SYNTHESIS OF 3 OCTOBER 2001 WORKSHOP

EVALUATING THE STATUS OF VICTORIA'S MARINE BIODIVERSITY:

MARINE PROTECTED AREAS

Department of Natural Resources and Environment (November 2001)

EXECUTIVE SUMMARY

The Victorian Government is committed to establishing a system of marine national parks and ensuring that Victoria's marine waters are used in ways that are ecologically sustainable. Management frameworks and operational programs to achieve this are being progressively implemented.

An October 2001 review workshop chaired by NRE Chief Scientist Sir Gustav Nossal provided scientific advice concerning a program for specifically assessing the long-term changes in marine biodiversity on shallow water rocky reefs.

The program involves the acquisition and interpretation of fish, invertebrate and plant community data from 59 sites. The sites are at four locations – the Heads at Port Phillip Bay, Phillip Island, Cape Paterson and Wilsons Promontory – that include areas proposed as marine national parks. The data have been collected at six-month intervals between three to seven occasions using underwater visual census techniques.

Background papers for the review workshop described the management context and objectives of the program, technical detail of the monitoring design and implementation, and quality assurance procedures.

Response to Key Issues Raised by Workshop Participants

The approach to the program was considered scientifically sound and it was recommended that it continue. Specific advice was provided on five issues that the Department of Natural Resources and Environment will act on as follows.

Background documentation will be revised to increase the detail and clarity of the program objectives, and to provide a glossary of terms to overcome the difficulties posed by varying meanings of the same terms in the international literature.

The conceptual ecological model of rocky reefs, including the interaction of physical and biological entities, that forms the basis of the monitoring program will be outlined. Supporting explanatory text will indicate that data are collected on a wide range of species attributes, from which the most appropriate indicator species (and their interactions with each other) will be elucidated over time.

For the field sampling program the cost-benefits of reducing transect length, sample frequency and timing options in the context of operational efficiency, information provided (e.g. dominant versus less dominant species) and logistical feasibility (e.g. the availability of unsampled reef) will be assessed and field programs will be revised accordingly.

Future statistical analysis of field data will explicitly describe the statistical models that form the basis of data analysis and associated management questions.

Opportunities to compare visual census techniques against other monitoring techniques will be pursued.

1. PURPOSE

This document is a record of a workshop that took place in October 2001 to provide the Department of Natural Resources and Environment (NRE) with scientific advice concerning a program for assessing the long-term changes in biodiversity within marine protected areas (MPAs). The document provides a summary of the workshop, a list of those who attended, an overview of the presentations and key specific issues raised in the discussions.

2. WORKSHOP SUMMARY

On 3 October 2001, a workshop was held to provide scientific advice concerning a program for assessing the long-term changes in biodiversity within MPAs. The methods and preliminary data analyses from a trial to monitor the biodiversity associated with Victoria's shallow water subtidal reefs was presented. The aim of the subtidal reef monitoring program (SRMP) is to provide data on the status of reef biodiversity through time so that managers can gain an understanding of how any changes to the status may relate to natural variations or human induced impacts.

Prior to the workshop, the reviewers were provided with a working background paper describing the context and objectives of the program, and a technical report detailing the monitoring design, sampling techniques and quality assurance procedures of the program.

To provide reviewers with an insight to approaches used elsewhere, a presentation was given on approaches used in Queensland to evaluate management of the Great Barrier Reef World Heritage Area. Presentations were also given on the design of the SRMP and results of some preliminary data analyses.

To evaluate whether the SRMP should continue in its current form, be modified, or cease as appropriate, workshop participants discussed the conceptual and operational approach to monitoring, as well as the design of the SRMP and usefulness of the data obtained so far.

The general advice given was that the approach developed for the SRMP was scientifically sound, and that the monitoring should continue in its current form, but that there may be opportunities to increase its cost effectiveness. The following key actions arose from the review:

- Program objectives will be reworded to increase clarity and, through the inclusion of relevant second and third order objectives, to more fully describe the outcomes sought by the SRMP. Revised documentation will include a glossary of terms.
- A conceptual model describing the interaction of physical and biological entities on temperate rocky reefs and an explanation of its relevance to the monitoring program will be included in revised documentation.
- Revised program documentation will make it explicit that data is collected on a wide range of species attributes, from which the most appropriate indicator species (and their interactions with each other) will be elucidated over time.
- Revised documentation will fully describe the statistical models and associated management question.
- The cost-benefits of reducing transect length, in the context of operational efficiency and the availability of unsampled reef, will be assessed and the results included in future field programs.
- Temporal features of the sampling program will be assessed in terms of information provided (e.g. dominant versus less dominant species) and logistical feasibility.
- Opportunities to evaluate data from visual census techniques against other monitoring techniques will be pursued.

3. ATTENDEES

Dr Alan Butler (CSIRO), Dr Nick D'Adamo (WA Department of Conservation and Land Management), Dr Zena Dinesen (James Cook University), Dr Graham Edgar (Charles Darwin Marine Research Centre, Galapagos), Dr Matt Edmunds (Australian Marine Ecology Pty Ltd), Mr Lawrance Ferns (NRE), Mr Rod Gowans (NRE), Mr Don Hough (NRE), Dr Greg Jenkins (MAFRI), Assoc Prof Michael Keough (University of Melbourne), Dr Jo Klemke (NRE), Sir Gustav Nossal (NRE Chief Scientist) *Chair*, Dr David Smith (MAFRI), Dr Sally Troy (Parks Victoria).

4. CHAIR'S INTRODUCTION - SIR GUSTAV NOSSAL

Over the past 10 years Victoria has embraced a vigorous debate concerning the role of marine protected areas (MPAs). This workshop is not about this debate; its purpose is to address the science related to the monitoring of marine biodiversity related to MPAs. This workshop will not consider how human-induced impacts may effect long-term changes in biodiversity; this topic will be discussed separately in the future.

The Victorian Government is committed to the ecologically sustainable development of natural resources. Performance assessment and triple-bottom line reporting is an absolute requirement of Victorian policy to ensure that resources are used in a sustainable manner.

Victoria's MPAs are intended to protect biodiversity; however, there is uncertainty as to which components of biodiversity should be targeted for monitoring. Key questions include: can biodiversity be safely and ethically monitored, and can the data be interpreted in a meaningful way? At the very least, the community expect approaches to be scientifically credible.

The focus of this workshop is to provide a forum to peer review the science in addressing *Objective 1* (Box 1) in terms of how this objective has been conceptualised and implemented so that the status of Victoria's marine biodiversity within MPAs can be monitored and reported. By way of an example, a trial program to monitor biodiversity associated with shallow water subtidal reefs will be presented.

For this review a consensus is not necessarily being sought. The goal is to seek a variety of views and to draw on expertise to improve any aspect of the program in terms of the objectives set, the implementation and monitoring design, and the usefulness of the data in terms of quality and interpretation.

Box 1

The goal of Victoria's MPAs is 'to ensure the protection (and continuance) of marine communities within Victoria's MPA system'. In order to meet this goal, the following 3 objectives have been set for a MPA biodiversity monitoring program:

Immediate term
Objective 1: To provide new understanding of long-term changes (if any) in the status of marine communities (note, this objective forms the basis of this review).

Medium term
Objective 2: To eventually determine how to separate whether any changes relate to natural processes or human-induced impacts.

Medium to long term
Objective 3: To understand if such changes ultimately affect the condition of marine communities.

5. PRESENTATIONS

5.1. Conceptual and Operational Approaches

5.1.1. Operational Approach for Monitoring Marine Biodiversity in Victoria

(Presentation by Rod Gowans)

Victoria is committed to establishing a system of marine parks for the protection of marine biodiversity. Stakeholders expect reports on the 'state' of marine biodiversity within MPAs. This expectation is in fact far greater than for our terrestrial parks. Victoria's MPA program has progressively shifted resources from statewide mapping and biological surveys for planning and establishment purposes, to monitoring of individual areas for the purpose of reporting on their performance.

This presentation reviews the experience gained from a trial program that has monitored biodiversity associated with shallow subtidal reefs. The trial has been undertaken around Victoria's current system of individual MPAs. Features considered in the trial monitoring program (in no particular order) have included:

- *relevance to MPA objectives and outcomes sought*
  (indicators collected should be relevant to the objectives of the MPA system)

- *cost-effectiveness and operational practicality*
  (how can we maximise the amount of data collected within the operational constraints of working in the sea?)

- *relevance to stakeholders*
  (data should ideally be articulated in a way that is valued by stakeholders. Stakeholders will expect natural resource managers to report on how well biodiversity has been protected)

- *scientific credibility*
  (monitoring techniques and sampling design should be appropriate for the management objectives)

- *spatial and temporal factors*
  (geographically, we need a range of sites to compare with each other, and we need to find out what is a reasonable time period between successive sampling events)

- *ability to interpret the data in a meaningful way*
  (data should not only be 'fit-for-purpose', but also the data must allow us to recognise and understand biases and errors as they occur)

- *statistical robustness*
  (data should be robust enough to make a scientifically informed management response, while recognising that the data is likely to generate scientific questions)

- *consistency and comparability with programs in other jurisdictions*
  (using relevant techniques/approaches already trialed and adopted may be more efficient, and provides direct comparison of data for broader regional reporting)

- *use of existing data sets, methodologies and information collection programs*
  (prefer to build and value-add to existing data collection programs wherever possible)

5.2. Evaluating Management of MPAs: Case Studies from the Great Barrier Reef

(Presentation by Zena Dinesen)

The presentation overviewed arrangements for the Great Barrier Reef and included, as case studies, consideration of anchor damage in the Whitsundays and the representative area program for the reef.

Performance assessment and development of performance indicators is an important program for the Great Barrier Reef Marine Park Authority (GBRMPA). In 1998 the Australian National Audit Office report on GBRMPA concluded that (*inter alia*):

> *the Authority does not have adequate data to determine whether it is achieving its primary objective of protecting, conserving and allowing for reasonable use of the Great Barrier Reef Marine Park….*

In response, a CRC Research Program was established to concentrate on questions such as:

- How can we measure 'in the field' success in achieving desired outcomes – ecological, economic and social performance indicators?
- How can we map the links between the management strategies and the outcomes achieved?

Existing performance evaluation frameworks were investigated, including:

- Commonwealth Government performance reporting guidelines
- State of the Environment Reporting
- Sustainability indicators developed under fisheries management initiatives
- IUCN/WCPA management evaluation framework (Hockings *et al* 2000)[1]
- US Coastal Zone management effectiveness
- WA CALM's Jurien Bay approach

The IUCN/WCPA management evaluation framework allows protected areas to be evaluated at a number of levels (after Hockings *et al.)*:

- Design (of plans, programs)
- Inputs (funding and resources)
- Processes (actions and activities)
- Outputs (activities completed, reports and infrastructure produced)
- Outcomes (did management make a difference?)

Using the IUCN/WCPA for guiding principles, a concise process for developing indicators for more specific objectives has been introduced as part of continuing the planning and evaluation cycle. The main components of this process are:

- Review management goals
- Develop specific 'operational' objectives for these goals, including 'middle order' and 'lower order' objectives
- For each specific objective:
  - identify possible indicators (what to measure)
  - identify possible reference points (baselines)
  - where possible, set targets (what to aim for) or 'limits of acceptable change'

Whitsundays Case Study: Anchor Damage

This study has set out to measure the success of a local 'Reef Protection Program' by drawing on 'Users' knowledge of anchoring techniques and controls, and 'Users' compliance with anchoring controls.

[1] Hockings, M., Stolton, S. & Dudley, N. (2000). *Evaluating effectiveness. A framework for assessing the management of protected areas*. World Commission on Protected Areas, Best Practice Protected Area Guidelines Series No. 6. IUCN – The World Conservation Union, Gland, Switzerland. pp. 121.

The amount of coral damage that is attributable to anchoring is a primary measure (indicator). Research is being undertaken on coral damage and recovery from anchoring activities as a basis for calibrating success.

The Anchor Damage study is also providing a range of recreational/visitor research opportunities in the Whitsundays. For example, 'recreational settings' are used to classify a range of tourism and recreation opportunities. Five settings are used to describe a spectrum of recreational uses ranging from 'Developed' to 'Protected'. These setting are defined mostly via maximum vessel length and visitor group size. There is an opportunity to refine the settings using measures related to 'access' and 'user-satisfaction'. It may also be possible to assess achievements related to social outcomes and links with management strategies as the study develops into the future.

Representative Areas Program Case Study

The aim of this program is to identify and protect representative examples of habitats and the ecological processes upon which species depend. The program is linked to scientific principles of the National Reserve System of Marine Protected Areas: to maintain biological diversity and ecological processes, to allow species to evolve and function undisturbed, and to provide an ecological safety margin and base for recovery.

The program has lead to a major review and revision of GBRMP zoning. Issues that might be evaluated include:

- Design criteria – is the zoning 'comprehensive', 'adequate' and 'representative' and have operational guidelines been implemented?
- Acquisition and analysis of data
- Public participation; resources; education; user knowledge; compliance
- Condition of key habitats and biota; status of threatened species
- Social and economic values

A challenge will be to measure the success of the Representative Areas Program in maintaining biodiversity. Evaluating the success of the Program should be based on how effective new management zoning will be. Therefore a 'BACI' or 'Beyond BACI'[2] type of approach, using a selected set of biodiversity indicators to monitor inside and outside zones with different management regimes, should be used. The design should include a geographical spread of management regimes and be replicated where possible. Data on the specific components to monitor should ideally be collected before a new management regime is implemented.

Concluding Remarks

There are challenges and learning opportunities for evaluating biodiversity. Issues to deal with include:

- Data is often lacking on 'baseline' condition and appropriateness of management strategies for managing biodiversity.
- Organisations should be encouraged to take on outcomes-based evaluation. MPA plans must have clear objectives and built-in performance monitoring. Performance indicators for outcomes are the most important, but are also the most difficult to measure.
- Indicators should be selected and focused for the scale of the MPA system of interest (e.g. indicators recommended for State of Environment Reporting have a role for regional scale reporting, but some are likely to be too broad/insensitive for understanding and interpreting biodiversity outcomes for MPAs).
- The Whitsundays case study illustrates how we might measure ecological and social outcomes and their links to management strategies.
- The GBRMPA Representative Areas Program has the challenge of assessing the benefit of fully protected zones by monitoring and comparing selected biota inside/outside these fully protected zones over time.

[2] The term 'BACI' refers to Before/After/Control/Impact treatments in a monitoring design.

5.3. SUBTIDAL REEF MONITORING PROGRAM

5.3.1. Monitoring Design and Methods

(Presentation by Matt Edmunds)

This presentation summarised the sampling design and monitoring techniques associated with the Subtidal Reef Monitoring Program.[3] The presentation covered the following topics:

- selection of sampling sites and logistical issues
- methodologies associated with visual census of macrophyte, macroinvertebrate and fish communities
- data management, quality assurance and reporting

5.3.2. Preliminary Data Analysis

(Presentation by Greg Jenkins and Ann Gason)

This presentation provided a summary of some preliminary analyses of the monitoring data to gain an insight into the data variability and power to detect change. Numerous data analyses and comments were presented as outlined below:

Data Variability

- Major variations in summary variables and individual species were evident at level of location and between sites; there was relatively low variation amongst surveys.
- Seasonal variation amongst surveys was not strong but was apparent in some demersal fish.
- Few individual sites showed excessive temporal variability relative to others.
- There was a suggestion of spatial autocorrelation in a few cases, e.g. algae show a trend to higher diversity from the west to east of Wilsons Promontory.
- Differences amongst locations (surveys nested within location) were very common, but confounded to some extent by different seasons of sampling.
- Significant differences between successive surveys at individual locations were found to be relatively uncommon; this indicates that there is relatively high inter-site variability but variability at individual sites is relatively low through time.

Power Analyses

- For individual localities, the number of sites required to detect a given temporal change is in the order of 20 sites to detect a 20–30% change in diversity/species richness and a 40–50% change in major individual species. This level is achieved at Wilsons Promontory and to a lesser extent at Bunurong.
- Power was reduced if 100 m or 50 m transects were used instead of 200 m, but not in proportion to effort. Only a few additional sites would be required to achieve similar power with 100 m transects as with 200 m.
- Good power if an 'event' occurred at Wilsons Promontory, and the 4 surveys were repeated could detect a 20% change in fish abundance and 10% change in diversity – good power to also detect change in blacklip abalone abundance.
- Greatest variability was calculated amongst locations and sites, however variability was relatively low between successive surveys.
- Power to detect temporal changes was satisfactory in most cases, particularly before and after a given point/event in time.

[3] Refer to Edmunds, M., Roob, R.M. & Ferns L.W. (2001). *Subtidal Reef Monitoring Program: Standard Operational Procedures Manual (1st Edition).* Parks, Flora and Fauna Division, Department of Natural Resources and Environment, East Melbourne, Australia.

Survey Efficiency

- In terms of cost/effort, 100 m transects appear to give much the same information on dominant species as do 200 m transects.
- Surveys could be reduced to annual, but ideally all locations should be sampled in the same season.
- Sites could be reduced to 100 m transects; a few additional sites would give equivalent power.
- In terms of future analysis there is also a need to investigate generalised linear modelling in more detail to analyse temporal trends.

5.3.3. Preliminary Analyses – Trends in Marine Species and Community Data, Statistical and Biological Considerations

(Presentation by Matt Edmunds)

This presentation provided an overview of some simple linear modelling applied to time series data on the more abundant species surveyed in the monitoring program. Examples were mainly drawn from Port Phillip Heads data.

Introduction

A useful outcome of a monitoring program is to be able to detect trends in species abundances, size structure and diversity, as well as stability and changes in macroalgal, invertebrate and fish communities through time. The detection and description of such trends enable:

- insights into ecological processes – correlations and rates of change
- performance assessment – responses to management actions/experimentation
- conservation – determining management responses to trigger points

Objectives

The objectives of the data analyses for this presentation were to:

- determine if simple trends are present;
- examine the nature of trends and other temporal patterns in the data;
- identify potential parameters for reporting trends; and
- identify limitations and considerations for more detailed analyses.

Univariate Methods

Univariate methods involved a simple least-squares line fitted to transformed variables vs time (following a similar approach used by the Australian Institute of Marine Science) and

- species abundances (abundances were log-transformed), size measures
- species richness and diversity indices measures

Univariate Results – Port Phillip Heads

- All species present were examined at least 5 of the 7 surveys completed at Port Phillip Heads.
- Example plots were presented for selected species which illustrated trend lines and other types of between-survey variation.
- Slopes of trends, variability about the trend line and statistical significance were presented:
    - For each species, trends and other types of variation can be quite different between regions/habitats of Port Phillip Heads.
    - Some concordance in temporal patterns within regions/habitats was observed.
    - Analyses provided some unexpected results: e.g. longer term trends in abundance of the thallose red alga *Ballia callitricha* – a species often assumed to be more ephemeral.

Multivariate Methods

Figures were presented showing:

- Assemblage structure of algae, invertebrates and fishes
- Bray-Curtis dissimilarity matrix from log-transformed abundances
- MDS plots for ordination/visual representation

- Difference between groups: analysis of similarities – ANOSIM R
- Dispersion within groups: index of multivariate dispersion – IMD
- Multivariate trend – cross-product matrix test (Bray-Curtis dissimilarity matrix of community difference between times and matrix of difference between times in years) – Mantel r

Multivariate Results – Port Phillip Heads

- MDS plots of time trends were presented for algae, invertebrates and fishes.
- Groups of sites cluster apart, with non-overlapping time trends.
- Significant differences were evident between these groups; however some differences must be interpreted with caution as heterogeneity of dispersion is likely in some cases.
- Group differences indicate that temporal differences are smaller than spatial differences and that spatial differences are generally maintained through time (indicating some degree of community stability over observed period). This also suggests that temporal changes in community structure as great as the spatial differences should be detectable.
- Some communities at some sites appear to vary randomly about a 'centroid' condition. Significant trends in community structure were detected at some sites for some communities.
- Greater variability was observed at sites with very low total abundance of individuals – changes of a few individuals representing a larger proportion of the community.

Summary

- The preliminary examination of the existing data indicates that trends can be detected and described in a useful manner.
- The trends and other temporal variations differ markedly between particular sites and reef habitats.
- At some sites, biologically significant changes were apparent, but were not statistically significant.
- Longer time series will enable a better appreciation of both trends and other temporal patterns, such as cyclical changes.

6. WORKSHOP DISCUSSION

The workshop discussion was broken into two sessions. The first session discussed the conceptual and operational approach of the program. The second session discussed the suitability of the design, field methods and data collected for the SRMP as a basis for monitoring, and understanding change in marine biodiversity associated with subtidal reef habitat.

For convenience, key issues raised in the discussion and what follow-up action will be taken by NRE are summarised together.

6.1. Session 1: Issues Related to the Conceptual and Operational Approach

For the first session the key questions were:

- Are the 3 objectives of the program relevant to the scientific principles, policy context and management goal?

- Is the implementation and staging of Objective 1 (i.e. *begin by evaluating the status of marine biodiversity and monitoring to understand change*) a logical way to proceed?

- Is the operational process (and the component steps outlined) for developing marine biodiversity monitoring programs related to Objective 1 logical and suitable? Can any aspect of the process be improved?

6.1.1. Objectives

National and international literature uses some key words in different ways. For example, the terms 'state' and 'condition' referred to in Box 1 may be used synonymously. A glossary of terms would be a useful addition to future documentation.

A rewording of the objectives, and inclusion of second and third order objectives, would help better reflect the design and purpose of the SRMP.

Program objectives as currently described in Box 1 will be reworded to increase clarity and, through the inclusion of relevant second and third order objectives, to more fully describe the outcomes sought by the SRMP. Revised documentation will include a glossary of terms.

6.1.2. Ecosystem Model

The process used to link program objectives to the selection of indicators, implementation of monitoring programs and review would be better supported by describing the model of the ecological system that is of management interest. This would provide a basis to explain why certain components/variables are chosen for monitoring, and what changes or interactions you might expect to elucidate. As information is gathered and changes are observed, the model can be gradually refined as necessary.

A conceptual model describing the interaction of physical and biological entities on temperate rocky reef and an explanation of the model's relevance to the monitoring program will be included in revised documentation.

6.2. Session 2: Issues Related to the Subtidal Reef Monitoring Program

Key questions with respect to understanding status and changes in biodiversity associated with subtidal reefs were:

- Are the selected indicators conceptually relevant to the objective? [ie do the selected indicators sufficiently 'represent' marine communities associated with shallow subtidal reef habitats (strengths and weaknesses)?]

- Are the field methods and data collected on the selected indicators suitable? From a scientific/technical perspective:
    - Are the methods used to measure the selected indicators themselves suitable (strengths and weaknesses)?
    - Is the design of the sampling (e.g. size, shape, replication of sampling unit) across subtidal reef habitats suitable (strengths and weaknesses)?

- Based on the preliminary data analysis presented, what can be inferred in terms of whether the data is suitable (or on track) as a tool for evaluating long-term changes?

6.2.1. Selected Indicators

The data gathered for SRMP was based on collecting data on a wide range of species attributes from which the most appropriate indicator(s) could be selected in the future, rather than targeting a set of pre-selected indicators. This was considered sensible, but should be more clearly defined in future documentation.

Revised program documentation will make it explicit that data is collected on a wide range of species attributes, from which the most appropriate indicator species (and their interactions with each other) will be elucidated over time.

6.2.2. Power Analysis

To clearly interpret the preliminary power analyses requires specific information on the statistical models on which they were based and the associated management question.

Revised documentation will fully describe the statistical models and associated management question.

6.2.3. Length of Sampling Transect

The current length of the sampling transect (200 m) has a variety of cost-benefits. Preliminary data analyses indicate that reducing the transect length from 200 m to 100 m would not appreciably reduce the power to detect change with the same degree of certainty, suggesting that a shorter transect would free up field time in which additional replicate sites could be monitored. Operationally, however, the less time required for shorter transects may not actually free up useful time, given the fix mobilisation and transect set up times for scuba divers operating from small vessels. The lack of additional reef habitat at some locations may also limit the establishment of additional sites.

The cost-benefits of reducing transect length, in the context of operational efficiency and the availability of unsampled reef, will be assessed and the results included in future field programs.

6.2.4. Sampling Frequency

Preliminary data analysis indicates that at some locations, with respect to dominant species there may already be sufficient data to enable sampling to be undertaken annually rather than biannually. It appears that few species show strong inter-seasonal trends in relative abundance (although some interesting seasonal changes are evident for one or two species at some sites). The question was posed: if monitoring were scaled back to annual sampling, would logistics allow the existing sites (and potential additional sites in other locations) to be sampled within a three to four month time period and in the same geographic sequence? A consistent geographic sequence was considered necessary to minimise temporal effects.

Temporal features of the sampling program will be assessed, in terms of information provided (e.g. dominant vs less dominantly observed species) and logistical feasibility.

6.2.5. Calibration of Monitoring Techniques

Visual census is one of variety of non-destructive techniques. The interpretation of visual census data and determination of its efficacy should be considered in relation to other non-destructive monitoring techniques such as trapping and tagging.

Opportunities to compare and evaluate visual census data against other monitoring techniques will be pursued.