OSPAR COMMISSION

MSFD Advice document on Good environmental status - Descriptor 8: Contaminants

A living document - Version of 2 March 2012

Approaches to determining good environmental status, setting of environmental targets and selecting indicators for Marine Strategy Framework Directive descriptor 8

Hazardous Substances Series

2012

OSPAR Convention

The Convention for the Protection of the Marine Environment of the North-East Atlantic (the "OSPAR Convention") was opened for signature at the Ministerial Meeting of the former Oslo and Paris Commissions in Paris on 22 September 1992. The Convention entered into force on 25 March 1998. The Contracting Parties are Belgium, Denmark, the European Union, Finland, France, Germany, Iceland, Ireland, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Convention OSPAR

La Convention pour la protection du milieu marin de l'Atlantique du Nord-Est, dite Convention OSPAR, a été ouverte à la signature à la réunion ministérielle des anciennes Commissions d'Oslo et de Paris, à Paris le 22 septembre 1992. La Convention est entrée en vigueur le 25 mars 1998.
Les Parties contractantes sont l'Allemagne, la Belgique, le Danemark, l'Espagne, la Finlande, la France, l'Irlande, l'Islande, le Luxembourg, la Norvège, les Pays-Bas, le Portugal, le Royaume-Uni de Grande Bretagne et d'Irlande du Nord, la Suède, la Suisse et l'Union européenne.

Version of 2 March 2012

Prepared by the OSPAR Committee of Hazardous Substances and Eutrophication (HASEC)

Disclaimer

This Advice Document is a living document and reflects the state of discussion at expert level at the time of its drafting. The document is of a non-binding nature and aims at facilitating coordination between EU Member States that are parties to the OSPAR Convention, with regard to developing indicators and targets for MSFD Descriptor 8. It does not prejudice the ongoing decision making process in Contracting Parties and their final conclusions in 2012.

Contents

Advice Summary

Summary of common approach toward indicators and targets for GES 8

The following table show the GES indicators and the advice on parameters, assessment criteria and preferred approach. Colours indicate the level of consensus between OSPAR CPs:

Green = high; Orange = some; Red = none; black = not enough information

Criterion	Indicator	Parameter	Assessment criteria	Monitoring	Advice/consideration
8.1 Concentrations of contaminants	8.1.1 Concentrations of contaminants measured in relevant matrix (such as biota, sediment and water) in a way that ensure comparability with the assessments under Directive 2000/60/EC	**Substances (in biota and sediment) listed in the CEMP** **Proposed monitoring of substances in seabird eggs**	**Associated EACs**	**CEMP**	There is good consensus between Contracting Parties on the approach to this indicator. Further EACs are currently under consideration, but further thought is needed about the extent to which EQS values proposed in the recent revision of the WFD and EQS Directives will be suitable for coastal and marine waters
8.2 Effects of Contaminants	8.2.1 Levels of pollution effects on the ecosystem components concerned, having regard to the selected biological processes and taxonomic groups where a cause/effect relationship has been established and needs to be measured	**Imposex in gastropods** **Biological effects techniques developed by OSPAR/ICES** **Proportion of oiled common guillemots (or other relevant bird species)**	**Index (VSDI classes)** **Available, not yet formally agreed** **Birds found dead or dying from oil pollution on identified beach areas**	**CEMP** **Pre-CEMP** **Voluntary monitoring programmes of nature conservation groups**	Only TBT-specific effect is in the CEMP; other effects measurements are in the pre-CEMP. It would be necessary to see how any effects targets can supplement EACs and could be related to measures

	8.2.2 Occurrence, origin, extent of significant acute pollution events *(e.g.* slicks from oil and oil products) and their impact on biota physically affected by this pollution	Risk analysis methods and sufficient emergency preparedness and response capacity in place for dealing with acute pollution events	Occurrence and extent of significant acute pollution events prevented or minimised to limit risks of accidental pollution	Reports in the framework of appropriate international organisations *e.g*. Bonn Agreement and under EU Seveso II Directive	Incidents involving spills from ships carrying oil and other hazardous substances, and from industrial installations at sea or in coastal areas, which can either be large or small, short-lived or long-term, generally result from accidents. Best addressed by Member States, Bonn Agreement or IMO.

Background Document:

OSPAR MSFD Advice Document on Contaminants (MSFD Descriptor 8)

1. What we found in the Quality Status Report – our "baseline".

A third of OSPAR Priority chemicals are expected to be phased out in the OSPAR area by 2020 if current efforts continue. Environmental concentrations of monitored chemicals have generally fallen, but are still above acceptable concentrations in many coastal areas of OSPAR Regions II, III and IV. Contamination with persistent organic pollutants is widespread and their long-range air transport to the OSPAR area, especially Region I is of concern. Historic pollution in aquatic sediments acts as a continued source for releases of persistent contaminants.

2. OSPAR work on hazardous substances will substantially help Member States to address the requirements of the Directive

OSPAR has already made substantial progress in addressing those hazardous substances, which pose a risk to Convention waters through implementing its Strategy on Hazardous Substances. A List of Chemicals for Priority Action has been agreed, and these chemicals have been evaluated to determine the risks they pose, what actions are needed to address those risks, and what monitoring strategies are required to evaluate the status of the North-East Atlantic with respect to those chemicals of key concern. Most of the chemicals on Annex X of Directive 2000/60/EC which EU Member States have to consider under the MSFD, are also on the OSPAR list.

OSPAR has a well-coordinated framework with agreed monitoring programmes and associated assessment criteria to focus work on those chemicals which will complement relevant activities made in other frameworks (*e.g.* HELCOM, the Water Framework Directive).

Annex 1 lists those substances which have been selected by OSPAR and HELCOM on their lists for priority action, together with those that need to be considered under the Water Framework Directive. It also highlights those that have been considered to be appropriate to include in the OSPAR Coordinated Environmental Monitoring Programme (CEMP), which requires agreed methodologies, quality assurance and assessment criteria, and those on the pre-CEMP where methodologies, quality assurance or assessment criteria are being developed.

The tools which OSPAR has developed through its CEMP to assess the status of hazardous substances in the OSPAR maritime area provides a good framework for EU Member States in the North-East Atlantic region to assess whether concentrations of contaminants are at levels not giving rise to pollution effects, and can be used as a well coordinated starting point for Member States to determine characteristics, targets and indicators for GES descriptor 8 and complement relevant assessments made in other frameworks (*e.g.* the Water Framework Directive).

3. Specific OSPAR contribution to targets and indicators arising from Commission Decision 2010/447/EU

3.1 General EU requirements

Member States shall in respect of each marine region (*e.g.* the North-East Atlantic, the Mediterranean) or sub-region concerned (*e.g.* the Greater North Sea, the Western Mediterranean Sea) determine, for the marine waters, a set of characteristics for good environmental status, on the basis of the qualitative descriptors listed in Annex 1 of the MSFD, one of which is descriptor (8): Concentrations of contaminants are at levels not giving rise to pollution effects.[1]

[1] Art. 9.1 of 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 (MSFD). OJ L 164, 25.6.2008, p. 19

Member States should use criteria and methodological standards in their determination of GES.[2] The Commission Decision identifies two criteria for descriptor 8: (8.1) concentrations of contaminants and (8.2) effects of contaminants. One of the two indicators under (8.2) is "occurrence, origin (where possible), extent of significant acute pollution events (*e.g.* slicks from oil and oil products) and their impact on biota physically affected by this pollution (8.2. 2nd indent)."

When determining GES and setting environmental targets/indicators, Member States shall take into account:

- the indicative lists of elements set out in Table 1 of Annex III and, in particular, physical and chemical features, habitat types, biological features and hydro-morphology, amongst others, the situation with regard to chemicals, including chemicals giving rise to concern, sediment contamination, hotspots, health issues and contamination of biota;

- also the pressures or impacts of human activities in each marine region or subregion, having regard to the indicative lists set out in Table 2 of Annex III, amongst others contamination by hazardous substances, *e.g.*:

  (i) introduction of synthetic compounds (*e.g.* priority substances under Directive 2000/60/EC which are relevant for the marine environment such as pesticides, antifoulants, pharmaceuticals, resulting, for example, from losses from diffuse sources pollution by ships, atmospheric deposition and biologically active substances;

  (ii) introduction of non-synthetic substances and compounds (e.g. heavy metals, hydrocarbons, resulting, for example, from pollution by ships and oil, gas and mineral exploration and exploitation, atmospheric deposition, riverine inputs).

With respect to Descriptor 8, relevant provisions of Directive 2000/60/EC in territorial and/or coastal waters have to be taken into consideration to ensure proper coordination of the implementation of the two legal frameworks, having also regard to the information and knowledge gathered and approaches developed in regional sea conventions. The Member States have to consider the substances or groups of substances, where relevant for the marine environment, that:

(i) exceed the relevant Environmental Quality Standards set out pursuant to Article 2(35) and Annex V of Directive 2000/60/EC in coastal or territorial waters adjacent to the marine region or sub-region, be it in water, sediment and biota, and/or

(ii) are listed as priority substances in Annex X to Directive 2000/60/EC and further regulated in Directive 2008/105/EC of the European Parliament and of the Council3, which are discharged into the concerned marine region, sub-region or subdivision, and/or

(iii) are contaminants and their total releases (including losses, discharges or emissions) may entail significant risks to the marine environment from past and present pollution in the marine region, subregion or subdivision concerned, including as a consequence of acute pollution events following incidents involving for instance hazardous and noxious substances.

3.2 Concentration of contaminants

The CEMP provides a common framework for the collection of marine monitoring data by OSPAR countries and the results indicate status and trends in pollution. Contamination by cadmium, mercury, lead, PAHs, PCBs and brominated flame retardants is assessed by monitoring concentrations in fish, shellfish and sediments. TBT is assessed by monitoring concentrations in sediments or biota. The CEMP is being extended to include planar CBs, alkylated PAHs, dioxins and PFOS.

[2] Commission Decision 2010/477/EU of 1 September 2010 on criteria and methodological standards on good environmental status of marine waters. OJ L 232, 2.9.2010, p. 14

[3] OJ L 348, 24.12.2008, p.84.

CEMP monitoring is designed to track contaminants which accumulate in the marine environment and through the food chain but which cannot necessarily be detected in seawater. Time and space integrated data acquired from example given (*e.g.* sediment, biota and passive sampling) gives a better picture of the status of the marine environment than point sampling of the water column. Therefore CEMP assessment results may lead to different conclusions about chemical quality status than monitoring under the EU Water Framework Directive.

OSPAR has developed the following assessment criteria[4] to measure progress towards OSPAR's Strategy objectives.

a. Background concentrations (BCs) represent the concentrations of hazardous substances that would be expected in the North-East Atlantic if certain industrial developments had not happened. The background concentration for man-made substances should be regarded as zero. Background assessment concentrations (BACs) are statistical tools defined in relation to the background concentrations, which enable statistical testing of whether observed concentrations can be considered to be near background concentrations.

b. Environmental assessment criteria (EACs) are assessment tools intended to represent the contaminant concentration in sediment and biota below which no chronic effects are expected to occur in marine species, including the most sensitive species. In preparing the QSR 2010, EACs have been applied to assess concentrations of CBs in sediment and PAHs in biota but other approaches, such as US EPA effect Levels Low and EU maximum concentrations in foodstuffs to protect public health, have been used where appropriate EACs could not be developed in time.

OSPAR is currently reviewing its approach to setting environmental assessment criteria and is developing a conceptual approach for choosing and applying the best methodology for deriving effect levels depending on the data and knowledge available at a given time and depending on environmental conditions. This includes an appraisal and comparison of existing approaches and effect levels, including OSPAR EACs, WFD EQS, EPA effect levels and alternative national approaches.

3.3 Effects of contaminants

Commission Decision on critertia and methodological standards on GES of marine waters (2010/477/EU) sets out the following criteria regarding the "Effects of Contaminants":

> *8.2.1 Levels of pollution effects on the ecosystem components concerned,* ***having regard to the selected biological processes and taxanomic groups where a cause/effect relationship has been established*** *and needs to be monitored.*

The CEMP encourages the monitoring and reporting of a range of contaminant-specific and general biological effects of hazardous substances. Contaminant-specific techniques allow to measure responses within marine organisms to the exposure of specific contaminants, thus providing a means of linking the presence of contaminants and impacts. The most successful technique is the measurement of TBT-specific effects (imposex) in gastropods, where the cause/effect relationship is well established. Other techniques are under development to reflect the responses to multiple contaminants, providing an early warning, including for pollution with substances not under attention of chemical monitoring and combined effects of substances. For example, data on fish diseases are collected under the CEMP and combined in an index as a potential tool for assessing fish population health and to evaluate the impact of human-induced stresses on wild fish.

It is not yet possible in most cases to link chemical monitoring with observations of effects in species in such a way that conclusions can be drawn about the impact of contaminants on the functioning of ecosystems at a regional level. OSPAR countries have made progress in standardising reference methods for monitoring biological indicators, but have not yet implemented a fully coordinated biological effects monitoring

[4] OSPAR agreement 2009-2 on CEMP assessment criteria for the QSR 2010, and associated background document (OSPAR publication 2009/461).

programme. This will be needed to support the regional assessment of hazardous substances. Efforts on biological effects monitoring and assessment should therefore continue and be enhanced, also in relation to combined effects on ecosystem function, for which chemical analysis is not suitable, but not all of the effects will be suitable for MSFD purposes.

The state of the art is reflected in the joint work of OSPAR and ICES through WKIMON, and the latest SGIMC process in 2010 (-> ICES 2010 advice) and 2011, which resulted in assessment criteria for a suite of biological effects techniques:

a. background values (concentrations, activities, scale of effects) that would be expected if certain industrial developments and pollution had not happened;

b. elevated response range determining the cause for concern of observed effects.

This work has also resulted in 2011 in a finalised scheme for integrated chemical and biological effects monitoring. A draft list of biological effects, for which monitoring guidelines and assessment criteria are in place, is at Annex 2. The results of SGIMC 2011 has resulted in the ICES official advice from June 2011 (-> ICES 2011 advice)[5]. HASEC 2012 considered this advice and adopted the JAMP Guidelines for use on a trial basis across interested Contracting Parties with the aim to determine their practical applicability of this advice on the assessment of biological effects and contaminants and the extent to which it can be applied by all Contracting Parties.

Although ICES had developed techniques for assessing the entire set of 'signals' in one integrated scheme and algorithm that could be used to express 'good environmental status' at various levels of geographic scale, there is still considerable debate as to how the biological effect techniques can be used for target setting under the MSFD. Biological techniques will have to be shown "fit for purpose" before being used for target setting. However, discussions at HASEC 2012 concluded that most Contracting Parties were willing to work together to consider the scope for more generalised use of a limited set of biological effect techniques in combination with the CEMP substances to have a streamlined application of the Integrated Guidelines in an OSPAR context, (*e.g.* imposex in dogwhelks) and where Contracting Parties are already undertaking a part of the recommended set of techniques, experiences of practical application will be shared within MIME in order to consider how to take this work forward.

3.4 Occurrence, origin and extent of significant acute pollution events (*e.g.* slicks from oil and oil products)

Commission Decision on critertia and methodological standards on GES of marine waters (2010/477/EU) sets out the following criteria regarding significant pollution events

> 8.2.2 *Occurrence, origin (where possible), extent of significant acute pollution events (*e.g. *slicks from oil and oil products) and their impact on biota physically affected by this pollution*"

Discharges of oil and oily mixtures from ships are regulated under the IMO, with more stringent regulations applying for the North Sea. Incidents involving spills from ships carrying oil and other hazardous substances, which can either be large or small, short-lived or long-term, generally result from accidents, diffuse pollution and illegal discharges.

For operational discharges of oil and chemicals from the offshore oil and gas industry OSPAR measures are in place and are implemented by Contracting Parties. Accidental pollution at sea is covered by international cooperation such as the Bonn Agreement. Furthermore, discharges in coastal areas of oil and chemicals, including 2hazardous substances from industrial installations are strictly regulated under EU and national legislation. However, accidents may occur but prevention, preparedness and response planning associated with these are covered under the EU Seveso II Directive[6].

[5] JAMP Guidelines for the integrated monitoring and assessment of contaminants and their effects
[6] Council Directive 96/82/EC

Contracting Parties regularly monitor oil in discharges from industrial installations, on- and offshore, rather than carrying out environmental monitoring in the marine environment. PAH (and alkylated homologues) as an important constituent of oil is part of the (Pre-)CEMP.

Monitoring and reporting being undertaken by OSPAR and the Bonn Agreement specifically relating to incidental and accidental releases of oil includes:

- occurrence/extent: aerial and satellite surveillance under the Bonn Agreement for spatial extent of oil pollution;
- origin: annual data on oil spills collected by the OSPAR Offshore Industry Committee (OIC) from offshore installations and also collected under the Bonn Agreement through areal surveillance;
- physically affected biota: North Sea EcoQO for beached oiled guillemots under the remit of the OSPAR Biodiversity Committee (BDC) and Committee on Environmental Impacts of Human Activities (EIHA). This parameter is designed for monitoring diffuse oil inputs and pollution (GES indicator 8.2.1) rather than being appropriate in the event of major accidents involving oil (8.2.2). In other parts of marine regions in Europe it may be more appropriate to select other relevant sea bird species as an indicator.

Background information is at Annex 3.

Conclusions

Following a risk-based approach, there seems no need to consider, with regard to oil (hydrocarbons), target setting and/or indicator development under GES criterion 8.1 for (concentrations of) oil or hazardous substances other than those covered under the CEMP or Pre-CEMP (*e.g.* PAHs and alkylated PAHs), whereas regulations are in place under OSPAR, IMO and the EU for operational discharges from offshore installations and shipping (sea-based activities) and industrial installations adjacent to the coastline (land-based activities) subject to national implementation.

Various response systems are in place in the OSPAR area which include relevant schemes for actions, including monitoring of damage caused, both under international cooperation organisations such as the Bonn Agreement and subject to the EU Seveso II Directive in case of major accidental pollution events in industrial installations in coastal areas. Therefore it is advisable to recognise these other fora by formulating an operational target for GES indicator 8.2.2 as follows:

"Occurrence and extent of significant acute pollution events (e.g. slicks resulting from spills of oil and oil products or spills of chemicals) and their impact on biota affected by this pollution should be minimised through appropriate risk analysis to mitigate the risk of an accident causing acute pollution events, and the provision of adequate emergency preparedness and response capability for dealing with such emergencies, taking account of relevant co-operation activities under the Bonn Agreement and to regulations under the EU Seveso II Directive. The response strategy and monitoring requirements should be incident-specific and utilise relevant assessment criteria (e.g. established EQS and EACs) to establish the potential significance of any impact. "

"*Significant acute pollution*" is not defined under either the Bonn Agreement or the EU MSFD as it is dependent on the specific location and extent of the accident or illegal incident and the scope and scale of the resources which are affected by the spilled oil or chemicals. There is therefore a need to consider and assess the impact of such incidents on a case-by-case basis, rather than trying to work towards further refined definitions for approaches to target setting. A possible approach for dealing with such incidents, where arrangements are not already in place is presented in Annex 3 (under Bonn Agreement).

4. Other data available that may be relevant for targets and indicators

In establishing a comprehensive set of environmental targets and indicators to guide progress towards achieving good environmental status, Art. 10 MSFD required EU Member States to take into account the indicative list of pressures and impacts set out in Table 2 of Annex III, and of characteristics set out in Annex IV to the MSFD.

Table 4.1 provides an overview of existing data streams of OSPAR which may be relevant to link with pressures listed in Table 2 of Annex III MSFD.

Other targets as referred to in Annex IV(2) of the MSFD could include

- the 2020 cessation target for OSPAR chemicals for priority action and similar targets in other frameworks (e.g. WFD);
- trend based targets for riverine inputs and direct discharges and atmospheric deposition to show whether measures are working to reduce inputs.

To support, in the future, linking of targets and indicators for state and pressures in relation to hazardous substances, further work is needed to align the component coverage and approaches of CEMP, RID and CAMP monitoring programmes.

Table 4.1 Overview of existing data streams in OSPAR which may be relevant to link with pressures listed in Annex III, Table 2 MSFD

	Data stream/indicator	Contaminant coverage	Responsible Committee
Contamination by hazardous substances	- ***"Introduction of synthetic compounds (e.g. priority substances under Directive 2000/60 which are relevant for the marine environment such as pesticides, antifoulants, pharmaceuticals, resulting e.g. from losses from diffuse sources, pollution by ships, atmospheric deposition and biologically active substances)"***		
	Atmospheric inputs: concentrations in precipitation and air/aerosol at coastal stations (CAMP)	lindane (mandatory); PCBs (voluntary)	HASEC
	Atmospheric deposition: EMEP model calculations and source apportionment for the entire OSPAR maritime area	lindane, PCBs	HASEC
	Riverine inputs and direct discharges (RID)	lindane (mandatory); PCBs, organohalogens (voluntary)	HASEC
	Diffuse sources: Contaminant concentration in dredged/dumped material	TBT, PAHs, PCBs	EIHA
	Pollution from offshore installations: chemicals used offshore and discharged with produced water		OIC
	- *"**Introduction of non-synthetic substances and compounds (e.g. heavy metals, hydrocarbons, resulting, for example, from pollution by ships and oil, gas and mineral exploration and exploitation, atmospheric deposition, riverine inputs)"***		
	Atmospheric inputs: Concentrations in precipitation and air/aerosol (CAMP) at coastal stations	Cd, Hg, Pb (mandatory); PAHs (voluntary)	HASEC
	Atmospheric deposition: EMEP model calculations and source apportionment for the entire OSPAR maritime area	Cd., Hg, Pb	HASEC
	Riverine inputs and direct discharges (RID)	Cd, Hg, Pb (mandatory); hydrocarbons, in particular PAHs and mineral oil (voluntary)	HASEC
	Diffuse sources: Contaminant concentration in dredged/dumped material	Cd, Hg, Pb	EIHA
	Point source: Mercury releases from the chlor-alkali industry. OSPAR target to phase out mercury cell technology by 2010 (Decision 90/3).	Hg	HASEC
	Offshore industry: chemicals and oil discharged with produced water; oil spills	Hydrocarbons, in particular oil and PAHs, heavy metals (Cd, Hg, Pb), any other non-synthetic substances	OIC
	- ***"Introduction of radioactive substances"***		
	Discharges of radioactive substances from the nuclear sector	Artificial radionuclides (synthetic substances)	RSC
	Discharges of radioactive substances from the offshore industry and other non-nuclear sectors	Naturally occurring radionuclides (non-synthetic substances)	RSC
Systematic and/or intentional release	***"Introduction of other substances, whether solid, liquid or gas, in marine waters, resulting from their systematic and/or intentional release into the marine environment, as permitted in accordance with other Community legislation and/or international conventions"***		
	Common understanding of the type of substances needs still to be developed. This could include e.g. non-hazardous substances whose releases are allowed (e.g. offshore installations (PLONOR), shipping etc.)		

5. Addressing the issue of geographic scale

The MSFD requires that good environmental status shall be determined at the level of the marine region or subregion. However, the OSPAR QSR 2010 showed many instances where status was compromised at a smaller scale (*e.g.* hazardous substances in industrialised estuaries). This needs further thought, but using a risk-based approach could enable different types of target to be set where there are many problems, or where there are few or no problems.

CEMP monitoring is mainly focused on coastal areas because, in many cases, the response of the ecosystem to pollution control measures can best be assessed there, close to discharge and emission sources. Increasing attention is being paid to monitoring offshore areas, where a number of human activities (*e.g.* oil and gas production, shipping) take place and as awareness of the significance of long-range transport of contaminants has increased. CEMP monitoring is less intensive in deeper waters and ways to expand cost efficient monitoring in deeper waters should be explored.

To improve the spatial design of CEMP monitoring for hazardous substances in support of regional assessments, work is under way in OSPAR to develop smaller scale assessment areas. Considerations of additional means to improve spatial resolution of monitoring include

a. use of novel techniques such as passive sampling which offers considerable potential for making the CEMP more effective;

b. use of biota matrices involving wider ranging species, *e.g.* measurement of concentrations in seabird eggs, *e.g.* of guillemots. Where pertinent, measurement of concentrations in selected organs of marine biota found at the trophic level could also be used.

The question of geographic scale and integration of data from different parameters (chemical and biological effects) is addressed in the ICES proposed Integrated Guidelines, (esp. Appendix B, Integrated assessment framework). They provide a mechanism for undertaking comparable integrated assessments at a wide range of scales, depending on the type of assessment required and the monitoring data available. The representation of the assessment maintains all the supporting information and it is easy to identify the causative determinants that may be responsible for exceeding EAC levels. In addition, any stage of the assessment can be readily unpacked to a previous stage to identify either contaminant or effects measurements of potential concern or sites contributing to poor regional assessments.

6. Links with other descriptors

Specific interactions of chemical contamination with other indicators of good environmental status include:

a. Descriptor 1: Biodiversity

   Hazardous substances and their cumulative effects are one of the many stressors for marine organisms, potentially impacting populations and therefore biodiversity. A specific interaction with descriptor 1 is the potential for certain synthetic substances, acting in low concentrations in the marine environment, to disrupt immune systems and chemical communication between organisms. Research on these topics is expanding rapidly.

b. Descriptor 4: Marine foodwebs

   Hazardous substances bioaccumulate and biomagnify up the food chain in marine foodwebs. There is opportunity for coordination of species used for monitoring concentrations and biological effects of hazardous substances under descriptor 8 with those used for descriptor 4. For example, seabird eggs provide a good matrix for contaminants in the higher trophic level; selection of seabird species for monitoring could be coordinated with species used as targets and indicators for descriptor 4, thus providing more complete information to explain trends (*e.g.* due to changes in feeding habits).

c Descriptor 9: Contamination of fish and other seafood for human consumption

This descriptor relates to methodological standards to protect human health and EU food limit values apply.

This descriptor requires that contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards. Associated monitoring is usually based on fish and shellfish taken from the market and therefore it is often difficult to link contamination clearly with the source. Combined monitoring for the purpose of descriptor 8 may be possible for shellfish, but not for fish.

d. Descriptor 10: Marine litter

There is growing evidence that 'microplastics' carry and release contaminants. This would need to be further explored.

7. Gaps in knowledge and issues in need for addressing

A number of gaps in knowledge remain as well as issues that need addressing. This includes for example:

a. Interaction of substances;

Hazardous substances, especially synthetic chemicals, occur in the environment as mixtures. The mixtures and their combined effect on organisms and the ecosystem are currently unknown, but this is subject to ongoing work and research.

b. Aggregation of information on substances;

There is a multitude of chemicals (and effects of them) in the environment and methods for a sound aggregation of information from monitoring have been addressed in various ways in recent assessments. OSPAR has developed, in the context of its CEMP assessments, a method for integration used in the QSR 2010 (see Chapter 13, OSPAR Biodiversity Series 390/2009), and HELCOM has developed a tool to aggregate monitoring data assessed against their threshold values (CHASE, see BSEP 120b and BSEP 122). ICES has recently recommended (MIME 11/5/1, Annex 1, Appendix B, pp. 19-24) an integrated assessment framework for contaminants and biological effects. Further experience with these integration tools is necessary for improving environmental assessment of chemical and biological effects status.

c. Climate change;

Warming of the atmosphere in response to climate change may increase the tendency for atmospheric transport of certain substances, more rain and floods can result in higher run-off from land and increased storminess may lead to additional remobilisation of contaminants from marine sediments. Change in sea water temperature and other possible biological impacts of climate change add to the stress on organisms and coupled with pollution effects may make marine organisms more vulnerable to chemical contamination. This may lead to the need for a regular review of assessment criteria used for targets and indicators.

d. Linking sources, pathways and environmental status: biogeochemistry of substances;

Monitoring programmes would need to be designed to allow tracing back chemicals from the environment via their pathways to the sources in order to allow the appropriate development of programmes of measures to achieve good environmental status and assess progress being made.

As a first step towards better linking up of monitoring, the OSPAR programmes RID, CAMP and CEMP require synchronisation to better combine data covering waterborne and atmospheric inputs and environmental concentrations and biological effects of hazardous substances in

assessments. This requires working towards alignment of the component coverage of the programmes and use of methods supporting comparison of trends.

e. Research needs;

Research needs to support the above concerns remain and support through the EU framework is needed to help closing gaps. This includes coverage of the Wider Atlantic and the deep sea for monitoring and assessment.

Annex 1: Overview of substances prioritised by OSPAR, HELCOM and WFD and coverage by OSPAR and HELCOM monitoring programmes

Italicised substances are those which may not be relevant for marine monitoring (i) due to volatility; (ii) as they will undergo rapid hydrolysis before reaching the marine environment; (iii) because the OSPAR monitoring strategy (Background Document) relies on use of WFD monitoring data; (iv) because the OSPAR monitoring strategy (Background Document) indicates that marine monitoring is not required.

*Legend: Combine = Cooperative Monitoring in the Baltic Marine Environment; BSAP = Baltic Sea Action Plan; EQS = Environmental Quality Standards; PHS = priority hazardous substance; * listed in EQS Directive Annex III as substance under review for possible identification as priority (hazardous) substance*

Compound	OSPAR			HELCOM			WFD	
	OSPAR List of Chemi-cals for Priority Action	Monitoring		HELCOM List of Chemi-cals for Priority Action	Monitoring		WFD Annex X or EQS Directive Annexes I & III	Sub-stances under review for WFD (status: March 2011)
		CEMP	Pre-CEMP		Combine indicator (core, main and sup-porting pro-gramme)	BSAP indi-cator		
1,2-Dibromethane				X				
1,2-Dichloroethane							X	
2,4,5-Trichlorophenoxyaceticacid				X				
2,4,6-tri-tert-butylphenol	X							
4-(dimethylbutylamino) phenylamine	X							
Aclonifen								PHS
Acrylonitrile				X				
Alachlor							X	
Aldrin				X			X	
Alkanes				X				
Aminomethylphosphonic acid							*	
Aramite				X				
Atrazine							X	
BDEs	X	X			X		X[1]	X
Bentazon							*	
Benzene							X	
Bifenox								X
Bisphenol-A							*	
Cadmium	X	X		X	X	X	PHS	
Carbon tetrachloride							X	
Chlordane				X				
Chlordecone				X				
Chlordimeform				X				
Chlorfenvinphos							X	
Chlorpyrifos							X	
Clotrimazole	X							
Copper				X	X			
Cyanides							*	X
Cypermethrin								X

Compound	OSPAR			HELCOM			WFD	
	OSPAR List of Chemi-cals for Priority Action	Monitoring		HELCOM List of Chemi-cals for Priority Action	Monitoring		WFD Annex X or EQS Directive Annexes I & III	Sub-stances under review for WFD (status: March 2011)
		CEMP	Pre-CEMP		Combine indicator (core, main and sup-porting pro-gramme)	BSAP indi-cator		
DDT				X			X	
Dibutylphthalate				X				
Dibutylphthalate and di(2-ethylhexyl)phthalate	X			X			X	PHS
Dichloromethane							X	
Dichlorvos								PHS
Diclofenac								X
Dicofol	X						*	PHS
Dieldrin				X			X	
Dioxin-like CBs	X		X			X		
Dioxins and furans	X		X			X	*	PHS
Diuron							X	
Endosulfan	X						PHS	
Endrin				X			X	
Ethylenediaminetetraacetic acid							*	
Fluoroacetic acid				X				
Glyphosate							*	
Heptachlor/heptachlor epoxide				X				PHS
Hexabromocyclododecane	X				X			PHS
Hexachlorobenzen				X	X		PHS	
Hexachlorobutadiene							PHS	
Hexachlorocyclohexanes	X			X	X		PHS	
Ibuprofen								X
Irgarol (Cybutryne)								X
Isobenzane				X				
Isodrin				X			X	
Isoproturon							X	
Kelevan				X				
Lead	X	X		X	X		X	PHS
Mecoprop							*	
Mercury	X	X		X	X	X	PHS	
Methoxyclor	X							
Mirex				X				
Morfamquat				X				
Musk xylene	X			X			*	
Neodecanoic acid, ethenyl ester	X							
Nickel							X	X
Nitrophen				X				
Nonylphenol, -ethoxylates	X			X			PHS	

Compound	OSPAR			HELCOM			WFD	
	OSPAR List of Chemi-cals for Priority Action	Monitoring		HELCOM List of Chemi-cals for Priority Action	Monitoring		WFD Annex X or EQS Directive Annexes I & III	Sub-stances under review for WFD (status: March 2011)
		CEMP	Pre-CEMP		Combine indicator (core, main and sup-porting pro-gramme)	BSAP indi-cator		
etc.								
Nutrients		X						
Octylphenol	X						X	
Organic oxygen compounds				X				
Organotins (TBT)	X	X		X	X	X	PHS	
Polyaromatic hydrocarbons								
Parent PAHs	X	X					PHS	X
Alkylated PAHs	X		X					
PCBs	X	X			X		*	
Pentachlorobenzene							X	
Pentachlorophenol	X			X			X	
PFOS	X		X			X	*	PHS
Phenols				X				
Polychlorinated terphenyl				X				
Quinoxifen							*	PHS
Quintozene				X				
Selenium				X				
Short-chain chlorinated paraffins	X			X			PHS	
Simazine							X	
Terbutryn								X
Tetrabromobisphenol-A	X							
Tetrachloroethylene							X	
Toxaphene				X				
Trichlorobenzenes	X						X	
Trichloroethylene							X	
Trichloromethane				X			X	
Trifluralin	X						X	PHS
Xylenes				X				
Zinc					X			
17 α-ethinylestradiol								X
17 β-estradiol								X

1 Only penta-BDE (CAS 32534-81-9) is PHS

Annex 2: Biological effects monitoring

Overview of biological effects techniques that may be relevant to the ecosystem components for integrated monitoring and assessment of chemical and biological effects data. For all biological effects techniques, background documents and assessment criteria are available.

Table 2 Biological effect techniques relevant to the ecosystem components for integrated monitoring and assessment of chemical and biological effects data. Status regarding availability of Background Documents, assessment criteria, and quality assurance.

Biological effect technique	**Background document**	**Assessment Criteria**	**Quality Assurance**
Oyster and mussel embryo test	X	X	A
Sea urchin embryo test	X	X	B
Copepod test (*Tisbe*)	X	X	A
Whole sediment bioassays	X	X	A
Sediment pore-water bioassays	X	X	A
Sediment sea water elutriates	X	X	A
DR-LUC	X	X	B (in future)
PAH metabolites	X	X	C, D
Cytochrome P4501A activity (EROD)	X	X	A, B, F
Vitellogenin	X	X	E
Acetylcholinesterase	X	X	B, E
Comet assay	X	X	E
Micronucleus formation	X	X	B, F
DNA adducts	X	X	
Metallothionein	X	X	A (fish), F (mussels)
Lysosomal stability (Cytochemical and neutral Red)	X	X	B (fish), B, F (mussels)
Liver histopathology	X	X	A
Macroscopic liver neoplasms	X	X	A
Intersex in fish	X	X	B (in future)
Mussel histopathology(gametogenesis)	X	X	B (in future)
Imposex/Intersex in gastropods	X	X	C
Stress on Stress (SoS)	X	X	not required
Scope for growth	X	X	B
Externally visible fish diseases	X	X	A
Reproductive success in eelpout	X	X	A

A: BEQUALM; B: Between particular independent laboratories; C: QUASIMEME; D: BEAST; E: WGBEC; F: MEDPOL

(Source: ICES, in publication)

Annex 3: Current work related to oil under OSPAR and other international organisations

OSPAR's Joint Assessment and Monitoring Programme (JAMP)

Monitoring

In OSPAR (under the remit of HASEC), oil as a natural hydrocarbon is not part of the Coordinated Environmental Monitoring Programme (CEMP, Agreement 2010-1) in any component in the marine environment. Oil is not an OPSPAR Chemical for Priority Action. However, polycyclic aromatic hydrocarbons (PAHs), as natural components of coal and oil (also formed during the combustion of fossil fuels and organic material) are monitored, as a group of OSPAR priority substances, under the CEMP in biota and sediment on a mandatory basis by 11 Contracting Parties. Alkylated PAHs are part of the Pre-CEMP and are therefore monitored on a voluntary basis by 5 countries in biota and by 2-3 countries in sediment). Under the Comprehensive Study on Riverine Inputs and Direct Discharges (RID), 2 Contracting Parties report on direct discharges of mineral oil on a voluntary basis as recommended under the principles of the RID study (Agreement 1998-5). Further in accordance with OSPAR's Joint Assessment and Monitoring Programme (under the remit of OIC), 7 Contracting Parties report on an annual basis on discharges, spills and emissions from offshore oil and gas installations, as this is relevant to these coastal states.

North Sea EcoQO on oiled guillemots

OSPAR (under the remit of BDC and EIHA) has developed and carried out a pilot project on ecological quality objectives for the North Sea, one of which shows that a reduced rate of oiled guillemots indicates decreasing oil pollution in the North Sea. The North Sea EcoQO relates to physically affected biota: The average proportion of oiled common guillemots in all winter months (November to April) should be 20% or less by 2020 and 10% or less by 2030 of the total found dead or dying in each of 15 areas of the North Sea over a period of at least 5 years.

Box: Reduced rate of oiled guillemots indicates decreasing oil pollution in the North Sea

(Source:OSPAR Quality Status Report 2010, chapter 9, page 95)

Guillemots are deep-diving seabirds that are common and widespread throughout the OSPAR area. They are very sensitive to oil pollution. A guillemot will soon die once it is oiled, due to hypothermia and because it is unable to forage and feed. These dead birds wash ashore and the proportion of stranded guillemots that are oiled can be used as an indication of oil pollution in specific areas.

In some parts of the North Sea, over 90% of all stranded common guillemots were oiled until only a few decades ago. Since then rates of oiled birds have declined substantially in most areas. This is thought to be the result of better enforcement of measures, improved awareness and the introduction of port reception facilities for waste oil. However, the EcoQO is achieved in very few parts of the North Sea. Current rates of oiled birds in the North Sea vary significantly from over 50% in the southern North Sea (the Netherlands, Belgium and south-east England) to approximately 4% in Orkney in the northern North Sea.

The main inputs of mineral oil originate from operational discharges from ships, land-based sources and, to a lesser extent, from the offshore oil industry. This partly explains why higher bird oiling rates are seen near busy shipping lanes (southern North Sea, Channel). Accidents at sea are a less frequent source.

Since the discharge of oil or oily mixtures that cause slicks is prohibited in the North Sea, management measures need to focus on the further enforcement of current regulations and raising awareness among operators of vessels to reduce illegal oily discharges.

Operational discharges from shipping, offshore oil and gas installations and other industries

Shipping

Discharges of chemicals, oil and oily mixtures are regulated under IMO, with more stringent regulations for oil discharges from ships applying for the North Sea 'special area'. Regulations covering the various sources of ship generated pollution are contained in Annexes of the MARPOL 73/78 Convention:

- Annex I deals specifically with pollution by oil. The regulations are strictly related to operational discharges from e.g. machinery spaces (bilge). These are prohibited unless they meet certain requirements for ships according to tonnage and distance from shore. Discharge of clean or segregated ballast is not prohibited;
- Annex II deals with pollution by noxious liquid substances in bulk and relates to operational discharges of ballast water, tank washings or other mixtures containing such substances which are prohibited unless they are in compliance with the applicable operational requirements (discharge standards for substances categorised on the basis of harmful properties) according to ship type, distance from shore and water depth, as well as recommended operational procedures for aircrew that may observe/detect an Annex II discharge from a vessel during a pollution control flight.

Offshore oil and gas installations

OSPAR measures address (under the remit of OIC):

- discharges of chemicals used offshore: OSPAR Decision 2002/2 amended by Decision 2005/1, Recommendations 2010/3 and 2010/4 and related guidelines (screening and selection according to hazardous properties, risk assessment, use of PLONORs acceptable, etc.);
- restriction of use and discharges of organic-phase drilling fluids and contaminated cuttings: OSPAR Decision 2000/3 (use of oil-based drilling fluids prohibited and discharge of OBF-contaminated cuttings restricted);
- discharges of dispersed oil in produced from offshore installations: OSPAR Recommendation 2001/1 as amended by Recommendations 2006/4 and 2011/18 (a discharge standard of 30 mg/l for dispersed oil has been set, with a possibility to add BTEX for the calculation of oil, and analytical standards have been defined for dispersed oil and BTEX). Work is ongoing concerning the development of a risk-based approach for discharges of produced water containing oil and other hazardous substances;
- discharges of displacement water with oil from offshore installations should be prevented for new and substantially modified existing installations: OSPAR Agreement 2003-4 (discharges of oil (bilge) from machinery spaces in offshore installations are subject to IMO regulations, as for shipping).

Other industrial installations

Discharges from chemical industry and refineries situated at estuaries and along the coastline are subject to licensing under the IPPC/EI Directive 2010/75/EU (discharge limit values are based on best available techniques, taking into account local circumstances of the marine environment).[7]

Incidental and accidental significant pollution events from these sectors

The following paragraphs address significant acute pollution events (*e.g.* slicks from oil and oil products in relation to their occurrence, origin and extent) and the way in which they are regulated and handled under different international forums.

[7] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control, Recast, OJ L 334, 17.12.2010, p.17) is covering a suite of existing OSPAR measures in the form of Decisions and Recommendations with regard to BAT and discharge and emission limit values for installations in the (petro)chemical industry and refineries (see Review of Applicability of Decisions, Recommendations and Other Agreements within the Framework of the OSPAR Convention; Summary Record OSPAR 10/23/1, §3.3 and Annex 5).

Bonn Agreement

Cooperation on combating pollution in the OSPAR maritime area is taking place in the following international forums:[8]

- The Agreement of 1983 for cooperation in dealing with pollution of the North Sea by oil and other harmful substances (Bonn Agreement). Contracting Parties are Belgium, Denmark, EU, France, Germany, Ireland, Netherlands, Norway, Sweden and UK (Spain is observer);
- The cooperation Agreement signed in 1990 for the protection of the coasts and waters of the North-East Atlantic against pollution, however this Agreement has not yet entered into force (Lisbon Agreement). Signatories are, France, EU, Morocco, Portugal, Spain.

The Bonn Agreement is the mechanism by which its Contracting Parties, and the European Union, have been working together since 1969 to help each other with combating such pollution from maritime activities, and to carry out surveillance as an aid to detecting and combating pollution in the Greater North Sea and its approaches. Further important active cooperation concerns planning, training and operational testing of emergency response systems, including joint operational response exercises. Another important activity is joint counter-pollution measures (see: Bonn Agreement Counter Pollution Manual on www.bonnagreement.org).

No definition of "significant acute pollution" exists under the Bonn Agreement. Incidents involving spills from ships carrying oil and other hazardous substances, which can either be large or small, short-lived or long-term, generally result from accidents or illegal discharges. Authorities need to act swiftly to such situations on the basis of emergency preparedness and response. Under the Bonn Agreement aerial and satellite surveillance is carried out for estimating the spatial extent of oil pollution, including of their (likely) sources (cooperation between countries on Tour d'Horizon flights and reporting). Methods are available to estimate the amount of oil slick or other polluting substances through sensor techniques. Subsequently Contracting Parties are also carrying out more specific spot sampling and analysis in order to identify sources of accidental and illegal pollution events for control and enforcement purposes. They also apply *e.g.* toxicity criteria for substances if they are known from the source, in order to make assessments of likely environmental impacts when responding to emergency situations. From a point of view of prevention, risk analyses are also being carried out on the basis of modelling in order assess the probability of accidents, through *e.g.* the IMO guidelines for formal safety assessment. Such risk analysis is important in view of concentration of activities such as in busy shipping lanes, around oil and gas offshore installations (shipping-free zones around platforms) and increasing activity of new wind farms (prohibitions to sail through wind farm areas).

In the context of oil spills, the International Tanker Owners Pollution Federation classify spills into three categories, < 7 tonnes, 7–700 tonnes, and > 700 tonnes, and the latter breakpoint could be used to define incidents for which monitoring and subsequent assessment of immediate impacts could be considered as the incident may be sufficiently large to affect GES in, at least, a localised area. For chemicals, it is much more difficult to establish a single threshold because of the wide range of behaviours and toxicity encountered compared to those of oil and oil products. The presence of extensive surface slicks of oil or chemicals, as evidenced by aerial surveillance or satellite imagery, may help to establish the size of the affected area. It should be borne in mind, though, that whilst aerial surveillance measures oil directly through IR or UV imaging, satellite radar infers its presence by locating flat areas of sea, which can lead to false positives in coastal areas subject to wind shadow (*e.g.* below cliffs) so ground-truthing is essential in this case. Many chemicals will not float, but may still exert considerable toxicity either in the dissolved phase or on the seabed. In addition, plumes of vapour might threaten or impact coastal human populations, and this aspect

[8] Cooperation in the EU in the field of marine pollution preparedness and response takes place in accordance with Decision No 2850/2000/EC of the European Parliament and of the Council of 20 December 2000 setting up a Community framework for cooperation in the field of accidental or deliberate marine pollution (OJ L332, 28.12.2000, p.1) and is supported by the European Maritime Safety Agency (EMSA) (Regulation (EC) No 1406/2002 of the European Parliament and of the Council of 27 June 2002 establishing a European Maritime Safety Agency (OJ L 208, 5.8.2002, p.1).

also needs to be considered. In the case of both oil and chemical spills, the observation of significant numbers of dead or moribund fish, shellfish or birds may provide a clear indication of impact and its extent.

Ideally, the affected Member State(s)/Contracting Parties should take responsibility for the design and operation of any monitoring and impact assessment programme which needs to be undertaken in relation to GES. Given the wide range of possible incidents, only generic advice can be given but the aim is to produce an incident-specific programme, which will directly address relevant end-points.

Such a programme could be developed by:

- Establishing as quickly as possible, which material(s) have been spilled, and whether there are further materials that may be lost at a later date. This information can usually be sourced from the primary response organisations;
- Conducting computer modelling of behaviour, transport and fate of the spilled material(s) in order to establish which areas are likely and unlikely to be impacted. The latter can be considered for use as reference areas;
- Sourcing existing background data for the area in which the incident has occurred or, if there are none, immediately collecting suitable samples which can be analysed to provide background data. These may come from adjacent areas unlikely to be impacted or those likely to be impacted but before the pollution arrives at those locations. The possession of these background data is extremely important if the impact is to be assessed effectively;
- Identifying resources at risk, whether species of commercial or nature conservation importance, by reference to spill sensitivity maps usually prepared as a component of national contingency plans. Potential impacts on human activities in coastal and offshore areas should also be considered;
- Designing an incident-specific monitoring programme which is able to establish, as cost-effectively as possible, any impacts on environmental status;
- In a major and long-lasting incident, continually revisit the last point in relation to the data gathered and the changing circumstances in order to ensure that the activities remain fit for purpose.

OSPAR Commission

An additional data source for the offshore oil and gas industry is the annual data collected and reported concerning oil and chemical spills carried out under OSPAR (OIC). Annual reports show frequency according to size of accidental spills (less and more than 1 tonne) per country.

Following the 2010 events of the Deep Water Horizon in the Gulf of Mexico OSPAR Recommendation 2010/18 requires Contracting Parties to gather and present information on their regulations to prevent significant acute oil pollution and to cooperate within ICG-DRILLEX (under the remit of OIC) in order to prepare a final assessment of the need for OSPAR actions in relation to the prevention of significant acute oil pollution from offshore drilling activities. From the reports already submitted by Contracting Parties an overview is available on their regulations to prevent significant acute oil pollution and if relevant, any planned or implemented measures to improve the safety of drilling operations. ICG-DRILLEX, based upon its report and evaluation, will develop a proposal for OSPAR actions on offshore drilling activities in extreme conditions for consideration at OIC 2012. Possible OSPAR actions could include OSPAR Guidelines as well as others options.[9]

[9] ICG-DRILLEX will take into account in its report the external reviews including the North Sea Offshore Authorities Forum (NSOAF), European Commission, the International Regulators Forum (IRF) and the USA Presidential investigation.

European Union

Important in relation to major accidents of industrial installations, also situated near or at the coastline, is the Seveso II Directive.[10] The Directive requires operators to produce a safety report for their installation, establishment, storage facility, or process (art. 9 and 10) and to establish an internal emergency plan. Competent authorities shall establish external emergency plans in case of major accidents of such installations. On 27 October 2011, the European Commission proposed a new regulation which sets out new safety standards for offshore oil and gas operations.[11] The new draft regulation sets rules that cover the whole lifecycle of all exploration and production activities from design to the final removal of an oil or gas installation.

[10] Council Directive 96/82/EC of 9 December 1996 on the control of major-accident hazards involving dangerous substances (OJ L 10, 14.1.1997, p.13), amended by Regulation (EC) No 1882/2003 of the European Parliament and of the Council of 29 September 2003 (OJ L 284, 31.10.2003, p.1) and Directive 2003/105/EC of the European Parliament and of the Council of 16 December 2003 (OJ L 345, 31.12.2003, p.97).

[11] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0688:FIN:EN:PDF

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