

inducer of mfo activity (*Mol. Pharmacol.*, 6, 178-183, 1970). However DBA apparently is relatively toxic to fish. Four out of seven skates which received 10 mg DBA/kg i.p. on days one and three, were dead by day 8, although four skates which received a single 10 mg DBA/kg i.p. dose survived to day 13 in a subsequent experiment. As shown in Table 3, both AHH and 7-EC activities were elevated in response to DBA pretreatment although cytochrome P-450 content was not increased and no shift in wavelength of the absorbance peak maximum of the reduced P-450-CO complex was observed.

These studies confirm that certain marine hepatic microsomal mixed-function oxidase activities can be increased by exposure to polycyclic hydrocarbons and TCDD without a corresponding change in the reduced cytochrome P-450-CO complex spectra or P-450 content. 1,2,3,4-Dibenzanthracene was identified as a relatively non-toxic (to mammalian species) inducer suitable for use in characterizing the induced AHH of little skates.

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Length-Tension Relationships in *Echinarachnius parma* Cleavage Furrows

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The division mechanism of echinoderm eggs consists of an equatorial surface ring underlain by microfilaments. The ring actively contracts, constricting the spherical egg into two blastomeres. The cross sectional area of the contractile ring remains relatively constant during cytokinesis so that it literally disappears as it functions and vanishes as cleavage is completed. Simple periodic measurements of equatorial diameter reveal that the circumference decreases at 45 per minute during the first cleavage and at 30 per minute during the second.

The force exerted by the furrow can be measured directly by placing a calibrated, flexible needle through and at right angles to the equatorial plane so that the cleavage process remains incomplete, because the furrow cannot overcome the resistance to deformation of the needle. When the furrow contracts isometrically, it consists of 2 parallel contractile strips of a length determined by the distance between the calibrated needle and a second, rigid needle which is also inserted across the division plane (Rappaport, *Science* 156, 1241, 1967). As the contraction approaches the isometric point, the shortening rate of the circumference appears somewhat erratic, because it is characterized by frequent pauses and small reversals of progress. The force exerted by the fi. cleavage furrow averaged 1.25×10^{-3} dyne and that o. the second averaged 1.48×10^{-3} d. At second cleavage the two blastomeres normally divide synchronously. Measurements made on one of a pair reveal that the contractile mechanism of the measured cell can continue to exert maximum tension up to 9 minutes after the control cell completed division. This observation suggests that the disappearance of the contractile ring may be intimately related to its function. Paired measurements of tensions exerted by the same furrow in isometric contraction at 2 different lengths, the shorter of which was about 30% less than the longer, were not

significantly different. The forces measured averaged 1.25×10^{-3} d. for the shorter, and 1.30×10^{-3} d. for the longer (Supported by NSF Grant BMS 74-18380)

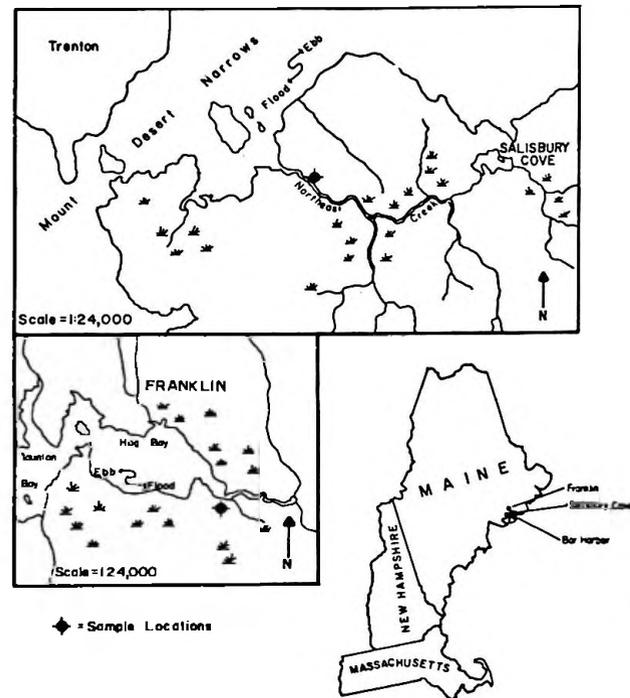
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Primary Production and Substrate Selective Properties of Maine Salt Marsh Plants

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Coastal marshes are among the most productive natural or cultivated ecosystems. Since there is increasing pressure to manage the economically important coastal zone, a knowledge of the component ecosystems is essential. The second year's study of the aerial primary productivity and underground biomass dynamics in Maine salt marshes was conducted simultaneously with studies

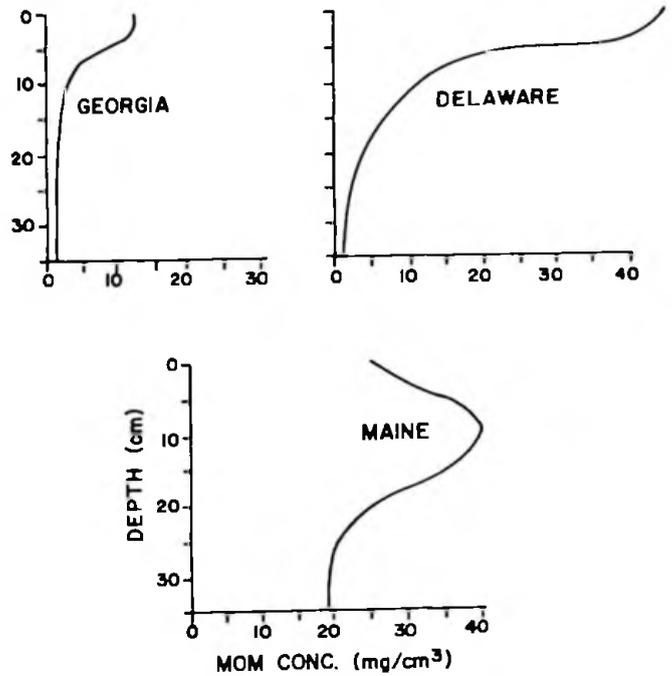
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in Delaware and Georgia. Substrate plant interaction were evaluated through the use of nutrient enrichment and soil analysis experiments.

Primary production was measured using paired plot harvest techniques (Wiegert and Evans, *Ecology* 45: 49-63, 1964); and underground plant parts and soil were collected by coring (Gallagher, *Soil Sci. Soc. Proc.* 36: 154-155). Stands of plants in Northeast Creek and Hog Bay marshes (Fig. 1) were sampled at 8 week intervals from April to October. Plant analysis procedures are explained in detail by Reimold *et al.* (*Recent Advances in Estuarine Research*, in press). Nutrient enrichment and soil analysis procedures were similar to those used by Gallagher (*Am. J. Bot.*, 62: 644-648, 1975).

SPARTINA PATENS



A comparison of live and dead aerial material for the marsh plants collected in Maine in September is shown in Table 1. Aerial primary production, instantaneous rate of disappearance of dead material, and mortality were calculated from biomass data and are shown in Table 2. Similar calculations have been made for each harvest period. Elemental analyses will be coupled with the biomass data to calculate mineral dynamics in the stands. Underground phytomass profiles of *Spartina alterniflora* and *Juncus gerardi* are similar to the *Spartina patens* profile from Delaware shown in Fig. 2. The annual increment for the underground phytomass in Maine is compared to that from marshes in Delaware and Georgia in Table 3. Samples collected from the nutrient enrichment studies have not been completely analyzed, but aerial biomass data indicate the plants did not respond to ammonium nitrate added to the soil in May. The microbes may have competed successfully for the nitrogen or the plants may not be limited by that nutrient. (Supported by U.S. Army Corps of Engineers, Waterways Experiment Stations, Contract No. DACW39-73-C-0110.)

Table 1
Comparison of Live and Dead Aerial Material for Plant Species Collected in Maine, 23 September 1974
(X=Mean, CV=Coefficient of Variation)

Species	Live Material				Dead Material				Live	
	Dry Weight Biomass g/m ²		Percent Dry Weight		Dry Weight Biomass g/m ²		Percent Dry Weight		Stem Density stems/m ²	
	X	CV	X	CV	X	CV	X	CV	X	CV
<i>Carex paleacea</i> (mx)	93.4	74.9	26.0	7.7	222.8	26.6	47.2	49.7	266	35.3
<i>Juncus gerardi</i> C (mx)	10.0	141.4	25.0	28.3	806.0	32.0	22.6	12.0	380	82.0
<i>Juncus gerardi</i> , H (mx)	82.0	65.3	37.4	21.2	43.2	17.8	18.0	7.9	2460	26.6
<i>Plantago</i> (mx)	10.6	163.9	16.5	4.3	7.0	173.2	29.5	2.4	152	143.2
<i>Spartina alterniflora</i> , C	211.0	16.1	23.4	50.7	431.8	41.0	15.2	10.8	842	48.1
<i>Spartina alterniflora</i> , H	133.0	41.0	28.4	1.9	640.6	17.0	31.0	8.2	322	37.4
<i>Spartina patens</i>	658.0	32.7	39.2	9.4	1126.0	27.9	28.8	19.7	5500	25.3
<i>Spartina patens</i> (mx)	120.8	19.6	40.2	4.8	118.6	56.1	45.4	17.0	3134	27.8

C represents Creekbank
H represents High marsh
(mx) represents a mixture of plant species within the sampling area

Table II
Comparison of Calculated Aerial Production Data
for Plant Species Collected in Maine During the Interval
from 29 July to September 1974
(X=Mean, r_i =Instantaneous Rate for the Disappearance of Dead
Material, Y=Production, X=Mortality)

Species	r_i	Y	X
	mg/g/day	g/m ² /day	g/m ² /day
	X	X	X
<i>Carex paleacea</i> (mx)	19.5	3.1	5.0
<i>Juncus gerardi</i> , C (mx)	-2.5	-18.0	-6.6
<i>Juncus gerardi</i> , H (mx)	0.0	-2.9	-0.1
<i>Plantago</i> sp. (mx)	—	-0.01	0.1
<i>Spartina alterniflora</i> , C	9.5	3.0	6.9
<i>Spartina alterniflora</i> , H	16.5	11.2	13.2
<i>Spartina patens</i>	17.9	8.4	12.2
<i>Spartina patens</i> (mx)	—	2.2	1.9

C=Creek bank

H=High marsh

(mx)=represents a mixture of plant species in the sampling area

Table III

Plant	annual increment (g/m ²)		
	G	D	M
<i>Spartina alterniflora</i>			
creek bank	2112	—	1301
creek head	—	—	202
high marsh	2017	—	—
<i>Spartina patens</i>	301	469	541
<i>Spartina cynosuroides</i>	3572	—	—
<i>Sporobolus virginicus</i>	582	—	—
<i>Distichlis spicata</i>	1078	3396	—
<i>Phragmites communis</i>	—	3615	—
<i>Juncus gerardi</i>	—	4279	1626
<i>Juncus roemerianus</i>	3354	—	—
<i>Salicornia virginica</i>	439	1428	—
<i>Borrchia frutescens</i>	818	—	—

Annual Increment for the Underground Phytomass in
Various Salt Marsh Plant Species from Maine (M),
Delaware (D) and Georgia (G)

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Methylmercury and Selenium: Distribution, Effect and Interaction in Teleost Fish.

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Mercury accumulates in the tissues of fish and marine animals following uptake through the gills or digestive tract. In most fish, more than 90% of the mercury in the tissues is found in the form of methyl-

mercury. In the American eel, *Anguilla rostrata*, previously found that increasing mercury concentration in the tissue up to 1.5 ppm correlated with decreasing intracellular potassium concentrations in the muscle (Pollution and Physiology of Marine Organisms, Academic Press, 1974; Fed. Proc. 33: 2137, 1974). In tunafish and marine mammals a major part of the mercury is not found in the form of methylmercury, and mercury and selenium are present in the livers of these animals in a 1:1 ratio on a molar basis (Nature 245: 385-386, 1971). Questions asked in the present study were: 1) does accumulated methylmercury have an effect upon osmotic volume and ion regulation in the various tissues? 2) does pretreatment with selenium have an effect upon mercury retention in the fish? 3) does selenium affect distribution of mercury in the tissues? 4) does selenium cause breakage of the methylmercury bond?

In the first part of the study methylmercury was administered intramuscularly to the winter flounder, *Pseudopleuronectes americanus*, repeatedly over a period of weeks. Mercury accumulated in the tissues without any apparent deleterious effects upon the fish. There was no effect on plasma osmolality in spite of mercury concentrations in the gills up to 24 ppm. Intracellular water content and ion concentrations were normal in muscle and all other tissues in spite of mercury concentrations ranging from 1 to 24 ppm. Intracellular water content was not significantly different in control and experimental groups. Na-K-ATPase levels in muscle tissues were not depressed, but were significantly higher in the bladder and kidneys of the methylmercury treated fish compared to the controls.

In the second part of the study *Fundulus heteroclitus* was used. Fish were either sham injected i.m. with 1% saline or injected i.m. with selenium (2 μ g B.W. of 2 mM Na₂ SeO₃). Thirty minutes later they were injected with labeled methylmercury in an equivalent amount (1:1 molar ratio). One group was injected with ²⁰³Hg methylmercury, another with ¹⁴C methylmercury. No difference in overall retention of mercury was found between control and selenium pretreated fish. A significant difference in distribution of mercury was seen between the two groups. The accumulation of mercury was significantly decreased in the kidneys of the selenium pretreated fish compared to those of the control group (Table 1). In the livers a slight decrease was seen, and in muscles an increase was seen. The results showed no significant difference in accumulation of the ¹⁴C labeled methylmercury compared to the ²⁰³Hg labeled methylmercury in liver or kidney. Because the labeled methylmercury group will be incorporated into other organic compounds following its hydrolysis, one could conceivably fail to see a difference in accumulation of the two compounds shortly after treatment. However, with time a significant difference in distribution could be expected. From the data presented in Table I it is clear that even after 3 days there is no difference in distribution of the two compounds and it is concluded that selenium does not increase breakage of the bond in methylmercury.

In conclusion: 1) accumulation of methylmercury in the tissues of the flounder has no effect on osmotic volume or ion regulation in the tissues; 2) pretreatment with