

BIOTECHNOLOGY AND BIOLOGICAL SCIENCES RESEARCH COUNCIL

RESEARCH GRANT REPORT FORM

PART ONE

Type of report

Final

Research grant reference number

96/E14253

Project title

Historical data retrieval and imputation for Soay sheep

Award amount

Start date

Duration

End date

1 April 2001

1 year

1 April, 2002

Grant holder

B.J.T. Morgan

Current position

Professor of Applied Statistics

Department and Institution

Institute of Mathematics and Statistics,
University of Kent,
Canterbury,
Kent,
CT2 7NF

**Numbers of BBSRC-
supported staff:**

(a) Research staff

(b) Technical staff

(c) Other staff

1

Project abstract (as in original application, including any amendments agreed with BBSRC Office)

Key data on the population dynamics of Soay sheep for the period, 1955-1967 will be gathered from 3 separate locations, added to the current Soay sheep data base (1985-present), and thoroughly validated and checked. Detailed, developing stochastic models for the behaviour of the Soay sheep population will be used to impute the data for the period, 1967-1985, for which no appropriate records exist. Models will be tested against the newly acquired 1955-1967 data. This will validate both the data and the models. The findings will be publicised and published.

Project title

Historical data retrieval and imputation for Soay sheep

Original objectives of research, including any amendments agreed with BBSRC Office

To collate the historical data, to add it to the St. Kilda database, and to do this in the standard format, corresponding to the existing database of data since 1985.

To extend our recent population modelling simulations, to impute data for the missing years, corresponding to the break in the Village Bay area study, from 1967-1985.

To test our detailed and developing models, incorporating individual (weight) and weather covariates on the Jewell data, which will have experienced different climatic regimes, in particular the severe winter of 1962.

To make available the Jewell and imputed data sets, spanning in total the period from 1955-1967-1985, for use and experimentation by interested parties.

To publish the data and our results in papers to ecological and statistical journals in which we will reveal the similarities and dissimilarities between the records for the two periods, and the results of the imputation study.

PART TWO**Report Summary (To be understood by an informed but non-expert reader. See guidance notes, para 5.3)**

The study of the wild population of Soay sheep on the island of Hirta in the St. Kilda archipelago has greatly influenced modern ecological thinking. However, the data mainly relate to the intensive studies since 1985. In addition there are counts of the whole island sheep population from 1955, but for the interim period from about 1967-1985, there is some doubt as to the accuracy of the figures. The study since 1985 has involved the collection of far more detailed data, and it has shown that characteristically the population grows quickly, followed by large mortality, succeeded by another period of fast growth, and so on. This almost cyclic pattern is not observed in the whole island count for the middle years.

This research project follows on from detailed probability models that have been fitted to the data since 1985, which encompass sex and age-structure of the population, as well as being driven by important individual and environmental variables, such as poor winter weather, and population density [THESE VARIABLES ARE ENVIRONMENTAL VARIABLES AND NOT INDIVIDUAL VARIABLES]. We knew that some detailed study data for this important population existed from about 1955, and that it was not properly documented. We set out to collate that data, and to make it available for use by other scientists. We were then interested to see if our models, derived from our analyses of the modern data, from 1985, were compatible with the earlier detailed data. We then intended to use the models to work out the whole island counts that we would expect during the middle period.

The early data were collected, and tabulated, and analysed using appropriate models. It was found that the data were essentially in good agreement with the models derived from the modern data. However, there was one very important finding, which was that the probability of recapture of live animals was found to depend on the age/breeding status of female sheep. This was not previously a feature of the models, and we note that it should be included in further work.

Confident that we could describe the detailed data from both the early and modern periods, we then set out to estimate the whole island counts that we would expect if the model held true for the entire period, without break, since 1955. This was done in two ways, by simulating data from the model, and also by using a new technique recently developed in Kent under a different BBSRC/EPSC grant. Both of the approaches gave rise to the same conclusions: as suspected for many years, the whole-island count for the middle years appears to be seriously wrong, and that the entire time-series of counts from 1955, without correction for the middle period, was unsuitable for

general time-series analysis. This is an important general conclusion, as the complete time-series has been used in its entirety for stochastic modelling. Furthermore, our findings agree with how ecologists believe the population should have behaved during the middle years.

In order to carry out the simulations, and to use the new technique, it was necessary to refine models for sheep fecundity. This work, as well as the collaboration with the other BBSRC/EPSRC grant mentioned above, was not anticipated before the project started, and consequently represents additional work, over and above the work in the original plan. Additionally, as mentioned above, we became aware of the importance of including in our models the breeding status of female sheep. One can go further than that, and use modern probability models in order to estimate the probabilities of sheep changing their breeding status from year-to-year. This is linked to important ecological theories of how animals optimise their life-history strategies, and we are currently developing ways of fitting such models to the data, and also seeking further grant funding to conclude these new avenues for future study.

A full report, covering no more than four sides of A4, must be appended to the form

PART THREE

Project title

Historical data retrieval and imputation for Soay sheep

Research outputs and dissemination of results arising as a direct result of BBSRC research grant (See paragraph 5.4 of the attached guidance notes)

- i) Publications in refereed journals (give authors, underlining the names of authors funded by this grant, date, title, journal, volume, page numbers)

- ii) Other significant publications (including trade journals)

- iii) Data lodged in public access databases

- iv) Patents and other forms of intellectual property rights

- v) Industrial or other collaborations (formal or informal)

- vi) Presentations to lay audiences, articles in popular journals, etc

- vii) Trained personnel

Signed **Date**
(Grant holder, on the behalf, and with the full consent, of all named co-applicants and/or collaborators. See note 5.8)

Name **Position** (Block

capitals)

PLEASE NOTE: PARTS 4 & 5 ARE

NOT PART OF THE FORMAL EVALUATION OF THE AWARD

PART 4: EXPLOITATION

Principal Investigator B.J.T. Morgan	Research Grant Reference	
Institution University of Kent		
Number 96/E14253		
Project Title Historical data retrieval and imputation for Soay sheep		
Start date	Duration 12 months	End Date 1 April, 2002

i) Exploitation potential

Progress to exploitation

Sector(s) of potential application of research. Please tick all that apply

<input type="checkbox"/> Agriculture	<input type="checkbox"/> Healthcare
Brewing and distilling	Pharmaceuticals
Chemicals	New product
Diagnostics/instrumentation	Process improvements
Environment	Platform technology
Food manufacture	Other (please state)

i) Would you benefit from any exploitation advice which BBSRC could provide?

PLEASE NOTE: PARTS 4 & 5 ARE

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PART 5: PUBLIC AWARENESS OF SCIENCE

Principal Investigator B.J.T. Morgan

Research Grant Reference

Institution University of Kent

Number 96/E14253

Project Title Historical data retrieval and imputation for Soay sheep

Start date

Duration

1 year

End Date 1 April, 2002

Please give details of any activities undertaken to promote public awareness, appreciation and understanding of the wider scientific area of the research project, for example media releases, public lectures, etc.

An unsuccessful application was made to BBSRC for Public understanding of Science funding for the work of this and related research grants. However, following discussions with Dr. Winstanley, the editor of BBSRC *Business*, an article has been published in the July 2002 issue of *Business*, which described the work mentioned above, on the Kalman Filter modelling, developed under a different, BBSRC/EPSRC grant. We were very pleased to note that our article was selected for the cover of that issue of the magazine. I am now in discussion with Dr. Winstanley, to explore the wider publicity that may be given for our work, supported by the BBSRC.