Descriptive Ecology and Conservation Biogeography

INTERNAL DISCUSSION PAPER - FIRST DRAFT

THE BIOLOGICAL SURVEY UNIT AT THE WAWRC -- ROLE, OBJECTIVES, STRATEGIES, RESOURCES & 1985 -1987 PROGRAM.

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CONTENTS

INTRODUCTION

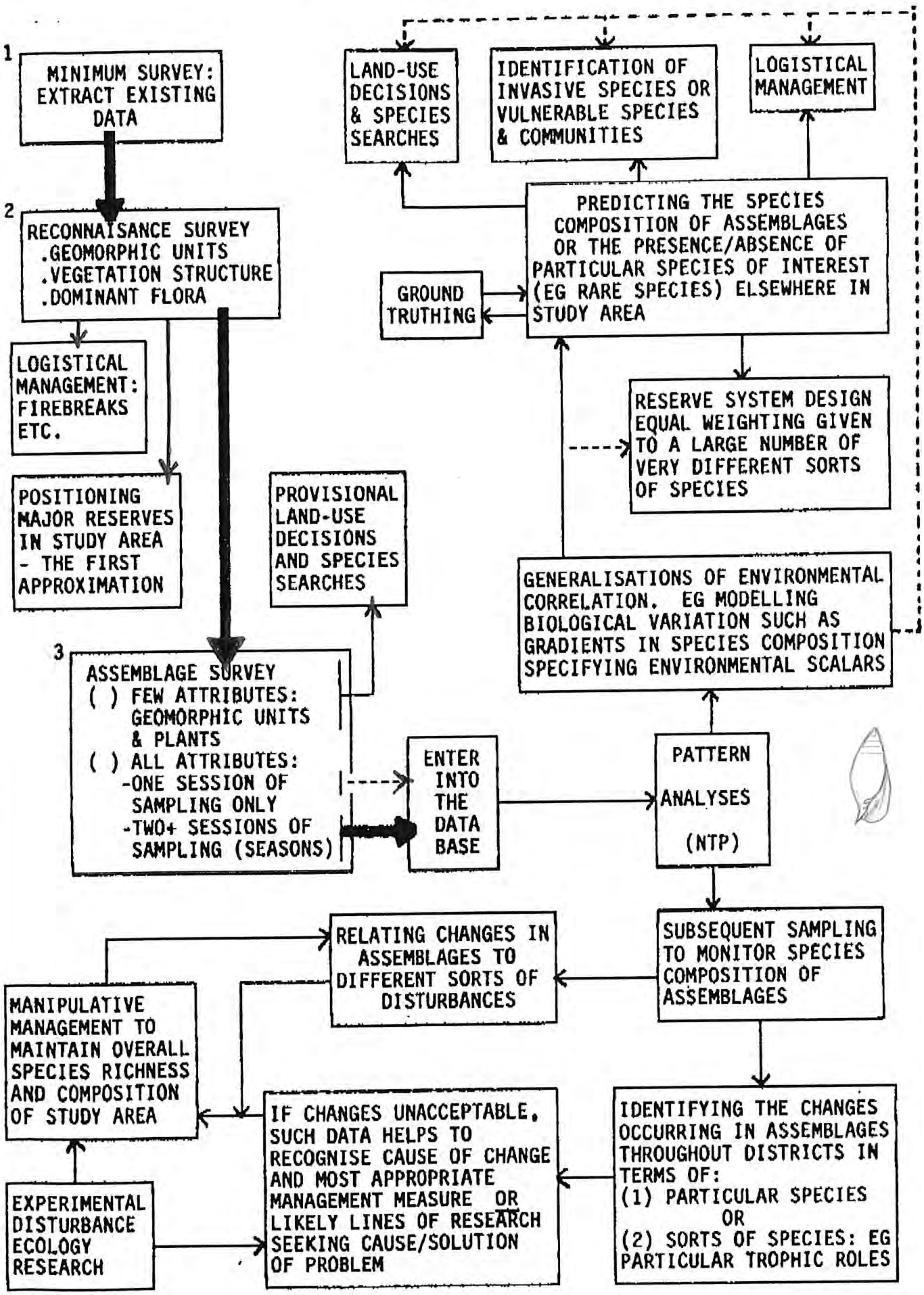
Many of the staff at the W.A. Wildlife Research Centre carry out biological surveys; mostly these focus on particular species (orchids, rock-wallabies, dugong) or on assemblages of a particular type of organism (vegetation, water-birds, reptiles). All of these projects are relevant to wildlife management and, like the work done by the biological survey group at the WAWRC, belong to "management research". Those carried out by the WAWRC staff specifically designated as "biological survey" merely sample a greater array of organisms over geographically much larger study areas.

Our biological surveys are descriptive and synecological; they aim to provide data on the species composition of a study area and the distribution of plants and animals across it. In some cases the study area is an entire natural district (eg. the Nullarbor) while in others it is an individual reserve. The synecological emphasis given to our survey work in W.A., and my obsession with relating the biological patterns that we identify to gradients in the physical environment, were dictated by the sheer size of W.A. and our ignorance of patterns in the biota of most districts at even a descriptive level for all but the most common and obvious species. This situation still persists in many parts of W.A. today (eg. Ashburton and Carnarvon Phytogeographic Districts).

The identification and characterization of patterns in the biota (see Fig. 1) is basic to many reserve management decisions. A wildlife management purpose for which this sort of survey data has most often been used is in the design of reserve systems.

This document aims to start discussion to clarify the relationship between the biological survey group at the

DESCRIPTIVE ECOLOGY MODEL



PLANNING OPERATIONS - OTHER RESEARCH PROGRAMS

W.A.W.R.C., the other research groups at the W.A.W.R.C., the Planning Branch, and other groups within C.A.L.M. such as those involved in biological survey work at the Mangimup research centre. In the last case it is important that we examine the extent to which we have common goals and ensure that proceedures and data-sets are compatible, if not standardized. In this paper I describe the sorts of data the survey group collects and discuss:

(1) The opportunities that data collected in our format present for analyses yeilding conclusions with immediate management application and for long-term monitoring.

(2) The obligations of the survey group to its own ongoing programs and our priorities for survey during the next two years, noting our obligation to be able to respond to <u>ad hoc</u>, urgent or unexpected needs for specific surveys from a variety of sources, both inside and external to C.A.L.M. This implies an indication of the extent to which we can undertake surveys to overcome the lack of data for many of the areas that urgently require specific land-use decisions or management plans.

(3) The different emphases in the duties of the people within the survey group at the W.A.W.R.C.

(4) Our current needs in terms of staff and logistical support so the expertise of existing survey people can be used more efficiently, particularly in supervisory roles. In this context, the provision of funds so we can make greater use of the available pool of skilled consultants is an essential option.

The development of biological survey concepts in W.A. has been discussed by McKenzie (1984, in: Survey Methods for Nature Conservation Vol. 2). As part of our on-going program of district surveys during the 1980s, the biological survey group proposes to establish a network of sites throughout W.A. where a standardized array of the species present is recorded in a way that allows us to measure the success of management strategies in maintaining the richness of our native biota. Where possible we will position a proportion of these sites in areas perceived to have immediate needs for management plans. This general objective requires that our surveys of sites:

(1) Encompass a variety of organisms that is wide enough (eg. in their nutritional roles) to provide some description of the different component parts of the biological system present at each site (because they function in nutritional pathways at very different points in biological networks)(see Paine 1980 J. Anim. Ecol. 49, 667-685).

(2) Be sufficiently exhaustive to allow us to detect changes in the biota of the site (with subsequent sampling) and identify specific management needs from the sorts of organisms appearing or disappearing. Examples may include the need to eliminate exotic herbivores because of widespread loss of vegetation biomass and evidence of over-grazing, or the protection of the site from fire so litter insect faunas can be

re-established (a loss of species richness and structure in the community of ground foraging insectivores such as the small lizards found in leaf litter). Where there is no single obvious cause for a loss in species richness detected at a site, experimentation will need to be initiated.

(3) Be carried out over a sufficient number of sites:
(a) Initially -- to allow us to identify and describe biological gradients across the study area, and to specify the gradients in terms of scalars (eg. climatic or soil attributes) of the physical environment.
(b) During each subsequent sampling session -- to allow us to distinguish a localized process from a regional change in species composition (see Weins 1981, Am. Nat. 117, 90-98 and Wilcox & Murphy 1985, Am. Nat. 125, 879-887).

Of course, such detail is unnecessary in many instances; a quick, superficial survey, even one limited to available data, is often sufficient.

RESOURCES

There are six biological survey staff based at the W.A.W.R.C. Three are employed in a professional capacity and three are employed as technical staff although all are professionally qualified:

N.L.McKenzie	-	zoologist	P3
G.J.Keighery	-	botanist	P2
A.H.Burbidge	-	zoologist/botanist	P2
L.J.Boscacci	-	zoologist	G II 1/2
J.J.Alford	-	botanist	G II 1/2
A.V.Danks	-	chemist/naturalist	G II 1/2

The above people comprise the core of two competent field teams that can operate simultaneously and so undertake major survey programs. A further person, A. Williams, is currently carrying out surveys under the direct supervision of the Planning Branch.

Considering the specific nature of the data required, six people are unlikely to be able to undertake enough surveys to provide for all wildlife conservation needs state-wide. W.A. has 23 natural districts most of which are about the size of the state of Victoria; there are in excess of 1400 conservation reserves plus nearly 2 000 000 ha of State Forest and Timber Reserve.

Our approach to this dilemma has been to adopt a strategy of survey capable of providing an overall species inventory, a description of patterning in the study-area, some measure of the sorts of changes occurring in the communities found across W.A.'s landscapes and a means of relating patterns in the biota to gradients (scalars) in the physical environment. At the same time, we propose to service the need for a selection of ad hoc surveys such as those needed before land is exchanged (eg. for rare species conservation), individual reserve acquisition opportunities, and immediate planning priorities both through our own involvement and through the employment and supervision of appropriate consultants.

N.McKenzie and G.Keighery focus on the district survey program to provide a site-specific survey data base of biophysical descriptors for W.A. and also advise and liase directly with other branches of C.A.L.M. and external organizations, in their areas of expertise (eg. plant identification for dieback research, Kemerton plan surveys, Fitzgerald River N.P. survey design).

N.McKenzie is responsible for the application of ecological concepts in the design of surveys, survey data bases, and in the analysis of survey data. Together with A. Danks, N.McKenzie also specializes in general zoological aspects of survey, particularly mammals and reptiles.

G. Keighery and J. Alford specialize in botanical aspects of survey including extensive liason with amateur organizations.

A.H. Burbidge and L. Boscacci form a biological team in their own right with particular responsibilities for ad hoc surveys, especially to co-operate with the Planning Branch and provide them with survey data on specific areas of land where there is an immediate need for management plans, primarily on conservation reserves.

Temporarily, A. Williams (GII 3/4) is undertaking a series of surveys at the direction of the Planning Branch. This is to allow the production of specific management plans for Forrestdale Lake and Woodman's Point. Planning Branch has proposed that his role in 1986 include compiling the results of the surveys of the islands north of Lancelin, Woodman's Point and Forrestdale Lake, and collating available data on the Albany to Eucla coastal strip and the Northern Forest Region.

As with all research staff at the W.A.W.R.C., survey people carry a 10% - 15% research obligation to areas of academic endeavour parallel to their field of responsibility and an additional 10% for public education, providing advice, internal administrative obligations (financial estimates, research reviews, purchasing), departmental files and committee work.

One major constraint on survey resources at present is the time consumed by the physical chores -- establishing the trapping structures used as a primary vertebrate sampling tool on quadrats and other logistical aspects of field-work such as the day-to-day maintenance of field equipment, loading vehicles, catering etc.

STRATEGY

Our current survey designs are based upon quadrat sampling and "assemblage-connectance" concepts. Such designs make it possible to readily combine the results of surveys in different areas to expand the total data base geographically and, by repeating the surveys in different seasons or diferent years, to expand the data base through time. They have been applied in our current program in the Western Australian Goldfields (Biol.Surv.Committee W.A. 1984, Rec.West.Aust.Mus.Suppl.No 18,1-15 and Nullarbor (McKenzie and Robinson in prep.). They are aimed at providing a data-base that:

(a) Is amenable to pattern analyses for the recognition of:

(i) biological gradients of change in species composition (both geographical and through time) by classifying and ordinating assemblages into groups according to similarities in their species composition and deriving the most suitable community domain boundaries for each of an array of different sorts of plant and animal groups. The correlation of these gradients with gradients in the physical environment (climatic etc) (Austin, Cunningham and Fleming 1984, Vegetatio 55, 11-27).

(ii) groups of organisms with related resource requirements whose species composition changes along the same physical gradients - by classifying species in terms of their fidelity to certain sorts of habitat to recognise groups of species that consistently occur together because they partition similar resources or, in the terminology of Paine (1980 p.682), they are "co-evolved modules within the community nexus".

These analyses provide an objective basis for land use decisions such as optimizing representativeness (Austin and Margules 1984, C.S.I.R.O. Div. Water Land Resour. Tech. Memo. 84/11) in reserve system design and in grouping reserves, community patches, or groups of organisms that have similar resource requirements (eg in terms of habitat parameters), for management planning. In study areas involving fragmented, truncated or patchy communities, these sorts of data also allow analysis of species richness and diversity in relation to habitat patch size.

Conservation strategies, both in reserve system design and manipulative management, must allow for the different temporal and spatial scales (mobility, longevity, foecundity) perceived by different groups of organisms (eg mammals,birds, and perennial plants). Noting that assemblages can be treated as sets of guilds (Adams 1985, J. Anim. Ecol. 54, 43-59) and that high connectance is found between species within a guild, there are still likely to be significant levels of connectance both between different guilds within an assemblage and between similar guilds at different assemblages. A guild often includes species with great differences in their geographic mobility (eg molossid bats cf.insectivorous lizards) and longevity (temporal mobility - Salmon Gum trees versus ephemeral plants). The characteristics of ephemeral plant assemblages are discussed by Grubb, Kelly & Mitchley (1982 Spec. Publ. No.1, British Ecol. Soc. - Blackwell: London). Examples are provided by my studies of the insect foraging guilds of bats in Kimberley mangrove stands (McKenzie & Rolfe 1986 J.Anim Ecol.55) which include very vagrant, mobile species such as *Chaerephon jobensis* whose populations are ubiquitous in the sub-region, as well as relatively sedentary species restricted to small territories and specialized habitat types (eg *Nyctophilis arnhemensis*). The causes of a decline in short-lived, resident species are likely to be identifiable locally and to be more recent (if not contemporary with the sampling) than they are for longer-lived species that have mobile populations (see the discussion on the "storage effect" by Warner & Chesson 1985, Am. Nat. 125, 769-787). Reserve-system design requirements are also going to be very different.

(b) Includes the sort of site-based survey data required for ecological monitoring, particularly monitoring the persistence of native species composition (and richness) in the communities typical of each of the 23 biogeographical districts currently recognised (Beard 1980 W.A.Herb Res.Notes No 3, 37-58) in W.A. Persistence of species composition through time indicates the persistence of complexity in ecological networks, and hence the continuation of natural processes, provided a wide-enough array of different sorts of organisms are included in the sampling (see Paine 1980). Our surveys need to provide the first and subsequent time-points for such ecological monitoring of the effects of ongoing natural processes as well as environmental disturbances. Disturbances of both natural and anthropogenic origin are ubiquitous throughout Western Australian communities; they range from community truncation or fragmentation (see Wilcox & Murphy 1980) in the W.A.Wheatbelt, to colonization by exotic species (eg *Carrichtera annua* on the Nullarbor and grasses in Wheatbelt reserves); they take a variety of forms ranging from press disturbances (such as pastoral usage, and predation by cats and foxes) to pulse disturbances. In the latter case, from predictable daily and seasonal climatic fluctuations to the usually unphased catastrophes such as wild fires.

METHODS

Survey Design Details

Site-based survey designs require data to be collected in the form of assemblages; sets of biophysical attributes arrayed at the same place at the same point in time. Each assemblage is described in terms of its set of attributes (the date that the site was sampled, site soil characters, species present, climatic attributes from BIOCLIM, geographic location etc). Certain sorts of attributes are recorded in association with a set of characters; for example each species is recorded in terms of its scientific name, the number of individuals detected, the plant stratum it occupied, its sex, age classes represented etc.

The number of assemblages sampled and their positioning within the study area is important. In practice, given a limit in the number of sites that can be sampled, stratified random sampling has proved to be most sucessful in providing representation of the biota in its various functional permutations.

A series of sample sites are positioned within each of the major surface types and vegetation units distinguished in the study area/s, on available maps, or by field reconnaissance. These units are a first approximation to community domain boundaries; a strategy of sampling along obvious biological and physical environmental gradients to optimise the ability of the data to distinguish the biophysical influences determining distributions of species during pattern analysis (Gillison 1983 in Myers, Margules & Musto, Survey Methods for Nature Conservation Vol. 2, CSIRO Div. Water & Land Resources, Canberra). Stratified sampling can induce patterns that are artifacts, so a predictive component, with ground-truthing, needs to be included in the analysis.

The number of sites sampled within each such unit depends on its areal contribution to the study area. Representation of the geographic extent of each unit recognised (whether it is patchy or continuous), the most likely direction of climatic and topographic gradients and patterning superimposed by widespread disturbances (eg fire) are all taken into account in positioning the sample sites within the land units. It is important that some of the sites (assemblages) sampled are replicated; both as adjacent quadrats in apparently homogeneous community-types and as geographically remote, but otherwise similar, replicates within the units discerned initially. Such replication provides a mechanism to assess:

(i) levels of similarity at different points within biophysical domains and,

(ii) the effectiveness of the applied sampling intensity and techniques in representing the assemblage actually present at each site (the extent to which chance influences the sampling results).

Sample-sites that represent localities thought to have special conservation significance (eg a rare species) need to be replicated because solitary records contribute no information to classification or ordination analyses of binary quadrat or species data.

Sampled sites should be small enough to:

(1) satisfy the assumption that there is syntopy between all biophysical attributes recorded from within it (that there is opportunity for connectance to influence the presence/absence of organisms included in the assemblage by the size of the sample-site) and,

(2) to allow the assumption that there is a reasonable level of internal homogeneity,

considering the mobility and longevity of, and the physical space occupied by, the organisms being sampled in the context of the density, productivity and standing biomass of the species comprising the biological component sampled in the assemblage. Our Goldfields quadrats were about 5 hectares and could have been 5 times larger. Those on the Nullarbor were about 300 hectares after allowance was made for patchiness.

A Hierarchy of Survey Designs

It is not always possible, or even necessary, to undertake a site-based survey to make land-use decisions. Without departing from the survey group's fundamental objective of providing a state-wide data base of assemblage information representing the diversity of W.A.'s natural communities at various time-points, a hierarchy of survey intensities can be discerned in the above methodology. Even the simplest of those described below will satisfy some short-term management plan requirements and, at the same time, contribute towards achieving the long-term objectives (see Fig. 1).

(a) MINIMUM SURVEY. The minimum biological survey is an extraction of information on a study area from existing geological, vegetation and climatic maps and, variably, an office research effort to list data on plants and animals known from the study area (from Museum and Herbarium records, from departmental files and by contacting people likely to be familiar with the area).

(b) RECONNAISSANCE SURVEY. Where no such maps are available at a scale sufficient to distinguish the study area, or to distinguish patterns within the study area, or where some additional documentation of dominant (or presence/absence of rare) species is required, a reconnaissance visit over a few or several days (depending on the study area size) can provide both:

(i) additional information for a management plan or to compare patches within the study area with similar patches in other areas for which management plans might already exist and,

(ii) a basis for stratifying the sampling in preparation for (future) site-based surveys.

(c) ASSEMBLAGE SURVEY. Where more detailed ecological data is required, there is no difference in effort between our contemporary site-based survey designs and the earlier land-unit based approaches to biological survey, except data collected by the earlier method lacks the levels of internal homogeneity required by data bases aimed at monitoring (measuring ecological change) and are not amenable to ordination and classification analyses in which equal loading is given to all species present at each site rather than to the presence/absence of eg. structurally dominant plants such as Salmon Gum trees. After all we are trying to conserve species richness. In both cases, intensity of survey effort can be variable depending on resources. At any given level of effort the assemblage-based approach provides much more information.

Logistical Aspects of Survey

Constraints on survey intensity are:

(1) Number of field specialists available.
(2) Time to compile field data.
(3) Number of taxonomists available.
(4) Publication/analysis expectations and availability of computer facilities.
(5) Time available - involvement in other projects, administration and advice commitments.
(6) The need for maintenance of field equipment eg. vehicles, traps,etc.

Time commitments for the various sorts of survey are set out below (but exclude days in lieu owing to technical staff for weekend field work, as well as constraint numbers 5 and 6 above):

MINIMUM SURVEYS - 2 days to 2 weeks - involve one day to two weeks of library, records, museum and herbarium research by a trained person and perhaps two days extra to compile the report and rough out draft maps of the area. An additional two days input by a botanist (1 day) and a zoologist to provide lists of likely species on the basis of distribution maps etc.

RECONNAISSANCE SURVEYS - 2 to 3 weeks - comprising 2 to 4 days for packing vehicles, organising food, obtaining maps etc., an average of 4 days travelling time, one to 10 days in the field (depending on the study area) by an experienced biologist and assistant, 4 to 7 days to identify common species such as structurally dominant plants. Two days to prepare a report. If the natural district in which the study area is sited has a formal data base (the Goldfields, Nullarbor and, in part, the Great Sandy Desert) a reconnaissance survey can provide sufficient data to classify the patch-types of concern.

ASSEMBLAGE SURVEYS - Surveys of this type vary in the effort required depending on:

(1) The extent of the study area,
(2) Its geological complexity,
(3) How rapidly climate and topography change along gradients,
(4) How many patches occur in the study area,
(5) How many sorts of attributes (soils, animal groups,vegetation groups) are included in the sampling,
(6) How good an estimate of internal homogeneity (eg. soil sampling) is required and,
(7) How many seasons need to be sampled (number of sampling events).

(1) to (3) determine the number of sample sites needed per patch.

There are two main sorts of assemblage survey:

(a) Vegetation Only, where quantified comparisons are required between study areas, though such surveys can also be undertaken for other groups as well, (eg. birds). Two people are required for three to seven weeks :

(1) 4 days for trip preparation: packing gear, arranging food etc; gathering background information (eg. maps) and designing survey.
(2) 2 to 4 days travelling.
(3) between 5 and 14 days of field sampling at 1 to 2 assemblages (quadrats) per day.
(4) 2 days to unpack vehicles and sort out the results.
(5) 3 weeks for specimen identification, updating data sheets, entering data into the computer and running a basic analysis of species similarities to compare the sites.
(6) 1 week to prepare the report, but not as a publication.

(b) Data-Base Surveys, for extending the survey data base. Plants, mammals, birds, reptiles (additional groups when possible, such as mygalomorph spiders), and soils are sampled. Soil descriptors are currently being re-appraised. Five assemblages (quadrats) are usually sampled simultaneously from one camp during a five day period. Sampling is carried out twice -- in different seasons (eg. in late spring and early winter). Two standard pit-fences are set per quadrat. A minimum of 3 specialist people as well as an assistant are required per camp, including 1 herpetologist/mammalogist, 1 botanist and 1 ornithologist. Soil sampling is probably best left to a consultant at present. Other design details (eg. quadrat replication) were discussed earlier (see also McKenzie & Robinson 1984, Nullarbor survey interim report). Other general needs include:

(1) Five days of logistical preparation for each team before each field-trip.
(2) A reconnaissance/quadrat selection and establishment trip is required in the case of a study area like the Nullarbor District. In that case it involved 6 people and lasted 6 weeks. For smaller study-areas involving only one or two camps, an extra 1.5 days per camp during the initial session of field-sampling is sufficient.
(3) About 1.5 days should be allowed for travelling between camps ; 5 days sampling at each camp.
(4) Two days for unloading vehicles at the end of the trip.
(5) Identification of specimens takes 4 to 5 weeks for major study-areas.
(6) Entering the data into a computer from data sheets took several months in the case of the Nullarbor survey.
(7) Report preparation as "descriptions only", if (6) is deferred, would take 3 to 4 weeks. However, when field data-loggers become available, steps (6) and (7) will be eliminated.

It seems that at least 10 camps will need to be surveyed across each of W.A.'s phytogeographic districts to characterize the district's major biological gradients and provide a data-base for future monitoring. In the Eastern Goldfields we sampled at 22 camps in each of 3 seasons. In the Nullarbor District we sampled 16 camps (82 quadrats) in each of 2 seasons, but only 8 camps were in W.A. - the Nullarbor is relatively uniform!

Of more limited geographical scope, but compatable with our data-base, are two surveys we are currently supervising: the Fitzgerald River National Park survey being undertaken by consultants to the F.R.N.P. Association, and the Kemerton survey being carried out by consultants to C.A.L.M. Other examples are current projects at Forrestdale Lake, Woodman's Point and at Toolina Cove.

The Eastern Goldfields sampling took 3 years and involved 2 teams (see B.S.C.W.A. 1984, Rec. W.A. Mus. Suppl. Ser. No. 18,1 - 15), though it was concurrent with other major projects. Write-up is estimated at 3 years full-time; no computers were used.

The Nullarbor survey, as a 75% effort by 4 people, took 23 months, although, during the 2 months of field sampling, 16 people were involved. It was semi-computerized : field-data were recorded onto paper data sheets that, after editing for consistency, were typed into a computer by the S.A. Department of Environment and Planning. Print-outs were then proof-read, etc. -- a very wastefull procedure that caused months of delay. Many of these delays will be avoided in future surveys; I estimate at least a 30% saving in time once the "Husky" micro-computers become available because they will remove the problems of:

(1) having to edit data sheets for consistency,
(2) having to enter the data into computer manually,
(3) needing to proof-read the entire data-set to remove the errors introduced while transcribing data-sheets into computer.

In addition, we now have a functional data-base with proven format and have selected and tried many of the analysis pathways appropriate to our needs.

Survey Research Requirements

A number of aspects of our current survey designs and methods need research and development. In particular, projects involving:

(1) more detailed analysis and follow-up research on our existing data bases. For example, how homogeneous were the quadrats we used on the Nullarbor and Goldfields and what changes in the conclusions do different levels of homogeneity imply? To what extent are the gradients perceived in the Nullarbor an artefact of the stratified sample design (see Wiens 1981)? Does the Nullarbor data base allow us to predict the presence of particular species or assemblage-types given the presence, at a

new site, of certain known physical descriptors (eg. soil, climatic or latitude/longitude) or of one or a few biotic attributes (eg. presence of a reptile species)? Should we be recording other physical attributes eg. soil drainage?

(ii) detailed appraisal of methodologies to improve their efficiency (eg. do our pit-fences need to have fences?).

(iii) improving rapid survey techniques (eg. the application of direct gradient surveys in W.A.).

(iv) fundamental concepts, eg. the association of biological attributes with contemporary physical attributes noting that the conditions under which a stand of trees germinated may no longer exist at a site, though the trees are still structural dominants. What are appropriate quadrat sizes for sampling a variety of biotic groups in syntopy and how do we establish optimimum size in each natural district; are our data-base surveys representing enough of the network to be sensitive to change or should we also record invertebrates and, if so, which ones?

PROGRAM

Staff Training and Write-up Obligations

An estimated three months is required in early 1986 for all survey staff to be trained in the use of microcomputers as data-base entry/analysis facilites and for data loggers. At the same time, software for data loggers needs to be developed and appropriate data-base designs re-evaluated.

N.McKenzie to write-up the Goldfields survey cell reports, the Buccaneer Archipelego Survey, the *Mormopterus* revision, the results of the Cocklebiddy/Toolina Cove re-sampling work and, in conjunction with A.Hopkins, the quadrat homogeneity work. Estimated duration: 1 year.

G.Keighery to write-up the Stirling Range vegetation survey. Estimated duration: 6 months. He also has an on-going commitment to the South-coast dieback project.

A.H.Burbidge has obligations to write-up further aspects of his Regent Parrot work relevant to nest tree characterization and its management implications.

Surveys

(1) Darling District

--- A.H.Burbidge is considering a proposal to organize a survey of the Whicher Range in the central forest regon in liason with appropriate CALM regional staff.
--- Survey group to establish monitoring sites on the W.A. Wildlife Research Centre reserve.

--- G.Keighery proposes to undertake vegetation surveys in the Dryandra State Forest. ?Data Base Survey in conjunction with A.H.Burbidge.

--- A.H.Burbidge to continue survey work on the Beekeepers Reserve near Cervantes.

(2) Eucla District

--- N.McKenzie and G.Keighery to undertake a survey of ten "assemblage prediction" quadrats (2 camps) on the Nullarbor during late September 1986.

(3) Eyre District

--- N.McKenzie and G.Keighery to undertake a reconnaissance of the Cape Arid area in early October 1986 for sample-site selection for field-sampling in early April 1987 and late September 1987. This survey is to link the Goldfields, the Fitzgerald River Nat.Park and the Nullarbor Data Bases, and to provide some pre-dieback descriptions and establish a formal monitoring program.

(4) Irwin and Carnarvon Districts

--- N.McKenzie to design a district survey of the Irwin and southern half of the Carnarvon Districts. Sample-sites are to be selected (and marked) in conjunction with G.Keighery in late October 1986 then established by the operations branch of CALM (I propose) during November and December 1986 under the supervision of A.Danks. Two, three week sessions of sampling will be undertaken in 1987 by the entire survey group as a data-base survey; the first in late May and the second in late October 1987. There will be a need to involve some consultants and internal or external funding (from A.N.P.W.S. and/or similar sources) will be sought.

(5) Avon/Austin Districts

--- A.H.Burbidge proposes to undertake a 'reconnaissance survey' of vacant Crown land in the Shire of Perenjori in 1986 for two weeks.

Flexibility

The above program needs to leave a proportion of time available to meet unexpected contingencies. A recent example was the need to appraise the conservation value of the previously forfeited Virginia Pastoral Lease prior to it again being released to the pastoral industry. The urgent need for a detailed biological survey where a reserve is to be explored for minerals provides another example.

Consultancy Obligations.

A number of the more immediate consultancy needs we perceive at present are listed below but many additional survey demands are expected to emerge during the next 12 months; a proportion of these will need to be serviced by consultants under our supervision. Appropriate funds will need to accompany requests for such surveys.

1. Goldfields - completion of the cell reports by the consultant botanists.
2. Entry of the Goldfields data-base into computer.
3. Bring Lee Belbin of C.S.I.R.O. Division of Water and Land Resources across from Canberra in March 1986 to present a user-orientated workshop on N.T.P., the computer package we currently use to analyse our biological survey data-base. At the same time he will establish the package for use in W.A. through Dr G. Beeston of the Dept. of Conservation and Environment.
4. Soil drainage characteristics of W.A. Nullarbor sample sites.
5. Re-survey of Kemerton area in late-February 1986.
6. (Indirect) involvement in Fitzgerald River N.P. continuing during 1986-1987.
7. Preparation of illustrations and maps for "Field Guide to the Plants of the Stirling Ranges".
8. A.Baynes to undertake a compilation of available data on the late-Holocene mammal fauna of the Irwin and Carnarvon Districts.
9. Preparation of historical vegetation maps for Dryandra Forest from ex-Forests Department files.
10. J.Rolfe to measure the morphological foraging niches of Pilbara bats - 2 weeks - and prepare the Nullarbor reptile collection and other miscellaneous spirit specimens held by the W.A.W.R.C. so they can be registered in the W.A.Museum collection.
11. A.Baynes to undertake a compilation of available material representing the late-Holocene mammal fauna of the Fitzgerald and Cape Arid areas.
12. Four weeks work by T.Postle (@ $400/week) to undertake an insect survey, in conjunction with J.Mager (W.A.I.T.), on the "predicted" Nullarbour quadrats:- to assess the feasibility of including certain invertebrate groups in our surveys by measuring their heterogeneity within our quadrat-sizes using an appropriate sampling design (e.g. sub-plots or transects). (Preliminary discussions already held for field-work in mid-1986 - see survey program above).

Survey Research and Development 1986-1987

(1) Alternative drift-fence designs - such a study is being carried out by A.H.Burbidge and L.Boscacci on an area needing survey near Cervantes (see survey program above).

- a consultant to the F.R.N.P.Association (A.Chapman) is comparing arrays of un-fenced pit-traps with our standard 50m pit-fences as part of his vertebrate survey of that Park. He currently has data from 20 quadrats sampled by each strategy.

- Dr G.Friend (W.A.W.R.C.) is comparing the reptiles captured by various pit-fence designs in a study area on the research centre reserve at Woodvale.

(2) Appropriate scales for reptile quadrats (in co-operation with Gordon Friend).

(3) Predictive ability and circularity of sampling results in the Nullarbor data base (see survey program above).

(4) Mobility - patch-size relationship in insectivorous bats.

(5) Heterogeneity of insect communities within and between our vertebrate/flora quadrats by sampling selected groups that are easily sampled, well known taxonomically, and of interest to locally available biologists:
 a. Mygalomorphs.
 b. Ants.
 c. Cockroaches.
 d. Hemiptera.
 e. ?Diptera.

 Bill Humphries (W.A.Museum) did a considerable amount of invertebrate sampling from quadrats during the Eastern Goldfields survey. He is currently appraising his results.

 We collected mygalomorph spiders during our recent survey of the Toolina Cove and Cocklebiddy quadrats; these are currently being identified.

(6) Drainage characteristics of soils -- A.Danks to undertake training in this area.

(7) Floristic heterogeneity of Nullarbor quadrats (with A. Hopkins and G.Keighery.

NEXT STEP

The next stage in the development of this manuscript is to discuss the expectations of the Planning Branch in relation to the priorities and objectives recognised by the biological survey group.

ACKNOWLEDGEMENTS

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TO JOHN W[illegible]
FROM NORM McKENZIE

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BIOLOGICAL SURVEY IN RELATION TO CONSERVATION

- especially its interface with management needs

You are invited to a workshop that will be held on Tuesday 29 April 1986 from 0900 - 1200 hrs at the Wildlife Research Centre Seminar Room. The purpose of the workshop is to discuss the objectives and strategies of the Biological Survey Research Unit at the W.A.W.R.C.

The background papers attached provide details of our program and the development of our current views on the subject. In brief, the aim is to develop and implement techniques for State-wide, broad-scale description of the composition and patterning of biota. The data contributes to management planning in the following areas:

selection { i) (1) Protection of the biota (e.g. reserve system design at the state-wide scale).

ii) (3) Logistical management (locating firebreaks, areas in reserves where people access should be controlled).

iii) (4) Identifying management problems (identification of species and communities that are rare or threatened).

iv) (2) Monitoring richness and composition of biota at a regional level. (Trends of change)

Dirty data or assemblage survey

The workshop will be in two parts:-

0900 - 1000 hrs

N.L. McKenzie will present an overview of the unit's biological survey activities (where, how and why). Greg Keighery and Allan Burbidge will briefly outline examples of some recent work.

Morning tea will follow (1000 - 1020 hrs).

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1020 - 1200 hrs

N.L. McKenzie will convene discussion on a set of specific questions:

1. Does CALM need to address all four of the management issues listed above? Where are the priorities in these four and are there other issues of even greater priority here?

2. Is the site-specific sampling strategy adopted by the W.A.W.R.C. Biological Survey Research unit scientifically valid and worthwhile as a program in the context of other W.A.W.R.C. (and CALM) research projects? For example:

   - is our approach to reserve system design valid and the best possible, and is a program of reserve acquisition still needed in all parts of Western Australia?

   - will a data-base as geographically tenuous as ours be a useful basis for monitoring long-term trends in the biota? If not, should we abandon it or direct more resources to improve its quality? In any case, is such monitoring needed to guide specific environmental manipulations/experimentation by managers or to assess the effects of their absence?

3. Are there better research techniques for addressing the above issues? Should they replace our approach or are they more specific and do they complement it? Noting that ours is the only broad-scale program being carried out in W.A.:

   - Should we focus on fewer sorts of organisms; in fact, should we adopt an autecological approach based on a few "indicator" species? Is this already done by other programs at the W.A.W.R.C.?
   - Should be confine our work to certain parts of the state (e.g. South-west Land Division) or even to a selection of small study areas in a partiuclar set of community-types.

4. How much flexibility should there be in our program? Should the third level in our hierarchy of surveys (see Fig. 1 in Attachment 1) dominate our field program? What percentage of the Biological Survey Research Unit's time should be spent documenting e.g. vegetation structural patterns on particular reserves to satisfy immediate needs for logistical management in plans? Indeed, should this be the role of a survey operations group (? Survey Operations) rather than a biological survey research unit? Perhaps it should be done by consultants.

If you believe additional questions should be discussed or if you have any queries on the workshop, please contact N.L. McKenzie on 405 1555.

We are trying to keep numbers down so this is a personal, not a general invitation.

DR ANDREW A. BURBIDGE
Principal Research Officer (Wildlife)

April 9, 1986

(1) Barry Wilson

(2) John Blyth

(3) Kevin McNamara