OSMOTIC BEHAVIOR AND BLEEDING OF THE OYSTER *CRASSOSTREA VIRGINICA*[1]

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The physiological processes required by aquatic molluscs to maintain a constant internal environment are more complex in fresh water than marine species. The body fluids of fresh water molluscs are kept hypertonic to their environment by an active regulatory process, primarily salt absorption against the concentration gradient. For example, the osmotic pressure of the blood of *Anodonta cygnea,* a freshwater bivalve, is lower than the osmotic pressure of the blood of all marine molluscs studied and greater than the osmotic pressure of its fresh water environment (Schlieper, 1935). Within limits, the blood concentration of *A. cygnea* remains more concentrated than its environment as the salinity of its environment is increased (Florkin, 1938).

On the other hand, marine molluscs are typically isotonic with their environment and poikilosmotic, as is characteristic of most marine invertebrates (Prosser et al., 1950). However, some marine molluscs are able to regulate their volume. Volume regulation is accomplished by the gain or loss of salts following an initial osmotic loss or gain of water. Molluscs unable to volume regulate will swell in hypotonic media and shrink in hypertonic media.

The blood and pericardial fluid of the Japanese oyster, *Ostrea circumpicta,* are hypertonic to the environment and the salinity of these fluids closely follows changes in the salt concentration of the environment. The blood is more concentrated than the pericardial fluid (Yamazaki, 1929).

The authors have learned through Dr. Thurlow C. Nelson that Dr. Imai of Japan is practically certain that the oyster referred to as *Ostrea circumpicta* by Yamazaki (1929) was actually *Crassostrea nippona.* The reason for believing the original name was incorrect is that *Ostrea circumpicta* is larviparous and belongs to the salt water flat type of oyster whereas *Crassostrea nippona* is oviparous.

Nelson (1938) postulated that the genus *Crassostrea* which is armed with a superior cleansing mechanism, the promyal chamber, has in its evolution invaded the upstream zones of its environment in contrast to *Ostrea* which has remained in the sea or at least in waters of higher salinity. *Crassostrea* should, therefore, be a better osmoregulator than *Ostrea.* Cole (unpublished data) has shown that the clam *Mercenaria*

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has no power of osmoregulation and is limited to waters of salinity which do not fall below approximately 15 ppt for any considerable length of time.

Hopkins (1936) showed that the initial effect of a rise or fall in salinity is to cause partial or complete adductor muscle contraction and slowing or cessation of water flow in *Ostrea gigas.* Adaptation of the adductor muscle and gill activities, as indicated by the openness of the valves and rate of pumping, was more rapid in response to increase in salinity than to decrease in salinity. Loosanoff (1952) demonstrated that as long as the valves of *Crassostrea virginica* remained open the changes in salinity of their shell and body fluids followed changes in salinity of the surrounding water.

Stauber (1950) has shown that three distinct physiological varieties of *Crassostrea virginica* occur along the Atlantic Coast with critical spawning temperatures of 16.4°C in Long Island Sound, 20°C in the Bideford River, and 25°C in Delaware Bay.

The fact that Gulf Coast oysters "bleed" to a greater extent than

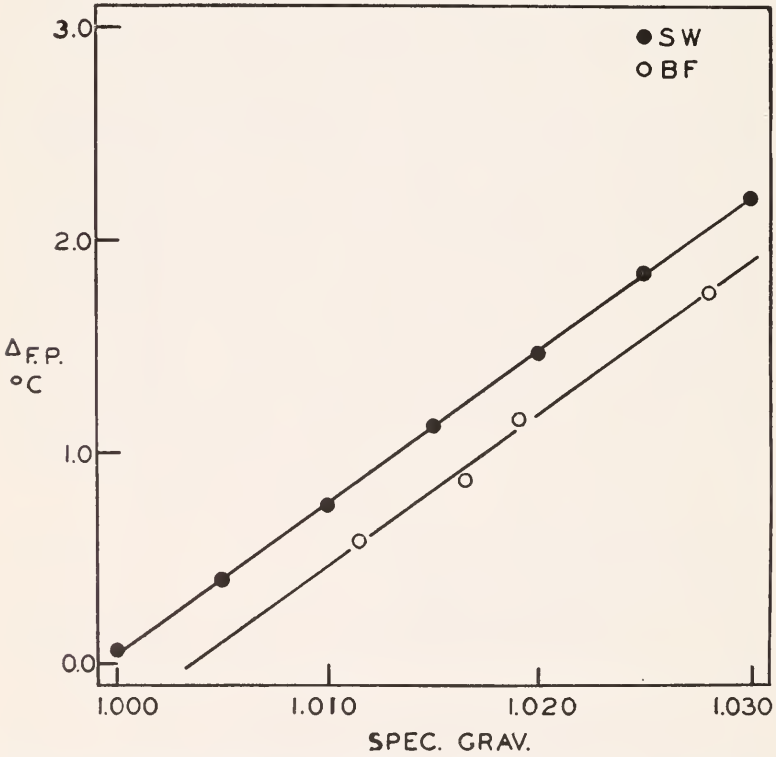

Figure 1. Freezing-point depression of sea water (SW) and oyster body fluid (BF) of various specific gravities.

Northern oysters is general information. Gulf Coast oysters may be, therefore, a fourth physiological variety.

The present investigation was undertaken with a twofold purpose. The first aim was to obtain quantitative information concerning the weight changes and fluid losses that occur during the summer months in Southern oysters after the body has been removed from the shell. The second aim was to investigate in a detailed fashion the osmoregulatory ability of the American oyster, *Crassostrea virginica.* Preliminary studies (*e.g.,* Loosanoff, 1952) of the osmotic behavior of *Crassostrea virginica* have been performed but as yet no detailed information is available.

Materials and Methods

Specimens of *Crassostrea virginica* used in these experiments were grown in the waters of Louisiana; the majority were from Barataria Bay.

The oysters were maintained in large plexiglass aquaria containing water filtered through cotton, glass wool, and charcoal before being recirculated. The salinity of the sea water in the aquaria was maintained at 17 ppt. Water with this salinity has a freezing-point depression of 0.88°C. Distilled water was added to the aquaria to compensate for evaporation. The oysters were allowed to acclimate to the water in the aquaria for at least 24 hours before they were used in an experiment.

The laboratory was airconditioned to assure that the temperature would not become lethal to the oysters. The water temperature was 18°C when the experiments were initiated and gradually increased to 24°C by the termination of the experiments reported below.

Specific gravities were determined by use of mixtures of chloroform and benzene. A mixture of these liquids was prepared such that a droplet of the fluid whose specific gravity was to be determined would neither rise nor sink in the mixture but would remain at whatever level it was placed. The specific gravity of this mixture was then determined by means of a hydrometer and was considered to be the specific gravity of the droplet.

The specific gravities of the body fluids were determined at 24°C and converted to the freezing-point depression at 15°C. Figure 1 was used in converting from the specific gravity to the freezing-point depression after the appropriate correction for room temperature was applied to the specific gravity value. The data of Figure 1 for sea water were taken from Zerbe and Taylor (1953). The data for body fluids were obtained experimentally. The highest specific gravity was obtained by adding salt to body fluid. The three lower specific gravity values were obtained by placing oysters overnight in aquaria which contained sea water of different salinities. The following morning the body fluids of the oysters were collected and the specific gravities were determined. The freezing-point depressions of the body fluids with different specific gravities were then determined

with the aid of a cryoscope thermometer. The line relating specific gravity of body fluid to freezing-point depression is parallel to and 0.30°C below that of sea water. This difference between sea water and body fluid was anticipated since freezing-point depression is a colligative property. The large protein molecules in body fluids have the same effect upon freezing-point as a chloride ion, for example, but have a greater effect upon specific gravity because of their large size.

The method of determination of freezing-point depression from specific gravity determinations allowed rapid determination of freezing-points with the result that more determinations could be run on a single day than would have been possible otherwise. In addition, the freezing-points could be determined with volumes too small for direct determination by standard cryoscopy.

Experiments and Results

Fluid and weight losses due to injury to the mantle and pericardium during shucking.—Eighteen oysters from each of eight lots, obtained on different dates, were shucked. In order to cause maximal fluid loss the mantle and pericardium were pierced while the oyster body was being removed from the shell.

The bodies of the oysters were placed in individual, covered containers after shucking and the initial body weight, including the fluids, was immediately determined. Fifteen, 30, 45, 60, 90 and 120 minutes following the initial determination of the weight, the weight of the body alone was determined. Before each of these weighings, the body was blotted to remove the external moisture.

The results have been expressed as the percentage of the original weight of the intact oyster body including the fluids. The data for each group of 18 oysters are presented in Table 1 which includes the date each experiment was performed. The averages of the eight

TABLE 1.

Weight Changes of Oysters Shucked with Injury to the Mantle and Pericardium. Weights are Expressed as the Percentage of the Original Body Weight.

Date	Minutes after Shucking						
	0	15	30	45	60	90	120
May 27	100.0	57.5	53.5	51.5	50.0	50.0	49.5
June 2	100.0	67.8	64.3	63.0	61.7	60.7	59.7
June 9	100.0	57.0	51.0	50.0	49.0	47.0	45.0
June 19	100.0	70.0	65.0	63.0	62.0	61.0	60.0
June 22	100.0	61.5	60.0	59.0	58.0	57.5	57.0
June 28	100.0	48.0	44.0	43.0	41.0	41.0	40.0
July 12	100.0	67.0	63.0	61.0	60.0	59.0	57.0
July 17	100.0	55.0	50.0	48.0	47.0	45.0	44.0
Average	100.0	60.5	56.4	54.8	53.7	52.7	51.5

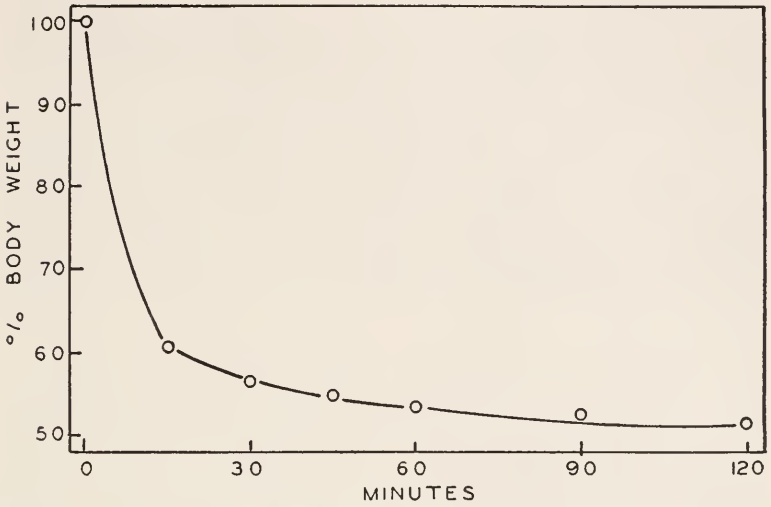

Figure 2. Weight changes of the body of oysters after shucking. The mantle and pericardium were intentionally ruptured during the shucking process.

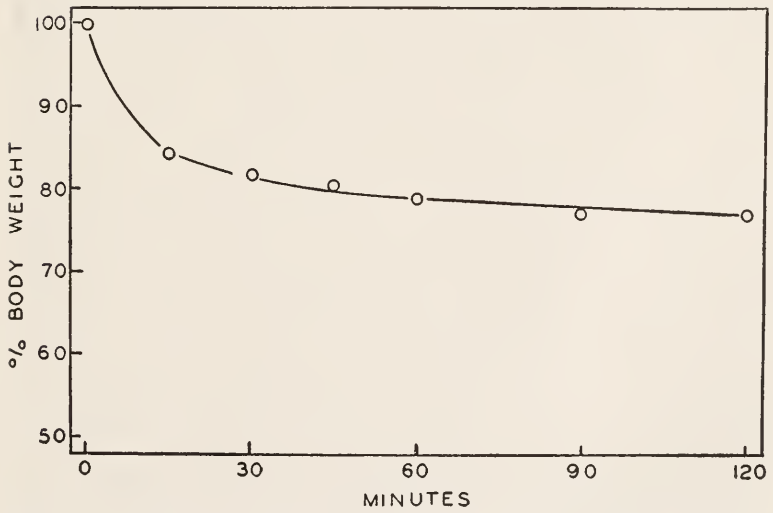

Figure 3. Weight changes of the body of oysters shucked without injury to the mantle or underlying parts.

experiments were used in the preparation of Figure 2. The greatest weight loss occurred during the first 15 minutes following the shucking. The rate of fluid loss then decreased sharply. Fifty percent of the original body weight was lost after two hours.

Fluid and weight losses following removal from the shell with no injury to the mantle.—Eleven oysters were shucked with a minimum of injury to the mantle and pericardium. The oyster shells were spread slightly. The adductor musle attachment was then carefully scraped away from each shell without putting the edge of the knife against the mantle. These oysters were placed in individual, covered containers and weighed in the manner described above at 0, 15, 30, 45, 60, 90, and 120 minutes from the time the oysters were removed from the shells.

The results of this experiment have been presented in Figure 3. As is evident from a comparison of Figures 2 and 3, approximately 25 per cent more of the body weight was lost when the mantle and pericardium were pierced. The weight loss of the oysters with the intact mantles was probably due to fluid exuded from the sinuses in the mantle and from the cut adductor muscle. The over-all shape of the curves of Figures 2 and 3 was the same. After the large initial weight loss the slopes of the curves in Figures 2 and 3 were also the same. Similarity of both shape and slope after the initial loss of fluid indicated that the mechanism of fluid loss from 15 to 120 minutes was the same in all the oysters, whether the mantle was punctured or not.

Weight losses induced by draining the free fluid between the shells.—Wedges were placed between the shells of each of 10 oysters. While the shells were agape in the aquaria the oysters were allowed to close on wedges which prevented complete closure of the shells. These oysters were then removed from the aquaria. The water between the shells was shaken out and the shells were blotted. The oysters were kept on the table top for 120 minutes as were the controls and were weighed at the same time intervals as the controls. Prior to each weighing the fluid which had accumulated between the shells was discarded. After the weighing at 120 minutes the oysters were sacrificed. Their original body weight was then determined by subtracting the weight of the shells from the original total weight. The weight changes of these wedged oysters were expressed as the percentage of the original body weight and are presented in Figure 4B.

A second group of 10 oysters was taken from the aquaria, blotted, and also kept on the table for the extent of the experiment. These oysters were weighed at the same time intervals as the controls and as the oysters with wedges. Prior to each weighing the shells were forced apart slightly and the free liquid shaken out. At the end of the experiment these oysters were also sacrificed and weighed. These weights were treated in the same fashion as the weights of the oysters that had been wedged open (Figure 4C).

As is evident from Figure 4, after 120 minutes the experimental

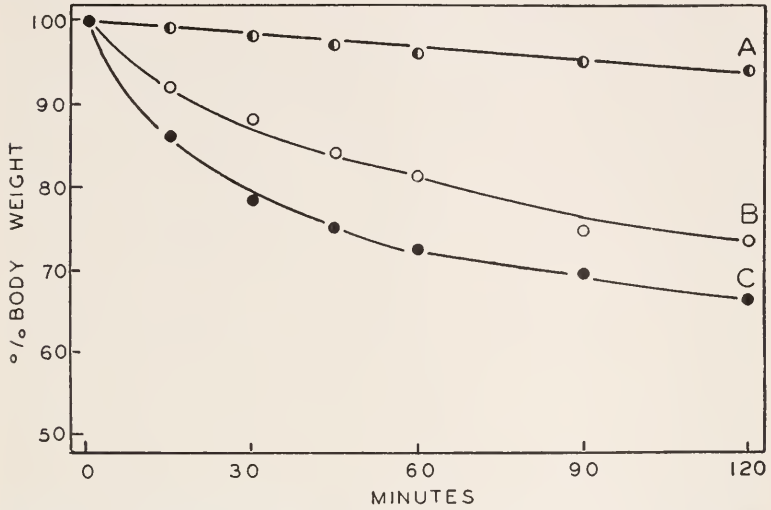

Figure 4. Weight changes of oysters kept in air for 120 minutes. **A**, weight loss of oysters due only to evaporation of water from the shell. **B**, weight loss of oysters kept agape in air by means of a wedge; fluid which accumulated between the shells was discarded prior to each weighing. **C**, weight loss of oysters whose shells were forced apart in order to discard the accumulated free fluid prior to each weighing. Actual weights are expressed as the percentages of the original body weight.

oysters had lost approximately 30 percent of their original body weight. The difference in weight loss between the oysters of Figure 4B and 4C was not significant.

Ten oysters were taken from the stocks in the aquaria to serve as controls. The outer surfaces of their shells were blotted to remove the excess water. These oysters were then kept on the table top for two hours and were weighed at 0, 15, 30, 45, 60, 90, and 120 minutes after blotting. After the final weighing the oysters were sacrificed and the body weights including the fluids were determined. The weight losses due to evaporation from the outer surface of the shells were then expressed as a percentage of the original body weight. Although the loss of weight was due to loss of fluid from the shells and not the body, this method of expressing the data was employed because a small portion of the weight loss experienced by the experimental oysters was due to evaporation from the surface of the shell. However the major portion of the weight loss of the experimental oysters was due to fluid loss by the body of the oyster. The control oysters which had been kept on the table top for two hours, lost the equivalent of six percent of their original body weight by evaporation of water from the outer surface of their shells (Figure 4A).

The oyster must be free to open and close its shell in a normal fashion in order to regulate its weight and consequently its volume.

Disruption of the rhythmic opening and closing of the shells interferred with the ability of the oysters to volume regulate. Removal of the free liquid between the shells stimulated further secretion to replace this fluid at the expense of the internal body fluids.

Weight losses of oysters drained of the free fluid between the shells and subsequently returned to the aquaria.—Ten oysters were wedged open in the manner described above and removed from the aquaria. The free fluid between the shells was then drained and the shells were blotted. The oysters were kept on the table top and weighed at 0, 15, 30, 45, 60, and 75 minutes after the free fluid had been drained from between the shells. The oysters with the wedges still between their shells were returned to the aquaria following the weighing at 75 minutes. The oysters were weighed at 15 minute intervals for 75 minutes after their return to the aquaria. Prior to each weighing of the oysters, which had been returned to the aquaria, their shells were blotted and the free fluid between the shells was drained.

The free fluid of a second group of 10 oysters was drained by forcing the shells apart prior to each weighing. This group was also kept on the table top and weighed at the same intervals as were the wedged oysters. The non-wedged oysters were also returned to the aquaria after 75 minutes on the table top and were weighed for an additional 75 minutes.

Both groups of oysters were sacrificed after the completion of the weighings. The original body weight was calculated by subtracting

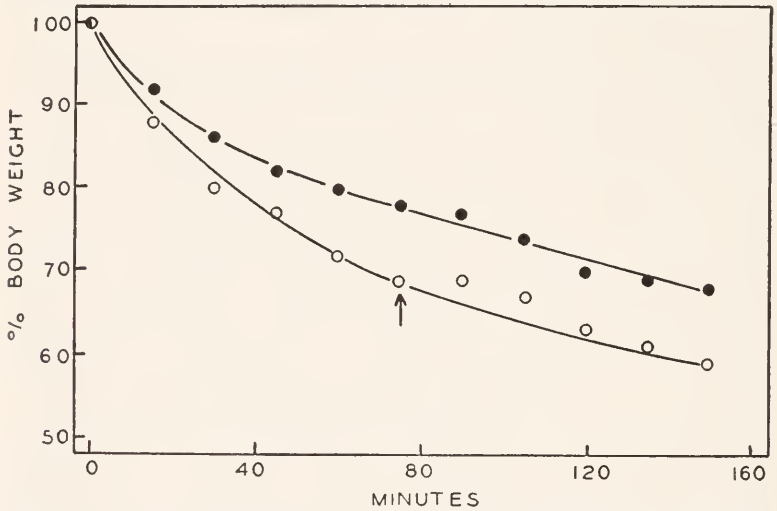

Figure 5. Weight loss of oysters whose shells had been wedged open (circles) or forced apart (dots) prior to each weighing. Both lots of oysters were kept out of water for the first 75 minutes of the experiment. Arrow shows when the oysters were returned to the aquaria. Free fluid between the shells was discarded prior to each weighing.

the weight of the shells from the original weight of the intact oyster. The weight changes, based on the original body weight, have been plotted in Figure 5. The circles represent the oysters which had been wedged open; the dots represent the oysters which had been forced open. The difference in weight loss between the two groups of oysters was not significant. Both groups of oysters continued to lose weight because of the removal of the free fluid after their return to sea water. A portion of the weight loss of oysters which had been forced open periodically may have been due to tearing of muscle fibers with concomitant injury to the blood spaces within the adductor muscle.

A control group of oysters had been weighed and immediately returned to the aquaria for the duration of this experiment, *i.e.*, 150 minutes. The control oysters experienced no weight change.

This experiment also demonstrated that the oyster was unable to regulate its weight unless free to open and close its shell in the normally rhythmic fashion. Forcing the shells open at regular intervals or keeping the shells agape by means of a wedge prevented the oyster from regulating its weight and consequently its volume both in air and in sea water. Non-wedged oysters would open their shells and pump water in the aquaria.

Weight changes of oyster wedged open in several concentrations of sea water.—Thirty oysters were wedged open, drained, blotted, and weighed in the manner described above. Ten of these oysters were

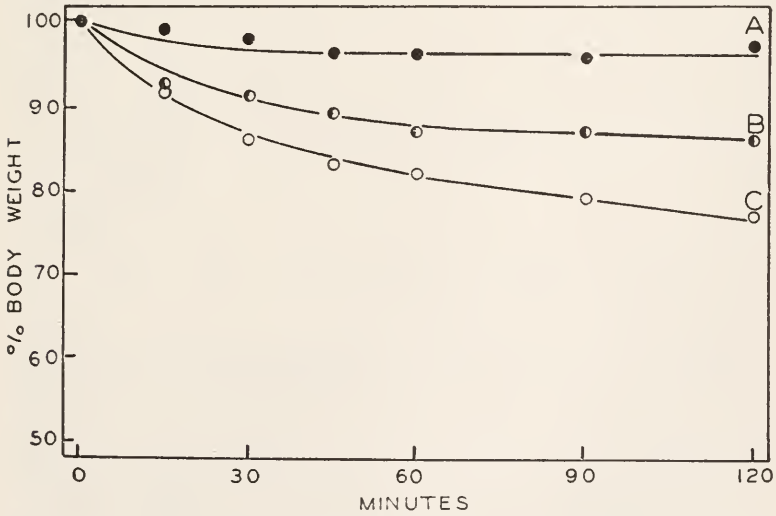

Figure 6. Weight changes of oysters with a wedge between their their shells. **A**, oysters in sea water with a freezing-point depression (Δ_0) of 0.61° C.; **B**, oysters in sea water with a freezing-point depression of 1.03° C.; **C**, oysters in sea water with a freezing-point depression of 1.54° C.

placed in an aquarium which contained sea water with a freezing-point depression (Δ_0) of 0.61°C, 10 in water with a freezing-point depression of 1.03°C, and 10 in water with a freezing-point depression of 1.54°C.

These oysters were also weighed at 15, 30, 45, 60, 90, and 120 minutes after having been placed in their respective aquaria. The weights have been converted to the percentage of the original body weight. The latter was determined by subtracting the weight of the shells from the original weight of the intact animal.

The results have been plotted in Figure 6. Curve A represents the weight changes of the oysters wedged open in the most dilute sea water, Δ_0 0.61; B, the weight changes in the intermediate salinity Δ_0 1.03; and C, the weight changes in the most concentrated environment Δ_0 1.54. The weight losses were directly proportional to the salinity of the environment. A simple osmotic phenomenon is the probable explanation of these results. This experiment led to the same conclusion arrived at in the previously described experiments; to regulate its weight and volume the oyster must be free to open and close its shells in a normal fashion.

Changes in the concentration of the combined mantle and pericardial fluids with changes in the salinity of the environment.—Four lots of 40 normal oysters each were taken from the stocks. A lot was placed in one of four concentrations of sea water. The freezing-point depressions of the sea water in each aquarium were (Δ_0) 0.54, 1.26, 1.62, and 1.98°C. At 0, 2, 4, 6, 8, 10, and 12 hours after having been put into the respective aquaria, three oysters from each salinity were weighed and sacrificed. At the same time, three oysters from the stock supply were also weighed and sacrificed. The freezing-point depression of the water in the stock aquaria was 0.88°C.

The mantle and pericardium were punctured when the oysters were sacrificed and the escaping fluid was collected. This fluid was a mixture, therefore, of the pericardial and mantle fluids. The specific gravity of this mixture was then determined. The changes in salinity of the body fluid (Δ_i) have been presented in Figure 7 for each of the salinities from which the oysters had been taken (Δ_0). In the dilute medium the combined body fluids became diluted and in a concentrated medium these body fluids became concentrated. These data indicate that the oysters did not osmoregulate but rather osmoadjusted.

In Table 2 are listed the percentage weight changes of the oysters in this experiment. These percentages have been based on the oyster body plus the shell. These percentages would have been magnified approximately five times if calculated on the weights of the body without the shell. The weight changes of the oysters in all but the most concentrated sea water were, without doubt, insignificant. In the most concentrated sea water, if any weight change occurred one would expect the weight to decrease rather than increase. This weight increase must have been due to some phenomenon other than osmotic. Acting on the valid assumption that weight and volume

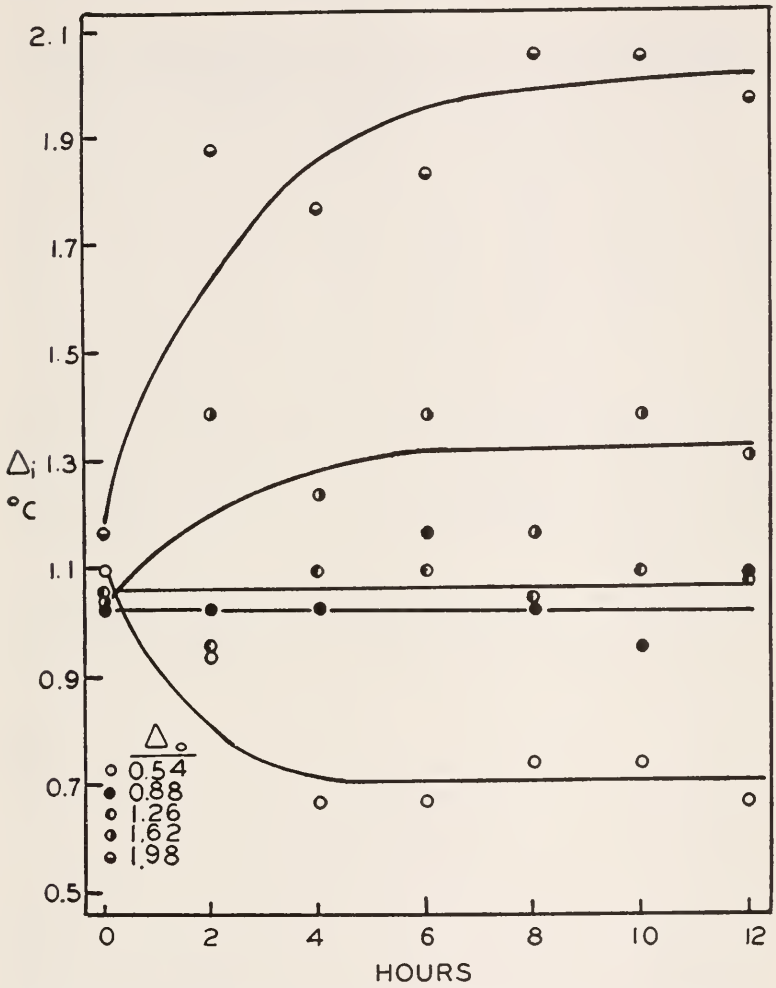

Figure 7. The changes with time of the freezing-point depression of the combined mantle and pericardial fluids (Δ_i) of oysters maintained in sea water of different salinities (Δ_o).

vary directly with one another, one may conclude that the oysters showed a volume regulation at least in sea water with freezing-point depressions ranging from (Δ_o) 0.54 to 1.62°C and perhaps as high as 1.98°C. Since the density of the combined body fluids changed and the body weight was constant, the changes in freezing-point depression must have been due to transfer of salts and not water.

The freezing-point depression values for the combined body fluids (Δ_i) from the 2, 4, 6, 8, 10, and 12 hour determinations for each

TABLE 2.

WEIGHT CHANGES OF OYSTERS MAINTAINED IN SEVERAL CONCENTRATIONS OF SEA WATER (Δ_0). WEIGHT CHANGE IS EXPRESSED AS THE PERCENTAGE OF THE ORIGINAL WEIGHT. WEIGHT OF THE SHELL IS INCLUDED IN THE CALCULATIONS.

	Hours						
Δ_0	0	2	4	6	8	10	12
0.54	100.0	100.0	99.5	99.6	99.6	99.8	99.9
0.88	100.0	99.6	99.8	100.7	100.2	99.7	99.7
1.26	100.0	99.4	99.7	99.5	100.0	100.2	100.2
1.62	100.0	100.3	99.9	100.1	100.1	100.1	100.1
1.98	100.0	101.5	100.8	100.6	101.4	101.5	100.5

environmental salinity (Δ_0) were averaged and have been plotted against the environmental salinity (Figure 8). At the intermediate environmental salinities in the range of 20 ppt the salinity of the body fluids was relatively constant. The salinity in which the oysters were grown along the Louisiana coast is usually between 14 and 25 ppt. Obviously, the environmental salinities best for the production of oysters are the salinities in which the oyster is best able to regulate its salt content.

Fractionation of the body fluids and osmoregulation.—Five lots of three oysters each taken from the stocks were placed in aquaria of

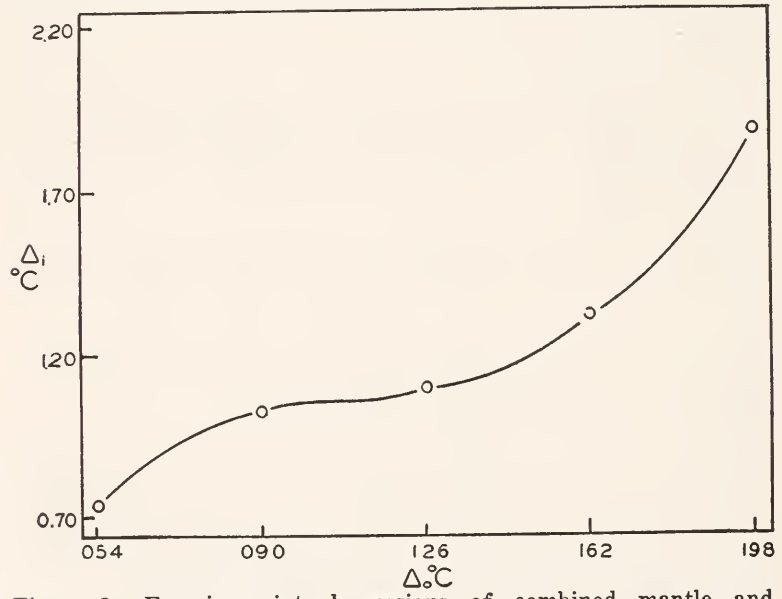

Figure 8. Freezing-point depressions of combined mantle and pericardial fluids (Δ_i) of oysters from several concentrations of sea water (Δ_0).

graded salinities. The freezing-point depressions of the water in the respective aquaria were: 0.54, 1.17, 1.24, 1.62, and 1.98°C. After six hours all oysters from each salinity plus three oysters from the stocks were sacrificed. The freezing-point depression of the water in the stock aquaria was 0.88°C. Instead of combining the body fluids as had been done in the experiment above, the body fluids were removed from the oysters in a manner that yielded four fractions. First, the shells were spread slightly and the free fluid between the shells was collected. Then, the adductor muscle was gently scraped from one of its attachments to the shell. This valve was removed. The mantle was then punctured and the mantle fluid was removed. The pericardium was pierced next and the pericardial fluid also collected. The fourth fraction was blood taken directly from the ventricle. The latter three fluids were collected in a syringe.

The specific gravity of each fraction was determined for all the oysters. The values for each lot of three oysters were averaged. These data have been plotted in Figure 9. The salinity of the blood, the fluid most removed from the environment, was the most constant and the fluid between the shells, the fraction closest to the environment, was the least constant in its salinity. Obviously, the oyster has at least a limited ability to osmoregulate. The salinity of the blood tended to remain constant at the expense of the other body fluids. The data of Figure 9 have been replotted in Figure 10. In this latter figure the freezing-point depressions of each of the body fluids (Δ_i) has been plotted versus the environmental salinities (Δ_0). Plotting the data in this fashion yielded additional information and facilitated the discussion of the results. The fluid in the mantle of the oysters kept in the most dilute sea water was hypertonic to the other body fluids considered in this series of experiments. The high salinity of the fluid in the mantle was probably due to an active physiological process. Between the environmental freezing-point depressions of 0.54 and 1.17°C the shell fluid was hypotonic to the other body fluids, but hypertonic to the environment. This hypertonicity was probably due to salt acquired from the mantle. In the dilute environment the pericardial fluid was hypotonic to the other internal body fluids. This hypotonicity was probably due to water removed from the blood by the nephridial organs and secreted into the pericardial cavity in an effort to maintain constant the salinity of the ventricular (arterial) fluid. The mantle was probably resistant to osmotic uptake of water from the environment because the mantle fluid was hypertonic to both the environment and the shell fluid when the oysters were in the extremely dilute medium (Δ_0 0.54°C).

The lack of a significant loss of weight after 12 hours in the gradient of salinities (Table 2), showed that the oysters were able to volume regulate. The changes in the salt concentration of the body fluids were due to loss or gain of salt rather than water.

The experiment was repeated twice in the same manner as described above with a change in exposure time only. Exposure times of four

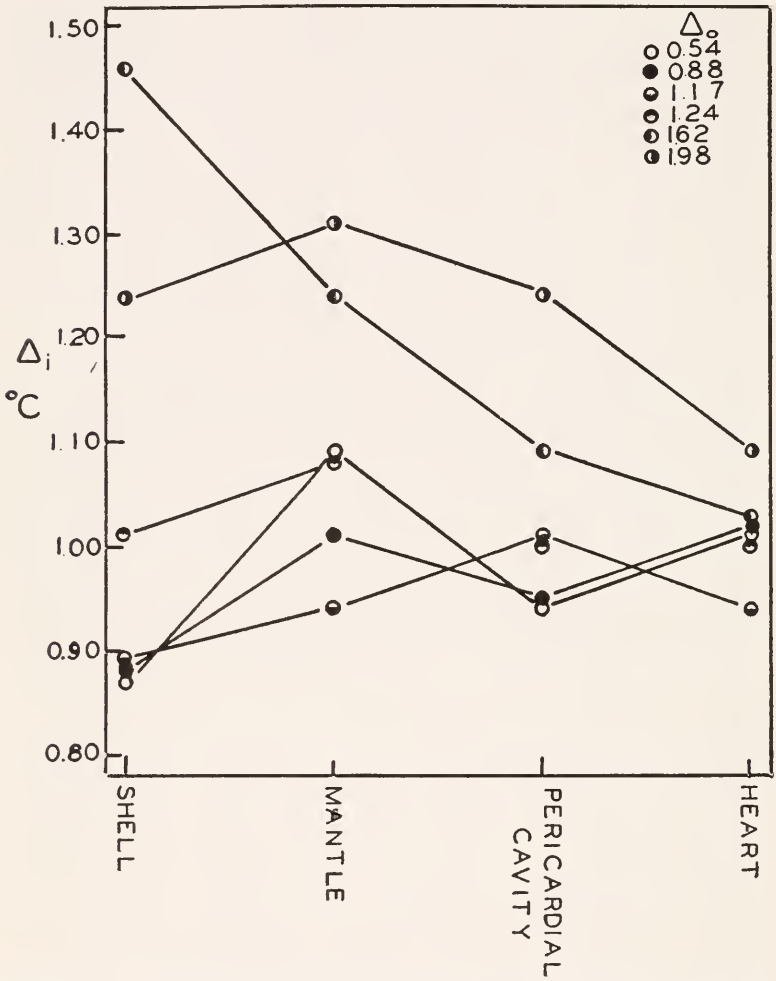

Figure 9. Freezing-point depressions of the body fluids (Δ_i) of the oysters maintained in several concentrations of sea water. Body fluids were not mixed to allow determination of the freezing-point depressions of the fluids (1) between the shells, (2) in the cavities of the mantle, (3) within the pericardium, and (4) within the heart.

and eight hours were used instead of the six hours of the first experiment. The results were essentially the same in the three experiments. The deeper in the oyster the fluid was obtained, the more constant was the freezing-point of the fluid. The difference between the lowest and highest freezing-point depressions with increased environmental salinity in the four hour experiment was: shell fluid, 0.58°C; mantle fluid, 0.37°C; pericardial fluid, 0.30°C; blood, 0.15°C. The

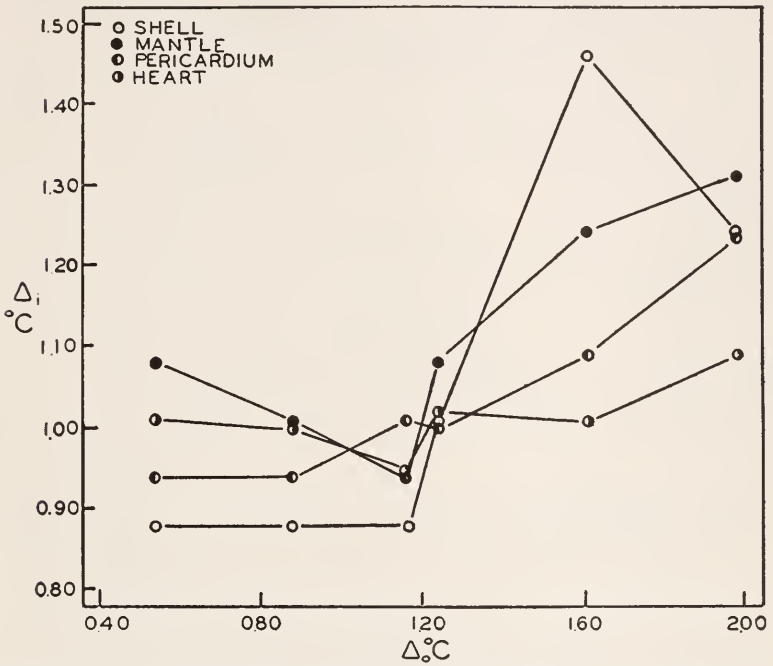

Figure 10. Relationship between the freezing-point depression of each fraction of the body fluids (Δ_i) and the salinity of the environment (Δ_0).

respective values for the eight hour experiment were: 0.44°C, 0.51°C, 0.30°C, and 0.22°C.

Growth of the oyster.—The oysters in the experiments described above were first and second year individuals. The combined weight of both shells has been plotted versus the number of individuals in each weight class (Figure 11). These values do not includes all the oysters used in these experiments because the weights of the shells of many of the oysters were not determined. The data form a bimodal curve. Each peak is probably due to the weights of the shells of individuals in the two age classes. The body weights and shell weights of the oysters have been presented in Table 3. As is expected, as the shell weight increased, the body weight also increased.

Discussion

The major portion of the exuded fluids was lost through ruptures in the mantle and pericardium. Fluids may, however, also be lost through the cut edges of the adductor muscle. The latter structure receives arteries directly from the heart. The heart in turn receives blood from the lacunar spaces of the mantle. These spaces are usually filled with fluid. Contraction of muscle fibers in the mantle may

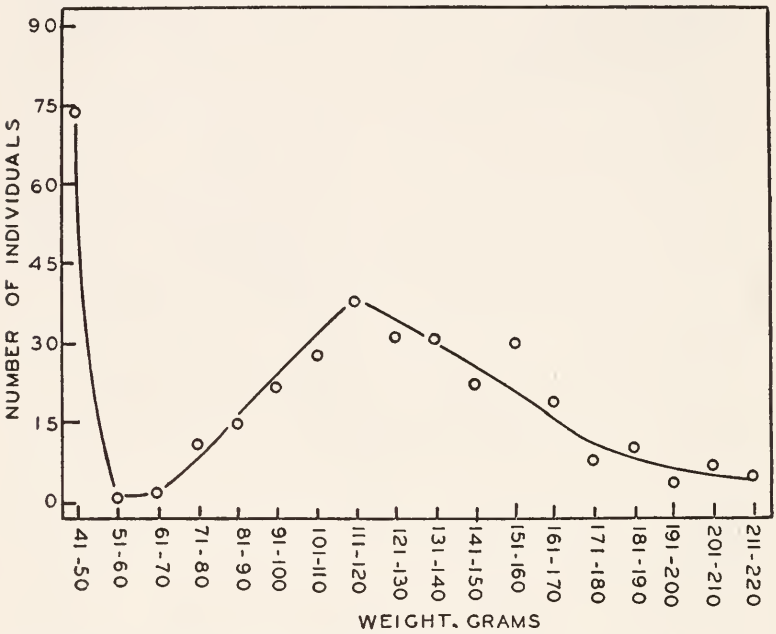

Figure 11. Combined weight of both valves of the oyster versus the number of individuals in each weight class.

contribute to an additional loss of fluid by actively forcing out the mantle fluid.

The limited osmoregulatory ability of the oyster *Crassostrea virginica* was probably due in part to the ability of the mantle (1) to resist the osmotic influx of water when the oysters were in an environment of low salinity and (2) to remain hypertonic to the other internal fluids in the upper and lower limits of the environmental salinity gradient used in these experiments. The nephridial organs probably also play a major role in osmoregulation (1) by removing salt from the fluid entering the arterial circulation when the animal is in a medium of high salinity and (2) by secreting a dilute urine when the animal is in an environment of low salinity.

The osmoregulatory abilities of the American oyster, *Crassostrea virginica,* and the Japanese oyster, *Crassostrea nippona* appear to be distinct. The salinity of the blood in the Japanese oyster, unlike that of the American oyster, closely follows changes in the salinity of the environment (Yamazaki, 1929). The American oyster tends to maintain the salinity of its blood constant at the expense of the other body fluids in spite of changes in the environmental salinity (Figures 9 and 10). The American oyster has evidently evolved a more efficient osmoregulatory ability than has been found in the Japanese oyster.

TABLE 3.

TOTAL WEIGHT OF BOTH SHELLS VERSUS WEIGHT OF THE BODY.

Shell Weight (grams)	Body Weight (grams)									
	11-15	16-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	Totals
41-50	21	30	7	11	1	4	0	0	0	74
51-60	0	1	0	0	0	0	0	0	0	1
61-70	0	1	0	1	0	0	0	0	0	2
71-80	2	9	0	0	0	0	0	0	0	11
81-90	3	5	5	1	1	0	0	0	0	15
91-100	1	7	9	4	0	0	0	0	0	21
101-110	1	8	14	4	1	0	0	0	0	28
111-120	2	9	15	9	3	0	0	0	0	38
121-130	2	7	11	6	2	2	1	0	0	31
131-140	0	5	10	12	3	1	0	0	0	31
141-150	1	1	5	6	5	2	2	0	0	22
151-160	0	4	7	9	8	1	0	1	0	30
161-170	0	1	4	4	5	4	1	0	0	19
171-180	0	0	1	0	2	4	1	0	0	8
181-190	0	0	1	3	1	3	1	1	0	10
191-200	0	0	0	0	1	1	1	1	0	4
201-210	0	1	0	0	2	1	2	0	1	7
211-220	0	0	0	1	2	1	0	0	1	5

Summary

1. Oysters which had been removed from their shells with no injury to the mantle and pericardium lost fluids equivalent to 26 per cent of their original body weight after 120 minutes. Most of this fluid loss occurred within 15 minutes after shucking. Puncturing the mantle and pericardium of shucked oysters resulted in a 50 per cent weight loss.

2. Oysters must be free to open and close their shells for weight and volume regulation. Oysters prevented from completely closing their shells lost weight both in and out of water due to secretion of body fluids.

3. Oysters have a limited ability to osmoregulate. The oysters tended to keep the salinity of their blood constant while the environmental salinity was altered.

4. The osmoregulatory abilities of an American and Japanese oyster are discussed.

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