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Individual distinctiveness in juvenile brown bears - have personality constructs predictive power across time and situations?

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1. Background and scientific importance of the thematic

Bears are the most complex predator species, which show a great ecological plasticity, very diverse diet and adaptability comparable with humans, occupying all kind of habitat ranges from rain forests, sub alpine and alpine mountain areas, tundra, deserts, to arctic regions. Many bear populations escaped extinction during the twentieth century owning to legal protection, habitat restoration and changes in public attitudes. Successful management has resulted in gradual recovery and return of carnivores to their original habitats in several countries, which has lead to many human-bear conflicts and damages to livestock in many areas worldwide. For large carnivores to have a long term future we have to allow them to occupy their habitats, which means in the same time integrating them into the landscapes transformed for fitting human life necessities. Because these areas are typically not coinciding with areas of favorable resource patches, carnivores are facing a trade-off between resource use and avoidance of humans. Whether or not this trade-off tip towards human avoidance is at the core of the debate on if large carnivores can survive in human-dominated landscapes. Thus, conservation of large carnivores becomes a challenging task. In Europe there are few, if any, wilderness areas with suitable habitats and size large enough to maintain populations of large carnivores without facing contradictory situations with humans. Therefore the conservation and management of carnivores is based on their integration into human-dominated multi-use landscapes and the long-term survival of carnivores is dependent on how the conflict situations are treated. The Romanian Carpathians are maybe the best example of this situation, where the surviving of the biggest brown bear (*Ursus arctos*) population of Europe (excluding Russia) was possible due to the well preserved connected habitats and former strict protection status. Of utmost importance in development of different management strategies for large, wide-ranging carnivores is the understanding of species-specific behavior and interactions with surrounding habitats. No conservation measure, land use planning or other strategies, neither “wise use” management can be efficient without that.

The thesis tries to go deep into behavior research, investigating traits that crystallize personality profiles at juvenile brown bears. The observations were performed by the author on a considerable sample size of 71 juveniles reared by him in an orphan bear rehabilitation center. Since the rehabilitation period was average 1.5 years followed by a post release monitoring, the observations on personality traits could be directly performed during the captivity period, and later correlated with the individual’s further movement patterns and habitat selection after release.

The author tried to answer the following questions in 5 thematic chapters:

1. **Do juvenile brown bears have measurable distinct personality?**
    a. Can the personality profiles be split in sub-units/traits that build up personality profiles?
    b. Which are the profiles that occur at most of the individuals?
    c. Are there behavioral "ingredients" that being part of the personality profile induces important attitude changes?
    d. Which are those behavioral traits that cluster the distinct personality profiles, and how these traits correlate with each other?
2. **Can the life history of the individual influence its personality development?**
    a. Is the interaction of the bear cubs with other individuals important during the early development? Does this influence the development of personality?
    b. Is captivity able to alter important behavioral traits at juvenile bears during early development stage?
    c. What is the impact of the mother's behavior on the personality of a cub?
3. **Have the personality profiles any influence on the later fate, or surviving capability of the individuals?**
    a. Can the personality profiles influence the surviving chance of the individuals?
    b. Which are the profiles that increase or decrease the survival chance?
    c. Are certain personality profiles vulnerable to predation?
    d. Do bears with latent disease develop certain personality patterns?
4. **Is there any relation between personality profiles and later individual dispersal patterns?**
    a. What is the effect of the personality profiles on the dispersal of juvenile bears?
    b. Are certain personality profiles influencing the dispersal of males and females in similar way?
    c. Are individuals with certain personality profiles more explorative than those with different profile configurations?
5. **Do the personality traits influence the habitat selection of juvenile brown bears?**
    a. Do the personality profiles have an influence on how bears respond to environmental and habitat changes in human dominated landscapes?
    b. Are there personality traits that bring individuals closer to humans?
    c. Do the habitat selection strategies of the individuals depend on their personality?

d. Are certain behavioral traits predictable as later involving the bear in conflict with people or in any other situations that could influence the faith of a specific individual?

2. Materials and methods

Since each thematic chapter can be considered an independent study, the materials and methods are described below for each section:

A. Do juvenile brown bears have measurable distinct personality?

The study was performed on a sample of 71 juvenile bear cubs (between 1 month and 2.5 years old), in the frame work of an orphan bear rehabilitation center. The cubs were kept in large enclosures, offering natural habitat. Observations of the behavior were performed in average of 2 hours per day from a minimum distance of 30 m avoiding as much as possible any interaction with the bears. A number of 60 rating adjectives were adopted from the literature, describing different behavioral traits. Pairs of bipolar dimensions were generated (ex. aggressive-submissive) and each bear was placed in a 1-6 scale dimension. Those which reached the scale 4 have been rated in the specific adjective category.

The personality profiles were defined based on clusters of behavior traits using a Principal Component Analysis.

B. The relation between the life history of bear cubs and their personality profile development.

The following life history variables were recorded of the same 71 bear cubs mentioned in the previous section: (i) Did the bear interact with other bears during the rearing process? (ii) Was or not the cub of a problematic (habituated to human food source) bear? (iii) Was the bear kept more than 5 months in captivity by humans before its arrival in the rehab center?

Pearson chi square cross tabulations with Phi and Crammer's V tests were performed between the life history variables and the personality dimensions. All standard residuals over the value of 1.96 were considered to indicate significant relation between the cross tabulated items.

C. Can personality profiles influence the later fate of juvenile bears?

The fate of 61 juvenile bears released from the rehabilitation center was assessed with VHF and GPS telemetry systems. Each individual that could be tracked over 6 months has been rated as "survived".

In order to test whether there is a relation between personality profiles and later fate, the fate frequencies have been cross tabulated with each personality profile, using a chi square test together with Phi and Crammer's V test. All standard residuals over the value of 1.96 were considered to indicate significant relation between the cross tabulated items.

D. The relation between personality profiles and later individual dispersal patterns?

The dispersal distances of 14 juvenile brown bears (8 males and 6 females) has been measured with VHF and GPS telemetry systems. The dispersal distance was considered from the release area to the middle of the 95% Kernel home range which fell at the most extremities.

Males and females were considered separate groups. In order to test the influence of each personality profile on the dispersal distance, the data was divided into subgroups, considering each personality profile a variable. An independent *t* test was performed in order to calculate the effect size (*r*), of the different profiles on the dispersal distance.

"*r*" ;

The effect size of a variable was considered weak if "*r*" is below 0.3, medium if is between 0.3 and 0.5, strong if falls between 0.5- 0.7 and substantial if above 0.7.

E. The relations between personality profiles and habitat selection.

In the study are included 9 juvenile bears below 4 years age, tracked with GPS collars. The collars were configured to save fixes every 4 hours.

Seven environmental variables were selected to describe the habitats with respect to food availability, shelter availability and human activity: elevation, ruggedness, slope, land cover type, forest succession stage, buffers of 500 m and 1500m around human settlements or artificial surfaces.

The habitat selection was analyzed using the sample protocol of Manley et al. (2002), adopting the design II study, exploring the graphics of the eigenanlysis as well.

3. Results

A. Do juvenile brown bears have measurable distinct personality?

Ten profiles have been distinguished: “irritable-aggressive”, “focused”, “opportunistic-bold”, “self-confident”, “curious-confident”, playful-sociable”, “greedy-assertive”, “shy”, “lazy” and “absent minded”. These profiles were results of the clusters of behavioral traits that correlated with each other in a significant way. These traits correlated negatively with opposite behaviors. For example the “irritable-aggressive” profile was clustered by behaviors that indicate impulsiveness and aggressiveness, traits that correlated negatively with those that indicated calmness and amiability. Most of the bears had their profile configurations built by the “opportunistic-bold”, “self-confident”, “curious-confident”, playful-sociable” profiles and only several had the “focused”, “aggressive”, “shy”, “lazy” and “absent minded”, as “ingredients”.

B. The relation between the life history of bear cubs and their personality profile development.

The results indicated that in the first year of their life, the social interaction with other bears (mother or other cubs) is important in the development of the “aggressiveness”, “focused”, “opportunistic-bold”, “playful-sociable”, “self confident” and “curious confident” profiles at sub-adult bears. “Absent minded”, “lazy”, “greedy” and “shyness” seems to be in no relation with whether the bears interacted with other bears or not during cub stage.

According with the results those bears which spent less than 5 months in captivity became with a bigger chance “aggressive”, “focused”, “bold”, “self-confident” and “playful” than the bears kept more than 5 months in artificial conditions.

From the test resulted that “aggressiveness”, “absent minded”, “lazy”, “greedy-assertive” and “shy” profiles have no relation with the behavior of the mother. Oppositely, there was a relation between the “focused”, “opportunistic-bold”, “playful”, “self confident” and “curious confident” profiles and whether the mother was a problematic bear or not. The cubs of problematic mothers were less “focused”, “bold”, “playful” and “curious” than those of normal mothers.

C. Can personality profiles influence the later fate of juvenile bears?

“Absent minded” and “Lazy” profiles had the smallest survival chance and highest risk that the bear with these traits be caught by other predators (mainly adult bears). The results indicate that these profiles are predictors of vulnerability. All the profiles related with boldness, explorative behavior, self confidence and focused traits showed a higher capability to survive. The up mentioned “vulnerable” profiles are usually correlated with a latent disease that destroys the animal.

D. The relation between personality profiles and later individual dispersal patterns?

The “curios-confident” was the only profile that expressed substantial effect on the dispersal distance at male juvenile bears. The “playful-sociable” and “self-confident” profiles had medium effect while all the other profiles had no effect on the dispersal distance of males. At females the “curios-confident”, “playful-sociable” “self-confident” profiles had a substantial effect on their dispersal.

The results indicated that curiosity and behaviors that enhance explorative traits are the most important factors leading the males during the natural dispersal process, while females have a totally different dispersing strategy, related with philopatry and matrilinear assemblages where “aggressiveness”, “playfulness” and “self confidence” differences between females influence their special relation between each other.

E. The relations between personality profiles and habitat selection.

The study indicated a high degree of habitat use flexibility at brown bears, with a considerable adapting capacity and persistence in human dominated landscapes. The most important factors influencing habitat selection are the food availability and human disturbance, the animals facing a trade-off between them. Though the bears that were subject of the habitat selection study showed a clear bias towards selecting mostly variables with low human access (high slopes and elevations, rugged terrain conditions, forested areas, shrub lands, and habitats out of 500 m perimeters of human settlements), the personality profiles influenced the selection ratios. There was a difference between individuals considering their proneness to take some risks. The bears with “shy”, “lazy” and “absent minded” profile combinations led the animals to different foraging strategies versus the bears with “explorative”, “bold” and “focused” traits. The “explorative” and “self-confident” profiles seems to bring the bears closer to “new” areas, that seem too dangerous to other con-specifics.

4. Scientific outcomes of the thesis

1. At least ten distinct personality profiles are measurable at juvenile brown bears: "irritable-aggressive", "focused", "opportunistic-bold", "self-confident", "curious-confident", playful-sociable", "greedy-assertive", "shy", "lazy" and "absent minded". Behavior traits that express similar attitudes or reaction characteristics correlate significantly, clustering a certain personality profile. Traits that express opposite behavior characteristics show significant negative correlation with them. The study describes a number of 60 behavioral sub-units that build up the profile configurations.
2. The personality profiles that characterize in average most of the bears are "opportunistic-bold", "self-confident", "curious-confident" and playful-sociable". This fact gives first time a logical explanation of what stays behind the fact that most of the bears are opportunistic, curios and playful animals.
3. The study discovered that traits building the "absent-minded", "shy", "lazy", "focused" and "aggressive" profiles induct predispositions for reacting significantly differently in similar circumstances.
4. The author describes and quantifies first time the importance of social interaction at bear cubs during early development and its effects in forming different personalities. The results of the study indicate that the development of "aggressiveness", "focused", "opportunistic-bold", "playful-sociable", "self confident" and "curious confident" profiles depend on the social interactions of sub-adult bears. This is important when designing rehabilitation centers in the future, where the possibility of interaction between the cubs of same generations must be taken in consideration.
5. The study describes that the long captivity period alters behavior attitudes as "aggressive", "focused", "bold", "self-confident" and "playful", traits that are important in the later survival of the individual. This information is extremely helpful for rehab centers in the decision process of accepting or not a certain cub in the facility.
6. This is the first research discovering that the development of some personality profiles ("focused", "opportunistic-bold", "playful", "self confident" and "curious confident") are in relation with whether the mother was a problematic bear or not. Since in every bear country there are problem bears too, and their management is a challenging task, this information gives insight on how the cubs of problematic females will exhibit certain behaviors in the future.
7. Survival capacity of the juvenile brown bears is dependent on their personality profiles. This is the first study discovering this fact and indicating that profiles related with boldness, explorative behavior, self confidence and focused traits have high predictability power in involving the bear in later risky situations. This information might be helpful for wildlife managers, who have the possibilities to observe juvenile bears at feeding places, and have decision power in selecting out certain individuals in order to decrease the chances of conflict situations.

8. The author is the first one who looked for and finds out that there are connections between personality traits at juvenile brown bears, and their natural dispersal strategies: “curiosity-confidence” at males, “curiosity-confidence”, “playfulness-sociability” and “self-confidence” at females has substantial effects on the dispersal distance. Thus the study brings light on the mechanisms that affect the dispersal differences between male and female juvenile bears. This could be helpful information for those who are interested in evaluating population densities and applying counting methods, since the dispersal of some juveniles increases the risk of multiple counts.
9. This is the first study in bear research finding out that in heterogeneous habitat conditions different personality traits gathered in distinct profiles influence the decision of the individuals in their response to the changing habitat conditions. Further investigations related with this issue might be extremely helpful to be able in the future to select individuals with higher conflict risks out of the population.
10. The study reveals first in the field of carnivore research that behavior traits noticeable at juveniles have a predicting power across time and situations.

5. The author's list of publications related with the thematic

Scientific papers published in reviewed journals:

Bereczky, L, M. Pop és S. Chiriac**.** 2009. The eco-ethology of the brown bear – studies based on post release monitoring of rehabilitated orphan bear cubs. Satu Mare – Studii şi Comunicări Seria Ştiinţele Naturii. Vol. X-XI, pp. 149-160.

Bereczky Leonardo, Ioan Mihai Pop, Silviu Chiriac. 2011. Trouble-making Brown bears Ursus arctos Linnaeus, 1758 (Mammalia: Carnivora) – behavioral pattern analysis of the specialized individuals, Travaux du Muséum National d'Histoire Naturelle Grigore Antipa, vol.54(2), pp.541-554.

Pop Ioan Mihai**,** Sallay Alexandra, **Bereczky Leonardo**, Chiriac Silviu. 2012. Land use and behavioral patterns of brown bears in the South- Eastern Romanian Carpathian Mountains: A case study of relocated and rehabilitated individuals. Elsevier. Procedia Environmental Sciences, 2012, 14, pp.111-122.

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John Beecham, Miguel G. Hernando, Alexandros A. Karamandilis, Richard A. Beausoleil, Kelcey Burguess, Dong H. Jeong, Mathew Binks, **Leonardo Bereczky,** N. V. K. Ashraf, Kira Skriptova, Lisa Rhodin, Janene Auger, Bae-Keun Lee. Management Implications for releasing Orphaned, Captive-Reared bears back to the wild. The Journal of Wildlife Management. DOI: 10.1002/jwmg.941. 2015.

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Bereczky, L. 2005. Orphan bear rehabilitation center. „Gyapár" Nature protection magazine. Gyergyószentmiklós.

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Bereczky, L. 2009. Techniques for rehabilitating orphan bear cubs in the Hasmas Mountains. Hubertus hunters magazine. Nr. 1.

Bereczky, L, M. Pop, S. Chiriac. 2010. Home range and habitat selection of reintroduced brown bears. Hubertusz hunters magazine. Nr. 2.

Bereczky, L. 2009. Aerial wildlife monitoring using microlight aircrafts. Pilot Magazin, Nr. 9

Oral presentation at conferences:

1. **Bereczky, L** şi X. Anegroaei. Orphan bear rehabilitation center – a pilot project in the Romanian Carpathians. Workshop: „Conserving Large Carnivores in Vrancea County“ Lepşa, Vrancea – 2004.

2. **Bereczky, L** şi X. Anegroaei. „Possibilities of reintroduction orphan bear cubs into natural habitats”. Európai bölény konferencia: „Az európai bölény visszatelepítésének lehetőségei Romániában” - Vânători Neamţ Nemzeti Park, 2004.

3. **Bereczky, L** şi X. Anegroaei. “The transfer of wild animals from semi-wild environment to wild environment”. International conference with the thematic: „Trans Boundary Migration Possibility of European Bison”. Targu Neamţ, 2005.

4. **Bereczky, L** şi X. Anegroaei. “Orhpan Bear Rehabilitation Centre – methods and achievements” – International conference on Bear Research and Management- Bucharest- Romania, 2005.

5. **Bereczky, L. “**A case study of 4 rehabilitated and released garbage habituated bear cubs – results and conclusions”. Workshop: Garbage Bears in Brasov”, Braşov, 2006.

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10. **Bereczky, L** şi X. Anegroaei. “Reasons why bears arrive in captivity – the European experience”. International IBA conference on bear research and management, Tbilisi – Georgia, 2010.

11. **Bereczky, L**, M. Pop, S. Chiriac. “A comparison of home range size, movements, habitat use and activity patterns of released orphan brown bears and wild captured brown bears in the Carpathian Mountains of Romania - documenting suitability for reintroduction of rehabilitated individuals”. International IBA conference on bear research and management, Tbilisi – Georgia. 2010.

12. **Bereczky, L**. „Researches of the ecology and behavior of brown bears in the Romanian Carpathians". Ph. D. Conference, Apr. 13, 2010. Sopron. Hungary.

13. **Bereczky, L.** „The brown bear in the Carpathians". Eco-conference, Bekescsaba-Hungary. 15. April. 2010.

14. **Bereczky, L,** M. Pop, S. Chiriac, X. Anegroaei „How can the surrounding environment model the behavior of brown bear cubs in the first two years of their life?", International Conference Enviornment-Landscape-European Identity, University of Bucharest, Bucharest. 2011.

15. Pop, I. M, A. Sallay, **L. Bereczky,** S. Chiriac. „Land use and behavioral patterns of brown bears in the South-Eastern Romanian Carpathian Mountains: A case study of relocated and rehabilitated individuals". International Conference Enviornment-Landscape-European Identity, University of Bucharest, Bucharest. 2011.

16. Pop, I. M, **L. Bereczky,** C. Stanga. "The analysis of the scores awarded to the trophies of brown bear skulls in the south-eastern part of the Eastern Carpathians - reflection on the wildlife management". International Conference of G. Antipa Museum. Bucharest. 2011.

17. Sallay, A., Hacklander, K., Zedrosser, A., **L. Bereczky,** I. M. Pop, S. Chiriac. "Research into conflict behavior and aversive conditioning of food-conditioned brown bears". 85th annual meeting of the German Society for Mammalian Biology, Luxemburg. 13th-17th September 2011.

18. Pop Ioan Mihai**,** Sallay Alexandra, **Bereczky Leonardo**, Chiriac Silviu. Land use and behavioral patterns of brown bears in the South-Eastern Romanian Carpathian Mountains: A case study of relocated and rehabilitated individuals, The 86th Annual Conference of the German Society of Mammalogy, 4-8 September 2012, Frankfurt, Germany.

19. Pop, I. M, A. Sallay, **L. Bereczky,** S. Chiriac. Land use and behavioral patterns of brown bears in the South-Eastern Carpathians: a case study of relocated and rehabilitated individuals. 21st International Conference on Bear Research and Management., New Delhi, India. 26-30 November 2012.

20. Pop, I. M, A. Sallay, L. Berde, **L. Bereczky,** S. Chiriac. "An equivocal relation between bear harvest and damage occurrence in the Eastern Romanian Carpathian Mountains" 21st International Conference on Bear Research and Management., New Delhi, India. 26-30 November 2012.

21. **Bereczky, L.** How to nurse orphan bear cubs to self sufficiency without getting problematic bears – 12 years of experience in bear rehabilitation. 21st International Conference on Bear Research and Management., New Delhi, India. 26-30 November 2012.

22. Alexandra SALLAY, Ioan M. POP, Lajos BERDE**, Leonardo BERECZKY,** Silviu CHIRIAC – An equivocal relation between demographic structures of harvested brown bears and damage occurrence in the Eastern Romanian Carpathian Mountains. 21st International Conference on Bear Research and Management., New Delhi, India. 26-30 November 2012.

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24. **Bereczky L.** Personality distinctiveness in juvenile brown bears – can behavior traits of juveniles predict later problematic behavior? 23rd International Conference on Bear Research and Management. Tessaloniky. Greece. 2014.

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1. **Bereczky, L** și X. Anegroaei. „Orphan bear rehabilitation centre: a pilot project in the Romanian Carpathians" . 20th. International Conference on Bear Research and Management – Ottawa, Canada. 2011.

2. **Bereczky, L,** S. Chiriac, M. Pop. „Analyze of brown bear populations regulating factors in the Romanian Carpathians based on a case study on survival rate and mortality cause of rehabilitated and re- introduced brown bears". 20th. International Conference on Bear Research and Management – Ottawa, Canada. 2011.

3. **Bereczky, L,** S. Chiriac, M. Pop. "Analyses of the Romanian South-Eastern Carpathians Human Bear Conflicts based on bear damages, human opinion, bear hunting. 20th. International Conference on Bear Research and Management – Ottawa, Canada. 2011.

4. **Bereczky, L**. Individual distinctiveness in juvenile brown bears. 21th. International Conference on Bear Research and Management – Provo - Utah, USA. 2013.