Bear Culling under the Habitats Directive in Slovenia – Analysis and Recommendations

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1. Background

The Slovenian Ministry of the Environment and Spatial Planning adopted a cull rate of 100 brown bears for 2007. An additional 30 bears were estimated to die in traffic accident or due to natural causes. Given that Slovenia is only a small country and is bound by the Habitats Directive to conserve its bear population in a favourable conservation status – concern arose whether a bear mortality of some 130 bears can be sustainable.

On 19 and 20 April the Slovenian Ministry of the Environment and Spatial Planning organized an informal expert meeting to discuss the 2007 bear cull rate. In the morning bear experts and managers from Slovenia provided an overview about the legal framework of bear management in Slovenia, the LIFE Natura project for the conservation of large carnivores, the on-going integral monitoring, first results from a pilot project on DNA sampling, the development of bear damages, the legal procedure behind exceptional culls, the work of the intervention group, and how and why the 2007 cull rate of 100 bears was determined. The afternoon was reserved for discussions and the evening for bear viewing at selected bear feeding sites. On the 20 April a field trip was organized travelling through prime bear habitat to meet the major of the local municipality Stari Trg pri Ložu and a local farmer raising sheep and cattle in the bear area. In addition, the participants were shown feeding places for brown bear also used for the annual counts.

In addition to the oral material, three reports (The brown bear conservation and management in Slovenia, The brown bear management in Slovenia Report 2007, and Brown bear (*Ursus arctos*) management strategy in Slovenia, 2002) and pdf versions of all presentations were provided to the participants and are accessible at:

http://www.mop.gov.si/en/areas_of_work/environment_directorate/sektor_za_politiko_ohranjanja_narave/large_carnivores_in_slovenia/upravljanje_z_rjavim_medvedom/

http://www.mop.gov.si/en/areas_of_work/environment_directorate/sektor_za_politiko_ohranjanja_narave/large_carnivores_in_slovenia/

On the workshop it became quite clear that the Slovenian bear experts and managers are both competent and dedicated to ensure that brown bears will be conserved in a favourable conservation status. Both science and management is driven by the will to use the most up-to-date methods and technologies as well as a good documentation. As the idea of the workshop was to provide a discussion forum, the following analysis summarizes our understanding of the situation. The recommendations are suggestions on how to tackle the challenging bear – people situation in Slovenia. We are fully aware that this is not an easy task!

2. Analysis of the bear situation

All data for our analysis are derived from the documents provided on the website of the Slovenian Ministry of Environment and Spatial Planning. Additional information came from the discussions at the workshop in Masun on April 19/20.

2.1. Cull data

The total mortality rate is composed of losses (mostly traffic), life captures for re-introduction projects in other countries, exceptional culls of nuisance bears, and so-called quota kills for population control. Quota kills usually are realized by traditional hunting. These make up for more than 50% (Fig 1). The total cull rate almost tripled within the last 11 years: from less than 40 bears in 1995 to over 120 bears in 2006.

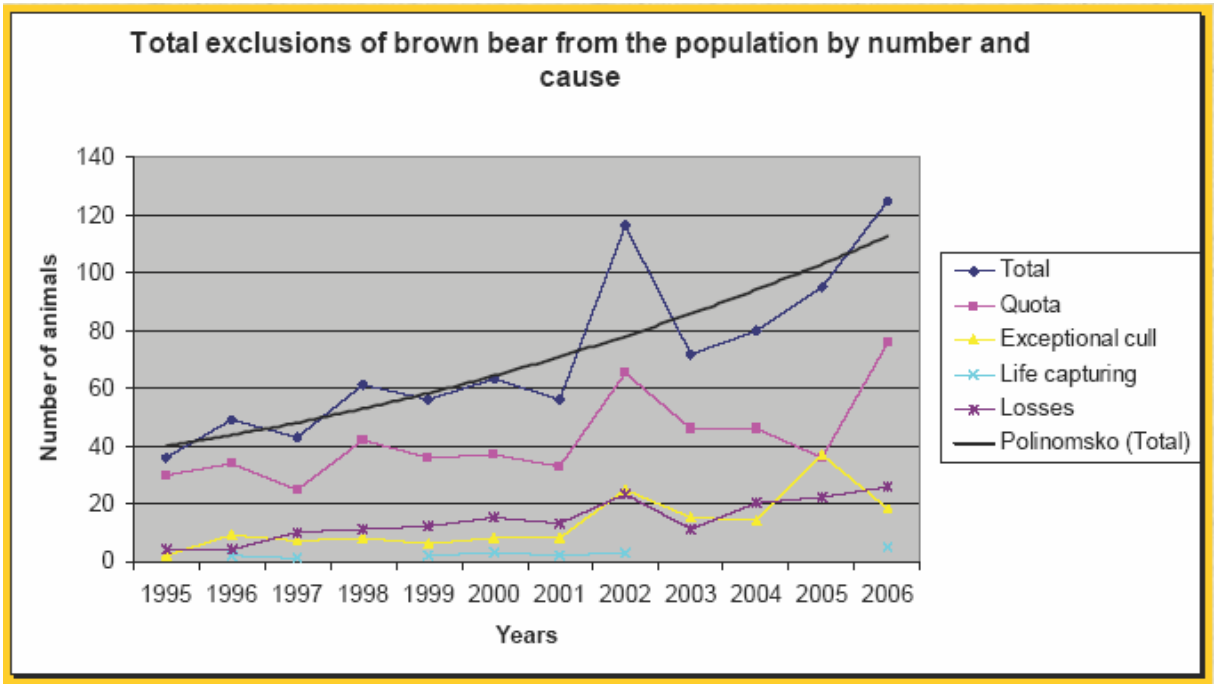

Fig 1: Cull rates of brown bears in Slovenia (Jonozovic, Masun 2007).

Whereas the sex ratio of the cull remained stable over time, the smaller weight classes seem to have slightly increased at the costs of larger bears (*Fig 2*).

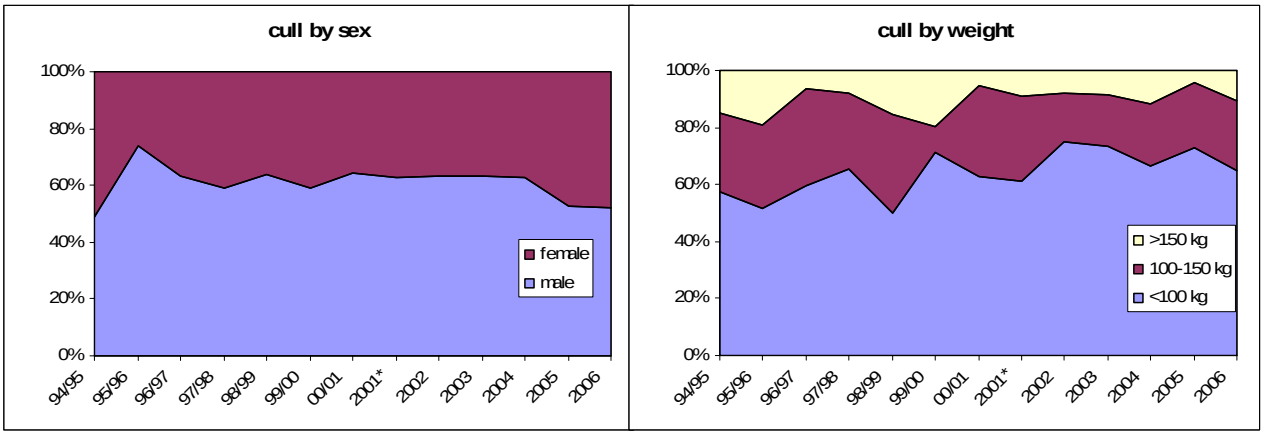

Fig 2: Culls by sex (left) and body weight classes (right) over time.

2.2. Monitoring data

The monitoring data are primarily based on the observations of bears at specific feeding sites. The data do not show any obvious trend, neither for the total number of bears counted nor for the percentage of females with cubs (Fig 3). However, in some years the data show large within-year variations (e.g. for the year 2000 for the total number of bears counted or for the year 2002 for the percentage of females with cubs; Fig 3).

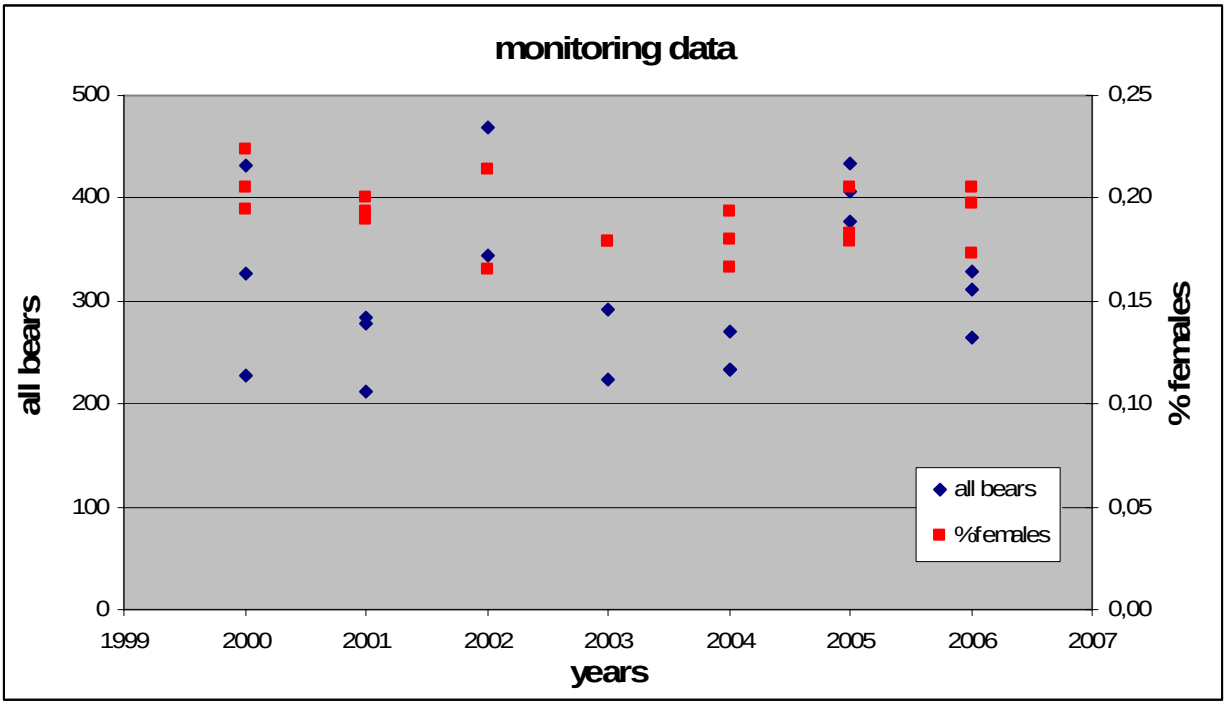

Fig 3: Monitoring data of brown bears in Slovenia 2000-2006.

Based on the counting data, both the total bear population and the percentage of females with cubs seem to be stable. However, there may be alternative explanations. Possibly social interactions among bears at feeding sites may restrict access to only certain groups of bears or a certain maximum number of bears per night.

Contrary to the counting data, the number of bear signs found by state hunters and foresters in SFS/PHASP Jelen (Sneznik) and Medved (Kocevje) increased since 1999. This suggests an increase in the bear population. However, there is no tested correlation between the number of bear signs and bear density under the current sampling design (e.g. the effort is unknown).

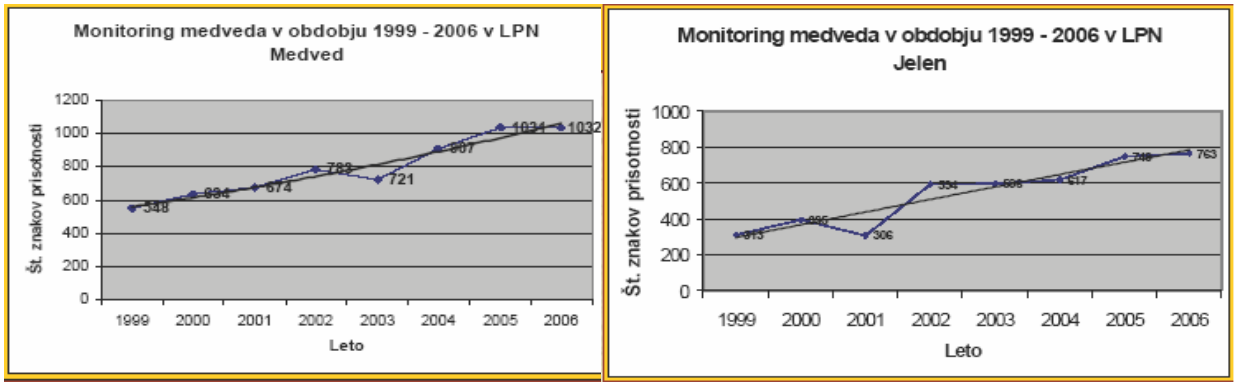

Fig 4: Bear signs in the two large state hunting grounds in Southern Slovenia. There is a positive trend in these data (Jonozovic, Masun 2007).

2.3. Damages and public acceptance

Bear damages in Slovenia dramatically increased from 1994 to 2006 and the reason for this are not fully understood (Fig 5). All participants agreed that the occurrence of damages is a poor indicator for bear density estimates. Experiences from other areas have shown that damages are not necessarily driven by an increase in the number of bears. Damage events depend also on a variety of factors, e.g. changes in land use, changes in the habitat quality, the damage compensation policy, the occurrence of "problem bears", people's perception of bears etc.

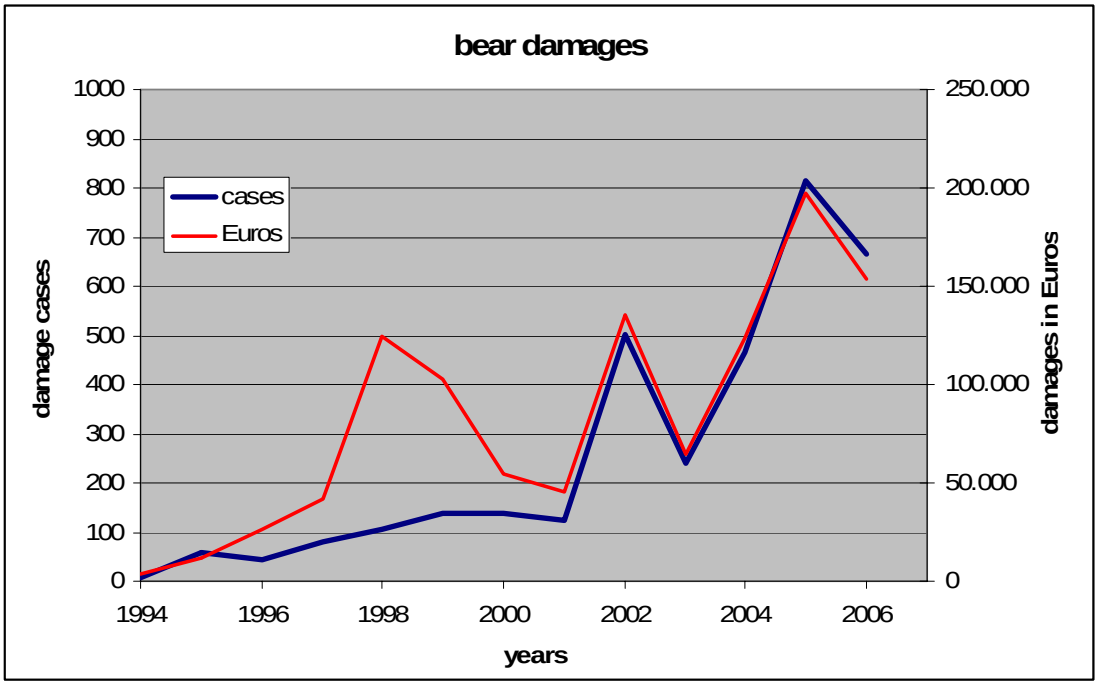

Fig 5: Bear damages in Slovenia from 1994 – 2006.

No recent studies on public acceptance of bears are available. Anecdotes give the impression that the acceptance has dramatically decreased since the late 1990ies (Kaczensky et al. 2004). From anecdotal data there are two possibilities: bear behaviour has changed and/or people's perception of bears has changed.

Apparently nowadays bears seem to frequently show up in the vicinity of villages and on open areas between single houses. This may be a consequence of having tolerated habituated females with cubs near villages in the past. As a consequence several litters may have become habituated or even food conditioned – resulting in a high encounter potential with people.

The social carrying capacity is a key for the coexistence of large carnivores and men. However, this social carrying capacity can be ruined by bad policy. Providing armed guards for children in order to go in the forest or school buses to protect children from bears is creating hysteria and is deteriorating public acceptance. In Slovenia people were used to live with bears, but seem in the process of loosing this tradition very rapidly.

As a reaction to increasing bear-people conflicts an intervention group was founded. The members are trained to address bear-people conflicts by providing information and/or deterring, translocating and removing problem bears. Despite the high level of human-bear

conflicts, most bears are still culled under the quota regime (traditional hunting) rather than as exceptional culls (Fig 6).

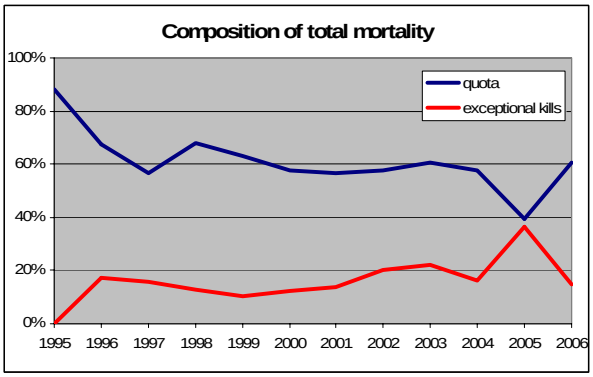

Fig 6: The percentage of quota (traditional hunting) and exceptional kills (nuisance animals) in the total cull. In all years the number of quota kills is higher than the number of nuisance animals killed.

In summary it is very difficult to assess the bear-people conflict situation due to the lack of hard data. On the one hand no statistics are provided on bear-people encounters, attacks on people or "unusual bear incidents" and on the other hand no representative data exists on the attitude of people towards bears. From the discussions it seems that there is a large difference in public perception of bears between urban and rural people.

2.4. Backcasting the bear population from 1994-2006

In order to get a better estimate of the actual size and structure of the Slovenian bear population we developed a simple population model. Using the available harvest data we tried to "re-simulate" the bear population dynamics from 1994-2006 by using a pattern-oriented approach (Grimm et al. 2005, Science). Our model is deterministic (no environmental or demographic stochasticity) and age and sex structured. We used the following parameters:

- age at first reproduction: 4 years
- inter-birth interval: 2 years
- sex ratio at birth: 1:1

Parameter values for natural mortality were taken from the bear population in Northern Sweden. Natural mortality rates are very low, ranging from 4-8% annual mortality for the different age classes. The annual cull rates by body weight classes were transformed to age and sex classes based on data from live-captured bears from Slovenia and Austria. The culling probability of females was corrected in order to reach the male biased sex ratio observed in the culls.

Because the reported ratio of 1.7 cubs per female is surprisingly low, we modelled different scenarios using three different values (1.7; 2.0; 2.4). The highest value of 2.4 cubs per female is based on cub ratios from Sweden, Croatia, and Austria. The size of the bear population in 1994 is not known. However, it is generally assumed to have numbered from 300 to 400 bears. We thus varied the starting population from 200 to 500 bears.

The pattern-oriented approach uses data and patterns as filters to model the most likely population development over the observed time. The idea is that the simulations fulfil all 3 patterns. The filters / pattern we used were:

(1) the absolute culls in each age and weight class per year,
(2) the observed population decline in 2003 after the high culls in 2002,
(3) the sex ratio based on the genetic analysis of Skrbinšek (Masun 2007).

Tab 1: Outcomes of the simulation model. Light green indicates parameter combinations, in which this filter conditions are fulfilled. Bold green indicates the final population sizes, where all filter conditions are fulfilled.

repro	initial pop	final pop	final sex ratio	popsize 2003<2002	years in which the cull could not be fulfilled. yrs 0 ad_m	yrs 0 m3	yrs 0 f3	yrs 0 m2
1,7	250	113	0,670	1	8	5	1	1
1,7	300	303	0,670	1	5	0	0	0
1,7	325	423	0,663	1	2	0	0	0
1,7	350	548	0,652	1	0	0	0	0
1,7	375	700	0,621	1	0	0	0	0
1,7	400	852	0,601	0	0	0	0	0
1,7	450	1157	0,576	0	0	0	0	0
1,7	500	1461	0,562	0	0	0	0	0
2,0	250	243	0,653	1	5	2	0	0
2,0	300	557	0,637	1	0	0	0	0
2,0	325	743	0,611	0	0	0	0	0
2,0	350	938	0,589	0	0	0	0	0
2,0	375	1134	0,575	0	0	0	0	0
2,0	400	1329	0,565	0	0	0	0	0
2,4	200	133	0,634	1	8	2	1	0
2,4	250	541	0,624	1	1	0	0	0
2,4	275	781	0,601	0	0	0	0	0
2,4	300	1042	0,578	0	0	0	0	0
2,4	350	1567	0,553	0	0	0	0	0
2,4	400	2093	0,541	0	0	0	0	0

Skrbinšek's sex ratio based on genetics			
mean	SD	95% CI_u	95% CI_l
0,569	0,043	0,65348	0,48492

Based on the simulations, the most likely population size for the present day bear population is 550-700 bears (Tab 1; Fig 7), which corresponds well with the estimates given by Slovenian bear experts and managers. According to the model between 26 and 29% of the total population are adult females, whereas the proportion of adult males is between 1 and 6%. This results in a highly skewed sex ration of 1:5-25 in adult bears. The rest of the population are young (23-26%) and subadult bears (44-47%). The proportion of 3-year-old females remained constant suggesting no cohort effects.

Reliability of this result: These results can be used only as a first estimate of the population size and a suggestion on how to approach this problem. There are the following shortcomings:

- The model is deterministic, ignoring environmental and demographic stochasticity. This might be of lesser importance as the availability of feeding sites likely buffers against natural food shortages. The relative large population size makes the population less susceptible for demographic stochasticity.
- The sex ratio is estimated only for a part of the Slovenian bear range. However, the ratio was only a weak filter and had no effect on the final model selection (Tab 1).
- The population size in the year 2003 was set to be significantly smaller than in the year 2002. This observation is not very well founded on data, but acted as a strong filter against high population numbers. This requires a more detailed analysis.

- It was necessary to be able to fulfil the observed cull. This is a very strong filter against small population numbers. Further modelling approaches should use more detailed data, e.g. the actual sex and age data based on the cross-section of the teeth.

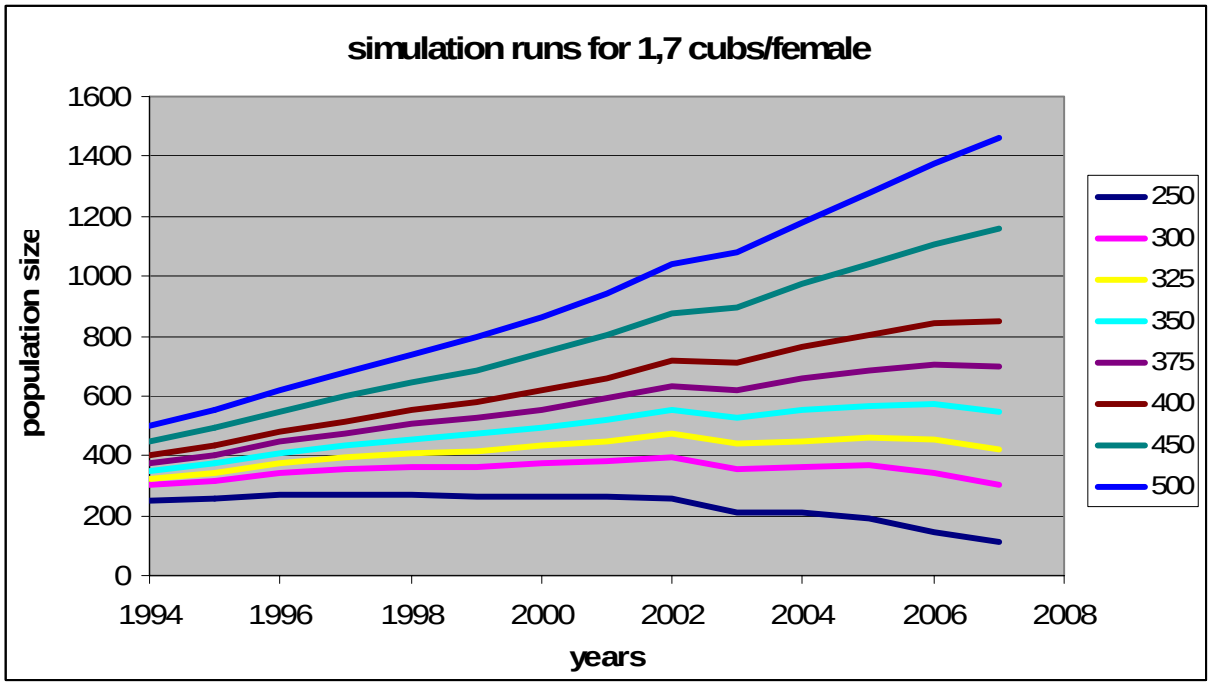

Fig 7: Simulation runs for different initial populations for a reproduction rate of 1,7 cubs/female. Only the runs with initial population sizes of 350 and 375 bears fulfilled the conditions of all filters.

2.5. Summarizing Analysis

- The backcasting modelling exercise, the monitoring results from SFS/PHASP Jelen (Sneznik) and Medved (Kocevje), and the number of losses suggest an increasing trend of the bear population since 1994. However, this is in contrast to the monitoring results from the specified observational spots, which suggest stable population numbers. This contradiction is very irritating.
- Preliminary genetic analysis in two test areas (Szneznik and Glazuta) estimates 12 bears/100 km² of forest. This rather high bear density does not suggest a population decline. So the good news is that the bear population does not seem to be at risk at the moment.
- The attitude of local people seems to have deteriorated. This might be a result of frequent bear-human encounters and the high damage level and false signals about the potential threat bears pose to humans. This negative attitude could become the key issue hindering the long-term conservation of this species in Slovenia.
- The total cull consists mostly of quota kills (traditional hunting), which is used to control the population. However, this is done in a way to maximize the population output by avoiding adult females to be culled. In this way a heavily biased sex ratio is produced and 44-47% of the population consists of subadult bears, which are the most likely trouble makers. In general, there is enough flexibility (in numbers) to increase the exceptional kills at the costs of quota kills.
- The actual situation is not promising for an expansion of the bear population into the adjacent alpine countries. Since mid of the 1990ies, subadult males are common in the border areas, but reproductive females only show up occasionally and disappear again soon. This situation is frustrating for Austria and Italy.

3. Recommendations

Based on our analysis of the situation we see three areas where adaptations are needed:

(3.1.) Slovenia needs a better data base for decision making.

(3.2.) Slovenia has to change the focus for culling from traditional game management to problem solving approaches sensu Art. 16 of the Habitats Directive.

(3.3.) Slovenia has to solve its problems not only by culling, but also by public awareness campaigns, changes in the decision making processes, and applied research.

3.1. Data as a reliable basis for decision making

The actual trend of Slovenia's brown bear population remains unclear. It can be stable or increasing. Decreasing seems to be very unlikely. However, the main monitoring tool, the counting on specified observational spots, gives contrasting results to the other sources (see above). It is necessary that all monitoring methods together do provide one sound basis for decision making. Therefore, we recommend to further develop these methods using deeper analyses and additional techniques e.g. population modelling (see above).

- the genetic monitoring should be expanded to the whole bear area
- the count data at the feeding stations should be analysed in respect to:
    - variation of counts within the year
    - variation of counts from feeding station to feeding station (e.g. as a result of distance or habitat parameters)
    - variation of counts over different regions (e.g. estimated high density areas (Jelen, Medved) versus lower density areas (Trnovski Gozd)
    - possible influence of other variables on count results (e.g. density of feeding stations in the area, % forest, fragmentation of the forest)
    - ideally in a test area 10-20 animals should be radiocollared and the number and frequency of their visits to feeding stations should be monitored throughout the year and especially during the count nights
    - ideally count data should be compared with density estimates from the genetic monitoring (e.g. in a test area all counting sites could be fenced with barbed wire for the nights of the counts and all bear hair collected for genetic analysis)

- mapping and analysis of changes in the land use within the last 10-20 years (forest, roads, houses, human population density, traffic density, sheep pastures, number of livestock by species) would help to better understand the present level of bear-human conflicts
- Research should focus on bears living in fragmented areas, rather than bears living in the backcountry. Radiocollaring bears in such habitat will allow understanding conflicts and can help to develop mitigation measures.
- A population model using the age and sex structure of previous bear culls should be developed to model the outcome of various cull quotas and strategies and should be the basis for future planning (see model example provided).

3.2. Culling as a problem solving tool

The culling strategy needs to shift from a hunting management (maximum harvest levels) towards a conflict mitigation management (removing primarily problem animals)

3.2.1. Focus on nuisance bears

If the presently high level of bear damages and human-bear conflicts is a result of tolerating habituated females with cubs near villages – these conflict animals (regardless of their sex and reproductive status) need to be targeted by the cull, rather than bears in the backcountry

The focus for cullings in the future should be on nuisance individual bears. These culls should be independent of age and sex classes. If there are habituated females with cubs, they also should be culled. They are producing trouble makers every second year! If the public acceptance is not given for this action, a public education campaign should be started to explain to the public that this strategy is important to conserve the brown bear on the long term.

Like today, exceptional culls should be preferably conducted by local hunters, to secure their acceptance. Focussing on nuisance bears probably will concentrate the culls in some areas. Attention should be taken that hunters of hunting clubs without nuisance bears have no disadvantage. This would be contraproductive. These hunters also could participate on culls in other areas.

3.2.2. Reduce the dynamics of the population

The present management allows maximum harvest levels. However, this also means high cull levels are necessary in order to control the population. In the future, the age and sex structure of the cull should be organized in a way that minimizes troubles and difficulties. The main point here is to increase the proportion of adult females in the cull. There seems to be three possiblities:

1. Close the weight class of bears with 100-150 kg during the spring hunt. In spring, adult females cannot be culled since they have cubs of the year or yearlings. Females with cubs are protected as cubs are fully dependent on their mothers for survival. Females with yearlings on the other hand separate during early summer and in autumn these females are alone and thus vulnerable for culling. In fall, most adult females will be in the weight class 100-150 kg. Closing the spring hunt for this weight class will most likely increase the proportion of adult females in the total cull.
2. Remove nuisance females with cubs (see above)! This will have a positive effect on the population structure, too.
3. Consider culling the mothers of yearling cubs in spring. Yearling cubs do not need their mothers anymore and will leave them between April and June anyway. However, many hunters will be unhappy with this approach and it will be necessary to discuss this option with the hunters.

These structural changes in the population will make it easier to keep the population at a stable level with a smaller proportion of subadult bears and a more even sex ratio in adults. This will result in lower culling rates in the future.

3.3. Science based management

3.3.1. Decision making process

All decisions in bear management should be based on scientific results, which should be provided to the authorities by Slovenian bear expert.

- Clear goals and definitions need to be provided to the national and international community.
- A clear policy and clear definitions about what "problem bears" and what "problem people" are needed as well as a clear outline of what will be done in case of conflicts e.g. a clear list of events with bears for risk assessment should be accessible for the public (e.g. http://www.wildlife.uni-freiburg.de/download/brunoEN.pdf).
- Messages to the public (international, national and locally) about bears need to be driven by the will to sustain a viable bear population in favourable conservation status, rather than by populistic motives.

3.3.2. Public awareness

There seems to be a hysteria due to nuisance bears in some regions in Slovenia. This might be partly caused by the presence of habituated bears, but partly also by a misinformed public. It is important that all people in rural areas know about things as waste removal and how to behave at close encounters and are able to give a rough judgement of the situation when observing a bear.

- A well designed attitude survey of the general public, as well as specific interest groups (e.g. hunters, farmers, tourists), is needed to understand the key issues and develop adequate PR strategies.
- More efforts should be put into bringing the local people and especially children in contact with bears in a positive way. Local hunters and foresters could organizing bear sign excursions, researchers can take people along for telemetry etc.

Literature cited:

Grimm V, Revilla E, Berger U, Jeltsch F, Mooij WM, Railsback SF, Thulke H-H, Weiner J, Wiegand T, DeAngelis DL. 2005. Pattern-oriented modeling of agent-based complex systems: lessons from ecology. Science 310: 987-991.

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