

# Quality Criteria for the Analysis of Microplastics in Marine Biota Samples

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## Background

Data on ingestion of microplastics by marine biota are quintessential for monitoring and risk assessment. Current studies portray a wide spread in results, but lack comparability in sampling and analysis methods. **Thus, comparing these data bears the risk of comparing apples with oranges.**



## Study Aim

Development of a scoring system to assess the reliability of presented ingestion data. The scoring system is based on 10 criteria that define a reproducible and controlled study and that offer a transparent and traceable approach to assess a study for risk assessment purposes.

## Scoring System

### 1. Sampling methods

Sampling approach, exact location and time as well as materials used should be fully reported.

2 1 0

### 2. Sample size

A suitable sample size of 50 individuals per research unit (species, food web, ecoregion, feeding type) and reporting the confidence interval of ingestion incidences are required.

### 3. Sample processing and storage

Sampled organisms should be frozen or preserved soon after the moment of capture, any sample handling outside the laboratory should be avoided.

### 4. Laboratory preparation

All materials, equipment and laboratory surfaces need to be thoroughly rinsed; lab coats and non-synthetic clothes should be worn at any time.

### 5. Clean air conditions

The handling of samples should be performed under clean air conditions. If this cannot be ensured fully, the implementation of negative controls will be even more important.

### 6. Negative controls

Three negative controls are advised to be treated in parallel for each batch of samples.

### 7. Positive controls

Three positive controls are advised for which microplastics of known polymer identity and of targeted sizes are added to "clean" samples.

### 8. Target component

To ensure monitoring of all ingested microplastic, the full gastrointestinal tract of fish and the entire body of smaller species, e.g. bivalves, should be examined.

### 9. Sample treatment

A digestion step (e.g. using KOH or enzymes) should be included to dissolve organic sample matter when aiming in the detection of microplastics smaller 300µm.

### 10. Polymer identification

Polymer identification is required for all, or at least a subsample of particles. The lower detection limit for particle size, the particle counts with confidence intervals, their detected polymer types and particle sizes should be reported.

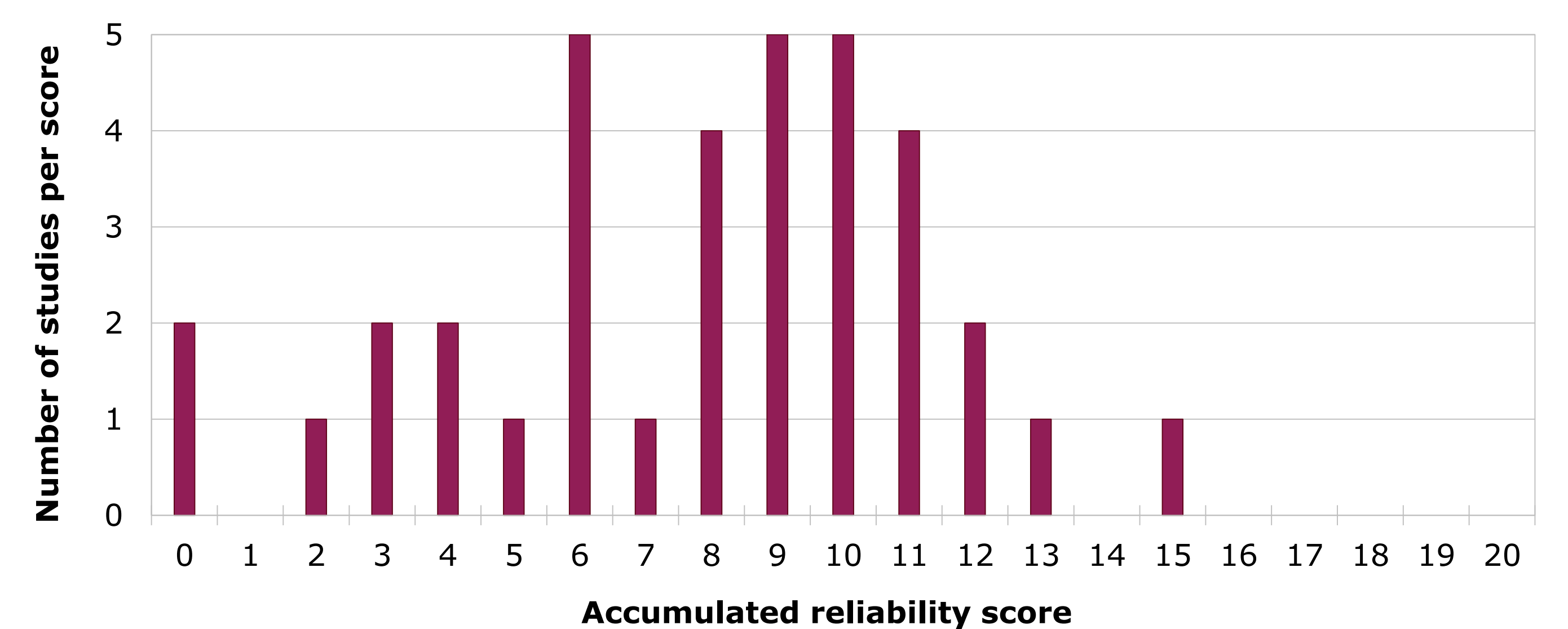
## Approach

Thirty-five studies on microplastic ingestion by marine biota were critically reviewed, with a focus on the methodologies used. Based on this, a set of 10 criteria was defined, relating to a standardized methodology, the description of procedures and the presentation of results.

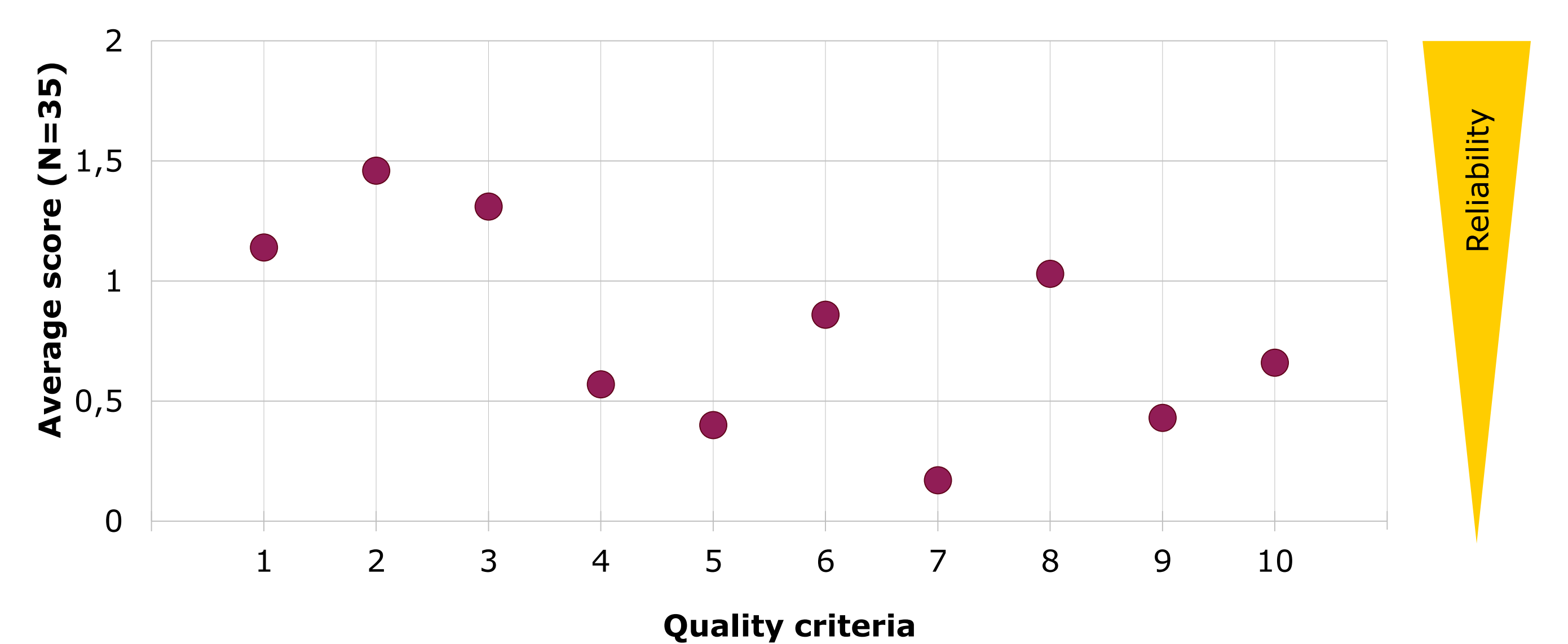
The scoring system was applied retrospectively to the reviewed studies, for each study and per criterion scores of 2 (reliable without restrictions), 1 (somewhat reliable but with restrictions) or 0 (not reliable) were assigned.

## Results

Considerable uncertainty with respect to applied methodologies was observed. Accumulated reliability scores ranged from 0 to 15 (max. 20), with an average score of 8 (Fig. 1). All studies scored 0 for at least one criterion, indicating some degree of uncertainty around presented data. Average scores varied strongly for the individual criteria (Fig. 2), pointing out crucial areas that should receive more attention, e.g. conducting of positive controls (av. score 0.2) or working under clean air conditions (av. score 0.4).



**Figure 1** Frequency distribution of assigned total accumulated reliability scores (calculated as the sum of individually scored criteria) for 35 studies on microplastic ingestion by marine biota.



**Figure 2** Average scores for the individual quality criteria after reviewing 35 studies on microplastic ingestion by marine biota.

## Conclusion

- The scoring system can be applied to control the quality of presented data and to enable an easier comparison of studies.
- The definition of 10 criteria and scoring guidelines make this approach easily accessible and transparent.
- The majority of studies (N=35) focused on visually sortable microplastics and the scoring system is tuned to this research aim. We foresee adaptations as the research field evolves (e.g. when targeting smaller microplastics).

Reference: Hermsen, E., Mintenig, S.M., Besseling, E. and Koelmans, A.A. (2018) Quality Criteria for the Analysis of Microplastic in Biota Samples: A Critical Review. *Environmental Science and Technology* 52(18), 10230-10240.

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