Evaluating methods for the Protected Natural Areas Programme

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CONTENTS

Abstract

The Protected Natural Areas Programme (PNAP) began in 1981 as a means of identifying natural ecosystems worthy of protection in more modified parts of New Zealand's landscapes, especially its deforested lowlands. The PNAP has proceeded by surveying natural areas in ecological districts. Since most of the areas surveyed are in private tenure, the surveys conducted over the 19 years of the programme constitute the major reconnaissance of New Zealand's biodiversity on private land. This report evaluates methods used in the PNAP. Initial use of reconnaissance plots (relevés) was developed to a formal plot-based survey method; yet, increasingly, other non-plot-based methods are in use. Furthermore, there is pressure to use plots to address needs of the Resource Management Act 1991 (RMA), especially the production of local authority plans, and to report change in biodiversity over time. To meet its needs and to hasten coverage, the Department of Conservation (DOC) may choose to use rapid methods that are not plot-based, while working with protection agencies to secure rapid protection of areas under immediate threat. However, this would be to ignore the inevitable pressures to use the data for RMA purposes, since there is an increasing demand for reliable and comprehensive data on biodiversity on private land, as well as the need to document the change of biodiversity with time. A partnership between territorial local authorities and DOC is recommended so that the original needs of the PNAP and those of the RMA can be best addressed simultaneously.

1. Introduction

This investigation considers aspects of the Protected Natural Areas programme (PNAP), and evaluates the methods used in the programme by the Department of Conservation (DOC) and other agencies (a full list of acronyms used in this report is provided in Appendix 1). Frustration has been expressed at the slow rate of progress of the PNAP while loss of habitats in the largely human-modified parts of the New Zealand landscape continue unabated. This has led to new means of assessing the landscape within DOC for the PNAP, while in other parts of New Zealand, PNAP is increasingly the province of territorial local authorities (TLAs). In this report, I evaluate the range of methods undertaken in PNAP surveys (both past and current) to allow informed choices to be made regarding methods for future surveys. It is intended that, as a result, DOC and other agencies that conduct PNAP surveys or use data from surveys can have confidence in choice of methods, so that they produce quality data that are cost- and time-effective, and can be used to accommodate a range of requirements, including those of the Resource Management Act 1991 (RMA). This investigation was carried out by staff of Landcare Research, Lincoln, for the Science & Research Unit of DOC, in April–July 2000.

2. Background

New Zealand's natural ecosystems have a long history of isolation and a high degree of endemism. Some of its ecosystems (e.g. alpine grasslands) are well protected in law within, for example, national parks, although even these are under increasing threats from introduced biota. However, many of the country's ecosystems are fragmented, modified, and much reduced in extent compared with pre-human times. For example, indigenous forests that once covered 78% of New Zealand's land surface were reduced to 53% following Maori fires, and now, following deforestation after European settlement, to 23% of their former area (Atkinson & Cameron 1993). In the cases of other ecosystems, such as wetlands, modification and reduction in extent have been even more drastic. Moreover, the nature of destruction of ecosystems has been selective. In the case of indigenous forests, it was the drier parts of New Zealand that were deforested by Maori fires, eliminating nearly all indigenous forests from the eastern parts of the South Island, and the central-eastern North Island (Ogden et al. 1998). Following European settlement, deforestation was concentrated on areas of fertile soils, such that very few forests now remain in these areas.

Coupled with European colonisation of New Zealand was the imposition of private and public tenure of land. Seventy percent of New Zealand's land surface is now privately owned (DOC and Ministry for the Environment [MfE] 2000). Especially among the ecosystems that have been severely depleted since human settlement, much of what remains is in private tenure. Furthermore much of New Zealand's threatened biota occurs only on privately owned land (e.g. 20% of its threatened vascular plants: Norton 2000).

Concern about the plight of many indigenous ecosystems, and recognition of the unrepresentative nature of protected areas in New Zealand motivated the Protected Natural Areas Programme (PNAP), which began in 1981. The legislative basis for the programme lay in the Reserves Act 1977. The goal of the programme is to achieve 'a viable network of representative samples of New Zealand's ecosystems, landforms and scenery which originally gave New Zealand its own natural character [that are] protected and restored' (Kelly & Park 1986).

The PNAP is now 20 years old. At least 83 (c. 31%) of New Zealand's approximately 270 ecological districts (EDs) have been surveyed. Of these surveys at least 43 have been published as PNAP reports (in four cases as PNAP reports for ecological regions (ERs) containing as many as five EDs, e.g. Espie et al. 1984), and at least 13 more are in drafts before publication. The net result is that the PNAP is *the* reconnaissance of New Zealand's biodiversity on the major part of New Zealand's land surface that is privately owned. No other initiative in the country's history provides any comparable information. The programme has also identified and described landforms comprehensively throughout New Zealand. While overall coverage remains far from comprehensive, the information is by far the best available to address the state of biodiversity on private land, and the adequacy of protection of biodiversity.

In the time since the inception of the programme, considerable legislative and administrative change has occurred in New Zealand (Kelsey 1997). The Biological Resources Centre and those parts of the Department of Lands and Survey, under whose aegis the PNAP began and was developed through its first 5 years, became part of the Department of Conservation with its new legislative mandate, the Conservation Act 1987.

The most profound change in conservation on private land, the area chiefly targeted in PNAP surveys, follows from promulgation of the Resource Management Act 1991 (RMA). The RMA devolved responsibilities for planning, and identifying and securing 'significant' natural areas, to territorial local authorities (TLAs) under local plans (section 6(c)). Here there is clearly some overlap with processes of the PNAP. Both the PNAP and promulgation of plans by TLAs entail a certain amount of gathering, or evaluation of data, i.e. a range of sites and ecosystems are evaluated before determining which are the best representative examples to become recommended areas for protection (RAPs, under the PNAP) and which are 'significant' natural areas (under requirements of the RMA, see Park 2000). However, there are key differences as well. For example, land areas within which both are assessed are different: the land unit that forms the basis of PNAP surveys is ecological districts (sometimes regions), whereas the land unit that forms the basis of RMA planning requirements is a TLA's boundaries. There may be little or no overlap between the two. More important is the definition of what constitutes 'significant' areas in the context of the RMA (e.g. Whaley et al. 1995; Norton & Roper-Lindsay 1999, and its appendix by C.D. Meurk); to date there has not been an attempt to reconcile definition of RAPs with those of 'significant' natural areas. Regardless of these conflicts, PNAP data have, without doubt, usually been the best (and often the only) information to underpin planning requirements of the RMA. However, use of data collected in the PNAP to meet requirements of the RMA has resulted in conflicts with land owners about the use of PNAP survey data by TLAs. Recognising the conflict between requirements of the RMA and those of the PNAP has led increasingly to TLAs taking a lead role. Some TLAs have commissioned or undertaken PNAP surveys in their own right (e.g. Denyer et al. 1993), whereas others have commissioned equivalent surveys within their own administrative boundaries, rather than those set by EDs (e.g. Meurk et al. 1993).

In addition, the RMA sets reporting requirements for TLAs to evaluate changes in the state of their environment, including biodiversity. However, a recent review (Kneebone et al. 2000) points to 'a lack of comprehensive or consistent information that can inform policy makers about the plight of [trends in] New Zealand's biodiversity'. In the absence of any information to use as a baseline for change in indigenous biodiversity, there is, and will be increasingly, pressure to use data collected in the PNAP as such a baseline. In this report I will evaluate the adequacy of methods used in the programme to address this growing need. At the same time that there are demands for more comprehensive information, there is also reluctance to pay for its collection. The costs are increasingly borne when the credibility of the information is challenged in courts. This report also evaluates the costs and benefits of field surveys in terms of their ability to provide comprehensive, reliable information.

3. Objective

- To evaluate the range of methods undertaken in PNAP surveys (both past and current) to allow informed choices to be made regarding methods for future surveys.

The anticipated outcome is that DOC and other agencies that conduct PNAP surveys or use data from surveys will have confidence that methods chosen produce quality data and are cost- and time-effective, and that the data will accommodate a range of requirements, including those of the RMA.

4. Methods

Letters were sent to people who have been involved in design and execution of PNAP surveys, requesting:

- Detail of PNAP survey methods they had employed.
- Why such survey methods were chosen.
- What were perceived as the merits in the methods employed.

Those whose comments were sought included staff of DOC, of TLAs, of universities and Crown Research Institutes, and of several private contractors who have worked under contract to DOC or to regional or other local authorities. Their comments form the basis for much of this report.

An assessment was conducted of 38 published PNAP survey reports, one from a PNA-type survey conducted within TLA boundaries (Meurk et al. 1993), and of an additional nine that are at advanced stages of production. Information was also provided in broad terms about methods used in a further three PNAP surveys, and from other similar surveys (e.g. from TLAs). This literature was assessed to describe the evolution of methods in PNAP surveys, how and why different methods have been used, and the degree to which methods are comparable across EDs.

Because it was not always easy to determine which methods had been used to collect field data in either published or unpublished PNAP surveys, extensive use was made of the National Vegetation Survey (NVS) databank of PNAP plot data. Photocopies of field data sheets are held for 62 EDs in archives in NVS, and electronic data exist in NVS for 59 of these EDs.

5. Results

The benchmark for methods in the PNAP was the publication of a manual by Myers et al. (1987). It advocated standard methods of survey and data collection, and for vegetation descriptions it advocated a modified version of reconnaissance plots widely used in New Zealand (Allen 1992 is the most recent revision). The PNAP manual contained pro-forma plot sheets and explicit guidelines of how to fill in forms. However, while Myers et al. (1987) have been cited frequently in many subsequent PNAP published reports, it is apparent on closer inspection (where possible) that some procedures recommended in this manual were followed, and other parts not at all. On reviewing the published PNAP survey reports, descriptions of field methods were often inadequate. Methods were described in some detail in the earliest (pilot) surveys, and many early surveys were well supported with maps showing exactly where field plots were measured (e.g. Overmars et al. 1998). It was possible to resolve some ambiguities or lack of clarity in some published PNAP reports by inspecting field data sheets in NVS (where many of these data are held), but this was not always the case.

Nearly all PNAP surveys have been conducted with some stratification of sampling. For example, most surveys have identified existing protected areas within the ED or ER (and some of these may be surveyed in the course of a PNAP survey to give a context for data from other areas), and then key areas to be surveyed have been identified in advance. This process has usually been founded on literature reviews, and inspection of available maps or aerial photographs, and use has been made of earlier survey data, particularly those conducted by the former New Zealand Wildlife Service in identifying sites of special wildlife interest (SSWI). A notable exception to stratification of a survey area before embarking on a survey was Wilson's (1992) survey of the Banks ER. In this survey, the entire ER was sampled on a regular grid, with fixed-area plots at grid points, but it is important to note that this survey was conducted earlier, and the results were used subsequently to address the requirements of PNAP.

An emphasis throughout the PNAP has been that the methodology should be simple, and rapid to use (Kelly & Park 1986; Dickinson & Mark 1988). For these reasons most surveys have restricted sampling to vascular vegetation alone, with notes on other more obvious biota (especially birds) seen in the course of survey work. A pilot group of ERs and EDs was selected in which to refine field methods (Espie et al. 1984; Brumley et al. 1986; Clarkson et al. 1986; Mitchell et al. 1992). However, from the outset of PNAP there has been a strong emphasis that surveys should focus primarily on landforms and descriptions of vascular plant vegetation (Myers et al. 1987). Methods by which vascular plant descriptions were conducted were variable among the first reports, although most were variations of standard reconnaissance plots or relevés used widely internationally (e.g. Mueller-Dombois & Ellenberg 1974) and in New Zealand (most recently described in Allen 1992). In reconnaissance plots, vascular plants are identified within fixed vertical tiers, and in each tier, the abundance (usually percentage cover) of each species is scored. The explicit link between landforms and vascular plant descriptions was the main tenet of many of the PNAP surveys that followed, most clearly manifest in some surveys in the eastern South Island (e.g. Arand & Glenny 1990; Courtney & Arand 1994).

Because of the difficulty in determining exactly which methods were used in some PNAP surveys, Table 1 may include some incorrect judgements in summarising methods used in collecting field data. Reconnaissance plots underpin the majority of PNAP surveys, and most of these are data from unbounded plots that conform to some relatively homogeneous landform (Myers et al. 1987; Allen 1992). Some current PNAP surveys continue to use reconnaissance plots (e.g. Kaipara/Otamatea EDs). Eight PNAP surveys have carried out vegetation descriptions within fixed areas (e.g. 10 m × 20 m plots, Simpson 1998), the advantage of which is that a better comparison is possible across plots of absolute abundance of plant species in one site versus another.

A sense of urgency to make progress in completing the PNAP for New Zealand (Dickinson & Mark 1988; DOC 2000) and pleas of limited resources have led to a number of more recent surveys being conducted that have not used reconnaissance plots (as advocated by Myers et al. 1987). Some surveys (e.g. Maxwell et al. 1993) have as their chief data vascular plant species lists recorded within defined areas without estimates of relative abundance or vegetation structure, similar to those used in former DSIR Botany Division surveys of Scenic Reserves (e.g. Kelly 1972). Emphasis there is on native species and usually only broad descriptions of exotic species. One survey (of the Moawhango ED) relied on field knowledge gained during 3 years of field reconnaissance by its author (Rogers 1993) and also did not use plot-based data. Other surveys have relied principally on visual assessments from vantage points of canopies and quantification of cover of constituent species (e.g. Leathwick et al. 1995; Conning & Miller 1999). In these latter surveys it is clear that some sites have been visited so that detailed information on, for example, ground herbs, attends site descriptions that could not have been detected by binoculars (i.e. 'where the opportunity arose, e.g. at a landowner's request, some sites were inspected in more detail and transects within the habitat undertaken': Conning 1998). However, it was not clear in most reports of this type (e.g. Conning 1998) which of the sites were visited to provide the detailed data, 'transects' were not defined, nor was it clear how the detailed information from these sites was included in overall analyses.

While nearly all reports contain maps that have defined areas of recommended areas for protection (RAPs), for most surveys it is not clear how the geographic extent of the surveyed areas, or vegetation units were defined in the field. A few PNAP surveys (e.g. Leathwick et al. 1995) incorporated survey information in a geographic information system (GIS) so that areal information was used directly in analyses.

Most PNAP surveys have not included quantitative data on biota other than vascular plants. The exception is birds (usually emphasising the presence of indigenous taxa over exotic) but rarely on other indigenous terrestrial vertebrates. Most surveys did not quantify relative abundance of animal species. Curiously, surveys have generally not recorded presence, let alone relative abundance, of introduced terrestrial mammals (either wild or domestic), although anecdotal information on presumed impacts of browsing mammals were often contained in descriptions of sites. With few exceptions, no data on invertebrates (other than conspicuous species) have been collected during PNAP surveys, or they have relied on published or collection records. There is no mention made in most reports as to whether museum or other collections

TABLE 1. METHODS USED IN PNAP SURVEYS.

METHOD USED	SURVEY AREA	REPORT
1. Reconnaissance plots *1a. Fixed area plots* Various sizes, methods outlined clearly in the report (O) or with tier descriptions as described in: Law et al. 1984 (L), Myers et al. 1987 (M), Park 1983 (P), Kelly & Park 1986 (KP), or unclear, but plot sheets in NVS show vegetation descriptions in fixed tiers (U).	Banks ER (O) Dansey (M) Hawkdun (M) Manorburn (O) Nokomai (KP) Old Man (P, L) Taringatura (O) Umbrella (O)	Wilson (1992) Comrie (1992) Grove (1994a) Fagan & Pillai (1992) Dickinson (1989) Brumley et al. (1986) Simpson (1998) Dickinson (1988)
1b. Unbounded plots Methods outlined clearly in the report (O), or conforming to methods of Allen & MacLennan 1983 (AM), Myers et al. 1987 (M), Park 1983 (P), Law et al. 1984 (L), Rose et al. 1988 (R), and unclear, but plot sheets in NVS show vegetation descriptions in fixed tiers (U). * = 'slightly modified version'.	Balaclava/Sedgemere/Dillon (R) Cheviot/Motunau (M) Coromandel ER (M) Egmont ER (L) Foxton (U) Herangi (M) Heron ER (L) Hundalee (O) Hunua (M) Kaikoura ER (U) Kaipara/Otamatea (U) Mackenzie ER (U) Manawatu Plains (M*) Matemateonga (M) Mathias/Mt Hutt (U) Maungaharuru (M*) Motu (P) North Taranaki (U) Ngakawau (AM) Pukeamaru (L) Rangitikei (M) Rodney (U) Southland Plains (U) Turanga (M) Waipori (M) Waitakere (M)	Courtney & Arand (1994) (Not yet available) Humphreys & Tyler (1995) Bayfield & Benson (1986) Ravine (1992) (Not yet available) Harrington et al. (1986) Moore (1999) (Not yet available) Breese et al. (1986) (Not yet available) Espie et al. (1984) Ravine (1995) Ravine (1996) Arand & Glenny (1990) Townsend (1996) Clarkson et al. (1986) Bayfield et al. (1991) Overmars et al. (1998) Regnier et al. (1988) Lake & Whaley (1995) Mitchell et al. (1992) (Not yet available) Clarkson & Clarkson (1991) Carter (1994) Denyer et al. (1993)
2. Species lists within areas	Christchurch City Eastern Hawke's Bay Heretaunga High Plains/Low Plains Taneatua Taumarunui Timaru District	Meurk et al. (1993) Maxwell et al. (1993) Lee (1994) (Not yet available) Beadel et al. (1999) (Not yet available) (Not yet available)
3. Generally not using plots Visual assessments of canopies from vantage points, and some site visits.	Ahipara Kaikohe Kerikeri Maniototo Puketi Tiniroto/Waihua/Mahia/Matawai Waiapu Whangaroa	Conning (1998) (Not yet available) Conning & Miller (1999) Grove (1994b) Conning & Moors (1998) (Not yet available) Leathwick et al. (1995) Conning (1999)
4. Other	Moawhango	Rogers (1993)

(e.g. the New Zealand Arthropod collection) have been scanned for records. Notable exceptions to this were the PNAP surveys of Umbrella, Nokomai and Hawkdun EDs (Dickinson 1988, 1989; Grove 1994a), which included extensive data collected during the surveys on invertebrates (e.g. Lepidoptera), as well as on freshwater fish for the former two. The most recent PNAP surveys undertaken by contractors to the Auckland Regional Council in Tamaki, Kaipara and Otamatea EDs have also placed much heavier emphasis on collection of faunal data, principally on bird habitats.

In general, data on cryptogam floras usually have not been collected (with some notable exceptions, e.g. Arand & Glenny 1990; Meurk et al. 1993), nor on fungi, and it is apparent that few surveys have sought to use herbarium or other (such as the Plant Diseases Division, PDD) databases for cryptogams. Analysis of vascular vegetation data has mostly been similar among PNAP surveys that have employed plot descriptions, defining vegetation groups on the basis of similarity using TWINSPAN (Hill 1979), and sometimes using ordination techniques in conjunction (e.g. de-trended correspondence analysis: Gauch 1982, as used in Simpson 1998). Vegetation groups thus identified are usually a key basis for definition of RAPs, with particular emphasis placed on sites that contain sole examples of vegetation groups identified from analysis (i.e. an emphasis on rarity), or which contain a wide range of the vegetation groups identified (i.e. an emphasis on representativeness, set in the context of what vegetation exists now). Clearly, those vegetation groups identified within tiers using all vascular plants on reconnaissance plots (herbaceous communities to canopy trees) would yield different communities if identified solely from assessments of canopy tree cover from vantage points. It is therefore unlikely that communities identified using these different methods would be comparable, even from adjacent EDs. In surveys where reconnaissance plots have not been used (e.g. Leathwick et al. 1995) there has been less emphasis on compositional differences among sites other than in broad vegetation classes (i.e. primary forest, secondary forests, wetlands, dunes, etc.). In these surveys there has been more emphasis on the extent of representation of indigenous vegetation within geographic, altitudinal, or other criteria.

Definitions of RAPs were variable among the pilot surveys (i.e. Espie et al. 1984; Brumley et al. 1986; Clarkson et al. 1986; Mitchell et al. 1992) as might be anticipated. Indeed, a reassessment of one of these areas (Mackenzie ER) considered that RAPs might be re-evaluated in light of later definitions of RAPs (Lee 1996).

The publication of the manual for PNAP surveys (Myers et al. 1987) instituted a standardised means of ranking surveyed sites. The criteria for evaluation of sites was founded on requirements of the Reserves Act 1977 and listed seven criteria for evaluating areas:

- Representativeness (the primary criterion)
- Diversity and pattern
- Rarity and special features
- Naturalness
- Long-term viability
- Size and shape
- Buffering and surrounding landscape.

Each of these criteria was defined in some detail by Myers et al. (1987), and most PNAP reports in selecting RAPs have adhered to these criteria. More explicit definitions of sites for ranking of faunal habitats (notably birds) have been used in recent surveys of EDs in the Auckland Region (M. Bellingham & A. Davies, private ecological consultants, unpubl. data). Some PNAP surveys have devised their own methods for ranking surveyed areas and their inclusion as RAPs. For example, Leathwick et al. (1995) devised a means of scoring surveyed areas based on:

- The total area
- Presence of 'primary' vegetation
- A diversity index for vascular plants that reached a canopy
- A ratio of edge to total area
- The extent of fragmentation of the surveyed area.

The first three were weighted equally and higher than the last two. Importantly, Meurk (in Norton & Roper-Lindsay 1999) distinguished between ranking sites according to criteria (such as those of Myers et al. 1987) and determining what should be protected. In highly fragmented cultural landscapes (e.g. Canterbury Plains) he argued that no habitats containing native species were superfluous to attaining an integrated, sustainable presence of native biota; and that these areas should serve as the basis for restoration in such modified landscapes.

6. Discussion

6.1 THE CHANGING NATURE OF THE PNAP

When the PNAP was initiated in the early 1980s, there was widespread destruction of natural ecosystems, including forests and shrublands under state-subsidised clearance for agriculture and plantation forestry in under-represented lowland ecosystems. The PNAP therefore operated in a political climate where securing reserves was paramount, under the aegis of the Reserves Act 1977. Over the 20 years since its inception, the need to secure reserves in areas under threat from changing practice in agriculture and forestry has remained. It is clear that the PNAP has achieved some goals in securing reserves, either as purchased land for the State or as covenants (including Nga Whenua Rahui), i.e. c. 13% of RAPs identified to date (of which about half have achieved protection through the Tenure Review process: DOC 2000).

However, social, legislative and political contexts have changed over the duration of the PNAP. DOC is still the principal agency directing the PNAP, and in addition to administering PNAP to meet the Reserves Act, it also has responsibility for conservation advocacy under the Conservation Act 1987, so that information derived in the course of a PNAP survey may have broader uses for DOC than facilitating the creation of new reserves. Data from PNAP surveys now provide information for other purposes, especially in the context of the RMA.

There is no comprehensive or consistent collection of biodiversity information outside currently protected areas (Kneebone et al. 2000). In the absence of such information, the PNAP is the only significant national source of data. As a consequence, there has been extensive use of data collected in PNAP surveys to underpin planning requirements of the RMA. It is precisely because such information is required to meet the RMA that there is a growing role of TLAs in directing the PNAP, sometimes with little or no involvement from DOC (although TLAs have been involved in the programme before the RMA, e.g. Denyer et al. 1993). The Auckland Regional Council commissioned PNAP surveys (Waitakere and Hunua EDs) very similar in remit and execution to those conducted by the Department of Lands & Survey and DOC. Since data from the PNAP have provided information for planning requirements and for managing natural heritage, some TLAs responded to this need for information by commissioning the equivalent of PNAP surveys, but surveys that conformed to TLA boundaries rather than those of EDs or ERs (e.g. for Christchurch City Council: Meurk et al. 1993).

6.2 THE CHANGING APPLICATION OF THE PNAP

Territorial local authorities and others are using PNAP data to meet RMA requirements, for example, importing PNAP data from electronic databases (e.g. NVS) into their Geographic Information Systems (GIS) for use in planning. However, it is evident there are perceived or real conflicts between the sampling framework of data collected for the PNAP on one hand, and those needed to meet requirements of the RMA on the other. Furthermore, in some instances there has been use made of data from PNAP surveys to address issues connected with the RMA without an appreciation of what was intended by the PNAP surveyors, or of limits to the data. This is particularly the case where district plans have often excluded protection to sites not identified as of high value in PNAP reports, or which were overlooked in PNAP reports that were not necessarily comprehensive. In one attempt to clarify the adequacy of existing PNAP data to meet multiple needs, Environment Bay of Plenty commissioned a review of PNAP data within their area of jurisdiction. This review assessed the ability of the PNAP data to meet needs under the RMA (Beadel & Shaw 1999; Shaw & Beadel 1999), including detailed evaluations of survey designs (rather than field methods). In other cases, current PNAP surveys have been commissioned by TLAs mainly to meet requirements of the RMA, notably PNAP surveys commissioned by the Auckland Regional Council in Kaipara, Otamatea and Tamaki EDs (the last in association with local city councils).

It is inevitable that use of PNAP data to meet RMA requirements will increase. Currently TLAs and DOC are collaborating in collecting PNAP data so that the greatest range of needs can be met (e.g. between Environment Bay of Plenty, Rotorua District Council and DOC Bay of Plenty). Public reaction to use of PNAP data for planning purposes has often been unfavourable, or even hostile. Unfavourable reactions have often arisen when PNAP surveys have been undertaken solely by DOC or its contractors, even though letters to landowners from DOC and TLAs in advance of surveys, especially those undertaken since the advent of the RMA, have made it clear that the data would be available to TLAs for planning purposes. In the course of preparing the present report, staff of TLAs expressed the view that more options exist now for protecting natural areas on private land now than at the start of the PNAP, and that land owners should be more involved in data collection and interpretation. Such a process would reduce the possibilities for conflict.

From DOC's perspective, there is a need to define when PNAP surveys may be unable to address representativeness within an ED (as suggested by Myers et al. 1987) when access to many sites is denied by landowners. For example, during the PNAP survey of the Motunau ED (J. Steven, DOC, unpublished), access was denied to over a third of the ED by local landowners. There needs to be a policy within DOC as to whether denial of access to many sites makes it not worthwhile pursuing the survey, or whether simply to assess the values of the sites that can be surveyed, but not make statements about their representativeness.

A collaborative approach is needed between DOC and TLAs to minimise duplication of effort, and set agreed standards for best practice in collection of field data. In this way the needs of DOC (as set out at the inception of the PNAP) can be addressed, as well as the burgeoning need for information by TLAs. There also needs to be an explicit arrangement between TLAs and DOC for data collection and sharing. This should lead to economies of effort and sharing of skills, i.e. in collecting data simultaneously for both assessments of areas as RAPs and to evaluate their 'significance' as required under the RMA, since there is a large overlap between those criteria set to define RAPs (Myers et al. 1987) and definitions of 'significance' under the RMA (Whaley et al. 1995; Norton & Roper-Lindsay 1999). Moreover, evaluation of landscape-level values may also be best achieved using GIS capabilities with expertise shared between DOC and TLAs. Since much of the difficulty experienced by TLAs in interpreting PNAP data is in applying the results to cadastral maps to meet RMA requirements (i.e. at scales of 1:5000), appropriate scales of sampling to meet all needs can be set in advance, rather than attempting to resolve issues of scale after data collection. In these circumstances where data sharing between TLAs and DOC is explicit at the outset, landowners can be made more aware about the wide range of uses to which data are likely to be put.

6.3 THE URGENT NEED FOR INFORMATION

Concerns were expressed even a decade ago about the need for urgency in completing the PNAP: 'there is an urgent need for promotion and action if [the PNAP] is to achieve its purpose, in competition with continuing land development, within the allotted time of one decade' (Dickinson & Mark 1988). Two substantial new reports on biodiversity management (DOC & MfE 2000; Kneebone et al. 2000), as well as the *State of New Zealand's Environment* (MfE 1997) have drawn attention to the paucity of information on which to base planning decisions.

A recent review of PNAP within DOC (2000) stated that at the 'current rate of progress [and] funding the Department will not be able ... to provide national coverage (assuming we could get access to all areas). Only four out of twelve Conservancies were confident of being able to complete PNAP coverage for the entire Conservancy. Wanganui Conservancy will complete PNAP coverage for the EDs this year. Significantly, no Conservancy in the South Island estimates it will be able to complete PNAP coverage in 10 years.' Because of the piecemeal approach to and poor funding of the PNAP, there has been a sense of frustration both within DOC and among other agencies that use PNAP data. This has led to some agencies synthesising existing data to meet conservation requirements. For example, the Nature (formerly Forest) Heritage Fund has commissioned reports that cover DOC Conservancies (e.g. Harding 1999) to assess the adequacy of protection of existing ecosystems and therefore to identify priorities for protection. These are very similar goals to those of PNAP (Kelly & Park 1986), albeit conducted at scales other than those of EDs and ERs. Likewise, some TLAs have responded by commissioning their own surveys; for example, Environment Bay of Plenty has commissioned 'natural heritage surveys' within the area of its jurisdiction.

Lack of adequate resources within DOC has also meant that, increasingly, cheaper evaluations of natural areas are being undertaken than the surveys envisaged at the outset of the PNAP (i.e. as set out in Kelly & Park 1986). This is also born out of a sense of frustration for immediate needs for information within DOC, so that its advocacy role can be conducted on the base of some rather than little information. A consequence of the inadequacy of resources for PNAP surveys was highlighted by Dr Bruce Clarkson (University of Waikato, pers. comm.), who has been involved in PNAP surveys since their inception. He drew attention to the degree of variability within PNAP surveys with which he had been involved as a consequence of funding available for surveys (of more than an order of magnitude, from $10 000 to >$150 000). As a result, there has been variability over time, not just of methods used (as highlighted in the Results section) but also of technical competence of survey staff, and of different scales of field definition of protected areas (from 1:25 000 to 1:50 000). There have also been difficulties in reconciling these findings to meet RMA requirements (i.e. where applications are for tenure maps at 1:5000 scale).

6.4 USE OF VEGETATION PLOTS TO UNDERPIN THE PNAP

Descriptions of vascular plant communities underpin all PNAP surveys and define RAPs. Most PNAP surveys have collected data on vascular plant communities using reconnaissance plots (Table 1). An advantage of the application of a consistent method of collecting data across PNAP survey areas is that comparisons can be made across EDs as to representation, distribution of plant species, etc. Moreover, information from PNAP reconnaissance plots is directly comparable with, or is only subtly different from, similar information collected from a wide range of habitats on land administered by DOC using a method in widespread use (Allen 1992). In some cases (e.g. Overmars et al. 1998) the sampling protocol as well as the methods for collecting data are almost identical to those used in many surveys of indigenous habitat on land administered by DOC. In this way PNAP survey data and survey data from DOC-administered land could be combined to develop a quantified, objective description of the vegetation of New Zealand. To date, PNAP data have scarcely been used in such synthetic studies, yet the potential is enormous.

Within DOC there is still a belief that a strength of PNAP is 'its national consistency, field approach and generally high data reliability' (DOC 2000). However, it is clear from this study that, at least in terms of consistency of field approach, this no longer applies and, increasingly, there are departures from methods recommended in the PNAP manual (Myers et al. 1987). Within DOC it is clear that inadequate resourcing has slowed the rate of completion of PNAP, and the initiative is driven by Conservancies rather than by DOC's Head Office. Inadequate resourcing, decentralisation, and an urge to complete the task quickly has meant that, increasingly, options have been taken to conduct surveys that do not involve detailed field inspections.

The use of methods other than reconnaissance plots to gather information in some PNAP surveys has been driven by a belief that using plots is slow and a drain on resources. For example, in both Hawke's Bay and Northland the imperative to survey and report on EDs rapidly was paramount, and PNAP survey reports from these areas have not used reconnaissance plots. Geoff Walls, who has had a long involvement in PNAP and who instigated PNAP surveys in Hawke's Bay (e.g. Maxwell et al. 1993), considers plot-based information for PNAP surveys potentially misleading (i.e. not necessarily the best means of describing vegetation within a surveyed patch) nor ideal for gathering information on what is required to determine a RAP. Vegetation information gathered in PNAP surveys in the Hawke's Bay (see Species lists within areas, Table 1) has been useful to the local TLA (Hawke's Bay Regional Council). Furthermore, as a result of these surveys, DOC and local representatives of the Queen Elizabeth II Trust have been notably successful in securing as protected areas many of the RAPs identified in these PNAP surveys. In other PNAP surveys that have not used plots, field staff have scanned areas with binoculars to define canopy covers, especially in Northland (e.g. Conning & Miller 1999) and in some East Coast areas (Leathwick et al. 1995).

6.5 HOW RELIABLE ARE PNAP SURVEY DATA?

Inadequate resources may also have led to less experienced or less qualified field staff gathering data. There is no central quality control procedure within DOC to assess quality of skills in field measurements. Geoff Walls (pers. comm.) stated that, above all, it is important to have reputable, well-trained staff conducting field surveys so that there can be confidence in the results. Without doubt, adherence to a method (plot-based or otherwise) without underpinning expertise will produce worthless results that will bring PNAP overall into disrepute. There is no agreed standard that field staff undertaking PNAP surveys should attain, and as a consequence one cannot be sure of the comparability of standards between one PNAP survey and another. Neither DOC nor TLAs have, at present, a means of assessing the quality of data collected during field surveys, nor a process of accrediting competent field staff; yet as these data increasingly enter the public arena in court or tribunal hearings, it is clear that data quality needs to be defensible.

If data are collected at a point that can be relocated in the field, there can be independent evaluation of data quality. For methods that rely on remote assessment of vegetation (e.g. Leathwick et al. 1995; Conning & Miller 1999) there also needs to be determination of likely error in these methods. For example, it is most unlikely that some common tree species can be distinguished adequately from a distance, even by very experienced observers. It is difficult to distinguish red beech (*Nothofagus fusca*) from hard beech

(*Nothofagus truncata*), hinau (*Elaeocarpus dentatus*) from pokaka (*Elaeocarpus hookerianus*), kanuka (*Kunzea ericoides*) from manuka (*Leptospermum scoparium*), and miro (*Prumnopitys ferruginea*) from matai (*Prumnopitys taxifolia*). Distinguishing many small-leaved trees and shrubs would be even harder (Wilson & Galloway 1993). Few, if any, PNAP survey reports acknowledge or define likely sources of error in their data collection.

6.6 ARE CURRENT METHODS THE MOST SUITABLE TO DEFINE AREAS THAT MERIT PROTECTION?

Surveys for the PNAP, and the recommendations that follow from them in defining RAPs, are founded on the premise that the best examples of vascular vegetation on particular landforms should be protected. Best examples of vegetation have often been chosen on the basis of species richness or diversity (e.g. Leathwick et al. 1995). The question can be asked: how sound is this premise as a basis for biodiversity conservation?

Very few PNAP surveys have attempted to document invertebrate species communities. In New Zealand, a strong relationship has been shown between vascular plant species richness and richness of terrestrial mollusc species in one study (Barker & Mayhill 1999), and with beetle species richness in another (Crisp et al. 1998). However, another study has shown inconsistent trends between vascular plant species richness and species richness of other invertebrate groups (Wardle et al. in press). Comparisons of vascular and non-vascular plant species richness have not been conducted in New Zealand. However, it is salient to note that one of the country's most depauperate forests in terms of vascular plants—monodominant mountain beech (*Nothofagus solandri* var. *cliffortioides*) forest at Craigieburn, inland Canterbury—has the most diverse wood-decaying fungal flora (> 200 taxa) documented anywhere (Allen et al. 2000). In New South Wales, Australia, overstorey species richness in forests was positively related to bryophyte species richness, but there was no relationship with lichen species richness (Pharo et al. 1999). In this same study fern species richness (as would be recorded in many PNAP survey plots) was positively related to bryophyte species richness, but was negatively related to lichen species richness; and a major determinant of richness of vascular plants, lichens and bryophytes in this study was disturbance history. This and another study (Pharo & Beattie 1997) also showed that the rate of turnover of vascular plant richness in New South Wales forests is quite different from that of non-vascular plants, and bryophytes in turn are quite different from lichens. These studies might therefore give some basis for challenging whether defining areas suitable for protection solely on the basis of vascular plants is also adequate for protecting invertebrate and cryptogam communities. At the least it suggests that herbarium databases and those of invertebrate collections should be scanned to determine whether rare taxa or known centres of diversity are included in the selection of RAPs and that, if resources are available, additional surveys may be required for invertebrates and other fauna, cryptogams and fungi within EDs.

Some recent PNAP surveys have described areas solely on the basis of canopy species (e.g. Leathwick et al. 1995; Conning 1998) and implicit in this is that areas with greater canopy species richness will also have greater species richness of vascular plants in forest understoreys. However, studies in New Zealand have shown that relationships between the composition of canopy species and understorey species can be uncoupled (e.g. Wilson & Allen 1990). Furthermore, an intact canopy may give no indication of the extent to which the understorey has been affected by browsing wild animals or livestock. For assessments based on composition of forest canopies, this is unlikely to meet one of the criteria advocated by Myers et al. (1987) for defining RAPs, i.e. the presence of rare species. Of c. 210 species that form trees in New Zealand (McGlone 1997), only five (2.4%) are threatened species (de Lange et al. 1999), and most of these have very narrow geographic ranges so are unlikely to be found in all but a very few EDs. These five species constitute 4.7% of the 107 threatened vascular plant taxa of New Zealand, but shrubs and herbs found in forest understoreys or at forest margins constitute 21.5% of the threatened vascular plant taxa (de Lange et al. 1999); it is very doubtful that any of these taxa would be detected from scanning of canopies alone. In other areas, assessing areas on the basis of canopy composition would suggest homogeneity of habitat where it is not the case; for example, under canopies almost entirely comprising beech (*Nothofagus*) species there are substantial reductions in number of vascular species along a rainfall gradient (Wardle 1984).

Criteria to rank surveyed habitats as advocated by Myers et al. (1987) are widely applied, and most of these have firm theoretical support in conservation biology literature. Acknowledgement needs to be given of which of the categories advocated by Myers et al. (1987) are rested on quantitative data, such as diversity; which can be quantified by several indices, e.g. as in Leathwick et al. (1995); and which are subjective assessments (e.g. 'naturalness'). The criterion of long-term viability is especially subjective and is predicated on the fact that some knowledge of long-term dynamics of the community assessed is known (doubtful for most New Zealand ecosystems, especially as many of the communities in the modified landscapes of New Zealand are successional, and may contain rare species). For communities that are successional, their long-term viability may be dependent on securing a larger area (Lee 1996) to allow for natural disturbances and recovery in a mosaic. Additionally, while extent of edge in a plant community is generally regarded as detrimental in ranking communities, edges may be favoured habitats of some invertebrate taxa, for example Lepidoptera (e.g. Devries et al. 1997), and some plants (e.g. divaricating shrubs).

Finally, the PNAP is still based on the division of the New Zealand landscape into ERs within which are EDs (McEwen 1987), and in these land units the programme sets out to recommend areas for protection. Other means of dividing the New Zealand landscape have been proposed on ecological grounds (e.g. Crosby et al. 1998; Leathwick 1998) and data gathered to date might be re-evaluated in light of these and other methods. Similarly, data gathered to date from the PNAP are being re-evaluated by TLAs in the context of their administrative boundaries. For the foreseeable future DOC is likely to retain the division of the New Zealand landscape into ERs and EDs. However, for some parts of New Zealand, notably the Northland peninsula, a substantially revised classification of that region has been proposed (cf. McEwen 1987), and the area surveyed according to these alternative EDs (Conning 1998, 1999; Conning & Moors 1998; Conning & Miller 1999 and others still being prepared). If these and other alternative classifications are to be accepted, their formal publication is needed in a revised edition (with maps) of McEwen (1987).

6.7 DOCUMENTING CHANGE IN BIODIVERSITY IN THE NEW ZEALAND LANDSCAPE

The national biodiversity strategy (DOC & MfE 2000) and a report on managing biodiversity of private land (Kneebone et al. 2000) have both drawn attention to the need to monitor change in biodiversity over time, especially with respect to land-use practices. State-of-Environment reporting by TLAs has similar requirements (e.g. Manukau City Council 1999). The challenge then becomes one of how to reliably document biodiversity in the New Zealand landscape, and how to reliably document changes that occur. Kneebone et al. (2000) stated '[TLAs] generally do not know whether the state of biodiversity is in decline and at what rate, and the extent to which their management efforts have been effective.'

Use of PNAP survey data (either from plots or other methods) to document change with time was not envisaged in early surveys, and is still not a feature of current surveys, even though the need is evident. DOC may wish to know how natural areas change over time; for example, in documenting whether securing RAPs has truly made a difference in protecting biodiversity, or whether violations of permissible uses of designated areas have truly degraded the sites. In the absence of any other data on biodiversity on private land, there is likely to be growing pressure to use PNAP data to document change in biodiversity on private land, not just under the auspices of RMA but other legislation (e.g. Forest Amendment Act 1993). Use of PNAP data to underpin RMA requirements is sometimes questionable when data collected over a decade earlier is used to meet current land-management needs (Shaw & Beadel 1999). This will be especially pertinent in areas where land use is changing rapidly, or where many of the areas surveyed in an ED are successional communities likely to change in composition fairly rapidly.

Increasingly, in some of the more recent PNAP surveys (from 1993 onwards), it is difficult to determine how much is existing field data (of age and quality not discussed in the text), and how much is field data collected in the course of the current exercise. Reliance on historical data (e.g. National Forest Survey plots (Regnier et al. 1988), New Zealand Wildlife Service surveys) in PNAP surveys is indeed desirable. These can enable a dynamic perspective to be given to the ecosystems of the communities described. However, the age of the data used to underpin an assessment of an RAP or other site should be made apparent. It is naive to presume that many communities will be stable in species composition even over fairly short periods (decade or less), especially those that are characteristic of primary or secondary successions, both of which are commonplace in the human-modified landscapes of New Zealand (Wardle 1991) that are the usual focus of PNAP surveys. Similarly, it is naive to presume that even in more developed communities, (e.g. old-growth forests) vegetation composition should be static. For example, should a fence have fallen to admit domestic stock to an isolated forest stand since historical data were collected, it is highly likely that selective elimination of palatable understorey plants will have occurred, as well as likely effects on invertebrate communities, both above and below ground.

With the PNAP having surveyed less than half the country's EDs, it is little wonder that scant attention has been paid, so far, to assessing change within EDs as an adjunct to the PNAP. However, some areas surveyed early in the PNAP have been revisited, especially with respect to addressing how PNAP data can meet RMA requirements. A resurvey of part of the MacKenzie ER showed that at least two RAPs had been completely destroyed since the publication of the original PNAP report (Espie et al. 1984 cf. Treskonova 1996). Partly this example illustrates dangers in using even 10-year-old data to set biodiversity management policies in a changing landscape, but it also shows there is some capacity to document extreme changes in biodiversity over time using PNAP data. In another re-evaluation of Mackenzie ER, Lee (1996) recommended expansion of some RAPs over the areas advocated by Espie et al. (1984). Partly this is because notions of what should constitute an RAP had changed in the intervening years, but partly it was also to give recognition to the successional nature of the vegetation; that is, a dynamic view of vegetation is required. Fourteen years after the PNAP survey of the Rodney ED (1983–84), a resurvey was undertaken in 1997–98 to determine changes in vegetation and habitat size (A. Julian, A. Davies & M. Bellingham, unpubl. data). In this ED, some sites had been cleared of vegetation. However, the capacity to document changes in floristic composition was poor, and for some it was apparent that map grid references were inaccurate or too vague in original recording to make relocation of original sites possible (M. Bellingham, unpubl. data). In resurveys of both the Mackenzie ER and the Rodney ED it was not possible to relocate the plots that underpinned the original vegetation analysis, since the plots were not permanently marked.

The recent (1 May 2000) 'unscrambling' of the Global Positioning System (GPS) means there is far greater capacity for accuracy in relocating plots in future (to an accuracy of 10 m). This has enormous implications for management. For both DOC and TLAs, relocation of points in the field with this degree of accuracy will enable the capacity to record change and to assess data accuracy with confidence. In this way vegetation could be resurveyed by TLAs to assess compliance with provisions of the RMA, or to record change for better or worse (e.g. demonstrating consequences of fencing after securing as an RAP). If non-bounded plots are preferred, then their approximate radius should be recorded to delimit future search areas and their centres marked. If fixed-area plots are used, then GPS coordinates should be determined at corner pegs for all but very small plots. Small metal pegs to mark positions of plots could be inserted with their tips beneath the ground so that they do not threaten domestic stock. GPS accuracy should be sufficient to enable their relocation within 10 m, at which point a metal detector would probably enable recovery of the plot.

An impediment to comparing data across EDs and to resurveying EDs to document change that became apparent in collating information from published PNAP reports in this study was the inadequacy of documentation that attended individual reports. Often I had to surmise what methods were used to collect data, and on other occasions when it was stated that a standard procedure was followed (e.g. typically 'methods followed Myers et al. (1987)'), it was often evident this was not the case, or that only selected parts had been followed. Shaw & Beadel (1999) stressed the need for far better metadata to accompany reports, even as appendices. The ability to repeat surveys in the absence of such data is severely compromised. A mandatory part of PNAP surveys is that published reports should contain example field-data sheets, except where they conform exactly to a type used and published in the past. Likewise, it is vital that both hard copies of field data sheets and accompanying metadata are archived adequately. Copies of field data sheets from most plot-based PNAP survey data resides in the NVS databank, and original copies reside at most Conservancies, although some original field-data sheets have been inadvertently lost or destroyed.

6.8 CAN EXISTING PNAP METHODS ADDRESS MULTI-PURPOSE NEEDS ADEQUATELY?

In Table 2 the methods employed in PNAP surveys to date (see Table 1) are compared broadly for benefits and costs that attend each. The comparisons are made as if the same field staff with the same degree of botanical expertise were used in each method. The comparisons have not been made with assumptions about inclusions of field staff with other disciplinary expertise, (e.g. geomorphological or entomological skills), since increasingly these skills are not employed in PNAP surveys.

While stratification of EDs before surveys saves time and cost, it is also likely that it creates bias in the selection of sites in favour of those that are conspicuous (i.e. having woody vegetation) and under-represents herbaceous communities, grassland communities etc., which may be under greater threat than, for example, forests. Also, herbaceous and grassland communities, especially in the lowlands, contain a disproportionate number of rare or threatened taxa (e.g. of vascular plants: de Lange et al. 1999). Above all, stratification compromises the ability to assess representativeness (Myers et al. 1987), since only a subset of the landscape is sampled. To date, only one PNAP survey (of Banks ER; Wilson 1992) has sampled an area representatively. Documenting change in biodiversity on the New Zealand landscape may require a similar unbiased sampling regime, and may be best conducted between DOC and TLAs.

Current use of reconnaissance plots in PNAP surveys has advantages of applying a standard, widely used method that allows comparability of data within sites, across sites and across EDs and, as stated earlier, with data collected in similar formats from conservation land. However, in accomplishing the immediate aims of PNAP, it may be too labour- and time-intensive for a programme already lagging far behind its intended date of completion. If DOC alone intends to pursue PNAP, it may be best to consider the methods employed in PNAP surveys in the Hawke's Bay (e.g. Maxwell et al. 1993)—that is, using a rapid non-plot-based reconnaissance of areas.

This is the view that could be taken if the sole purpose was to determine RAPs. However, taking the most rapid cost-effective option is also likely to compromise the utility of the data for other purposes. As the present report

TABLE 2. BENEFITS AND COSTS OF METHODS EMPLOYED IN PNAP SURVEYS (SEE TABLE 1).

METHOD	BENEFITS	COSTS
Systematic v. stratified sampling		
Systematic sampling	• Better able to gauge representativeness. • More likely to sample non-woody habitats. • Addresses biodiversity issues in all land-uses.	• Labour- and time-intensive.
Stratified sampling	• Targets some areas likely to be of high value, thus obtains results rapidly.	• Biased to woody or conspicuous vegetation. • Can only address some issues of biodiversity across a landscape.
Plot v. non-plot based sampling		
Sampling with plots	• Quantitative data for analyses. • Standard method allows comparability between and across sites, EDs and with conservation land.	• Time spent when a rapid reconnaissance may yield more species, including rare ones (plots sample the norm rather than the exception).
Fixed-area plots	• Absolute abundances quantifiable. • Potentially readily remeasured (with GPS) to give change with time.	• Time spent establishing plots.
Variable-area plots	• Method is widely used and data are comparable. • Potentially remeasurable (with GPS). • Less time-consuming than fixed-area plots.	• Less reliably useful for change-with-time measures.
Sampling without plots	• Rapid. • Potentially able to cover a greater area.	• Data not readily comparable within sites, across sites, or across surveys.
Species lists	• Could be more exhaustive than plots for describing a site, and better able to detect rare species.	• Non-quantitative. • Unlikely to be reliable in providing change-with-time assessments.
Canopy assessments	• Quantitative evaluation of composition. • Potentially useful in assessing change with time.	• Ignores all variation and composition below canopy. • Very unlikely to detect rare species • High potential for misidentifying species.

shows, there are clear needs for information on biodiversity in the managed and privately owned landscape, both in terms of providing up-to-date information and of documenting change with time. If PNAP continues as a partnership between DOC and TLAs, then it may be more appropriate to use quantitative plot-based data. The use of GIS in storing and manipulating PNAP data gives more powerful quantification of spatial data (Leathwick et al. 1995), and since GIS is a major tool in TLA planning, it is sensible to include storage of PNAP data in GIS-compatible formats that can be linked with other databases (e.g. tenure and cadastral maps, and databases of agencies involved in conservation protection such as Queen Elizabeth II Trust and the Nature Heritage Fund). Current PNAP reconnaissance plots cannot be used reliably to document change with time, but used in conjunction with GPS, this need can be addressed. Likewise, to meet TLA needs there is potentially greater benefit in a systematic sampling of the landscape than a stratified sampling as currently used in PNAP to define all natural biodiversity within an area. Clearly there is a greater cost in time and resources, which can only be contemplated in a collaborative approach. Even with such an approach, a preliminary rapid reconnaissance with a sharp focus on the main goals of PNAP—securing unrepresented or under-represented ecosystems for conservation—will remain an important goal, since the rate of loss continues unabated (DOC & MfE 2000).

7. Conclusions

The original reasons for establishing the PNAP remain and some successes have been achieved in securing identified areas as protected sites. However, the rate of progress is slow, and resources to see its completion are meagre, despite ever-growing demands for data. At current rates of progress at least another 20 years would be required to complete the programme. Thus there are pressures to speed up the process to achieve its original aims of protecting ecosystems; and alternative, more rapid methods of assessment of habitats than those advanced at the outset of the programme have had notable successes. If DOC wishes to simply assign areas as RAPs as quickly as possible, this may be the best means, and DOC may wish to align such an effort nationally with other rapid assessments by agencies that fund nature conservation (e.g. Harding 1997).

There is a cost, however, in retaining such a narrow focus. As stated earlier, the data that derive from a standard and more-or-less consistent method of sampling the managed and fragmented parts of the New Zealand landscape (as has been the case until recently in the PNAP) present the only data available for assessing the state of New Zealand's biodiversity. This need is expressed in numerous policy documents; PNAP data are potentially the best available for tracking changes in biodiversity over time. There is no doubt that the types of data that derive from point-based (and at best repeatable) measures from plots can underpin conservation advocacy but, above all, set criteria for maintaining biodiversity and sustainable land management. These latter issues are the province of TLAs. Therefore, with refinement, use of plot-based data may prove the best means of sustaining the longer-term goals of PNAP. A more comprehensive, systematic collection of data may therefore meet the greatest range of needs, but it is beyond DOC's resources to conduct this alone. It could only be undertaken in partnership between DOC and TLAs with the goals of both agencies clear at the outset. Partnership with agencies that fund conservation may also secure areas for protection. A partnership approach between DOC and TLAs would also alleviate problems of data sharing between agencies, where it is explicit that data collected by both agencies will be used not only for the aims of the PNAP but also to meet the requirements of the RMA. Data sharing arrangements can also utilise the strengths of both agencies to ensure that data are collected at appropriate spatial scales, and to ensure that information can be managed in national databases (e.g. NVS) and in GIS-compatible formats.

DOC and TLAs need to have better means of assessing the data quality in PNAP reports; it has not been possible in the scope of this exercise to conduct field checks of data quality. Use of GPS should be mandatory in future surveys, but it is not possible to revisit sites to determine accuracy of field identification. Some means of rapid assessment of areas (e.g. scanning forest canopies from a distance) has high potential for misidentification of species, and is unlikely to be able to detect rare species. Both DOC and TLAs need to determine some agreed minimum standards of field data quality, without which poor data sets run the risk of bringing the whole programme into disrepute.

8. Recommendations

It is the author's opinion that:

- While this report identifies some problems and inadequacies in PNAP, DOC should proudly defend its record, and the overall quality and integrity of PNAP data. PNAP remains *the* reconnaissance of New Zealand's biodiversity and landforms on the major part of New Zealand's land surface that is privately owned, and no other data begin to compare in comprehensiveness. DOC needs to publicise this, in conjunction with other agencies that collect PNAP data.
- The current state of PNAP should be formalised and released for public inspection in the context of DOC's current Stategic Business Plan and its RMA strategy. In these documents, the achievements of PNAP and the rate of area surveyed should be documented as well as the proportion of land secured as protected areas by ED. These strategies can set a basis for partnerships between DOC, TLAs and conservation agencies, and can inform landowner groups (e.g. Federated Farmers, Landcare groups) about the aims of PNAP, and the uses to which PNAP survey data are put.
- DOC needs to decide whether to embark on a rapid evaluation of areas solely to meet objectives of the PNAP, or whether to continue the PNAP in the broader context of the RMA (i.e. to formalise a partnership with TLAs). There is no doubt that any information gathered in the course of the PNAP will be used to meet RMA requirements.
- An evaluation should be conducted nationally (possibly by MfE) of the adequacy of PNAP data to meet the needs of the RMA. Such a report might follow the terms of a similar evaluation, prepared at a local scale by Beadel & Shaw (1999). The compatibility of data should be addressed to meet both definitions of representativeness for the PNAP (as defined in Myers et al. 1987) and of ecological significance, under section 6 (c) of the RMA (e.g. as proposed by Norton & Roper-Lindsay 1999 and Meurk 2000).
- DOC might recommend to MfE that it convene a forum to mediate among parties that are often in conflict over use of PNAP data. In addition to MfE and DOC, participants might include umbrella agencies for TLAs, and non-governmental organisations including those representing land owners (including tangata whenua), primary industry and environmental NGOs, so that the uses and strengths of data used to determine and value biodiversity on private land are known. This forum may also serve as a basis for devising means of long-term protection of indigenous biodiversity (following recommendations in Kneebone et al. 2000).

- A new edition of McEwen (1987) should be produced with appropriate peer review and consultation, and should include revised maps to show ED boundaries, digitised in a format that can be imported into GIS packages used by TLAs as well as DOC.
- DOC (in conjunction with TLAs) needs to set quality standards and means of assessing these standards. Standards also need to be set about when, for reasons of denial of access, it is not possible to evaluate representativeness within an ED adequately.
- Use of GPS devices to the highest degree of accuracy possible should be a feature of all future site locations, if possible at least to roughly delimit a search area about the point of origin. A metal peg buried in the ground could be used if the land owner was agreeable so that, in combination with a metal detector, a given point could be relocated with confidence.
- Archiving copies of field data sheets from PNAP surveys in the NVS databank should be mandatory.
- Standards for metadata for PNAP surveys need to be agreed (e.g., definitions of what field methods were used, how areas were chosen for survey, etc.), and archived together with field data sheets.

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Appendix 1

LIST OF ACRONYMS

Acronym	Definition
DOC	Department of Conservation
DSIR	Department of Scientific & Industrial Research (disestablished 1991; now various Crown Research Institutes)
ED	Ecological District
ER	Ecological Region
GIS	Geographic Information System
GPS	Global Positioning System
MfE	Ministry for the Environment
NVS	National Vegetation Survey databank
PDD	Plant Diseases Division (national fungal herbarium, curated by Landcare Research)
PNAP	Protected Natural Area(s) Programme
QEII	Queen Elizabeth II Trust
RAP	Recommended Area for Protection
RMA	Resource Management Act (1991)
TLA	Territorial Local Authority