DAIMON Toolbox Fact Sheets:

Methods to Study the Impact of Dumped Munitions on Marine Biota

Assessment category 3: Biological effects

Toolbox component: Fitness

Fact Sheet 3.7: Hepatosomatic Index (HSI) in fish

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What is it?

Mathematical relationship between body weight and liver weight:

*HSI = Body Weight (g) * 100 / Liver Weight (g)*

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 HSI.

What does it tell you?

As CF (see Fact Sheet 3.5, Lang & Straumer 2019), HIS (often the term liver somatic weight, LSI; is used) is in first instance an indicator of nutritional status and energy metabolism of fish. However, HSI is also considered as a generic non-specific indicator of habitat quality and environmental stress, reflecting the well-being and fitness of fish. High values in general indicate a good status; low values a poor status. Changes in HSI (often a decrease) may be caused by a variety of natural and anthropogenic stressors, including exposure to hazardous substances (van der Oost et al. 2003, Hansson et al. 2017, Morado et al. 2017). HIS may have a natural annual cycle, which has to be taken into account when interpreting data.

Since HSI 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 use it in isolation.

Type of Indicator (tick box)

☒ non-specific stress indicator
☐ specific for groups of contaminants incl. CWA or explosives
☐ CWA-specific indicator
☐ specific for substances related to explosives (e.g. TNT)

How to measure it?

***Species*:** HSI can be measured in all fish species used for chemical/biomarker analysis.

***Matrix*:** whole fish and liver

***Equipment*:** For dissection of the fish, appropriate dissection tools are required (forceps, scalpel/knife etc.). For measurement of total weight and liver weight, an appropriate balance is needed. For weight measurements 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?prdct=1) which are able to integrate over fluctuating values.

***Measurements and units*:** For each fish, the somatic weight is recorded after dissection (gutting) of fish and removal of inner organs (digestive tract and attached liver, spleen and gall bladder as well as gonads). In addition, the weight of the liver is determined for calculation of the hepatosomatic index (HIS).

***Sample size*:** Ideally, HIS should be recorded in 100 specimens per sampling site. These should be the same fish that are used for recording the somatic condition factor (CF) based on gutted weight.

How to analyse and assess the data?

From the individual HSI 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 HSI, two commonly applied approaches can be used:

(1) Statistical comparison of mean HSI 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 HSI in fish have been established. One reason is that such criteria have to be species-specific, because the mean HSI values and the range of HSI values occurring in a population differ by species. In the data analysis and assessment for the DAIMON project, BAC and EAC values for HSI in cod were defined on the basis of the highest 25 % percentile (BAC) and the lowest 10 % percentile (EAC) of all HSI values recorded in fish from reference areas during winter time. The following criteria were used:

- Cod (*Gadus morhua*): BAC: HSI ≥7,15; EAC: CF ≤4,0

References

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