DPSIR (and its offspring!) in marine and coastal ecosystems:
Lessons from two decades of use

Joana Patrício, Chris Smith, Nadia Papadopoulou, Krysia Mazik & Mike Elliott
The DPSIR Framework

DPSIR is policy oriented and provides a framework for categorizing a problem domain, along a causal chain.
Type of Publication used as source

- Peer-reviewed article: N=134
- Book chapter
- Conf. prooc.
- Report
- Editorial
- Other pub.
### Categories considered

1. **Studies collected**

<table>
<thead>
<tr>
<th>Reference</th>
<th>Date of publication</th>
<th>Study site</th>
<th>Habitat</th>
<th>Region</th>
<th>Framework/Model type</th>
<th>Issue/problem</th>
<th>Implementation level</th>
<th>Type of publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fock et al. 2011</td>
<td>2011</td>
<td>German EEZ</td>
<td>Marine</td>
<td>Europe</td>
<td>PSR</td>
<td>Linking marine fisheries to environmental objectives (seafloor integrity)</td>
<td>Applied</td>
<td>Research paper</td>
</tr>
<tr>
<td>Gimpel et al. 2013</td>
<td>2013</td>
<td>German waters of the North Sea</td>
<td>Marine</td>
<td>Europe</td>
<td>DPSI</td>
<td>Changes in nursery grounds</td>
<td>Applied</td>
<td>Research paper</td>
</tr>
<tr>
<td>Langmead et al. 2007</td>
<td>2007</td>
<td>Baltic Sea, Black Sea, Mediterranean Sea and North-East Atlantic</td>
<td>Marine</td>
<td>Europe</td>
<td>mDPSIR</td>
<td>Organise information relating to habitat change, eutrophication, chemical pollution and fishing</td>
<td>Applied</td>
<td>Final project report</td>
</tr>
<tr>
<td>Andrulewicz 2005</td>
<td>2005</td>
<td>Baltic Sea</td>
<td>Marine</td>
<td>Europe</td>
<td>DPSIR</td>
<td>Indicators for management of human impact</td>
<td>Conceptual and Applied</td>
<td>Book chapter</td>
</tr>
<tr>
<td>Sundblad et al. 2014</td>
<td>2014</td>
<td>North and Baltic seas, Sweden</td>
<td>Marine</td>
<td>Europe</td>
<td>BPSIR</td>
<td>Framework for structuring the social information that can play an important role in MSFD implementation (case studies: phosphorous load, mercury load and cod fishery)</td>
<td>Conceptual and Applied</td>
<td>Research paper</td>
</tr>
<tr>
<td>Tett et al. 2013</td>
<td>2013</td>
<td>Northwestern part of the North Sea</td>
<td>Marine</td>
<td>Europe</td>
<td>DPSIR</td>
<td>Framework for understanding marine ecosystem health</td>
<td>Conceptual and Applied</td>
<td>Research paper</td>
</tr>
<tr>
<td>Cooper 2013</td>
<td>2013</td>
<td>-</td>
<td>Marine</td>
<td>Europe</td>
<td>DPSWR</td>
<td>Define the DPSWR framework and comment on its application to marine systems</td>
<td>Conceptual</td>
<td>Research paper</td>
</tr>
<tr>
<td>Curtin and Prelezzo 2010</td>
<td>2010</td>
<td>-</td>
<td>Marine</td>
<td>-</td>
<td>DPSIR &amp; PSR</td>
<td>Help management to form sustainability indicators (EBM)</td>
<td>Conceptual</td>
<td>Review paper</td>
</tr>
<tr>
<td>Elliott et al. 2006</td>
<td>2006</td>
<td>-</td>
<td>Marine</td>
<td>Europe</td>
<td>DPSIR</td>
<td>Management approach for marine environment (i.e framework to explain the causes and consequences of state change in the marine environment)</td>
<td>Conceptual</td>
<td>Technical report</td>
</tr>
</tbody>
</table>

2. Each reference was categorized by...

(...)

3. Reference Date of publication Study site Habitat Region Framework/Model type Issue/problem Implementation level Type of publication
Evolution of the conceptual framework

.... applied, discussed, developed, published...

NOTE: the arrows do not represent the year in which the frameworks were proposed but correspond to the first time the framework is mentioned in the publications considered in this review.
Studies published per year

Frameworks

- DPSI
- IMBER-ADApT
- DAPSI(W)R
- PSBR
- BPSIR
- eDPSEEA
- DPSWR
- tetrahedral DPSIR
- eDPSIR
- PD
- mDPSIR
- DPCER
- DSR
- PSIR
- PSR/E
- PSR

75%
Implementation level

- definition/revision of framework
- reporting outline
- framework to select indicators/assess biodiversity
Regions covered

- Africa
- Asia
- Europe
- Oceania
- North America
- South America
- Not specified

N=134

Other regions: only 15% APPLIED
Habitats covered

- Coastal: 48%
- Coastal and marine: 13%
- Marine: 19%
- Not habitat specific: 21%

Only 8 are applied case studies!!! (N=134)
Framework context of use: different purposes

- Development and assessment of indicators
- Assessment of eutrophication
- Assessment of impacts and vulnerabilities
- Fisheries and aquaculture management
- Integrated coastal management
- Management of marine aggregates
- Assessment of seagrass decline
- Management of water resources
- Assessment of wind farming consequences
- Framing social information in the MSFD implementation context
Pros and Cons of DPSIR

Pros
✓ Unifying framework for RA and RM - it allows us to work out where the risks are coming from (D, P), what they are causing (S, I) and how to manage and minimize them (R)
✓ DPSIR can be applied to all types of environmental problems
✓ It is an anthropocentric action oriented framework, capable of conceptualizing the ecological and the social system
✓ It can be applied in a standard way and be used to involve all the relevant actors at any level of detail
✓ It is largely understood and used by many different organizations

Cons
➢ Standard is not so standard...
  (Definitions and interpretations vary – within as well as between disciplines)
Pros and Cons of DPSIR and derivatives

*Standard is not so standard...*

Issues in the definitions of DPSI – between users

*Fundamental difference for ‘S’ and ‘I’ between natural and social scientists*
**Pros and Cons of DPSIR**

**Cons**

- Standard is not so standard… (Definitions and interpretations vary – within as well as between disciplines)
- DPSIR oversimplifies the problems
- Problems addressed tend to be one-dimensional (developed in one plane, for one set of problems/solutions) – not so relevant to a ecosystem-based management approach

... but this is where new developments, DPSIR derivatives and refinements are taking us...
Refining DPSIR into well defined frameworks
e.g. DAPSI(W)R(M) framework

Drivers (societal basic needs)

Activities (of society)

Pressures (resulting from activities)

State change (on the natural system)

Responses (economic, legal, etc) (Measures)

Impacts (on human Welfare) (changes affecting wealth creation, quality of life)

addition of A is a major step forward

Wolanski & Elliott 2015
Latest Conceptual Developments

Expansion of DPSIR to accommodate **multiple pressures** towards a common Response (using Measures) leading to integrated management

![Diagram of DPSIR model with expanded pressures](adapted from Atkins et al 2011)
**Nested DPSIR** for complex ecosystems (e.g. different parts of a catchment area)
Latest Conceptual Developments

Considering **multiple activities and drivers** that cause **common pressures**

Drivers: (D)

Activities: (A)

Pressures: (P)

State changes: (S)

Impacts (on Welfare): I(W)

Responses (for Measures): R(M)

adapted from Atkins et al 2011
Multiple DPSIRs can also be grouped to investigate **multiple pressures from different activities**

**All P stacked into a 3D DPSIR**

Smith et al. 2014
DPSIR is a fundamental tool for standardised problem solving.

It has been well taken up, within international organisations, particularly within Europe.

It has led to a large amount of thought (more than 15 derivatives) to customize the framework to better fit specific problems or bring better clarity/improvement to the framework.

It is often used as a visualization tool for complex interactions.

This review shows the evolution and the latest research developments made towards a better understanding of the processes, mechanisms and types of measures needed to properly frame a problem in the context or risk assessment and management.

Nested DAPSI(W)R(M) appears to overcome many of the criticisms of DPSIR.
Thank you