Sorted Samples and Quantitative Counts in Appendicularian Catches

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Abstract
Sorting centers are important for processing material collected during extensive oceanic expeditions. Based on information obtained from samples of appendicularians, this paper demonstrates that usual procedures adopted in sorting centers produce samples which contain only a fraction of the organisms present in the original catch (or subsample). In addition, the proportion of individuals sorted varies considerably. In four "Indian Ocean Standard Net" catches collected in the Arabian Sea, subsamples (called "sorted samples" in this paper) are compared with careful microscopical counts ("quantitative counts") performed by the author. The numbers of appendicularians found in quantitative counts were 2.4 to 19.2 times higher than those in the sorted samples. Sorting efficiency varies in different forms of appendicularians; it is particularly low in Fritillaria sp. Bad preservation and small body size further reduce the portion sorted out. Under certain conditions (e.g. net clogging), numerous small appendicularians are retained which normally would pass easily through the meshes of the plankton net.

Introduction
In zooplankton investigations, catches, or subsamples thereof, are usually sorted taxonomically in sorting centers or laboratories. Samples of different taxa are sent to specialists for further treatment. While not all the specimens of a taxon originally caught will be represented in the sorted sample, the quantity of animals found in these samples has been used repeatedly as a rough measure of abundance (Bückmann, 1967, 1970, 1972). In regard to appendicularians collected in the Arabian Sea (Bückmann, 1972) it was found that the numbers sorted in the plankton laboratory of the "Institut für Meereskunde an der Universität Kiel" (Kiel, FRG) were, on the average, four times larger than those obtained in the Indian Ocean Biological Center (IOBC); this difference was assumed to be due to poor preservation of the latter. However, a detailed study of the situation revealed a quite different state of affairs.

Material and Methods
Unsorted subsamples collected at Stations 218, 219, 220, and 238 of the Indian Ocean Expedition (IOE) of R.V. "Meteor" to the Arabian Sea in 1964—1965 were obtained from the "Institut für Meereskunde, Kiel". The sorted samples of these stations have been previously dealt with (Bückmann, 1972). The stations were selected for purposes unrelated to sorting efficiency and may, therefore, be considered as random.

Droplets of the unsorted subsamples were examined under the microscope at 20-fold magnification. The appendicularians were counted and determined as to species. For determination, magnifications up to 320-fold were used. A quantitative count was thus obtained for each species present and for undeterminable parts of appendicularians. Body parts are found in all catches, resulting from the structural delicacy of these organisms. The data obtained by this procedure are, in the following, called "quantitative counts" as opposed to "sorted samples" issued from the sorting centers. The sizes of the subsamples are listed in Table 1.

Table 1. Subsample sizes: fractions of catches obtained at the stations indicated

<table>
<thead>
<tr>
<th>Stations:</th>
<th>218</th>
<th>219</th>
<th>220</th>
<th>238</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sorted samples:</td>
<td>3/8</td>
<td>3/8</td>
<td>3/8</td>
<td>3/16</td>
</tr>
<tr>
<td>Quantitative counts:</td>
<td>3/8</td>
<td>3/8</td>
<td>3/8</td>
<td>1/9</td>
</tr>
</tbody>
</table>

For all comparisons made below, the figures obtained were recalculated to the level of total catches.

Results and Discussion
The total numbers of appendicularians in the catches are presented in Table 2. In all 4 catches, the quantitative counts yielded numbers 2.4 to 19.2 times higher than those in the sorted samples. This seems to exclude a possible error in subsampling, particularly as there were parallel differences in species composition, as will be shown later. Moreover, the ratio of the numbers established in quantitative counts to those found in sorted samples varied widely between the catches.

For two stations, the samples sorted in the IOBC were also at our disposal. From these sorted samples, 64 specimens are calculated for Station 218 (44:1) and
Table 2. Total number of appendicularians in 4 catches, calculated on the basis of quantitative counts and of sorted samples

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Station no.</th>
<th>218</th>
<th>219</th>
<th>220</th>
<th>238</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantitative counts (a)</td>
<td></td>
<td>2506</td>
<td>1381</td>
<td>2081</td>
<td>18714</td>
</tr>
<tr>
<td>Sorted samples (Kiel) (b)</td>
<td></td>
<td>1162</td>
<td>72</td>
<td>883</td>
<td>2206</td>
</tr>
<tr>
<td>Ratio a:b</td>
<td></td>
<td>2.4:1</td>
<td>19.2:1</td>
<td>2.4:1</td>
<td>7.5:1</td>
</tr>
</tbody>
</table>

544 specimens for Station 220 (3.8:1). Considering these ratios and their considerable fluctuations, the number of appendicularians in sorted samples can by no means be used for estimations of the population density prevailing under in-situ conditions (cf. also Bückmann and Kapp, 1973).

Species Composition in Quantitative Counts and Sorted Samples

It is important to examine whether the species composition found in sorted samples may be considered representative of that established in quantitative counts. Table 3 presents the abundance of each species (including indeterminable specimens), calculated for the level of total catches; it comprises a comparison between quantitative counts and sorted samples.

Table 3. Calculated composition of total appendicularian catches based on (a) quantitative counts (Hamburg), (b) sorted samples (Kiel)

<table>
<thead>
<tr>
<th>Species</th>
<th>Station</th>
<th>218</th>
<th>219</th>
<th>220</th>
<th>238</th>
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<tbody>
<tr>
<td>Oikopleura cornutogastrea</td>
<td></td>
<td>13</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O. fusiformis</td>
<td></td>
<td>35</td>
<td>3</td>
<td>45</td>
<td>13</td>
</tr>
<tr>
<td>O. gracile</td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>337</td>
</tr>
<tr>
<td>O intermedia</td>
<td></td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>337</td>
</tr>
<tr>
<td>O. longicaulda</td>
<td></td>
<td>1229</td>
<td>688</td>
<td>155</td>
<td>37</td>
</tr>
<tr>
<td>O. albicans</td>
<td></td>
<td>29</td>
<td>45</td>
<td>24</td>
<td>8</td>
</tr>
<tr>
<td>O. ophioecerca</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>O. dioica</td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>337</td>
</tr>
<tr>
<td>O. parva</td>
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<td>3</td>
<td>3</td>
<td>3</td>
<td>337</td>
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<tr>
<td>O. rufescens</td>
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<td>3</td>
<td>3</td>
<td>3</td>
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<tr>
<td>Megalocercus huxleyi</td>
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<tr>
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<td>3</td>
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<tr>
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<td>2506</td>
<td></td>
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