National Feral Animal Control Program

Final Report to the Bureau of Rural Sciences
Agriculture, Fisheries and Forestry - Australia

Adaptive fox and rabbit management in agricultural areas

Vicki Linton
Rural Solutions SA
Department of Primary Industries and Resources SA

for Animal and Plant Control Commission, SA
Department of Water, Land and Biodiversity Conservation

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ANIMAL AND PLANT CONTROL COMMISSION
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NAME OF PROJECT

Adaptive fox and rabbit management in agricultural areas.

A summary of project dates, extensions and modifications can be found in appendix I.

PROJECT AIMS AND OBJECTIVES

- Analyse the effect on lamb production of group rabbit and fox control programs (only rabbits or foxes controlled by groups in some cases; both or none in others), by comparing a range of groups of treated and untreated properties

- Compare the effect on production of pest control with that of other livestock and property management practices

- Work with groups to adapt strategic control strategies where deficiencies are identified and evaluate what effect these changes have on farm production

- Use the information from the study to assist local animal and plant control boards to determine and promote the benefits of strategic pest control programs by groups. Assist boards with a strategy to help analyse the performance of control groups and to modify their management practices to maximise the benefit for farm production by reducing the impact of rabbits and foxes

- Liaise with pest control agencies or groups interstate to obtain comparable information or to establish further trials with similar methodology and whose results can be integrated with those of this study

- Develop extension materials and an education strategy for pest control boards and PIRSA to promote adoption of “best practice” strategies for maximising lamb production

- If possible determine the benefits for native fauna and flora of group fox and rabbit control

- Disseminate the results interstate and incorporate them into national guidelines

PROJECT LOCATION

The project officer was located in Adelaide, SA. The project data was collected from across the state, with all regional areas represented (except Kangaroo Island where rabbits and foxes are absent).

METHODOLOGY

The project funded the employment of a project officer. The project officer liaised with Animal and Plant Control Boards (APCBs) and industry sheep production groups in the agricultural areas of SA to set up groups of properties willing to participate in the project. A number of landholder groups were already conducting coordinated fox control programs (sometimes involving rabbits as well), and the aim was to capitalise on this activity and to expand it to include rabbit control and the establishment of experimental “controls” (landholders who did not practice coordinated pest control).

The experimental design of the project was to compare lamb production in areas (within and between groups) with all combinations of fox and rabbit control represented (ie. R+F+, R+F-, R-F+, R-F-)[1]. Where possible these groups were to be arranged in blocks of four in close proximity to limit the effect of variation in weather and climatic events. Twenty to 50 groups were anticipated.

As an adaptive management project, the focus was on learning from current practices exercised by land managers, rather than a formal, replicated trial. This provided advantages of large sample sizes to reduce the effect of variation at the property level and allowed the inclusion of a broad range of management practices and regional variation.

Groups

Twenty-two project groups (108 participants) were constructed around existing fox baiting groups across regional SA (see figure 1). It proved difficult to attract participants that did not control foxes or were prepared to stop fox control (non-baiters), so two of the possible four treatment types were under-represented (F-R+, F-R-).

Instead of restricting group size to the four treatment types (given it was difficult to get two treatment types represented anyway), it was decided that a more open structure to groups would be beneficial. Group size varied from one to eighteen participants.

Group and participant statistics are listed in appendix II.

Data collection

Data were routinely collected on a range of management options available to participants including:

- Pest density
- Pest control (type, timing, intensity, frequency, cost etc)
- Sheep management (time of lambing, lambing results etc)
- Pest damage
- Environmental conditions (pasture monitoring, rainfall etc)

Data collection was by way of a survey form sent to individuals every 3-months. Participants were supplied with a Reply Paid envelope to facilitate the return of forms. This information was then stored on a database (Access 97).

Supplementary information was sought from participants throughout the project, including baiting practices and sheep management surveys. Other sources of information were also integrated into the data, including local knowledge kept by APCB officers and the Animal and Plant Control Commission (APCC) data base on fox bait use across the state (1993 – 1999).

Survey return rates remained extremely high throughout the project. The worst return rate (from the final survey form) was only 80%. The best return rate was 94%.

See appendix III for examples of data collection forms.

[1] F+ = with fox control, F- = without fox control, R+ = with rabbit control, R- = without rabbit control

Figure 1: Map of group distribution

Statistical analysis

The data were analysed using GLIM (Release 4, 1992, Royal Statistical Society, London).

Although over one hundred properties supplied data, most of these did not submit complete data sets. Different properties omitted different items of data, and it was not possible to conduct multiple regression analysis involving large numbers of explanatory variables because sample sizes were too small. This situation was handled by conducting separate analyses on relatively large subsets of the data to explore the influence on individual variables, using mean values for each property, and then to test for the simultaneous significance of variables significant on their own by testing them together in a data set using a smaller number of properties but where data for different years from the same property are treated as independent observations (with the degrees of freedom adjusted for pseudoreplication).

Particular attention was placed on the response of lamb marking % (LM%) to fox control and sheep management practices. It was expected that the effect of explanatory variables on the response variable would be multiplicative, so LM% data were log transformed.

Communication

APCB and project participants were kept up-to-date with project progress and new innovations and knowledge in pest control through the 3-monthly newsletter (From the Fox Den) and annual reports (1998 and 1999). Field days and workshops were held and attended throughout the project. An extension package was developed at the end of the project. This included a book and CD, both titled "Spotlight on foxes". These were distributed widely in SA through the APCB system, and also sent interstate.

See appendix IV for "From the Fox Den" newsletters.
See attachment 1 for annual reports
See attachment 2 for "Spotlight on foxes" book

RESULTS

Model explaining lambing marking percentage after group fox control began

Pre-fox control LM% (ie the LM% before the group started fox baiting) and ewe fat score at joining[2] (EFSAJ) were both significantly related to post-fox control LM% (see figure 2).

LM% increased after group fox control began, with the greatest benefits (up to two-thirds) achieved by those participants who started out with a low LM% (50-80%). Participants who had high LM% (100% or more) pre-fox control only realised small increases from fox control (less than one-tenth). EFSAJ also affected LM%. Participants who achieved EFSAJ of 4 obtained one-third more lambs than participants who realised EFAJ of 2. The corresponding benefit for EFSAJ of 3 or 5 was about one-sixth.

[2] Nutritional status or condition of ewe at the time of mating, usually scored between 1 (ie. very poor condition) and 5 (ie. very good condition)

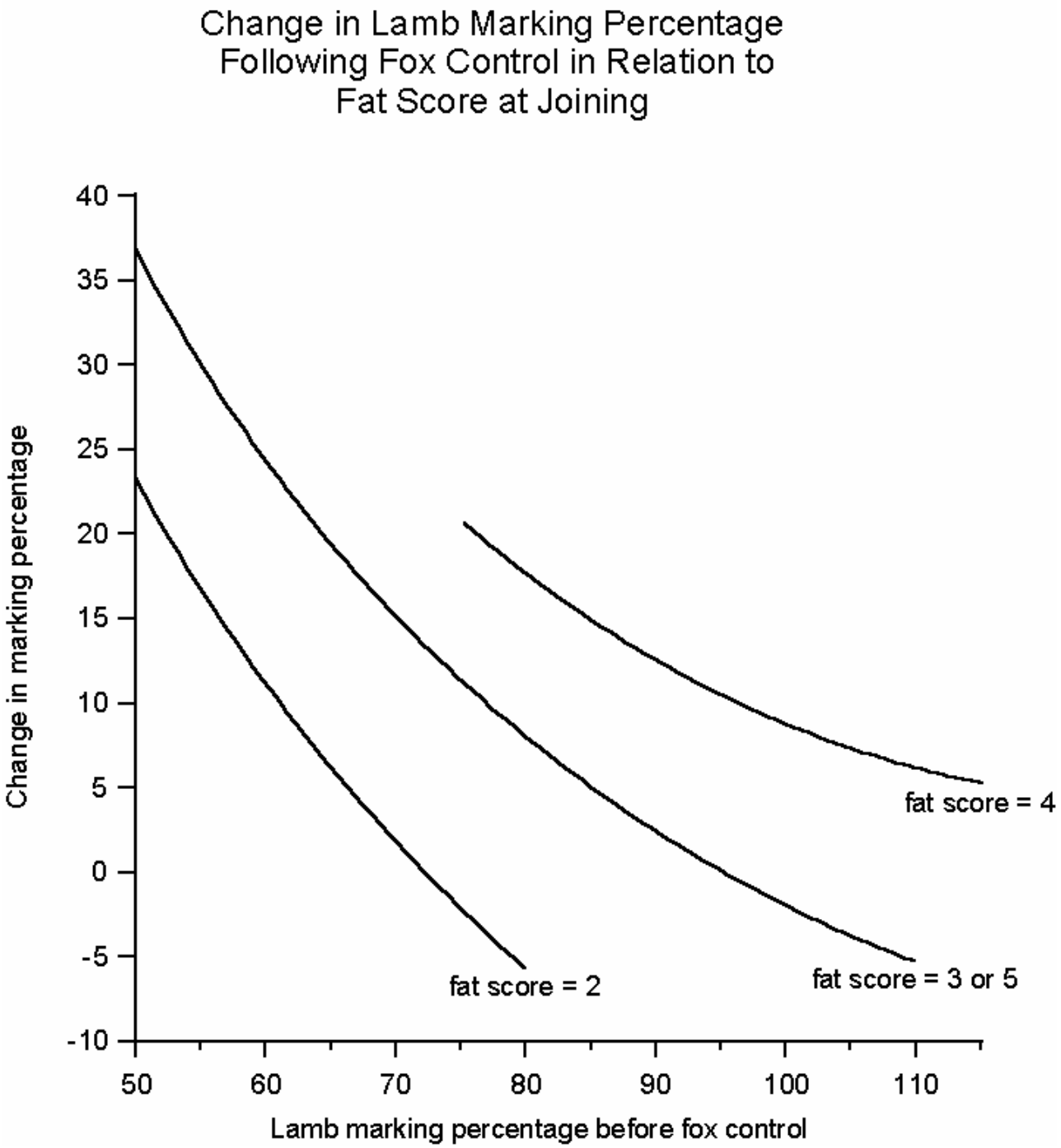

Figure 2: Change in lamb marking % following fox control in relation to ewe fat score at joining

There was no difference between fox control and no fox control treatments. All properties appeared to benefit. Two possible explanations for this are:

1. The benefits of fox control extend beyond the boundary of the property baiting. The increase was due to fox control, and the absence of any difference between fox control and no fox control treatments was due to re-equilibration of fox densities ie foxes redistributed themselves from properties not practising fox control to those

doing so. This is supported by the frequency of baiting required for wildlife protection in response to fox migration into intensively baited areas[3].

2. The increase was unrelated to fox control and due to some other factor, not discerned during our experiment. Analysis of group data has excluded season (rainfall) and sheep management practices collected as part of this project (see appendix IV).

POST PROJECT ANALYSIS CONTINUES

Further analysis since the completion of the project is attempting to distinguish between these possibilities by seeing whether the differences in lamb marking percentage present before our experiment began (ie before group fox baiting commenced) could be explained in terms of the general level of baiting occurring elsewhere in the district.

If foxes moved between the properties comprising a group, they may also have moved between properties located in the general area within which the group was located. The hypothesis (consistent with explanation 1 above) being that before baiting commenced on the properties in the project groups, their lambing percentages would be influenced by the level of fox control occurring elsewhere in the district.

For this test, the Hundred (an administrative unit with an area of about 300 km^2) has been selected. A centralised database of bait use across SA for the period 1993 – 1999 has been used to calculate the number of baits distributed yearly in the Hundred in which the property was located, and also in the contiguous (surrounding) Hundreds.

Preliminary analysis suggests that high levels of bait usage in a Hundred resulted in an increase in lamb marking percentage on the properties in the project groups (which had not themselves begun controlling foxes at that time), thereby supporting explanation 1 above. In addition, the result indicates that fox movement occurs on a much larger scale than implied by this explanation or previously demonstrated, and was not restricted to the area of the group.

State government funding is supporting continued analysis of this data post-project.

DISCUSSION OF THE RESULTS AND THE IMPLICATIONS FOR FUTURE MAN AGEMENT OF PEST ANIMAL DAMAGE

General

Progress towards project aims & objectives, milestones, outcomes & outputs and performance indicators are summarised in appendix V. More detailed information can be found in attachment 1 (1998 and 1999 annual reports).

[3] Kinnear, J.E., Onus, M.L., and Bromilow, R.N. (1988). Fox control and rock-wallaby population dynamics. *Australian Wildlife Research* **15,** 435–450.

Project data

Sheep producers can use the results from this project to prioritise management options to increase LM% through either fox control activities and/or ewe nutrition at joining, depending on the current state of their enterprise. For example, producers with a LM% of 50-60% should be able to derive a larger benefit from fox control than they can by manipulating ewe nutrition, although they might choose to do both. Producers with LM% greater than 100% can expect only small benefits from fox control, but they can still expect the same high benefit from ensuring optimal ewe condition at joining. Under these circumstances, landholders who are not already doing so might choose to control foxes only if their LM% falls and they can not account for the decline in any other way other than fox predation.

So results for sheep producers from fox control will vary according to current LM%. Presumably, those marking 100% or more do not have a fox problem (or no longer have a fox problem due to their actions or the actions of others). Past studies on the impact of foxes on lamb production has often presented conflicting results. Some studies suggest that fox impact on lamb production is significant, whilst others suggest fox impact is negligible. Both results may be correct and be related to the LM% "before fox control" for the study areas ie the Adaptive fox and rabbit management in agricultural areas project may go some way to explaining the variation in past research.

Implications for national guidelines

The model explaining lambing marking percentage after group fox control identifies options for sheep producers to make decisions on how to gain the best production results for their enterprise. On property actions (ie. fox baiting) can improve LM% (depending on the starting LM%). However, the model also suggests that sheep producers can gain similar benefits without taking any action (non-participant), as long as others in the district are taking action (ie baiting foxes). Effectively, the participating landholders (baiters) are taking action on behalf of the non-participants.

This hypothesis has been supported by preliminary analysis of a wider data set (bait usage per Hundred). Should this be confirmed, it presents a social justice challenge for policy makers and communities. If everyone benefits from the actions of a few, how should those actions be funded? Should the individual bear the cost for the community benefit? Does the community subsidise those willing to undertake the actions? Should the role be rotated through the district? Should everyone be forced to participate?

These questions can form part of a regional pest prioritisation program. A group from this project (based around Port Kenny) has been identified as a potential trial area for a new pest prioritisation model developed by Mike Braysher and Glen Saunders (in press). There is potential to involve this community in addressing the types of questions raised from this project. Should funding for implementing the prioritisation model eventuate under NHT stage II, these issues should be included in the process.

In the mean time, the Animal and Plant Control Commission is funding further analysis of data from the Adaptive Fox and Rabbit Management in Agricultural areas project. Any further developments will be reported informally to the funder, with formal communication through publication of a research paper in an appropriate journal (paper currently in preparation).

AUDITED STATEMENT OF EXPENDITURE

The last payment for this project was received in February 2001. This amount was acquitted in previous progress reports. For information, a copy of the Natural Heritage Trust acquittal form for period ending 30th June 2001 appears on the following page.

APPENDIX I: SUMMARY OF PROJECT DATES, EXTENSIONS AND AMENDMENTS

- Funding started 09/97, due to end 08/00
- Project officer started 12/97, permission from Bureau of Rural Sciences (BRS) to run project over full 3 years, so finish project 11/00
- From 01/05/00, project officer transferred from Animal and Plant Control Commission (APCC) to Rural Solution SA, project sub-contracted to Rural Solutions SA from APCC, project officer allocated 0.5fte to fox project, thus extending the life of the project from Nov 00 to June 01 (agreed to by BRS).
- Unspent money in the project (in Rural Solution SA account) at June 01 paid for second print run of extension material and some project officer time to evaluate project outcomes (limited). During this period, some project time was used to assist BRS with implementation of Braysher/Saunders prioritisation model.

APPENDIX II: GROUP AND PARTICIPANT STATISTICS

Number of groups established	22	
Number of participants	108	
Regions represented	7	Riverland 5 groups Mallee 2 groups South East 4 groups Central 1 group Yorke Peninsula 2 groups Mid-North 2 groups Eyre Peninsula 6 groups
Key enterprises represented *participants key enterprises *sheep may be secondary enterprise	9	Cereal/sheep 34% Wool/Grazing 17% Prime lamb 13% Other+ 11% Cereal/legumes 10% Beef cattle 10% Wethers 2% Sheep stud 2% Goats 1%

+Other enterprises included conservation, almonds, flowers, hobby farms and vacant land

APPENDIX III: DATA COLLECTION FORMS

APPENDIX IV: FROM THE FOX DEN NEWSLETTERS

APPENDIX V: PROGRESS TOWARDS PROJECT AIMS & OBJECTIVES, MILESTONES, OUTCOMES & OUTPUTS AND PERFORMANCE INDICATORS

Aims & Objectives	**Comments**
Analyse the effect on lamb production of group rabbit and fox control programs (only rabbits or foxes controlled by groups in some cases; both or none in others), by comparing a range of groups of treated and untreated properties.	It appears that a "true" experimental control of "no fox control" was unachievable for the project due to the mobility of foxes and a behaviour of previous and current baiting in regions where project was established. Owing to the premature arrival in SA of RHD, effects due to rabbits were undetectable.
Compare the effect on production of pest control with that of other livestock and property management practices.	Sheep producers can prioritise management options to increase LM% through either fox control activities and/or ewe nutrition at joining, depending on the current state of their sheep enterprise.
Work with groups to adapt strategic control strategies where deficiencies are identified and evaluate what effect these changes have on farm production.	Participants have been prompted (by data sheets) to evaluate their control strategies based on pest damage rather than pest density or bait take. Also see below.
Use the information from the study to assist local animal and plant control boards to determine and promote the benefits of strategic pest control programs by groups.	The results from this project have wider implications. Whilst sheep producers can benefit from actions on their own property, there is also a flow-on effect (for foxes at least) to non-baiters eg from activities on neighbouring properties. See comments on national guidelines (5 boxes below).
Assist boards with a strategy to help analyse the performance of control groups and to modify their management practices to maximise the benefit for farm production by reducing the impact of rabbits and foxes.	[see previous 2 boxes].
Liaise with pest control agencies or groups interstate to obtain comparable information or to establish further trials with similar methodology and whose results can be integrated with those of this study	Despite contacting over 20 landholder groups interstate and liaising with interstate agencies, no interstate groups were recruited into the project. Interstate input was sought when developing extension material.

Develop extension materials and an education strategy for pest control boards and PIRSA to promote adoption of "best practice" strategies for maximising lamb production.	"Spotlight on foxes" guide and CD produced.
If possible determine the benefits for native fauna and flora of group fox and rabbit control.	Only two groups measured native fauna. Results were inconclusive.
Disseminate the results interstate and incorporate them into national guidelines.	"Spotlight on foxes" guide and CD produced and distributed to WA, Qld, NSW, Vic, ACT and Tas. It is too early to incorporate these results into national guidelines. More work is required to establish an equitable and effective means for regions or groups to share the costs and benefits of fox control.
Milestones	**Comments** (see also attachment 1)
20-50 groups participating (milestones 1-4).	22 groups in total. No interstate groups recruited (see above).
Six-monthly reports submitted (milestones 1-5).	On-time. Project modified (with funder's permission) which extended the project final date to 30th June 2002.
Annual reports to participants (milestones 2, 4 and 6).	First 2 annual reports delivered on time. Third report delayed by extension to project final date.
Education strategy (milestones 5 and 6).	"Spotlight on foxes" produced, second print run required. CD version created.
Final report	Sent to funding body July 2002.
Expected outcomes and outputs	**Comments**
Improved fox control leads to higher lambing % and to environmental benefits.	Fox control can increase lambing % by up to two-thirds or as little as one-tenth, depending on lambing % before control starts.
The bigger the group and the higher proportion of participating landholders the better the lambing %.	Benefits from fox control extend beyond the property boundary, no significant result for group size or participation rate, however a dose rate may apply (ie baits/100ha).

A knowledge of the other contributing factors that improve lambing %.	Obvious sheep management practices to improve lambing % (eg. later lambing, grain legumes in enterprise) were confirmed by data analysis. Significant result from integrating ewe nutrition at joining and fox control included in final model (described elsewhere).
Determination of the extent to which fox control is facilitated by rabbit control,	During the project, rabbit numbers barely recovered from RHD. This reduced the project's ability to determine effects of rabbit control versus no rabbit control.
Determination of the optimum frequency for fox control.	None determined.
Cost effective strategy for integrating fox/rabbit control with other farm management practices to maximise lambing %.	Significant result from integrating ewe nutrition at joining and fox control (described elsewhere).
Determination of the degree of regional variation in optimal strategies.	No significant results in regional (or seasonal) variation.
An education strategy to facilitate the adoption of outcomes.	The absence of clear pest control strategies (eg. frequency, timing etc), education strategy was developed to encourage landholders to monitor damage rather than focus on pest control. Adopted strategic management guidelines from BRS series.
A package of extension materials incorporating the above outputs.	Spotlight on foxes guide and CD.
Outcomes used by local pest control boards when setting priorities for fox and rabbit priorities within district	It is too early to incorporate these results into local guidelines. More work is required to establish an equitable and effective means for regions or groups to share the costs and benefits of fox control.
Promotion by all boards with significant fox and rabbit populations of best practice fox and rabbit control.	Uptake by APCB of Spotlight on foxes guide high (2nd print run required).
Adoption of best practice fox and rabbit control by a progressively higher percentage of landholders.	Not measured.

Techniques for local pest control boards to monitor adoption of best practice and to evaluate the results achieved so that they can guide them to modify their fox and rabbit control practices to maximise benefits for farm production.	Not measured.

Performance indicators	**Comments**
Changes in:	
• Lambing %	Lambing % increased after fox control for both baiters and non-baiters.
• % landholders in a group area participating in group pest control	Group fox and rabbit control participation dropped during project time for a range of reasons including low lamb values and RHD.
• Number of groups involved a region	Slight increase as project went on, due more to exposure at regional level.
• % Boards promoting best practice	14 (of 26) regional APCB covered by project. Best practice guides incorporated into all Board's operational procedures.
• Fox bait usage at individual property level	Recorded in project. Bait use by project participants over 3 years increased 4-fold.
• Fox bait usage at state/regional level	Recorded separately and incorporated in project. Bait use at state level remained constant but number of people baiting dropped (remaining individuals increased effort).
• Spotlight counts of foxes and rabbits	Not recorded.
• Other measures of pest activity	Participants had difficulty in estimating and measuring pest density (see 1999 annual report for further comments).
• Rabbit bait usage	Recorded by not analysed due to insufficient data provided by participants.
• Level of warren activity	Recorded by not analysed due to insufficient data provided by participants.
• The extent to which inappropriate management practices change	Not recorded.

Adaptive Fox and Rabbit Management in agricultural areas

FINAL REPORT

ATTACHMENT 1
Annual reports

Adaptive Fox and Rabbit Management in agricultural areas

FINAL REPORT

ATTACHMENT 2
Spotlight on Foxes