Kandidatarbeten i skogsvetenskap
Fakulteten för skogsvetenskap

2015:25

Predators and Losses of Farm Animals
- Using Historical Swedish Data to Evaluate Bounties

Rovdjur och förluster av tamdjur
- analys av historiska data för att utvärdera skottpengar

Photo: Ashley Van Haeften

Edvin Rapp & Joakim Lundsten

Sveriges Lantbruksuniversitet
Institutionen för skogens ekologi och skötsel
Kandidatarbete i skogsvetenskap, 15 hp,
Handledare: John Ball, SLU, Inst för Vilt, fisk och miljö
Examinator: Tommy Mörling, SLU, Inst för skogens ekologi och skötsel

Program: Jägmästarprogrammet

Kurs:EX0592 Nivå:G2E

Umeå 2015

Kandidatarbeten i Skogsvetenskap

Fakulteten för skogsvetenskap,
Sveriges lantbruksuniversitet

Enhet/Unit	Institutionen för skogens ekologi och skötsel Department of Forest Ecology and Management
Författare/Author	Edvin Rapp & Joakim Lundsten
Titel, Sv	Rovdjur och förluster av tamdjur - analys av historiska data för att utvärdera skottpengar
Titel, Eng	*Predators and Losses of Farm Animals* *- Using Historical Swedish Data to Evaluate Bounties*
Nyckelord/ Keywords	Bounty, bounties, Sweden, historical, predators, farmanimals, damage, wolf, sheep/Skottpengar, Sverige, historia, rovdjur, tamdjur, skada, varg
Handledare/Supervisor	John Ball, Dept. of Wildlife, Fish and Environmental Studies Inst för Vilt, fisk och Miljö.
Examinator/Examiner	Tommy Mörling Institutionen för skogens ekologi och skötsel/ Department of Forest Ecology and Management
Kurstitel/Course	Kandidatarbete i skogsvetenskap Bachelor Degree in Forest Science
Kurskod	EX0592
Program	Jägmästarprogrammet
Omfattning på arbetet/	15 hp
Nivå och fördjupning på arbetet	G2E
Utgivningsort	Umeå
Utgivningsår	2015

PREFACE

We performed this study as a 15 bachelor's thesis at the Swedish University of Agricultural Sciences. We would like to thank our supervisor John P. Ball at the Department of Wildlife, Fish, and Environmental Studies.

ABSTRACT

Bounties have been a widely used method of wildlife management, especially for predators. Bounties were used by ancient Greeks and are still used frequently around the world. Despite this, there are few quantitative evaluations of the methods efficiency. In this study our goal was to test the hypothesis that bounties are effective by analyzing historical data from 1876 to 1930 in Sweden. We tested if the total amount of paid bounties reduced the economic losses of farm animals killed by predators. We also tested if the number of bears (*Ursus arctos arctos L.*), wolves (*Canis lupus* L.) and lynx (*Lynx lynx* L.) killed caused a decrease in the amount of sheep (*Ovis aries* L.) killed. Our hypothesis was that these factors would not have a significant effect and it was supported by our results. Many authors have been skeptical towards the efficiency of bounties, and there many potential flaws like fraud. Another problem with this economical motivation for hunting is that when the population decreases, large bounties are needed for hunters to keep the population from recovering. Even though bounties have often failed in controlling populations, people seem to forget these mistakes resulting in more resources being wasted. Our analysis suggests that the bounty system has had no significant effect on the economic loss caused by predation on farm animals in Sweden. The results also supported the hypothesis that the number of bears, lynx and wolves killed did not affect the number of sheep killed.

SAMMANFATTNING

Skottpengar har varit en vanligt förkommande metod för viltvård, särskilt rörande rovdjur. Det användes av antikens greker och används fortfarande frekvent runt om i världen. Trots detta så finns det få kvantitativa utvärderingar av dess effektivitet. Vårt mål med den här studien var att bidra till diskussionen genom att analysera historiskt data from 1876 tom 1930 i Sverige. Vi testade om det sammanlagda beloppet av utbetalda skottpengar hade en negativ effekt på den ekonomiska förlusten på grund av husdjur som dödats av rovdjur. Vi testade även om antalet dödade björnar (*Ursus arctos arctos* L.), vargar (*Canis lupus* L.) och lodjur (*Lynx lynx* L.) orsakar en minskning i mängden dödade får (*Ovis aries* L.). Vår hypotes var att dessa faktorer inte skulle ha en betydande effekt. Många författare har varit skeptiska till skottpengars effektivitet, och det finns många potentiella brister som t.ex. bedrägeri. Ett annat problem med en ekonomiskt motiverad jakt är att när rovdjurspopulationen minskar så krävs höga skottpengar för att jägare ska fortsätta jaga och förhindra en populationsåterhämtning. Även om skottpengar ofta har misslyckats med att kontrollera populationer, så verkar man glömma dessa misstag vilket leder till att mer resurser slösas bort. Vår analys stödde vår hypotes och föreslår att skottpengar inte har haft någon väsentlig effekt på den ekonomiska skada som orsakats av predation på boskap. Resultaten stödjer också hypotesen att mängden björnar, lodjur och varg som dödades inte påverkade antalet tagna får.

1. INTRODUCTION

Bounties have been used frequently through history, the earliest reports of bounties we found date back to approximately 500 B.C. in Athens and is concerning wolves (*Canis lupus* L.) (Mech & Boitani, 2003). The first occurrence found in Swedish laws was in Södermannalagen 1327 (Inger, 2015, Anon, 1870) where it states that a person who killed a litter of wolf -pups or an adult was entitled to money from every farmer in the affected area. The first law which included bounties from the state was established in 1647 and promised bounties for both brown bear (*Ursus arctos arctos* L.) and wolf (Anon, 1870). During the following years more and more species were added to the list and by the time that our study period begins in 1876, hunting bounties were offered for basically every predator from seals (*Halichoerus grypus* Fabricius*, Pusa hispida* Schreber *and Phoca vitulina* L.) to eagles (*Aquila chrysaetos* L. *and Haliaeetus albicilla* L.)*)* (Anon, 1876).

In modern times, this method has been used in some areas of Sweden as recently as 2008 for both mink (*Neovison vison* Schreber) (Anon. 2015a) and for red fox (*Vulpes vulpes* L.) (Anon, 2008).

Overall then, bounties seem to be a popular and well-known management method for problematic species and it is not uncommon to suggest it as a solution. The Swedish Association for Hunting and Wildlife Management recently stated that it would be the best option for dealing with the increasing population of raccoon dog (*Nyctereutes procyonides* Gray) in northern Sweden (Andersson, 2010) and in some areas the Federation of Swedish Farmers have recently suggested it for wild boar (*Sus scrofa* L.) (Anon, 2011).

Hunting bounties has also been used all around the world with a number of species e.g. coyote (*Canis latrans* Say) in USA (Bartel & Brunson, 2003), red fox in Australia (Kirkwood, Sutherland et al 2014) and puma *(Puma concolor* L.*)* in Argentina (Llanos, Travaini et al 2014).

Despite the widespread use of bounties as a method of population management, we found few studies that evaluated and came to a clear conclusion on the effect of bounty systems. Among those who actually did an analysis, all concluded that individually bounties did not cause the desired effect (Kirkwood, Sutherland et al 2014; Omand, 1950). Most of these studies are from Australia where bounty schemes have been popular but have successively been replaced with more effective methods e.g. poisoning (Smith. 1990, Fairbridge & Marks, 2005).

This question has been discussed for a long time and we have found skeptical reports in the early 20th century, for example “Nearly all experienced writers on the subject question the efficacy of bounties” (Henderson & Craig, 1932). It is a complex question which has not been fully answered yet and we hope to help with our study by focusing on the big predators, bear, wolf and lynx (*Lynx lynx* L.) and sheep (*Ovis aries* L.) in Sweden from 1876 to 1930.

1.2 Purpose

The purpose with this study is to test if there is evidence from the long-term data available for Sweden that bounties on predators reduce subsequent losses of farm animals. From what we have found, no similar study has been made in Sweden or elsewhere and we think that it is important to evaluate whether or not such a widely-used method is effective in controlling predator damage. We have chosen to split this into two questions:

1. Is the economic damage done by predators lower in time periods following a large amount of bounties?

2. Is the amount of sheep killed lower in time periods following a large amount of killed predators?

1.3 Hypothesis

The null hypothesis we test is that in neither of the questions, the bounty system has had little or no effect on the damage on farm animals by predators.

Many are skeptical towards bounty systems (Neubrech, 1949: Henderson & Craig, 1932)(Bartel & Brunson, 2003; Fairbridge & Marks, 2005; Omand, 1950). There may be several potential problems e.g. that for hunters, it is more profitable to treat bounties as a sustainable harvest instead of exterminating all animals and collecting one big bounty (in other words, they will kill predators in year one, but be careful to not kill all so they can collect more bounty money every year after). There is also a risk of people bringing killed animals from another area to get the bounty (Henderson & Craig, 1932).

2. MATERIAL AND METHODS

This study was carried out between the 23rd of February and the 24th of April 2015, at the faculty of forestry, SLU, Umeå. Our data was collected from Statistics Sweden and the forestry library in Umeå.

2.1 Study Overview

1. The topic was researched through collecting articles and books on the subject.
2. Data concerning killed farm animals, killed predators, economic loss and bounties paid on predators was collected from historical documents.
3. The data was entered and processed in Excel to permit analysis.
4. The analysis was made in the statistical software JMP Ver. 11.2.1 (SAS Institute, Inc. Cary, North Carolina, USA).

2.2 Data Collection

Historical data about livestock killed by predators, number of predators killed and bounties paid were collected from the webpage of Statistics Sweden, SCB, under the heading Forestry 1870-1910 there the reports from Skogs-styrelsen/Domänverket where the original reports were scanned in as pdf's up until 1910 (Figure 1.) (Anon. 2015b). The reports from Skogs-styrelsen/Domänverket after 1910 were found in the SLU, University library, Umeå (Anon. 1911-1921; Anon. 1922-1930). Our data thus includes all of Sweden, divided in to 24 counties (Figure 2.) and runs for 55 years.

The data was extracted and compiled in a Microsoft Excel document for further analysis in the statistical software JMP.

Bil. 36.

Dödade rofdjur, samt skottpenningar, år 1880.

L ä n.	Björnar.	Vargar.	Lodr.	Jerfvar.	Räfvar.	Mårdar, Illrar och Lekatter.	Uttrar.	Sälar.	Roffåglar.	Kråkor.	Skottpenningar, af statsmedel. Kronor.	öre.	af andra medel. Kronor.	öre.
Norrbottens	18	16	—	105	373	—	—	100	219	330	1,530	—	—	—
Vesterbottens	5	5	2	14	571	146	—	218	273	98	840	—	—	—
Jemtlands	16	15	3	7	417	6	3	—	233	359	960	—	—	—
Vesternorrlands	2	—	4	2	607	—	—	—	403	397	715	—	1,024	20
Gefleborgs	—	—	6	—	374	4	7	116	152	127	225	—	111	—
Kopparbergs	6	—	1	—	468	1	—	—	544	184	175	—	1,046	50
Vermlands	1	—	7	—	945	—	—	—	1,472	124	125	—	4,272	—
Örebro	—	—	1	—	626	—	—	—	681	—	—	—	1,866	80
Vestmanlands	—	—	1	—	546	—	—	—	990	901	25	—	6,153	10
Uppsala	—	—	—	—	645	—	—	—	237	—	25	—	1,939	10
Stockholms	—	—	—	—	807	—	—	—	1,000	3,494	—	—	3,984	80
Södermanlands	—	—	—	—	992	3	—	—	437	3,044	—	—	1,794	40
Östergötlands	—	—	—	—	1,243	—	—	—	1,583	—	—	—	8,416	50
Gotlands	—	—	—	—	173	—	—	—	180	1,130	—	—	700	—
Skaraborgs	—	—	—	—	491	—	—	—	146	1,513	—	—	1,349	—
Elfsborgs	—	—	—	—	766	2	—	—	284	1,140	—	—	2,239	—
Göteborgs och Bohus	—	—	2	—	589	—	—	—	239	1,005	—	—	2,332	—
Kalmar	—	—	—	—	1,004	—	—	—	1,143	401	—	—	4,220	50
Jönköpings	—	—	—	—	486	—	—	—	150	1,108	—	—	1,834	35
Kronobergs	—	—	—	—	624	2	—	—	395	300	—	—	1,863	—
Hallands	—	—	—	—	443	—	—	—	284	—	—	—	2,456	25
Blekinge	—	—	—	—	254	—	—	—	396	—	—	—	904	—
Kristianstads	—	—	—	—	635	—	—	—	572	2,484	—	—	168	50
Malmöhus	—	—	—	—	797	—	2	—	1,182	7,009	—	—	79	10
Summa	48	36	27	128	14,876	164	12	434	13,295	25,148	4,620	—	48,753	60

Bil. 37.

Husdjur, dödade af rofdjur, år 1880.

L ä n.	Hästar.	Nötkreatur.	Får.	Getter.	Svin.	Renar.	Fjäderfän.	Beräknad skada. Kronor.	öre.
Norrbottens	2	3	428	7	—	1,896	30	17,511	—
Vesterbottens	—	—	166	5	—	407	136	4,909	—
Jemtlands	—	18	169	22	—	400	222	5,300	—
Vesternorrlands	—	—	567	16	—	1	943	3,735	—
Gefleborgs	—	—	65	1	—	—	310	551	—
Kopparbergs	—	10	104	22	—	—	462	1,157	—
Vermlands	—	3	272	8	—	—	1,207	2,454	—
Örebro	—	—	27	—	—	—	1,101	1,084	—
Vestmanlands	—	—	40	—	—	—	1,041	1,304	—
Uppsala	—	—	2	—	—	—	1,762	1,532	—
Stockholms	—	—	26	—	—	—	1,792	1,903	—
Södermanlands	—	—	41	—	—	—	2,046	2,348	—
Östergötlands	—	—	187	—	—	—	1,340	2,142	—
Gotlands	—	—	186	—	—	—	322	1,419	—
Skaraborgs	—	—	94	—	—	—	1,623	2,176	—
Elfsborgs	—	—	841	15	5	—	1,799	5,182	—
Göteborgs och Bohus	—	—	97	—	—	—	2,912	2,680	—
Kalmar	—	—	1,204	—	—	—	3,017	6,903	—
Jönköpings	—	—	717	—	—	—	1,218	3,729	—
Kronobergs	—	—	2,270	34	5	—	2,746	10,268	—
Hallands	—	—	893	33	—	—	2,206	6,490	—
Blekinge	—	—	786	30	20	—	3,811	7,563	—
Kristianstad	—	—	495	—	—	—	4,195	6,080	—
Malmöhus	—	—	186	—	—	—	4,957	6,103	—
Summa	2	34	9,863	193	30	2,704	41,198	104,523	—

Figure 1. Extract from Skogs-styrelsens underdåniga berättelse, report from 1880 illustrating how the data were recorded over a century ago (Image: SCB).

Figure 2. Historical map of Sweden, with county borders and county names as used prior to 1998 (Image: Hans Högman).

Data on the number predators killed was found as early as the year 1827, but the earliest data we found on farm animals killed and economic loss was from 1856 and this was summarized in five year periods, and therefore would not fit in to our yearly analysis. However, from 1876 there are yearly reports. After 1930 the collection of data on number of predators killed was discontinued. Our study thus ends up covering the 55 years 1876 to 1930.

We noted that some of the counties have changed names over the years from 1876 up until the present. Kopparberg is now Dalarna, Malmöhus and Kristianstad are now merged into Skåne county, Göteborg och Bohuslän, Älvsborg and parts of Skara is now merged in to Västragötaland. However, these changes were made in the 1990s and do therefor not affect our study (Anon. 1998). In our study, we use the names of the counties when the data were collected.

Because our data covered over such a long time period, the value of the Swedish krona was not constant (due to inflation, etc.). To solve this problem we converted all economic values to present day value, using a website by a docent in economic history at Stockholm University (Edvinsson, 2013). This uses the value of goods and services to transform currency from different time periods (e.g. 100SEK in 1876 equals the value of 5319SEK in goods and services in 2015).

Few data sets are perfect, especially when dealing with data this old and collected over so many decades. Below we list some sources of variation in our dataset.

- From 1910 and forward, only bounties paid out by the state were recorded in Domänverkets yearly report, but for all other years the yearly reports that are the basis for our data provide bounties from both state and other sources. Most of the other sources are from hunting clubs and municipalities and is mainly paid for small predators, like fox and birds of prey (figure 3.).

- For 1911 and after the bounty data only covers wolf, seal and wolverine. However for the rest of the 36 years we have bounty data from all species, still making our study the long-running data set on bounties that we could find.

- Reports on the number of bears killed from 1896 to 1927 are not to be found. This will not bias our conclusions, but does reduce our sample size a bit.

- Data on number of total number of sheep are not documented in 1912 and from 1919 to 1927 and 1927 to 1930. As noted above, this will not bias our conclusions, but does reduce our sample size a bit.

- The original reports did not generally distinguish between zeros and missing data. We handled this in a conservative manner by treating all as missing data. Thus, if a given year had a blank for the number of sheep killed, we treated that as “missing” and did not assume zero sheep were killed. Our analysis is thus based on reliable data, and data for which the value was unsure (i.e. missing or zero) were excluded to ensure that the conclusions we reach are reliable.

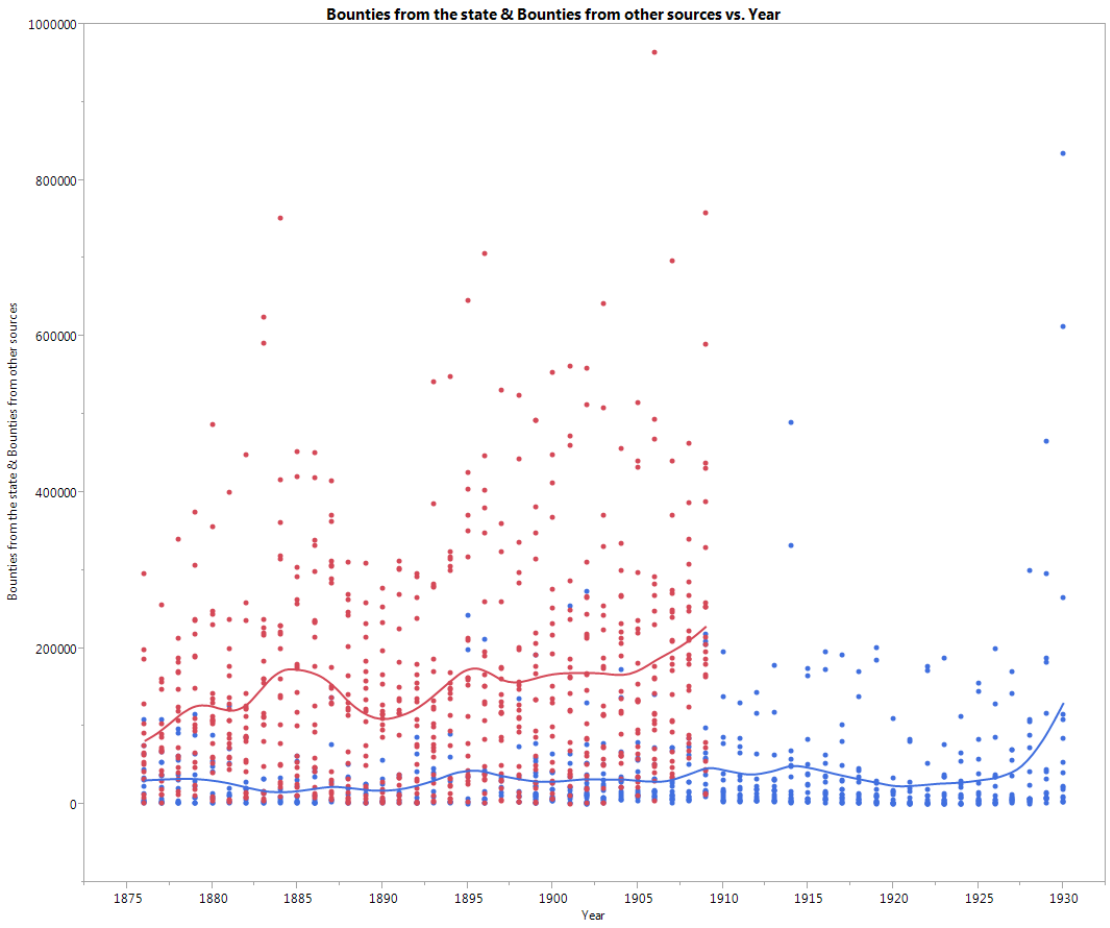

Figure 3. Bounties from the state and bounties from other sources over time. The red line shows bounties from hunting clubs, municipalities etc. and the blue line shows bounties paid by the states.

2.3 Analysis

Question 1: Is the economic damage done by predators lower in time periods following a period with a large amount of bounties?

To test the first question we performed a regression analysis using the data of economical loss with zero to three years of time lag vs total bounties paid for every year and county.

We then counted the occurrence of positive/horizontal slopes and compared it to the number of negative. If paid bounties have no effect on the economic loss there should either be an equal proportion between the two options or the number of positive/horizontal should be greater. An excess of negative slopes however is not consistent with the hypothesis that bounties are ineffective. In that case we continue the testing using a binomial test (Siegel & Castellan, 1988).

It seems reasonable to suspect that there might be a time lag between the moment of payment and the effect on economic loss, however we do not think that the time lag would be longer than three years. Therefore we did the analysis four times, first with total bounties and economic loss and then with bounties and economic loss with one, two and three years' time lag.

Question 2: Is the amount of sheep killed lower in time periods following a large amount of killed predators?

For the second question we did the same analysis as above but we used the percentage of sheep killed with zero to three years of time lag vs the amount of killed bears, lynx and wolves.

Our analysis focuses on the predation of bear, wolf and lynx on sheep. Sheep is the farm animal that is most vulnerable to predation by large predators and is preyed upon by all the earlier mentioned predators (Karlsson J et al. 2014 (Dahle, Sorensen, Wedul, Swenson, & Sandegren, 1998; Dondina, Meriggi, Dagradi, Perversi, & Milanesi, 2015; Kavcic, Adamic, Kaczensky, Krofel, & Jerina, 2013; Stahl et al., 2002). In our dataset sheep is also the most abundant farm animal of those who are potential prey for wolf, bear and lynx. Because the number of sheep varied greatly among years and among counties, we analyzed the percent of the sheep population killed by predators.

In Sweden large predators are a hot topic of discussion at the moment, and because time limitations did not permit us to analyze every predator, we did not include the smaller predators like wolverine (*Gulo gulo*), fox, mink, birds of prey and badger (*Meles meles* L.).

We examined all Swedish counties in all 55 years of our study. To ensure that our sample sizes were large enough to be reliable, we limited our analysis of sheep killed to counties where there was at least 10 distinct years in which predators of each species were killed. This leaves us with four counties, Jämtland, Kopparberg, Norrbotten and Västerbotten.

We suspect that the effect of bounties and killed predators probably has a time lag of a few years. Because there could be different recovery rates for different predator populations, the effect of bounties and killed predators might remain for a couple of years in some places, but in others it might disappear quickly. The recovery rate might also differ from year to year depending on e.g. population size and reassures available. We therefore added time lags in the data using Excel. It seems improbable that the effect would linger more than a couple years, but we chose to do up to three years of lag to have a margin of safety.

3.RESULTS

3.1 Overview

To give an overview of the data and our results we first present a number of graphs showing the extent of our study. The amount of killed animals varied greatly throughout the years as well as the bounties and economic loss (figure 4, figure 5). The proportions between the two sources of bounties varied from county to county with a consistent trend where sources other than the state played a bigger role in the southern parts of Sweden compared to the north (figure 6.).

.

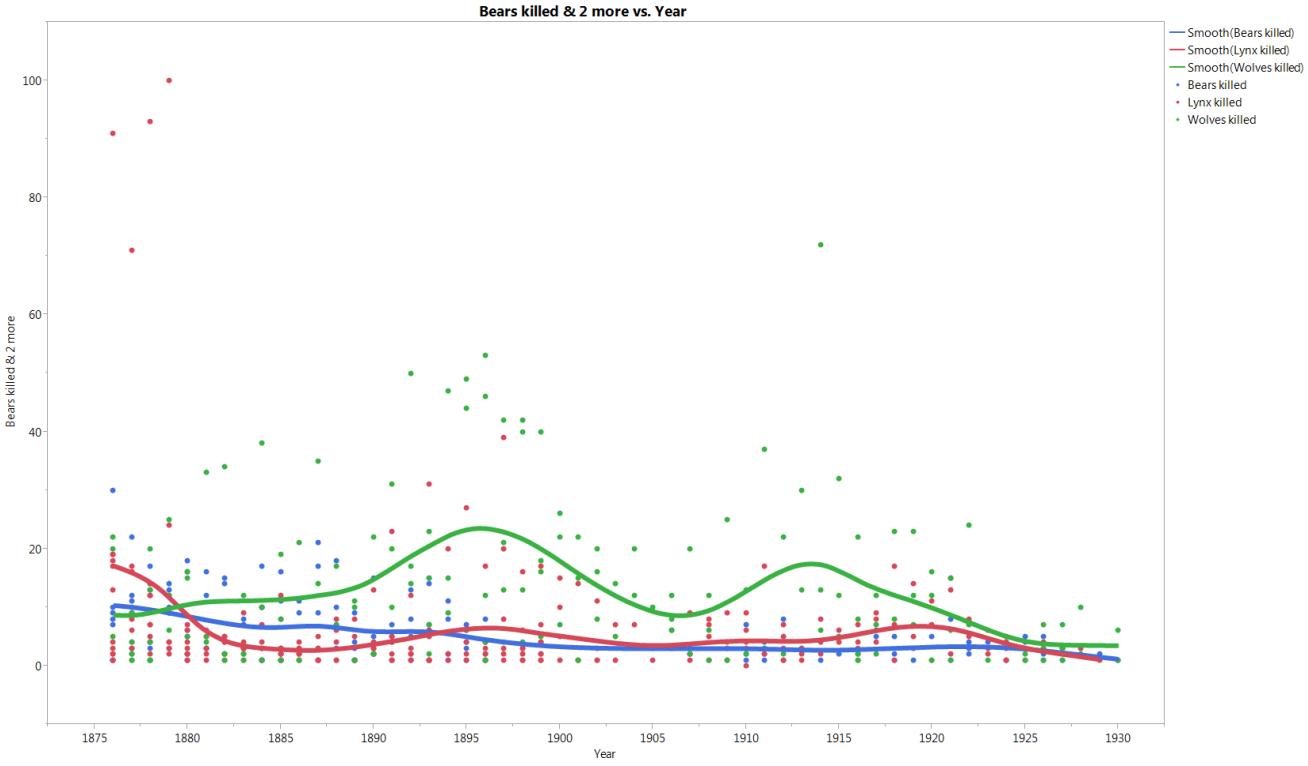

Figure 4. Number of bears (blue), wolves (green) and lynx (red) killed in Sweden each year 1876 to 1930.

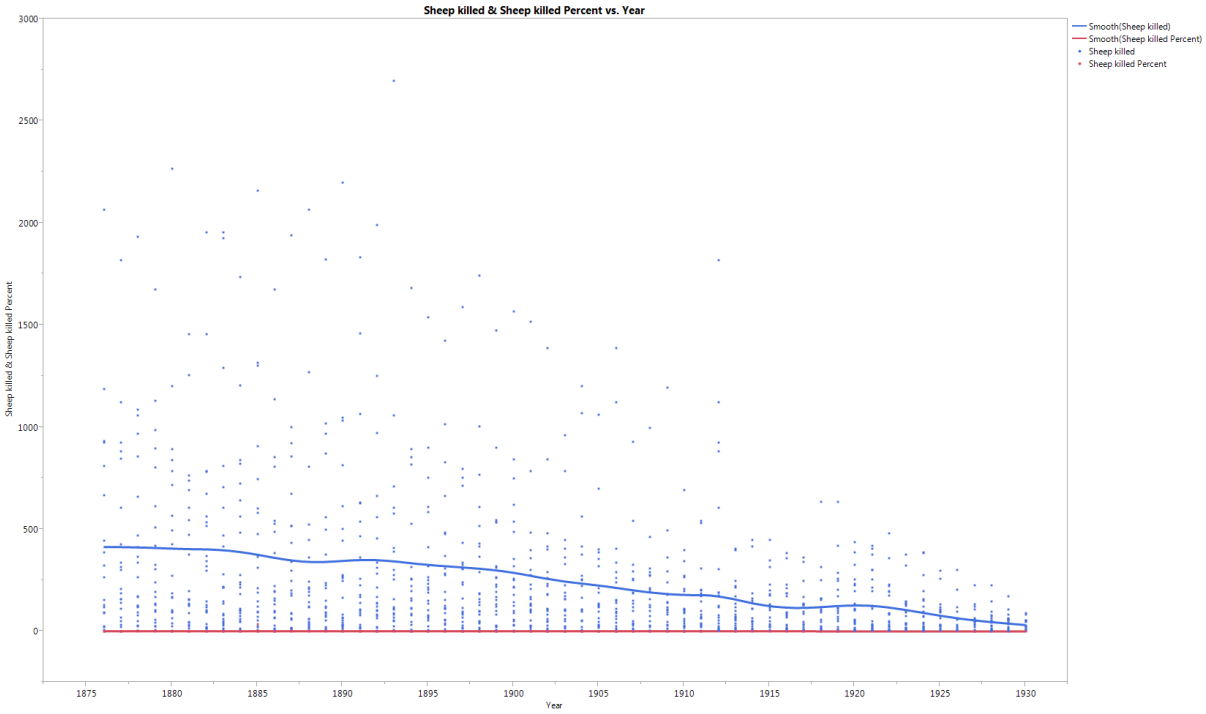

Figure 5. Number of sheep killed by predators in Sweden each year 1876-1930 in total amount (blue) and in percent of sheep population (red)

Figure 6. Bounties paid by the state (blue) and bounties from other sources (red) in every county and year 1876-1930.

3.2 Results

Question 1: Is the economic damage done by predators lower in time periods following a large amount of bounties?

With 24 counties during 55 years and with zero to three years of time lag, we got a sample size of 96 bivariate relationships. 38 (39,6%) of the regression slopes showed a negative relation between paid bounties and economic loss and the 58 remaining slopes were positive (Figure 7.).

If bounties did not have any effect, the 96 samples would be divided into a roughly equal numbers of both negative and positive relationships. If bounties were effective we would have significantly more than 50% negative relationships between bounties and economic loss and we would then perform further testing using the binomial test (Siegel & Castellan, 1988). In fact we got fewer than 50% of negative relationships between bounties and thus less then would happen by chance alone. This result strongly supports our hypothesis that the bounty system has had little or no effect on the damage on farm animals by predators and we therefore do not need to perform the binomial test.

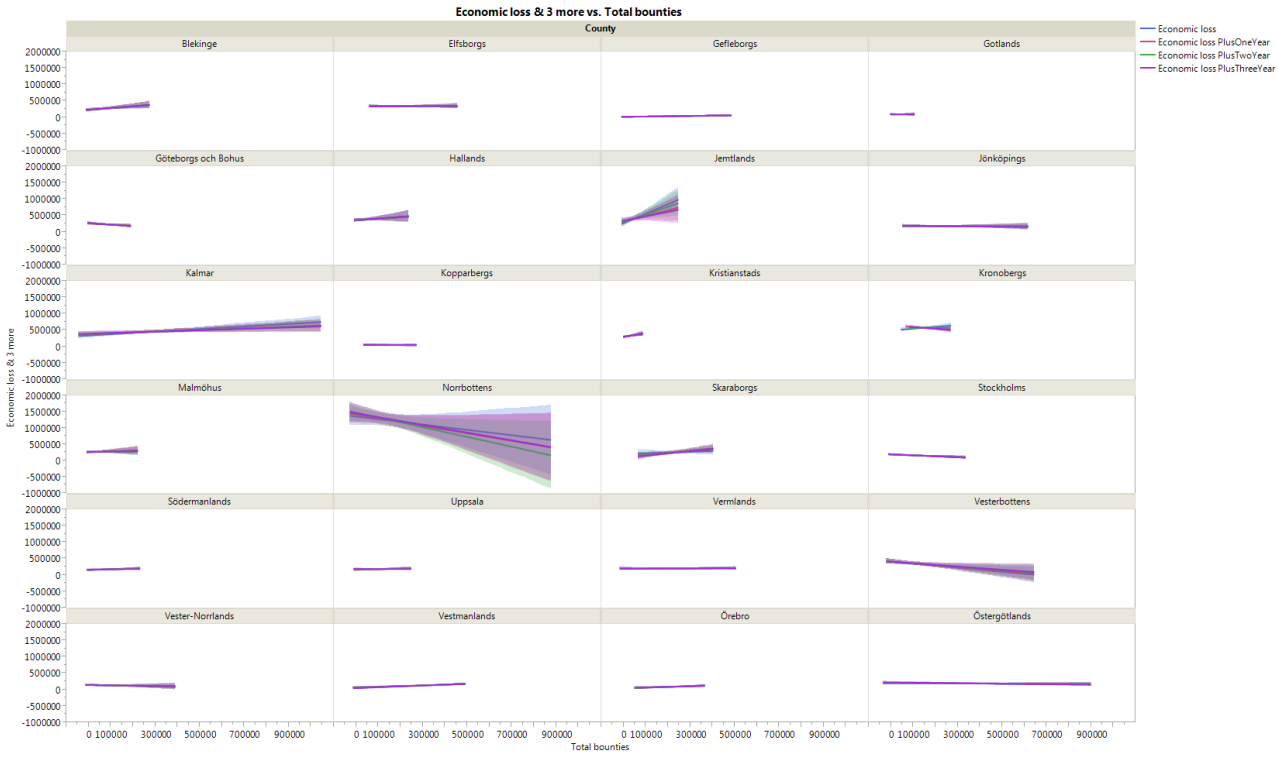

Figure 7. Regression analysis of economic loss with time lag from zero to three years vs total bounties.

Question 2: Is the amount of sheep killed lower in time periods following a large amount of killed predators?

The four counties with three different species of predators and zero to three years of time lag gave us a sample size of 48. 16 (33,3%) of the regression slopes showed a negative relation between paid bounties and economic loss and the 32 remaining slopes were positive (figure 8.).

These results are similar to the results in the first question and supports the hypothesis that the amount of bears, wolves and lynx killed, had little or no effect on the number of killed sheep.

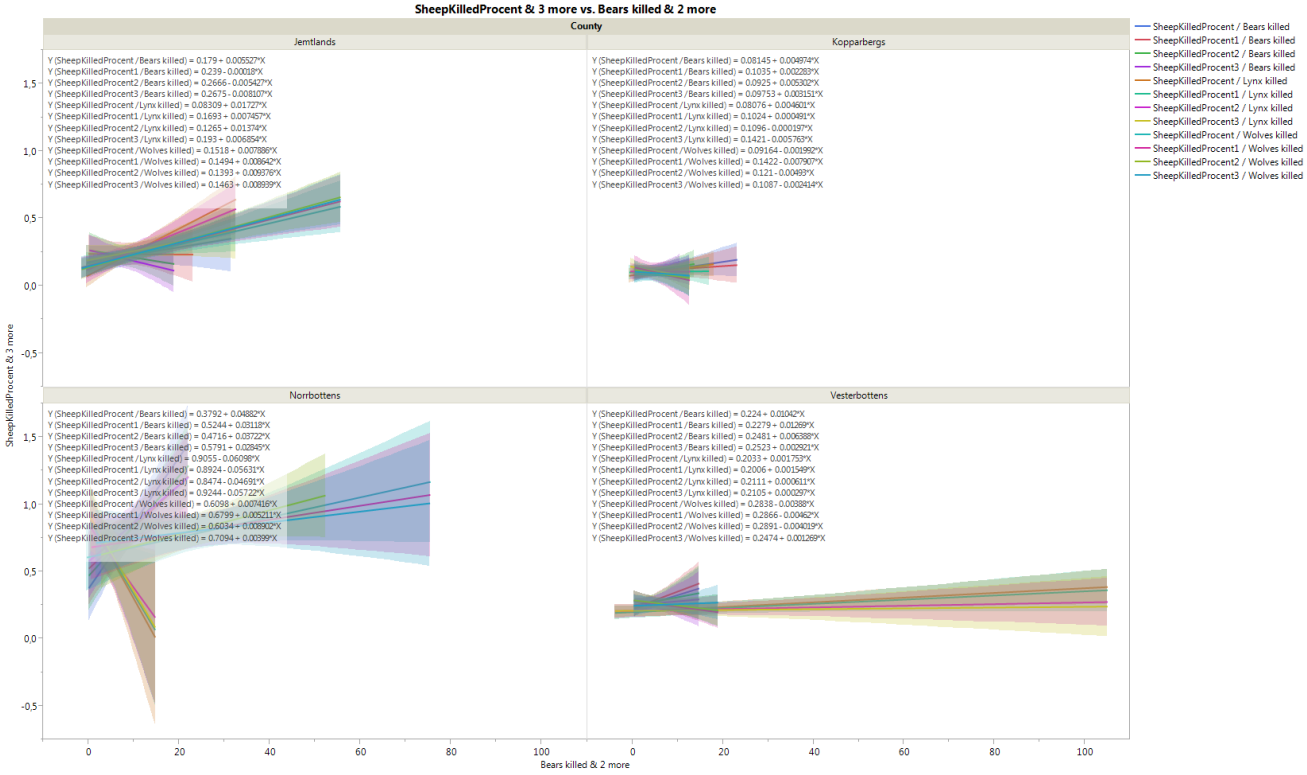

Figure 8. Sheep killed with zero from three years of time lag vs bears, wolves and lynx killed.

4.DISCUSSION

Regarding the effectiveness of bounty systems, our analysis of this long-running dataset revealed that bounties had no significant effect on the loss of farm animals.

As we mentioned in the introduction there are many possible ways for a bounty system to fail, an important one is that the main motivation for people to kill the unwanted animals is economic.

If bounties are low then hunters will only hunt as long as the species is abundant because it is not profitable when the animals get too hard to find and kill. Therefore high bounties are needed to make sure that predator populations do not get a chance to recover. High bounties on the other hand, become very expensive and also increase the risk for fraud (Neubrech, 1949, Henderson & Craig, 1932).

There is an array of frauds that can occur, if one area offers exceptionally high bounties it is likely that people bring killed animals from other areas to earn more money. There are even reports on people raising coyotes and wolves in farms and killing them for bounty because it was more profitable than raising livestock (Anon. 1902; Henderson & Craig, 1932).

Regarding the effect of predators killed on the number of sheep killed, one reason could be that the hunting does not focus on specific problematic individuals. Studies have shown that different predator individuals have different tendencies towards killing livestock (Stahl et al., 2002), so a general decrease in a predator population might not lead to a significant decrease in the predation on livestock.

Initially we did not know which counties that would be included in our analysis of farm animals vs predators and thus we did not invest the many hours to enter the reindeer (*Rangifer tarandus* L.) data. Since they were only present in a few counties it did not seem to be an important species. In hindsight though, three counties of the four that we looked at in this analysis (Norrbotten, Västerbotten and Jämtland) had extensive data on reindeer killed. We suggest that future studies could follow in our footsteps and investigate this.

Working with such old data there is no way for us to check if it is absolutely correct and it is possible that there are faults. In some reports we found corrections regarding earlier editions. Also some editions stated that the reported numbers could have a certain degree of unreliability and that Domänstyrelsen had tried to correct the data when possible. Still, it must be remembered that this is the official Swedish data, and that it was as correct as possible at the time.

One potential source of variation in the data is that during the study period, to copy data people had to do it by hand and in this case probably it was probably copied numerous of times before it got to the reports. However, since we follow so many years and our sample sizes are quite large, it is unlikely that such mistakes will alter our conclusions.

The results of our study concur with previous studies (Fairbridge & Marks, 2005; Kirkwood, Sutherland, Murphy, & Dann, 2014) but we still believe that more research is needed as bounties are still being used (Long, 2014).

In several of the previous studies there are also evaluations of other methods which have replaced bounty systems. Methods like poisoning and having employed hunters who focus on killing mainly problematic individuals have shown to be more effective then bounties (Neubrech, 1949 (Kirkwood et al., 2014)

4.1 Conclusion

Our analysis of this 55 year data set covering all of Sweden indicated that neither the amount of bounties paid nor the number of predators killed had any effect on the loss of farm animals in general, or on sheep specifically. Even though bounty systems have been criticized for decades, it is still being used frequently around the world.

It is a very simple idea in theory; give people money they will kill the unwanted animals. However it is a much more complex issue in practice, like in many cases where there is an economic motivation you will get cheating and frauds as a byproduct. Bounties seem to have a psychological effect of satisfaction however, and is perhaps popular because it seems to promise a fast fix when, for example, farmers complain of predators killing their livestock.

After researching the subject, it seems more effective to use other methods like poisoning or hiring hunters to kill problematic individuals.

5.REFERENCES

Andersson, R. (2010). Vill ha skottpengar på Mårdhundar. Jakt & jägare. Vill ha skottpengar på mårdhundar [2015-04-22].

Anon. (1870). Skogs-styrelsens underdåniga berättelse angående skogs- och jagtväsendet I Sverige intill år 1870. Skogsväsendet . Bidrag till Sveriges officiela statistik. http://www.scb.se/H/BISOS%201851-1917/BISOS%20Q%20Skogsv%C3%A4sendet%201870-1910/Skogsvasendet-Q-1870-I.pdf [2015-04-17].

Anon. (1876). Skogs-styrelsens underdåniga berättelse angående skogs- och jagtväsendet I Sverige år 1876. Skogsväsendet . Bidrag till Sveriges officiela statistik. http://www.scb.se/H/BISOS%201851-1917/BISOS%20Q%20Skogsv%C3%A4sendet%201870-1910/Skogsvasendet-Q-1876.pdf [2015-04-17].

Anon. (1880). . Skogs-styrelsens underdåniga berättelse för år 1880. Skogsväsendet . Bidrag till Sveriges officiela statistik. http://www.scb.se/H/BISOS%201851-1917/BISOS%20Q%20Skogsv%c3%a4sendet%201870-1910/Skogsvasendet-Q-1880.pdf [2015-04-24].

Anon. (1902). Farmers in Nebraska find a new industry. The New York Times, January 20, 1902.

Anon. (1911-1921). Kungl. Domänstyrelsens förvaltning: Skogsväsendet. Sveriges officiella statistik.

Anon. (1922-1930). Domänverket. Sveriges officiella statistik.

Anon. (1998). Svensk författningssamling 1998:1349. Tillkännagivande (1998:1349) om länens indelning i kommuner. Svensk författningssamling 1998:1349 Tillkännagivande (1998:1349) om länens indelning i kommuner - riksdagen.se [2015-04-22].

Anon. (2008). Åtgärdsprogram för fjällräv 2008-1012. Rapport 5927. Naturvårdsverket.

Anon. (2011). LRF vill införa skottpengar på vildsvin. Svensk Jakt. LRF vill införa skottpengar på vildsvin - Svensk Jakt [2015-04-22].

Anon. (2015a). Invaderande arter. Länstyrelsen Västerbotten. Invaderande arter - Länsstyrelsen Västerbotten [2015-04-22].

Anon. (2015b). Skogsväsendet 1870-1910. Statistiska centralbyrån Sök historisk statistik - Statistiska centralbyrån [2015-03-20].

Bartel, R. A., & Brunson, M. W. (2003). Effects of Utah's coyote bounty program on harvester behavior. Wildlife Society Bulletin, 31(3), 736-743.

Dahle, B., Sorensen, O. J., Wedul, E. H., Swenson, J. E., & Sandegren, F. (1998). The diet of brown bears Ursus arctos in central Scandinavia: effect of access to free-ranging domestic sheep Ovis aries. Wildlife Biology, 4(3), 147-158.

Dondina, O., Meriggi, A., Dagradi, V., Perversi, M., & Milanesi, P. (2015). Wolf predation on livestock in an area of northern Italy and prediction of damage risk. Ethology Ecology & Evolution, 27(2), 200-219. doi: 10.1080/03949370.2014.916352

Edvinsson, Rodney. (2013). Prisomräknare från medeltiden till 2100. Prisomräknare från medeltiden till 2100 [2015-03-05].

Fairbridge, D., & Marks, C. (2005). Vertebrate pest research: evaluation of the 2002/03 Victorian Fox Bounty Trial. Vertebrate pest research: evaluation of the 2002/03 Victorian Fox Bounty Trial., 1-27.

Henderson, J., Craig, E.L. (1932). Economic Mammalogy, 178-180.

Högman, Hans. (2015). Hans Högman's Genealogy and History Site _Hans Hogman's Genealogy and History Site [2015-04-23].

Inger, G. (2015). Södermannalagen. Nationalencyklopedin. Södermannalagen - Uppslagsverk - NE [2015-04-17].

Karlsson, J. et al. (2014). Viltskadestatestik 2013 - Skador av fredat vilt på tamdjur, hundar och gröda. Rapport från viltskadecenter, SLU 2014-1. 6.

Kavcic, I., Adamic, M., Kaczensky, P., Krofel, M., & Jerina, K. (2013). Supplemental feeding with carrion is not reducing brown bear depredations on sheep in Slovenia. Ursus, 24(2), 111-119.
Kirkwood, R., Sutherland, D. R., Murphy, S., & Dann, P. (2014). Lessons from long-term predator control: a case study with the red fox. Wildlife Research, 41(3), 222-232. doi: 10.1071/wr13196
Llanos, R., Travaini, A., Montanelli, S., & Crespo, E. (2014). Age structure of cougars (Puma concolor) hunted under the bounty system in Patagonia. Selective or opportunistic capture? [Estructura de edades de pumas (Pumas concolor) cazados bajo el sistema de remocion por recompensas en Patagonia. Selectividad u oportunismo en la captura?]. Ecologia Austral, 24(3), 311-319.
Long, W. (2014). New Victorian Government says fox bounty stays, wild dog bounty goes. ABC Rural. New Victorian Government says fox bounty stays, wild dog bounty goes - ABC Rural (Australian Broadcasting Corporation) [2015-04-22].
Mech, L.D., & Boitani, L. (2003). Wolves: Behavior, Ecology and Conservation, 318.
Neubrech, W. (1949) Predator Control Policy of Washington State Department of Game. *The Murrelet*, Vol. 30, No. 2: 37-39.
Omand, D. N. (1950). THE BOUNTY SYSTEM IN ONTARIO. Journal of Wildlife Management, 14(4), 425-434. doi: 10.2307/3797272
Siegel, S and Castellan, N.J. (1988). Nonparametric Statistics. For the Behavioral Sciences, second edition: 38-44.
Smith, M.J. (1990). The Role of Bounties in Pest Management with Specific Reference to State Dingo Control Programs. http://trove.nla.gov.au/work/8407242?q&versionId=9697898 [2015-04-24].
Stahl, P., Vandel, J. M., Ruette, S., Coat, L., Coat, Y., & Balestra, L. (2002). Factors affecting lynx predation on sheep in the French Jura. Journal of Applied Ecology, 39(2), 204-216. doi: 10.1046/j.1365-2664.2002.00709.x
Van Haeften, A. (Lynx picture on cover) https://www.flickr.com/photos/wikimediacommons/16357275719/in/photolist-6ipV8C-eD3Z8b-eaBQWt-eazZiX-95fqaB-eaA38z-qVrjca-dm21BE-nVXC6X-gjZjGn-bdWxgr-axrqoa-btku6x-iDuSLD-iqZKuX-ey7eHh-ay2bPq-dx47vS-9LCQrs-fGQybx-odJcAh-aARc3D-mVQFWd-bUg9mm-pApCju-k4UpY1-hXyU5f-qi2FjA-fjqRB1-pWaMYR-dWXzri-ohSVQR-jSrFxB-mskGBk-cKaxxJ-oKgwAz-fYaeca-bHfQ7z-j2hyfW-bujZwo-dJpG93-fQZPhS-iXjHvD-ojq1mz-bGbeyV-jDHRCq-mPFdgh-fmnWXe-aLbJri-bbn6oP