



# Conceptual Model Analysis

## Complete

### Milestone M3

Dissemination level

**Public**

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## 1. Introduction

DEVOTES project Milestone 3 concerns the completion of the analysis of conceptual models within Task 1.1, “Produce/refine conceptual models for pressure-impact links on biodiversity”. Pressure-State-Response frameworks and derivatives have been explored and reviewed. They have been refined to produce a new model focusing on the way in which state changes arise. Difficulties are addressed which deal with cumulative impacts, in particular with multiple simultaneous pressures, which more often occur in multi-use and multi-user areas. An improved understanding of the interactions between drivers, pressures and states (or, more particularly, the pressure-state change (P-S) linkage) is important to help facilitate consideration of possible Responses, but this is not something that is specifically provided for by application of the DPSIR (Driver-Pressure-State-Impact-Response) approach alone. Assessment tools including matrices assessments, dynamic ecosystem models and Bayesian Belief Networks (BBN) are described. The BowTie application is introduced as a risk assessment and risk management tool, and the conceptual framework is refined for the DEVOTES project to incorporate mechanisms of pressure effect into a new model structure (DPSIR-BT; DPSIR-BowTie) that supports the application of risk management approaches. In turn, the challenges for moving from conceptual frameworks to assessments are investigated. A detailed description of the results can be seen in DEVOTES Deliverable 1.1 (Smith *et al.*, 2014). In the following section the structure of the deliverable is explained, but for further detail and clearer explanation, the reader is directed to the full Deliverable:

Smith C, Papadopoulou K-N, Barnard S, Mazik K, Patricio J, Elliott M, Solaun O, Little S, Borja A, Bhatia N, Moncheva S, Robele S, Bizsel KC, Eronat AH (2014) Conceptual models for the effects of marine pressures on biodiversity. DEVOTES Deliverable 1.1. Devotes FP7 Project. 80 pp.

[www.devotes-project.eu/wp-content/uploads/2014/06/DEVOTES-D1-1-ConceptualModels.pdf](http://www.devotes-project.eu/wp-content/uploads/2014/06/DEVOTES-D1-1-ConceptualModels.pdf)

## 2. Work Completed

The work undertaken consisted of the lead partner, in discussion with other participants, outlining the ideas for the deliverable. This was followed by a workshop held at the beginning of 2014 with the majority of the participating institutions present. At the workshop the outline was discussed, actions were agreed and work proceeded along three major axes;

- development and current use of conceptual models,

- an extensive but non-exhaustive review of the literature primarily directed at DPSIR and derivative frameworks, and
- tailoring of the DPSIR framework to the DEVOTES project.

Responsibility to coordinate/undertake the different sections of work, contributing references, text and analyses was delegated to several key partners in the task. The deliverable document was compiled over several months with a number of editorial rounds/reviews to focus the content and improve the final text.

### 3. Structure of the Deliverable

The deliverable is divided into several parts, as outlined below, with a sequential development from the theoretical to practical approaches of the DPSIR/Derivatives Conceptual Framework.

#### 3.1. Introduction and Development of DPSIR

The document describes how conceptual models allow for simple visualising and summarising linkages between processes and components in complex environments, thus allowing for risk assessment and risk management. Conceptualising these problems diagrammatically may lead to production of “horrendograms” which may not be so easy to understand. The DPSIR framework developed over the past few decades provides some structure to the way that complex issues can be conceptualised in a standard and more clear way. The development of DPSIR and adoption by international organizations in the last few decades is described and the components defined.

In the ‘real world’ elements do not work in isolation and so the concept is taken from single cycle DPSIR chains through endogenic managed pressures to more complex situations with inclusion of exogenic unmanaged pressures, multiple interacting DPSIR cycles from a common pressure (for example from multiple drivers), to including a further step of multiple pressures.

### 3.2. Conceptual models

As a first part to this section, concentrating on known concepts, a comprehensive but non-exhaustive review of the available literature concerned with the DPSIR framework, its ‘derivatives’ and other related frameworks is reported. During the review 19 different defined derivatives were identified. A total of 23 research projects and 125 reports/publications, focussing on coastal and marine habitats, are described and categorised for their use of DPSIR. The second part of this section deals with moving from concepts to assessments and the techniques available for analyses. These include simple matrices approaches, ecosystem modelling and BBN. The BowTie approach is also introduced.

### 3.3. Cumulative Effects

The first part to this section, in recognising that in the “real-world” multiple activities and pressures are in evidence, notes that overall pressures will rarely be consistent, and that their different combinations will lead to cumulative and in-combination effects (including synergistic and antagonistic). Some of the current knowledge on these effects is summarised. In the second part of the section, key cumulative impact studies in regional sea studies are identified – comprising of both overlap and weighted cumulative methods.

### 3.4. DPS Chains in the MSFD

A major example is given of the complexity of interactions within the context of the Marine Strategy Framework Directive (MSFD) for just one sector (fishing) with one activity (demersal trawling). From the Directive defined issues, this considers the multiple pressures exerted by the activity, acting on multiple habitats, multiple environmental characteristics, multiple species groups, and their multiple structural and functional characteristics.

### 3.5. DEVOTES Conceptual Framework

The Pressure-State change linkage of DPSIR is explored in detail producing a model that considers in detail the state change trajectory from the pressure. Here the physico-chemical and biological state changes arising from pressures can cause a biological state change at any level (population, community or ecosystem), either progressively through a sub-lethal response at the individual level which, over time, can lead to state changes at higher levels, or directly by acting at a higher level, leading to more

immediate community and ecosystem state change. The state change conceptual model is put into the context of risk assessment.

### **3.6. Data Challenges in Moving from Conceptual Frameworks to Assessments**

The final section of the deliverable investigates the challenges in moving from a conceptual framework to a data-based or expert judgement-based analysis. These challenges involve the identification of all the components and their linkages within the greater problem, indicators availability and their quality or thresholds, equality of data from different areas, assessment scales and scaling up assessments, and finally confidence in the assessments.