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# State-wide synthesis of threats to natural values in Victoria's Marine National Parks and Marine Sanctuaries

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*October 2007*

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**Parks Victoria Technical Paper Series No. 34**

**State-wide Synthesis of Threats to  
Natural Values in Victoria's Marine  
National Parks and Marine Sanctuaries**

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## EXECUTIVE SUMMARY

The declaration in 2002 of a complete system of marine national parks and marine sanctuaries in Victoria created imperatives for robust, scientifically defensible approaches to identifying threats to valued ecological attributes of the parks, setting management priorities and developing monitoring systems. We developed an inclusive and transparent protocol to provide the opportunity for stakeholder involvement in the identification of valued attributes within the parks, as well as in the assessment of associated risks. Sixteen workshops were held at various locations across the state, with a total of 206 stakeholders participating.

Over 500 hazards were identified, each defined in terms of a threat to a nominated natural value at a specific park or sanctuary. Some hazards such as the poaching of commercially valuable species, were common to many parks across the state. Others were location-specific, for example, the trampling of mangrove flats and saltmarsh by hard-hoofed animals such as cattle and sheep. While many hazards involved predictable, tangible threats such as poaching, pollution, invasive species and disturbance by park visitors, the approach also identified a number of less obvious threats including governance issues and the ecological knowledge-base for the parks. Collectively, water quality issues were prominent among stakeholder concerns. Slightly more than half of the contaminant threats to water quality originate in adjacent catchments. Of those not arising from terrestrial sources, 58% referred to oil or fuel contamination from maritime activities.

The workshops consistently identified threats not previously considered by Parks Victoria in its internal assessments. Half were threats to ecological values on a wider scale than the parks alone, for example, catchment-based issues of water quality and sediment transport. A further 27% of the new threats referred to governance issues and 16% to the ecological knowledge-base of the parks.

Parks Victoria used information generated in the risk assessment workshops as a direct input to the management planning process that coincided with the workshops. In some cases the output from workshops was used to refocus sections of the management plans on certain threats or include more discussion of possible management responses. The information on threats and values also informed the marine research strategy being developed during 2006-2007. It has allowed a detailed analysis and prioritization of the research gaps in each park, as well as more broadly across the state.

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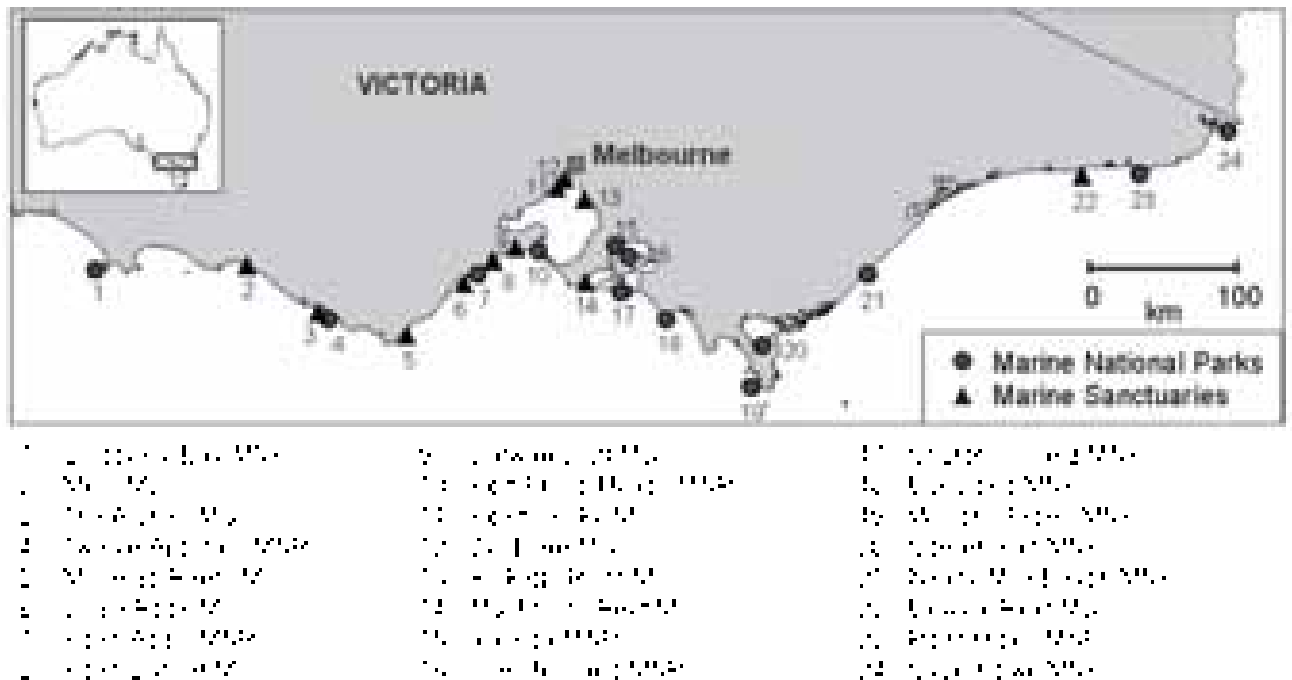
# 1. INTRODUCTION

The system of 13 marine national parks and 11 marine sanctuaries in Victoria (Figure 1) was established in 2002 and is managed by Parks Victoria. The primary purpose of the system is to protect and conserve representative samples of biodiversity, ecological processes and natural features in Victorian coastal waters (Parks Victoria 2003a). The system contributes to Australia's National Representative System of Marine Protected Areas, and represents a major contribution to Australia's international arrangements as a signatory to the 1993 United Nations' Convention on Biological Diversity.

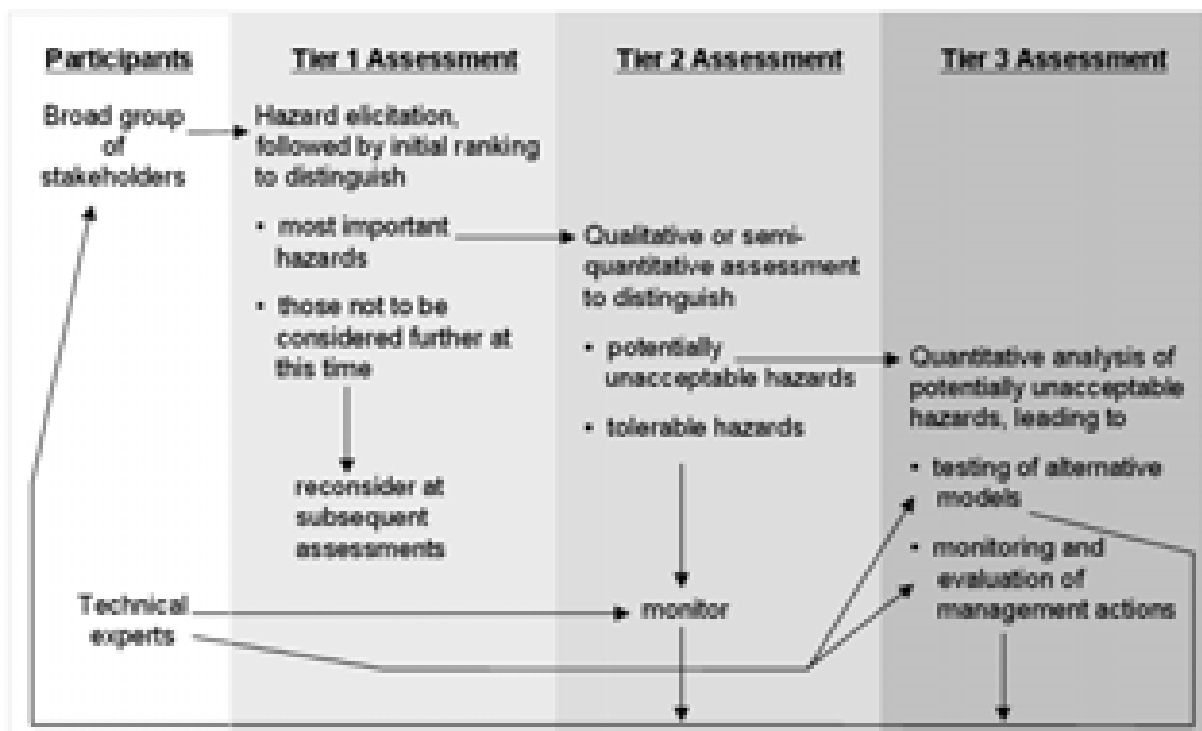
The marine national parks (MNPs) are relatively large areas providing protection for biodiversity and maintaining representative examples of natural ecosystems in perpetuity. In contrast, the marine sanctuaries (MSs) are smaller areas protecting sites of special value for conservation, recreation or education (Parks Victoria 2003a). Management responsibilities for the new system created imperatives for robust, scientifically defensible approaches to identifying threats (stressors) to the ecological values of the parks, setting management priorities and developing monitoring systems. Where management resources are limited, setting priorities for the values and threats allows resources to be used most effectively to achieve policy goals.

We are developing a protocol for ecological risk assessment in the parks that has due regard for the perception of risks by individuals, and ensures that stakeholder values are an intrinsic part of decision-making. Ecological risk assessment has previously tended to assume a level of 'expert knowledge' in attributing values (O'Brien 2000). The challenge in making our protocol inclusive and transparent, is to provide all stakeholders with an opportunity to identify values of concern, as well as assessing the associated risks. The protocol follows a tiered approach where hazards deemed to be of varying importance receive different treatments in the risk assessment process (Figure 2). Low risk hazards (Tier 1) are recorded, but are not considered further until the next iteration of the risk management cycle. Higher risks are addressed more thoroughly, perhaps by monitoring the ecological effects of the threat (Tier 2). Potentially unacceptable risks may be treated more rigorously again, perhaps invoking quantitative modelling, or by direct management action followed by monitoring and evaluation of the outcomes (Tier 3). The protocol applies technical risk analysis methods to ensure that conceptual models are consistent with data and theory, and that monitoring provides pertinent information. This approach is consistent with risk assessment protocol in other areas of natural resource management such as water quality (ANZECC 2000), irrigation (Hart *et al.* 2005) and fisheries management (Fletcher 2005). It differs from some protocols by providing a place for stakeholders with and without formal technical expertise to rank hazards and set priorities. Outputs from the project contribute directly to the management plans for the parks (e.g. Parks Victoria 2006, 2007) and provide the basis of a detailed strategy for future marine research across the park system.

The first stage of the risk assessment project was a series of stakeholder workshops across the state, drawing on the expertise of agency staff, community groups, fishers, industry representatives, academics and park neighbours to identify hazards of concern in each of the parks. Individual reports were prepared detailing the outcomes of each workshop. This report presents a synthesis of information from the 16 workshops on risks to the natural values of the marine national parks and sanctuaries. An assessment of the workshop process used to elicit information from park stakeholders is presented in a companion report (Carey *et al.*, in prep.) as is the detailed information from each workshop (Carey *et al.*, 2007).



**Figure 1** Marine National Parks and Marine Sanctuaries in Victoria, Australia



**Figure 2** A tiered approach to ecological risk assessment

## 2. STAKEHOLDER WORKSHOPS

Each workshop was restricted to a single day, due to the difficulty in bringing together a diverse group of stakeholders. It was however, generally possible for at least some stakeholders to meet together informally on the evening preceding each workshop. This provided the facilitator with an opportunity to develop a sense of the ecological issues likely to arise and the interactions among stakeholders that might affect the course of the workshop. In some cases, it was deemed appropriate to assess two or more parks or sanctuaries in a single workshop. The dates of the workshops and the parks assessed in each are listed in Table 1.

**Table 1.** Stakeholder workshops.

Workshop	Park / Park Cluster	Date	Location
1. Western Port (1)	Churchill Island MNP French Island MNP Yaringa MNP	14 July 2004	The Anchorage, Hastings
2. Port Phillip Heads	Port Phillip Heads MNP	27 July 2004	PIRVic, Queenscliff
3. Surf Coast	Point Addis MNP Eagle Rock MS Point Danger MS	11 August 2004	Anglesea Surf Life Saving Club
4. Shipwreck Coast	Twelve Apostles MNP The Arches MS Merri MS	18 August 2004	Warrnambool Surf Life Saving Club
5. Mushroom Reef	Mushroom Reef MS	25 August 2004	Flinders Yacht Club
6. Promontory	Wilsons Promontory MNP Corner Inlet MNP	15 September 2004	Parks Victoria facility, Tidal River
7. Ricketts Point	Ricketts Point MS	22 September 2004	Beaumaris Life Saving Club
8. Barwon Bluff	Barwon Bluff MS	5 November 2004	At the Heads Café Restaurant, Barwon Heads
9. Point Cooke	Point Cooke MS	10 November 2004	Werribee Park Mansion, Werribee
10. Bunurong	Bunurong MNP	17 November 2004	Community Hall, Cape Paterson
11. East Gippsland	Beware Reef MS Point Hicks MNP Cape Howe MNP	2 December 2004	Dept. of Sustainability & Environment, Cann River
12. Jawbone	Jawbone MS	2 February 2005	Parks Victoria, Williamstown

13. Marengo Reefs	Marengo Reefs MS	2 March 2005	Apollo Bay Hotel
14. Discovery Bay	Discovery Bay MNP	8 March 2005	Discover IT Centre, Portland
15. Ninety Mile Beach	Ninety Mile Beach MNP	16 March 2005	East Gippsland Institute of TAFE, Sale
16. Western Port (2)*	Yaringa MNP French Island MNP	2 February 2006	Warneet Motor Yacht Club, Warneet

\* A second Western Port workshop was held in February 2006 to complete the assessment begun in July 2004.

The objectives of each workshop were

- to identify valued attributes of the park(s) or sanctuary(sanctuaries), and potential threats to those attributes,
- to rank the importance of hazards using subjective assessments of likelihood and consequence,
- to develop a register of major hazards, and
- to outline conceptual models for selected hazards.

## 2.1 Participants

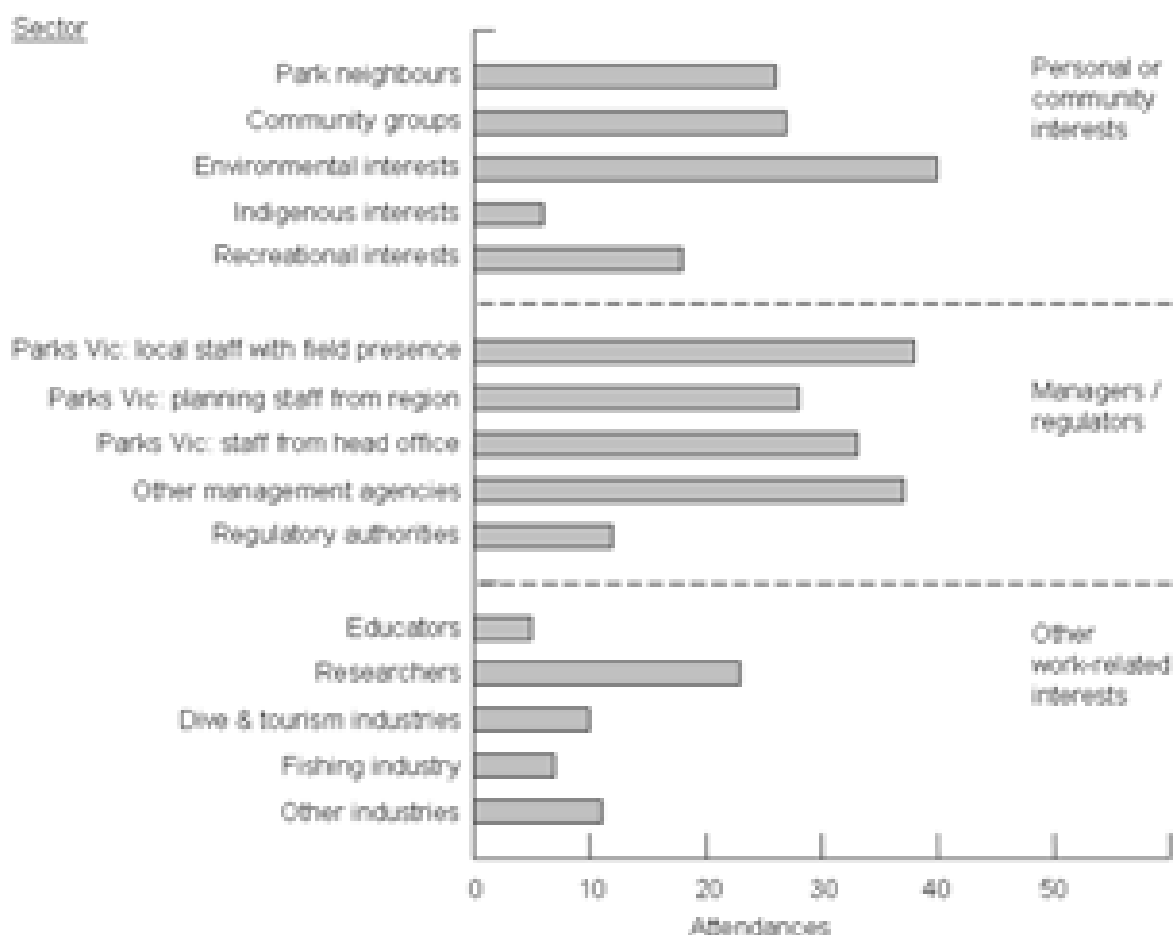
Overall, 206 individuals participated in the risk assessment process, with 13% attending more than one workshop. Attendance at individual workshops ranged from 6 to 23 stakeholders.

Each workshop aimed to attract as diverse a group of park stakeholders as possible. To encourage attendance by local residents, workshops were held in the vicinity of the park or parks to be assessed. The existing Parks Victoria network of stakeholders was the starting point for identifying potential workshop participants. This was supplemented with local staff knowledge of important individuals and groups living near the parks, and occasionally by the facilitator identifying gaps in the range of stakeholders. Some stakeholders were already involved in a formal process of community-engagement for management planning, while others were groups or individuals who had an interest in the parks, either supportive or not.

After the workshop series was completed, stakeholders were broadly classified in terms of their primary reason for participating, on the basis of the introductions made at the beginning of each workshop. For example, the attendance of a participant who introduced him/herself as “a long-term resident of the area with an interest in shorebirds” was classified as “personal/community”, while “I am with Fisheries Victoria” (a regulatory body) resulted in classification as “work-related”. Seventy-nine percent of attendances were primarily work-related. However, it was apparent that many stakeholders, particularly those at regional workshops, had more than one reason for participating. A local park ranger could also be a long-term resident and a member of a local community group. A park neighbour with an interest in natural history could also be the operator of a local dive-tour business.

A further breakdown of attendances is shown in Figure 3, where some individual stakeholders may be represented in more than one category. The largest group of attendances was from Parks Victoria, the agency responsible for managing the Marine

National Parks and Marine Sanctuaries. Parks Victoria staff split broadly into those with regional planning or statewide corporate responsibilities (11% and 13% of attendances respectively) and staff with a field presence who also lived locally (15% of attendances). Other management agencies, park neighbours and those from community groups or with a personal interest in environmental matters were also strongly represented.



**Figure 3** Summary of stated reasons for stakeholder participation in risk assessment process. Note that individual stakeholders may be represented in more than one category.

## 2.2 The Workshop Process

The workshops themselves followed a procedure previously trialled with Parks Victoria in terrestrial parks and described by Carey *et al.* (2004, 2005). While the procedure was modified slightly as the series of workshops progressed, all workshops followed the same general pattern:

- Introduction to project and workshop
- Hazard identification
- Hazard ranking

- Summary of workshop and future developments in the project

## Introduction to project and workshop

Participants were given a short introduction to the project, to the park or sanctuary, and to risk assessment in general. The latter included the influence of cognitive biases, and the concept of uncertainty in decision-making.

The context of the assessment was then defined. The spatial setting was usually confined to the park or sanctuary under consideration. This restriction applied only to the ecological values of concern, and not to the potential threats, many of which arise beyond park boundaries. Exceptions to this spatial restriction on values were Wilsons Promontory MNP, Corner Inlet MNP and Bunurong MNP, where other types of protected area cover waters adjacent to the MNPs, and Marengo MS where areas of fully exposed reef above high water mark are, atypically, part of the sanctuary. The time frame to be considered was 10 years in all cases, chosen because this is the intended life span of the Parks Victoria management plans.

## Hazard identification

Defining hazards in terms of their potential consequences for specific values of concern is an approach to ecological risk assessment that avoids confusion where a threat has the potential to affect a number of different values. It focusses the assessment on values rather than on threats alone, and has been used successfully in the irrigation and mining industries (Hart *et al.* 2005, Burgman 2005). It also facilitates the development of mathematical models by explicitly identifying ecological values, and guides the identification of potentially useful assessment endpoints. In the one-day workshops, all stakeholders in turn nominated hazards about which they were particularly concerned, defining each hazard in terms of the specific ecological value(s) they believed to be potentially under threat. The facilitator could of course, have presented a set of values for consideration at the outset of each workshop, but this could have had the undesirable effect of restricting discussion to the values thought most important by the facilitator.

Hazard identification took place during two brainstorming sessions, the first unstructured and the second aided by checklists of threats and values identified in other studies or previous workshops. The checklists were designed to prompt a fuller consideration of hazards, and to identify values or threats that may otherwise have been overlooked. The list of natural values (Appendix 1) was specific to the park or sanctuary in question, and was drawn largely from the Environment Conservation Council recommendations for marine protected areas (ECC 2000) and a report on the natural values of the marine protected areas (Plummer *et al.* 2003). The list of threats was more generic, and from the second workshop onwards, was based on the disturbances and activities listed in the Southeast Regional Marine Plan (SERMP; NOO 2002). Rationalising the SERMP-based list and adding other threats identified by the facilitator or in the previous workshop produced a list of 84 threats for the third workshop. This list was used at all subsequent workshops and revised as appropriate with additions from each, to number 145 threats by the end of the series (Appendix 2). Combined in a hazard matrix (Figure 4) either literally or conceptually, the lists of threats and values generated a large number of potential hazards for consideration by participants.

In addition, a conceptual model for a generic Victorian marine national park containing both natural values and potential threats (Figure 5) was progressively developed throughout the workshop series. It was presented at workshops 12 to 15 to further prompt thinking about

possible hazards. Further conceptual models were developed as necessary to help resolve language-based uncertainties and other arbitrary sources of misunderstanding, leading to better defined hazards.

Potential Threat	Natural Value					
	Rarely terrestrial habitat	Subtidal seagrass beds	Migratory shorebirds	Commercial fish species	Water quality (marine life)	Biodiversity
Trampling by humans	X					
Introduced species	X	X				X
Sewage discharge		X			X	X
Oil spill from shipping	X	X	X		X	X
Litter			X	X		
...						

**Figure 4** Example of a hazard matrix, used as an aid to identifying threats of concern in relation to specific ecological values.

### Hazard ranking

The next step in the assessment process was to select a subset of hazards deemed to be of most concern for the next stage of the risk assessment. This was achieved by inviting participants to vote for their “top” hazards, those scoring the highest numbers of votes being promoted to a formal risk register usually numbering between 10 and 15 hazards. Those hazards not making the initial cut-off (Tier 1 hazards) were recorded for reassessment in a subsequent iteration of the risk management cycle.

The subset of “top” hazards was then ranked, broadly following the process outlined in the Australian Standard for Risk Management, AS/NZS 4360 (SA/SNZ 1999). Participants were divided into groups, usually of three or four people. Each group was as mixed as possible in terms of the interests and experiences of its members. Each group subjectively assigned values to the likelihood of the hazard eventuating (i.e., not simply the likelihood of the threat occurring) and the severity of the consequences should it do so.

Both likelihood and consequence were scored on a scale of 1 to 5, where a higher value indicated a greater likelihood or a more severe consequence. Groups were provided with definitions of the levels used (Appendix 3) in order to minimise differences in interpretation. A score of one indicated a rare event or an insignificant consequence, while a score of five indicated an almost certain event or a catastrophic consequence. Assigning values to the essentially qualitative levels of likelihood and consequence allowed calculation of a numeric risk rating (SA/SNZ 1999) as the product of the likelihood and consequence, with possible

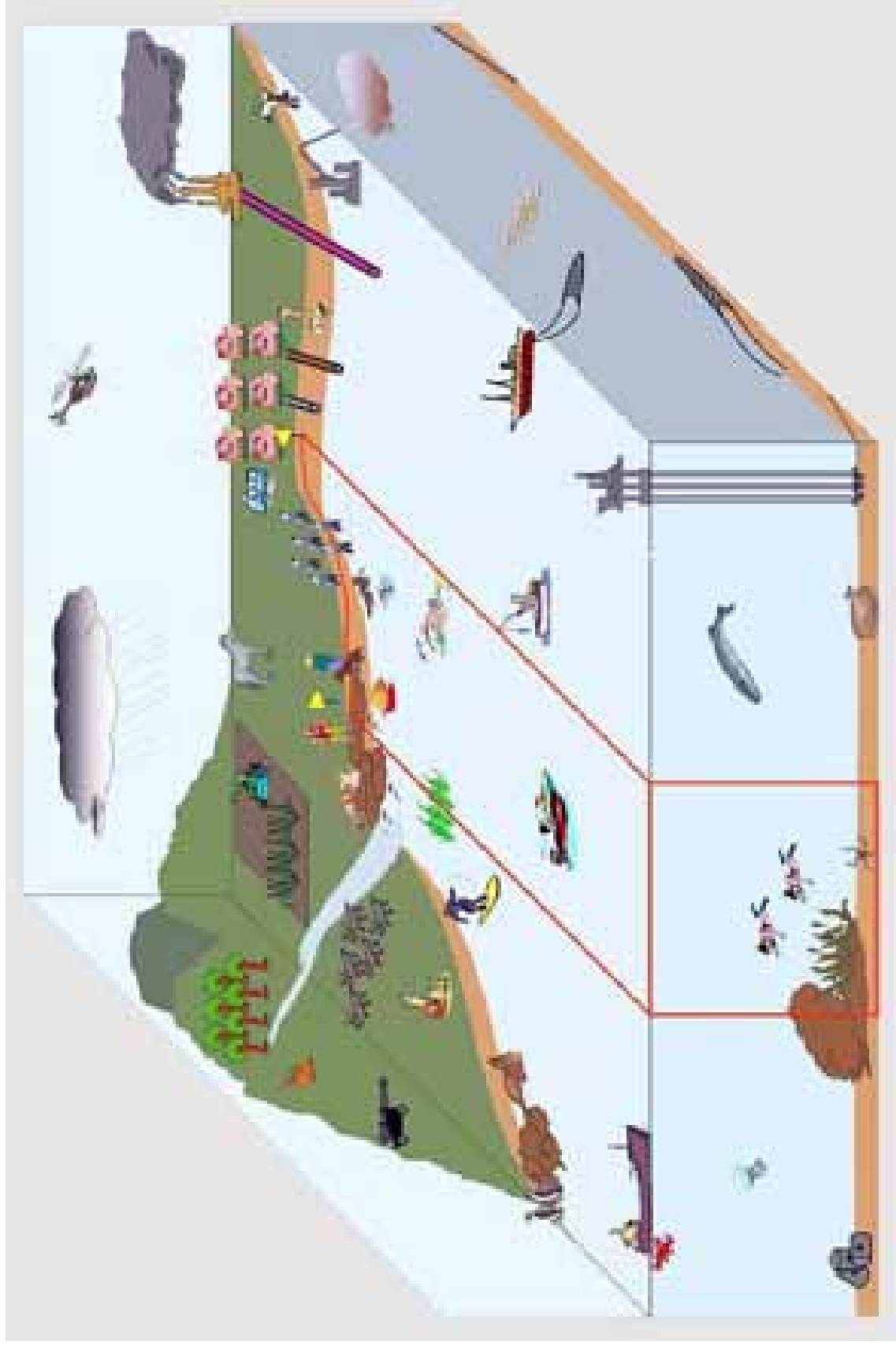


Figure 5 Conceptual model of generic marine national park

scores ranging from 1 to 25 (Figure 6). From these risk ratings, the hazards were ranked for each group, from highest priority to lowest. Any uncertainty surrounding the subjective scores was explicitly incorporated by allowing groups to place bounds on their estimates if they wished (e.g. consequence, moderate to major). This was carried through to the risk rating calculation by the use of interval arithmetic (e.g. likelihood 3 to 5 and consequence 2 to 3 results in risk rating 6 to 15).

Likelihood	Consequence				
	1 (insignificant)	2 (minor)	3 (moderate)	4 (major)	5 (catastrophic)
5 (highly likely)	5	10	15	20	25
4 (likely)	4	8	12	16	20
3 (moderately likely)	3	6	9	12	15
2 (unlikely)	2	4	6	8	10
1 (very unlikely)	1	2	3	4	5

**Figure 6** Risk scores as the product of likelihood and consequence scores.

The level of agreement between pairs of groups was then measured using Spearman's rank correlation, where +1 indicates perfect agreement in rank order, -1 perfect disagreement, and values around 0 indicate no particular pattern between the two sets of ranks. The use of a specialised computer program "Subjective Risk Assessment" (Chisholm *et al.* 2005), allowed rapid calculation and display of risk scores and rank correlations for all pairs of groups. With a view to identifying and possibly resolving of some types of disagreement, the correlations and the likelihood and consequence scores were examined to identify major disagreements, and selected hazards were discussed in detail. There was no demand for consensus in the ranking process, the aim being to acknowledge and retain genuine differences of opinion. Following the discussion, groups had the opportunity to revise their likelihoods and consequences if they wished. Any changes were then entered in the ranking software and the risks and ranks recalculated.

The risk posed by each hazard was recorded in the risk register, where the range of values for likelihood, consequence and risk for each hazard reflected the final range of opinion among the groups of participants. Risks were also categorised on a four-point scale in accordance with AS/NZS 4360 (SA/SNZ 1999) for consistency with previous Parks Victoria practice (Figure 7). Note that there is no simple conversion from the 25-point risk rating scale used here (Figure 6) to the four risk categories.

Likelihood	Consequence				
	1 (insignificant)	2 (minor)	3 (moderate)	4 (major)	5 (catastrophic)
5 (highly likely)	High	High	Extreme	Extreme	Extreme
4 (likely)	Moderate	High	High	Extreme	Extreme
3 (moderately likely)	Low	Moderate	High	Extreme	Extreme
2 (unlikely)	Low	Low	Moderate	High	Extreme
1 (very unlikely)	Low	Low	Moderate	High	High

**Figure 7** Risk categories based on likelihood and consequence in accordance with AS4360, Appendix E (SA/SNZ 1999).

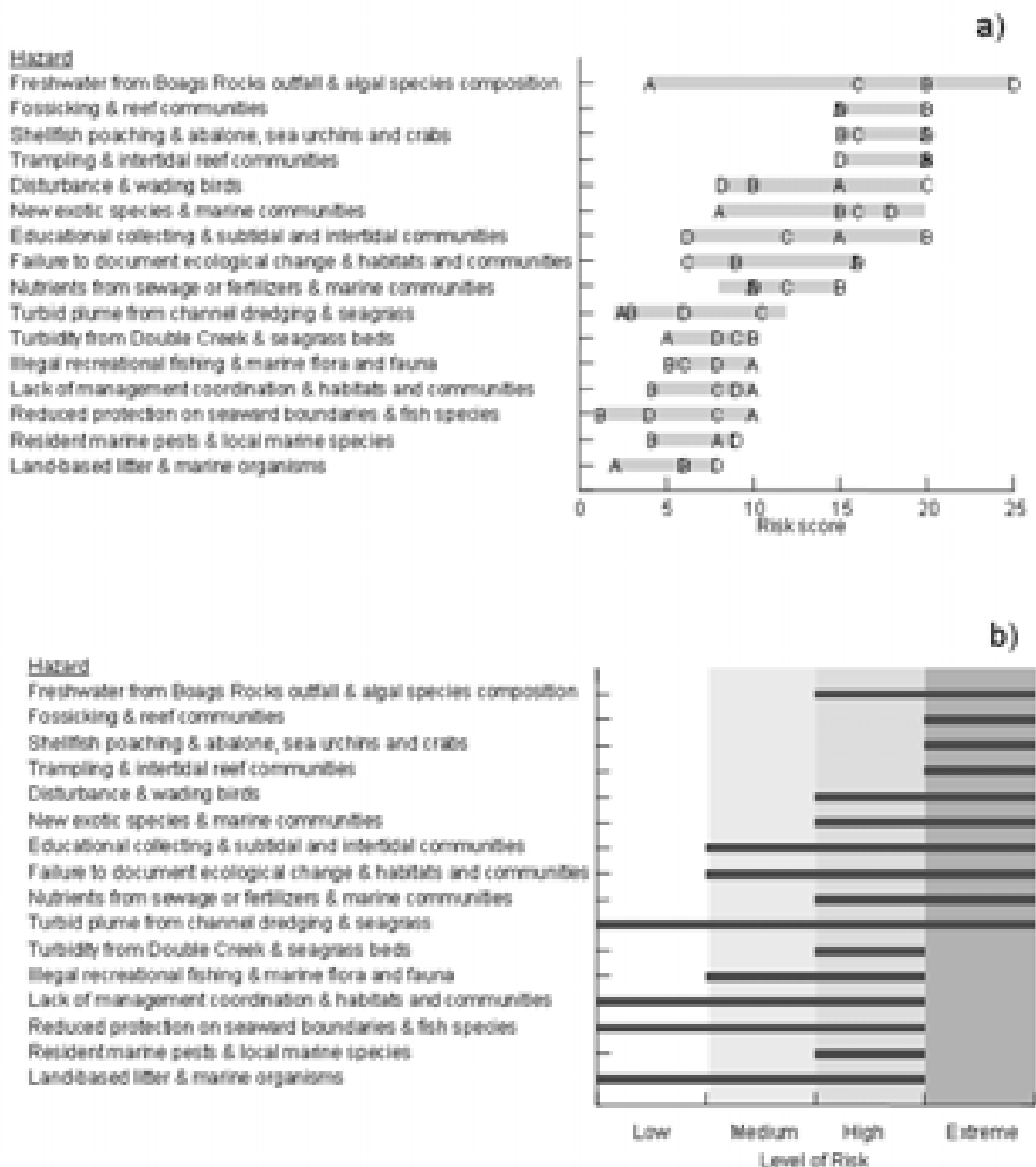
### Summary of workshop and future developments in project

At the end of the day, the facilitator presented a summary of the hazard ranking exercise; in the later workshops, this included a graph displaying a priority order of the hazards together with the uncertainty associated with the risk score of each (e.g. Figure 8a). The senior Parks Victoria manager or planner present then explained how the workshop information would be used, and outlined later stages of the risk assessment project.

## 2.3 Statewide Synthesis

Over 500 hazards were nominated by stakeholders during the workshops, thus some post-workshop synthesis was necessary to identify state-wide patterns in the threats and values. This was achieved by the primary workshop facilitator breaking down each hazard into its component threat(s) and value(s) for inclusion in a matrix identifying the individual parks in which each threat or value was of concern. The final matrix consisted of 114 categories of threat and 45 ecological values. The body of the matrix contained 1482 entries representing parks at which the various combinations of threat and value occurred.

The manner in which threats or values were categorised and the degree to which categories were split or lumped, could have a bearing on the results of the synthesis (Florig *et al.* 2001). To evaluate the possible effects of this process, a condensed version (52 threats x 31 values) of the hazard matrix was used to identify common hazards and re-estimate the priority orders of threats and values. Scores for the 52 threats of the condensed matrix were calculated as the number of parks affected by a given threat, summed across all values in a matrix. This was done from both the original matrix with 45 values, and a condensed matrix with 31 values. The rank orders of scores from the two matrices were then compared using



**Figure 8** Examples of risk scores and categories displaying associated uncertainty Mushroom Reef workshop.

Spearman’s rank correlation. A similar process was applied to the 31 values of the condensed matrix, comparing the priority order of those values based on the full list of 114 threats to that based on the condensed list of 52.

Multidimensional scaling (MDS; Clarke 1993) was applied at the level of individual parks, to identify any broad similarities among the parks in terms of the 114 threat categories of the

full threat x value matrix. A Similarity Percentages analysis (SIMPER; Clarke 1993) was then used to determine which threats contributed most to any patterns identified by MDS.

### 3. MAJOR OUTCOMES

Overall, 525 hazards were defined during the workshops, 41% of which were of sufficient concern to participants to be promoted to the risk register for formal scoring (Table 2). Some hazards such as the poaching of commercially valuable species, were common to many parks across the state. Others were location-specific, for example, the trampling of mangrove flats and saltmarsh by hard-hoofed animals such as cattle and sheep. The full list of hazards is provided in Appendix 4, and a summarised version of the hazard matrix in Table 3.

**Table 2.** Count of hazards by workshop and priority.

Workshop	Risk Register hazards	Secondary hazards	Total
Discovery Bay	10	8	18
Shipwreck Coast <sup>#</sup>	17	16	33
Marengo Reef	16	20	36
Surf Coast	12	17	29
Barwon Bluff	18	16	34
Port Phillip Heads	12	18	30
Point Cooke	15	21	36
Jawbone	13	18	31
Ricketts Point	14	23	37
Mushroom Reef	16	23	39
Western Port (1)	10	32	42
Western Port (2)	16	24	40
Bunurong	11	18	29
Promontory	14	20	34
Ninety Mile Beach	11	14	25
East Gippsland	8 *	24	32
Total	213 *	312	525

# At the Shipwreck Coast workshop, hazards arising in the two brainstorming sessions were not distinguished

\* The 8 risk register hazards at the East Gippsland workshop were scored separately for each of the 3 parks considered, bringing the total number of hazards scored to 229.







### 3.1 Threats

While many hazards involved predictable, tangible threats such as poaching, pollution and disturbance by park visitors, the approach also identified a number of less obvious threats (Table 4). Management issues ranged from the complexity of interactions among multiple management agencies operating around a park, to the ability of park managers to mark in-water park boundaries successfully. A lack of detailed ecological knowledge was a widespread concern because such knowledge was considered important for park managers to make informed decisions across many values.

**Table 4.** The most common threats at stakeholder workshops

(i.e. those arising for the highest number of parks and values)

No. parks/values where threat of concern	Primary threat category	Secondary threat category	Activity or Agent
74	Biological	Human	Poaching / theft
50	Miscellaneous	Ecological knowledge	
48	Miscellaneous	External management	
48	Physical	Litter - marine sources	Entanglement / smothering / ingestion
47	Physical	Small boats	Physical contact
46	Chemical	Oil/fuel spill	Commercial shipping
45	Miscellaneous	Park management	
44	Physical	Litter - terrestrial sources	Entanglement / smothering / ingestion
37	Biological	Human	Trampling
35	Physical	Noise	Small boats / PWCs
32	Biological	Human	Presence
31	Biological	Human	Fossicking
30	Miscellaneous	Development	

The less tangible threats of governance and ecological knowledge also appear in the summary of common hazards (i.e. threats and values together) presented in Table 5. Here it is notable that workshop participants were unable to be specific about the values most at risk from these less tangible threats. Recreational boating, dogs and the introduction of exotic

species appear among major concerns when threats are considered in conjunction with the natural values seen to be at risk

**Table 5.** The most common hazards from stakeholder workshops.

(i.e. those arising for the most parks)

No. Parks	Hazard (Threat & Value)		Combining Related Hazards from Previous Column	No. Parks
14	Poaching of abalone	}	Poaching of abalone or finfish	23
14	Poaching of finfish			
19	Lack of ecological knowledge ultimately leading to detrimental effects on park biota in general	}	Lack of ecological knowledge ultimately leading to detrimental effects on park biota in general or park habitats	21
15	Lack of ecological knowledge ultimately leading to detrimental effects on park habitats			
11	Park management affecting park biota in general	}	Governance issues (park or external management) affecting park biota in general or park ecosystems in general	20
11	External management affecting park ecosystems in general			
14	Dogs disturbing or injuring shorebirds			
12	Noise from small boats and personal water craft disturbing shorebirds	}	Noise from small boats and personal water craft disturbing shorebirds or seabirds	13
10	Noise from small boats and personal water craft disturbing seabirds			
10	Litter from marine sources affecting park biota			
10	Trampling of intertidal rock platforms by park visitors			
10	Removal of biota other than commercial seafood species from parks			
10	Exotic marine species, introduced via commercial shipping, affecting park biodiversity			

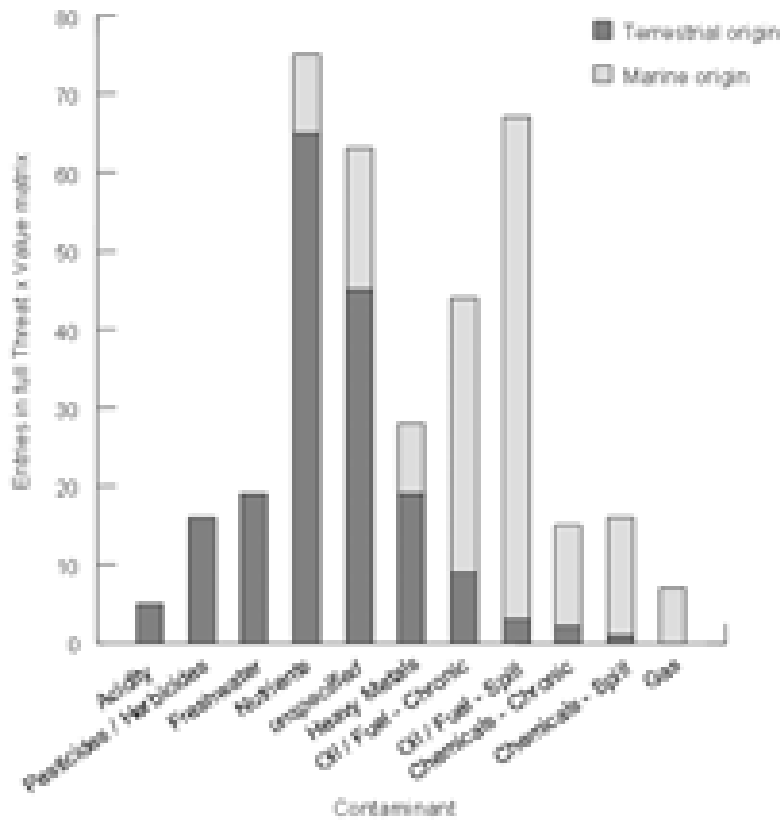
Twenty-four hazards were of sufficient concern to workshop participants to achieve risk scores with an upper bound of 25, the maximum possible. Those of greatest concern (i.e. those with the highest lower bounds) are listed in Table 6, together with the workshop at which they were nominated.

**Table 6.** Most extreme hazards (i.e. with highest upper bound of risk score)

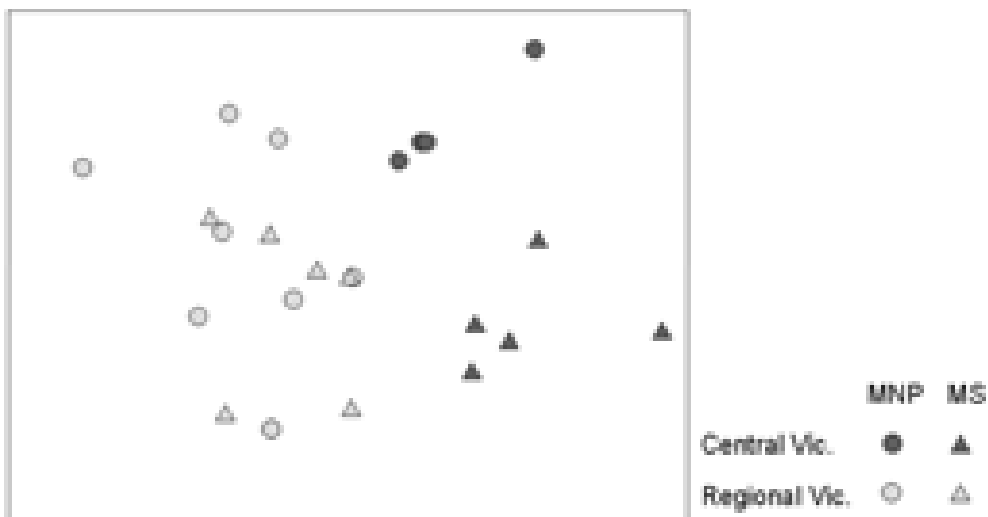
Upper bound of risk score	Lower bound of risk score	Hazard	Workshop
25	15	Invasive species competing for space with local marine biota	Point Cooke
25	12	Divers or snorkellers illegally taking edible species such as abalone, crayfish and resident fish and thereby affecting the size distribution of these species within the sanctuary	Marengo Reefs
25	12	New or existing marine pests outcompeting local species	Ricketts Point
25	12	Sediments and nutrients in catchment runoff affecting water quality and seagrass in Corner Inlet MNP	Promontory
25	12	Oil spills from offshore rigs or shipping affecting seabirds and intertidal habitats and communities	Shipwreck Coast
25	12	Coastal erosion causing smothering slime over seagrass, resulting in seagrass dieback	Western Port (2)
25	10	Commercial tour groups or other organised groups of human visitors on the reef disturbing seals	Marengo Reefs

Collectively, water quality issues were prominent among stakeholder concerns. Twenty-four percent of the 1482 entries in the full threat x value matrix involved suspended sediments or contaminants such as oil, heavy metals and nutrients. Slightly more than half of the contaminant threats to water quality originate in adjacent catchments (Figure 9). Of those not arising from terrestrial sources, 58% referred to oil or fuel contamination from maritime activities.

Threats varied with the type of park and its location within Victoria. The multidimensional scaling in Figure 10 shows a clear distinction between parks in central Victoria and those to the east or west, and also between marine national parks and marine sanctuaries within the central area. SIMPER analysis indicated that the pattern apparent in Figure 10 is not driven by just a few key threats. Rather, many threats each contributed a small amount (<3%) to dissimilarities among the four groups of parks. No clear pattern of threats was found with estimated visitation rates (Parks Victoria 2005) or with a subjective measure of park accessibility generated by the facilitator.



**Figure 9** Type and origin of contaminants of concern to workshop participants.



**Figure 10** MDS plot of marine national parks (MNP) and marine sanctuaries (MS) based on presence/absence of threats of concern to workshop participants and using Bray-Curtis dissimilarities. (stress = 0.18)

### 3.2 Ecological Values

Ecological values specified in the hazards were grouped into 45 categories. To minimise information loss in this process, some categories were subsets of others, and values were allocated to the most specific category possible. Of 1482 entries in the body of the hazard matrix, 38% referred to the broad value categories “habitats in general”, “biota in general” or the “ecosystem in general” (Table 7). This usually indicated an inability or unwillingness of participants to be more specific about values they believed to be under threat.

**Table 7.** Most common values (i.e. arising for the highest number of parks and threats)

No. parks/threats where value of concern	Primary category	Secondary category	Specific value
257	Biota in general		
185	Ecosystem in general		
125	Habitats in general		
101	Biota	Shorebirds	
61	Other values	Biodiversity	
70	Biota	Seabirds	
57	Other values	Ecological processes	
50	Other values	Water quality	
49	Habitats	Intertidal	Rock platforms
43	Habitats	Intertidal in general	
40	Biota	Seals	

### 3.3 Sensitivity to classification

Priority orders of both threats and values from the full (114 x 45) and condensed (52 x 31) threat x value matrices were similar. A rank correlation coefficient of 0.992 indicated a high level of agreement in rank order for threat scores from the two matrices. A similar procedure with the rank orders of 31 values produced a correlation coefficient of 0.988, again indicating a high level of agreement. Common hazards from the condensed matrix values incorporated all those listed in Table 5, which was constructed from the full matrix.

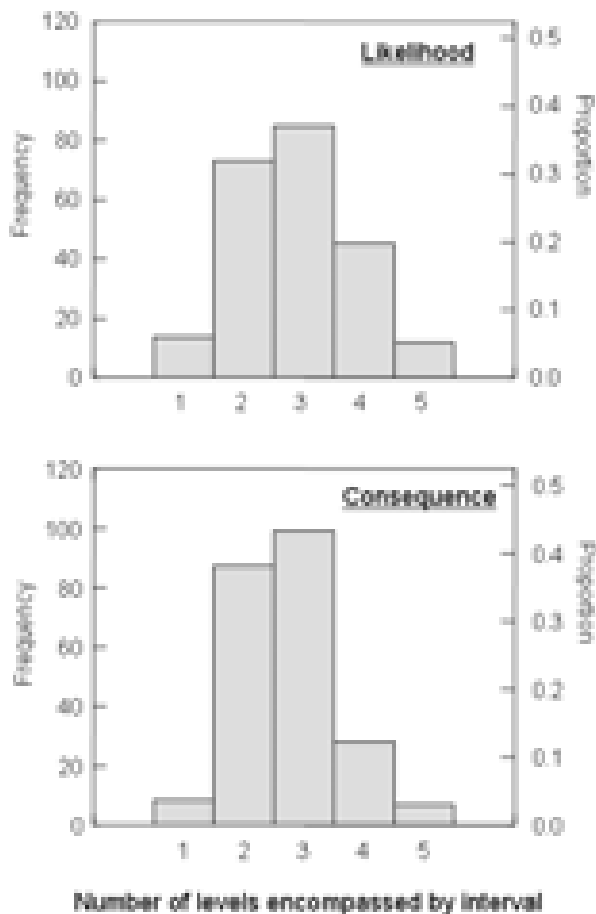
### 3.4 Scoring of Risk Register hazards

For the 229 risk register hazards, there was considerable uncertainty associated with the subjective scores for both likelihood and consequence. This stemmed from both uncertainty within groups in assigning scores, and from differences of opinion between groups. Likelihood scores spanned on average 2.9 units (st. dev. = 1.0) and consequence scores 2.7 units (st. dev. = 0.8) (Figure 11). Scores for likelihood tended to have higher upper bounds than those for consequence (Figure 12).

The uncertainty associated with likelihood and consequence scores carried through to the risk scores, with 99% of scores being intervals rather than point scores. Risk scores on average spanned 11.5 units (st.dev. = 4.7), with the upper bound falling between 16 and 20 in over 50% of cases (Figure 13) The only two hazards with point scores for risk were:

- dogs off-lead disturbing of migratory wading birds (Jawbone MS), risk score = 15.
- exotic species introduced via aquaculture affecting the ecological integrity of park populations (Discovery Bay MNP), risk score = 4.

Seventy-nine percent of the 229 hazards formally scored had upper bounds categorised as “extreme” (Figure 14). The upper bounds of a further 20% were rated as “high”.



**Figure 11** Degree of uncertainty associated with likelihood and consequence for all 229 risk register hazards.

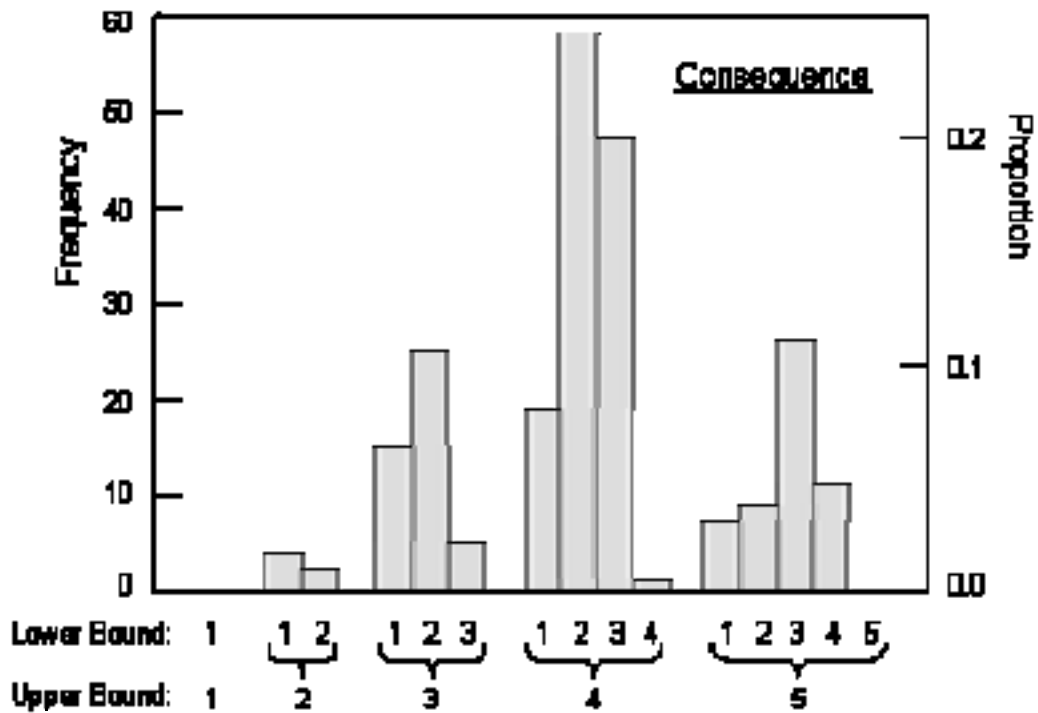
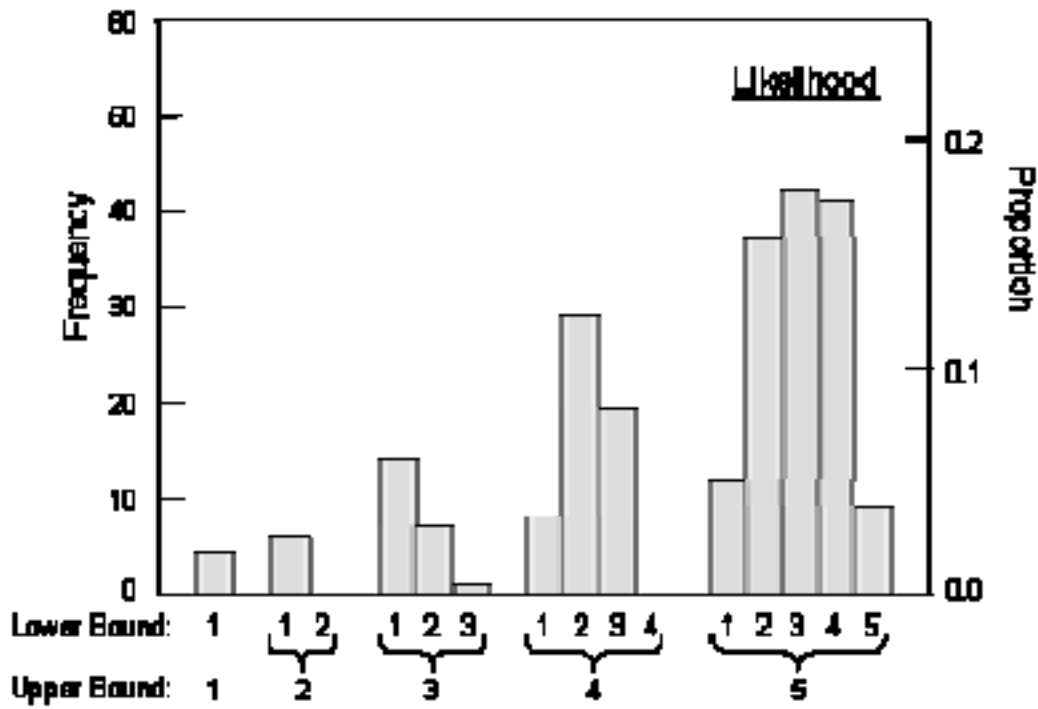


Figure 12 Likelihood and consequence intervals for all 229 risk register hazards.

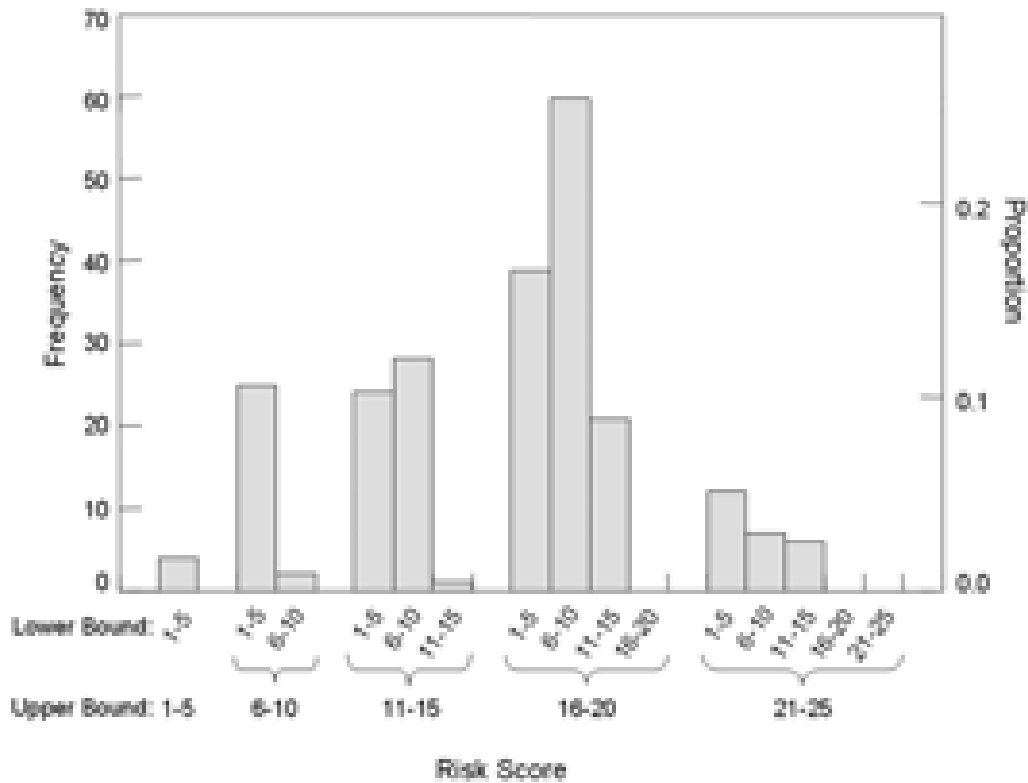


Figure 13 Risk scores for all 229 risk register hazards.

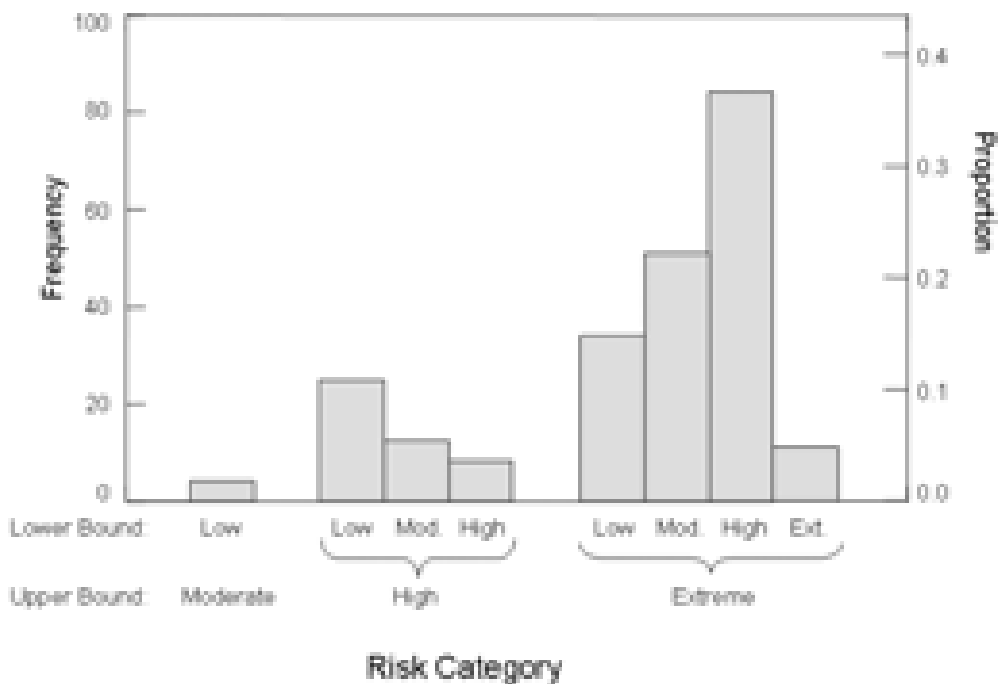


Figure 14 Risk categories for all 213 risk register hazards. Level of risk based on likelihood and consequence in accordance with AS4360, Appendix E (SA/SNZ 1999).

### **3.5 Comparison with internal Parks Victoria assessments**

Prior to the series of risk assessment workshops, Parks Victoria had undertaken ecological threat assessments internally as part of its compliance and management planning processes. A comparison of outcomes of the two sets of assessment indicates that the workshops consistently identified threats not previously considered (Table 8). These “new” threats are listed in Appendix 5. Half were threats to ecological values on a wider scale than the parks alone, for example, catchment-based issues of water quality and sediment transport. A further 27% of the new threats referred to governance issues and 16% to the ecological knowledge-base of the parks.

**Table 8.** Comparison of threats from previous internal Parks Victoria assessments (Parks Victoria 2003b, 2003c, 2004) with those from Risk Register hazards. (Note that partial matches of threats are recognised in this comparison.)

Workshop: (Park)	Previous Assessment		Workshop Assessment			
	Total no. of threats considered	No. of threats rated High or Extreme	No. of hazards in Risk Register	Threats from Risk Register rated High or Extreme in Previous Assess.	Threats from Risk Register rated Low, Moderate or not scored in Previous Assess.	Threats from Risk Register not considered in Previous Assess. (i.e. "new" threats)
Discovery Bay	59	7	10	4	1	5
Shipwreck Coast <sup>a</sup>	59	8	17	2	6	9
Marengo Reefs	59	8	16	1	9	5
Surf Coast <sup>a</sup>	59	8	12	2	7	3
Barwon Bluff <sup>b</sup>	16	14	18	5	0	13
Port Phillip Heads: <sup>a b</sup>	25	20	12	4	0	7 <sup>c</sup>
Point Cooke <sup>b</sup>	23	13	15	4	2	9
Jawbone <sup>b</sup>	23	13	13	5	0	8
Ricketts Point <sup>b</sup>	22	15	14	6	0	8
Mushroom Reef <sup>b</sup>	22	10	16	6	3	7
Western Port (1): <sup>b</sup> Churchill Island MNP	20	9	10	5	0	5
Western Port (2): <sup>b</sup> Yaringa MNP	12	2	16	2	1	13
French Island MNP	12	5	16	2	2	12
Bunurong	51	27	11	5	0	6
Promontory: <sup>d</sup> Wilson's Prom. MNP	50	32	7	2	0	5
Corner Inlet MNP	52	18	10	7		3
Ninety Mile Beach	51	25	11	8	2	1
East Gippsland: <sup>e</sup> Beware Reef MS	54	42	8	5	0	3
Point Hicks MNP	50	21	8	4	0	4
Cape Howe MNP	50	23	8	4	0	4

a Comparison made on a combined Compliance Plan threat list for all parks or park components

b For these parks, high risk in the relevant Compliance Plan was effectively =10 on a 25-point scale of risk.

c An identical threat occurred in two separate hazards (i.e. hazards differed only in values affected).

d Parks were compared individually because the majority of hazards at this workshop were park specific.

e Parks were compared individually because parks at this workshop were scored individually.

## 4. DISCUSSION

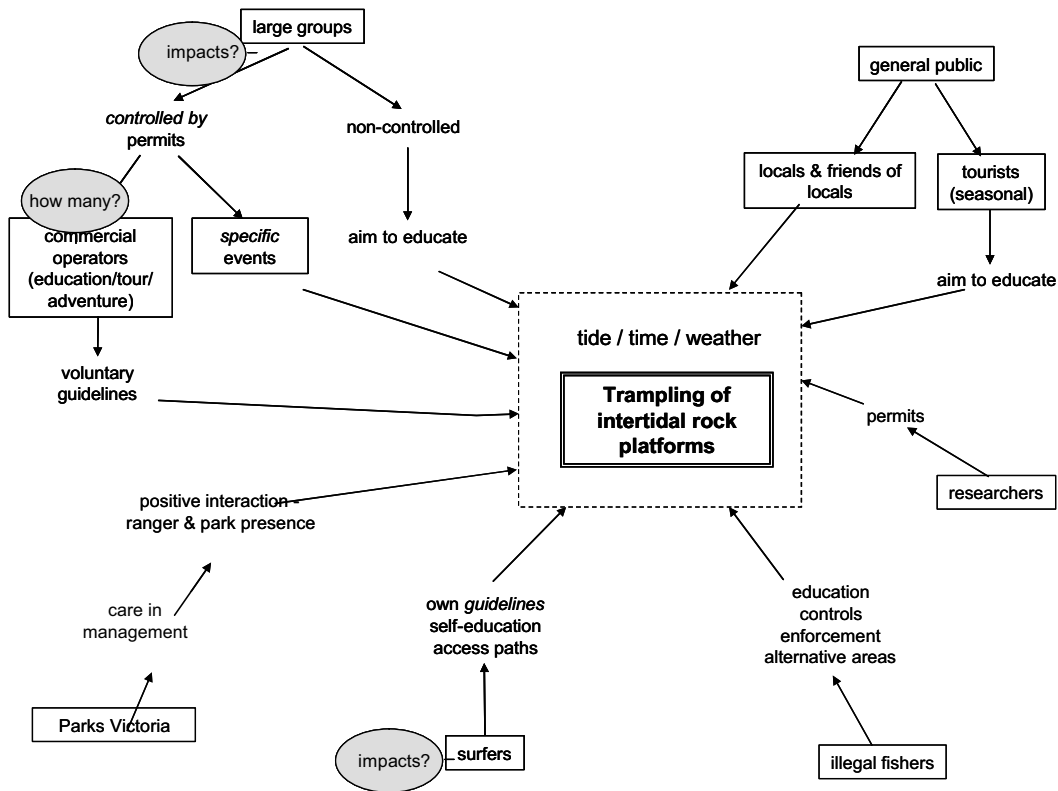
### 4.1 Management planning

Parks Victoria used information generated in the risk assessment workshops as a direct input to the management planning process that coincided with the workshops. In some cases the output from workshops was used to refocus sections of the management plans on certain threats or include more discussion of possible management responses. Risk assessment is a now standard tool in the management planning and community engagement toolkit (Greenwood, pers. comm.). Through the risk assessment project, Parks Victoria reinforced its recognition of the strength of local community input. Input to the management planning process has always been as broad as possible and is designed to capture local knowledge and views.

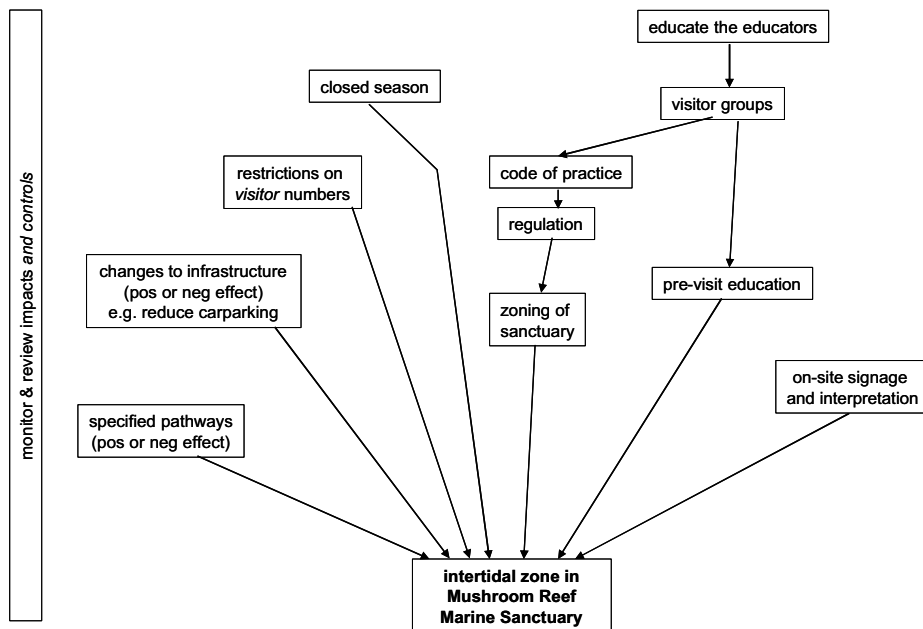
The workshop results led to Parks Victoria and the research team choosing a subset of threats (both at a statewide and local level) for further assessment. The aim was for the research team and agency jointly to develop tractable theoretical management responses to the subset of threats. Over a period of a year or more, the theoretical management responses explored via modelling will be trialled in adaptive management experiments in the parks. The results of such experiments enable managers and researchers to refine both the theoretical models and the actual management responses.

The trampling of intertidal rock platforms was one of the common hazards identified and is a candidate for Tier 2 or Tier 3 assessment. It may involve different groups of park visitors (Figure 15). This hazard is relatively well understood, its effects having been the subject of a number of ecological studies both in Victoria and elsewhere (e.g. Beauchamp & Dowling 1982, Keough & Quinn 1998, Milazzo *et al.* 2005). Trampling may reduce algal cover on an intertidal rock platform, and this may in turn affect the associated invertebrate community. Trampling of intertidal platforms is also amenable to direct management response. Possible actions include educational programs to modify the behaviour of park visitors, or limiting access to particularly vulnerable sections of platform or at specific high impact times (e.g. summer, midday, low tides) (Figure 16). Over the summer of 2006-2007, the research team and Parks Victoria rangers will do an adaptive management experiment to assess the efficacy of possible management responses in minimizing the threat at parks with high visitor use and potentially vulnerable platforms (Barwon Bluff, Merri and Ricketts Point Marine Sanctuaries, and the Point Lonsdale section of the Port Phillip Heads MNP). It is important to consider not only the environmental effectiveness of any management action, but also its potential impact on visitors' enjoyment of the intertidal platforms.

Management of some other common hazards will be less straightforward than that of the more tangible hazards such as trampling. For example, the lack of ecological knowledge was a concern in 21 of the 24 parks and sanctuaries (Table 5). Along with issues of governance, it does not immediately offer a tractable management response that could be implemented, tested and refined within the time scale of this research. However, monitoring the ecological effects of various threats and modelling the links between effects and a number of management responses will increasingly allow park managers to base future work on available evidence rather than instinct or intuition.



**Figure 15** Groups of park visitors who may cause damage to intertidal reef assemblages by trampling (Model from Surf Coast workshop).



**Figure 16** Possible management responses to effect of trampling on intertidal reef assemblages (Model from Mushroom Reef workshop).

## 4.2 Research needs of Parks Victoria

The second goal driving Parks Victoria involvement in the risk assessment project was to gather information to inform research needs. The basic research needs for the system were outlined in the Marine Management Strategy 2003-2010 (Parks Victoria 2003a), and a more specific marine research strategy for the next five years is being developed during 2006-2007. The information on threats and values generated in the current project is allowing a detailed analysis and prioritization of the research gaps in each park, as well as more broadly across the state. The final future research strategy will be a statewide document and will be necessarily focussed on what can be achieved within the limits of available funding. Input from the 16 local workshops helped identify threats, gaps and even topics for further investigation that may not have been proposed without the workshops. An example is the "lack of ecological knowledge" threat. Whereas there was already a process for gathering baseline biological information and detailed mapping of marine habitats across the MPA system, the finding from the workshops has led to a re-assessment of how to address the gap in a targeted way to best meet management needs at the park level. The information derived locally across the state has allowed for a more knowledgeable prioritization of research needs by Parks Victoria.

## 4.3 Hazard scoring

The formal scoring of hazards produced ranges of values rather than point scores in nearly all cases. The ranges reflect the different opinions held by workshop participants, which are in turn influenced by each participant's personal values and perceptions. It is as important to preserve genuine differences of opinion and take them into account when making management decisions, as it is to eliminate any differences that arise through misunderstanding and misinterpretation. Our protocol attempts to recognise and retain the former, while minimising the latter.

A wide range of scores may also reflect a lack of data that would permit more informed estimates of the likelihood of events occurring. For example, had it been available, data on the numbers of people walking across a given rock platform at different times of year, and where on the platform they tended to walk, would inform estimates of the likelihood of trampling damage to intertidal biota on that platform. Efforts should be made to compile any such data for the next iteration of the risk management cycle.

## 4.4 Sensitivity of hazards to classification

The analyses of the degree of splitting of hazards suggested that this process had only a minor influence on the resulting priorities for management of hazards. The ranks of threat were little affected by reclassification, with Spearman rank correlation coefficients in excess of 0.99 resulting from comparisons between classifications.

## 4.5 Threats across the state

The state-wide synthesis identified a distinction in threats between parks on the central Victorian coast and those along regional coastlines (Figure 10). We believe this reflects the fact that the central coast is the focus of human activity in Victoria. The state capital,

Melbourne, is the largest population centre in the state, with over 3.5 million people. It is the focus of commercial shipping (Larcombe *et al.* 2002) and probably also of water-based recreational activity.<sup>1</sup>

Each of the stakeholder workshops identified one or more threats not previously considered during internal assessments by the management agency. In keeping with a world-wide tendency in marine protected area management, the internal assessments tended to have what has been called an "inside perspective", rather than seeing the parks in a wider context (Cicin-Sain & Belfiore 2005). We attribute much of the more outward-looking assessment at our workshops to the broader base of participating stakeholders. On average, more than half the stakeholders at any one workshop came from outside Parks Victoria. For these external participants, management and planning tasks related to the parks were not everyday issues. These participants brought a wider range of personal experiences, opinions and values to the assessment process than would have been expected from a purely internal assessment.

## 4.6 Ecological values

We suggest the reluctance or inability of participants to be specific about ecological values in many hazard definitions may be due partly to the relatively poor state of general knowledge of Australian marine biota (Poore 1995), and in particular the marine invertebrates which comprise the great bulk of marine biodiversity (Ponder *et al.* 2002). Although shallow coastal waters in south-east of Australia are some of the better studied of Australian waters, there are still many gaps in our knowledge. The persistent concern with "lack of ecological knowledge" is also a symptom of this situation. Many environmental values identified during the process of selecting areas for inclusion in Victoria's system of marine national parks and sanctuaries tended to be general in nature. For example, "these two small reefs provide a wide variety of microhabitats in a small area" (ECC 2000, p. 74) or "extensive intertidal rock platforms, and subtidal rocky reefs, uncommon along the Victorian coast, which extend several kilometres from shore but which are in relatively shallow water" (ECC 2000, p. 69). Detailed knowledge of the habitats or communities within the parks is patchy and often restricted to conspicuous geological features or larger and charismatic species. However, the involvement of local participants in the risk assessment process provides a heightened educational and reporting opportunity for managers and researchers alike. Community management reference groups are in place to support the gathering of information on these sites and through experience or training, to recognize new threats as they occur.

## 4.7 Participation in workshops

Many people invited to the workshops were unable to attend for various reasons, despite workshops being held close to or within the park in question. Many with personal or

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<sup>1</sup> A 2002 report on marine safety regretted the almost complete lack of data on the usage of recreational boats in Victoria (MUARC 2002)

community reasons for wishing to attend were unable to do so because of work or other commitments. This was of particular concern because it may have led to the under-representation of local viewpoints, at least from stakeholders not working in management agencies. Figure 3 suggests that we did in fact achieve a moderate level of balance in representation, but this impression can be partly attributed to many of the personal/community participants explicitly giving multiple reasons for attending. A higher proportion of non-agency participants would have been desirable and future iterations of the process should strive to increase the attendance of stakeholders with personal or community-based interests in the parks. This may require different engagement strategies to ensure a more extensive representation of interests.

#### **4.8 The risk assessment project**

In the final stage of the risk assessment project, mathematical models (e.g. Bayesian networks) for several of the key hazards identified during the workshops will be developed. Introduced marine species and catchment-related contaminants in water are threats of particular interest for this final stage. The models will incorporate any existing data that is relevant, and will be linked to management responses where appropriate (see Section 4.1). The assistance of knowledgeable park stakeholders will be sought to ensure that such models are consistent with their understanding of park systems.

### **5. ACKNOWLEDGEMENTS**

We thank the stakeholders who attended the workshops for their time and enthusiasm. This project is supported by a Linkage grant (LP0561075) from the Australian Research Council.

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## **7. SOFTWARE**

Chisholm, R., Campbell, H., Burgman, M. & Carey, J. (2005) *Subjective Risk Assessment, Version 3*. University of Melbourne.

## **8. PERSONAL COMMUNICATION**

Ms Linda Greenwood. Team Leader, National Park Planning, Parks Victoria.

## APPENDIX 1.

Ecological values presented in checklists for structured brainstorming.

This checklist was compiled from various sources, which are listed below the table.

Workshop	Value
Discovery Bay	<p>Part of largest coastal basalt formation in western Victoria, and among highest wave energy environments in State.</p> <p>Rocky habitats of complex forms, including low profile calcarenite-capped basalt platforms, isolated low calcarenite reefs, and heavy sloping basalt walls.</p> <p>Calcarenite reefs with thick growths of sessile invertebrates (33 - 55 m).</p> <p>Basaltic reefs covered by kelps, including <i>Ecklonia radiata</i> (18 m)</p> <p>Subtidal soft sediments of mainly fine sand, with carbonate content about 80%.</p> <p>High diversity of intertidal and shallow subtidal invertebrates, including rock lobster and abalone.</p> <p>Blue whales and great white sharks are regular visitors to area.</p>
Shipwreck Coast	<p>Dramatic underwater arches and canyons with marine life striking in colour and shape (Twelve Apostles MNP)</p> <p>Substrate complexity, including various geological rock types (limestone, calcarenite, mudstone, sandstone) (Twelve Apostles MNP)</p> <p>Rocky habitats complex in form (Twelve Apostles MNP)</p> <p>Subtidal soft sediments (Twelve Apostles MNP)</p> <p>Highest diversity of intertidal and shallow subtidal invertebrates on limestone in Victoria (Twelve Apostles MNP)</p> <p>Sandstone intertidal rocky platforms around Moonlight Head, characterized by rich intertidal and shallow subtidal invertebrate communities (Twelve Apostles MNP)</p> <p>Shoreline, rockstacks and islands providing breeding colonies for seabirds (Twelve Apostles MNP)</p> <p>Threatened shorebirds and seabirds (Twelve Apostles MNP) *</p> <p>Spectacular limestone arches and canyons in 19 - 25 m of water (The Arches MS)</p> <p>Invertebrates characteristic of deeper Bass Strait waters in 19 - 25 m of water (The Arches MS)</p> <p>Giant kelp forests providing important habitat for suite of marine animals (The Arches MS)</p> <p>Seabed at river mouth providing range of habitats and diverse marine life (Merri MS)</p> <p>Rocky overhangs and canyons supporting variety of fish (Merri MS)</p> <p>Penguin colonies (Merri &amp; Middle Is) (Merri MS)</p>

	<p>Frequent visitation by marine mammals (Merri MS) *</p> <p>Flora and fauna traditionally accessed by local Aboriginal groups (Merri MS)</p> <p>Threatened shorebirds (Merri MS) *</p>
Surf Coast	<p>Sandy beach</p> <p>Intertidal rocky reef with rockpools</p> <p>Deeper water reef with abundant fish life</p> <p>Biota of Ingoldsby Reef, including leafy sea-dragon</p> <p>Seagrass beds - <i>Amphibolis</i></p> <p>Subtidal soft sediments, with abundant epibenthos providing shelter for fish</p> <p>Pt Addis limestone - State geological significance</p> <p>Availability of biota for fishing and food collection by local Aboriginal people</p> <p>Presence of Australian Fur Seals and dolphins</p> <p>High wave-energy shoreline (suitable for surfing - Bells Beach)</p> <p>Varied geology (sandstone &amp; basalt) with platforms, pools, fissures &amp; boulder fields</p> <p>Diversity of invertebrates on rock platforms (intertidal and subtidal)</p> <p>Subtidal kelp forests</p> <p>Opisthobranch fauna - 96 species, 20% of which are undescribed</p> <p>High invertebrate diversity on limestone substrate</p>
Barwon Bluff	<p>Sandstone and basalt reefs with thick patches of giant and bull kelp</p> <p>Shore platforms with diversity of marine life (used extensively for marine education)</p> <p>Spectacular subtidal sandstone arches and gutters</p> <p>Complex geology - basalt from lava flow from Mt Duneed &amp; old sandstone formed under ancient seas</p> <p>Probable foraging area for nearby Hooded Plovers (endangered sp; FFG listed)</p>
Port Phillip Heads	<p>High invertebrate diversity on intertidal calcarenite reef (Pt Lonsdale)</p> <p>Algal diversity and abundance on Lighthouse Reef (Pt Lonsdale)</p> <p>Undercut structure of Lonsdale Reef (feature seldom found on Vic open coast) (Pt Lonsdale)</p> <p>Diverse fish and invertebrate communities on Lonsdale Wall (Pt Lonsdale)</p> <p>Shorebird feeding habitat of State significance - calcarenite shore and reef platforms (Pt Lonsdale)</p> <p>Presence of threatened marine mammals (Pt Lonsdale)</p> <p>Islets and shoals of Mud Islands - highly unusual feature and of State significance (Mud Islands)</p> <p>Dense seagrass beds supporting invertebrates and juvenile fish (Mud Islands)</p> <p>Shorebird habitat of international significance (RAMSAR &amp; Register of National Estate) (Mud Islands)</p> <p>Salt marsh communities largely protected from human disturbance (Mud Islands)</p>

	<p>Shorebird habitat of international significance (RAMSAR &amp; Register of National Estate) (Swan Bay)</p> <p>Orange-bellied parrot - key wintering site (Swan Bay)</p> <p>Extensive seagrass beds with diverse community and providing important fish habitat and nursery areas (Swan Bay)</p> <p>Intertidal mudflats and extensive saltmarsh of regional significance and supporting rich fauna (Swan Bay)</p> <p>Distributary delta of regional significance (Yarram Creek) (Swan Bay)</p> <p>Unusual natural shoal formation topped with man-made rock structure and supporting rich benthos (Popes Eye)</p> <p>Artificial structure where Australasian Gannets nest and roost - State significance (Popes Eye)</p> <p>Diverse and abundant fish assemblages (fishing prohibited since mid/late 1970s) (Popes Eye)</p> <p>Unusual geomorphological feature (steep remnant section of Yarra River) with associated fauna (Portsea Hole)</p> <p>Dynamic sedimentation regime with sustained sandy accretion at Observatory Point (Pt Nepean)</p> <p>Unusual shore platform, developed in contrasting wave environments (Pt Nepean)</p> <p>Extensive calcarenite reefs with diverse flora and fauna and long history of protection from boat landings (Pt Nepean)</p> <p>Presence of pods of dolphins along bayside coast (Pt Nepean)</p> <p>Shorebird habitat - reef and sandy beach (Pt Nepean)</p>
Point Cooke	<p>Very shallow shore of Port Phillip Bay with narrow beaches of mud and sand</p> <p>Low basalt reef with algae and associated epibenthic fauna</p> <p>Probable contribution to feeding grounds for migratory birds from nearby Ramsar site</p>
Jawbone	<p>Largest occurrence of mangroves in Port Phillip Bay (among massive basalt boulders)</p> <p>Diverse algal community and associated fauna - unusually unmodified for Port Phillip Bay</p> <p>Subtidal sediments of fine clayey sands which support high species richness</p> <p>Basalt platform that serves as a roosting site for migratory waders</p> <p>Shorebird feeding area of national significance</p>
Ricketts Point	<p>Rocky (sandstone) intertidal and subtidal habitats</p> <p>Sandy beaches</p> <p>Subtidal soft sediments</p> <p>Seagrass meadows</p> <p>Small area of regional significance for roosting and feeding shorebirds</p> <p>Widest shore platform in area. Tertiary Black Rock sandstone (regional/local structural, palaeontological and geomorphological significance)</p>

Mushroom Reef	<p>One of most diverse intertidal rocky reef communities in Victoria</p> <p>Highly complex intertidal basalt substrate providing rich variety of microhabitats</p> <p>Abalone population</p> <p>Gastric-brooding seastar (<i>Smilasterias multipara</i>)</p> <p>Seagrass beds (<i>Amphibolis</i>)</p>
Western Port (1)	<p>Mangrove stands (particularly Yaringa MNP)</p> <p>Saltmarsh (particularly Yaringa MNP)</p> <p>Seagrass beds (particularly French Is. MNP)</p> <p>Unvegetated mudflats (Yaringa MNP?)</p> <p>Channel system (French Is MNP)</p> <p>High tide roost site at Barralliar Island (French Is MNP)</p> <p>Saltmarsh plant community of Watson Inlet and Quail Is (national importance)</p> <p>32 migratory bird species (RAMSAR wetlands)</p> <p>White mangrove <i>Avicennia marina</i> (State significance)</p> <p>“Living fossils”- brachiopod <i>Magellania flavescens</i>, bivalves <i>Neotrigonia margaritacea</i> and <i>Anadara trapezia</i></p> <p>Watson Inlet and Quail Is. (Yaringa MNP) - relatively undisturbed mangrove and saltmarsh area - geological/geomorphological features of State significance</p> <p>Barrallier Is. (French Is. MNP) - small gravelly island - geological/geomorphological feature of regional/local significance</p>
Western Port (2)	<p>Rich floristic seagrass communities</p> <p>Extensive mangrove and saltmarsh communities</p> <p>Intertidal mudflats supporting waderbird foraging</p> <p>Network of deep tidal channels</p> <p>Relict multiple curved sand spit at Bungower Point</p> <p>Sand ridges and islands of regional/local geomorphological significance</p>
Bunurong	<p>Extensive intertidal rock platforms, and subtidal rocky reefs which extend several kilometres from shore but which are in relatively shallow water.</p> <p>Mixed brown algal marine ecological community (<i>Cystophora/Sargassum</i> dominated), rich in red and brown species</p> <p>Highest diversity of intertidal and shallow subtidal invertebrate fauna recorded in Victoria on sandstone.</p> <p>Beds of seagrass <i>Amphibolis antarctica</i></p> <p>Threatened marine mammals (seals &amp; whales) - reported sightings.</p>
Promontory	<p>Unusual granite habitats, including extensive heavy reefs with smooth surfaces, boulders and rubble and low profile reefs (Wilson's Prom. MNP)</p> <p>Smooth-walled granite cliffs plunging abruptly to the sea-floor (Wilson's Prom. MNP)</p>

Sandy beaches sloping gradually to depths of 30 to 50 m within 3 km offshore (Wilsons Prom. MNP)

Significant seagrass beds in some sheltered bays (e.g. *Amphibolis* & *Halophila* in Waterloo Bay, *Heterozostera* in Oberon Bay) (Wilsons Prom. MNP)

Deep heavy reefs with dense cover of epifauna, especially sponges, stalked ascidians and sea whips, and abundant fish life (Wilsons Prom. MNP)

Soft sediment areas with diverse biotic assemblages (Wilsons Prom. MNP)

*Phyllospora-Ecklonia* dominated macroalgal community, with fleshy red algae and some other brown species abundant (MEC M6) (Wilsons Prom. MNP)

*Phyllospora* dominated macroalgal community, with *Ecklonia* & encrusting corallines abundant (MEC M7) (Wilsons Prom. MNP)

South to east invertebrate community: very abundant *Heliocidaris erythrogramma* (urchin), *Haliotis rubra* (blacklip abalone) & *Cenolia trichoptera* (feather star) and typically *Nectria macrobranchia* (seastar) (MEC IN1) (Wilsons Prom. MNP)

North west invertebrate community: very abundant *Heliocidaris erythrogramma* (urchin), *Haliotis rubra* (black-lip abalone) & *Cenolia trichoptera* (feather star) and typically *Patiriella brevispina* and *P. vernicina* (seastars) (MEC IN1) (Wilsons Prom. MNP)

Western fish community with dominant species *Casioperca rasor* (barber perch), *Notolabrus tetricus* (blue-throated wrasse), *N. fucicola* (purple wrasse), *Dinolestes lewini* (long-finned pike) and *Odax cyanomelax* (herring cale) (MEC F3) (Wilsons Prom. MNP)

Eastern fish community with dominant species *Casioperca rasor* (barber perch), *Notolabrus tetricus* (blue-throated wrasse), *N. fucicola* (purple wrasse) and *Dinolestes lewini* (long-finned pike) (MEC F4) (Wilsons Prom. MNP)

Nationally significant area for recovery of Great White shark populations (Wilsons Prom. MNP)

Representative areas of extensive beds of seagrass *Posidonia australis* (Corner Inlet MNP)

High invertebrate diversity in soft sediments (Corner Inlet MNP)

Intertidal flats that form part of internationally significant feeding areas for migratory waders (Corner Inlet MNP)

Breeding colonies of Little Penguins (near Wilsons Prom. MNP)

Breeding colonies of Australian Fur Seals (near Wilsons Prom. MNP)

Shorebird habitat of State significance on islands within MNP (Wilsons Prom. MNP)

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Ninety Mile Beach Subtidal soft sediments, consisting of fine to medium sands with some silt, gravelly sand and shell material

Patchy, low profile calcarenite reefs dominated by invertebrates

Large, endemic southern Australian seastar *Coscinasterias muricata*

Unusual soft coral *Pseudogorgia godeffroyi*, only found in Victoria between McGaurans and Delray beaches

Low relief reefs that may be remnants of dune systems formed when sea levels

	<p>where lower</p> <p>Fossils in mud between some reefs</p> <p>Likely feeding area for aggregations of young white sharks</p> <p>Known feeding area of snapper</p>
East Gippsland	<p>Rocky habitats with varied forms, from large boulders rising to six metres, to clusters of smaller rocks and stones (Point Hicks MNP)</p> <p>Subtidal soft sediments of variable grainsize, with a low carbonate content (Point Hicks MNP)</p> <p>Very high faunal species richness, including intertidal and shallow subtidal invertebrates (Point Hicks MNP)</p> <p>Plentiful and beautiful marine flora and fauna, including spectacular subtidal reefs with colourful and diverse sessile invertebrates (Point Hicks MNP)</p> <p>Kelps including <i>Ecklonia</i> and <i>Phyllospora</i>, and small algae (Point Hicks MNP)</p> <p>Significant pelagic species - which? (Point Hicks MNP)</p> <p>Rocky habitats with complex structure, including eroded low-profile sandstone reef and high-profile granite reef (Cape Howe MNP)</p> <p>Sandstone reefs to 50 m depth heavily covered with diverse array of sponges, hydroids, ascidians and gorgonians (Cape Howe MNP)</p> <p>Subtidal soft sediments of mainly fine and medium grainsize, with a low carbonate content (Cape Howe MNP)</p> <p>High diversity of intertidal and shallow subtidal invertebrates (Cape Howe MNP)</p> <p>Presence of many warmer-water species at the southern limits of their range (Cape Howe MNP)</p> <p>Probable foraging area for threatened sea/shorebirds</p> <p>Isolated granite reef, arising from sandy substrate and having forests of bull kelp (Beware Reef MS)</p> <p>Diversity of invertebrates, algae and fish (Beware Reef MS)</p> <p>Haul-out area for Australian fur seals (Beware Reef MS)</p>

\* Value modified during workshop

#### Sources:

ECC. (2000) *Marine Coastal & Estuarine Investigation. Final Report*. Environment Conservation Council, East Melbourne.

Ferns, L.W. and Hough, D. (2002). *High Resolution Marine Habitat Mapping of the Bunurong Coast (Victoria) - Including the Bunurong Marine and Coastal Park*. Parks, Flora and Fauna Division, Department of Natural Resources and Environment, East Melbourne.

Parks Victoria (2004a) *Beware Reef MS Draft Environmental Conservation Objectives - 25 June 2004*. (Unpublished)

Parks Victoria (2004b) Cape Howe MNP Draft Environmental Conservation Objectives - 25 June 2004. (Unpublished)

Parks Victoria (2004c) Point Hicks MNP Draft Environmental Conservation Objectives - 25 June 2004. (Unpublished)

Parks Victoria. (2004d) Port Phillip Heads Marine National Park Draft Management Plan. Parks Victoria, Melbourne.

Plummer, A, Morris, L, Blake, S & Ball, D (2003). *Marine Natural Values Study, Victorian Marine National Parks and Sanctuaries*. Parks Victoria Technical Series No. 1, Parks Victoria, Melbourne.

## APPENDIX 2.

Generic list of threats for structured brainstorming.

This generic checklist was created from two initial lists, one provided by T. Caling (Parks Victoria, Bairnsdale) which was based on the Southeast Region Marine Plan report *Impacts - identifying disturbances* (NOO 2000), the other generated by the workshop facilitator. The generic list was updated after each workshop to reflect any “new” threats identified.

Activity	Source
Biological threat	
Bait collection	Jawbone workshop
Casual fossicking by divers in subtidal	TC / Facilitator
Casual fossicking in intertidal	TC / Facilitator
Damage to habitats/organisms by divers	Facilitator
Deliberate harassment of wildlife	TC
Discarding of fish	TC
Disturbance by dogs	TC
Disturbance to fauna by recreational boating	TC / Facilitator
Disturbance to fauna by terrestrial vehicles	TC
Disturbance and damage by horses	Barwon Bluff workshop
Educational/research collection of specimens	Mushroom Reef workshop
Illegal recreational fishing (theft)	Facilitator
Interactions with wildlife (e.g. rockpool ramble, dolphin swims)	TC
Introduction of fish bait	TC
Intrusion of hard-hoofed animals as a result of inadequate fencing	Promontory workshop
Legal fishing or other collection of organisms in areas surrounding reserve	Marengo Reefs workshop
Predation by introduced species (e.g fox, cat)	Facilitator
Presence of farm carcasses	Mushroom Reef workshop
Shooting	TC
Unlicensed commercial fishing (theft/poaching)	TC
Contaminants / pollutants	
Acid rain from nearby industries	Ricketts Point workshop

Acts of terrorism	Port Phillip Heads workshop
Agricultural discharge (i.e. nutrients) via drains and runoff	TC & Bunurong workshop
Air-borne pollution from aircraft operation	Point Cooke workshop
Artificial opening of river mouths	Shipwreck Coast workshop
Bacterial contamination from dog excrement	Mushroom Reef workshop
Chemical spills from recreational activities	TC
Chemical spills from shipping	TC
Contaminants from antifouling (recreational)	TC / Facilitator
Contaminants from antifouling (shipping)	TC / Facilitator
Contaminants from ballast water discharge	TC
Contaminants from vessel maintenance	TC
Cooling water discharge from shipping	TC
Elevated levels of lead etc from accumulated ammunition in sediments	Jawbone workshop
Garbage discharges from recreational vessels	TC
Garbage discharges from shipping	TC
Grey water discharges from recreational vessels	TC
Grey water discharges from shipping	TC
Heavy metals and chemicals from industrial or waste disposal sites leaching into groundwater	Bunurong & Jawbone workshops
Industrial discharge (e.g. dairy)	TC
Legal dumping of munitions or chemicals in marine areas	Promontory workshop
Loss of containers or other deck cargo from shipping	TC
Major rain event after extended dry period causing waterbody with concentrated contaminants to overflow in park	Jawbone workshop
Natural petroleum seepage from offshore	Mushroom Reef workshop
Nutrients in groundwater from nearby farms	Discovery Bay workshop
Oil spill from shipping	TC
Oily waste from shipping	TC
Pesticides and herbicides in runoff from land	Marengo Reefs workshop
Pesticides and herbicides in groundwater from nearby market gardens	Point Cooke workshop
Pollution from inboard or outboard motor operation	TC / Facilitator
Release of contaminants by dredging/disposal	TC / Facilitator

Release of contaminants from recreational groundings/sinkings	TC / Facilitator
Release of contaminants from ship groundings/sinkings	TC / Facilitator
Rupturing of gas pipelines	Port Phillip Heads workshop
Sewage discharges resulting from failure of treatment plant	Marengo Reefs workshop
Sewage discharges (recreational)	TC
Sewage discharges (shipping)	TC
Shore-based litter	TC
Treated wastewater (sewage)	TC
Urban discharge (e.g. stormwater)	TC
Introduced marine species	
Exotic species via aquaculture stock	TC
Exotic species via ballast water discharge	TC
Exotic species via commercial fishing vessels	TC
Exotic species via feeding in aquaculture operations	TC
Exotic species via fish bait	TC
Exotic species via hull fouling of commercial shipping	TC
Exotic species via recreational vessels	TC
Exotic species via translocation of aquaculture pens	TC
Re-introduction of species mistakenly believed to be local	Barwon Bluff workshop
Introduced pathogens	
Pathogens via aquaculture operations	Shipwreck Coast workshop
Pathogens via discarded fish bait	Mushroom Reef workshop
Pathogens via shipping ballast water discharge	TC
Miscellaneous	
Alienation of indigenous cultural values/perspectives in management	Shipwreck Coast workshop
Change in indigenous practices	Shipwreck Coast workshop
Coastal management practices in areas adjacent to parks	Ricketts Point workshop
Delayed access/lack of equipment for emergencies in remote parks	Shipwreck Coast workshop
Edge effects (concentration of usage around park borders)	Shipwreck Coast workshop
Failure of parks to meet community expectations, leading to lack of community support	Promontory workshop

Failure to document ecological change	Port Phillip Heads workshop
Fragmentation of ecological processes (e.g. larval supply)	Ricketts Point workshop
Fragmentation of habitats	Point Cooke workshop
High profile of protected areas, resulting in reduced management focus on surrounding areas	Promontory workshop
Inappropriate off-site development (e.g. wind farms)	TC
Inappropriate on-site development (e.g. moorings, markers, signage)	TC
Inertia in decision-making	Promontory workshop
Information sufficient to stimulate vandalism but insufficient to deter it	Barwon Bluff workshop
Infrastructure vandalism	TC
Insufficient resourcing for enforcement of no-take zones, bag limits etc.	Bunurong workshop
Lack of co-ordination among multiple management agencies	Surf Coast workshop
Lack of ecological knowledge	Western Port workshop
Lack of efficacy of signage	Ricketts Point workshop
Lack of environmental etiquette on the part of park visitors	Ricketts Point workshop
Lack of flexibility in management to respond to new hazards	Surf Coast workshop
Lack of government recognition of individual preferences	Promontory workshop
Lack of political commitment to effectively resource parks	Bunurong workshop
Misguided action to deal with introduced pests	Ricketts Point workshop
Native title claims	Mushroom Reef workshop
Reduced protection of MNPS or MSs on seaward boundaries	Mushroom Reef workshop
Single-focus management agencies	Surf Coast workshop
Technology creep (new extraction/exploration methods)	Shipwreck Coast workshop
Noise	
Noise from aircraft (repeated operation for training/testing)	Jawbone workshop
Noise from fishing boats	TC
Noise from recreational vessels, including PWCs	TC
Noise from shipping	TC
Noise from tour boats	TC
Physical change or damage	
Acts of terrorism	Port Phillip Heads workshop

Artificial opening of river mouths	Shipwreck Coast workshop
Change in coastal systems (e.g. dune stabilisation)	Bunurong workshop
Change in sea level due to global warming	Surf Coast workshop
Change in sea temperature due to global warming	Surf Coast workshop
Change to habitat by wrecked shipping	TC
Damage to habitat by aircraft crash	Marengo Reefs workshop
Damage to habitat by benthic fishing gear (trawls and dredges)	Ninety Mile Beach workshop
Damage to habitat by wrecked recreational vessels	TC
Damage to habitat from anchoring of recreational vessels	TC
Damage to habitat from anchoring of shipping	TC
Damage to habitat from anchoring of tourism vessels	TC
Damage to habitat from European artefact collection (e.g. from shipwrecks)	TC / Facilitator
Damage to habitat from terrestrial vehicles	TC
Damage/change to habitat from disposal of dredged material	TC
Damage/change to habitat from dredging	TC
Damage/change to habitat from erosion of nearby cliff tops	Discovery Bay workshop
Damage/change to habitat from major geological events (e.g. earthquakes)	Mushroom Reefs workshop
Excavation for development	Port Phillip Heads workshop
Increased frequency of extreme storm events (due to global warming?)	Ricketts Point workshop
Injury to organisms from seismic testing *	Surf Coast workshop
Injury/death of organisms from active fishing gear legally operated outside reserve	Marengo Reefs workshop
Injury/death of organisms from litter (e.g. fishing gear)	Facilitator
Obliteration of habitat from coastal construction	Facilitator
Propeller scour/damage from recreational vessels	TC / Facilitator
Propeller scour/damage from shipping	TC / Facilitator
Reclamation for development	Port Phillip Heads workshop
Stray military/naval projectiles	Mushroom Reef workshop
Turbidity / light	
Change in turbidity from agricultural discharge (e.g. drains)	TC

Change in turbidity from artificial opening of river mouths	Shipwreck Coast workshop
Change in turbidity/light from altered tidal flow	TC / Facilitator
Change in turbidity/light from coastal construction	TC
Change in turbidity/light from disposal of dredged material	TC
Change in turbidity/light from domestic waste disposal	TC
Change in turbidity/light from dredging	TC
Change in turbidity/light from erosion	TC
Change in turbidity/light from industrial discharge (e.g. dairy)	TC
Change in turbidity/light from sewage discharges	TC
Localised change in turbidity/light from propeller operation	Marengo Reefs workshop
Urban discharge (e.g. stormwater)	TC

\* This threat was inadvertently omitted from the list during the course of the workshops

#### Reference:

NOO. (2002) *Impacts - identifying disturbances*. The South-east Regional Marine Plan Assessment Reports. National Oceans Office, Hobart.

## APPENDIX 3.

### Definitions of Likelihood and Consequence

(after SA/SNZ 1999 and ICE/FIA 1998)

#### Likelihood

- Highly likely (5):        Expected to occur in most circumstances  
                                  (For “everyday” events, approx. once per week.  
                                  More than 85% chance of occurring within specified time frame)
- Likely (4):                Will probably occur in most circumstances  
                                  (For “everyday” events, approx. once per month.  
                                  50-85% chance of occurring within specified time frame)
- Moderately likely (3): Might occur at some time  
                                  (For “everyday” events, approx. once every 3 to 6 months.  
                                  21-49% chance of occurring within specified time frame)
- Unlikely (2):             Could occur at some time  
                                  (For “everyday” events, approx. once per year.  
                                  1-20% chance of occurring within specified time frame)
- Very unlikely (1):        Not expected to happen  
                                  (For “everyday” events, approx. once every 2 to 5 years.  
                                  Less than 1% chance of occurring within specified time frame)

**Ecological Consequences**

Catastrophic (5): Major ecological kill, long-term or permanent disruption of ecological processes, substantial ecological change.

Major (4): Likelihood of long-term or permanent, major ecological impact.

Moderate (3): Temporary ecological impact extending beyond originating disturbance, some local or short-term ecologically important consequences.

Minor (2): Temporary and non serious ecological impact.

Insignificant (1): No serious ecological impact.

ICE/FIA. (1998) *RAMP: Risk analysis and management for projects*. Institution of Civil Engineers and the Faculty and Institute of Actuaries. Thomas Telford, London.

SA/SNZ. (1999) *Risk Management*. (AS/NZS 4360:1999) Standards Australia of Australia, Strathfield NSW.

## **APPENDIX 4**

Hazards nominated in risk assessment workshops.

(RR = risk register hazard, 2nd = secondary hazard)

**For access to this Appendix please refer to the Parks Victoria Website:**

<http://www.parkweb.vic.gov.au>

and follow the link to our publication database and the link to the Technical Series.

## APPENDIX 5

Threats from risk register hazards where the threat had not been assessed internally by Parks Victoria in its Compliance Plans.

Note that some quite specific threats have not been listed as “new” because they may have been considered under a more general category in the internal assessments (e.g. seismic testing as a specific example of noise).

Workshop	Threat
Discovery Bay	<p>Lack of clear communication of the purpose of the park, resulting in loss of community support</p> <p>Lack of ecological knowledge</p> <p>Lack of monitoring and research into impacts on park, resulting lack of effective management</p> <p>Increased sea temperature due to global warming</p> <p>Exotic species introduced via aquaculture</p>
Shipwreck Coast	<p>Lack of knowledge</p> <p>“Island-based” management focus</p> <p>External management complexity (e.g. common boundary of Twelve Apostles MNP with Federal MPA)</p> <p>Alienation of indigenous cultural values and perspectives</p> <p>Artificial opening of river mouths producing silt plumes</p> <p>Government influence on management</p> <p>Technology creep (i.e. better oil/gas extraction/exploration methods, exploitation of new resources, new ways of accessing resources via bioprospecting, aquaculture etc.)</p> <p>Terrestrial events/activities such as floods, fires, droughts, nutrients, (<i>water</i>) extractions</p> <p>Funding for management</p>
Marengo Reefs	<p>Failure of the nearby sewage treatment plant</p> <p>Small size of the sanctuary affecting management decisions and resourcing</p> <p>Lack of public awareness of the existence of a marine sanctuary</p> <p>Increased quantity of sediment resulting from land practices around the estuary and discharged via the river</p> <p>Lack of ecological knowledge leading to inappropriate/ineffective management</p>
Surf Coast	<p>Lack of ecological knowledge</p> <p>Nutrients and heavy metals from sewage outfalls</p> <p>Trampling and disturbance to intertidal platforms</p>
Barwon Bluff	<p>Increasing nutrients from the Barwon River</p> <p>Increasing human population and thus increasing pressure on the intertidal community</p>

	<p>Increasing numbers of organised education groups resulting in increased removal and trampling</p> <p>Lack of accurate baseline data leading to uninformed management</p> <p>Insufficient information (i.e. indicating the existence of the sanctuary, but not why it is important) stimulating vandalism</p> <p>Lack of resourcing resulting in lack of (insufficient?) management (research, enforcement and education)</p> <p>Lack of environmental etiquette on the part of sanctuary visitors (e.g. not returning rocks to original position)</p> <p>Lack of appreciation of natural values</p> <p>Coastal infrastructure</p> <p>Failure to document ecological change</p> <p>Water-based recreational activities (snorkelling, diving, surfing, jetskiing, etc)</p> <p>Catchment infrastructure</p> <p>Freshwater from stormwater discharges</p>
Port Phillip Heads	<p>Sand movement from dredging</p> <p>Failure to document ecological change – lack of baseline and monitoring data</p> <p>Sediment load from dredging</p> <p>Lack of community awareness leading to inappropriate behaviour, development and visitation</p> <p>Incremental development</p> <p>Dumping of dredged spoil</p> <p>Planning decisions leading to changed hydrology</p>
Point Cooke	<p>Walkers</p> <p>Feral carnivores (foxes, cats)</p> <p>Increasing development leading to increasing runoff and thus increasing nutrient loads</p> <p>Rising sea level due to climate change</p> <p>Ineffectiveness of seaward signs and boundary markers (too few/too far apart)</p> <p>Failure to document ecological change</p> <p>Current Port of Melbourne channel deepening project causing increased turbidity</p> <p>Industrial spills or seepage into Skeleton Creek</p> <p>Groundwater seepage of pesticides and herbicides from market gardens</p>
Jawbone	<p>Continuous heavy metal or petrochemical pollution from Kororoit Creek</p> <p>Stormwater containing freshwater, contaminants, litter and nutrients, discharging from the drain near the school</p> <p>Predation by domestic cats</p> <p>Major rain event after long dry period causing concentrated contaminants in lake to overflow into sanctuary</p> <p>Sedimentation and reduced light penetration due to the PoMC Channel Deepening project</p>

	<p>Lack of information / knowledge of biota and indigenous values for management of ecosystem, resulting in sub-optimal management actions</p> <p>Small size of sanctuary resulting in edge effects (concentration of activity)</p> <p>Spills causing heavy metal or petrochemical pollution from Kororoit Creek</p>
Ricketts Point	<p>Nutrients from stormwater discharges</p> <p>Increased turbidity and thus decreased light penetration, and the release of toxicants, both resulting from the Channel Deepening project</p> <p>Bureaucratic timelines and inertia, and lack of co-ordination among multiple management agencies</p> <p>Failure to document ecological change</p> <p>Lack of accessible ecological knowledge affecting management</p> <p>Coastal management practices in areas adjacent to the sanctuary (e.g. construction of groynes/seawalls, protection of roads, maintenance of carparks) *</p> <p>Lack of consistent resourcing for sanctuary management (i.e. for Parks Victoria and Fisheries Victoria, with flow-on effects to Friends groups etc.)</p> <p>Loss of local community support</p>
Mushroom Reef	<p>Failure to document ecological change</p> <p>Turbid plume from channel dredging</p> <p>Increased turbidity from Double Creek</p> <p>Lack of coordination of everyday activities among multiple management agencies</p> <p>Freshwater in plume from Boags Rocks</p> <p>Individual/recreational fossicking *</p> <p>Nutrients from sewage or fertilizers (golf course, farming)</p>
Western Port (1)	<p>Increased concentration of nitrogen and phosphorus from rivers and streams</p> <p>Fox predation</p> <p>Sediment load from rivers and streams</p> <p>Increased stormwater</p> <p>Boat-based visitor activities</p>
Western Port (2)	<p>Coastal erosion</p> <p>Lack of resources for compliance and enforcement</p> <p>Sedimentation from development corridor</p> <p>Lack of integrated arrangements/ management</p> <p>Increasing pressure from urban activities</p> <p>Lack of knowledge of marine ecosystems</p> <p>Impacts of farm effluents and contaminants</p> <p>Lack of perception of importance of values at all social and political levels</p> <p>Poor uptake of information/education within catchment on impacts of poor land management and tools/strategies that could improve land management</p> <p>Noisy and fast moving vessels</p>

	<p>Lack of knowledge about the way changes in hydrology (including the rate of siltation) impact on flora and fauna</p> <p>Lack of recognition of boundaries by public. Not managing the park within the context of the marine system and inputs.</p>
Bunurong	<p>Increased residential development in the broader catchment, leading to increased trampling of intertidal biota</p> <p>Lack of political commitment resulting in insufficient resources (money &amp; staff) for Parks Victoria to effectively manage the park</p> <p>Lack of effective (i.e. well-resourced) and broadly-based education (i.e. ecosystem-focussed) of park and agency staff, the general community and park visitors</p> <p>Dogs off-lead</p> <p>Inappropriate coastal development (strip development on existing farm land) adjacent to the park leading to increased trampling</p> <p>Insufficient resourcing of relevant agencies for enforcement (e.g. no-take zones, bag limits)</p>
Promontory	<p>Presence of seawalls affecting breeding of fish such as shark and flounder</p> <p>High profile of MNPs leading to reduced management and/or environmental focus on surrounding marine areas, to the subsequent detriment of the MNPs</p> <p>Dredging operations in Corner Inlet affecting water quality and seagrass beds and disturbing shorebirds and seabirds in MNP</p>
Ninety Mile Beach	Lack of ecological knowledge leading to inappropriate management
East Gippsland	<p>Increased sediment loads from catchment runoff associated with timber harvesting</p> <p>Lack of ecological knowledge leading to inappropriate management</p> <p>Increased sediment loads from catchment runoff from park/forest road</p>

\* In the Mushroom Reef workshop report, this threat was incorrectly omitted from the list of those with no comparable threat in the previous internal Parks Victoria assessment.

#### References:

- Parks Victoria. (2003a) *Regional Compliance Plan - Marine National Parks and Sanctuaries: City and Bays Region*. (Unpublished)
- Parks Victoria. (2003b) *East Region Marine Compliance Plan - Draft (April 2003)*. (Unpublished)
- Parks Victoria. (2004) *Regional Compliance Plan - West Region*. (Unpublished)

*Parks Victoria is responsible for managing the Victorian protected area network, which ranges from wilderness areas to metropolitan parks and includes both marine and terrestrial components.*

*Our role is to protect the natural and cultural values of the parks and other assets we manage, while providing a great range of outdoor opportunities for all Victorians and visitors.*

*A broad range of environmental research and monitoring activities supported by Parks Victoria provides information to enhance park management decisions. This Technical Series highlights some of the environmental research and monitoring activities done within Victoria's protected area network.*

*Healthy Parks Healthy People*

For more information contact the **Parks Victoria Information Centre** on **13 1963**, or visit [www.parkweb.vic.gov.au](http://www.parkweb.vic.gov.au)