Conversion Factors Estimated for Bigeye and Yellowfin Tunas Distributed in Surrounding Waters of Taiwan

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July, 2002

This paper is prepared for the 15th meeting of the Standing Committee on Tuna and Billfish (SCTB) held in Hawaii, July 22-27, 2002. Document not to be cited without permission of authors.
ABSTRACT

Conversion factors (CVF) for bigeye and yellowfin tunas distributed in surrounding waters of Taiwan were estimated from 386 yellowfin and 139 bigeye samples taken from Tung-Kang fishing port from November 1999 to November 2000. There were no statistical differences found for CVF between sexes for bigeye tuna in all seasons. However, the CVF for yellowfin tuna were found significant different between sexes in the 1st and the 3rd quarters, but not for the 2nd and the 4th quarters. The CVF for female fishes, in general, also were slightly larger than the male in both species. For sex combined data, the CVF was significant different among seasons for yellowfin tuna, but not for bigeye tuna. For practical use of these factors, a value of 1.1136 for bigeye tuna and 1.0995 for yellowfin tuna were suggested for catches obtained from Taiwanese offshore tuna longline fishery. The limit on use of these factors and comparisons with estimates obtained from other organizations were also discussed.
INTRODUCTION

The bigeye and yellowfin tunas are two of the most important tuna species distributed in surrounding waters of Taiwan. Total catch of these species landed in domestic ports of Taiwan has reached about 17,000 mt in 2001. Such an amount has accounted for about 34% of the total domestic catch of tuna and tuna-like fishes in offshore tuna longline fishery. Most of these fishes were brought into markets as a whole fish, and were processed immediately before they sold in local fish markets or shipped to Japan for fresh sashimi markets. Since several markets reported landings in processed form, thus, the conversion factor (CVF) for each species is necessary to reflect actual catch of each species. Such information also is required for reliable stock assessment of the species when total biomass of the species landed is required.

The CVF for bigeye and yellowfin tunas are available in several international management bodies such as ICCAT and IOTC, however, very limited information is available for fish in the Pacific region. In addition, these factors may also different among countries depending upon how the fish was processed. In this short report, we examined CVF for bigeye and yellowfin tunas collected in surrounding waters of Taiwan. Because a large proportion of these catches were exported to foreign countries, these factors will be used to adjust landing estimates reported from foreign ports.

MATERIALS AND METHODS

Biological parameters of bigeye and yellowfin tunas were collected from Tung-Kang, the largest tuna longline fishing port of Taiwan from November 1999 to November 2000. However, length and weight information were continuously collected in the same port up to February 2002. Body length (in centimeter) and initial weight (in kilogram) of fishes, that brought into the market, were recorded after auction was completed for each shipment. Fish were then, processed by removing their fins, gills, guts, gonads...etc. internal organs completely (see video for details). For each fish, the removed internal organs were then, gathered, weighted and recorded. Gonad weight and sex ratio were recorded separately. The conversion factor (CVF) for each species was calculated as:

\[ \text{CVF} = \frac{\text{whole weight}}{\text{whole weight} - \text{weight of viscera}} \]

The CVF was analyzed by species, sexes, seasons and sizes of fish. Statistical
methods including t-test, ANOVA and covariance analyses were used to identify differences between sexes, sizes of fish and among seasons. All analyses were done using SAS program.

RESULTS AND DISCUSSION

Sample size collected for this study included 386 yellowfin tuna and 139 bigeye tunas, however, not all samples recorded contain species, sex, length, weight and weight of internal organs etc. information, as a result, sample presented for each specific analysis may differ in size.

Table 1 showed the conversion factors estimated for bigeye and yellowfin tunas by sexes and quarters. There were no statistical differences found for CVF between sexes for bigeye tuna in all seasons. However, the CVF for yellowfin tuna were found significant different between sexes in the 1st and the 3rd quarters, but not for the 2nd and the 4th quarters. The CVF for female fish, in general, also were slightly larger than the male in both species. This may have been related to differences in gonad weight and/or differences in seasonal feeding condition (i.e., stomach content) between sexes.

If data for both sexes were combined and analyzed, the CVF was significant different among seasons for yellowfin tuna, but not for bigeye tuna (Table 2). Although sample size and variance may affect these results, the difference found here may also relate to the seasonal variations in feeding condition or gonad development of yellowfin tuna as major spawning activity for the species was reported (Ueyanagi, 1978) to be in the first half of the year in the northern latitude of the west and central Pacific region.

Figure 1 showed the relationships between CVF and size of fish by sexes for bigeye and yellowfin tunas. It was clear that CVF was lower when fish become bigger, and this is true for not only female fish but also male fish on both bigeye (Figure 1A) and yellowfin tunas (Figure 1B). These results indicated that in terms of weight, the percentage of internal organs for smaller fish was higher than bigger fish for both species. This may reflects difference in feeding condition of fish among size classes.

For practical use of these factors, one value for each species (with both sexes and all seasons combined) was estimated to be about 1.1136 for bigeye tuna and 1.0995 for yellowfin tuna. These values were not much different from those estimated by Pacific Community (Table 3) although our sample size was larger. Besides, because
our estimates did not include weight of fins for each species, the actual CVF for both species suppose to be a little bit higher than current estimates (although weight of fins for both species is only a very minor percentage of the total weight). It was also reported that tail of fish was removed in most catches from distant water tuna longline fishery, if this is true, then CVF for these catches will be higher than current estimate. And, current uses of CVF of 1.16, which adopted from IOTC, for both species in distant water tuna longline catches in the Pacific may be appropriate. But, for the offshore tuna longline catches that exported to foreign countries, the CVF used may need to be adjusted accordingly.
Table 1. Conversion factor of bigeye and yellowfin tunas estimated by sexes and quarters.

<table>
<thead>
<tr>
<th>Species</th>
<th>Quarter\sex</th>
<th>Bigeye</th>
<th>Yellowfin</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>male</td>
<td>female</td>
<td>male</td>
</tr>
<tr>
<td>Bigeye</td>
<td>Q1</td>
<td>1.107</td>
<td>1.131</td>
</tr>
<tr>
<td></td>
<td>Q2</td>
<td>1.055</td>
<td>1.119</td>
</tr>
<tr>
<td></td>
<td>Q3</td>
<td>1.1</td>
<td>1.115</td>
</tr>
<tr>
<td></td>
<td>Q4</td>
<td>1.109</td>
<td>1.115</td>
</tr>
<tr>
<td>Yellowfin</td>
<td>Q1</td>
<td>1.103</td>
<td>1.107</td>
</tr>
<tr>
<td></td>
<td>Q2</td>
<td>1.098</td>
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<td>1.109</td>
</tr>
<tr>
<td></td>
<td>Q4</td>
<td>1.086</td>
<td>1.089</td>
</tr>
</tbody>
</table>


* T-test: significant at 5% level

Table 2. Conversion factor of bigeye and yellowfin tunas estimated by quarters (for all sexes combined).

<table>
<thead>
<tr>
<th>Quarter\Species</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
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</thead>
<tbody>
<tr>
<td>Bigeye</td>
<td>1.117</td>
<td>1.111</td>
<td>1.104</td>
<td>1.11</td>
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<tr>
<td>Yellowfin</td>
<td>1.104</td>
<td>1.102</td>
<td>1.094</td>
<td>1.089</td>
</tr>
</tbody>
</table>


* ANOVA: significant at 5% level
Figure 1. Relationships between conversion factor and body size (cm) for (A) bigeye and (B) yellowfin tunas collected from Taiwanese domestic offshore longline fishing fleet.
Table 3. Comparison of conversion factor for bigeye and yellowfin tunas estimated by PC and current study

<table>
<thead>
<tr>
<th>Organizations</th>
<th>Bigeye</th>
<th>Sample size</th>
<th>Yellowfin</th>
<th>Sample size</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC</td>
<td>1.1018</td>
<td>92</td>
<td>1.0896</td>
<td>116</td>
</tr>
<tr>
<td>OFDC</td>
<td>1.1136</td>
<td>139</td>
<td>1.0995</td>
<td>386</td>
</tr>
</tbody>
</table>

* PC: Pacific Community
* OFDC: Overseas Fisheries Development Council of the Republic of China (Taiwan)