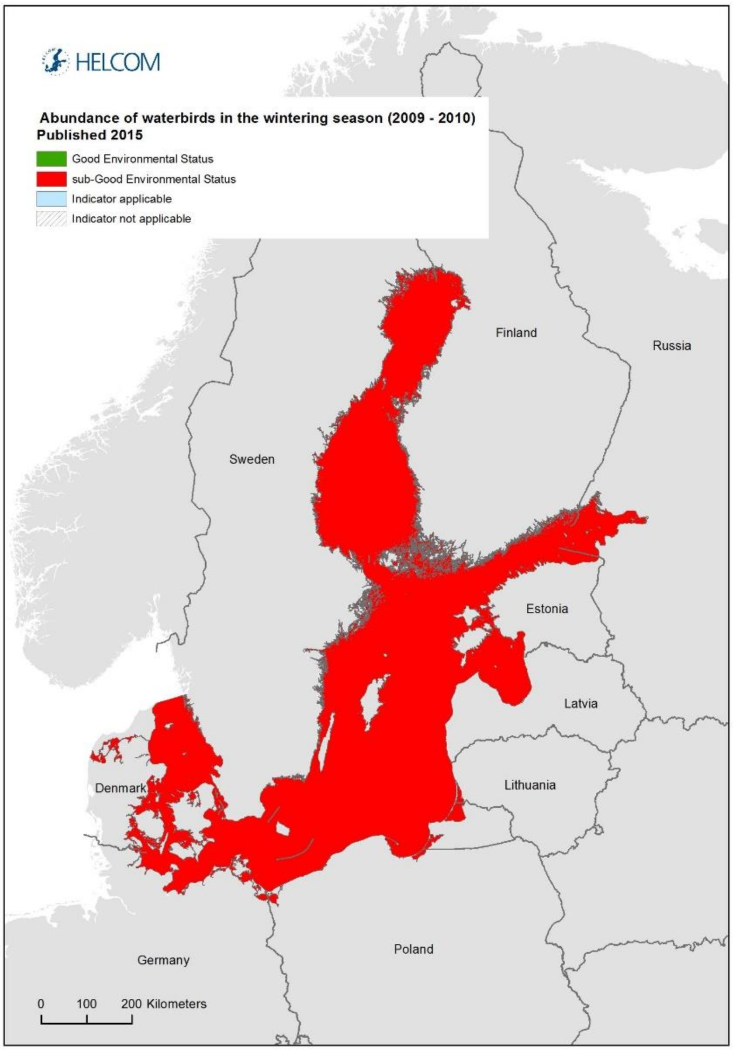
Abundance of waterbirds in the wintering season

Key message



The abundance of waterbirds wintering in the Baltic Sea shows that the populations are not at Good Environmental Status (GES). This evaluation is based on data of 12 waterbird species using data from winter 2009-2010 and should regarded as preliminary, because species wintering in offshore areas are not included in the assessment due to lack of data. The indicator is currently operable and allows GES evaluations by considering annual single species indices. In the future, the evaluation may include aggregated indices for functional groups (benthic feeder, fish feeders, herbivores).

Using the current reference period (ten year period 1991-2000), the confidence of the indicator is low, but it appears possible to increase the confidence by considering data from previous surveys. Also future inclusion of more species would increase the confidence.

Relevance of the core indicator

As predators at high levels in the food web, but also as herbivores that may remove large proportions of macrophytes by grazing, waterbirds are an integral part of the Baltic marine ecosystem.

The indicator follows temporal change in the abundance of key waterbird species, which have functional significance in the marine ecosystem and respond to numerous pressures, many of them cause by anthropogenic impact. Thus, the indicator gives an overall view on the state of marine birds in the Baltic and reflects the cumulative impact of pressures.

Policy relevance of the core indicator

	BSAP **Segment and Objective**	**MSFD** **Descriptors and Criteria**
Primary link	Biodiversity • Viable populations of species • Thriving and balanced communities of plants and animals	D1 Biodiversity 1.2 Population size (abundance, biomass) •
Secondary link	Eutrophication • Natural Distribution and occurrence of plants and animals	D1 Biodiversity 1.1 Species distribution (range, pattern, covered area) D4 Food-web 4.3 Abundance/distribution of key trophic groups and species
Other relevant legislation: EU Bird Directive (migrating species Article 4 (2); Red-throated Diver, Black-throated Diver, Slavonian Grebe, Whooper Swan, Steller's Eider, Smew, Little Gull listed in Annex I); BD Article 12 report, parameter "Population trend"; Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA).		

Cite this indicator

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Indicator concept

Good Environmental Status

Evaluation of Good Environmental Status (GES) according to the Marine Strategy Framework Direction (MSFD) is determined as the proportion of bird populations exceeding the limits of population fluctuations. The period 1991-2000 is used as the reference period against which GES is evaluated.

The indicator follows the approach of the similar OSPAR indicator 'Species-specific trends in relative abundance of non-breeding and breeding marine birds, developed by ICG-COBAM MSFD (ICES 2013). According to this approach, GES is achieved when 75% of the considered populations are not more than 30% below the baseline level (20% in species laying only one egg per year). This method of evaluation has recently been modified in the EU LIFE project MARMONI for the Baltic Sea by correcting the numbers of birds counted for effects of climate change and is used in this core indicator (i.e. winter temperature, see below and Aunins et al. 2013b).

If the number of birds of a population is less than 70% (80%) of at the baseline level, GES is not achieved. If bird numbers are more than 30% (20%) above the baseline level, this is supposed to reflect disorder in the environment and is reported as an alert, but not treated as a failure in regarding GES. The indicator includes several waterbird species. In order to evaluate if GES is achieved for an area, all occurring species are to be considered. GES is achieved when less than 25% of the species deviate more than 30% (20%) downward from the baseline level (ICES 2013).

Upward deviations of 30% or more from the baseline may indicate imbalance of the system and are reported, as an alert, but are not treated as target failure. Furthermore, increases of rare or depleted populations are not necessarily a bad sign. As it is difficult to identify a reference level representing natural conditions, bird abundances from the beginning of data compilation (average of the years 1991-2000) have tentatively been set as the reference values. Owing to the relatively low number of years covered, the confidence of the target is considered to be moderate to low.

As a single year (e.g. the starting year of the indicator) is prone to random events influencing the number of birds in that year, the mean abundance of the years 1991-2000 has been tentatively chosen to serve as the reference period used for defining the status that reflects baseline conditions. The baseline status may be replaced by species-specific values in further development work.

It is possible to calculate the geometric mean of all annual single species indices to get an overall wintering waterbird index (following Gregory et al. 2005) or to aggregate species according to their role in the food web, i.e. to functional groups (benthivores, piscivores, herbivores). As an option for the future, such composite indices could serve as assessment tools. It remains to be tested whether the single species approach or the aggregated indices are more robust and better suited to assess GES with respect to population sizes of wintering waterbirds.

As all approaches are sensitive to the number of populations represented, the aim is to include as many species representative for the Baltic environment as possible. However, some species (e.g. Mallard, Coot, some gull species) show strong connections to other (non-marine) habitats and are therefore not appropriate to include in an indicator addressing the status of the Baltic Sea. Furthermore monitoring and assessment needs to be expanded to the offshore areas of the Baltic. So far only birds wintering close to the shore have been considered.

Anthropogenic pressures linked to the indicator

	General	MSFD Annex III, Table 2
Strong link	The most important anthropogenic threats to wintering waterbirds are the incidental by-catch in fishing gear (gill nets), prey depletion, oil pollution, intake of hazardous substances and habitat loss owing to offshore wind farms, aggregate extraction and shipping	Biological disturbance: - selective extraction of species, including incidental non-target catches (e.g. by commercial and recreational fishing) Contamination by hazardous substances: - introduction of synthetic compounds (oil) - introduction of synthetic compounds (pesticides) - introduction of non-synthetic compounds (heavy metals, hydrocarbons) Physical damage: - abrasion (e.g. impact on the seabed of commercial fishing, boating, anchoring) - selective extraction (e.g. exploration and exploitation of living and non-living resources on seabed and subsoil) Nutrient and organic matter enrichment: inputs of fertilizers and other nitrogen- and phosphorus-rich substances
Weak link	-	Other physical disturbance: - marine litter

The status of waterbird populations is affected by several anthropogenic pressures, including mortality caused though oil-spills, by-catch in fisheries and hunting as well as anthropogenic eutrophication affecting the food web structure and function. Functional groups of species can potentially reflect in a more specific manner, which pressures are affecting the status.

In general, waterbirds strongly respond to food availability. Therefore human activities influencing the food supply of waterbirds are reflected in bird numbers. For fish-eating birds, direct anthropogenic pressure is posed by the extraction of fish, while the physical damage of the seafloor affects benthic feeders. Indirect pressure can act via eutrophication: In the oligotrophic end of the eutrophication state, the bird populations are limited by the availability of food sources, whereas towards eutrophic conditions plant and zoobenthos biomass increases, which first benefit seabird populations, but in the extreme end cause decrease in food availability.

Among anthropogenic pressures causing losses of individual waterbirds, drowning in fishing gear (mainly gill nets) is a serious problem. Estimates of the number of birds by-caught are uncertain, but probably amount to a magnitude of 100,000-200,000 birds annually (Žydelis et al. 2009). In addition high numbers of seaducks are hunted, with big quotas in particular for Common Eider and Common Goldeneye (Mooij 2005). Though the number of oil slicks has decreased, oil pollution causing oiled plumage, hypothermia and finally death is still affecting waterbirds in the Baltic (Larsson & Tydén 2005, Žydelis et al. 2006). Bird health is constrained also by the intake of contaminants (Broman et al. 1990, Rubarth et al. 2011, Pilarczyk et al. 2012).

Some waterbird species are prone to habitat loss caused by human activities, which perhaps reduce the carrying capacity of certain wintering sites. Avoidance of offshore wind farms has been observed to affect the spatial distribution of divers and Long-tailed Ducks (Petersen et al. 2011, 2014, Percival 2014). These species as well as other seaducks also keep off shipping lanes (Bellebaum et al. 2006, Schwemmer et al. 2011). For benthic feeders, additional habitat loss is caused by physical damage of the seafloor from both fisheries and aggregate extraction.

It is important to note that all human activities mentioned have a cumulative impact on waterbird populations, not only in the non-breeding season, but also carrying over to the breeding season (e.g. affecting breeding success). The cumulative impact on waterbirds has been reviewed by the example of Red-throated Diver and Black-throated Diver (Dierschke et al. 2012). The indicator dealing with the abundance of wintering waterbirds combines the effects of different quality.

Assessment protocol

The assessment is currently made for the entire Baltic Sea using the scale 1 of the HELCOM assessment unit system (HELCOM Monitoring and Assessment Strategy Attachment 4, 2013). The use of a finer scale is constrained by the high mobility of waterbirds, i.e. movements within winter and distributional changes between winters may go much across the borders of Baltic Sea sub-basins (17 areas in HELCOM assessment unit scale 2). On the other hand it would be desirable to assess units smaller than the entire Baltic, because it would be easier to localize problems and to implement necessary regional or local measures to improve the status. For the future, the aim is to combine sub-basins to six or seven assessment units. This can be tested as soon as current data are available. Future surveys should take into account that the relevance of Bothnian Bay and eastern Gulf of Finland may increase after a few years due to the predicted milder winters as a consequence of climate change.

Compared to first results from the indicator in HELCOM CORESET I (Aunins et al. 2013a), the further development of the scientific framework has been done in the EU LIFE project 'Innovative approaches for marine biodiversity monitoring and assessment of conservation status of nature values in the Baltic Sea' (MARMONI; LIFE09 NAT/LV/000238). The main progress is to replace the classical TRIM analyses (van Strien et al. 2004) by GAM modelling, which includes winter air temperature as a covariate (Aunins et al. 2013b). This procedure gives yearly single species indices corrected for the temperature and thus – in a long view - for effects of climate change.

Starting from the number of actually counted waterbirds, generalized additive models (GAM) are used to calculate annual indices for each waterbird species, which are corrected for effects of climate change by adding three datasets of January air temperatures as covariates to the input variables (year, counting site, species and bird numbers; Aunins et al. 2013b) and which are Kalman smoothed. The inclusion of temperature data is an important progress, especially with respect to the above-mentioned predicted milder winters and subsequent redistributions of sea ice and waterbirds. Indices calculated by these GAMs can serve for the current approach of evaluation (i.e. the consideration of single species), but would also be a helpful tool if composite indices for functional groups are used in the assessment in future. Such multi-species indices are calculated as the geometric mean of the single species indices, with every species treated equally and standard errors used to show the variability of data.

Index values for any year (or period) of assessment are used for the comparison with the reference level, which is the average of the starting period of Baltic-wide data availability (1991-2000), unless species-specific reference levels may be found more useful in future.

Relevance of the indicator

Policy Relevance

The indicator addresses the HELCOM ecological objective 'Thriving and balanced communities of plants and animals" as well as "Viable populations of species' that are part of the biodiversity goal 'Favourable status of Baltic biodiversity'. It also refers to the eutrophication goal 'Natural distribution and occurrence of plants and animals' (HELCOM 2007).

The HELCOM 2013 Ministerial Declaration notes protection of seabirds in relation to the global convention on biodiversity and the need to cooperate with other regions to protect migratory bird species (para 4B);

> 4 (B). WE DECIDE to… protect seabirds in the Baltic Sea, taking into consideration migratory species and need for co-operation with other regions through conventions and institutions such as the Agreement on Conservation of African Eurasian Migratory Waterbirds (AEWA) under the Convention on Migratory Species (CMS), and particularly in the North Sea (OSPAR) and Arctic (Arctic Council) areas.

For the EU Marine Strategy Framework Directive (MSFD) the indicator addresses the criterion 'population size' (1.2.) as required for assessments of the MSFD qualitative descriptor 1 (biodiversity) (European Commission 2008) and stated in the EC Decision 477/2010/EU for the MSFD (European Commission 2010b). In addition, information is made available for the criterion 'species distribution' (1.1.). The indicator can also contribute to the assessment of the MSFD qualitative descriptor 4 (food webs), where the relevant criterion is 'abundance/distribution of key trophic groups and species'.

The EU Bird Directive (a) lists in Annex 1 Red-throated Diver, Black-throated Diver, Slavonian Grebe, Whooper Swan, Steller's Eider, Smew and Little Gull as subject of special conservation measures and (b) generally covers all migratory species and they have to be reported (European Commission 2010a). Thus, all species included in the concept of the indicator are also covered by the Bird Directive, which implies the conservation of habitats in a way allowing birds to breed, moult, stage during migration and spend the winter.

Furthermore, the Baltic Sea is located in the agreement area of the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA), an intergovernmental treaty dedicated to the conservation of migratory waterbirds and their habitats. Contracting parties (all countries in the Baltic except for Poland and Russia) are obliged to undertake measures warranting the conservation of migratory waterbirds. Therefore, the goals of BSAP, MSFD, AEWA and Bird Directive are largely overlapping, and the data needed for the indicator are roughly the same as needed for reporting in the frame of the Bird Directive.

In order to protect migrating birds in the Baltic Sea region, HELCOM has adopted the recommendation 34/E-1 'Safeguarding important bird habitats and migration routes in the Baltic Sea from negative effects of wind and wave energy production at sea'. Since some species included in the concept of the indicator are vulnerable to habitat loss caused by wind farms and others are prone to collisions (e.g. Petersen et al. 2011, 2014, Furness et al. 2013, Percival 2014), the indicator is linked to the intentions of the recommendation.

Role of waterbirds in the ecosystem

Waterbirds are an integral part of the Baltic marine ecosystem. They are predators of fish, macroinvertebrates and other bird species, scavengers of carcasses and fishery discards and herbivores of littoral vegetation. Most species are specialized on certain species and/or size classes of prey. As they cannot survive without a sufficient food supply, changes in the number of waterbirds reflect conditions in the food web of the Baltic. A high number of wintering waterbirds may not automatically indicate a good environmental state, because for instance piscivorous species benefit from a high availability of small fish, which in turn may point to disorder of the food web owing to overfishing of large fish species. These competitive interactions between fish feeding birds and large fish affect the setting of baselines and defining GES for instance with respect to the current long-term management plan of cod, since increased cod stocks would likely affect (negatively) the food availability for birds.

As predators at or close to the top of the food web, waterbirds are accumulating contaminants and their numbers indicate the degree of contamination. Contaminants ingested in winter may have carry-over effects on breeding success and, as several waterbird species are predated by white-tailed eagles, are transferred to a higher level in the food web.

Some waterbird species are not only wintering, but also breeding in the Baltic. For several reasons those species are potentially included in the concepts of both breeding and wintering waterbird abundance indicators. First, the intention of the indicators is to support the assessment of environmental status of marine areas rather than the state of bird populations per se. This is most obvious in species differing in distribution patterns between breeding and wintering seasons (e.g. alcids). Second, most wintering waterbird species aggregate in suitable feeding habitats, often well apart from the breeding sites. In addition, there is a turnover of individuals within species, meaning that some individuals of a given species leave the Baltic for wintering in other marine areas, whereas others are living in the Baltic only in winter. In general, the explanatory power of the indicator is constrained by factors acting on the waterbirds in the breeding season, either also in the Baltic or in breeding areas in northern Eurasia as far east as Siberian Taimyr Peninsula.

Waterbirds use all ice-free areas of the Baltic Sea as a wintering area and therefore the distribution may change depending on environmental conditions. The HELCOM supporting parameter 'Ice season' (http://helcom.fi/baltic-sea-trends/environment-fact-sheets/hydrography/ice-season/) provides insight into the highly variable coverage of ice in the Baltic Sea during the last centuries.

Results and confidence

The concept of the indicator is well developed, based on long-running monitoring through International Waterbird Census (IWC), i.e. land-based waterbird counts in mid-winter. Further modules such as monitoring and assessment of waterbirds wintering in offshore sections of the Baltic Sea can be added in the future.

The evaluation for 2010 (i.e. winter 2009/2010) is based on IWC data of 12 species (

Table **1**). Results from more species are not considered, because only a fraction of the Baltic Sea winter population is covered by IWC, which is land-based and cannot give data for birds wintering offshore.

Of the twelve considered species, four (33%) show index values below the 70% threshold, namely Common Pochard, Greater Scaup, Steller's Eider and Goosander. This means that GES for wintering waterbirds is not achieved in 2010. However, this result should be considered as preliminary, because the evaluation does not include important species such as long-tailed duck, velvet scoter, common scoter and divers. As some of them are known to have declined strongly (Skov et al. 2011), the results of the indicator may still be meaningful.

Table 1. Kalman smoothed index values for wintering waterbirds in the Baltic Sea in 2010 compared to the reference period 1991-2000 (set to 1) and the respective GES assessment (red: more than 30% below reference value; light green: less than 30% deviation from reference value; dark green: more than 30% above reference value). Index values are based on land-based counts, the International Waterbird Census conducted annually in mid-January and were processed by GAM including winter air temperature as covariate.

Functional group	Species	Index value 2010	GES 2010
herbivore	Mute Swan	0.92	
herbivore	Whooper Swan	no data	n. a.
benthic feeder	Common Pochard	0.56	
benthic feeder	Tufted Duck	constant*	
benthic feeder	Greater Scaup	0.61	
benthic feeder	Steller's Eider	0.30	
benthic feeder	Common Eider	0,93	
benthic feeder	Long-tailed Duck	0.58	n. a.**
benthic feeder	Common Scoter	1.52	n. a.**
benthic feeder	Velvet Scoter	0.22	n. a.**
benthic feeder	Common Goldeneye	1.06	
fish feeder	Smew	2.26	
fish feeder	Goosander	0.67	
fish feeder	Red-breasted Merganser	0.88	
fish feeder	Great Crested Grebe	1.23	
fish feeder	Red-necked Grebe	no data	n. a.
fish feeder	Slavonian Grebe	no data	n. a.
fish feeder	Red-throated Diver	constant*	n. a.**
fish feeder	Black-throated Diver	constant*	n. a.**
fish feeder	Great Cormorant	1.85	
fish feeder	Razorbill	no data	n. a.
fish feeder	Common Guillemot	no data	n. a.
fish feeder	Black Guillemot	no data	n. a.
fish feeder	Great Black-backed Gull	no data	n. a.

*** Kalman smoothed index is constant. ** no evaluation, as only minor parts of the wintering population have been covered by the available data from the land-based surveys.**

Confidence of indicator status

To achieve a high confidence assessment for the abundance of wintering waterbirds in general it needs to fill spatial and temporal gaps in the monitoring of offshore sections of the Baltic Sea. However, for those species restricted to coastal waters the confidence is already **high**, because numerous locations are surveyed annually for 25 years or more.

Monitoring requirements

Monitoring methodology

General information on monitoring of waterbirds in the HELCOM community is available in the HELCOM Monitoring Manual:

http://helcom.fi/action-areas/monitoring-and-assessment/monitoring-manual/birds/marine-wintering-birds-abundance-and-distribution

The aim is to include guidelines for monitoring of wintering waterbirds into the Monitoring Manual during 2015-2016. Currently monitoring practices vary and are described for offshore censuses by Camphuysen et al. (2003), Skov et al. (2007, 2011) and Nilsson (2012), whereas for coastal areas census methods are standardized by Wetlands International for the International Waterbird Census. Guidelines for monitoring methods needed for this indicator are developed by HELCOM BALSAM.

The indicator on wintering waterbirds is primarily based on the mid-winter counts of waterbirds along the shorelines, i.e. is restricted to coastal staging areas. The coverage of these land-based surveys is outlined in the CORESET I report (Aunins et al. 2013a) and in the HELCOM Monitoring Manual (http://helcom.fi/action-areas/monitoring-and-assessment/monitoring-manual/).

It is aimed to expand the indicator by including waterbirds wintering in offshore sections of the Baltic. This will require the use of ships and/or aircrafts as observation platforms for manned transect counts or the use of digital imagery. Currently, monitoring has been implemented in only few parts of the Baltic, and a strategy for offshore monitoring covering the whole HELCOM area has to be developed in future. For selected species it is also possible to count migrating birds at exposed sites by visual observation (e.g. Long-tailed Duck, Hario et al. 2009), but this approach excludes any finer assessment scale as the entire Baltic.

Description of optimal monitoring

Concerning coastal waterbirds, the land-based International Waterbird Census already serves as an optimal monitoring system. It can continue as it is, but should ensure monitoring in the new ice-free areas (Gulf of Bothnia, eastern Gulf of Finland).

It would be desirable to include offshore parts of the Baltic in the assessment of wintering waterbird numbers. Important components of the avian community concentrate in marine areas not covered by land-based surveys, i.e. divers, grebes, seaducks, gulls and alcids. As depending on weather conditions and other (e.g. dietary) reasons the distribution of some species shows variability between years, simultaneous surveys in all parts of the Baltic are reasonable (and already existing in the land-based International Waterbird Census). Owing to their high costs it has to be discussed whether surveys in the offshore parts of the Baltic can be performed at larger intervals, e.g. in one or two years within a six-year reporting cycle of MSFD or Birds Directive. Therefore, it is recommended to survey the entire Baltic Sea at least every three years in a coordinated way. All ice-free areas should be surveyed and attention should be turned also to new ice-free areas in the Gulf of Bothnia and Gulf of Finland. It is further recommended to develop digital methods for aerial surveys. It has to be noted that so far only two data points for the total of waterbirds wintering in the Baltic are available (Durinck et al. 1994, Skov et al. 2011). International coordination is necessary in order to integrate national monitoring schemes into Baltic wide surveys. Where reasonable, special programmes such as the visual observation of long-tailed duck migration should add valuable information in order to support the explanatory power of the monitoring results.

Current monitoring

Monitoring of coastal wintering waterbirds, the International Waterbird Census, is organized by Wetlands International (Wageningen) and is carried out in mid-January annually for more than 50 years, with a very high coverage of the Baltic Sea from 1991 onwards. It is currently running in all riparian countries of the Baltic and is mainly based on volunteers.

There is no coordinated monitoring for offshore sections, but national programs are implemented in several countries (HELCOM 2014). The offshore sections are far from complete coverage, and intervals of monitoring as well as methods and platforms differ between programs. All past and ongoing offshore surveys are included in a metadatabase developed in BALSAM (HELCOM 2014). Any extension of offshore monitoring would benefit from coordination regarding the periods of surveys and methods applied. More details are listed in the HELCOM Monitoring Manual. As long-tailed ducks in the non-breeding season do not migrate beyond the Baltic, counts of passing birds from observatories in the Gulf of Finland can be used as an additional indicator (Hario et al. 2009).

Description of data and confidence

Metadata

For this update of the CORESET I report (Aunins et al. 2013a), no new data are available. Analyses have been done in the EU Life Project MARMONI (Aunins et al. 2013b).

Contributors, archive and references

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Archive

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