Name of indicator	1.4 Abundance index of large (TL>250 mm) perch (*Perca fluviatilis*) in monitoring catches
Type of Indicator	State indicator
Author(s)	Lauri Saks, Roland Svirgsden, Kristiina Jürgens, Aare Verliin, Markus Vetemaa
Description of the indicator	The indicator describes the abundance of large perch (TL>250mm) in the local community. Thus, this indicator should be considered as index describing the age and size structure of the local perch population and fishing (both commercial and recreational) pressure on local fish communities. Decrease in the values of this index may be symptoms for heavy fishing pressure which may result in decrease of the mean trophic level of the community, which in turn may be associated with decline in local biodiversity (Fig 1).
Relationship of the indicator to marine biodiversity	Generally, higher frequencies of older and larger individuals are considered to be in correlation with the health of fish stocks (Piet *et al*. 2010). Larger individuals have a more specific role in the ecosystem if compared to smaller individuals. Besides occupying higher trophic level, larger individuals contribute disproportionately more to the reproductive potential of a population than smaller fish (see e.g. Beldade, 2012 and Olin *et al*. 2012 for example on perch). At the same time, commercial fisheries are targeting specifically larger individuals (e.g. HELCOM, 2012a). It is proposed that the proportion of larger individuals in a population is very sensitive to exploitation and starts to decrease in case of strong fishing pressure (see. e.g. Olsen *et al*. 2005, HELCOM, 2012a and Pukk *et al*. 2013 for example on perch, Fig 2).
Relevance of the indicator to different policy instruments	This indicator is included to the MSFD descriptors 1 (D1.3.1: Population condition, demographic characteristics) and 3 (D3.3.1: Commercially exploited fish and shellfish, Population age and size distribution, Proportion of fish larger than the mean size of first sexual maturation). In case of perch, this indicator ("Abundance index of large (TL>250 mm) individuals in monitoring catches") was used instead of proportion of fish larger than the mean size of first sexual maturation as suggested by ICES (2012). This decision was made, as perch achieves sexual maturation already at relatively small size (♀♀ TL> 157, ♂♂ TL>101; Pihu *et al*., 2003 transformed according to Saat *et al*., 2007). However, the rationale of this indicator (D3.3.1.1) is to describe the abundance of larger individuals in the catches and thus this indicator was preferred.
Relevance to commission decision criteria and indicator	1.3.1. Population demographic characteristics (e .g. body size or age class structure, sex ratio, fecundity rates, survival/ mortality rates)
Method(s) for obtaining indicator values	Data on the abundance of large perch (TL>250mm) in the local communities was gathered during annual monitoring catches according to Thoresson (1993). The abundance of large perch is calculated as number of larger than 250 mm (TL) perch individuals per one monitoring station (catch per unit effort - CPUE) (Eschbaum *et al*., 2012).
Documentation of relationship between indicator and pressure	The values of this indicator have been shown to relate with selective (recreational) fishing pressure (HELCOM 2012a). However, it is likely that in circumstances of heavy (selective) fishing pressure, the proportion of large individuals (especially predatory fish species) will decrease in the community (see e.g. Pukk *et al*. 2013). Thus, decrease in the values of this index may be symptoms for decrease in the mean trophic level of the community, which in turn may be associated with decline in local biodiversity (Fig 1). Associations between indicator values and fishing pressure were tested by comparing monitoring areas near Kihnu and Vilsandi islands (Fig 3) with different commercial fishing pressures (Table 1). Evidently, indicator values were considerably lower (U-test: Z=5,22; p<0,00001; n=30) for Kihnu (stronger fishing pressure) than for Vilsandi monitoring area in 2013 (Fig 4).
Geographical relevance of indicator	1. Local
How Reference Conditions (target values/thresholds) for the indicator were obtained?	As no data on quantitative historic reference conditions (target values/threshold values) is available, qualitative criteria are used at the moment. Relatively long data series from different monitoring areas (see. e.g. Martin 2013) tend to be collected during the period when perch populations in these areas were suffering from overfishing (Ådjers *et al*. 2006). Thus future data collection and analysis is required to determine the quantitative reference conditions of this indicator.
Method for determining GES	Trend-based approach is used to determine GES. GES can be considered when no decreasing trend is evident from time series. However stable trend of low indicator values should not always be considered as GES because strong fishing pressure may have affected the population structure before the beginning of data collection (see e.g. Ådjers *et al*. 2006, Martin 2013 pp. 269-270).
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Illustrative material for indicator documentation	

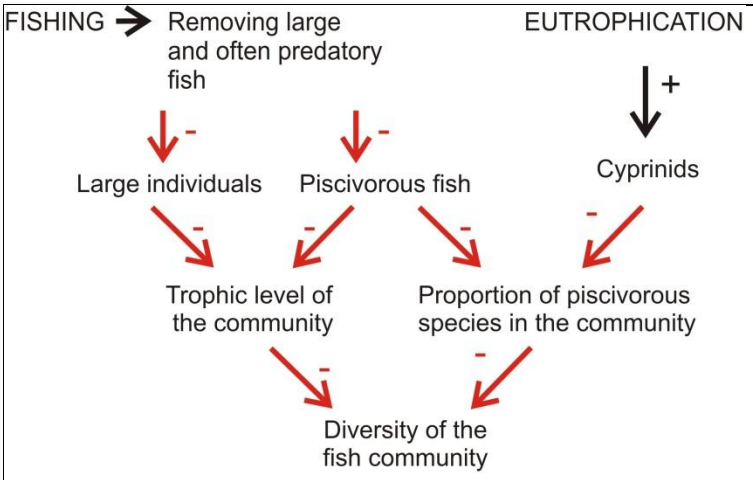

Figure 1. Relationship between biodiversity of the fish community and anthropogenic pressures (modified from HELCOM 2012b)

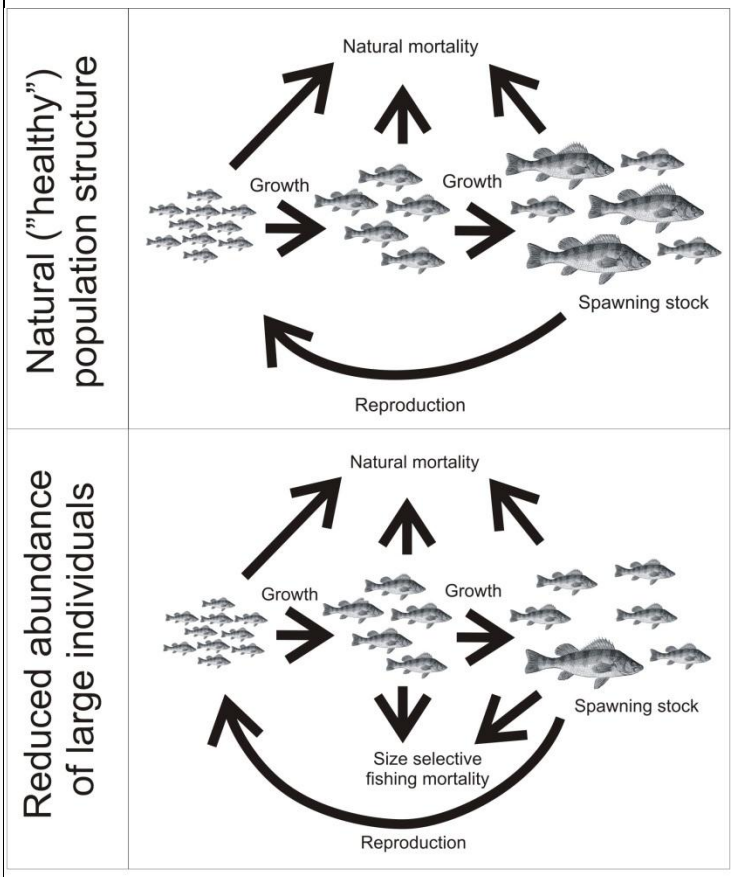

Figure 2. Strong fishing effort can shift the natural population structure. The individuals which grow faster are removed from the spawning stock by size-selective fisheries and thus alternative life-history strategies (slow growth and/or early maturation) prevail.

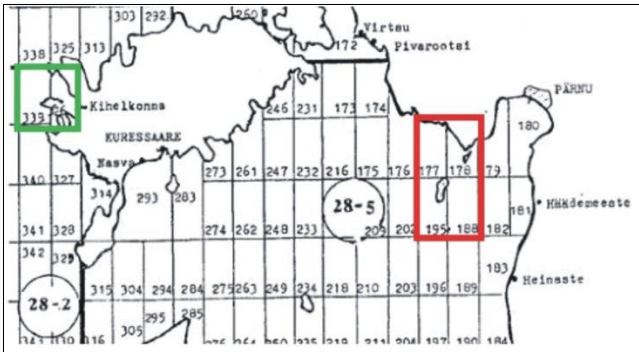

Figure 3. The areas (green box denotes Vilsandi and red box Kihnu area) used for testing the relationship between indicator and pressure

Table 1. Commercial fisheries statistics from Vilsandi and Kihnu area

Area	Section	Nr. of gillnet nights	Perch landings (kg)
Kihnu	177	5 380	12 857
	178	25 162	133 879
	188	6 668	39 728
	195	3 247	11 630
	total	**40 457**	**198 094**
Vilsandi	326	654	448
	339	146	29
	total	**800**	**477**

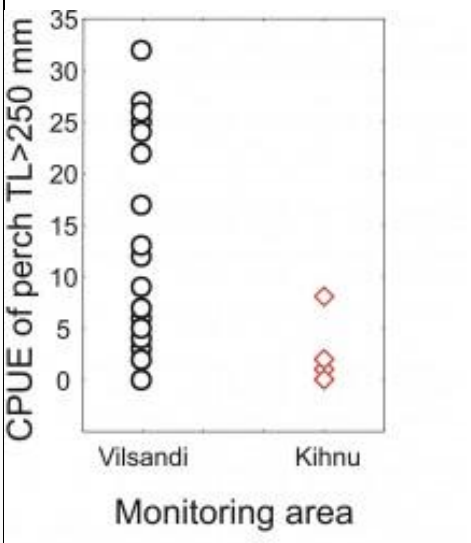

Figure 4. Comparison of indicator values in monitoring stations in areas with different fishing pressure.