TABLE 1

HEPATIC CLEARANCE OF ORGANIC ANIONS IN ELASMOBRANCHS

	BILE	LIVER	LIVER & BILE	% CONJUGATES IN BILE	MEAN B/P RATIOS
	(% DPM's at 24 Hours)				
Squalus acanthius					
^{35}S-BSP (5)	50.5 ± 20.7	28.7 ± 12.3	79.1 ± 13.3	12.4 ± 4.1	4057:1
^{14}C-NaTC (2)	75 ± 3.1	5.4 ± 2.7	80.4 ± 5.8	------	4180:1
Raja erinacea					
^{35}S-BSP (3)	48.3 ± 21	30.0 ± 17.4	78.4 ± 10.0	24.7 ± 6.0	1592:1
^{14}C-NaTC (2)	57 ± 18	2.3 ± .25	59 ± 17.5	------	2071:1

Numbers in parenthesis equal # of animals studied.

The mean ± standard deviation are given.

These studies demonstrate that despite the slow rate of biliary excretion of ^{35}S-BSP and ^{14}C-NaTC transport mechanisms exist in an elasmobranch liver which ultimately clear these organic anions from plasma into the liver and excrete them against large concentration gradients into bile. Thus despite the presence of gills and kidneys mechanisms have already evolved in primitive marine vertebrates for selective concentrative transport of these compounds into liver and bile.

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BILE SECRETION AND COMPOSITION IN THE LITTLE SKATE, *Raja erinacea*

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Previous studies in the spiny dogfish *Squalus acanthias* (Boyer, Bull. MDIBL 11:4-5, 1971) indicated that continuous collections of hepatic bile could be successfully obtained in the free swimming fish after cannulation of the biliary tree through the gallbladder. These techniques were adopted for use in the little skate *Raja erinacea* in order to assess bile secretion and composition in this species. Male and female skates weighing approximately 1.0 kg were anaesthetized and restrained on a skate board for approximately 15 minutes while the gills were perfused with oxygenated sea water. A ventral incision was made, the gallbladder drained, and a 260 PE cannula inserted through the gallbladder and tied in place. The externalized cannula was attached to readily removable small balloons and the skates were allowed to swim freely in large tanks. Bile composition studies (Table 1) were performed on gallbladder bile removed at the time of cannulation and on hepatic bile obtained during the first 24-hour period of bile collection; these values are compared

to plasma. Rates of bile secretion were measured over a three-day period. Bile secretion in 20 studies ranged from 0.54 - 4.5 ml/kg body weight per day but averaged 1.99 ± 1.1 ml on day 1; 2.66 ml ± 0.89 on day 2; and 1.8 ± 1.02 ml by day 3.

The composition of hepatic bile obtained from the cannula was identical to plasma with respect to Na^+ and Cl^- concentrations. Osmolarity and HCO_3^- concentration slightly exceeded plasma values whereas K^+ and Mg^{++} were significantly greater. In contrast gallbladder bile composition was

TABLE I

COMPOSITION OF PLASMA, HEPATIC AND GALLBLADDER BILE IN THE SMALL SKATE, *Raja erinacea*

		OSMOLARITY (mosmoles/L)	BILE SALTS (mmoles/L)	Na^+ (mmoles/L)	K^+ (mmoles/L)	Cl^- (mmoles/L)	HCO_3^- (mmoles/L)	Mg^{++} (mg%)	Ca^{++} (mg%)
PLASMA	Time 0	958 ± 14 (4)	.....	285 ± 13 (10)	4.3 ± .6 (10)	281 ± 13 (10)	4.4 ± .5 (4)	2.5 ± .2 (10)	16.4 ± .22 (10)
	24 hrs.	946 + 15 (4)							
CANNULA (Hepatic) BILE	0-24 hrs.	1010 ± 28* (4)	7.96 ± 5.21 (5)	295 ± 12 (5)	13.0 ± 2.1* (5)	280 ± 25 (5)	6.2 ± 2.0* (5)	6.2 ± 1.7* (4)	32.8 ± 4.0* (5)
GALLBLADDER BILE	Time 0	920 ± 9** (5)	35.16 ± 10.09 (10)	267 ± 31 (10)	4.6 ± .8 (10)	221.5 ± 25** (10)	5.1 ± 1.7 (5)	2.7 ± .3 (10)	20.7 ± 3.1 (10)

*Significantly greater than plasma ($p < .01$)
**Significantly less than plasma ($p < .01$)
numbers in parentheses = # of studies

identical to plasma except for slightly smaller osmolarity and Cl^- concentrations. Gallbladder bile salt concentration was four to five times the concentration in cannula (hepatic) bile suggesting that the gallbladder reabsorbed water. However these studies differed from previous findings in the dogfish shark where gallbladder reabsorption of water, HCO_3^-, and Cl^- were more striking (Boyer, Bull. MDIBL 11:4-5, 1971). The increase in hepatic-plasma bile ratios of K^+, HCO_3^-, Mg^{++}, and Ca^{++} together with an increase in hepatic bile osmolarity were not observed in the dogfish suggesting that the biliary cannula may stimulate ductular secretion of these ions in the skate. The large variation in range of bile flow and the possibility that cannulation alters ion transport suggests that *in vivo* studies of bile secretory function in the little skate may be difficult. An isolated perfused organ system may be preferable.

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MAXIMUM RATES OF BICARBONATE REABSORPTION BY THE DOGFISH KIDNEY

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The dogfish is credited with an extraordinary capacity for the renal reabsorption of filtered