Differential Rate of Death for Large and Small Fishes Caused by Hard Cold Waves

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In 1930 Hildebrand and Cable (*3*) noted some indication that young marine fishes survived sudden cold spells better than larger ones. Gunter (*2*) in 1938 independently made observations indicating that young poikilothermal marine animals survived cold spells better than their elders. The question was raised again in 1941 by Gunter (*2*) in a discussion of the mortality caused on the Texas Coast by the hard cold wave of 1940.

Baughman (*1*), in a recent popular account of the damage done by the January 1947 freeze on the Texas Coast, noted the peculiar absence of small redfish, *Sciaenops ocellata* (Linnaeus), among fishes killed by the freeze, although their larger congeners were quite abundant.

TABLE 1
Numbers, Sizes, and Means of Two Species of Fishes Taken Following the Cold Spell of January 1, 1942, in Copano Bay, Texas

Species	Condition	No.	Length range (mm.)	Arithmetic mean	Median	Mode
Anchoa mitchilli diaphana	Alive	150	22–76	37.2	34.8	34.8
	Dead	38	27–68	41.2	40.5	44.3
Menidia beryllina peninsulae	Alive	127	22–74	40.0	36.3	31.2
	Dead	10	38–55	46.6	46.8	45.5
Both species combined	Alive	277	22–76	38.9	35.6	30.8
	Dead	48	27–68	42.3	43.0	44.7

On January 1, 1942, a light cold wave struck the Texas Coast. The occurrence was described by Gunter in 1945 (*2*). Since regular observations were being made at set stations at that time, it was hoped that any differential mortality occurring between young and older fishes would be detected. However, the cold spell was light and few fishes were killed. Only in Copano Bay, where two small fishes, the bay anchovy, *Anchoa mitchilli diaphana* Hildebrand, and the Gulf silverside, *Menidia beryllina peninsulae* (Goode and Bean), were killed in small quantities, were all conditions proper for comparison. Total length frequency curves for each species were drawn, and although "they might appear to be slightly indicative of a differential effect of cold on the smaller and larger fish," due to the small numbers of the sample and the slight differences shown they were not accepted as proof and were not presented. However, since the size ranges of the two species corresponded very closely, it has been decided that there is no logical reason why the two samples should not be combined to give better exposition of the data.

The conditions under which the two fishes were caught were stated in some detail by the writer in 1945 (*2*) and will not be repeated. All fishes were measured in millimeters. Although 392 anchovies were taken, only 150 were measured. All dead anchovies and all silversides taken were measured. The numbers of specimens of each species, alive and dead, the length ranges, and means for all groups, separate and combined, are given in Table 1. Application to these data of Fisher's method (*Statistical methods for research workers*, 10th ed., p. 96) for the treatment of 2 x 2 tables was made by Frank W. Weymouth, to whom the writer is much indebted. If the distributions are divided into "large" and "small" at the size giving no "small" dead fish, the 2 x 2 tables given in Table 2 are derived. The chances of getting the numbers in the cells with the observed marginal totals are 4 and 5 in 10,000, a highly significant difference in mortality for large and small fish.

These data are taken as indicative of the fact that under natural conditions the larger specimens of certain species of fishes are killed by cold waves in proportionately greater numbers than the smaller specimens. The observations bear out unchecked general observations previously made by the writer and others and cited above.

Much more extensive observations on this subject should be made both in the field and in the laboratory. Pearse and Wharton (*4*), in connection with their life-history study of the marine turbellarian, *Stylochus inimicus* Palombi, found that young worms survived induced cold better than larger specimens. This is the only experimental work on the subject with which the writer is acquainted.

TABLE 2*

	Anchoa mitchilli diaphana		
	Small (26 mm. and less)	Large (27 mm. and more)	
Alive	31	119	150
Dead	0	38	38
p = .0045	31	157	188

	Menidia beryllina peninsulae		
	Small (37 mm. and less)	Large (38 mm. and more)	
Alive	70	57	127
Dead	0	10	10
p = .0054	70	67	137

* Dividing the distributions into "large" and "small," at the length below which there are no small dead fish, gives the 2 x 2 tables, showing a significant difference in mortality of large and small fish. See text for full explanation.

Reasons for a possible differential mortality of young and old poikilothermal animals are completely unknown, and any discussion of the point would be pure conjecture. However, this subject raises many interesting questions concerning comparative and general physiology, especially as they are concerned with the phenomena of aging.

References

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3. Hildebrand, S. F., and Cable, L. E. *Bull. U. S. Bur. Fish.*, 1930, **44**, 383–488.
4. Pearse, A. S., and Wharton, G. W. *Ecol. Monogr.*, 1938, **8**, 606–655.