# Estimating Total Length of Headless White Hake, *Urophycis tenuis*, Landed in Maine

EDWIN P. CREASER and KERRY M. LYONS

*ABSTRACT—Whole, assorted, white hake,* Urophycis tenuis, *of commercial size were obtained from commercial fishermen at five geographical locations along the Maine coast. Measurements of total length from the tip of the snout to the end of the caudal fin ($L_T$), the distance between the anterior base of the first dorsal fin and the end of the caudal fin ($L_D$), the distance between the forward edge of the pectoral fin and the end of the caudal fin ($L_P$) and the distance from the anus to the end of the caudal fin ($L_A$), were obtained. Analysis of covariance on the linear relationships $L_T$:$L_D$, $L_T$:$L_P$, and $L_T$:$L_A$ from each geographical location showed no significant differences and the data were combined. Slopes, y-intercepts, and correlation coefficients were calculated for geographically combined data and $L_T$:$L_D$ was selected as the most satisfactory method for measuring headless white hake. The equation for this regression is $L_T = 1.328\ L_D - 0.041$.*

*Fish measuring strips, constructed from polystyrene, were calibrated and marked in increments of 0.753 cm calculated from the above linear regression. Each increment of 0.753 cm was equivalent to 1 cm and was marked as such on the strip. Strips were inserted into a slot on a special measuring board, and an ice pick was positioned vertically at the 0 mark. Headless white hake from commercial vessels were placed on top of these strips and the fish were moved until the anterior base of the erected dorsal fin was positioned against the ice pick. The estimated total length of the fish was then read directly from the strip to the nearest cm.*

## Introduction

The white hake, *Urophycis tenuis*, occurs in continental waters between the Gulf of the St. Lawrence and the Middle Atlantic States from near the tide mark to a depth of about 545 fathoms (Bigelow and Schroeder, 1953). It supports a valuable commercial fishery in the Gulf of Maine and is abundant toward the mouth of the Bay of Fundy where it is landed by Nova Scotia, New Brunswick, and Maine fishermen. Historically, the center of abundance along the Maine coast occurs between Machias and Mt. Desert Island, in Frenchmen's Bay, and off Penobscot Bay (Fig. 1). Smaller concentrations occur outside the islands from Penobscot Bay to Cape Elizabeth and along the western side of the Gulf of Maine, especially near Boon Island, Isle of Shoals, Ipswich Bay, and the lower slopes of Jeffreys and Stellwagen Banks (Bigelow and Schroeder, 1953).

White hake landings dropped from 7.1 to 1.0 million pounds between 1948 and 1969. Since 1970, landings and landed value have increased to a high of 9.4 million pounds (1983) and $1,367,000 (1985), respectively.

Despite the importance of white hake as a commercial resource, little is known about the length composition of this species landed from Maine fishing vessels. This is because hake are frequently landed with the heads removed (Williams, 1967). This study was made by port sampling personnel of the Maine Department of Marine Resources to develop an easy and rapid method of determining total lengths of headless white hake at unloading sites.

The authors are with the Maine Department of Marine Resources Research Laboratory, West Boothbay Harbor, ME 04575.

## Materials and Methods

Assorted commercial-sized white hake used for this study were obtained from five geographical locations (Fig.

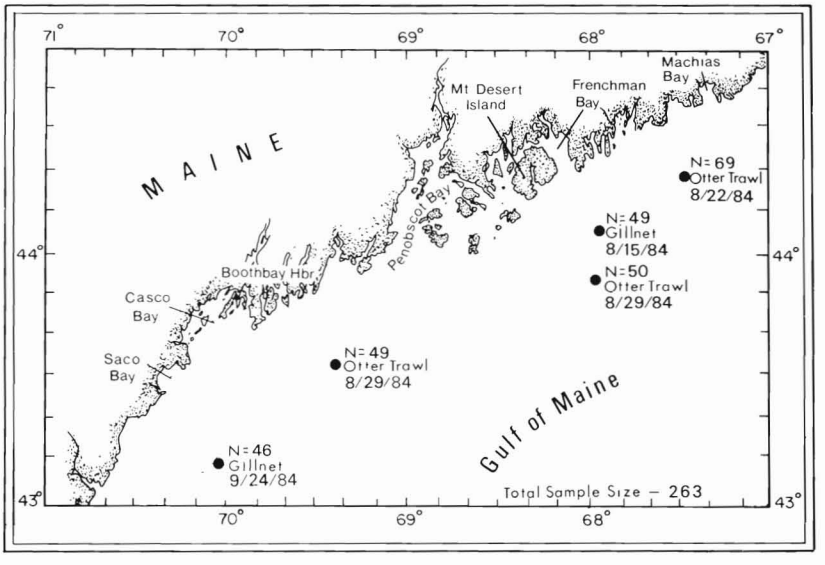


Figure 1.—Locations where whole white hake samples were obtained.

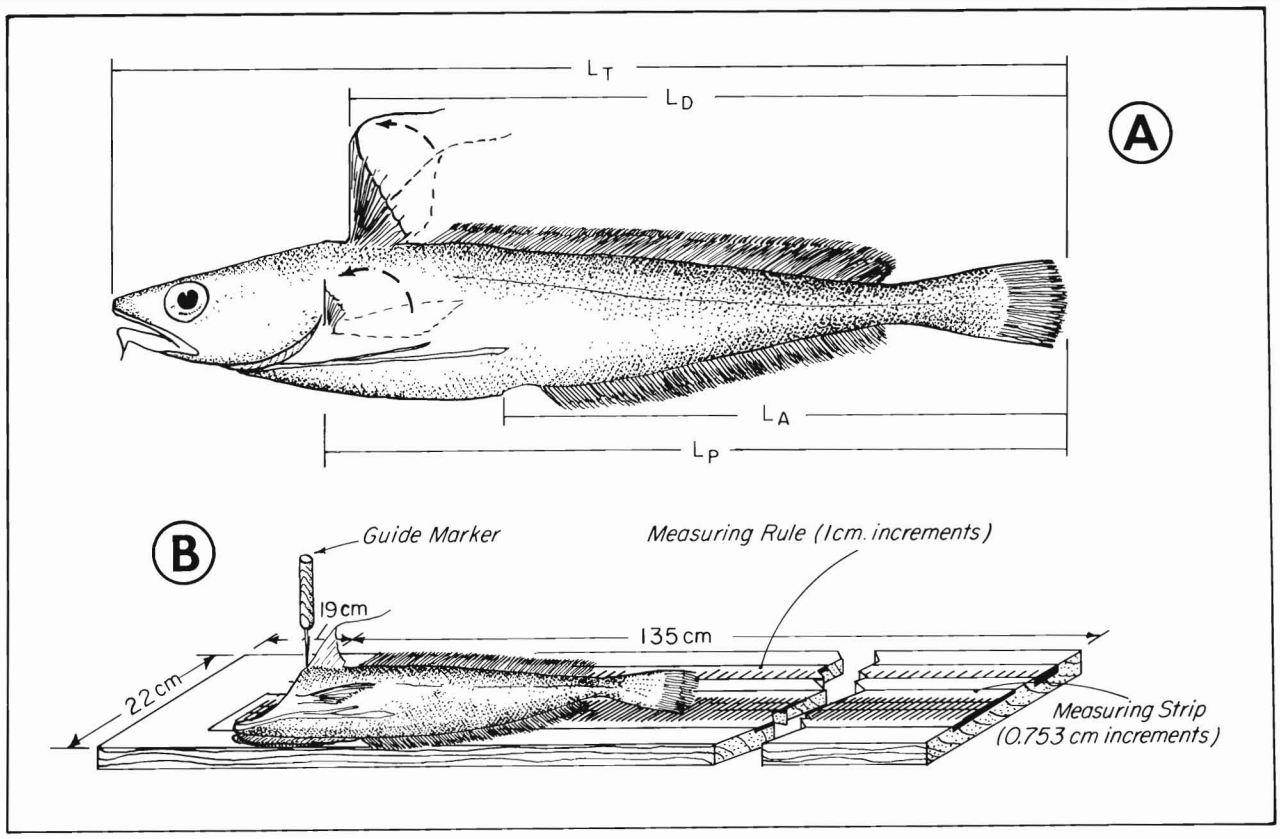


Figure 2.—The measuring procedure and board: A) Measurements obtained and B) construction and use of measuring board.

1) in August and September 1984 through prior arrangement with dragger and gillnet fishermen. Fish were gutted, cooled, and landed with the heads intact. Fish were obtained from commercial operations (as opposed to research tows) because it was desirable to duplicate the conditions the fish were subjected to prior to being landed commercially.

## Species Identification

Species' identification was confirmed by three methods: Body length, the length of the third ray of the first dorsal fin, and the number of gillrakers on the epibranchial of the first gill arch. Confirmation was desirable because both white hake and red hake, *Urophycis chuss*, are sometimes encountered in the same tow.

The quickest and most obvious method of confirmation was based on length. Some white hake exceeded the maximum length of 72 cm (30 inches) reported for red hake (Bigelow and Schroeder, 1953), and identification was confirmed on this basis alone. The length of the filamentous portion of the third ray of the first dorsal fin was also used as an identification criterion. Bigelow and Schroeder (1953) reported that this ray is a little longer than the fin proper is high on white hake but it is 3-5 times longer on red hake (if undamaged).

The most reliable means of separating the two species in the field is by counting the gill rakers on the epibranchial of the first gill arch (Flescher, 1980; Musick, 1974). The white hake has two gill rakers and the red hake has three. Based upon these criteria, it is unlikely that there were any misidentifications of white hake.

## Measurement and Data Analysis

Four measurements in millimeters were obtained from whole fish supplied by commercial fishermen (Fig. 2A). Total length ($L_T$) was recorded using a measuring board (with headstop) and the remaining three measurements—dorsal ($L_D$), pectoral ($L_P$), and anal ($L_A$)—were obtained using a modified board of similar dimensions but lacking a headstop. This board was constructed with a 19 cm platform to support the anterior portion of the fish. A guide marker (ice pick) was inserted vertically into a hole located at the 0 mark on the rule. The dorsal measurement ($L_D$), was obtained by holding the fin erect and sliding the fish along the board until the forward edge of the fin touched the guide marker (Figure 2B). The pectoral measurement ($L_P$) was

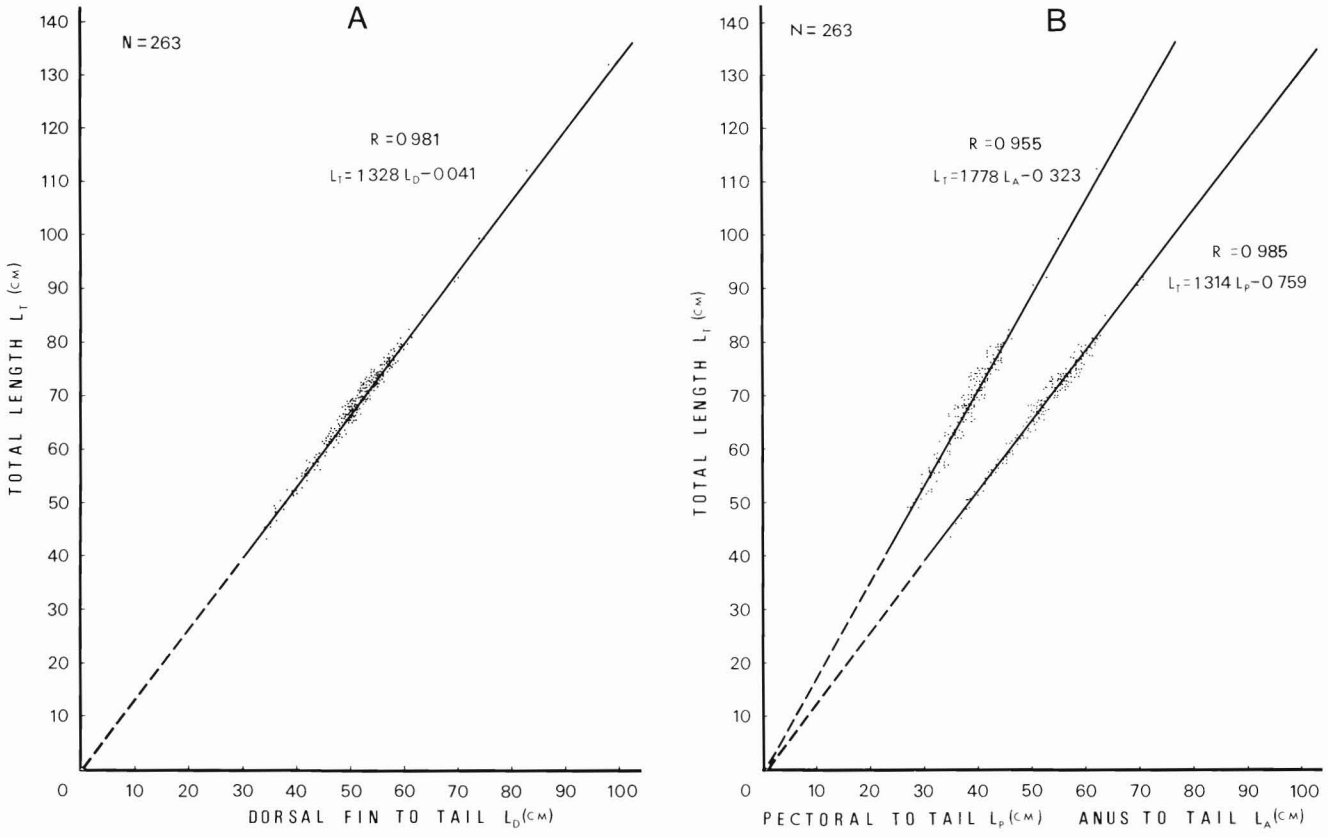


Figure 3.—Linear regressions for A) The relationship of $L_T$:$L_D$ and B) the relationships of $L_T$:$L_P$ and $L_T$:$L_A$.

obtained by lifting the pectoral fin so its anterior edge was parallel to, and directly in line with, the vertical guide marker. The anal measurement ($L_A$) was obtained by placing the anterior edge of the anus in contact with the guide marker. Analysis of covariance was performed on the linear relationship between $L_T$ and the measurements $L_D$, $L_P$, and $L_A$ on all fish from the five locations.

## Results and Discussion

### Statistical Analysis

No significant geographical differences were found when linear relationships between $L_T$ and $L_D$, $L_P$, and $L_A$ from the five geographical areas were tested by analysis of covariance, and the data were combined. These results suggest that white hake along the Maine coast may belong to one population. Our findings are consistent with those reported by Musick (1974), who combined New England and Nova Scotian white hake on the basis of morphometric analysis. Slopes, y-intercepts, and correlation coefficients were calculated for each set of combined measurements and the results are presented in Figure 3. The correlation coefficients for $L_T$:$L_D$, $L_T$:$L_P$, and $L_T$:$L_A$ were 0.981, 0.985, and 0.955, respectively.

The total length to dorsal length relationship was chosen as the standard method for calculating white hake total lengths because: 1) Differences between correlation coefficients of 0.981 and 0.985 were negligible and 2) it was easier to measure the dorsal length. Williams (1967), in calculating total length of headless fish, incorrectly treated the predicted total length, $L_T$, as the independent variable and $L_P$ and $L_A$ as dependent variables. However, we have treated $L_T$ as the dependent variable and $L_D$, $L_P$, and $L_A$ as independent variables in calculating the linear regression lines. The resulting linear regression for $L_T$:$L_D$ is:

$$L_T = 1.328\ L_D - 0.041. \qquad (1)$$

Using equation (1) and solving for $L_D$, we find

$$L_D = 0.753\ L_T + 0.032.$$

### The Measuring Strips

Measuring strips constructed from aluminum and laminated polystyrene are used extensively by National Marine Fisheries Service port samplers on both the east and west coasts. The modified measuring strips we developed are similar in design and calibration to those

used by Williams (1967), though the means to calculate them differed as noted.

We constructed fish measuring strips of polystyrene measuring 7.6 cm wide × 101.6 cm long × 1.6 mm thick. Numbers and calibration increments were applied using silk screening techniques.

Measuring strips were calibrated and marked in 0.753 cm increments (equivalent to 1 cm in total length) calculated from the linear relationship selected, $L_T$:$L_D$ (Fig. 4). The first increment was half the width of the succeeding increments because lengths lumped within each centimeter grouping included measurements 0.5 cm below and 0.5 cm above that grouping (Schultz[1]).

The calibration also allowed total lengths to be rounded to the nearest centimeter. For instance, a fish measuring between 40.5 and 41.4 cm ($L_T$) would be read as 41 cm ($L_T$) on the strip. The y-intercept value (0.032) was not significantly different from 0 and was therefore ignored.

Calibrated measuring strips were inserted into the slot on the modified measuring board (lacking a headstop), and headless white hake were placed on the strip for measuring. A pencil mark (No. 1 pencil) was placed at the end of the caudal fin in the appropriate interval numbered to correspond to the total length of the fish. After measuring a sample of fish, pencil marks were easily removed with liquid or powdered detergents; thus, the strips were reuseable.

[1]Schultz, R. L. 1974. Manual for sampling, interviewing, and coding for the Northeast Region. U.S. Dep. Commer., NOAA, NMFS Stat. Market News Div., Gloucester, Mass., 144 p.

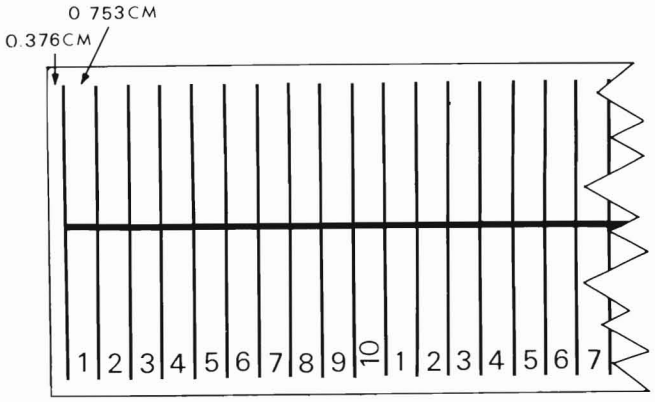


Figure 4.—The calibrated measuring strip.

Our measuring strips were used at commercial unloading sites in Maine to obtain information on the length-frequency distribution of commercially landed white hake. The application of this method appears to be a very quick and reliable means of converting headless white hake lengths directly into estimated total lengths. It is likely that the same method could be used to obtain estimated total length information on other commercial fishes landed headless such as anglerfish, *Lophius americanus* (Lyons and Creaser, 1986) and halibut, *Hippoglossus hippoglossus*.


## Acknowledgments

We gratefully acknowledge the cooperation of the Maine fish dealers and fishermen who provided the assorted white hake samples used in this study. Appreciation is also extended to Margaret Hunter and Dave Sampson of the Maine Department of Marine Resources and Thurston Burns (NMFS Northeast Fisheries Center, Woods Hole, Mass.) for assistance in the statistical analysis of data, James Rollins of the Bigelow Laboratory for photographic services, and Russ Knowles of the Maine Department of Transportation for drafting and construction of fish measuring strips.


## Literature Cited


Bigelow, H. B., and W. C. Schroeder. 1953. Fishes of the Gulf of Maine. Fish. Bull. (U.S.) 53(74): 1-577.

Flescher, D. D. 1980. Guide to some trawl-caught marine fishes from Maine to Cape Hatteras, North Carolina. U.S. Dep. Commer., NOAA Tech. Rep. NMFS 431, 35 p.

Lyons, K. M., and E. P. Creaser. 1986. Estimating total length of headless anglerfish, *Lophius americanus*, landed in Maine. Mar. Fish. Rev. 48(3):50-53.

Musick, J. A. 1974. Seasonal distribution of sibling hakes, *Urophycis chuss* and *U. tenuis* (Pisces, Gadidae) in New England. Fish. Bull. (U.S.) 72(2):481-495.

Williams, T. 1967. A method of measuring headless fish. J. Cons. Perm. int. Explor. Mer. 31:279-283.