

THE EARLY GONADAL ACTIVITY IN CROATIAN BROWN BEARS AND ITS MANAGEMENT IMPLICATIONS

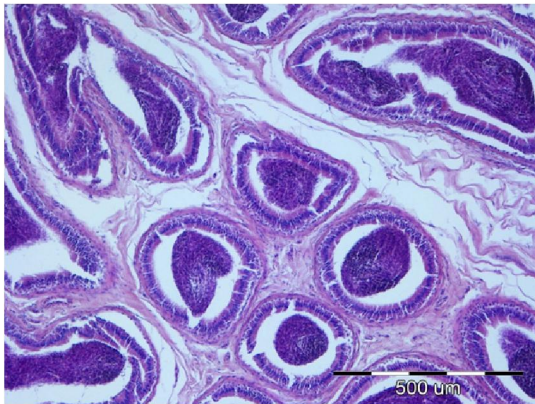
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The goals of the study

1. To get insight of the **age span** of brown bear reproductive activity, especially of the **age of first reproduction** by:

➤ morphometric and



➤ histological examination of gonads.

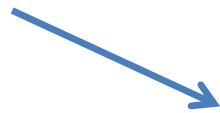
2. To test the management implications of findings using two-sex matrix modeling.

$$P_i = \begin{bmatrix} 0 & 0 & 0 & s_{nf2_4} \times F & s_{nfs_{19}} \times F & s_{nfs_{19}} \times F \times 0.925 & s_{n20} \times F \\ s_{ncoy} \times WL & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & s_{nf1} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & s_{nm2_4} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & s_{nm2_4} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & s_{nms_{19}} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & s_{nfs_{19}} & s_{n20} \end{bmatrix}$$

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Why this findings could be important for management decisions?

- Census population size (N_c)
- Sex (and age) structure
- The reproductive span of the bear's life, especially the age of the first reproduction
 - As a standard, for brown bears in Croatia, we used the age of 4 years for the first reproduction (Knott et al, 2014, Eur J Wildl Res)
- Effective population size (N_e)
- Recruitment rate



More accurate quota allocation

Testicles and ovaries...



- In pilot phase we examined testicles and ovaries of 30 hunted or traffic-killed bears in Croatia in 2012-2014 period:

- **23 males**

- **7 females**

- We measured:

- **length,** 

- **width** of each gonad; 

- **mass** of testicles.





Ovaries

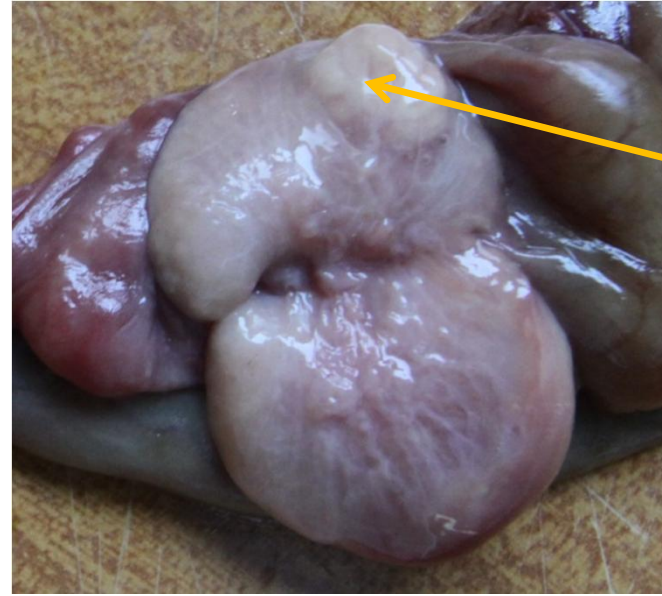
- Average length 2.36 (1.8 – 2.9) cm



- Average width 1.70 (1.3 – 2.0) cm

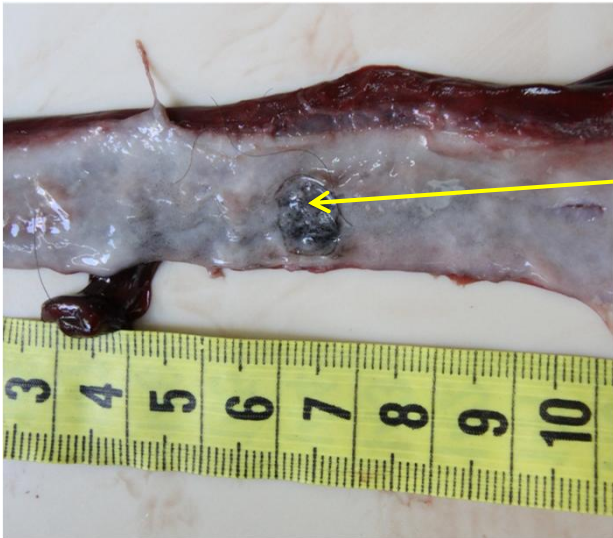
Ovaries macroscopically

Presence of signs of cyclicity



CL

Uterus



Placental scars
- evidence of giving birth last winter

Testicles

❖ Mature

- Average length 6.52 (5.1 - 8.3) cm
- Average width 3.16 (2.2 - 3.8) cm
- Average mass 63.5 (24.0 - 95.5) g



❖ Juvenile and old inactive



- In average smaller than mature ones: 16.8 g vs 49.8 g, respectively

Correlation index between total testicles mass and body mass ($I_t = m_t / m_b$)



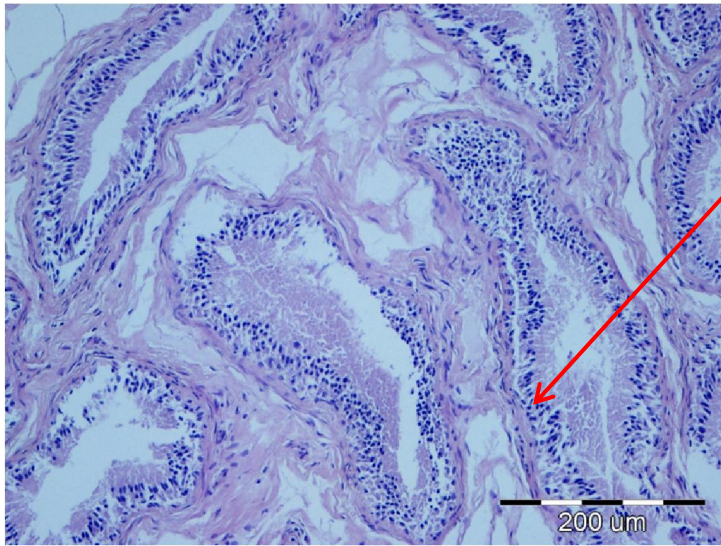
❖ **Mature**
 $I_t = 0.85$
(0.45-1.34)

❖ **Juvenile**
 $I_t = 0.42$
(0.39-0.45)

❖ **old inactive**
 $I_t = 0.31$
(325 kg body mass)

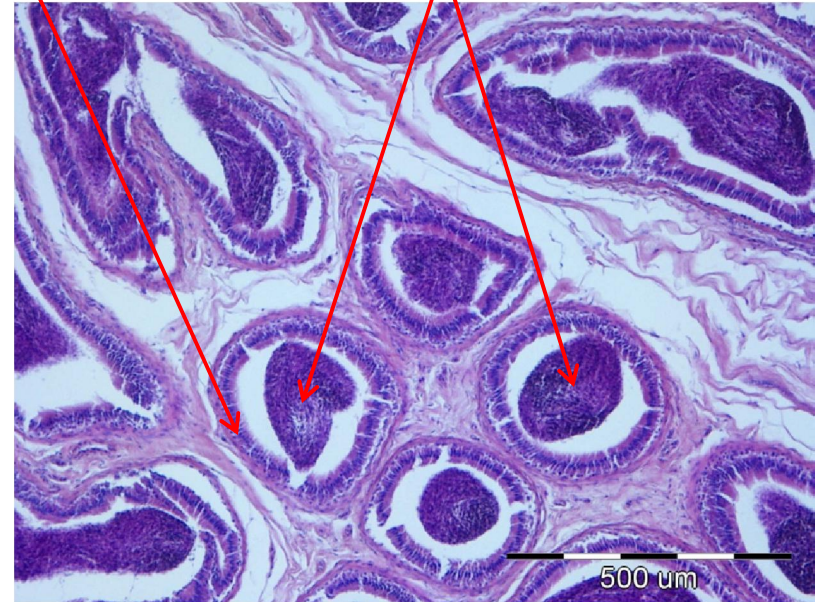


Histological findings



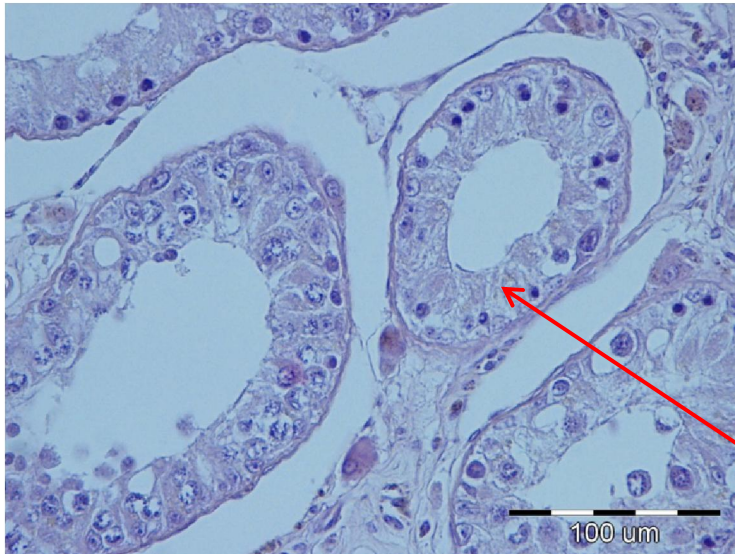
Stratified seminiferous epithelium

Sperm cells - spermatozoa



Immature testis (young bear)

Mature/active testis (adult bear)



Cuboidal epithelium

Unproductive testis (old bear)

Histological findings



- inactivity of the testicles in the first two years,
- first signs of gonadal activity and maturity were present in the **third year** of a male's life.

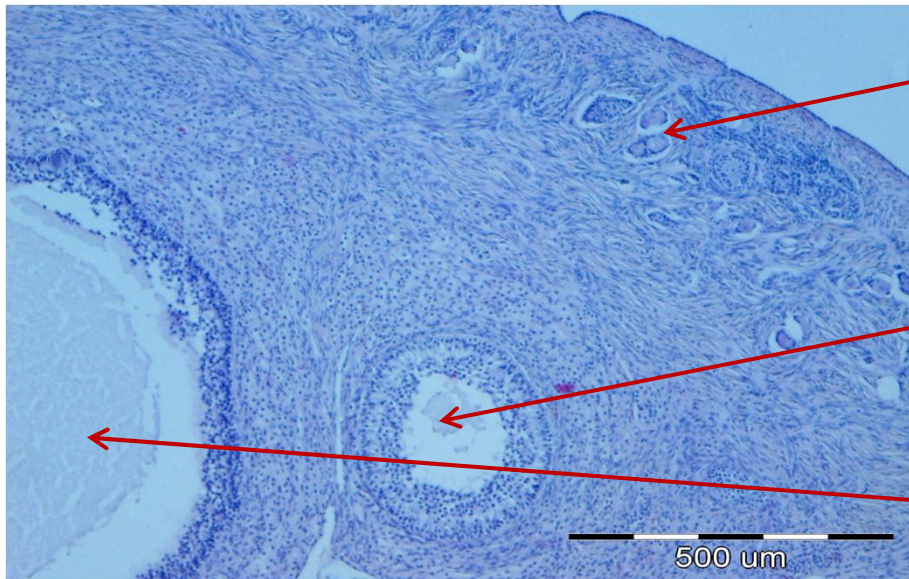
Which implies potential reproductive activity in that mating season.

Histological findings



- Results from a previous study* revealed that ovaries from 2 females held in captivity were active in their **third year** as well.

Cortical area of the fertile ovary from young female



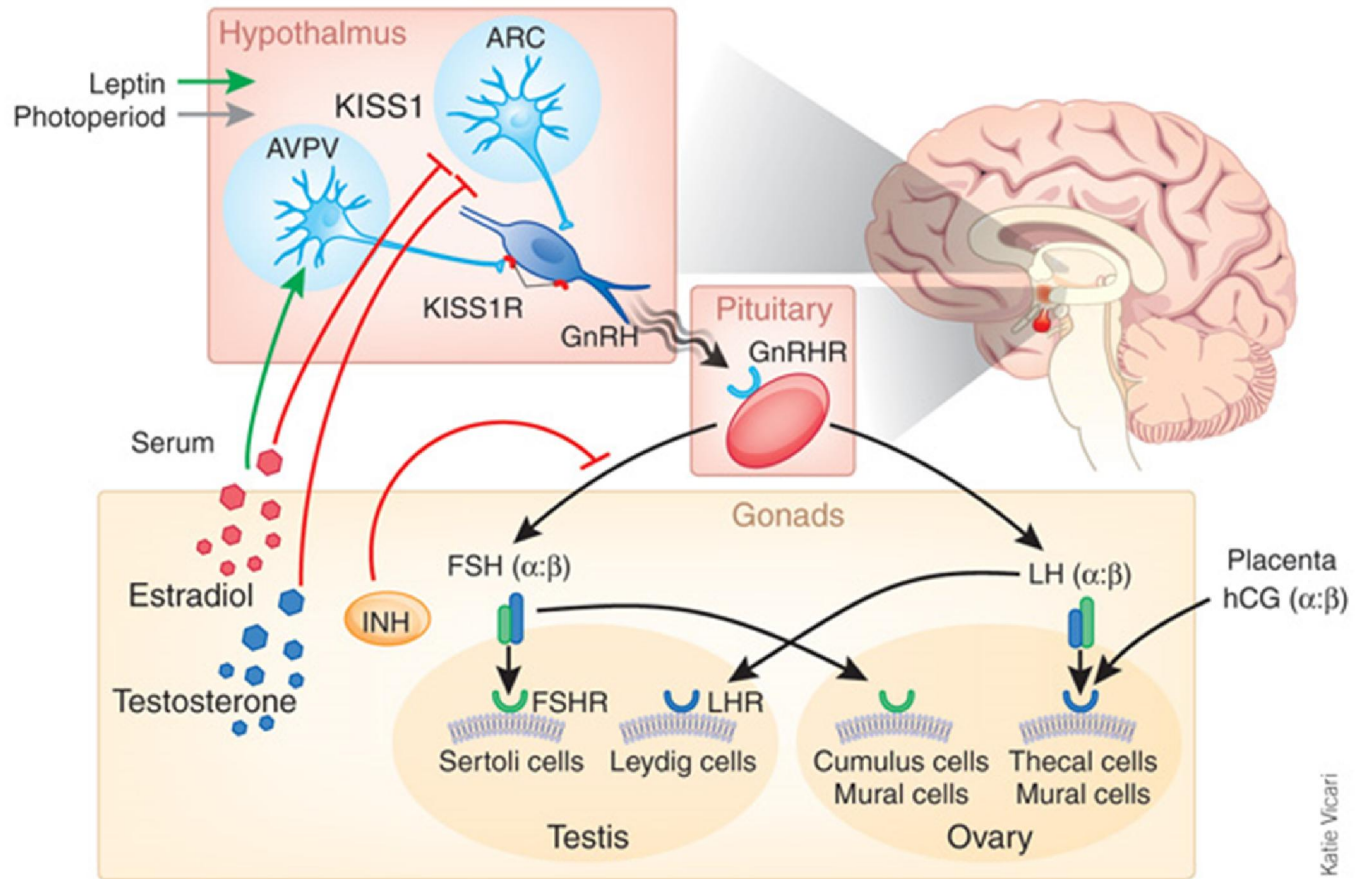
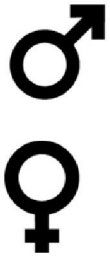
Multiple primordial and primary follicles in the ovarian cortex

One late secondary follicle within inner cortical layer

Tertiary (Graafian) follicle

*Reljić et al. Incidence of ovulation in brown bears (*Ursus arctos*) as indicator of range of reproductive age (IBA2012, New Delhi, India)

Puberty...

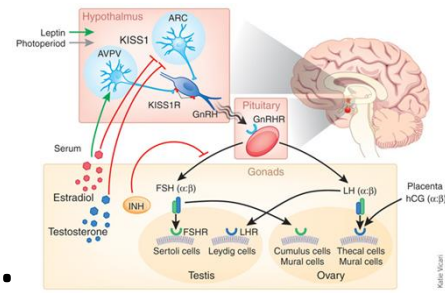


www. <http://flipper.diff.org/app/pathways/info/3997>

Katie Vicari

The onset of puberty depends upon the ability of specific hypothalamic neurons to produce gonadotropin-releasing hormone (GnRH) in sufficient quantities to promote and support gametogenesis.

...Puberty



Development of GnRH neurons is influenced by:

- 1) development of threshold body size,
- 2) exposure to a variety of environmental and social cues,
- 3) the genetics of the animal.

➤ Female mammals must:

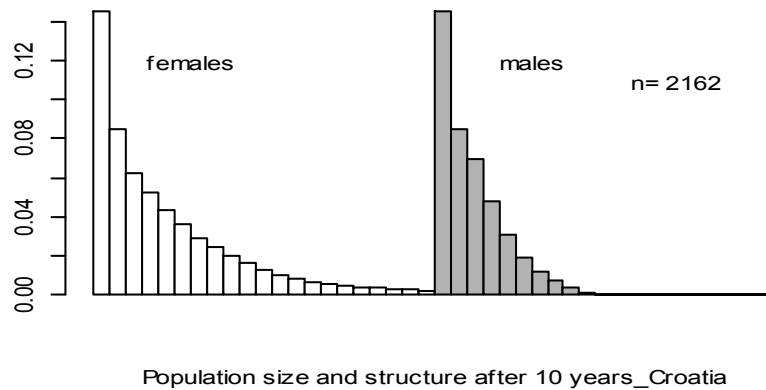
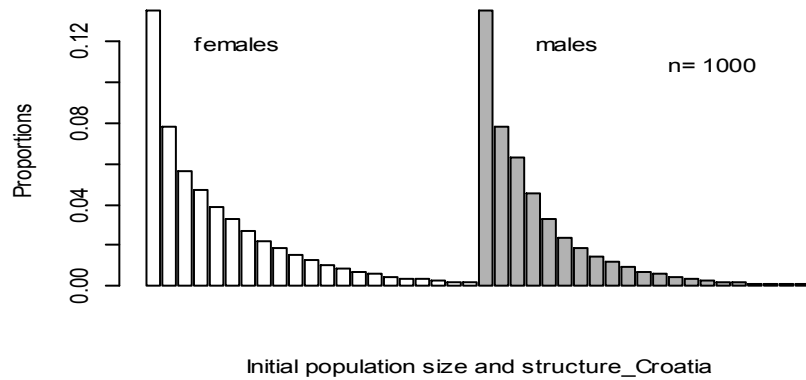
- 1) acquire a certain body size
- 2) develop a certain degree of „fatness“
before reproductive cycles can be initiated.

It is believed that level of hormone leptin, directly correlated with amount of body fat cells, initiates cyclicity.

Population management

- In the trophy hunting system in Croatia **77% of hunted animals** are males and in total mortality proportion is 67%.
 - lack of older males in the population
- Supplementary feeding is practiced:
“Can supplementary feeding of free-living bears mimic the feeding conditions in captivity and hence initiates puberty onset earlier and to what extent?”
- We built age structured Leslie matrix model:
 - two sex
 - post-breeding census
 - density independent
- We included the animals from **3rd-year age class** as reproductive in the matrix model.

Population management



Age	Females	Males
1	0.13443	0.13443
2	0.07852	0.07710
3	0.05681	0.06244
...
After 10 years		
1	0.14343	0.14343
2	0.08637	0.08650
3	0.06330	0.06905
...

❖ Increase in recruitment to effective population size for Croatian management system could be maximum **12.8-16% for males** and **10.9-11.4% for females**.

Conclusions

- Onset of maturity of gonads along to all other characteristics that can influence the reproductive success, can help answering the questions:
 1. how large can be the „effective population size“ and
 2. how much mortality, hunting in particular, can be compensated.



If humans continue to feed us and to kill many older bears we could reproduce earlier.

Thank you!

