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PRELIMINARY ANALYSIS – PLEASE DO NOT QUOTE!

Making bushmeat hunting sustainable: economic incentives or draconian measures?

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Abstract

Central African peoples are very dependent on the natural resources they collect from the forest. The hunting of several animal species (bushmeat) is currently higher than their reproduction. In the long run, this will become a conservation crisis on the one hand with the possible extinction of several endemic species, while on the other hand the survival and quality of life of the people dependent on these resources are jeopardized.

A dynamic simulation model is developed to introduce a method which shows explicitly the impact of different policies on the animal population dynamics. The model and its simulation show an interesting perspective of the complexity of the wild meat extraction issue. No one single policy will be able to alter the current pattern of *unsustainable use – only a combination of policies and other measures will have a chance of succeeding with the conservation of the Central African fauna.*

Keywords

Bushmeat; Wild meat; Hunter; Economics; System dynamics; Non-linear modelling

Summary

Wild animal meat, or bushmeat, is an important source of protein in rural and urban households throughout Central Africa and is therefore a key component of food security in the region (Fa and Peres 2001; Fa, Currie et al. 2003). In the Congo Basin moist forests alone, between 1 and 3 million metric tonnes of dressed (slaughtered) wild meat is eaten each year (Wilkie and Carpenter 1999; Fa, Juste et al. 2002). The magnitude of exploitation and consumption, varies by country according to availability, but is also influenced by governmental controls on hunting, socio-economic status and cultural prohibitions. In areas where wildlife still exists, people collect, hunt, purchase and eat bushmeat for a variety of reasons.

Polices that address the bushmeat trade have been aimed at promoting the creation of animal sanctuaries where no hunting is allowed, or banning the exploitation of the more vulnerable species. Laws that stop the use of indiscriminate hunting techniques (e.g. leg-hold snares), or prohibit hunting in logging concessions have also been suggested. However, policies that directly tackle the trade suggest increasing the price of bushmeat, or encouraging production of cheaper alternative meats (domestic livestock) to topple dependence on wild meat (Bennett and Robinson 2000; Wilkie and Godoy 2001; Livestock & Wildlife Advisory Group 2002; Milner-Gulland, Bennett et al. 2003).

Through system dynamics modelling, we evaluated the current situation based on some general assumptions outlined below and then evaluated the impact of different policies on a series of scenarios to improve the current situation. Specifically we wanted to make a simulation model which shows the effect of different policies on a range of aspects of the system and how these feed back into this system. Using system dynamics, we built a simple bio-economic model for bushmeat hunting. To add realism to the variables in the model, we used data from bushmeat studies by John Fa on Bioko Island, Equatorial Guinea (Fa 2000) and from a recently terminated study by Lise Albrechtsen in the same area (Albrechtsen, unpublished data, 2004). Using the model we tested the impact of different policies on the viability of large and small animal populations on the island. This was done through an evaluation of the behaviour of the model against different policies.

The model is initialised in equilibrium where there are no hunters present in the system. From a modelling aspect, without hunting present, the animal population is stable and assumed to be at its carrying capacity.

To create a benchmark simulation, a number of professional hunters (70) are introduced into the model. Running the model with the hunters present, we see a sharp decline in both animal population groups (please refer to figure 2-9 showing the results of the model simulations with the different policies present). The decline is natural and does not tell us whether or not the harvest is sustainable. Although we know that the forest is continuously harvested, the decline comes from the assumption that when the simulation with the hunters starts, the animal population was at its carrying capacity. Any harvested population cannot continue to stay at its carrying capacity, however it can find a new lower equilibrium level (Milner-Gulland and Mace 1998). The benchmark simulation gives shows what would happen to the two animal groups in the model without policy interventions of any kind. As mentioned, we are modelling an already heavily hunted area and the seen decline echoes the severe reduction of animals that we predict is happening at the moment. Again, as this is a hunting system currently operating, the steepness of the decline is likely to come from an initial growth in hunter numbers. As the active hunters in the model is developed from a constant evaluation of hunter profit versus the profits gained from alternative labour, the initial increase in hunters could be seen as an ongoing process at the moment where alternative employment is still lacking. The benchmark simulation is portrayed in all the graphs.

After a review of the literature regarding different policy initiatives such as fines for hunting protected species (Damania, Milner-Gulland et al. 2004) and the purchase of permits to be allowed to hunt (Robinson 2004), we conducted an assessment of these and decided that there are at least three viable initiatives which could be applied on the island. These include an increase in the price of the larger animals in the market (policy 1a)[1] and/or of the smaller animals in the market (policy 1b);[2] ban the use of gun hunting which specifically target the larger animals, hence there are no primates being hunted (policy 2ab); and, finally, a 50% increase in the average alternative income on the island (policy 3).

Overall, the best single issue policy was a total ban on gun hunting – that is, no hunting on the large animal population (policy 2ab). Naturally, it was best when it came to conserving the large animal population (figure 4), but it also performed best when it came to conserving the small animals (figure 5) and in reducing the overall number of active hunters (figure 2). On second place came policy 1b, which reduced the price of the small animals in the market with 80%. The least favourable of the tested policies were policy 1a which reduced the price of the large animals in the market.

After identifying the best individual policy, we created a matrix and tested two policies in combination. In combination, there were two polices which came out particularly favourably: 1) a combination of reduced price per SA and no hunting of LA, and 2) the simulation with all the policies taken together[3] (that is, reduced price per SA, no hunting of LA due to a gun ban and an increase in the alternative profit).

Modelling aimed at improving conservation through understanding animal population dynamics or finding the sustainable yield of the animal population is no

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[1] This policy was introduced as a step function in which the price per LA decreased with 80%, the policy was initiated in year.

[2] Again, this policy was a step function decreasing the price per SA with 80% starting in year 1.

[3] One cannot combine policies 1a and 2ab as these are contradictory – that is, one cannot increase the price of the large animal population when there is no hunting of these animals.

novelty today. Modelling has been undertaken in order to support the findings of the research. New to the field in recent years, however, has been the increasing realisation of combining conservation biology with economics and social issues. Popular approaches such as bio-economics and ecological economics have often been used for melting the strong individual sciences into one. Unfortunately, all too often these approaches are used purely theoretically, developing (fancy) models which are hard to apply in a sensible way. This is not the rule, but applicable models are hard to come by.

It is important to recognise and understand the limitations of the model and the evaluated policy recommendations. Implementing any of the policies above will not only involve much effort, but it will also cost a fair amount of money for enforcement and regulation. In addition it requires that the local people also changes part of their behaviour (with regards to their preferences) and, at an extreme, aspects of their cultural and traditional meat consumption. However, that aside, the model gives us interesting insights into the dynamics of the system within the range of the underlying assumptions of this model.

Areas where we foresee further development and work on the model is to add other components to it, such as meat market dynamics (reference to the price dynamics and variations in the quality of the meat, such as smoked versus fresh versus live), dynamics of the stock of potential hunters (includes components on the significant population growth, 2-3 % per year, in this part of Africa), and to complete other sections of the supply chain of the meat such as including the intermediaries (the transporters of the meat from the hunters to the markets) and to introduce the bushmeat vendors into the system.

Figures

Figure 1:
A causal loop diagram identifying the main feedback loops present in the model. In total there are 7 balancing (negative) loops and one reinforcing (positive) loop which create the behaviour seen in the model. The behaviour of the system is a result of the dynamics of these different loops. The grey arrow from animal population to carrying capacity is not directly part of the feedback loops, but indicates that the carrying capacity is set based on the initial size of the animal population.

Figure 2:
The number of hunters' present for the different policy simulations. The aim is to reduce the number of hunters as there is a direct link between the actual number of hunters and the amount of animals being harvested. The policy which performs the best is policy which ban hunting with guns.

Figure 3:
An important factor for the individual hunters decision whether or not to hunt is the opportunities they have to earn a decent living. That is, the potential profit that they might earn in comparison with the average alternative income is of key importance.

Plotting the average hunter's income we are able to better understand the economic decision making of the hunters. The policy performing best is the no gun hunting one.

Figure 4:
The size of the large animal population (the six primate species) is of crucial importance for conservation. All of the policy simulations, bar the policy which does not allow hunting with guns, show a severe and serious decline in the population size. It is first after 10 – 12 years that the behaviour moves from decreasing increasingly to decreasing decreasingly. The best policy option here is the ban of use of shotguns for hunting.

Figure 5:
The small animal population, consisting of two rodents and an ungulate, are the most frequently seen animals in the Malabo meat market. In our simulation, there is an increase in this population after some 20 – 25 years in all scenarios, but the best performing policy is again banning the use of guns.

Figure 6:
When combining the policies, we see a different and improved behaviour. With regards to the hunter numbers, there is a sharper and more rapid decline in the number of active hunters. Here, our evaluation shows that the combined policy of a decrease in the price of small animals, no shotgun hunting and an increase in the alternative income is the best option.

Figure 7:
A combination of policies creates initially a volatile reaction in the average hunters' profit graph. At the end we do see that the best policy is the combination decreasing the price per small animal sold in the market and not hunting the larger animals (i.e. banning the use of guns).

Figure 8:
For the large animal population, all the policies (three of them) which include the ban on guns perform the best. In other words, only a prohibition on hunting these species will save them from severe depletion within this model.

Figure 9:
The small animal population performs best under the combination with all policies where there is a significant improvement in the population size over the 80 years of simulation within the model.

Figure 1: Causal loop diagram

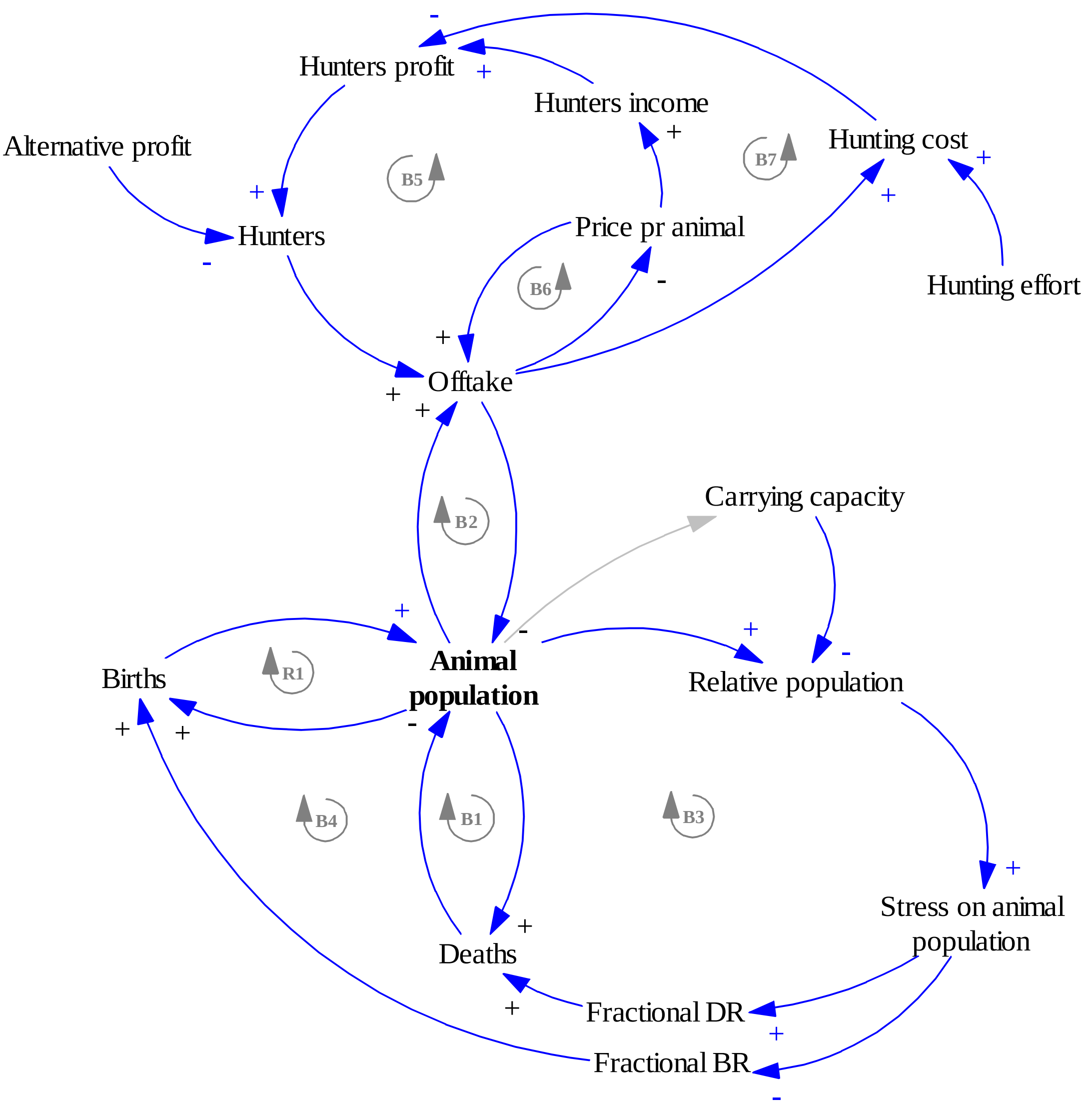


Figure 2: Single policies impact on hunter numbers.

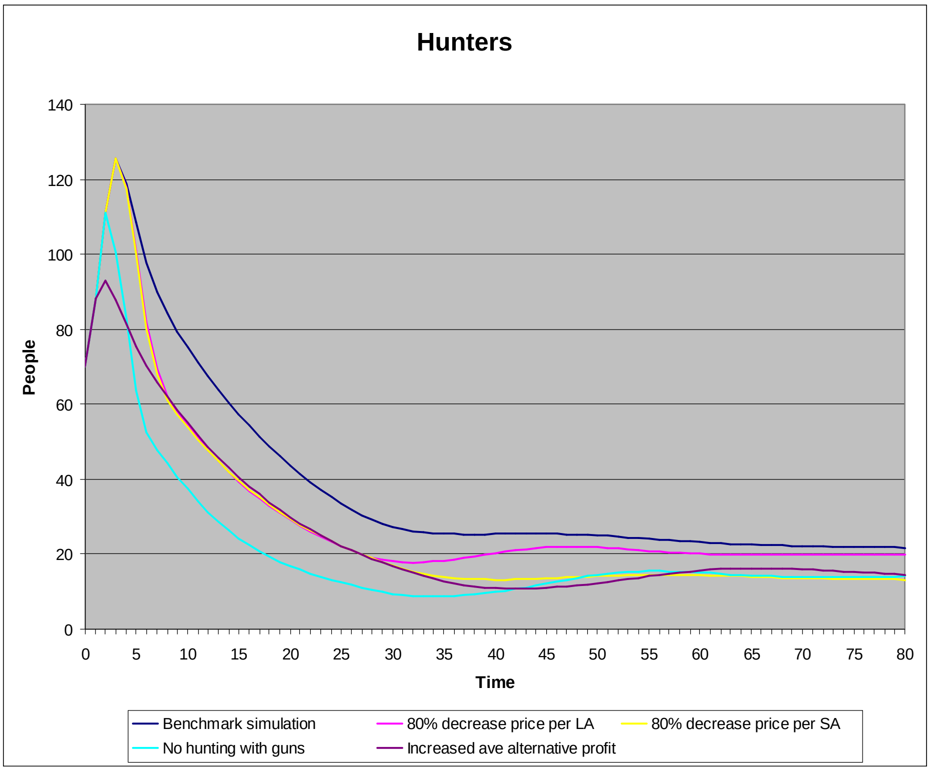


Figure 3: Single policies impact on the average hunter's profit

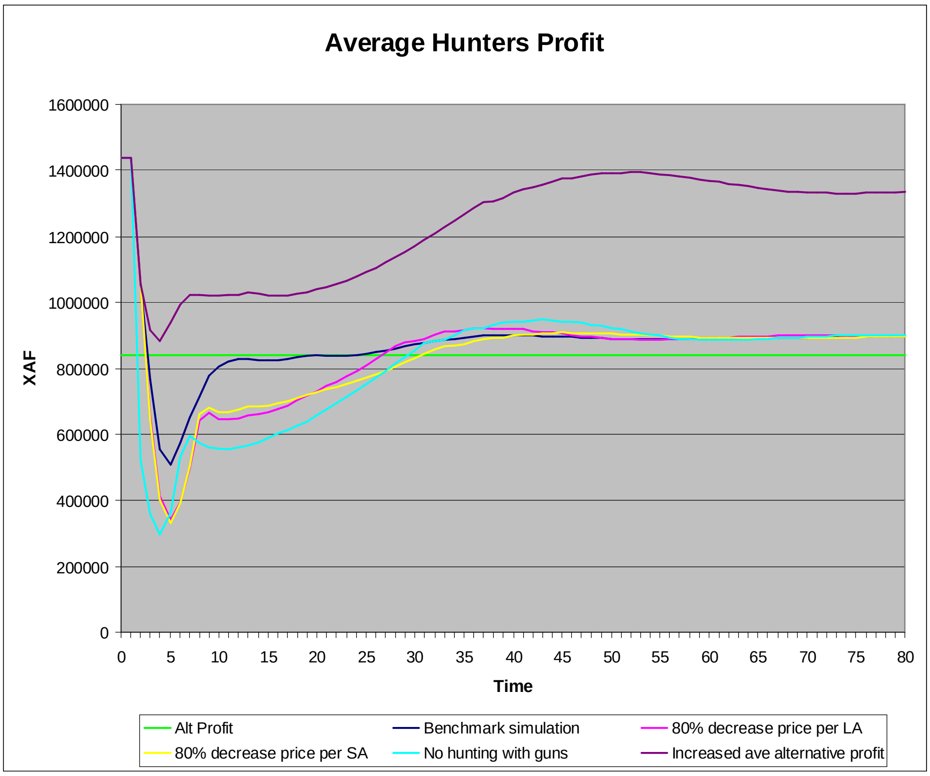


Figure 4: Single policies effect on the large animal population

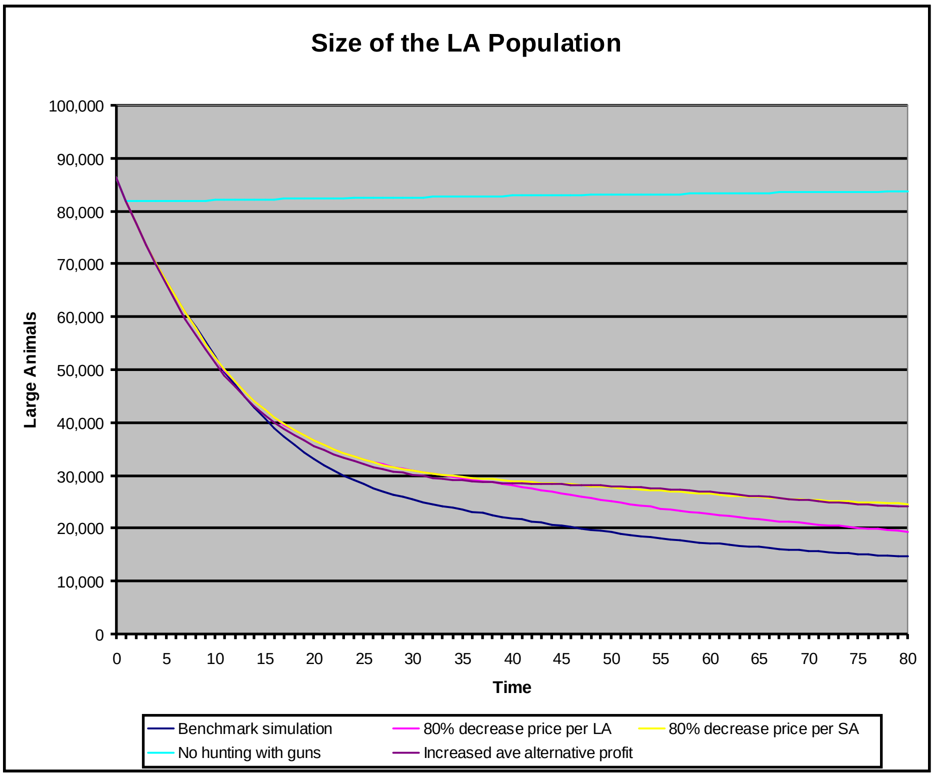


Figure 5: Single policies effect on the small animal population

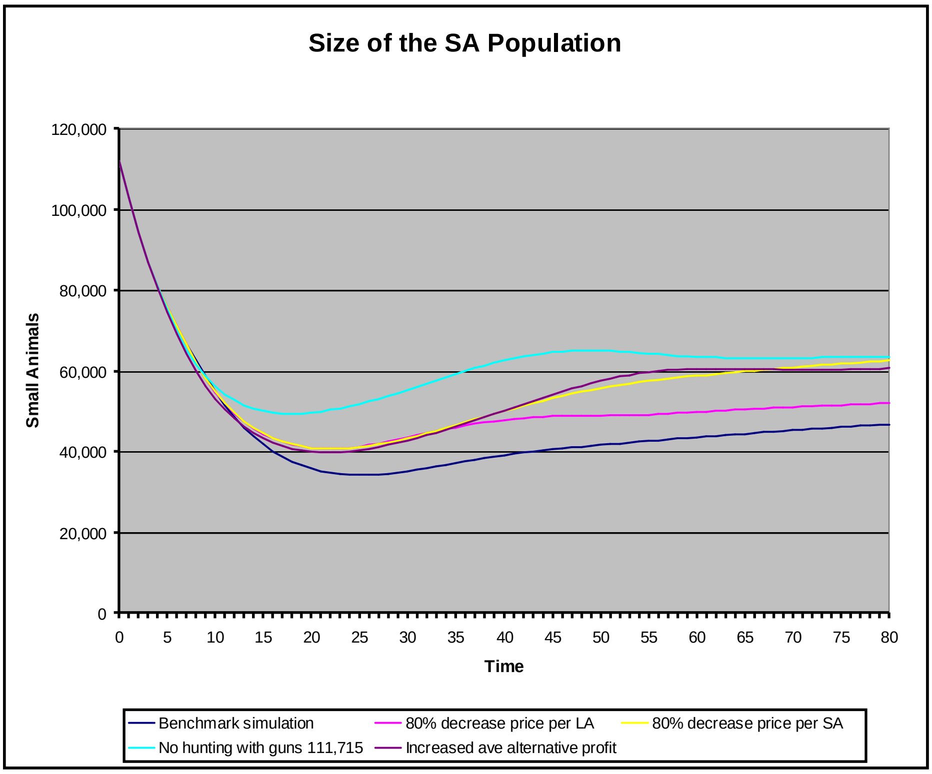


Figure 6: Combined policies impact on the number of active hunters

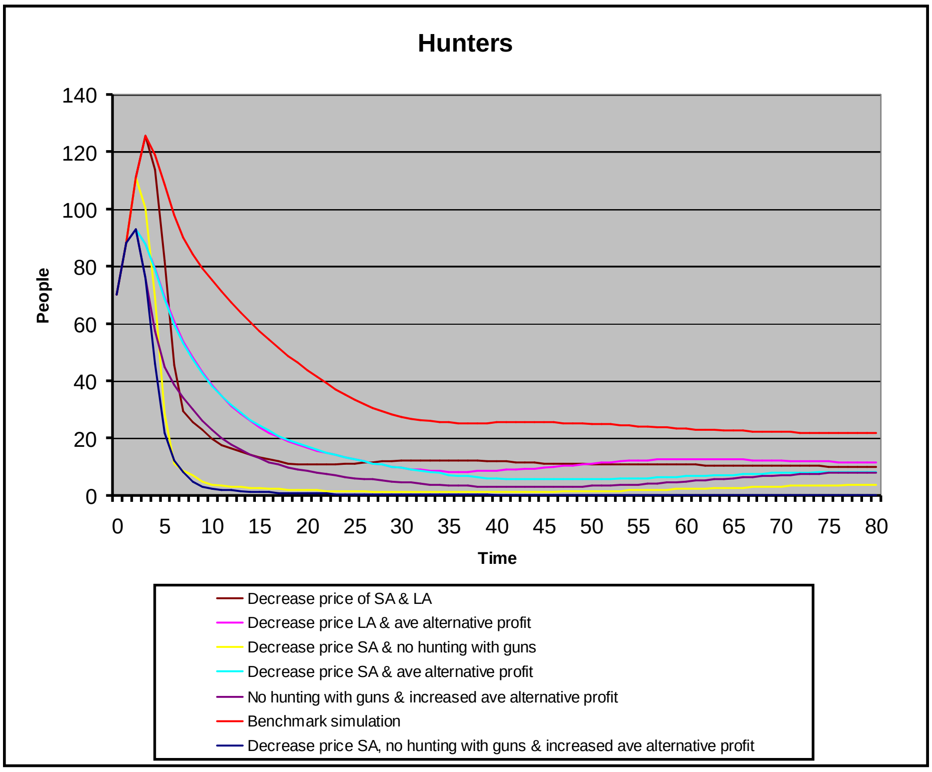


Figure 7: Combined policies impact on the average hunter's profit

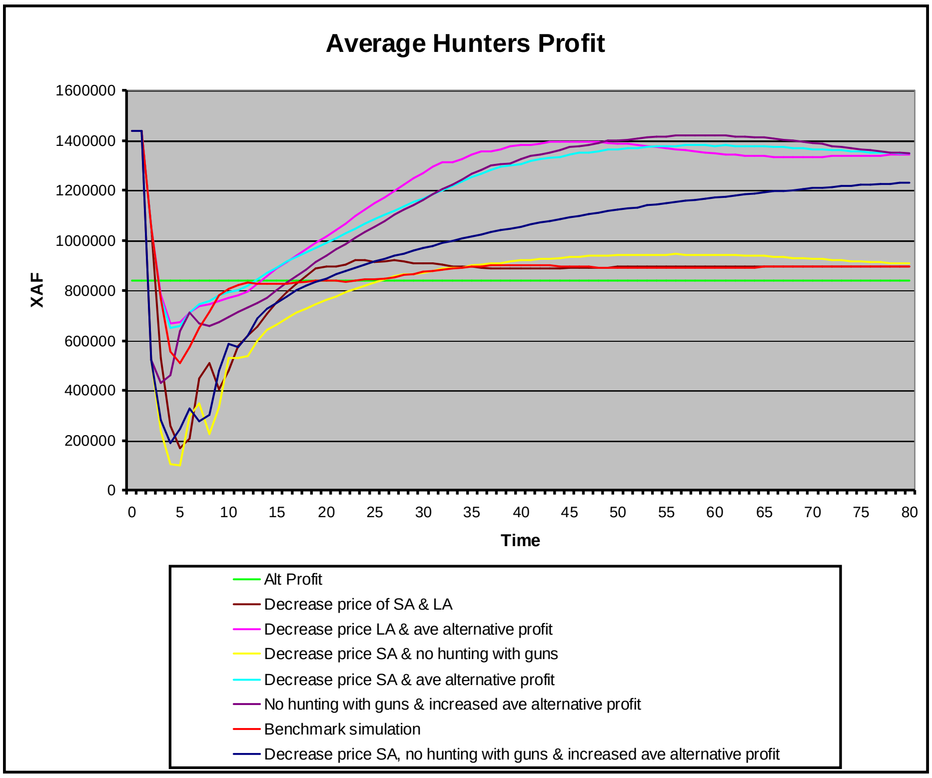


Figure 8: Combined policies effect on the size of the large animal population

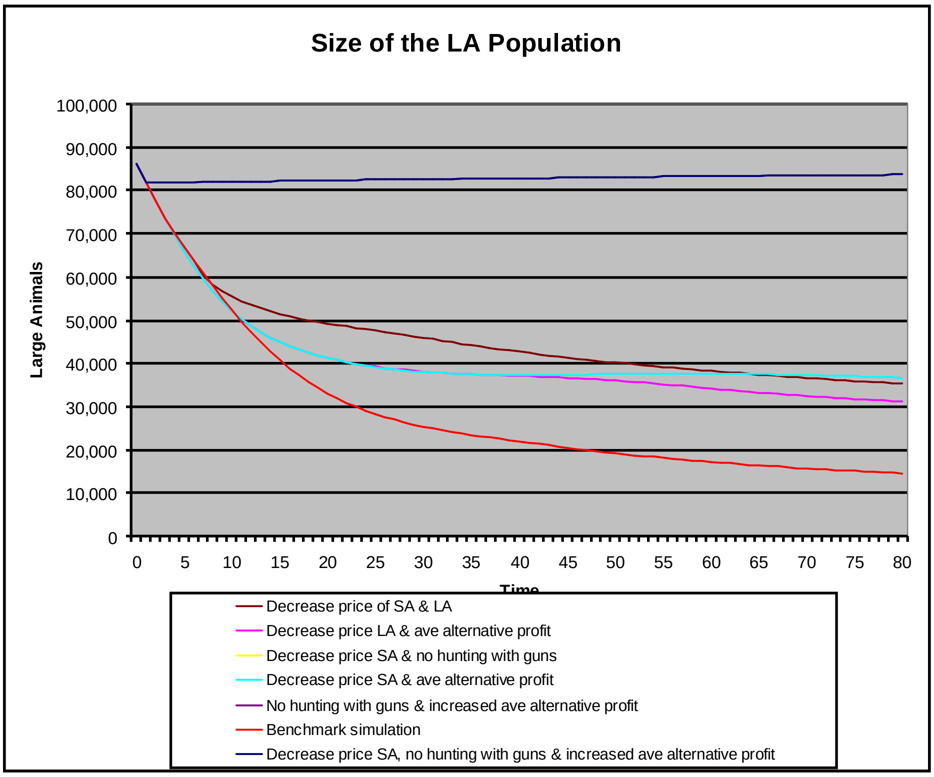
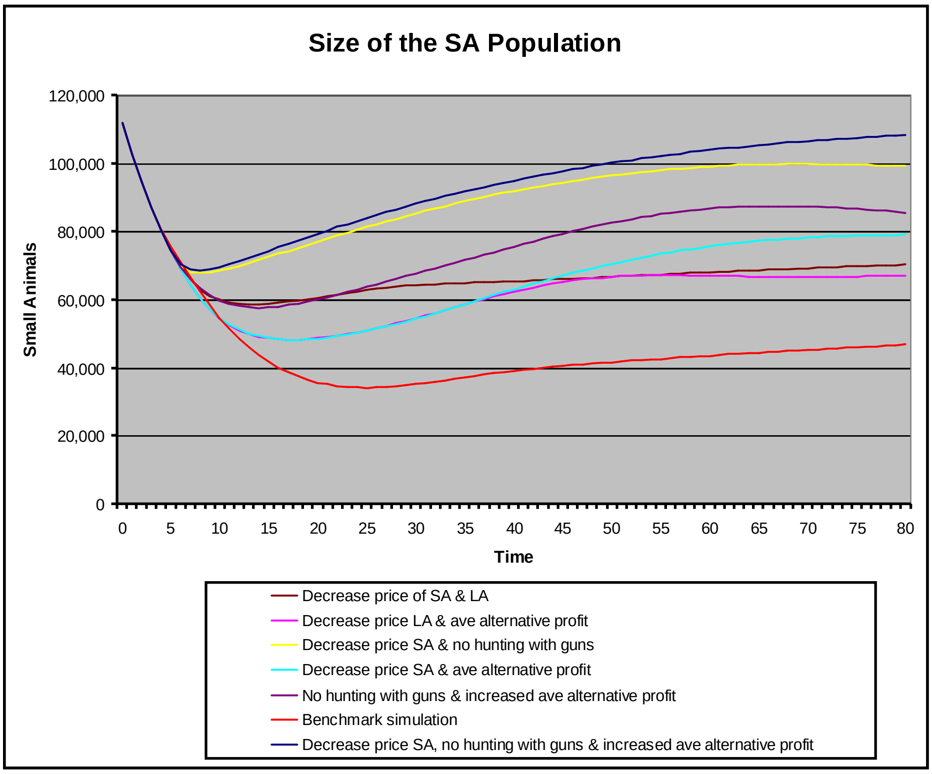


Figure 9: Combined policies effect on the size of the small animal population



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