Guidelines for non-indigenous species monitoring by extended Rapid Assessment Survey (eRAS)

1 Background

1.1 Introduction

The human-mediated introduction and establishment of non-indigenous species (NIS) in the marine environment are of worldwide concern. The main vectors for species introduction are maritime transport by either transport of organisms via ballast water or biofouling, and aquaculture. Further spread of species might also occur by smaller vessels and pleasure craft. Climate change and rising temperatures facilitate their establishment in temperate regions since many NIS originate from warmer areas. Nowadays notable efforts are undertaken to prevent or at least minimize new introductions. Unlike terrestrial NIS, marine invaders are almost impossible to eradicate and therefore, avoiding introduction is the most important mitigation measure. The HELCOM Baltic Sea Action Plan recognizes this in its Management Objectives for Maritime Activities: “No introductions of alien species from ships”.

1.2 Purpose and aims

Rapid Assessment Surveys (RAS) have been tested in many coastal areas and proven to be suitable and practicable tools for the monitoring of NIS (e.g. Pederson et al. 2003, Arenas et al. 2006, Minchin 2007, Nall et al. 2014, Bishop et al. 2015, Collin et al. 2015). RAS records the presence of mainly [1]benthic NIS at defined study locations, but can be combined with a settlement panel program applied at different sites under defined conditions, i.e. the extended RAS (eRAS). This increases the likelihood of detecting small and rare fouling organisms or species living in deeper water. eRAS links the NIS monitoring sub-programme to the benthic part of the HELCOM/OSPAR port monitoring survey scheme, which is aimed at the Ballast Water Management Convention.

The resulting data can be used as part of the input for the assessment of the HELCOM core indicator ‘Trends in arrival of non-indigenous species’. The indicator compares NIS diversity at defined temporal intervals to a baseline, evaluating the present status relative to earlier situations.

2. Monitoring methods

2.1 Monitoring features

1. Standardized Rapid Assessment surveys (RAS) combined with a settlement panel program are used to detect mainly introduced macroscopic benthic species at coastal sites.
2. RAS requires no boats or diving gear and a recommended minimum of one visit per site and year. One or two additional visits are needed when settlements panels are used.
3. Comprehensive taxonomical expertise is needed as well as knowledge of alien species’ habitat preferences.
4. Site-specific procedures have to be repeated each year, therefore systematic documentation and mapping of each site is required.
5. Settlement panel investigations enhance the likelihood of detecting small or rare species or organisms occurring in a water depth not accessible to sampling with a dip net.
6. Standardized RAS coupled with settlement panel investigations at hotspots of introduced species allow for early detections of new NIS and can reveal temporal trends in the number of NIS per site.

[1] also netting and observing swimming organisms

7. All collected data on NIS need to be summarized in a common central database for introduced and cryptogenic species.

2.2 Time and area

All RAS fieldwork is conducted during late summer to early fall (end of July to October) since the abundances of most species are highest during this time. A chronological order of the sampling stations is maintained each year for comparable results.

Sampling in tidal areas is done at low tide, especially the inspection of tidal flats or beaches. The investigation of floating pontoons is generally independent from the tidal status but sampling with the incoming tide is preferred in order not to miss larger planktonic organisms (medusae) that are driven by currents and drift near the surface.

The focus of the surveys is on assumed hotspots of introductions, based on potential vectors and hydrographic features:

- **Ports and harbors**. Primary introductions occur in big ports via transoceanic cargo vessels, cruise ships, ferries or navy vessels. If direct sampling in the harbor of concern is unpractical, sampling is concentrated on smaller harbors and marinas nearby where sampling is more feasible.
- **Waterways and canals.**
- **Aquaculture sites**.
- **Hydrographic factors**. Salinity is considered as an important factor affecting the survival and establishment of alien species. Therefore, marine sites in the Belt area as well as brackish water estuaries, harbors of decreasing salinity and sites with oligohaline conditions are selected.

The majority of sampling sites are easily reachable and accessible. Some harbors require a permit from local authorities. Since many marinas are not open to the public, entering and working on the pontoons needs to be checked in advance. If access turns out to be impossible, the harbor is rejected as a monitoring site.

2.3 Monitoring procedure

2.3.1 Monitoring strategy

Due to the diverse nature of the sampling sites, a high degree of flexibility and expertise is needed. The aim is not to identify each and every NIS, which is virtually impossible, but to establish the yearly rate of new introductions with comparable effort.

Depending on the station surveyed and the number of persons involved, the sampling time differs. The minimum time spent per station is 90 minutes while it often it takes up to 3 hours or more to inspect all habitats thoroughly. Large harbors with more complex structures and many jetties require a more extensive search and sampling procedure than marinas with only few pontoons smaller sedimentary patches and less rocky structures.

2.3.2 Sampling method(s) and equipment

2.3.2.1 RAS

Careful visual inspections of artificial hard structures, sediment surfaces or vegetation are used to reveal the majority of macrofauna and -flora of reasonable/detectable size. Species are listed and if possible the frequency of their relative occurrence is roughly estimated to ‘dominant’, ‘abundant’, ‘rare’ or ‘present’. If the taxonomic status of a species is certain, none or only few individuals are collected.

Since fouling communities on the surface of floating pontoons tend to include a variety of small-sized species, scratch samples with a scraper from different sites off the substrates are taken for identification in the lab. Clustered mussels, algae etc. from the side, from underneath or between the docks are collected,

covering as many different physical conditions as possible: exposure to sun, currents or wind, freshwater inflow, tidal level, substrate type etc.

Sediments are sampled, where accessible, with handheld grabs, corers or shovels. Samples are sieved with a mesh size of 1 mm. Associated swimming and drifting fauna is sampled with a dip net or sieve with a 1 mm mesh.

When macroscopic inspections of all habitats in question yield no additional NIS for approximately 15 minutes, the survey is regarded to be complete. Whereas the exact pattern of scratch and sediment samples will vary from harbor to harbor, care must be taken to repeat the same pattern in each harbor every year to achieve comparable result in the long run. Therefore, a complete documentation of each site is necessary.

2.3.2.2 eRAS – use of settlement panels

Settlement panels are deployed in spring/early summer and left in situ for 3 - 4 months. PVC panels with a size of 150 x 150 x 5 mm and a central hole (15 mm in diameter) are used. This allows fixing three panels at one rope with defined distances using sailor knots. At one end of the rope, a weight is used to stabilize the experimental set-up in the water column. The rope is fixed to artificial harbor structures (walls, pontoons etc.) in a way that the panels are positioned at defined water depths: 1 m below the surface, at half the water depth, and 1 m above the bottom respectively.

In tidal areas where the water depth might be lower than 2-3 m at low tide, panel positions should be flexibly adapted to the specific site. However, the uppermost plate should be positioned at about 30 cm below the surface, the lowermost plate about 30 above the bottom and the middle plate in between. Care should be taken that the weight does not reach the bottom at low tide. After the exposure period, the settlement panels are carefully collected, stored individually in plastic bags with sea water and transported immediately to the laboratory in a cooler. If the number of settled specimen on a panel turns out to be too high to be processed in a reasonable time, panels are fixed in 98 % ethanol (preferred) or other preservative.

2.3.3 Sample handling and analysis

All RAS samples as well as settlement panels are carefully examined in the lab with the aid of stereomicroscopes and microscopes. The species number and density of individuals from settlement panels are quantified. Specimens are identified to the lowest taxonomic level possible, preferably to the species level. Identification is done according to established taxonomic keys and current neobiota literature. Identifications of rare or novel species are sometimes extremely time consuming and may require correspondence with taxonomic experts.

Species of concern are fixed (alcohol, formalin/seawater etc.) and stored. For future genetic analysis of controversial species, storage in alcohol may be preferable.

2.4 Data analysis

Results are analysed in accordance to the needs of the HELCOM Core Indicator ”Trends in arrival of new non-indigenous species” (see: Assessment protocol).

3. Data reporting and storage

*A*ll collected data on NIS need to be summarized in a common central database for introduced and cryptogenic species. AquaNIS, the database on aquatic non-indigenous and cryptogenic species, will be supported with the NIS data generated during the surveys. The use of AquaNIS as a central data storage for HELCOM NIS data is currently under discussion.

4. Contacts and references

4.1 Contact persons

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4.2 References

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