GEOCRINIA RECOVERY TEAM

ANNUAL REPORT
1998

Project # 175

BY

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GEOCRINIA RECOVERY TEAM

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Summary
1998 was again a busy year for the Geocrinia Recovery Team. Major achievements included the: discovery of 4 new populations of G.alba and the completion of an additional 4900 m of conservation fencing on private property, bringing to approximately 13 km the total length of riparian fencing on private property built by the team since 1994. The completion by Simon Conroy of his PHd fieldwork and his interim results with regard to eggmass and metamorph survival provide hope towards the success of future translocations.

The major disappointment during the year was the postponement of the experimental translocation of G.vitellina egg masses. The opportunity to apply the techniques developed by Conroy and the loss of opportunity to transfer the skills and knowledge developed over the past 3 years to CALMScience staff who will be involved in future translocations will add an additional challenge to the team.

The continual decline in the small sized populations of G.alba and a deficiency in our understanding of the causal factors has become the primary concern for the team. Future research work will need to be directed to identifying these factors and developing strategies to managed them. Additionally it is uncertain if the recently discovered Chytrid fungus presents a threat to these species, monitoring of this situation will be required over the next few years.

Major goals for 1999 will be:
1) Undertake an experimental translocation of G.vitellina.
2) Research and analyse of the characteristics of the small sized and recently declined G.alba with the aim of determining some commonality between these sites which may contribute to their decline.
3) Complete the review and commence implementation of the fire management strategies for all sites.
4) Continue the population and fire ecology monitoring programs.
5) Develop appropriate weed control techniques for use within the conservation fencing program.
6) Continue the pig control program.

Introduction

During 1998 , the Geocrinia Recovery Team's seventh year of operation, the focus of the team was on ascertaining the impact of the last years fire on the G.vitellina populations contained in the Spearwood Creek System and consolidation of the annual population monitoring program. Further additions to the conservation fencing program, noted in the 1997 annual report were completed during 1998, as was the implementation of a number of fire protection measures in and around the Spearwood Creek populations.

Recovery team meetings were held in July and December. The December meeting coinciding with a special workshop to report on research and operational findings to date and to identify future research and operational priorities. (Summary notes attached: Appendix 3)

As reported in the 1997 Annual Report the major goals for 1998 were to be:
1) Completion of the conservation fencing on location 2718.
2) Continuation the population and fire ecology monitoring programs.
3) Enhancing the pig control program with particular attention given to the G.vitellina sites.
4) Review the pre and post fire management strategies of all sites.
5) Prepare operational guidelines for field translocation techniques
6) Continue with implementation of the communications plan.

I am pleased to report that items 1, 2, 3 and 5 were achieved during the year. Item 4 has commenced and a number of field actions have been implemented, but it is not expected to complete the review of all sites until mid 1999. Small gains were made with Item 6.

Team Membership

Team membership has remained relatively stable through the year with only one addition: Adrian Wayne a forest ecologist from the CALMScience section in Manjimup joins the team filling the research vacancy created when Grant Wardell-Johnson resigned from the team and department late in1996.

Team Membership as at December 1998 comprised of:

Andrew Burbidge	Director WATSCU	CALM – NatCons Div
Kim Williams	Rgnl. Nature Conservation Officer	CALM - Regional Office
Roger Banks	District Manager	CALM - District Office
Greg Voigt	Dist. Nature Conservation Officer	CALM - District Office
Adrian Wayne	Forest Ecologist	CALM - CALMScience
Dale Roberts	Zoologist	UWA - Zoology Dept.
Simon Conroy	PhD Student	UWA - Zoology Dept.
Jack Stannard	Shire Ranger	Augusta/Marg River Shire
Sue Prater	Councillor	Augusta/Marg River Shire
Lyn Serventy	Community Representative	Leeuwin Conservation Group

Recovery Plan - Annual Report on Scope Items

Geocrinia vitellina

3.1.1 Survey of Riparian Habitat

A number of creek systems to the east and south of the Spearwood Creek Complex were searched this year to confirm the presence or absence of populations of G.vitellina. This work replicated the original riparian habitat survey work undertaken at the commencement of the recovery plan in the 1992-94 period on the basis that in the 4-6 years between surveys any subadult populations of G.vitellina which may have been present but not calling in the original survey should have matured into active breeding populations in this time.

The 1998 surveys targetted riparian habitat with outwardly similar attributes to the known sites, with special attention being directed to "junction zones" along the length of the creeks. Additionally preliminary assessment of the suitabilty of these systems as potential translocation sites was undertaken. No new populations of G.vitellina were discovered as a result of these surveys.

3.1.2 Land Mangement and Tenure

This action was completed in 1994

3.1.3 Fire Management and Research

Following the fire at Spearwood Creek in September 1997 a review of fire management strategies for all vitellina and alba sites was commenced during the year. Though not due for completion untill mid 1999, a number of actions have already been implemented. Specifically access within the western side of the Spearwood Creek burn exclusion zone has been improved with the construction of 2.3 km of firebreak running parallel to the riparian habitat and small east-west firebreaks separating the burnt from the unburnt habitat have been installed. (See Map 1) A parallel break protecting the GV2 population immediately to the south of spearwood creek has also been constructed. Existing old logging tracks to the north of Denny Road will be upgraded and an assessment of the need to construct additional water points to protect the unburnt GV1A site will undertaken under dry soil conditions in the first few months of 1999.
When completed these measures will greatly assist both suppression and fire management activites in this area to minimise the re-occurrence of a September 1997 type fire.

3.1.4 Habitat Protection

Pig Control

The pig control program using volunteer pig hunters was maintained during the year. Through a combination of trapping and hunting 28 pigs were destroyed from the Blackwood River area near the general locality of the G. vitellina sites, though no pig disturbance was recorded at the actual sites. A total of 213 pigs have been destroyed under the banner of the Recovery Team during the 1994 – 1998 period. Following on from the fire in the Spearwood Creek Complex last September the team was concerned that a potential increase in pig activity over the summer months may occur. To compensate, an increase in the number of patrols and the placement of traps closer to the G.vitellina sites was implemented. These actions appear to have been successful with no evidence of pig activity within the burnt areas being recorded.

3.1.5 Wider Community participation

Refer to this heading for G.alba

3.1.6 Population Monitoring

Ten Geocrinia vitellina sites were monitored during the year using both point and transect counts.

All populations were present, although for two sites (GV1b and GV1d) numbers of calling males were reduced following last years fire.

The extension of the Hutt Pool population (GV3) west across Great North Road was again comfirmed this year. This population (GV3b) which was first recorded in 1997 increased in size from 5 to 15 calling males in the 1997-98 period. The GV4a monitoring transect was relocated approximately 100m upstream to accommodate the gradual movement of the population over the last 4 years away from the original monitoring site.

The 1998 monitoring data has been entered into the Team's databases and first drafts of updated maps showing monitoring sites and species distribution have been produced. GPS's in conjunction with field maps were again used to improve the locational data for all of the Geocrinia vitellina sites and all G. alba sites surveyed this year.

The recent confirmation of the presence of Chytrid fungus in the outer metropolitan areas of Perth prompted the introduction of hygiene measures to all vehicles and equipment used in this years monitoring program. Though it is believed the threat from this fungus to both species of Geocrinia will be minimal, a precautionary approach is being adopted.

3.1.7 Genetic Studies

This action was completed in 1994

3.1.8 Translocations

A proposal to undertake an experimental translocation of G.vitellina egg masses from the Spearwood Creek Complex to suitable sites in creek systems to the east was approved by CALM's Director of Nature Conservation in September. Specifically the proposal sought to create two new populations of orange-bellied frogs and undertake an eight year monitoring program to determine the success of the action. (copy attached: Appendix 2) Unfortunately the translocation did not proceed due to the limited availability of key staff. The intention is to proceed with the program next year.

Geocrinia alba

3.2.1 Survey of Riparian Habitat

This action was completed in 1994.

3.2.2 Land Tenure and Management

Following the unsuccessful attempt in 1997 to secure NHT funding for the part purchase of location 83, no further action on this matter has been taken.

3.2.3 Fire Management and Research

See item 2.2.3

3.2.4 Habitat Protection, Conservation Fencing

The construction of a conservation fence on location 2718 was completed early in the year. This 4900m fence is the longest the team has constructed and encloses approximately 16.7 ha of riparian vegetation and 5 populations of G.alba.

An inspection of the condition of the all 13 kms of conservation fences was undertaken during the year. All were found to be in relatively sound condition, however repairs resulting from windthrown trees and restraining of a small section washed out across a creek crossing were required on two locations.

Pasture grass encroachment and eucalypt regrowth along a number of the fences is starting to need attention. Weed control within the fenced areas will be undertaken over the summer months as water levels within the creeks recede and machinery is able to gain access. Advice is being sought from researchers at Curtin University as to the selection of suitable herbicide and application details to minimise any impact on the populations arising from herbicide use.

3.2.5 Public Information and Land-owner participation

Further copies of the Geocrinia Recovery Plan and the Farmers Kit were circulated to absentee landholders with frog populations who did not receive a kit in 1997.

All landholders were offered the opportunity of accompanying team members during the monitoring of the G. alba populations on their properties, however unlike previous years no offers were taken up. Responses to a number of media enquiries concerning general frog issues and decline were made during the year.

3.2.6 Population Monitoring

The targets for the 1998 monitoring program included: sites which were not monitored in 1997, all sites which exhibited a decline in 1997 compared to the 1994 dataset, all sites being worked on by our PHd student but who's exact location had not been accurately mapped, and a selection of transect sites. Results were :

- Fifty Seven Geocrinia alba sites were monitored during the year, 42 sites had calling animals, 15 sites had no calling males.
- Four sites which had animals calling in 1997 did not have any calling males in 1998,
- Seven sites recorded an increase in the number of calling animals in 1998 compared to 1997.
- Four new sites were located in 1998, in areas which were previously searched 1992-1994.
- All other sites were recorded as having the number of calling males at similar or slightly reduced figures compared to the 1994 survey.

In general the trend of the previous years remains unchanged; that being the small size populations continue to decline, medium size populations fluctuate and large sized populations remain stable.

3.2.7 Genetic Studies

This action was completed in 1994

3.2.8 Translocations

Refer to item 2.2.8

Conclusion

1998 marked the end of the second phase of the Geocrinia Recovery Plan with the completion of research into the eggmass and metamorph survival and its application to future translocations, and the construction of what is likely to be the last significant addition to the conservation fencing program. A workshop to identify future research and operational directions for the team was held in mid December, its outcomes reinforcing the urgency to identify factors and mechanisms contributing to the decline of small G.alba populations. On a positive note there has been no further loss of frog habitat from fire events during the year.

Attachments:
Appendices 1, 2, 3
Map 1

Appendix 1

Progress Report – Research Activities

Simon Conroy

The "Geocrinia Recovery Team UWA Research Contract" expired on June 30, 1998, before the start of the 1998 *Geocrinia* breeding season. This report details not only progress up to that date, but also activities undertaken during the 1998 *Geocrinia* breeding season.

During early 1997 I completed the collection of data on nest mortalities. The data collected on *Geocrinia alba* and *G. vitellina* now represents one of the most detailed and thorough data sets compiled on the survival of pre-metamorphic anurans. Preliminary analysis indicates that these species have unusually low survival for direct developing anurans, although the number of investigations with which to do comparisons is very small.

A Department of CALM fuel reduction fire in late October jumped the prescribed boundaries and burnt through several of my field sites in an area designated for fire exclusion. This has had a serious impact on the analysis of this work and will be touched upon below. The fire also necessitated field work during the 1998 breeding season (after the expiry of the Geocrinia Recovery Team UWA research contract) in order to gain some measure of the influence of the fire on the survival of animals, a task which the Department of CALM was apparently unwilling to perform or to fund. The pattern of the burn (through my sites) precludes statistical analysis, but in spite of this the data on the influence of the fire are compelling and suggest that populations burnt in the fire have been severely reduced.

Following the 1998 breeding season, the mark recapture data span 6 years for some sites and 7 years for others. Preliminary analyses of these data suggest that while small populations of these species are able to grow at a relatively rapid rate in some instances, the overall picture is one of growth rate being constantly checked by environmental perturbations (both natural and human-induced). Because only a small proportion of the adult population survive beyond their first reproductive year, recruitment plays an important role in population regulation. Limited recruitment in even a single year can seriously reduce population numbers. In the absence of a sustained period of growth (resulting from a stable and beneficial environment), many of the *G. alba* populations are probably unable to grow beyond a 'minimum viable size' (that is, one which renders them relatively immune from extinction due to chance events).

Finally, during the 1998 field season I was able to obtain reliable estimates for survival from metamorphosis to maturity by recapturing frogs marked and released as metamorphs. I now have estimates from 8 sites for 2 different cohorts. This represents a major step forward and the low variance among the estimates suggests that the estimates are accurate. To the best of my knowledge this is only the second time that such data have been collected for anurans.

Appendix 2

TRANSLOCATION PROPOSAL

ORANGE-BELLIED FROG (*GEOCRINIA VITELLINA*) FROM SPEARWOOD CREEK TO NEARBY SITES

1. SUMMARY

This proposal is to create, by introduction, two new populations of the orange-bellied frog, Geocrinia vitellina. These new populations will act as insurance against catastrophic loss of the restricted set of known populations of this species. G.vitellina has a range of 6.3 km2 with an area of suitable habitat less than 20 ha. Most of the range of this species was burnt by wildfire in 1997.
Specific actions will include:
1) introduction of egg masses to two creek systems north of the Blackwood River and east of the current range.
2) eight year monitoring of introduction sites to determine whether populations establish.

2. NAME AND AFFILIATION OF PROPONENTS

Simon Conroy and Dale Roberts, Zoology Department, The University of Western Australia, and Adrian Wayne and Ian Wheeler,CALM on behalf of the Geocrinia Recovery Team.

3. BACKGROUND

The Orange-bellied Frog (*Geocrinia vitellina*) has the smallest known Extent of Occurrence (6.3 km^2) and Area of Occupancy (*ca* 20 ha) of any known vertebrate on the mainland of Australia. The species is listed as threatened fauna in Western Australia pursuant to the WA *Wildlife Conservation Act 1950* and ranked by the WA Threatened Species Scientific Committee as Vulnerable. It is also listed as Vulnerable in the Commonwealth *Endangered Species Protection Act 1992.*

The Orange-bellied Frog, together with the White-bellied Frog *Geocrinia alba*, is being managed via an approved Recovery Plan, the implementation of which is coordinated by the Geocrinia Recovery Team. The Recovery Plan describes what was known about the speciesí biology and ecology in 1994. New relevant information is provided below.

Recovery Action 3.1.7 of the Recovery Plan covers translocations and prescribes that translocations take place from Spearwood Creek to two nearby creek systems to the east of Spearwood Creek and to the north of the Blackwood River as an experiment to determine the feasibility of egg-mass translocation. The Recovery Team will investigate other creek systems south of the Blackwood River and proposes to translocate to some of these if suitable habitat is found.

Initially, the Recovery Team arranged for experimental captive breeding of the closely related *Geocrinia rosea* at Melbourne Zoo, with the aim of translocating adult, captive-bred frogs. Although this work had some success, the colony was lost due to ant infestation.

More recently, temporary translocations of egg-masses of the Orange-bellied Frog as part of experiments to determine nest site specificity have proven successful. These temporary translocations were carried out within the current distribution of the species, but indicated that appropriate conditions for embryonic and larval development were unlikely to be limiting. This work has demonstrated that translocation of egg-masses is feasible and is likely to be simpler and cheaper than translocation of captive-bred adults. Furthermore, recent evidence indicates that adult males may establish burrows little more than a few metres from the nest out of which they metamorphosed. If this is the case then translocation of egg-masses may also provide better results than translocation of captive bred adults.

4. THE TRANSLOCATION

This proposed translocation is an introduction, not a re-introduction. CALM Policy Statement No 29 *Translocation of threatened flora and fauna* lays down guidelines for introductions. Relevant sections are:

> ìBecause of the possible negative impact of introductions on the balance of natural systems, introductions should be considered only where there are exceptionally strong conservation reasons for so doing and where it has been demonstrated that the impact of the introduced species is unlikely to be significant. As a general principle, introductions will not be approved if opportunities for re-introductions exist.î

Introduction of Orange-bellied Frogs to creek systems near their current habitat is proposed for the following reasons:

1. Re-introductions are not possible ñ the total known range of the species is currently occupied. It is possible, even likely, that the species occupied a larger area in the recent past and has become locally extinct through frequent fire. Research has revealed that movements between sites is highly unlikely.

2. The extremely restricted Extent of Occurrence and Area of Occupancy means that the species is vulnerable to events such as repeated unplanned fire and pollution. Research on fire ecology of *Geocrinia* species indicates that fire intervals of 10 to 12 years may maximise population numbers for this species. Fuel loadings become high in this area after about five years. Translocation to sites south of the Blackwood River will, if successful, establish populations in an area some distance from Spearwood Creek. A single wildfire is unlikely to affect both areas simultaneously.

3. Habitats in the creek systems near Spearwood Creek are very similar to habitat occupied by the Orange-bellied Frog and the introduction of frogs to them is unlikely to have any negative impact.

4. The very restricted distribution of the species means that there are exceptionally high nature conservation reasons for the proposed introduction. In addition, translocations of the closely related White-bellied Frog will be necessary in the future to re-establish populations that have already or will become locally extinct. The proposed translocation of Orange-bellied Frogs will provide techniques that can be used for future reintroductions or translocations of white-bellied frogs.

Source of animals for translocation. Egg-masses will be taken from ëGeo Creekí, a tributary of Spearwood Creek, and from Spearwood Creek, north of Denny Rd. Geo Creek has one of the largest populations and the highest known densities of Orange-bellied Frogs. Spearwood Creek has a number of large populations. Egg masses will be taken from north of Denny Rd to avoid areas affected by fire in 1997 where egg removal might impact on population recovery

Number, age and sex of animals to be translocated. A minimum of 20 egg-masses (8 to 20 eggs per mass: mean = 11)) will be translocated. Sexing embryos or larvae is not possible. Egg-masses will be moved from Geo Creek and Spearwood Creek to 2 translocation sites in the Adelaide Creek system or thte first un-named creek immediately east of Adelaide creek intercepting Denny Road. Specific transplant sites will be chosen after consultation with CALM personnel, Conroy and Roberts. Exact sites will depend on soil moisture and litter and vegetation cover.

Conservation genetics. Studies by Driscoll (1998) showed significant genetic structuring amongst populations of *G. vitellina*.. The four eastern populations from Crinia, Geo and Spearwood (north and south) Creeks clustered closest of all seven populations compared. Crinia Creek differed from the other three eastern sites due to the absence of the "*b*" allele at *Me-1* locus and in having a very high frequency of the "b" allele for *Gpi*. Spearwood North and Geo Creek did not differ significantly in allele frequencies at *Me-1* but there was a significant difference at the *Gpi* locus. The absolute genetic differences between Spearwood North, Spearwood South and Geo are small. Mixing of eggs from Geo and Spearwood North represent the minimum possible genetic disturbance

Transport. Egg-masses will be collected by Simon Conroy and **J Dale Roberts** using a corer and will be transported to new sites within the corer to minimise disturbance. CALM personnel may assist. One to four

hours will elapse between collection and deposition. The nest locations at introduction siteswill be selected by Simon Conroy. No prior preparation of sites is necessary as there are no identifibale threats to egg survival that can be managed. Egg masses will be transplanted between October 31 and December 20, 1998.

Monitoring. Two levels of monitoring are planned:
1) eggs masses wqill be followed through until hatching and egg survival monitored. Egg clutches will be monitored on a fortnightly basis.
2) sites wil be monitored for eight years to detect successful recruitment of calling males and egg deposition. Eight years is chosen as males can mature at a minimum age of two years but delay maturity to three or four years old (Driscoll 1996). Eight years will cover two generations giving time to assess initial establishment and.subsequent growth.
3) all monitoring will be conducted by CALM staff (Adrian Wayne and Ian Wheeler)

5. FUNDING

Funding for all operational costs of the translocation will be provided by CALM from the Environment Australia, Endangered Species Program, Orange-bellied and White-bellied Frog Recovery. CALM staff costs will be met CALM.

6) ENDORSEMENTS

7) ANIMAL ETHICS EXPERIMENTATION COMMITTEE APPROVAL

An application to vary the current ACE approval has been made to the UWA ACE.

8. REFERENCES

Wardell-Johnson,, G., Roberts, J.D., Driscoll, D and Williams, K. (1995). Orange-bellied and White-bellied Frogs Recovery Plan. Wildlife Management Program No. 19. Department of Conservation and Land Management, Perth.

Driscoll, D. A. 1996. Understanding the metapopulation structure of frogs in the *Geocrinia rosea* complex throuhg population genetics and population biology: implications for conservation and evolution. Unpublished Ph D thesis, Department of Zoology, University of Western Australia.

Driscoll, D. A. 1998. Genetic structure, metapopulation processes and evolution influence the conservation strategies for two endangered frog species. Biological Conservation 83, 43-54.

ATTACHMENTS

Orange-bellied and White-bellied Frogs Recovery Plan.

Appendix 3

WORKSHOP ON TWO THREATENED WESTERN AUSTRALIAN FROGS – WHITE-BELLIED FROG *GEOCRINIA ALBA* AND ORANGE-BELLIED FROG *GEOCRINIA VITELLINA*

CALM Wildlife Research Centre, Wildlife Place, Woodvale,
15 December, 1998, 9 AM

SUMMARY OF ISSUES

BIOLOGY AND ECOLOGY OF GEOCRINIAS – Dr J. Dale Roberts and Mr Simon Conroy, UWA Zoology Department.

1. There are four WA species of *Geocrinia* – *G. rosea*, *G. lutea*, *G. alba* and *G. vitellina*. There may be two species within what is currently understood as *G. rosea*. *G. alba* and *G. vitellina* are very distinct species, not colour morphs of the same taxon.
2. All Geocrinias have the same basic breeding biology – they have direct egg development with no free feeding tadpole stage. The tadpoles develop within the egg and depend on the yolk for food - this means that there is no potential for tadpole dispersal. Males dig burrows from which they call to attract a mate. The female lays the egg mass in the burrow and the male them moves a short distance, digs another burrow and tries to attract another female. Sex ratio is probably 1:1.
3. There are extremely large genetic differences between populations of all WA *Geocrinia* species – in fact they have the most genetically subdivided populations of any frogs in the world. Genetic studies indicate a long term pattern of population contraction and expansion. There is no evidence of significant adult or juvenile dispersal – most recaptures are within 20 m of the first capture point and the maximum movement recorded is about 50 m.
4. Both taxa have very small distributions. *G. vitellina* has an area of occupancy of approximately 5 ha – this is the smallest of any Australian mainland vertebrate and smaller than most threatened plants. *G. alba* is largely restricted to two creek systems within which there appears to be many suitable sites where it is absent.
5. Both species live in a highly specialised habitat – swampy flats on the edge of creeks. They do not occur in open water.
6. *G. alba* occurs mostly on private land and more than 70% of its range has been cleared. Most *G. alba* populations are small with less than 20 calling males. Since work commenced (1983) there have been many local population extinctions. Extinctions are more likely if the adjacent land has been cleared, but have also occurred in natural areas. Extinctions have happened on publicly-owned and privately-owned land.
7. All G. vitellina sites are within State forest and there have been no significant declines or local extinctions (but see point 9).
8. Fire research (mostly carried out on *G. rosea*) indicates that hot fires have significant long term effects on populations, possibly causing local extinctions. Cool, early spring fires have little effect on adult males or on egg masses, but do affect females and recruits, which are not in burrows. Post-fire monitoring data (incomplete) show a 30% population decline after a cool fire with a slow recovery and indicate that there should be 8-10 years between cool spring fires.
9. The September 1997 fire that affected the largest *G. vitellina* population has resulted in a major decline in calling males. Where there was >100 calling males there are now two. Another population not affected by the fire continues to increase in size.
10. Population extinction of small *G. alba* populations in the absence of hot fire may be due to loss of genetic diversity (inbreeding) or to stochastic events (chance) due to small size.
11. There is no indication that the chytrid fungus possibly implicated in frog declines in eastern Australia is causing the declines in *G. alba*.

RECOVERY PLAN IMPLEMENTATION - Kim Williams, CALM

The Recovery Plan was drafted in 1992 and published in 1995. Recovery Team members come from UWA Zoology, The Shire of Augusta - Margaret River, the Leeuwin Conservation Group, Environment Australia and CALM. A local LCDC was represented but the member resigned and has not been replaced. CALMScience has not had a member since 1996.

Major actions that have been implemented (apart from research actions discussed above) include:

1. Fencing of stream zones on private land. Voluntary agreements with landholders have resulted in 13 km of fencing being constructed at a cost of about $75,000. Ongoing maintenance means that yearly work is required. Farmers with fences are happy with the result but are not willing to advertise the fact that they are helping the frogs.
2. Pig control. Arrangements with a CALM Volunteers have ensured that pigs are controlled in the general area of *G. vitellina* populations. There has been no damage to frog habitat. This has cost about $3,500 over five years.
3. Population monitoring. Region and District staff have committed an increasing amount of time to this over the past two years and a reasonable quality database of sites and population size now exists.
4. Communication. All private property owners with *G. alba* populations have been given 'Frog Recovery Kits' that provide information about the frog and advice on land management issues, eg, fire and chemicals. A tape recording of frog calls is included. While there is interest in the Recovery Plan from local conservation groups there has been little opportunity for them to become involved in actual work and landholders are reluctant to let them onto their properties.
5. Translocations. Data on survival of eggs and recruits indicates that large numbers of egg masses or juveniles must be introduced to an area to have any real chance of establishment. Data indicate that about 60 egg masses must be translocated to a new site and this will need one person for three to four days per week during the whole breeding season (September to November). This number of egg masses can only be taken from sites with a relatively large number of calling males without having a major effect on the local population. Captive breeding was tried (by Melbourne Zoo) but with only limited success, and anyway large numbers of juvenile frogs would be required. Noting that recruits move only a very small distance form the egg masses from which they emerged, egg mass translocation may be required in order to 'imprint' recruits on their habitat.

FUTURE MANAGEMENT AND RESEARCH ISSUES

1. **Management of small populations**

   Some small populations have disappeared, others have increased in size. Reasons are unclear and data on possible threatening processes, eg, changes in size of swamps and hydrology following clearing or establishment of blue gum plantations, are lacking. More work is need to attempt to correlate extinctions with local environmental changes.

2. **Fire management**

   The long term fire experiment with *G. rosea* near Walpole needs to continue, but with a reduction in work by UWA, will need to be taken over by CALM.

3. **Landscape management and conservation**

   Connectivity between populations may be necessary for long term population survival. Some major *G. alba* populations are not protected. The best cluster of populations of *G. alba* is within Location 83, a privately-owned, large area of land that connects the main State forest block to the east with Forest Grove State forest. One attempt to purchase this land has failed and the major issue is cost – the area is valued at over $2 million. Planning schemes and State land clearing policies may be the best way of protecting the frog habitat.

4. **Resources**

   The Recovery Team has depended largely on UWA Zoology for research into Geocrinias over the past six years. No more PhD studies are likely in the short to medium future. Research input from CALM is

needed to continue fire research and commence translocations.

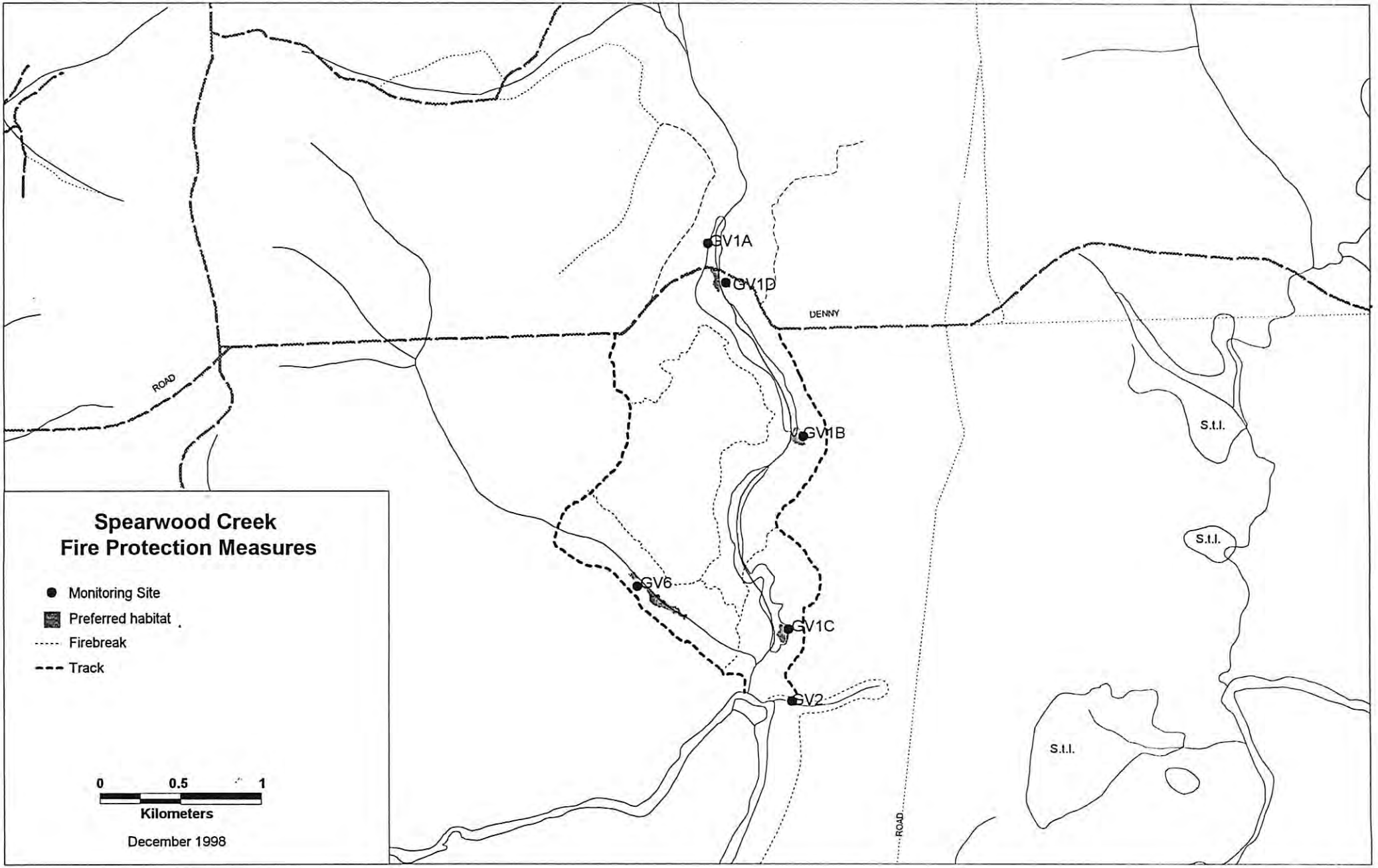
There is sufficient money available to continue fence maintenance, firebreak construction, etc. for another one to two years. An application for further Commonwealth funding will need to be developed in 1999.

Conservation Status

G. vitellina is currently ranked as Vulnerable and this is unlikely to change unless there is no recovery from the 1997 fire or frequent fires affect its habitat. Should a decline be confirmed, it will move directly to Critically Endangered, because of the extremely small area of occupancy.

G. alba is currently ranked as Endangered. In an 'in press' paper by Dale Roberts, Simon Conroy and Kim Williams it is stated that it meets IUCN 1994 Red List Criteria for Critically Endangered. If this is confirmed by the Threatened Species Scientific Committee and the Minister, it may have significant ramifications for CALM resources and public perceptions.

Map 1.


GV1A
GV1D
DENNY
ROAD
GV1B
S.t.l.
S.t.l.
GV6
GV1C
GV2
S.t.l.
ROAD
Spearwood Creek
Fire Protection Measures
Monitoring Site
Preferred habitat
Firebreak
Track
0
0.5
1
Kilometers
December 1998