Development of Fishery Regulations Using Confounded Data: A Case Study from the South Florida Greater Amberjack Commercial Fishery

RICHARD W. BEAVER[1] and NANCIE CUMMINGS[2]
[1]*Florida Department of Environmental Protection*
Florida Marine Research Institute
South Florida Regional Laboratory
2796 Overseas Highway, Suite 119,
Marathon, Florida, 33050 USA
[2]*National Marine Fisheries Service*
Southeast Fisheries Science Center,
75 Virginia Beach Drive,
Miami, Florida, 33149 USA

ABSTRACT

We measured lengths and weights of greater amberjack *(Seriola dumerili)* sampled from commercial fishery landings in south Florida from 1990 - 1992 to obtain conversion factors for different length:length and weight:weight types. We measured fork (tip of snout to fork of tail), core (head and viscera removed), and log (head, viscera and tail removed) lengths and gutted, core, and log weights. Regression equations were developed describing linear relationships between core, log, and fork lengths and between gutted, core, and log weights. The fitted equations allowed us to convert cored and logged lengths and weights of greater amberjack to fork lengths and gutted weights. These newly developed conversions are critical for converting whole, cored, and logged landings weight records to consistent units and are needed by fishery analysts to develop a more accurate representation of greater amberjack landings. Analyses of the data suggested that a commercially caught fish of legal size (914 mm FL) that was processed at sea resulted in a core length of 863 mm, 51 mm less than the legal core length. These data provide a case history of use of confounded and insufficient data in developing fishery regulations.

KEY WORDS: Confounded data, fishery management, greater amberjack.

INTRODUCTION

Fishery managers rely on the best scientific data available to make decisions regarding optimal use of available resources. Data may include fishery landings weight, catch statistics, individual length measurements and other appropriate information. Regulations allow fishers in many situations to process their catches at sea, which results in fish of the same species being landed in different physical forms, (gutted [viscera removed], cored [head and viscera removed], or logged [head, viscera and tail removed]). The length and weight measurements of these fish in different forms cannot currently be compared. In some cases, data are available that allows us to convert gutted weight to whole weight; however more often fish are cored or logged, and data needed to convert these measurements to standard length and weight units are lacking.

Frequently, regulations have been created with little supporting data or based on confounded data. The use of such confounded data in fisheries analyses may result in inaccurate management information. However, if such disparate data can be adjusted to common units, potential inaccuracies in analyses can be reduced, thus making the information used in developing management/regulations more accurate.

In the South Florida greater amberjack, *Seriola dumerili*, commercial fishery confounded data have been used out of necessity. Fish may be landed in gutted, cored, or logged form at the dock before they are weighed. In response to sharp increases in the exploitation of greater amberjack during the 1980s, federal and state fishery management councils implemented regulations in 1990 (South Atlantic Fishery Management Council Fishery Management Plan Amendment #7, 1990.; Florida Administrative Code, 1990). These included individual size limits of 711 mm or 28 in. fork length and a bag limit of three fish per person per day for recreational fishers. Regulations for the commercial fishery included size limits of 914 mm or 36 in. fork length, 711 mm or 28 in. core length, and a spawning season closure during April and May. Because data necessary to convert fork length to core length were unavailable, management councils used testimony from individuals with personal experience to determine conversion measurements; the councils estimated that a fish of 914 mm fork length would have a 711 mm core length after processing.

Catches sold in Florida are required to be reported to the Florida Trip Ticket System which assigns a numerical code for each species and, in the case of greater amberjack, for whole, gutted, cored, or log weight. Federal and state port agents encounter fish in gutted, cored, or logged form during sampling and may take length measurements from any of these. Because there are no

conversion factors reported in the literature, cored and logged length measurements cannot be converted to fork length. This lack of results in confounded data since lengths of processed fish cannot be converted and cannot be used in management analyses; thus the confounded data may lead to biased information.

In this paper, we develop equations to convert core and log lengths to fork length and core and log weights to gutted weight. These equations will provide a means to standardize length and weight units in the greater amberjack fishery of south Florida so that unbiased data will be available for management and law enforcement purposes.

MATERIALS AND METHODS

Between December 1990 and June 1992, commercial hook-and-line catches of greater amberjack from 24 fishing trips were sampled at fish houses in Islamorada and Marathon, Florida. Catches were made by fishers using hydraulically or electrically operated reels in the Straits of Florida, southwest of Islamorada, near an area known locally as the "Humps" (24° 42'N, 80° 30'W). Fish were sampled for length and weight, and catch and effort information was recorded. Special agreements were made with several fishers to land fish whole so that all measurements could be obtained on each. For these catches, individual measures of fork length, core length, log length, gutted weight, core weight, and log weight were taken.

All measurements were obtained during normal fish-house operations. Fork length and gutted weight were recorded before fish were cored. Processing was completed by fish-house personnel to ensure consistency in cutting procedures. Obtaining whole weight was not possible because most amberjacks are gutted at sea. Processing began when the fish-house worker removed the head by inserting a knife just behind the pectoral fin and made cuts forward toward the head and belly. The fish was turned over and the process repeated. The spinal column was broken or cut and the head discarded. The tail was removed by a vertical cut at the posterior end of the second dorsal fin (Figure 1). In all cases the first cut was at the posterior base of the pectoral fin.

Length was recorded to the nearest 5 mm on a fish measuring- board, as described by Trent *et al.* (1987); fish were weighed on fish-house scales and weight recorded to the nearest 0.45 kg (1 lb.). Three length measures were taken: 1) fork--the straight- line length from the tip of the snout to the center edge (fork of the tail), 2) core--the straight-line length from the center edge of the body of a fish after the head was removed to the fork of the tail, and 3) log–the

straight-line length from the center edge of a cored fish to the cut made when the tail was removed. Core lengths and log lengths were measured using a rule marked in 5 mm divisions. Straight-line measurements of core length were made by holding the rule on the edge of the cut surface (at the base of the pectoral fin) in the center of the fish which was lying on its side and aligning the rule with the fork of the tail. If log-length measurements were needed, the rule was placed at the cut made when the head was removed and at the caudal-cut edge. Individual weight measurements included gutted weight (whole fish with guts removed), core weight (head and guts removed), and log weight (head, guts, and tail removed).

Data were transcribed from field notes to computer files, and Axum, a scientific graphics program, was used for plotting and analyses. Individual length and weight observations were plotted to determine if linear or curvilinear relationships best described the data. These plots suggested that linear relationships were most appropriate. Thus, simple linear regression methods were used to obtain estimates for the following models: fork length vs. core length, fork length vs. log length, gutted weight vs. core weight, and gutted weight vs. log weight.

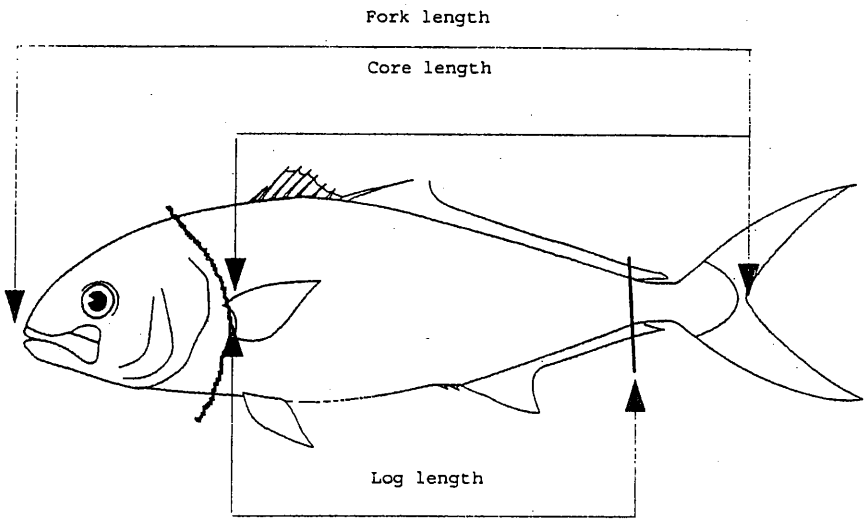

Figure 1. A greater amberjack and the cuts made to core or log a fish and the locations of measurement points.

RESULTS

A total of 214 greater amberjacks were measured for this study. Fork and core lengths were recorded, and a subset of 58 were measured for log lengths. Both gutted and cored weights were obtained from 38 of these fish, and gutted and log weights were obtained from 41 fish. Sample sizes for each measurement type differed because of time constraints imposed by fish-house personnel.

Superimposing lines derived from regression equations describing length:length and weight:weight relationships on plots of the data show that good fits were obtained (Figure 2). Values for r^2 were high (Æ 0.90) for all relationships examined (Table 1), indicating that the first processing cut was always made in approximately the same location, at the posterior base of the pectoral fin, by personnel processing the fish.

Table1. Regression equations describing length:length and weight:weight relationships for greater amberjack from south Florida. FL = fork length. CL = core length. LL = log length. GW = gutted weight. CW = core weight. LW = log weight.

Equation	N	r^2
FL = 1.30CL + 80.48 mm	214	0.95
FL = 1.32LL + 184.79 mm	58	0.94
CL = 0.69FL + 29.01 mm	214	0.95
GW = 1.27CW + 1.22 kg	38	0.99
GW = 1.35LW + 1.03 kg	40	0.98

DISCUSSION

In the past, the total quantity of greater amberjack landed commercially was unknown because individual fish were landed in one of three forms: gutted, logged, or cored. No conversion factors were available to convert these weight units (log or core) to a standard unit(gutted weight). This lack of conversion factors for cored or logged fish reduces the accuracy of fishery landings data which affects the reliability of data provided to fishery managers since stock-assessment models require that total landings (weight) be known. Conversion equations developed in this study for length:length and

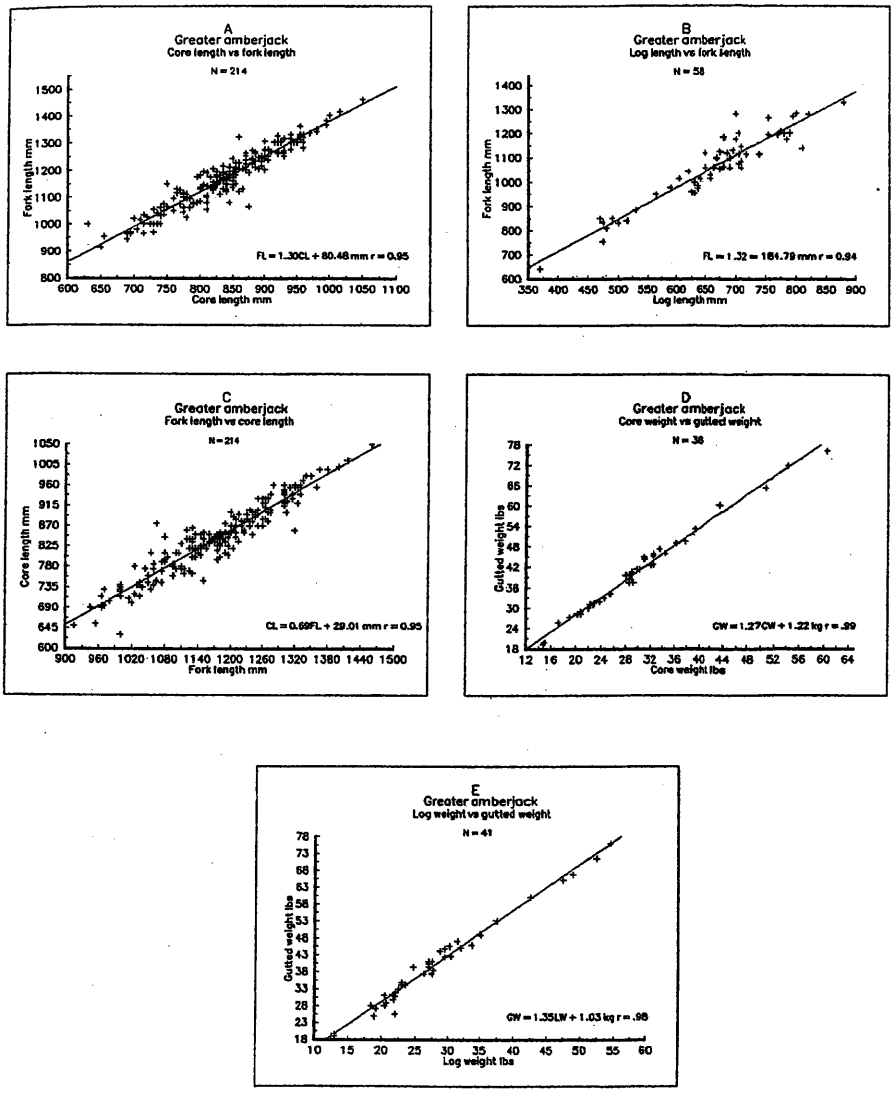

Figure 2. Greater amberjack meristic data showing calculated regression lines for the following fork length vs core length (A), fork length vs log length (B), core length vs fork length (C), gutted weight vs core weight (D), and gutted weight vs log weigh (E)

weight:weight will allow analysts and other researchers to convert weights of cored and logged fish landed to total weight landed and conversion of core and log length measurements obtained by biostatistical samplers to fork length.

Regulations include minimum size limits of 914 mm (36 in.) fork length and 711 mm (28 in.) core length. The fork length to core length regression equation derived in this study indicates that if a greater amberjack of 914-mm fork length is cored, the core length of that fish will be 660 mm core length, or 51 mm below the legal limit (711 mm). So, under current management regulations, some legal-sized fish cored at sea can be construed as illegal if inspected after processing.

Regulations that allow different size limits for different types of measurements--such as measurements for cored or logged fish--should be made so that fishers are less vulnerable to unwarranted charges of noncompliance. The spiny lobster fishery for example, has historically operated with alternative minimum size limits of 76.2 mm (3 inch) carapace length (cl) and 139.7 mm (5.5 in.) tail length. Tail length is measured when processing has begun and the whole animal is no longer available. In some circumstances, a 139.7 mm long tail will come from a lobster of less than 76.2-mm carapace length, but a lobster of 76.2 mm cl will never have a tail length of less than 139.7 mm. Thus, the tail measurement gives the fisher some benefit of the doubt regarding lobster size and can prevent unwarranted charges of noncompliance. When providing alternative types of size measurements fishery managers should structure regulations to allow some benefit of doubt for fishers; this leeway will likely improve fishers' compliance with those regulations.

Fish sampled in this study included sizes of greater amberjack that are representative of those landed by nearly all commercial and recreational fishers. The equations developed herein for converting cored and logged fish to standardized length and weight units are useful for converting the range of sizes most commonly encountered in landings and should not require extrapolation beyond the range of data used. Although we sampled only greater amberjack from the Florida Keys, the equations derived are not limited to fish from this area. This species is migratory (Burch, 1979; Manooch, 1984), and we are unaware of information to suggest there are significant morphometric differences with respect to location. These equations should be useful throughout the range of greater amberjack for converting landings data of cored, logged, and unprocessed fish to standard measures of length and weight.

This study provides a case history of the use of confounded data in fishery management and in establishing fishery regulations. Conversion equations

developed in this study of greater amberjack will allow different types of weight data to be combined so that more complete, unbiased information will be available for fishery management purposes. The results also show that current fishery regulations regarding core length should be revised because they currently make fishers of cored and logged greater amberjack more vulnerable to unwarranted prosecution for noncompliance with size regulations.

LITERATURE CITED

Burch, R.K. 1979. The greater amberjack (*Serolia dumerili*): its biology and fishery off southeastern Florida. M.S. Thesis, Univ. Miami, Coral Gables, Florida. 112 p.

Florida Administrative Code. 1990. *Florida Marine Fisheries Commission, Amberjack Rules.* Chapter 46, No. 40.

Manooch, C.S. 1984. *Fisherman's Guide. Fishes of the southeastern United States.* North Carolina State Museum of Natural History, Raleigh, North Carolina. 362 p.

South Atlantic Fishery Management Council. 1990. *Fishery Management Plan.* Amendment 7.

Trent, L., Palko, B.J, and Trimble, A. 1987. Improved method of measuring lengths of large samples of fish. *The Progressive Fish-Culturist* **49**:310 - 312.