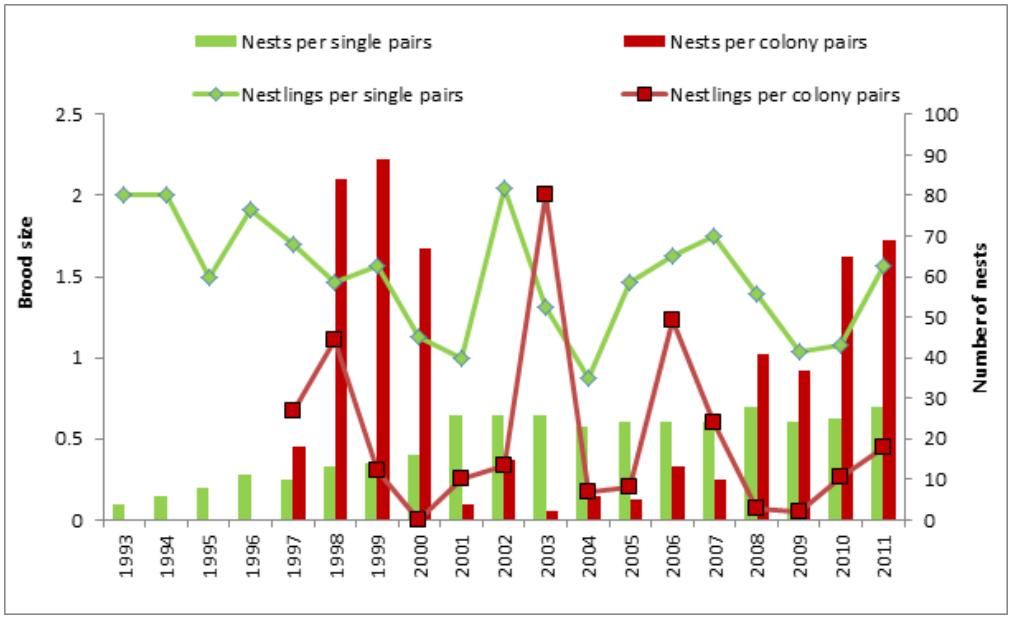
Name of indicator	4.10 Breeding success: clutch and brood size of breeding species
Type of Indicator	State indicator
Author(s)	Andres Kuresoo, Ainars Auniņš, Leif Nilsson, Leho Luigujõe, Antra Stīpniece, Martti Hario
Description of the indicator	This is a set of single species indicators and it reflects breeding success and productivity of the particular species. Indicator has two values: 1. clutch size or number of eggs per clutch laid 2. number of juveniles per breeding female. Breeding success reflects population condition of particular species - productivity, survival of nests, ability of population to re-estabilsh its population after losses. The breeding success data sets are still limited and more sites and species in more countries need to be monitored. Indicators are calculated separately for each of the following species: *Phalacrocorax carbo, Tadorna tadorna, Melanitta fusca, Somateria mollissima, Larus canus, Larus fuscus, Sterna caspia, Sterna hirundo, Sterna paradisaea, Sterna sandvicensis, Sterna albifrons*. Species lists for national and subbasin levels of these indicators are country and subbasin specific.
Relationship of the indicator to marine biodiversity	Breeding success reflects the availability of food resources, abundance of predators (incl. introduced species) and human disturbance, but also pressures related to climate change. Breeding success of the waterbirds is affected by bioaccumulated hazardous substances, particularly organochlorines and oil in the water.
Relevance of the indicator to different policy instruments	The indicator addresses the population condition as required for assessments of the MSFD qualitative descriptor 1 (biodiversity) (Anon. 2008) and stated in the EC Decision 477/2010/EU for the MSFD (Anon. 2010). The indicator can also be used for the assessment of the MSFD qualitative descriptor 4 (food webs) as recommended by the MSFD Task Group 4 (Rogers *et al.* 2010). The indicator addresses the HELCOM ecological objective 'Viable populations of species' which is part of the biodiversity goal 'Favourable conservation status of Baltic biodiversity' (HELCOM 2007). HELCOM CORESET: there is general agreement for the need of this indicator.
Relevance to commission decision criteria and indicator	1.3. Population condition 1.3.1. Population demographic characteristics (e .g. body size or age class structure, sex ratio, fecundity rates, survival/ mortality rates) 1.6.1. Condition of the typical species and communities
Method(s) for obtaining indicator values	Field data collection: to obtain clutch size of the species, searching for nests in sample plots and recording clutch size is needed. In case of larger colonies that cannot be taken whole as a sample plot (i.e. all nests found and clutch size recorded) a sampling within the colony is needed. Random or stratified random sampling design id needed to obtain reliable data. To obtain brood size (number of young per breeding female) for the species number of breeding pairs and number of young per brood (brood size) need to be recoded. Random or stratified random sampling design id needed to obtain reliable data. For game species the proportion juveniles can be estimated from game bags; - proportion of juvenile individuals Indicator calculation: The clutch size is calculated as the mean number of eggs per nest. The brood size is calculated as The measured parameter is defined as 'number of juveniles per breeding females'. Several field methods can be applied, for example: - number of fledglings per breeding females (field counts); - the proportion of Common Eider juveniles could be estimated from game bags; - proportion of juvenile individuals in the wintering population of Long-tailed Ducks could be assessed from photographs.
Documentation of relationship between indicator and pressure	This indicator is more sensitive to short term changes and processes within the population (such as problems with productivity or survival of nests) that will impact abundance of the population in longer term than abundance indicators (either in breeding or nonbreeding seasons). The pressures associated with this clutch size are those affecting body condition of female birds such as decreased food stocks or quality of food items and decline in area of suitable

	feeding habitats. The pressures associated with this clutch size are predation and disturbance during nesting period.
Geographical relevance of indicator	1. Local 2. Regional 3. National waters 4. Baltic Sea wide
How Reference Conditions (target values/thresholds) for the indicator were obtained?	Target indicator values both for clutch size and brood size are species specific. The actual GES targets and boundaries have not been set. Meanwhile a trend based GES reference conditions can be used - if the trend in the clutch size and brood size is negative, the indicator cannot be at GES.
Method for determining GES	More ecological studies are needed to set species specific GES targets and boundary values for age ratio. While precise GES targets and levels cannot be set, a negative trend in clutch and brood size suggest that the indicator can be considered as not being at GES.
References	Anon. (2008a): Directive 2008/56/EC of the European Parliament and the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive). Official Journal of the European Union, L 164/19, 25.06.2008. Anon. (2010): Commission decision of 1 September 2010 on criteria and methodological standards on good environmental status of marine waters (2010/477/EU). OJ L 232/14, 2.9.2010. Bergman G (1980): Single-breeding versus colonial breeding in the Caspian Tern *Hydroprogne caspia*, the Common Tern *Sterna hirundo* and the Arctic Tern *Sterna paradisaea*. (Räyskän, kalatiiran ja lapintiiran pesimisestä yksittäispareina ja yhdyskunnittain). – Ornis Fennica 57: 141–152. Cury PM, Boyd IL, Bonhommeau S, Anker-Nielsen T *et al*. (2011) Global Seabird Response to Forage Fish Depletion—One-Third for the Birds. Science 334: 1703-1705. Edler L, Kononen K & Kuosa H (1996) Harmful algae. In: HELCOM (1996), Third periodic assessment of the state of the marine environment of the Baltic Sea, Chapter 8.1. Available at: http://www.baltic.vtt.fi/balticinfo/index.html Ekroos J, Fox AD, Christensen TK, Petersen IK, Kilpi M, Jónsson JE, Green M, Laursen K, Cervencl A, de Boer P, Nilsson L, Meissner W, Garthe S & Öst M (2012) Declines amongst breeding Eider *Somateria mollissima* numbers in the Baltic/Wadden Sea flyway. Ornis Fennica 89: 1-10. Hario M, Kastepold T, Kilpi M, Staav R, & Stjernberg T (1987): Status of Caspian Terns *Sterna caspia* in the Baltic. – Ornis Fennica 64: 154–156. HELCOM (2012) Development of a set of core indicators: Interim report of the HELCOM CORESET project, PART A. Description of the selection process. Baltic Sea Environment Proceedings No. 129 A. Available at: www.helcom.fi/publications. Hokkanen T (2012) Eastern Gulf of Finland, seabird populations, ornithological surveys. Nature Protection Publications of Metsähallitus. Series A 195. [In Finnish, abstract in English and Swedish] Nordström, M., Högmander, J., Laine, J., Nummelin, J., Laanetu, N., Korpimäki, E. 2003. Effects of feral mink removal on seabirds, waders and passerines on small islands in the Baltic Sea. Biological Conservation, 109: 359–368. Ottvall R, Edenius L, Elmberg J, Engström H, Green M, Holmqvist N, Lindström Å, Tjernberg M & Pärt T (2008) Populationstrender för fågelarter som häckar i Sverige. Naturvårdsverket Rapport 5813. [In Swedish, summary in English] Rogers, S., Casini, M., Cury, P., Heath, M., Irigoien, X., Kuosa, H. *et al*. (2010) MSFD, Task Group 4 Report, Food webs. European Commission Joint Research Center and ICES. Available at: http://www.ices.dk/projects/projects.asp. Österblom H, Bignert A, Fransson T & Olsson O (2001) A decrease in fledging body mass in common guillemot *Uria aalge* chicks in the Baltic Sea. Marine Ecology Progress Series 224:

	305-309. Österblom H, Olsson O, Blenckner T & Furness RW (2008) Junk-food in marine ecosystems. Oikos 117: 967-977
Illustrative material for indicator documentation	 Figure 1. Brood size and the number of nests of Caspian Tern of single pairs and colony breeders in the eastern Gulf of Finland. Modified from Hokkanen (2012). The brood size of Caspian Tern in the Eastern Gulf of Finland has fluctuated during the time series and the poor nestling production of the colony-breeders is especially noteworthy. The greatest threats to the breeding success are bad weather conditions and predation by Herring Gull, American mink and White-tailed Eagle and to a smaller extent disturbance by boating and landing on breeding sites.