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DO TRAPPING INTERVENTIONS EFFCTIVELY REDUCE OR ERADICATE POPULATIONS OF THE AMERICAN MINK, MUSTELA VISON?

Systematic Review

TYLER, C., CLARK, E. AND PULLIN, A.S.

Centre for Evidence-Based Conservation. - School of Biosciences - The University of Birmingham - Edgbaston - Birmingham - B15 2TT - U.K.

Correspondence: *cxt031@bh am.ac.uk*
Telephone: 0121 414 6873

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Systematic Review No. 7.

Do trapping interventions effectively reduce or eradicate populations of the American Mink, *Mustela vison*?

Review Report

Compiled by
Tyler, C., Clark, E. and Pullin, A.S.

Centre for Evidence-Based Conservation
School of Biosciences
The University of Birmingham
Edgbaston
Birmingham
B15 2TT
U.K.

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SUMMARY

Background

American mink, *Mustela vison*, are native to North America. They were brought to Great Britain for fur farming in 1929. Deliberate releases and inevitable escapes have resulted in feral population establishment in Britain. As *M. vison* is considered a threat to native fauna population control is an option. Commonly used techniques are trapping, shooting, and hunting. Assessment of the effectiveness of these techniques will inform management planning where there are ecological and/or economic impacts arising from presence of *M. vison* populations.

Objectives

To assess if management interventions effectively reduce or eradicate population numbers of *Mustela vison*?

Secondary objectives

- Is heterogeneity within results introduced through ecological variation within the studies?
- Are isolated *M. vison* populations reduced more effectively?
- Is effectiveness of an intervention altered by seasonality?

Search strategy

Relevant studies were located through the computerised searches of English Nature's 'Wildlink database', JSTOR, ISI Web of Knowledge (comprising BIOSIS previews: 1969 to 2004, CAB abstracts: 1973 to 2004, ISI current contents: 1997 to 2004, ISI proceedings: 1990 to 2004, ISI Web of Science: 1975 to 2004), Scirus: 1920 to present, Copac: 1100 to present, ScienceDirect, Index to Theses online: 1973 to 2004, Agricola, Scopus: 1966 to 2004 and Digital Dissertations. Web searches were made using www.alltheweb.com (PDF, and word doc. search), www.google.co.uk, and direct interrogation of the following websites: DEFRA, Scottish Natural Heritage, The Wildlife Conservation Research Unit (WildCRU) at Oxford University, The Royal Society for the Protection of Birds, The National Trust, British Wildlife, The Mammal Society, Mammals Trust, and The British Trust for Ornithology.

A secondary search was made of bibliographies of all articles accepted at full text.

Selection criteria

1) Subject
American Mink, *Mustela vison*, populations.

2) Intervention
After initial scoping of the literature, the main intervention under consideration was the practice of trapping *M. vison* for population control. Studies over all time scales and geographical locations were included.

3) Comparator
Any articles that did not include a control site/comparator were rejected in the first instance. Lower quality evidence was later incorporated into the review due to the lack of comparators in the studies located.

4) Outcome
Any study that reported on the outcome of trapping for the control of *M. vison* was accepted. Ideally, studies that reported on change in abundance were most relevant. It was a requirement that if abundance was the measurement, the population size before and after trapping was assessed independently of the number of *M. vison* trapped.

Data collection and analysis

Article inclusion/exclusion assessments were performed by the primary reviewer with a subset assessed by a second reviewer for verification of repeatability within the methodology; any disagreements were resolved by discussion. Data extraction and study quality were performed by the primary reviewer with the use of pre-designed assessment forms, and then entered into a spreadsheet. Due to the lack of available data, statistical analysis could not be performed. Results are thus presented qualitatively in a summary table.

Main results

Available qualitative evidence from 7 studies demonstrates that *M. vison* populations decrease over the time of observation. Due to the lack of control areas within the experimental designs, observed decreases cannot be attributed to any single factor, i.e. traps, as there is no formal investigation into other intrinsic and extrinsic variables that could also be acting upon the *M. vison* population.

Reviewers' Conclusions

No firm deductions can be made from current studies because of limitations of study design and lack of controls for comparison. Future studies should incorporate a more robust experimental design, including a population estimation before and after the intervention occurs and a control population that is not subject to the intervention.

1. BACKGROUND

American mink (*Mustela vison*) are native to North America; they were first imported into Britain for fur farming in 1929 as they breed easily and produce a high standard of pelt (Baker 1989, Dunstone 1993, Macdonald and Harrington 2003). Inevitable escapes and deliberate releases from fur farms led to establishment of feral populations, with the first record of breeding in the wild in 1957 in Devon (Linn & Stevenson, 1980). This problem is not confined to the U.K. as escapes have led to feral populations in Sweden (Gerrell, 1971), Ireland (Smal, 1991), Iceland, Germany, France, Spain, the Former USSR (Macdonald & Strachan, 1999) and Patagonia, Argentina (Previtali *et al*. 1998).

M. vison is a semi-aquatic carnivore, belonging to the family Mustelidae. It is a successful predator on land and in water, commonly found near waterways (Smal, 1991) and a wide prey range (birds, bird eggs, fish, and small mammals) enables successful adaptation to new habitats and locations (Dunstone, 1993, Gerrell, 1971). The control of *M. vison* is considered necessary in Britain, as they are a threat to native species, e.g. water voles (*Arvicola terrestris*), seabirds, waterfowl, and ground nesting birds. Although they will often kill far in excess of their food requirements, this may not be the only reason for the decline in their prey, as habitat degradation and climate change have also been shown to be a correlate of decrease in water vole abundance (Macdonald *et al* 2002, Rushton *et al* 2000).

Permitted control methods for *M. vison* in the U.K. include hunting with foot packs and terriers, shooting, live or fatal trapping, and exclusion barriers, such as fencing (Macdonald *et al.*, 2000). Complete eradication of this species from Britain is unrealistic; however, reduction is considered necessary by many conservation organisations. Determining the impact that different interventions have will aid management planning where mink populations present a problem. Results should inform policy and guide future research.

2. Objectives

2.1 Primary objective

To systematically collate and synthesise published and unpublished evidence in order to address the question "Do management interventions effectively reduce or eradicate population numbers of American Mink, *Mustela vison*?"

2.2 Secondary objectives

- Is heterogeneity within results introduced through ecological variation within the studies?
- Are isolated *M. vison* populations reduced more effectively?
- Is effectiveness of an intervention altered by seasonality?

3. METHODS

3.1 Question formulation

M. vison control was highlighted as an intervention that would aid in the conservation of the water vole, *Arvicola terrestris*. Contact with representatives from English Nature led to the formulation of the question: "Do management interventions effectively reduce or eradicate population numbers of *Mustela vison*?" The three elements of the question are:

Population: Mustela vison

Intervention: Any treatment with the view to control *M. vison* population.

Desired outcome: The reduction of *M. vison* population size.

Key reasons for heterogeneity (variation within the results) led to the formulation of the secondary objectives of the review which would be investigated if sufficient data exist.

3.2 Search strategy for identification of studies

Relevant studies were located through the computerised searches of English Nature's 'Wildlink database', JSTOR, ISI Web of Knowledge (comprising BIOSIS previews: 1969 to 2004, CAB abstracts: 1973 to 2004, ISI current contents: 1997 to 2004, ISI proceedings: 1990 to 2004, ISI Web of Science: 1975 to 2004), Scirus: 1920 to present, Copac: 1100 to present, ScienceDirect, Index to Theses online: 1973 to 2004, Agricola, Scopus: 1966 to 2004 and Digital Dissertations. Web searches were made using www.alltheweb.com (PDF, and word doc. search), www.google.co.uk, and direct interrogation of the following websites: DEFRA, Scottish Natural Heritage, The Wildlife Conservation Research Unit (WildCRU) at Oxford University, The Royal Society for the Protection of Birds, The National Trust, British Wildlife, The Mammal Society, Mammals Trust, and The British Trust for Ornithology.

After initial scoping of the literature, the main intervention under consideration was the practice of trapping. The search terms used in the assessment of trapping interventions were:

- *Mustela* AND *vison*
- *Mustela* AND *vison* AND trap*
- *Mustela* AND *vison* AND control*
- *Mustela* AND *vison* AND management
- *Mustela* AND *vison* AND pest
- Mink AND trap*
- Mink AND control*
- Mink AND management

- Mink AND pest

Bibliographies of accepted articles (full text) were searched for further studies that had not appeared in any of the computerised searches of the databases. Foreign language searches were not performed. Authors of articles where all relevant data had not been presented, or where its existence had been inferred but not published, were contacted for the original data. Further articles were acquired through personal communication with relevant researchers in the field.

3.3 Study inclusion criteria

Screening of articles at title and abstract for relevance to the review question was performed by a single reviewer (EC). Articles were accepted for full text viewing if they appeared relevant to the review, or if they had an ambiguous title/abstract that did not allow inferences to be drawn about the content of the article.

For inclusion into the review, articles accepted at title and abstract were then assessed at full text by a single reviewer (EC), a subset (15) were read by a second reviewer (CT) for measure of agreement; methodology of inclusion/exclusion criteria was verified with 100% agreement between reviewers. Derivation of inclusion criteria from the review question led to the requirement of the articles to report on primary research studies that include a:

1) Subject

Mustela vison populations or subpopulations.

2) Intervention

Any intervention was considered appropriate for inclusion in this review as the object was to ascertain the most effective method of control of *M. vison*. After initial scoping of the literature, the main intervention under consideration was the practice of trapping. Studies over all time scales and geographical locations were included, and in all habitats relevant to the range of *M. vison.*

3) Comparator

The control/comparator is a *M. vison* population that is not experiencing any type of management. Any articles that did not include a comparator were rejected in the first instance. Lower quality evidence was later incorporated into the review due to the lack of comparators in the studies located.

4) Outcome

Any study that reported on the effect of an intervention on *M. vison* population size was included.

3.4 Study quality assessment

All included studies (articles may report on more than one study) underwent a methodological assessment of quality. This was performed by a single reviewer (EC) using a study quality assessment instrument, modified with respect to the review question. Sources of heterogeneity expected within the methodology of the experiments were also recorded. Weighting was given to the most important factors, primarily the study design, using a hierarchy of evidence adapted from Stevens and Milne (1997) and Pullin and Knight (2001).

The criteria for assessment are listed below:

Study design:

In decreasing order of importance: Randomised control trial, Quasi-Randomised control trial, Controlled trial, Historical control trial, Site comparison, Time series, Interrupted time series, Questionnaire, or Expert opinion.

Performance bias:

Baseline comparison: Size of experimental area, Habitat type, and Location/geographical area.

Intra-treatment variation: Size of experimental area, Habitat type, and Location/geographical area.

Measurement of intervention and co-intervention: Shooting, Trapping, or Others.

Assessment bias:

Parameter of abundance: Is the measurement used to assess success of the intervention objective or subjective?

Number of replications: In descending order of quality: No replication, one or two replications, or more than two replications.

Attrition bias:

Subject units lost during the experimental/investigational period than cannot be included in the analysis (e.g. units removed due to deleterious side-effects caused by the intervention).

Tables of assessment for individual studies, (Appendix 1) were constructed based on scoring of the above criteria. An overall score was then awarded to each study. The studies that maintain homogeneity between the treatment and control in the experiments were awarded higher scores, in order to receive these higher scores this information first has to be presented within the methodology of the articles, without such information, homogeneity is unknown and studies lose scores.

3.5 Data extraction

Data sets were extracted by a single reviewer (EC) into a spreadsheet from all studies included at full text by the use of a data extraction form specifically designed for experiments with the control of *M. vison* as a priority. All data that report on the effect of trapping on a *M. vison* population were extracted. This involved reporting on the mean, sample size and standard deviation, where available, of both the experimental population and the control population.

Further information on both ecological and experimental variables were extracted as these may form reasons for heterogeneity within the results presented. Of primary importance were those variables specified *a priori* within the secondary objectives of the review; however, any variable that could potentially affect the effectiveness of the trapping intervention was extracted for *post hoc* investigation of heterogeneity.

Where articles contained incomplete data sets or where data were inferred but not presented, contact with the authors was attempted. Relevant organisations were also contacted for further information or articles that they may have.

Due to data quality within included studies it was necessary for the criteria laid down in the protocol to be modified to allow inclusion of data without controls. Without this amendment there would not have been any studies suitable for inclusion into the review. By including lower quality studies, suggestions for future research can be formulated and possible trends, due to trapping, hypothesised.

3.6 Data synthesis

3.6.1 *Handling of missing main outcome data*

None of the datasets extracted contained standard deviations and consequently inferences could not be drawn about potential variance. It was thus decided that such measures could not be included in the review. Population sizes of control populations were also missing.

3.6.2 Choice of measure of effect and method of analysis

Absolute values of the number of mink trapped or the percentage trapped where presented, provided an objective measure of the abundance; however, as stated above, standard deviations of the studies were not presented, and there are no control populations. Consequently meta-analyses could not be performed on the data and all following analyses are qualitative.

4. RESULTS

4.1 Review statistics

The primary objective of the review was to assess the effectiveness of interventions used to control American Mink, *M. vison*. Searching revealed only sufficient studies to assess the effectiveness of trapping as an intervention to reduce the population size. Therefore subsequent results refer to trapping only.

Searching retrieved 780 articles. A further 18 articles were later found through searching bibliographies and a further 22 were obtained from personal communications with authors, libraries and relevant organisations, increasing the total number of 'hits' to 840. Removal of duplicates reduced this figure to 690 unique articles to be assessed for relevance at title and abstract. After this initial assessment stage, 91 articles required viewing at full text for relevance to the inclusion criteria.

The majority of these articles were inapplicable to the question; 26 did not have the relevant populations, 33 did not use the relevant intervention and 6 did not report an outcome. A further 19 articles were unobtainable leaving seven in the final review. Articles were labelled unobtainable only after attempts at acquisition through contact with the author, organisation or inter-library loans services. The final seven articles generated 10 datasets, none of which included a control for comparison of treatment against non-treatment.

4.2 Study quality

For the purpose of study quality, all studies that were accepted at full text were subjected to assessment, independent of whether the data was suitable for meta-analysis.

4.3 Summary of scores

As no controls were included in the experimental design, the baseline comparison and intra treatment variation could not be measured for any of the studies. No replication was carried out for any of the experiments. The studies accepted for final review could only be awarded a score for their basic study design; all studies were Time Series and received a quality score of 30 (see Appendix 1).

4.4 Outcome of the review

The 10 time series datasets accepted into the final review have been analysed qualitatively in Table 1, which includes the potential reasons for heterogeneity that exist.

Table 1: Ecological and experimental characteristics of the ten datasets accepted into the final review.

	Reasons for heterogeneity						Population size		
Study	**Length of experiment (months)**	**Habitat**	**Season**	**Size of area**	**Trapping effort**	**Other predators**	**Before trapping**	**After trapping**	**Number of mink trapped**
Moore et al (2003)	16	Varied , blanket bogs, lakes and streams, hilly area, max altitude = 719m	All seasons	1114 Km^2	2300 traps, 2.25 - 3.1 traps per Km2, over 62, 000 trap nights.	Otters, *Lutra lutra* and ferrets, *M. furo*	487	263	224
Maran, T. (2000)	17	9 hunting regions divided form the area	All seasons	1000 Km^2	45 - 65 traps over 1000 sq Km	Beavers	74	62	12
Macdonald, D.W. & Harrington, L.A. (2003)	12	Nature reserve, no details of habitat	All seasons	20 x 30 Km	Intensive	No details	Max 100	20 to 30	70-80% caught
Nordstrom, et al. (2003)a	108	Archipelago National Park in the Baltic Sea, South Western Finland, sparse vegetation with patches of grass or juniper	Mainly Autumn and Spring	Trapping area = 72 Km^2 sea areas and 1.15 Km^2 land area, Control area = 35 Km^2 sea area and 0.57 Km^2 land area	No info on intensity	White Tailed Eagle and Eagle Owl.	No info	No info	98
Nordstrom, et al. (2003)b	36	Archipelago National Park in the Baltic Sea, South Western Finland, sparse	Mainly Autumn and Spring	Trapping area =125 Km^2 sea area and 1.08 Km^2 land area, and Control	6 or 7 traps on and around islands	White Tailed Eagle and Eagle Owl.	No info	No info	50

		vegetation with patches of grass or juniper		area = 130 Km^2 sea area and 1.07 Km^2 land area					
Baker, S. (1989)	84	Across East Anglia, varied habitats	All seasons	1590 Km^2	1983 to 1985, number of traps increased 229%. Between 1987 and 1988, traps used increased by 12%	Coypu	No info	No info	370
Reynolds, J. (2003)a	4	River	Summer	12 km	10 rafts/km	No details	No info	No info	8
Reynolds, J. (2003)b	5	River	Autumn and Winter	12 km	10 rafts/km	No details	No info	No info	7
Mitchell, J.L. (1961)a	>12	River	All seasons	33.022 Km^2	Intensive	No details	280	165	115
Mitchell, J.L. (1961)b	>12	River	All seasons	33.022 Km^2	Intensive	No details	109	69	40

In studies where the estimate of the original population size was provided, calculated independently of the number of *M. vison* trapped (Moore et al 2003, Maran 2000, Macdonald & Harrington 2003, and Mitchell 1961), a decline in the population number can be seen (Table 1). Further statistical analysis is required to assign this reduction to the effect of trapping or an ecological feature of the selected sites, unfortunately the data does not exist to allow this to happen.

Nordstrom *et al* (2003), Baker (1989) and Reynolds (2003) do not provide an initial estimate of the population, only reporting on the number of *M. vison* caught, therefore the only conclusions that can be drawn is that the traps in these studies are capable of catching *M. vison*, the impact the trapping has on the *M. vison* population is unknown.

4.5 Reasons for Heterogeneity

Reasons for heterogeneity could not be investigated; the effect size for the studies could not be determined due to the lack of controls and thus the presence of heterogeneity within and between the studies could not be examined.

5. Discussion

The captured studies provided insufficient good quality data to allow meta-analysis to be performed. Thus an overall measure of effectiveness of trapping as a mechanism to reduce mink populations is not obtainable. Although a general decline in the *M. vison* populations is evident from those studies that included an original population estimate (calculated independently from the number of *M. vison* trapped), the cause of this decline cannot be attributed to any specific factor. This is primarily due to the absence of a control area where trapping did not occur. The secondary objectives of the review could not be investigated due to lack of data.

Further techniques for control are available such as shooting, hunting with dogs, and exclusion barriers but, due to lack of experimental evidence, such interventions could not be included in the review. This review focused on the U.K. and only English language searches were conducted. *M. vison* is not just recognised as a problem in the U.K. as escapes have led to feral populations in Sweden (Gerrell, 1971), Ireland (Smal, 1991), Iceland, Germany, France, Spain, the Former USSR (Macdonald & Strachan, 1999) and Patagonia, Argentina (Previtali *et al*. 1998). Therefore an extension of the review to include global searches is a possibility.

If the true effectiveness of trapping *M. vison* is to be established studies need a more robust design. Explicit reporting of the experiment and results is required so other influences that may be acting upon the outcome are known and investigated fully. Unfortunately studies often omit to report on such important detail. Without a control population to compare the experimental population to, assessment of the population trends due to food availability or fluctuations in birth and death rates are unknown, and little can be determined about the rate of immigration or emigration between local populations. Without taking these factors into consideration decrease in the abundance of *M. vison* in an area cannot be attributed to trapping alone. Although *M. vison* trapping and monitoring of the population size is occurring the efforts are essentially wasted as very little can be determined from the figures presented. Effective

monitoring will aid the production of effective management plans; this can only be cost effective in the long term, and reduce the population size of *M. vison* we see today.

Reviewer's conclusion

Implication for conservation practice
As the review shows evidence of effectiveness of trapping is inconclusive, no recommendations for change in current practice can be given. The effectiveness of current monitoring in areas where *M. vison* are subject to control efforts needs to be higher quality and more rigorous, incorporating recording of all ecological or treatment factors that could be acting upon the *M. vison* population.

Implication for future research
Further research into effective control of *M. vison* is essential. Only studies that investigated the effect of trapping were incorporated into the final review due to the lack of literature on other mechanisms, although other interventions do exist. There is thus a requirement that interventions such as shooting, hunting or exclusion barriers are explored to allow the most appropriate course of action to be determined.

For future studies to yield more valuable data they must incorporate a more robust experimental design. Experiments on natural populations are subject to a number of factors outside of the control of the experimenter and thus ideal experimental designs are rarely feasible, however, the design needs to incorporate both an experimental area and a control area; with the baseline characteristics recorded to allow potential reasons for heterogeneity to be identified. The baseline and final population sizes need to be calculated independently of the intervention, using a method such as mark-recapture. Once the experiment has begun the intervention effort must be recorded, and the site monitored for any changes. Ideally, monitoring of the experiment needs to be maintained to enable long-term success of the intervention to be assessed and, if re-treatment is required, the time-scale over which the intervention requires repetition.

As no analyses could be performed on variables that could affect effectiveness of the traps the implication here is that all ecological and experimental variables within the trials need to be reported and potentially further investigated if sufficient variability exists to warrant further work.

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Appendix 1
Summary sheets of the data quality scores for each articles included in the review.

Study	**Baker, S. (1989)**	
Methods	Details of two trapping campaigns, one by the MAFF in 1965, and one by Coypu Control throughout 1981 to 1988.	
Population	Homogenous population over seven years	
ion and Co interventions	O d	
Outcomes	Experiment/treatment	mink removal
	Campaign	152 captured (no original
Study design	Time series: 30	
Baseline Comparison	No control therefore comparisons can not be made: 0	
Intra treatment variation	No information: 0	
intervention and Co interventions	No information:0	
Replication & parameter of abundance	No replication:0	
Attrition bias	No information:0	
Sum of Data quality	Study	A
	Data quality score	30
Notes		

Study	Macdonald *et al.* (2002)	
Methods	series experiment. The area was 600Km^2. The first session was in 1992.	
Population	homogenous.	
Intervention and Co interventions	T ntion. No mentio tions.	
Outcomes	Experiment/treatment	mink removal
	1992	70 – 80 (80%)
ign	Time series: 30	
Comparison	There is no control are thus a comparison can not be made: 0	
Intra treatment variation	No information: 0	
Measurement of interventions	Trapping effort not stated however, trapping was intensive as the situation was urgent (threatened European mink). As it was a time series experiment, there was no trapping in the control treatment. There is no mention of previous control attempts in this area: 0	
parameter of abundance	There is no data regarding the replication of experiments: 0	
Attrition bias	eriments: 0	
Sum of Data quality	Study	A
	Data quality score	30
Notes	One section of a large report on the conservation of the European mink. Further details available in a review (Macdonald *et al.*, 2003).	

Study	Maran, T. (2000)		
Methods	mink onto the island. Three sessions of trapping was used, variations were made between sessions to improve results by trial and error. The area size is 1000 sq Km. A snow tracking survey estimated 74 mink present, rather then the 300 originally estimated. 45 – 65 traps were used over 3 separate 1 – 2 month sessions (90 – 180 trap nights) in 1999.		
Population	1 population contained on an island. Previous control attempts in the area but no co-interventions occurring during study		
Intervention and interventions	Trapping was the only intervention used. Previous control attempts had b area, but no c were mentioned at the time of the study.		
Outcomes		% mink removal	
	Experiment A: 1 – 21 Dec 1998 for three weeks and then again from 1 – 21 Feb 1999, by local trappers	12 of estimated 74 in 6 weeks of trapping over two sessions, population estimate after was 60 – 62 animals	
	1999, assisted by experts.	Last individuals trapped no sign detected of mink presence once completed, considered eradicated.	
	Exp. A & B are both time series: 30		
Baseline Comparison	There is no control area for comparison: 0		
Intra treatment variation	No information: 0		
Measurement of intervention and Co interventions	Number of mink caught compared to a population estimate is the method for measurement. No other co interventions occurred during treatment or		
Replication & parameter of abundance			
Attrition bias			
Sum of Data qua	Study	A	B
	Data quality score	30	30
Notes	The study outcome is that the estimated 74 mink on the island were trapped, with none remaining on the island. The first two sessions resulted in 12 mink captured, and in the 3rd session the rest of the population was removed. Further details in a review by Macdonald *et al.* (2003).		

Study	Mitchell, J.L. (1961)	
Methods	population estimate provided by mark release trapping. Number of tagged animals trapped commercially were used in a Lincoln Index to provide the population estimate	
Population	Mink population on Lower Madison River, Montana	
Intervention and Co interventions	C ing, and mark was used.	
Outcomes	Experiment/treatment	% mink removal
	commercial trapping. Of 39 tagged animals, 16 were trapped commercially to give pop estimate of 280	115 of 280
	to estimate 109 mink before commercial trapping commenced by using number (15) of marked mink caught commercially	40 of 109
	Time series experiment: 30	
Baseline Comparison	There was no control thus comparisons can not be made: 0	
Intra treatment variation	No information: 0	
intervention and Co interventions	No co-interventions mentioned. Trapping measured my number caught in a set time period, of an estimated number of mink.: 0	
parameter of	No replicates: 0	
Attrition bias	sses to report: 0	
Sum of Data quality	Data quality score	30
Notes	This study was on a mainland area, not isolated. It was conducted by commercial trappers, whose experience may increase trapping efficiency.	

Study	Moore, N.P., Roy, S.S. & Helyar, A. (2003)	
Methods	nesting birds. First, a feasibility study was conducted, more information was required on population size, habitats, and trapping success was required to estimate chances of success across the Western Isles of Scotland, so a preliminary trial was carried out. The trial area is 1114 Km2 (33% of colonised area). The trial began in 2001, aiming to eradicate mink on North Uist and Benbecula (533Km2) and to lower populations in South Harris (238 Km2) to reduce the risk of recolonisation of southern islands. After the discovery of mink beyond their previously known range, 343 Km2 was added to the area in southern Uist. Mink population numbers were estimated, for 3 occurring habitats in the location by capture-mark-recapture technique, these figures were then used to estimate minimum population numbers in each of the three habitats in linear density (mink/Km) then multiplied by habitat length. This provides an estimate of pre-breeding capacity. This figure was used to give a population estimate for the HMP area only (1114 Km2) which was used to compare to 16 subunits of the area after 7 initial nights of trapping. These subpopulation estimates were then summed to give an overall area estimate at the start of trapping of 487. Estimated population size was well below estimated carrying capacity of 2266.	
Population	Homogenous population, as it is a time series experiment.	
Intervention and Co interventions	Trapping is used throughout as an intervention, dogs were used in the final weeks to aid trapping.	
Outcomes	Experiment/treatment	% mink removal
	Experiment A: trapping between 001 and Feb 28 2003	224 of 487
design	Time series: 30	
Comparison	There was no control area so comparisons can not be made:0	
Intra treatment variation		
Measurement of intervention and interventions	A total of 2300 traps were used. Trap densities are recorded as traps per Km2, mean trap densities at 2.25 traps per Km2, but most of the mean densities over the area were 3.1 per Km2. Lower trap density in southern Uist at 0.6 traps per Km2. 62,000 trap nights were included (24 hours). No co interventions reported during the experiment, however trapping was carried out previous to the campaign by local gamekeepers, possibly explaining low populations co ared to carrying capacity: 0	
Replication & parameter of dance	No replications carried out, but repeated experiment over 16 continuous cannot be regarded as replications as the population numbers would be	
Attrition bias		
Sum of Data qua	Study	A
	Data quality score	30
Notes		
Other outcomes	Populations were reduced Trapping success was varied among seasons; most mink caught autumn and spring, esp. August and September. Only one artic tern colony of 97 was lost, suspected to relocate after loss of 83 eggs.	

Study	Nordstrom *et al*, (2003)	
Methods	has on breeding birds. This involved trapping of *M. vison* and thus provides data for this review.	
Population	Both trials are located in a small group of rocky islands.	
Intervention and Co interventions	S n the islands	
Outcomes	Experiment/treatment	ink removal
	A	98 trapped
		50 trapped
ign	Time series: 30	
Comparison	No control therefore comparisons can not be made: 0	
Intra treatment variation	No information: 0	
intervention and Co interventions	No information is provided on the number of mink killed by shooting:0	
Replication & parameter of abundance		
Attrition bias	No information:0	
Sum of Data quality	Study	Data quality score
	A	30
	B	30
Notes		

Study	Reynolds, J (2003)	
Methods	A trial for the Game Conservancy Trust, mink raft	
Population	No details about the rivers the trials were carried out on.	
Intervention and Co interventions	Trapping is the main intervention, no other information is provided.	
Outcomes	Experiment/treatment	mink removal
	A	8 mink trapped
	B	7 mink trapped
Study design	Time series: 30	
Baseline Comparison	No control therefore comparisons can not be made: 0	
Intra treatment variation	No information: 0	
Measurement of intervention and Co interventions	No information:0	
Replication & parameter of abundance	No replication:0	
Attrition bias	No information:0	
Sum of Data quality	Study	Data quality score
	A	30
	B	30
Notes		