Centre for Environment Fisheries & Aquaculture Science

Cefas

World Class Science for the Marine and Freshwater Environment

Cardigan Bay Stakeholder Workshop Report

Marine Ecosystems Research Programme – Module 8, Cumulative impacts and management of marine ecosystems

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The University Of Sheffield.

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Note: The views expressed in this report are those provided by the workshop participants as part of a research project. Whilst, every effort was made to have all interested parties represented in the workshop there were some significant omissions, so inevitably there are some views expressed that might be challenged by those who were absent; or where knowledge and evidence that the participants were not aware of could change the views expressed; or additional issues to those raised at the workshop that have not been captured. However, as the basis for progressing this research the outputs from the workshop are a valuable resource.

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Acknowledgement

This work was supported by the Natural Environment Research Council and Department for Environment, Food and Rural Affairs grant number *NE/L003279/1* Marine Ecosystems Research Programme. Sincere thanks are given to the workshop participants for their time, energy and enthusiasm. Thanks also to Bangor University for organising the venue, accommodation, caterings and logistics for the workshop and to the staff at the Metropole Hotel for their hospitality and support.

1 Introduction

1.1 Marine Ecosystems Research Programme

The Marine Ecosystems Research Programme (MERP) commenced in 2014 and is a five-year research project jointly funded by the Natural Environment Research Council (NERC) and the Department for Environment, Food and Rural Affairs (Defra). MERP is a multi-disciplinary project, involving over 50 UK scientists from 12 research organisations. The programme is designed to improve understanding of the processes governing the dynamics of marine food webs and how changes in them affect the sustainable delivery of ecosystem services. Specifically, MERP aims to:

• Understand how marine food webs and the services they provide (e.g. food production and recreation) are regulated by natural mechanisms or human pressures.

• Integrate the improved understanding of food web regulation with existing ecosystem models and explore the impact of environmental change on the structure, function and services associated with marine food webs.

• Apply new model developments to test the impact of potential management measures on the structure and function of marine food webs.

1.2 Cumulative impacts and management of marine ecosystems (Module 8)

The focus of MERP module 8 is to develop scientific understanding of how multiple activities interact to affect marine ecosystems and the services they provide. The overall aim is to show how empirical data, modelling, and expert judgement can be translated into both context-specific guidance and general principles for marine management. MERP outputs which collate existing data are being used to document spatial and temporal trends in a number of key indicators of ecosystem state, which are already embedded into management practices at various spatial scales. Policy drivers include the need to maintain (or restore) these indicators to within target ranges.

Frequently, managers are required to consider the effects of multiple pressures on multiple indicators at once. For example, what are the effects of pressures from fishing, marine litter and recreational water sports on bottlenose dolphin and seabird abundance? How do existing management measures protect levels of bottlenose dolphin and seabirds? How might new management measures affect both dolphins and seabirds? And could these measures have unexpected consequences elsewhere?

Such questions can be formalised as Cumulative Effects Assessments (CEA), and our aim in this module is to extend existing risk assessment-based CEAs to address critical and recurring evidence gaps. These include issues of spatial and temporal scale (e.g. interactions between local and regional effects, expected timescales of responses to management and thus recovery

potential), limited empirical data, lack of understanding of the functional aspects of the relationships between pressures and effects, and of how effects themselves interact, as well as the cumulative effects of management actions themselves.

1.3 Cardigan Bay Stakeholder Workshop

We recognise that local stakeholder communities represent a considerable (and largely untapped) source of expert knowledge and judgement. When designing this module, we wanted to ensure that engagement with local stakeholders formed a key part of our work. This is achieved through workshops which bring together stakeholders with a wide range of interests to share their knowledge and experiences, to identify key environmental pressures, establish how these pressures affect species and habitats, and investigate the likely effects of regional management actions on the environment, people's enjoyment of the environment and people's livelihoods and well-being.

Cardigan Bay in Wales was chosen for one of these workshops due to its diverse fishery and wildlife tourism activity coinciding with internationally important nature conservation designated sites, nationally important populations of bottlenose dolphin (*Tursiops truncates*), sizeable populations of other cetaceans and seabirds. MERP is interested in understanding links between environmental pressures and these habitats and species, and the likely effects of different management actions, the social and economic benefits generated by the environment, and how changes in environmental conditions could impact local communities.

The workshop was held from 13 – 14 November 2017 at the Metropole Hotel, Llandrindod Wells in Wales. Participants with a wide range of interests were invited to the workshop (Appendix 1). Twenty of the participants (including three MERP projects members) live and work in Wales.

1.4 Environmental, social and economic context

The Welsh marine area consists of around 32,000 km^2 of sea, as well as 2,120 km of coastline. 42% of the Welsh coastline is defined as Heritage Coast. Designated sites for nature conservation cover 35% of the sea area; 75% of the coastline. The Welsh marine area comprises diverse and valuable natural resources that underpin our well-being and that of future generations (Welsh Government, 2015, 2017).

1.4.1 Governance

Management of activities in Welsh waters is split between devolved functions which are the responsibility of Welsh Ministers (e.g. aggregates, recreation and tourism), and functions which are retained by UK Government (e.g. defence). The draft Welsh National Marine Plan is the first marine plan for Wales and represents the start of a planning process to support sustainable use and development of marine resources through economic, social and environmental objectives and policies. The Well-being of Future Generations (Wales) Act 2015 (Welsh Government, 2016a) aims to improve the long-term social, economic, environmental and cultural well-being of Wales. The Environment (Wales) Act 2016 (Welsh Government, 2016b) puts in place a legislative framework to promote the Sustainable Management of Natural Resources (SMNR).

1.4.2 Society

Over 60% of the population of Wales lives and works on the coast. The sea and its associated activities play a significant role in people's well-being by providing jobs and opportunity for recreational activities and by supporting cultural diversity and a sense of heritage. People at the coast are more likely to be skilled, but less likely to be employed full-time. In 2013, the marine sector in Wales supported 5,800 employee jobs (0.5% of the total for Wales (compared to 0.7% for the UK) (Welsh Government, 2017). The Gross Value Added (GVA) generated by the marine sector in Wales in 2014 was around £317 million (Welsh Government, 2017). The total marine contribution to Wales GVA ranged between 0.4% and 2.2% between 2005-13 and the total marine contribution to UK GVA ranged between 2.2% and 3.2% between 2005-13 (Welsh Government, 2017).

1.4.3 Goods and services

Cardigan Bay supports the following goods and services (Welsh Government, 2015, 2017):

- **Marine aggregates** GVA £4 to 40 million between 2009 & 2013, supporting 500 Full Time Equivalent (FTE) (47% of all sand & gravel sold in Wales is from marine)
- Nine **aquaculture** businesses, employing 23 FTE, total GVA £3.7 million
- **Military** practice areas cover 11,453 km^2 (37%) of the area of the Welsh Zone.
- **Navigation dredging** GVA £0.8 million for 2013/14 (1.73 million tonnes returned to sea)
- **Fisheries** GVA £27 to 50 million between 2005 and 2013 (731 fishermen (6% of UK total), 13,285 tonnes of fish and shellfish landed into Wales by UK vessels in 2013 (11,510 tonnes of shellfish and 1773 tonnes of demersal fish), in 2015, Welsh seafood exports were worth £29.2m,
- **Marine renewable energy** GVA £127 million for 2013/14, with 1149 direct employees and a further 862 indirectly employed in the sector
- **Oil and gas** GVA £173 – 748 million between 2010 and 2014, supporting over 1000 FTE
- **Ports & shipping** GVA £133 to 256 million between 2005 and 2013. 14 ports handling commercial traffic (11% of UK port traffic), 3300 port related jobs and 11,000 wider related jobs. The total freight traffic through Welsh ports accounted for 54.6 million tonnes (Mt) of goods: 36.5 Mt goods inwards; and 18.1 Mt goods outwards. Welsh ports accounted for 11% of the total UK port traffic of 501 Mt.
- **Tourism and recreation** - tourists bring in around £14 million per day to Wales. This amounts to around £5.1 billion a year with 132,400 direct employees in 2015. In 2014 coastal walking attracted 43.5 million visits equating to £31 million and generating 12,230 FTE. In 2013 coastal tourism in £602 million.

1.4.4 Climate change

Wales is experiencing hot, dry summers, warm wetter winters and changes in intensity of weather events. There will be impact on biodiversity with key species predicted to migrate or vacate Wales over the next 100 years. Sea level rise will bring increased risk of coastal erosion, damage to infrastructure and habitats.

Around 208,000 properties in Wales are at risk of flooding from rivers or the sea (Welsh Government, 2017). Erosion occurs along 23% of the Welsh coastline (Welsh Government, 2017). A 415 km network of hard sea defence is in place to help protect some £8 billion of coastal assets, with £50 million a year invested in flood and coastal risk management (Welsh Government, 2017). Support will be needed for communities to adapt and increase self-sufficiency and resilience.

1.4.5 Bottlenose dolphins in Cardigan Bay[1]

The EU Habitats Directive provides a common framework for the conservation and sustainable use of biodiversity. The Habitats Directive is also an instrument for integration of biodiversity requirements into other EU policy areas. The Habitats Directive sets out the requirements for establishing Special Areas of Conservation (SAC). Each SAC has conservation objectives to maintain (or restore) the habitat and species features, as a whole, at (or to) Favourable Conservation Status within the site. Collectively, SACs, along with other designations (e.g. Special Protection Areas for birds and Ramsar wetland sites), are termed Natura 2000 sites. Natura 2000 sites provide conservation of species and habitats across the entire natural range in the EU, irrespective of political boundaries and have strong legal protection. Natura 2000 site selection is exclusively scientific. They promote sustainable development - new activities or development affecting Natura 2000 sites are not automatically excluded.

Bottlenose dolphins are locally distributed in coastal waters, with summer concentrations in Cardigan Bay and Winter concentrations in North Wales. Bottlenose dolphins are afforded protection under Annex II of the Habitats Directive. They are features of both the Cardigan Bay SCA and the Pen Lyn a'r Sarnau SAC. The SAC conservation objectives for bottlenose dolphin include: Population Dynamics (size, structure, reproductive success, physiological health), Range, Habitat (distribution, extent, structure, function and Quality) and Management of Activities and Operations. Surveys show that >50% of observed bottlenose dolphins are resident with the rest occasional visitors or transients. The bottlenose dolphin range extends beyond the limits of the SACs. Human activities in Cardigan Bay, such as water sports, sailing, dolphin watching, scallop dredging, and potting have the potential to have short-term (avoidance; increased dive times and swim speeds; vocal behaviour; disruption of social groups) and long-term (reduced birth rates; decreased abundance; movement away from the affected areas) effects on bottlenose dolphins.

[1] Sourced from workshop presentation by Peter Evans (Bangor University / Sea Watch Foundation)

2 Method

2.1 Workshop Conveners

The workshop was convened by: Adrian Judd, Daniel Wood and Mike Spence (Cefas); Mike Kaiser, James Waggitt and Peter Evans (Bangor University); Tom Webb, Paul Blackwell and Miriam Grace (Sheffield University) and Tara Hooper (Plymouth Marine Laboratory).

2.2 Pre-workshop questionnaire

A questionnaire was sent out to the participants (Appendix 2). Most of the responses to the questionnaires were received on the day of the workshop. A range of areas of interest and issues of concern regarding the environmental management and integrity of Cardigan Bay were considered. The issues most frequently raised by participants in the questionnaires were:

- Wildlife Tourism
- Recreational boating / water sports
- Coastal developments (including sea defences)
- Scallop dredging
- Litter
- Lack of joined up decision-making; lack of enforcement
- Sea angling
- Lobster potting
- Chemicals, nutrients, organic enrichment of marine sediments

2.3 Workshop stakeholder engagement exercises

A core goal of management is the sustainable use and development of marine resources which requires us to balance environmental, social and economic considerations (Figure 1). Management of marine resources is expected to achieve an increasingly diverse set of conservation, social and economic goals. The setting of these goals must acknowledge the potentially conflicting interactions, and hence trade-offs, between the natural environment and society. These trade-offs mean that not all benefits can be maximised simultaneously. Since stakeholders need to make informed decisions about their relative preferences, marine managers must be able to explain the impact and distribution of these trade-offs for differing marine management regimes. While these topics can be considered from a desk, direct input from stakeholders can greatly increase the usefulness and impact of the end products of this project. Without stakeholder input, key areas, concerns or sources of information may be missed. Many of the stakeholders are directly affected by the environment of Cardigan Bay and therefore benefit from effective management. The aims of the engagement activities were to identify which environmental issues Cardigan Bay stakeholders deemed to be most important. The activities aimed to identify these issues and to extract/collate as much information on the issues.

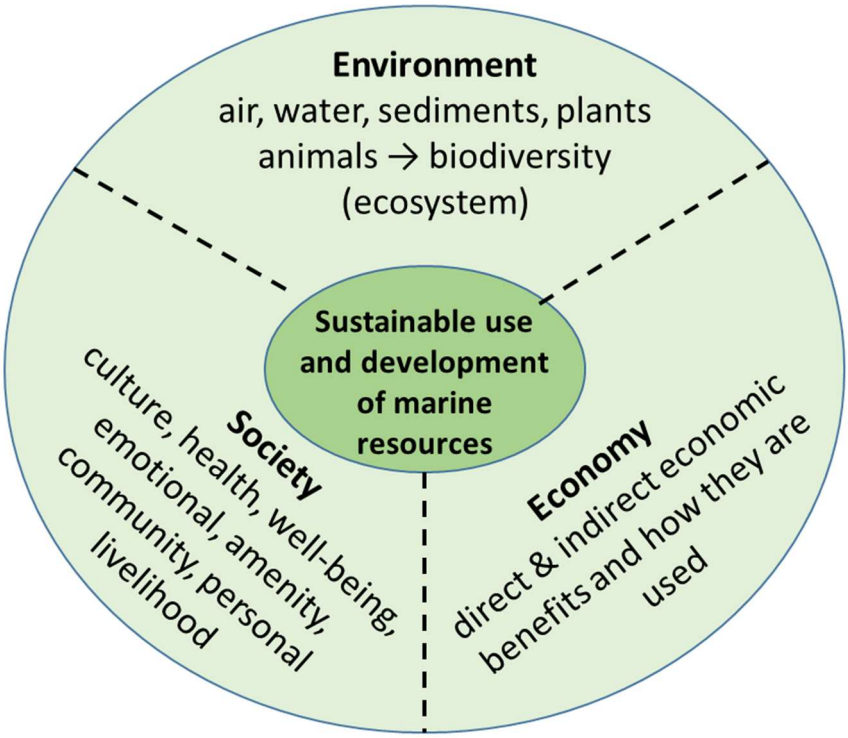


Figure 1. Elements of sustainable use and development.

There were four elements to the workshop (Figure 2):

1. The content of the returned questionnaire to identify issues and activities of interest.
2. The consequences (e.g. impacts) associated with these issues and activities – (Exercise 1).
3. The threats / causal factors associated with these issues and activities (Exercise 2).
4. The preventative or remedial management actions that are applied (and the effectiveness of these measures - Exercise 3).

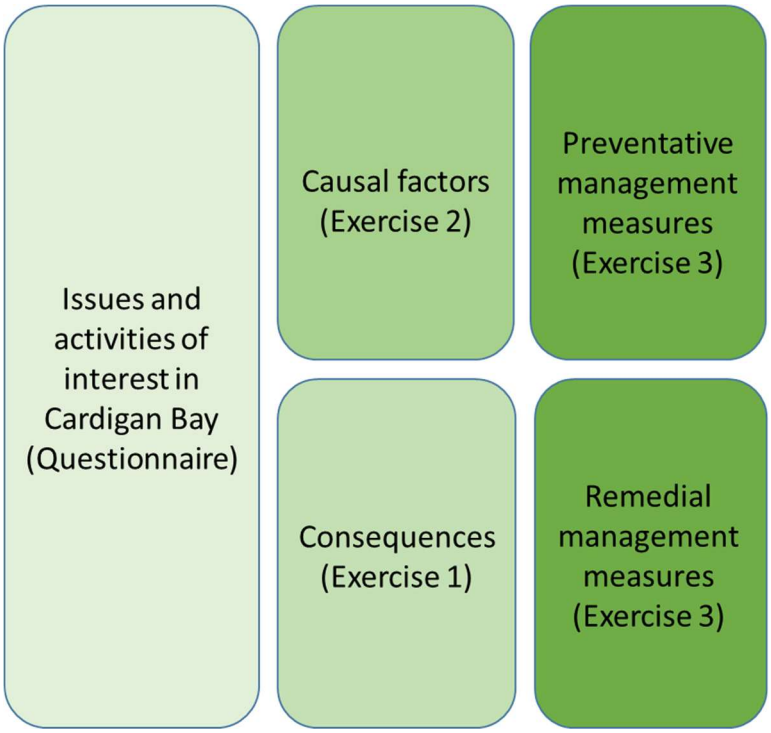


Figure 2. Elements of the Group Exercises.

The workshop participants were asked to consider the issue marine litter. They were then given three exercises to complete which were run sequentially (Figure 2). To ensure all stakeholders had an opportunity to speak, the workshop participants were split into four groups. Members of the MERP project team were placed in each group to facilitate discussions. Participants were provided pens and post-it notes. Three flip charts were provided (Figure 3) to collect the outputs from each exercise (the outputs of the four groups were collated on one flip chart for each exercise).

Exercise 1. The participants were asked to write down the 'consequences' / 'impacts' of litter on the beach. The participants were asked to consider and note:

- Whether impacts were social, economic or environmental
- If there is/are location(s) where the consequence occurs
- Any evidence to support their points.

Facilitators helped to group similar / related issues on the flip charts under the broad headings 'environmental', 'social' and 'economic'. The facilitators encouraged discussion and prompted thinking to tease out issues that are of greatest concern or interest to the participants. The facilitators tried to ensure that where supporting evidence could be referenced that this was noted (as much as is practicably possible within a workshop environment).

Exercise 2. Participants were next asked to write down the causal factors. Again, they were asked to consider and note:

- Whether impacts were social, economic or environmental
- If there is/are location(s) where the consequence occurs
- Any evidence to support their points.

Exercise 3. Participants were then asked to write down the 'preventative' or 'remedial' management measures that are or could be applied. As before, they were asked to consider the same three points as above. In addition, participants were asked whether management measures were currently in place or should be in place.

Once the three exercises for marine litter had been completed the flip charts for each exercise were lined up as shown in Figure 3. The post-it notes were grouped on their respective flip charts into social, economic and environmental categories. We did not draw out full bow ties within the workshop as it was felt this would be too time consuming.

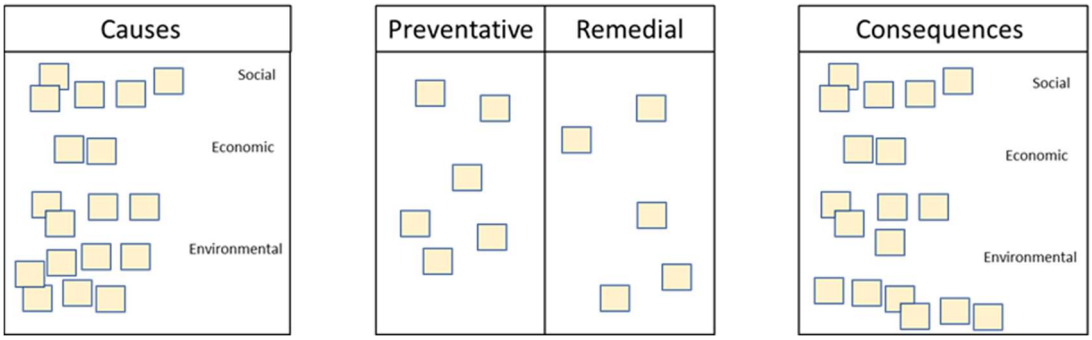


Figure 3. Flip charts for Exercise 1 (Consequences); Exercise 2 (Causes) and Exercise 3 (Preventative or Remedial management measures) for a defined topic (e.g. marine litter).

The participants were talked through a presentation (Figure 4 to Figure 7) to describe how the outputs from the exercises fit together. It was explained that the approach that we have been undertaking is a risk assessment and management support tool known as Bow Tie Analysis. The first step, which we took from the participants questionnaires, is to identify a hazard (which in risk assessment is defined as anything that has the potential to cause harm) and a 'top event' which describes a loss of control of the hazard (Figure 4). In the marine litter example, the 'hazard' is all forms of waste management and the loss of control ('top event') is littering. In exercise 1, the participants identified the consequences associated with this loss of control of the 'hazard' (Figure 5). In Exercise 2, they identified the causal factors for this loss of control of the 'hazard' (Figure 6). In Exercise 3, they identified preventative and remedial management measures (Figure 7). The resultant Bow Tie Analysis (IEC 31010:2009) is a supporting standard for ISO 31000 which provides guidance on selection and application of systematic techniques for risk assessment. We have been developing this as a tool for cumulative effects assessment for the Ecosystem Assessment Outlook workstream (OSPAR, 2017) to describe the status of the North East Atlantic as part of the OSPAR Quality Status report 2023 (which takes a Regional Sea overview of Member States determinations of Good Environmental Status under the EUs Marine Strategy Framework Directive).

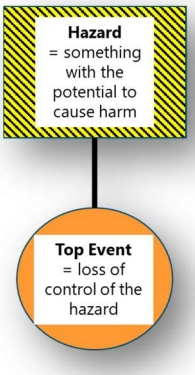


Figure 4: Components of Bow Tie Analysis - Hazard & Top Event.

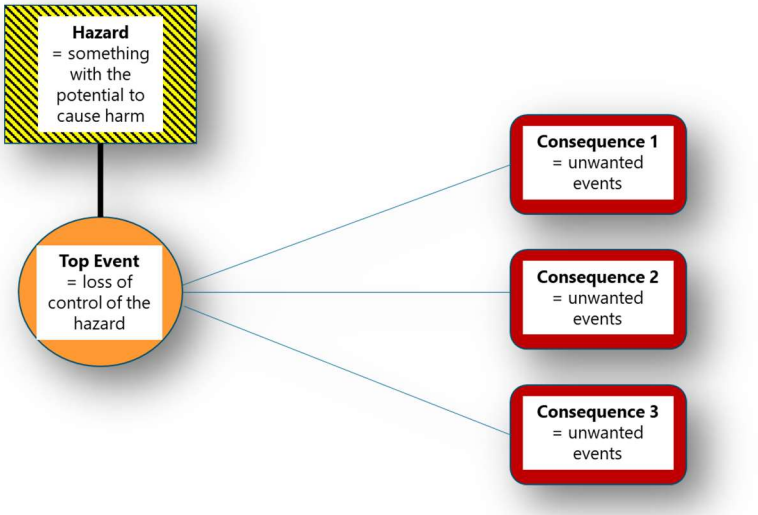


Figure 5. Components of Bow Tie Analysis - Consequences.

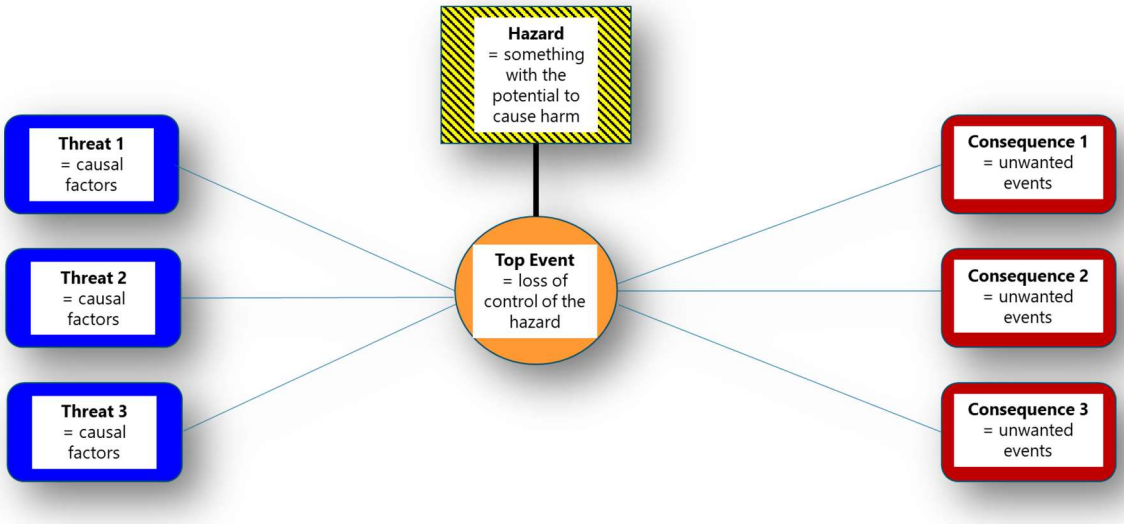


Figure 6. Components of Bow Tie Analysis - Causes/Threats.

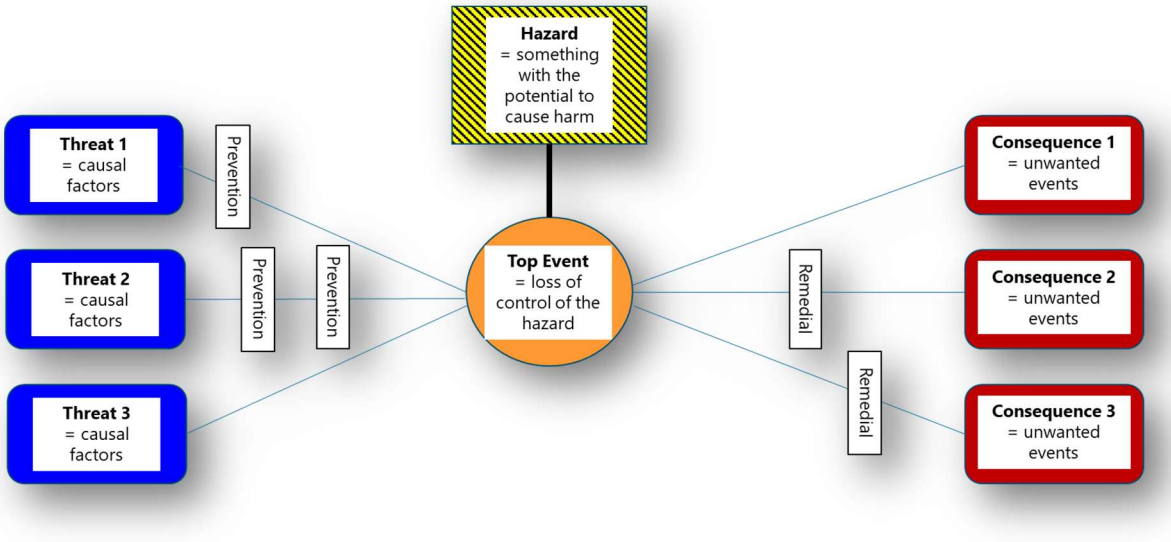


Figure 7. Components of Bow Tie Analysis - Management Measures.

The three exercises were repeated for six more issues and activities derived from the participants questionnaires:

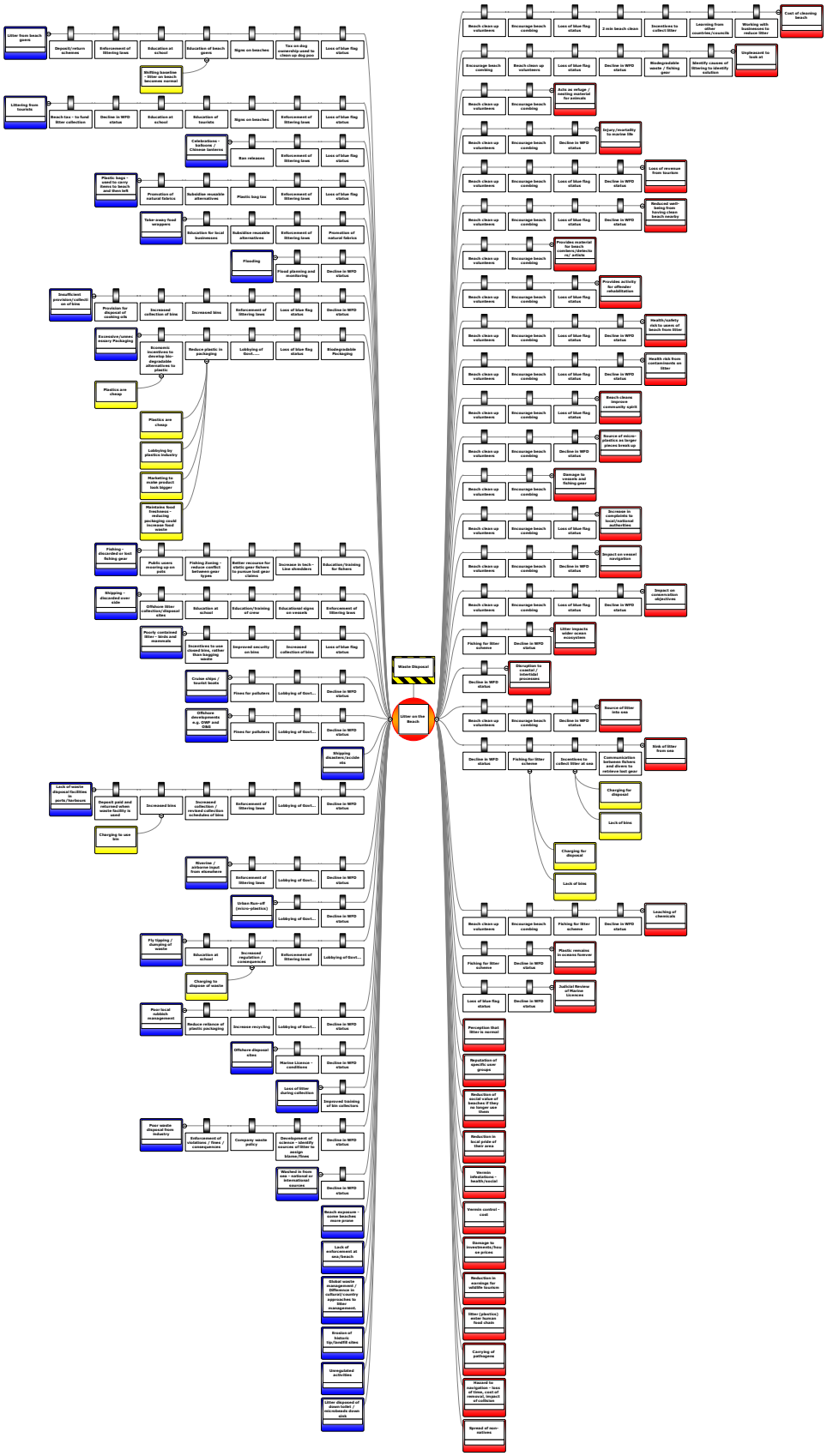
- Wildlife tourism
- Recreational boating / water sports
- Coastal developments (including sea defences)
- Sea angling
- Scallop dredging
- Lack of joined up decision-making, lack of enforcement

Following the workshop, Bow Tie XP software was used to covert the post-it note laden flip charts into bow ties for each of the seven issues and activities.

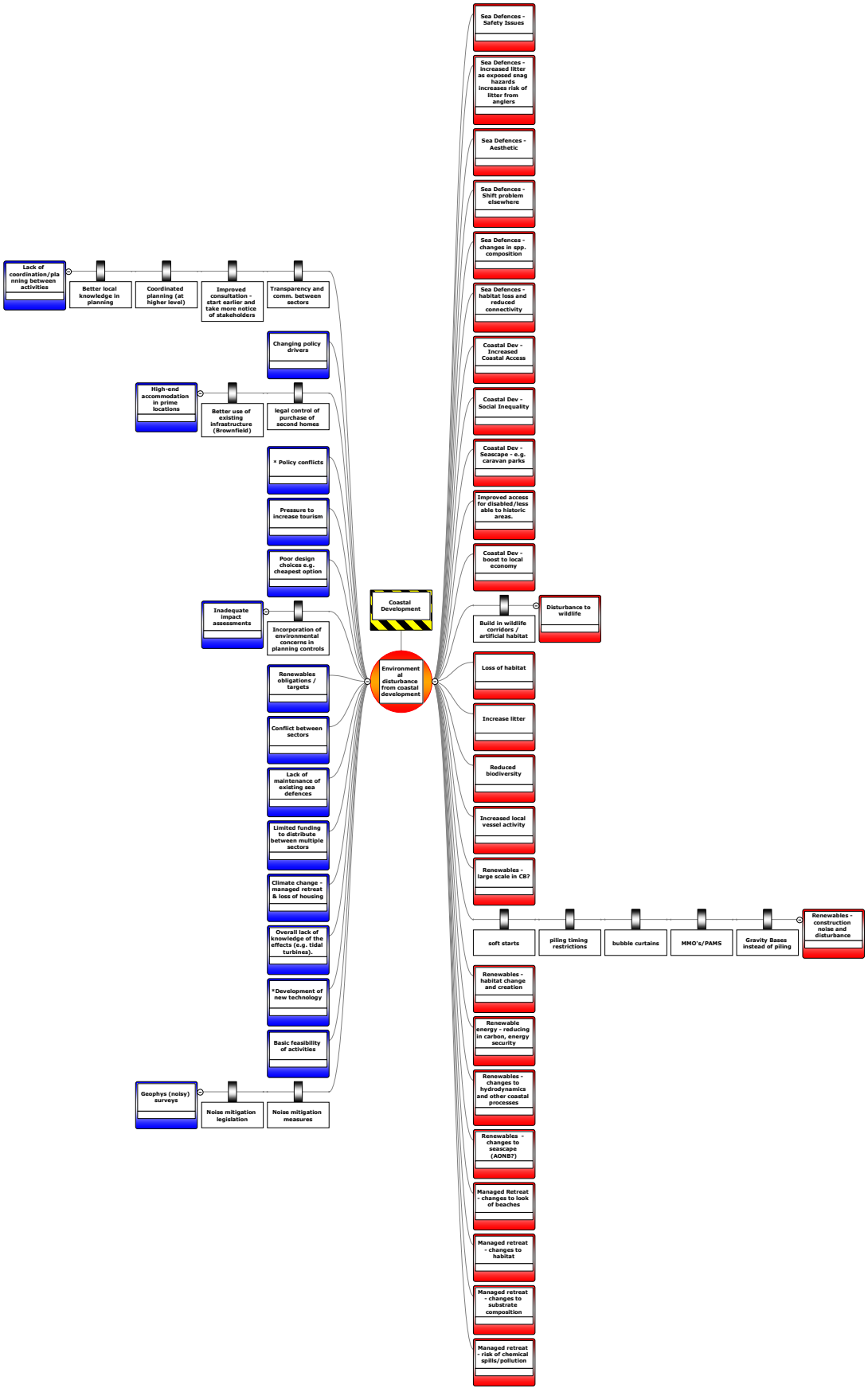
3 Results

The raw information from the workshop are shown below in sections 3.1 to 3.7. Note that to view the detail of each bow tie diagram, the reader will need to zoom the pages.

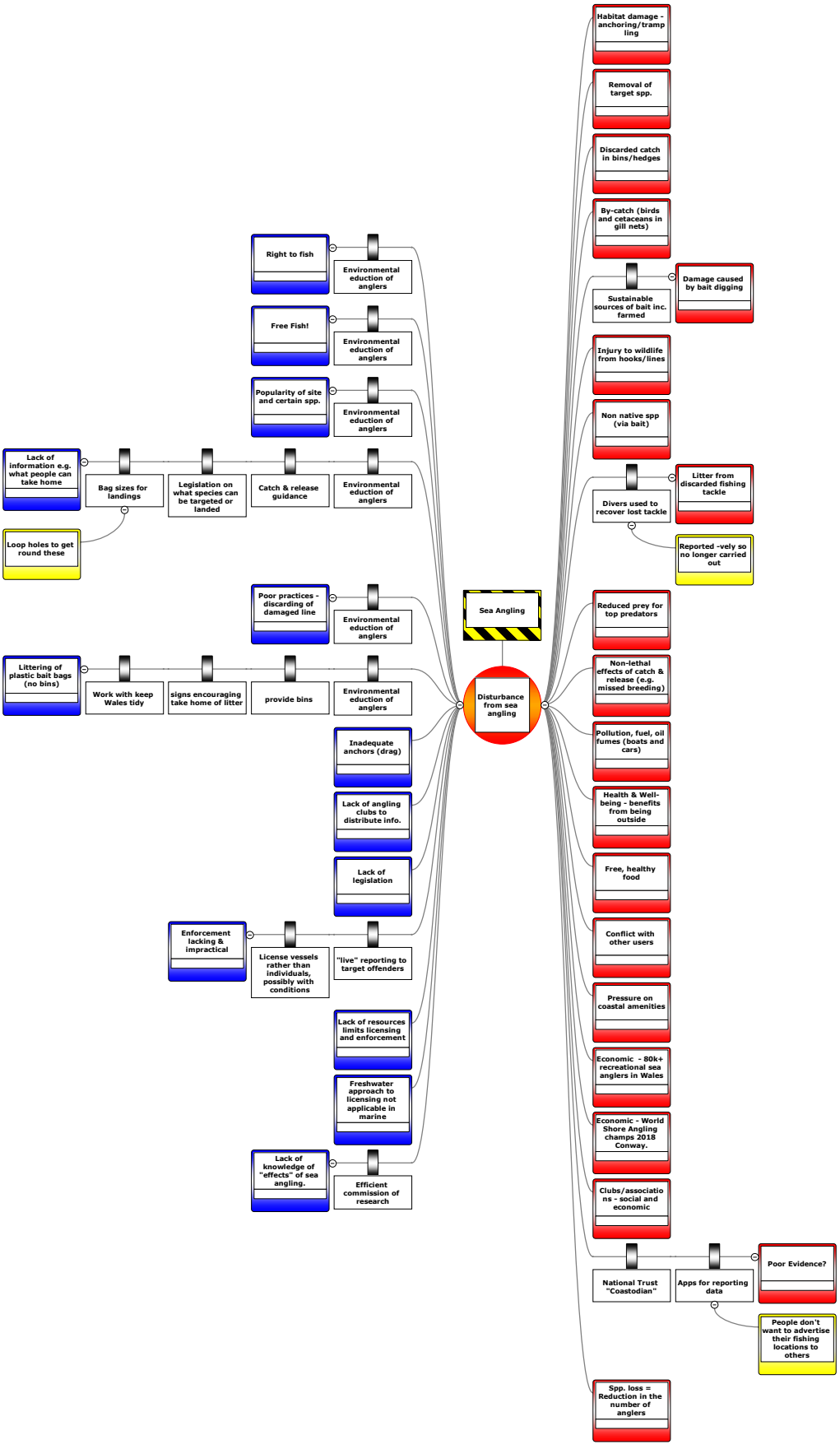
3.1 Bow tie for Litter on Beaches



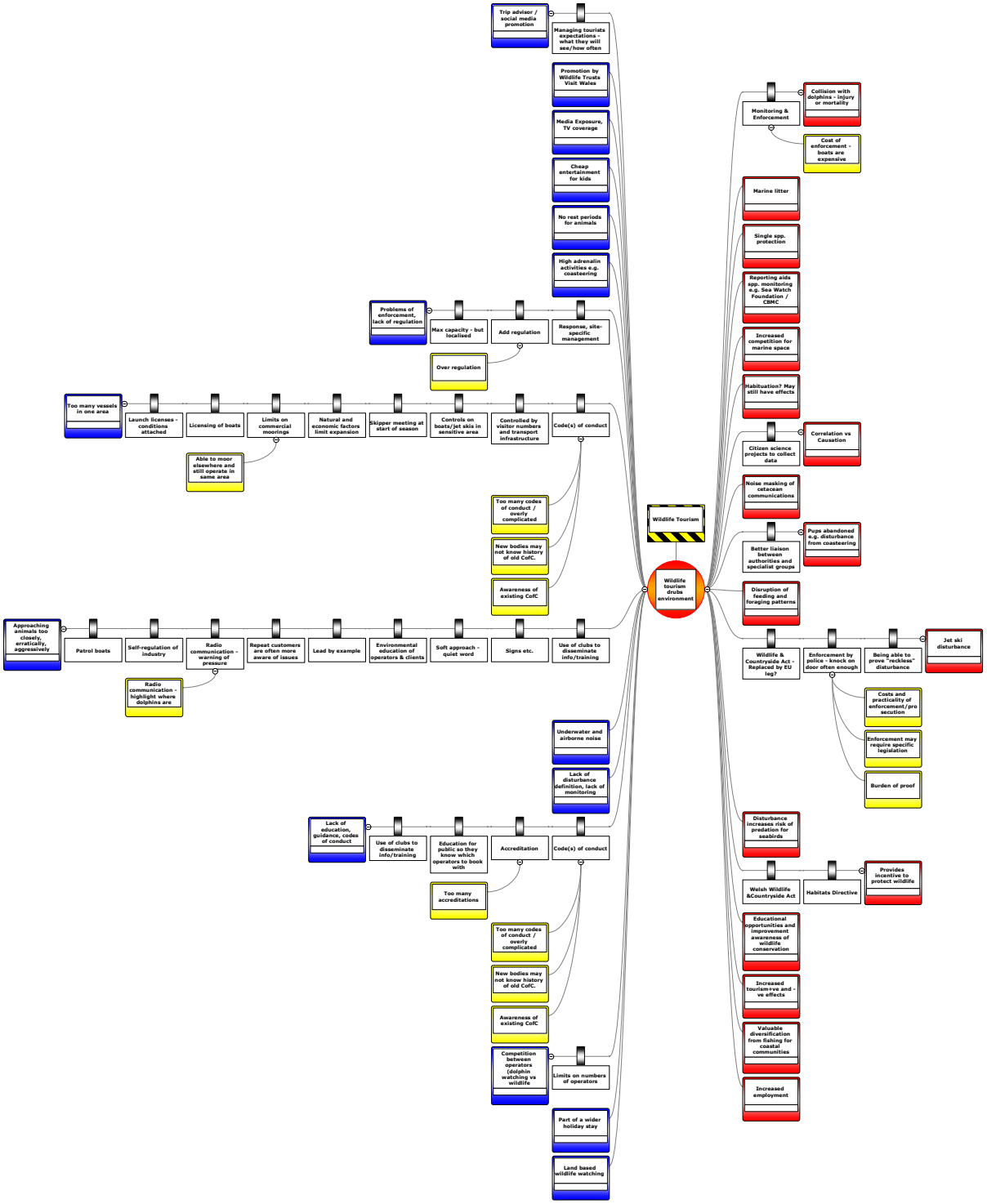
3.2 Bow tie for Coastal Development



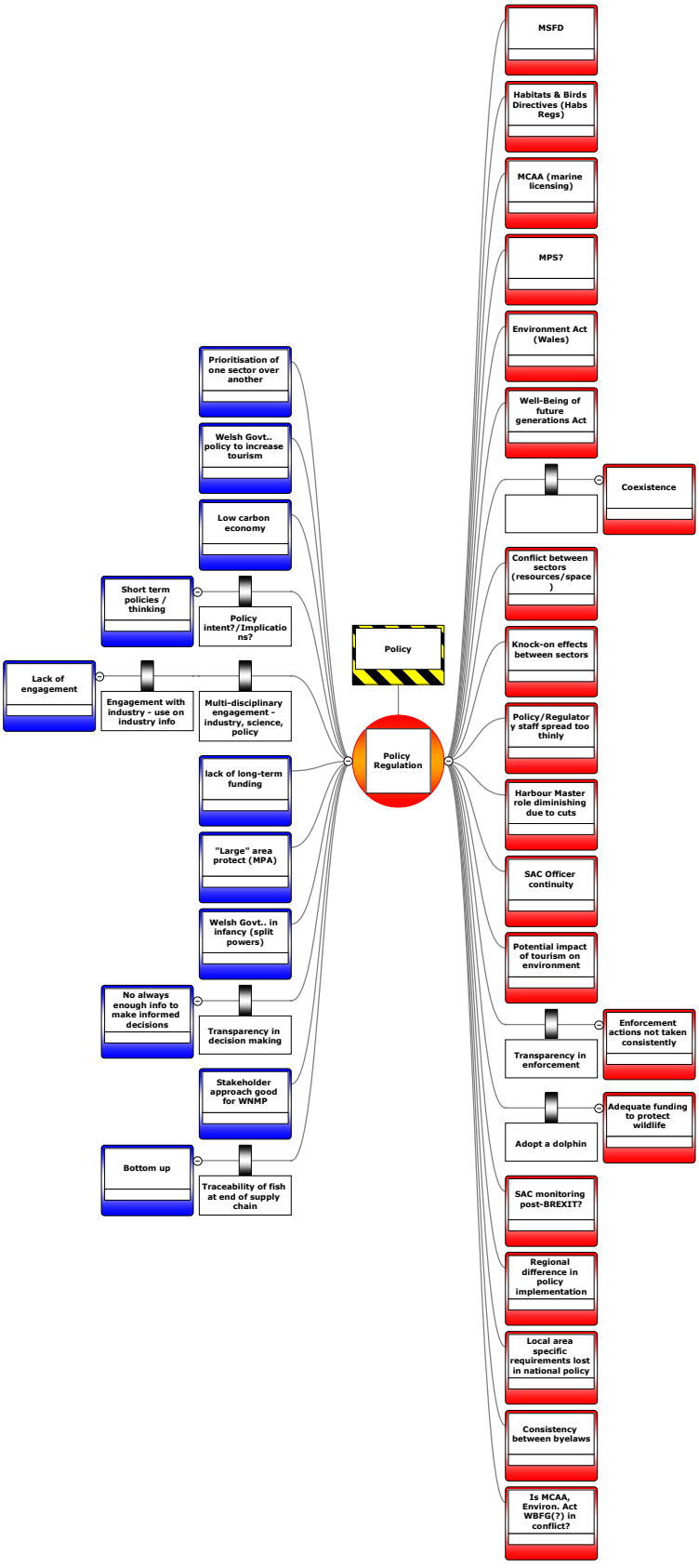
3.3 Bow tie for Sea Angling



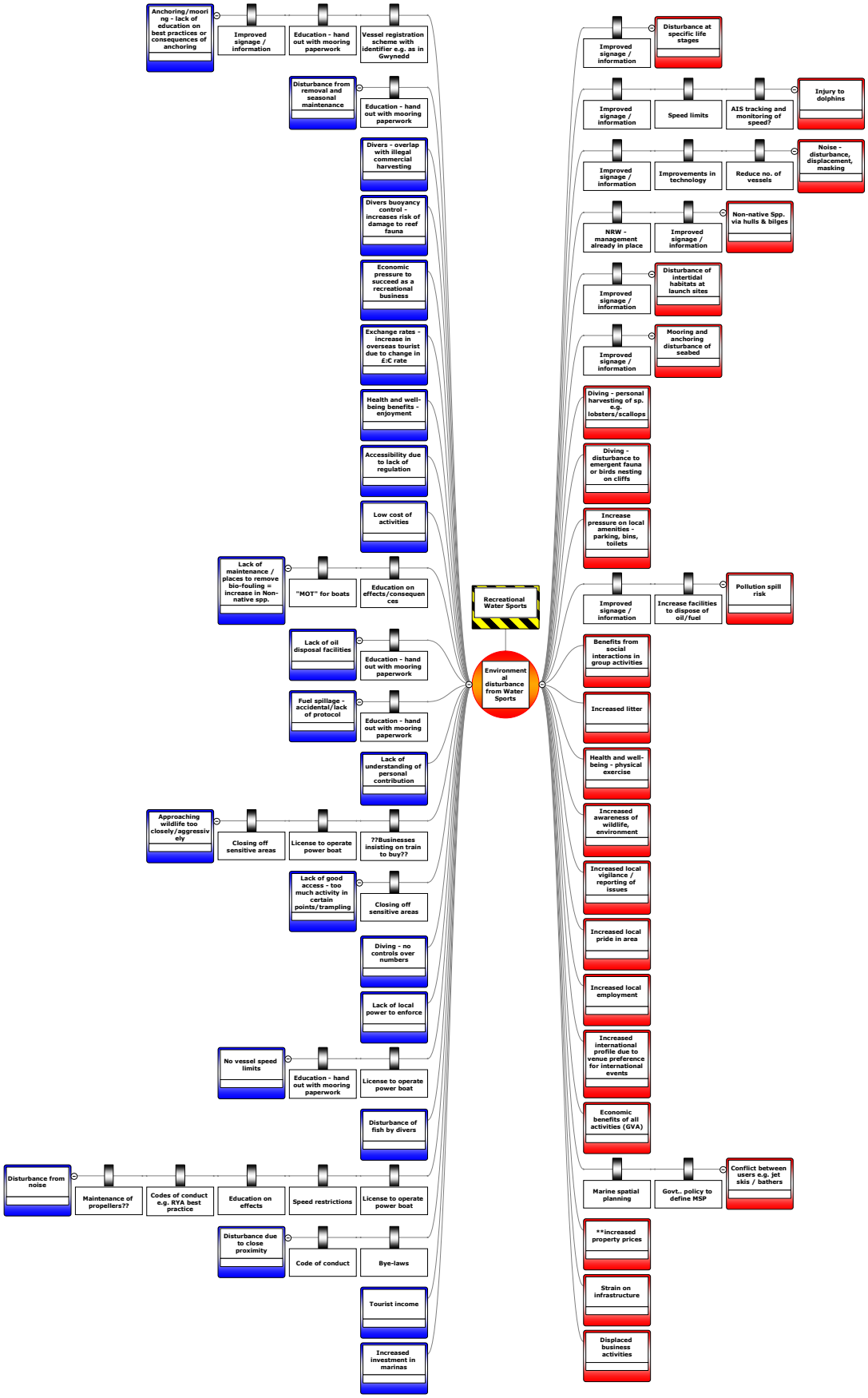
3.4 Bow tie for Wildlife Tourism



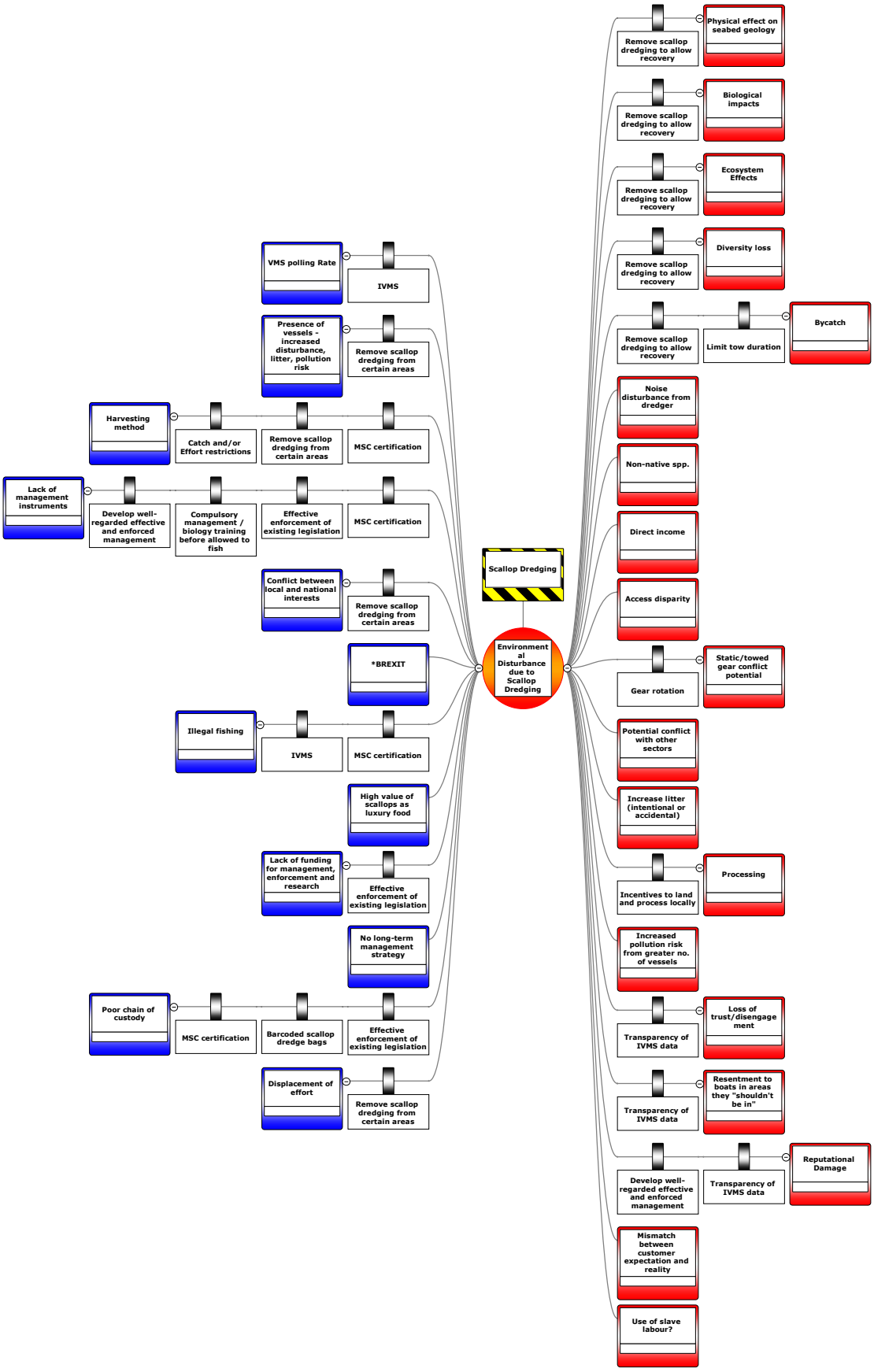
3.5 Bow tie for Policy & Regulation (lack of joined up decision-making; lack of enforcement)



3.6 Bow tie for Recreational Water Sports



3.7 Bow tie for Scallop Dredging



4 Discussion

4.1 Using Bow Tie Analysis as a Stakeholder Engagement Tool

To our knowledge, this is the first time that Bow Tie Analysis has been used in a live situation to collate stakeholder knowledge and experience. A number of lessons were learnt from the process that could inform further events:

- It is crucial to define the top event well before starting a stakeholder workshop. If the top event is loosely defined, it forms more of a topic for discussion rather than a specific unwanted scenario. Individual stakeholders typically have their own views on what the top event should be, based on their own priorities/industry interests. Constructing a bow tie diagram live on a screen can be time consuming (and probably difficult for the audience to follow). The post-it note method works well as it is inclusive and allows everyone to present their views.
- Good facilitation is needed to ensure data are collected in the right places. Facilitators play an important role in keeping stakeholders focused on the top event. In some cases, it was difficult to determine which barriers related to which threats/consequences, particularly when the same barrier applied to multiple threats or consequences.
- It may be better to draft a basic bow tie diagram before the workshop and then use stakeholder input to improve it and add evidence.
- Some evidence presented by stakeholders was highly targeted to a specific issue of case. Evidence presented by stakeholders was of diverse nature and origin, ranging from often site- and case-specific empirical evidence to anecdotal evidence where the source of information needs to be verified.
- As with all stakeholder events it is difficult to get complete stakeholder representation. This can lead to a skewed perception within the results. Within this workshop there was no representation made by the scallop dredging industry. Some NGOs and local businesses were also missing. However, overall, we had broad representation from most stakeholders.

4.2 Identifying appropriate parameters for cumulative effects assessment from Bow-Tie-Analysis (BTA)

The first step following the workshop will be to better define the “Top Event” i.e. the central knot of each bow tie, or unwanted scenario. Within many of the discussion groups of the workshop, it was clear that the topics have many complex layers. The bow ties created during the workshop will be broken down into a series of smaller bow ties. This will allow us to identify individual unwanted events. We will then link these individual bow ties to produce a coherent picture of how different activities effect Cardigan Bay. Wherever possible, data/evidence will be added to the components of the bow ties. The end goal is to quantify as many of the bow tie components. It is unlikely to be possible to quantify all components – for many aspects the data simply do not exist. This will move towards a quantitative view of the activities taking place within Cardigan Bay, their ecological and socio-economic effects and the response of the ecosystem to management measures.

Of interest are the multiple "escalation factors" (identified as yellow boxes in the diagrams above). These are factors that tend to compound a problem. The stakeholders were invaluable in identifying many of these factors. Adding detail, data and evidence to these factors will help to understand how existing policies are working to protect the environment in Cardigan Bay.

5 Next Steps

The draft bow ties produced during the workshop (section 3) will be refined and detail added as appropriate. The content of questionnaires (with names and affiliations removed) will be used to expand or divide the draft bow ties. A project report, one scientific paper and a briefing note are planned. The scientific paper will report the use of bow tie analysis as a stakeholder engagement tool. The briefing note will focus specifically on the topics raised by the stakeholders on the Cardigan Bay area (noting that these are the views of the participants and that not all parties with an interest in the management of Cardigan were present so this is an incomplete picture).

The workshop has provided a means for a bottom-up consideration of the issues (through direct assimilation of the stakeholder views). It has sets the parameters / context for the suite of models used in MERP. It will help focus the MERP outputs into usable products. Stakeholder views can be fed into models to help create more realistic and relevant scientific outputs.

6 References

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Appendix 1:

Cardigan Bay Stakeholder Workshop Groups

Group 1		Group 2		Group 3	
Tom Webb (facilitator)	*University of Sheffield*	Mike Kaiser (facilitator)	*Bangor University*	Tara Hooper (facilitator)	*PML*
Paul Blackwell	*University of Sheffield*	Peter Evans	*Bangor University / Sea Watch Foundation*	Miriam Grace	*University of Sheffield*
Katrin Lohrengel	*Sea Watch Foundation*	Alison Palmer Hargrave	*Gwynedd Council SAC Officer*	Lee Murray	*NRW*
Jenny Oates	*WWF*	Roland Sharp	*NRW*	Tom Stringell	*NRW*
Clive Pearce	*Welsh Federation of Sea Anglers*	Alejandra Vergara Peña	*Bangor University*	Mick Green	*Whale & Dolphin Conservation*
James Waggitt	*Bangor University*	Helen Pearce	*Welsh Federation of Sea Anglers*	Emily Williams	*RSPB*
Sarah Perry	*Wildlife Trusts Wales*	Gerwyn Evans	*Visit Wales*	Tony Bruce	*Enlli Charters*
Mike Spence	*Cefas*	Jonathan Evans	*Dolphin Spotting Boat Trips*		
		Mike Parry	*Pwllheli Partnership*		
		John Eddington	*Welsh Yachting Association*		

Appendix 2:

Questionnaire

MERP Cardigan Bay Workshop

Pre-arrival questionnaire

*Required

1. **Please give your name ***

2. **Which organisation are you representing at this workshop? ***

3. **Please briefly describe your association with Cardigan Bay's marine environment**
   For example, how long have you been associated with it, and in what capacity? Which kinds of species, habitats or activities do you know most about?

4. **From your own perspective, what are the main activities that need to be considered when thinking about managing Cardigan Bay's marine area at the moment?**
   We have listed what we consider to be the main four issues. In the next question you will have the chance to add more issues.
   Mark only one oval per row.

	Not important	Somewhat important	Extremely important
Scallop dredging	◯	◯	◯
Lobster potting	◯	◯	◯
Angling	◯	◯	◯
Wildlife tourism	◯	◯	◯

5. **Are there other major issues or activities that are currently affecting Cardigan Bay's marine area?**

6. **In your opinion, what factors can cause harm to the issues that you have identified as most important in the previous two questions?**

7. **In your opinion, what are the most significant and uncertain factors that could affect the future of the environment, way of life and livelihoods connected to Cardigan Bay's marine area?**

   Think in general terms, with a 25-year time horizon, and list up to five.

8.

9.

10.

11.

12. **In your experience, what practices and regulations have the biggest impact on your life and livelihood?**

    Think of things like laws and byelaws, planning rules, voluntary agreements, etc., and list up to five.

13.

14.

15.

16.

17. **Management of Cardigan Bay includes consideration of environmental, social and economic issues, in your opinion are these**
Mark only one oval.

- ◯ equally important
- ◯ in a hierarchy (if so please rank them below)

18. *Mark only one oval per row.*

	1st (most important)	2nd	3rd (least important)
Environmnental issues	◯	◯	◯
Economic issues	◯	◯	◯
Social issues	◯	◯	◯

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Through the application of our science and technology, we play a major role in growing the marine and freshwater economy, creating jobs, and safeguarding public health and the health of our seas and aquatic resources

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- other scientists from research councils, universities and EU research programmes.
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