

## Standard Operating Procedure (SOP)

### Aim of SOP (tick box)

- |   |   |
|---|---|
| <input type="checkbox"/> Munition detection or identification | <input type="checkbox"/> Toxicity                 |
| <input type="checkbox"/> Sampling                             | <input type="checkbox"/> In situ exposure studies |
| <input type="checkbox"/> Chemical analysis                    | <input type="checkbox"/> Bioassays                |
| <input checked="" type="checkbox"/> Bioindicators/biomarkers  |   |

### 20. Fulton's Condition Factor (CF) in fish

version 1.1

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### Scope

CF is in first instance an indicator of nutritional status/growth of fish. However, CF is also considered as a generic non-specific indicator of habitat quality and environmental stress, reflecting the well-being and fitness of fish and is, thus, often recorded as supporting variable for measurements of biological effects of contaminants in fish<sup>1</sup>. High values indicate a good status; low CF values a poor status. Changes in CF (often a decrease) may be caused by a variety of natural and anthropogenic stressors, including exposure to hazardous substances<sup>1-6</sup>. CF may have a natural annual cycle, which has to be taken into account when interpreting data.

Since CF is a generic stress indicator, it is applicable in a screening or detailed study on effects of conventional or chemical munitions and warfare agents, but only in concert with selected more specific biological indicators (biomarkers). Because of the non-specificity of the indicator, it is not recommended to be used in isolation.

### Summary of the method/SOP

Preferably, body weight is based on somatic (gutted) weight instead of total weight, in order to avoid an impact of either stomach/intestine fullness, weight of inner organs or gonadal maturity status on CF<sup>7</sup>. However, CF can also be calculated based on total weight if somatic (gutted weight) cannot be recorded. CF can be measured in all fish species used for chemical/biomarker analysis.

Mathematical relationship between body length and body weight<sup>8,9</sup>:

$$CF(or K) = Body Weight (g) * 100 / Body Length (cm)^3$$

### Safety aspects

Gloves should be worn to protect the observer's skin.

### Documentation

If spreadsheets are used instead of hand-written protocols, a PC with the software installed is required and should be checked. PCs used in the lab should be placed in a clean and dry environment.

Length and weight need to be noted. The CF can be calculated accordingly using the formula above.

From the individual CF values, mean values per sample and sampling site can be calculated; e.g., arithmetic means and standard deviation or arithmetic means and 95 % confidence intervals. Depending on the distribution of the data and the form of the mathematical relationship, medians with percentiles are also applicable.

For the assessment of effects on the CF, two commonly applied approaches can be used:

- (1) Statistical comparison of mean CF values obtained from impacted areas (e.g. a munitions dumpsite) and from un-impacted reference areas,
- (2) The use of assessment criteria (BAC: background assessment criteria; EAC: environmental assessment criteria) reflecting a good, medium or bad fitness status.

So far, no generally applicable assessment criteria for CF in fish have been established. One reason is that such criteria have to be species-specific, because the mean CF values and the range of CF values occurring in a population differ by species. In the data analysis and assessment for the DAIMON project, BAC and EAC values for CF (for total weight) were defined on the basis of the highest 25 % percentile (BAC) and the lowest 10 % percentile (EAC) of all CF values recorded in fish from reference areas.

## Methods

CF can be measured in all fish species used for chemical/biomarker analysis.

Sampling fish is described separately in “Wild fish sampling” and “External visible fish diseases”.

### Equipment:

- a balance, display in gram [g]: at sea on unstable platforms (e.g., onboard research vessels), special balances (scales) are required (e.g. <https://marel.com/fish-processing/systems-and-equipment/on-board/surimi/receiving--handling/weighing/marine-scales/303?prdt=1>) which are able to integrate over fluctuating values
- an appropriate length measure board, scale in centimeter [cm]

### Ungutted weight:

For each fish, total weight (including organs) (in g) and total length (commonly in cm) are recorded.

### Gutted weight:

After dissection (gutting) of fish and removal of inner organs (digestive tract and attached liver, spleen and gall bladder as well as gonads) the somatic weight can be recorded. The weight of liver and gonads can be determined for calculation of the hepatosomatic index (HIS) and gonadosomatic index (GSI), respectively.

### Length measurement:

Fish length is commonly measured as total length of the fish placed on the measure board in natural position (i.e., not with stretched caudal fin). Length is either measured on a cm or a mm scale. Commonly, length is recorded as cm.

## References

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## Change history

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