

### 30 Technical annex: assessment criteria for biological effects measurements

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Table 30.1. Assessment criteria for biological effects measurements. Values are given for both background assessment criteria (BAC) and environmental assessment criteria (EAC), as available

BIOLOGICAL EFFECT	APPLICABLE TO:	BAC	EAC	
Vtg in plasma; $\mu\text{g ml}^{-1}$	Cod	0.23		
	Flounder	0.13		
Reproduction in eelpout; mean frequency (%)	Malformed larvae	1		
	Late dead larvae	2		
	Growth-retarded larvae	4		
	Frequency of broods with malformed larvae	5		
	Frequency of broods with late dead larvae	5		
EROD; $\text{pmol mg}^{-1}$ protein $\text{pmol min}^{-1} \text{mg}^{-1}$ protein S9 $^* \text{pmol min}^{-1} \text{mg}^{-1}$ microsomal protein	Dab (F)	178		
	Dab (M)	147		
	Dab (M/F)	680 <sup>*</sup>		
	Flounder (M)	24		
	Plaice (M)	9.5		
	Cod (M/F)	145 <sup>*</sup>		
	Plaice (M/F)	255 <sup>*</sup>		
	Four spotted megrim (M/F)	13 <sup>*</sup>		
	Dragonet (M/F)	202 <sup>*</sup>		
PAHs bile metabolites;  <sup>*</sup> 1-OH pyrene <sup>**</sup> 1-OH phenanthrene	Dab	16 $\text{ng ml}^{-1}$ ; HPLC-F <sup>*</sup>		
		3.7 $\text{ng ml}^{-1}$ ; HPLC-F <sup>**</sup>		
	Cod	0.15 pyrene-type $\mu\text{g ml}^{-1}$ ; synchronous scan fluorescence 341/383 nm	22 pyrene-type $\mu\text{g ml}^{-1}$ ; synchronous scan fluorescence 341/383 nm	
		21 $\text{ng ml}^{-1}$ ; HPLC-F <sup>*</sup>	483 $\text{ng g}^{-1}$ GC-MS <sup>*</sup>	
	Flounder	2.7 $\text{ng ml}^{-1}$ ; HPLC-F <sup>**</sup>	528 $\text{ng g}^{-1}$ GC-MS <sup>**</sup>	
		1.1 pyrene-type $\mu\text{g ml}^{-1}$ ; synchronous scan fluorescence 341/383 nm	35 pyrene-type $\mu\text{g ml}^{-1}$ ; synchronous scan fluorescence 341/383 nm	
	Haddock	16 $\text{ng ml}^{-1}$ ; HPLC-F <sup>*</sup>		
		3.7 $\text{ng ml}^{-1}$ ; HPLC-F <sup>**</sup>		
	Haddock	1.3 pyrene-type $\mu\text{g ml}^{-1}$ ; synchronous scan fluorescence 341/383 nm	29 pyrene-type $\mu\text{g ml}^{-1}$ ; synchronous scan fluorescence 341/383 nm	
		13 $\text{ng ml}^{-1}$ ; HPLC-F <sup>*</sup>		
	Haddock	0.8 $\text{ng ml}^{-1}$ ; HPLC-F <sup>**</sup>		
		1.9 pyrene-type $\mu\text{g ml}^{-1}$ ; synchronous scan fluorescence 341/383 nm	35 pyrene-type $\mu\text{g ml}^{-1}$ ; synchronous scan fluorescence 341/383 nm	
DR-Luc; $\text{ng TEQ kg}^{-1}$ dry wt,	Sediment (extracts)	10	40	

silica clean-up				
DNA adducts; nm adducts mol DNA	Dab	1	6	
	Flounder	1	6	
	Cod	1.6	6	
	Haddock	3.0	6	
Bioassays; % mortality	Sediment, <i>Corophium</i>	30	60	
	Sediment, <i>Arenicola</i>	10	50	
	Water, copepod	10	50	
Bioassays; % abnormality	Water, oyster, and mussel embryo	20	50	
	Water, sea urchin embryo	10	50	
Bioassay; % growth	Water, sea urchin embryo	30	50	
Lysosomal stability; min	Cytochemical; all species	20	10	
	Neutral red retention: all species	120	50	
Micronuclei; 0/00 (frequency of micronucleated cells) *Gill cells **Haemocytes *Erythrocytes	<i>Mytilus edulis</i>	2.5 <sup>*</sup>		
		2.5 <sup>**</sup>		
	<i>Mytilus galloprovincialis</i>	3.9 <sup>**</sup>		
	<i>Mytilus trossulus</i>	4.5 <sup>**</sup>		
	Flounder	0.0-0.3 <sup>+</sup>		
	Dab	0.5 <sup>+</sup>		
	<i>Zoarcetes viviparus</i>	0.3-0.4 <sup>+</sup>		
	Cod	0.4 <sup>+</sup>		
	Red mullet	0.3 <sup>+</sup>		
	Comet assay; % DNA tail	<i>Mytilus edulis</i>	10	
Dab		5		
Cod		5		
Stress on stress; days	<i>Mytilus sp.</i>	10	5	
AChE activity; nmol min <sup>-1</sup> mg <sup>-1</sup> protein <sup>1</sup> Gills <sup>2</sup> Muscle tissue <sup>3</sup> Brain tissue *French Atlantic waters **Portuguese Atlantic waters *French Mediterranean Waters **Spanish Mediterranean Waters	<i>Mytilus edulis</i>	30 <sup>1*</sup>	21 <sup>1*</sup>	
		26 <sup>1**</sup>	19 <sup>1**</sup>	
	<i>Mytilus galloprovincialis</i>	29 <sup>1*</sup>	20 <sup>1*</sup>	
		15 <sup>1**</sup>	10 <sup>1**</sup>	
	Flounder	235 <sup>2*</sup>	165 <sup>2*</sup>	
	Dab	150 <sup>2*</sup>	105 <sup>2*</sup>	
	Red mullet	155 <sup>2*</sup>	109 <sup>2*</sup>	
		75 <sup>3**</sup>	52 <sup>3**</sup>	
	Externally visible diseases*** Ep,Ly,UI Ep,Ly,UI Ac,Ep,Fi,Hp,Le,Ly,St,UI,Xc Ac,Ep,Fi,Hp,Le,Ly,St,UI,Xc Ac,Ep,Hp,Le,Ly,St,UI,Xc Ac,Ep,Hp,Le,Ly,St,UI,Xc Italics: ungraded, bold: graded	Dab	FDI:	FDI:
			F: 4.4, 1.8	F: 13.9, 6.6
		M: 5.2, 2.2	M: 32.8, 17.3	
		F: 7.0, 3.1	F: 17.8, 7.8	
		M: 10.4, 4.6	M: 29.8, 13.3	
		F: 6.2, 2.8	F: 16.0, 7.4	
		M: 9.5, 4.3	M: 26.5, 12.4	
		M: males F: females		
Liver histopathology-non-specific	Dab	NA	Statistically significant increase in mean FDI level in the assessment period compared with a prior observation period or statistically significant upward trend in mean FDI level in the assessment period	
Liver histopathology-	Dab	Mean FDI <2	Mean FDI ≥2 A value of	

contaminant-specific			FDI = 2 is, e.g. reached if the prevalence of liver tumours is 2% (e.g. one specimen out of a sample of 50 specimens is affected by a liver tumour). Levels of FDI ≥2 can be reached if more fish are affected or if combinations of other toxicopathic lesions occur
Macroscopic liver neoplasms	Dab	Mean FDI <2	Mean FDI ≥2 A value of FDI = 2 is reached if the prevalence of liver tumours (benign or malignant) is 2% (e.g. one specimen out of a sample of 50 specimens is affected by a liver tumour). If more fish are affected, the value is FDI >2
Intersex in fish; % prevalence	Dab	5	
	Flounder		
	Cod		
	Red mullet <i>Zoarces viviparus</i>		
Scope for growth Joules/h g <sup>-1</sup> dry wt.	Mussel ( <i>Mytilus</i> sp.; provisional, further validation required)	15	5
Hepatic metallothionein µg g <sup>-1</sup> (ww) <sup>1</sup> Whole animal <sup>2</sup> Digestive gland <sup>3</sup> Gills *Differential pulse polarography	<i>Mussel edulis</i>	0.6 <sup>1</sup> *	
		2.0 <sup>2</sup> *	
		0.6 <sup>3</sup> *	
	<i>Mytilus galloprovincialis</i>	2.0 <sup>1</sup> *	
		3.9 <sup>2</sup> *	
		0.6 <sup>3</sup> *	
Histopathology in mussels	VVbas: Cell type composition of digestive gland epithelium; µm <sup>3</sup> µm <sup>-3</sup> (quantitative)	0.12	0.18
	MLR/MET: Digestive tubule epithelial atrophy and thinning; µm µm <sup>-1</sup> (quantitative)	0.7	1.6
	VVLYS and lysosomal enlargement; µm <sup>3</sup> µm <sup>-3</sup> (quantitative)	VvLYS 0.0002	V>0.0004
	S/VLYS: µm <sup>2</sup> µm <sup>-3</sup>	4	
	Digestive tubule epithelial atrophy and thinning (semi-quantitative)	Stage ≤1	Stage 4
	Inflammation (semi-quantitative)	Stage ≤1	Stage 3
Imposex/intersex in snails	Gastropod molluscs	See OSPAR adopted criteria	See OSPAR adopted criteria

\*\*\*Assessment criteria for the assessment of the fish disease index (FDI) for externally visible diseases in common dab (*Limanda limanda*).

Ac, *Acanthochoondria cornuta*; Ep, epidermal hyperplasia/papilloma; Fi, acute/healing fin rot/erosion; Hp, hyperpigmentation; Le, *Lepeophtheirus* sp.; Ly, lymphocystis; St, *Stephanostomum baccatum*; Ul, acute/healing skin ulcerations; Xc, X-cell gill disease.

Full details of the assessment criteria and how they were derived can be found in the SGIMC 2010, SGIMC 2011, and WKIMON 2009 reports on the ICES website and in the OSPAR background documents for individual biological effects methods.

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