM glucose or, even better, a standard concentration of 10 mM glucose in the bathing solutions was of extreme importance to obtain the results presented here. Table 1 shows the average values for experiments performed with the gland, indicating the stimulatory effect of theophylline and Db cyclic AMP, the inhibitory action by furosemide, and the requirement for the presence of 10 mM glucose in the solutions to obtain maximal development of the short circuit current.

On the basis of the orientation of the potential difference and the short circuit current, and of the inhibitory effect of furosemide it is probable that the rectal gland transports chloride ions from the blood to the lumen and that this is the main driving force for the secretion of sodium chloride; however, determination of ionic fluxes across the gland in these experimental conditions will be needed to determine the actual source of the short circuit current.