LAURS, R. M., AND R. J. LYNN.
1977. Seasonal migration of North Pacific albacore, *Thunnus alalunga*, into North American coastal waters: Distribution, relative abundance, and association with Transition Zone waters. Fish. Bull., U.S. 75:795-822.
LOWMAN, F. G., T. R. RICE, AND F. A. RICHARDS.
1971. Accumulation and redistribution of radionuclides by marine organisms. *In* Radioactivity in the marine environment, p. 161-199. Nat. Resour. Counc., Natl. Acad. Sci., Wash., D.C.
LOWMAN, F. G., AND R. Y. TING.
1973. The state of cobalt in seawater and its uptake by marine organisms and sediment. *In* Radioactive contamination of the marine environment, p. 369-384. Int. At. Energy Agency, Vienna.
OSTERBERG, C., N. CUTSHALL, AND J. CRONIN.
1965. Chromium-51 as a radioactive tracer of Columbia River water at sea. Science (Wash., D.C.) 150:1585-1587.
OTSU, T., AND R. N. UCHIDA.
1963. Model of migration of albacore in the North Pacific Ocean. U.S. Fish Wildl. Serv., Fish. Bull. 63:33-44.
PEARCY, W. G.
1973. Albacore oceanography off Oregon—1970. Fish. Bull., U.S. 71:489-504.
PEARCY, W. G., AND C. L. OSTERBERG.
1968. Zinc-65 and maganese-54 in albacore *Thunnus alalunga* from the west coast of North America. Limnol. Oceanogr. 13:490-498.
PILLAI, K. C., R. C. SMITH, AND T. R. FOLSOM.
1964. Plutonium in the marine environment. Nature (Lond.) 203:568-571.
POWELL, D. E., D. L. ALVERSON, AND R. LIVINGSTONE, Jr.
1952. North Pacific albacore tuna exploration—1950. U.S. Fish. Wildl. Serv., Fish. Leafl. 402, 56 p.
REICHLE, D. E., P. B. DUNAWAY, AND D. J. NELSON.
1970. Turnover and concentration of radionuclides in food chains. Nuc. Saf. 11:43-55.
SVERDRUP, H. U., M. W. JOHNSON, AND R. H. FLEMING.
1942. The oceans, their physics, chemistry, and general biology. Prentice-Hall, Inc., N.Y., 1087 p.
U.S. ENVIRONMENTAL PROTECTION AGENCY (previously Public Health Service).
1960-72. Radiation data and reports, 1960 through 1972. (Mon. Rep.) U.S. Gov. Print. Off., Wash., D.C. 13 vol.

Earl E. Krygier
William G. Pearcy

School of Oceanography
Oregon State University
Corvallis, OR 97331

LENGTH-WIDTH-WEIGHT RELATIONSHIPS FOR MATURE MALE SNOW CRAB, *CHIONOCOETES BAIRDI*

Snow crabs have been exploited commercially in Alaska since 1961 (Alaska Department of Fish and Game 1975). *Chionocoetes bairdi* is the predominant species with *C. opilio* composing up to 25% of the catch from the Bering Sea. Landings were small and intermittent in the early 1960's but increased to about 3.2 million lb in 1968. Landings expanded dramatically thereafter and exceeded 60 million lb in 1974, with an ex-vessel value of more than $12 million.

Carapace width measurements have been collected from the commercial snow crab catch by biologists since the inception of the fishery; individual weights, however, are not routinely collected because the task is rather time-consuming. The relationships between carapace width, length, and body weight are of interest to biologists and processors. The relationship between carapace length and width is of interest because the carapace shape is one of the diagnostic characteristics to distinguish between *C. bairdi* and *C. opilio* and hybrids of the two species (Karinen and Hoopes 1971). The relationships between carapace width and weight and carapace length and weight have many uses. They are, for example, indicators of condition, used to calculate biomass, and used to estimate recovery of edible meat from crabs of various sizes.

Materials and Methods

Carapace length and width and body weight measurements were taken from 240 mature male *C. bairdi* from commercial catches made south of the Alaska Peninsula in the vicinity of the Shumagin Islands in May 1975. Length and width measurements were taken to the nearest millimeter with vernier calipers and weights were recorded to the nearest gram. Length was measured from the posterior medial edge of the carapace to the anterior medial point of the right orbit. The rostrum was not included in the length measurement because it often erodes when crabs are carried in the live tank of fishing vessels. Width was measured at the widest part of the carapace and included the lateral branchial spine. Width ranged from 128 to 185 mm, weights from 635 to 2,230 g, and lengths from 92 to 143 mm.

The basic linear regression formula $W = a + bL$ was used to express the relationship between width (W) and length (L). Weight (Wt) was related to width and length by the power functions, $\log_{10} Wt = \log_{10} a + b \log_{10} W$ and $\log_{10} Wt = \log_{10} a + b \log_{10} L$. The constants a and b were determined empirically.

Results

The length–width, length–weight, and width–weight relationships are summarized in Table 1. All relationships were characterized by very high correlation coefficients. No relationships between length, width, and weight have previously been reported for *C. bairdi*.

TABLE 1.—Length–width, length–weight, and width–weight relationships for mature male *Chionocoetes bairdi*. [Sample size was 240 animals for each relationship.]

Relationship	Coefficient	Formula
Length–width	0.96	$W = -3.584 + 1.268L$
Length–weight	0.99	$\log_{10} Wt = -3.076 + 2.956 \log_{10} L$
Width–weight	0.99	$\log_{10} Wt = -3.363 + 2.936 \log_{10} W$

Literature Cited

ALASKA DEPARTMENT OF FISH AND GAME.
1975. Alaska 1974 catch and production, commercial fisheries statistics. Alaska Dep. Fish Game Stat. Leafl. 27, 49 p.

KARINEN, J. F., AND D. T. HOOPES.
1971. Occurrence of Tanner crabs (*Chionocoetes* sp.) in the Bering Sea with characteristics intermediate between *C. bairdi* and *C. opilio*. (Abstr.) Proc. Natl. Shellf. Assoc. 61:8–9.

DUANE E. PHINNEY

Alaska Department of Fish and Game
Kodiak, AK 99615
Present address: *Washington Department of Fisheries*
Olympia, WA 98504

TEMPORAL ASPECTS OF CALLING BEHAVIOR IN THE OYSTER TOADFISH, *OPSANUS TAU*

The oyster toadfish, *Opsanus tau* (Linnaeus), produces two calls: an agonistic grunt and a boatwhistle associated with courtship (Fish 1954; Tavolga 1958, 1960; Gray and Winn 1961). The boatwhistle is produced only by males on nests (Gray and Winn 1961) and is endogenously driven as well as influenced by calling of surrounding males (Winn 1964, 1967, 1972; Fish 1972). A toadfish, not hearing other males, may still boatwhistle for long periods and attract a female. Although toadfish may be influenced to call by the calling of adjacent males, one would assume the circadian patterning of the boatwhistle to be influenced by photoperiod and the fish's behavioral strategy relative to it. Additionally, the rate of calling may be a key to a male's internal state. Calling rate has been manipulated experimentally (Winn 1967, 1972; Fish 1972; Fish and Offutt 1972), but no one has studied the calling rate of undisturbed individual fish. This note is a preliminary attempt to look at these twin problems (when and how fast toadfish call) by recording the boatwhistles of individual males on their nests.

Materials and Methods

Terra cotta drainage tiles were set out individually adjacent to the pilings of a dock at Solomons, Md. Male toadfish which settled into three of the tiles started calling, and the calls were monitored between 9 and 15 June 1969. Because of changing tapes and mechanical problems, the record was not continuous. The recording system consisted of individual Clevite[1] oyster (CH 15-J) hydrophones with their own General Electric Phono-Mic preamplifiers (UPX-003C) and a Precision Instrument Model 207 multichannel tape recorder. The gain was turned down so that only boatwhistles from the fish in the tile adjacent to the hydrophone would present a loud signal. The tapes were transduced onto strip chart paper (Bruel and Kjaer level recorder type 2305), and segments equivalent to 6 min of real time were continuously marked on the chart paper. The number of boatwhistles in each segment was counted.

Results

The activity patterns for the three fish appear aperiodic (Figure 1; Table 1). All of the animals called both day and night (11 calling periods day, 9 night), and the total number of boatwhistles produced for day and night was similar (7,905 day, 6,202 night). Considering the data on a calls-per-hour basis, since daylight hours exceed nighttime in June, does not appreciably alter the results. The fish averaged 41.3 boatwhistles/h during the day and 46.1/h at night from recordings covering 191.5 h of daylight and 134.5 h of darkness. Not only were crepuscular peaks absent, but dawn and dusk appeared irrelevant as cues for calling behavior. There are similarities between certain periods in the data, such as the nights of 14 and 15 June for channel 2, but these similarities are a

[1] Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.