Histological Diagnosis of Health Condition of the Black Rat "*Rattus rattus*" Reproductive Organs

Farida Becir and Hadjira Hannachi
Department of Biology, Domain S. N. V., Chedli-Ibn-Jdid University, El-Tarf, 36000, Algeria
Email: Becir_f@hotmail.com, fridaty@gmail.com

***Abstract*—The study was conducted at El-Kala National Park, located in the far northeast of Algeria. This national park contains a mosaic of habitats that make it the environment of several interactions, it is also a good site for studying the degree of adaptation and evolution of species that live in it. This park has also suffered from many forms of natural and man-made degradations, the most important of which are fires and the environments' fragmentations for the farms settlement. The black rat - *Rattus rattus* – is a very common and cosmopolitan species, It came from Asia, and managed to colonize all types of terrestrial environments; This could translate a behavioral great adaptive power and a genetic closely turned adaptation, which deserve to be studied. The protection and the safeguarding of the fauna require a general knowledge of its ecology or specifically of its cell biology. Halfway between cell biology, anatomy, biochemistry and physiology, histology aims to explore the structure of living organisms, the constitutive and functional relationships between their functional elements, as well as the tissues renewal. It participates in the exploration of pathological processes and their effects. This study represents a histological diagnosis of the state of health of the black rat reproductive organs in northeastern Algeria. In fact, of the twenty-six organs examined, no pathology was diagnosed except for one functional cyst and a beginning of infertility noticed in the elderly subjects.**

***Index Terms*—*Rattus rattus*, national park, histopathology, reproductive organs, fertility**

I. Introduction

Rats reproduction has been the subject of several studies because it represents a good study model [1], [2]. In lower mammals (rodents, canids, bovid, etc.), reproductive behavior, and in particular copulation, is relatively stereotyped. Reproductive behavior is generally divided into two phases: the motivational phase, which corresponds to the triggering of sexual arousal, then the physical approximation of the partners; And the second so-called consumptive phase, which corresponds to copulation [3].

The ovary is the reproductive female organ. It is oval-shaped, and connected to the uterus by the fallopian tubes which ensure carrying the mature oocytes to the uterus. Folliculogenesis is the set of transformations that an ovarian follicle undergoes, from the fetal stage where it was blocked to ovulation. This follicle, like many others, might not reach the evolution, because there is an important follicular atresia (degeneration of the follicles). During folliculogenesis, the follicle moves from the primordial follicle stage to the primary follicle stage, then to the secondary full follicle, tertiary cavity follicle (with one or more cavities filled with fluid) and finally to the mature follicle or the De Graaf follicle. Folliculogenesis stops at the same time as the hormonal activity of the ovary during menopause.

The ball is the reproductive male organ. Even in number, they lie outside the abdomen in a pocket called the scrotum. This location gives them a temperature that is about two Celsius degrees lower than that of the body [4]. Spermatogenesis is the maturation of germline stem cells: the spermatogonia inside the seminiferous tubulus of the testes. These transformations will begin at puberty and spermatogonia will progressively pass through the stages of spermatocytes I, spermatocytes II, spermatids and finally spermatozoa. During these transformations, they will undergo all stages of meiosis. This reduction of chromosomes is relevant and occurs during the maturation of ovules (or more exactly oocytes).

II. Methodology

This study was conducted at El-Kala National Park (P.N.E.K.). Created in 1983, El-Kala National Park is located in the far north-east of Algeria (Fig. 1). Its surface is 80000 ha, it is bordered on the north by the Mediterranean Sea and on the east by the Tunisian border [5], it is home to many lakes and a unique ecosystem in the Mediterranean basin. The park was listed as a National Heritage and Biosphere Reserve by the UNESCO in 1990 [6]. This rich park has been exceptionally open to housing.

The black rat of El-Kala National Park had an overwhelming abundance (Fig. 2) in comparison with the other small rodents caught in this park, a cosmopolitan presence, as well as a better adaptation to the variations of the environment [6]. The color and the intensity of its fur changes with the color of the dominant vegetation, for example, those caught near peanut farmland, have a light golden color, while those of dense forests are dark grey almost black. This ranks it in the lowest level of ecological requirement expressed by the cosmopolitan character. As variation of fur color from one area to another could be a natural camouflage device that helps the animal to melt into the setting and flee the predator

Manuscript received August 16, 2019; revised December 22, 2019.

doi: 10.18178/ijpmbs.9.1.23-26

[7]. We also noticed an exceptional diversity of parasites carried by the populations of small mammals essentially the black rat. These parasites are either external: ticks, mites, fleas; or internal prasites they are parasital worms or whipworm or tapeworm [7].

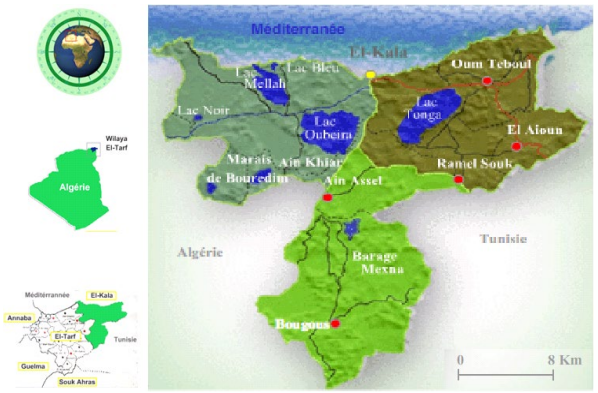

Figure 1. Location of the study area [6].

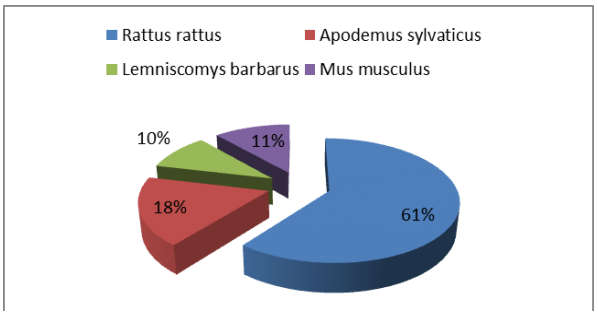

Figure 2. The rat's abundance in the national park [6].

The study was conducted over a period of one year. The work was done in three phases: Sample capture; Sacrifice, reproductive organ harvesting, organ measurement, organ harvesting and; then Preparation of histological sections and reading of prepared slides.

III. Findings

After the sacrifice and the recovering of the reproductive organs: the ovary in the female (Fig. 3) and the testis in the male (Fig. 4). Our samples were classified into mature and other immature subjects, for which we relied on the measurements of the animal as well as those of the testis and the appearance of the seminal vesicles in males; and the number of placental scars in females [8].

The measurements of the recovered rat testicles varied as follows: Length [19.7, 23.5] and Width [8.8, 23,5].

Twenty-three prepared slides treatment allowed two types of pathologies identification: The first represents an infertile male subject (Fig 5): on this slide, we note the seminiferous tubes that are empty and the interstitial cells that are loose. This blade has been compared with the blade of a very fertile subject (Fig. 6). During the observation, we classified this slide as one that represents a pathological anomaly [9]. After the consulting the data, we noticed that is not a pathology because the subject was old and fertility decreased with age until full infertility was reached [10].

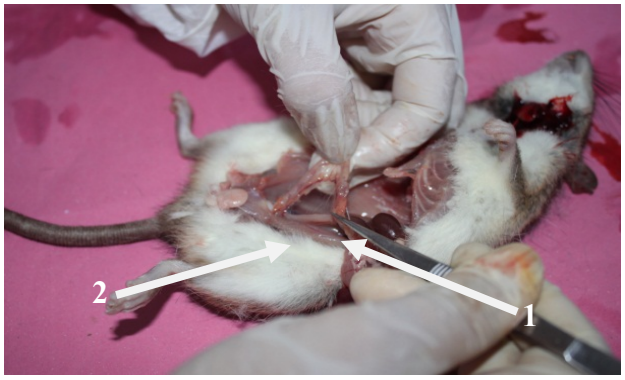

Figure 3. Black rat (1: ovary, 2: fallopian tube).

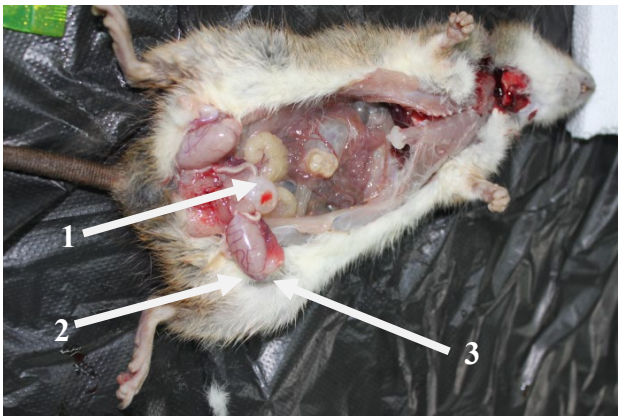

Figure 4. Black rat (1: testicle, 2: seminal vesicle, 3: epididymis).

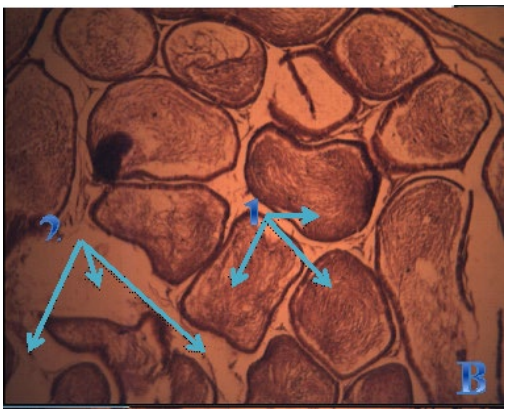

Figure 5. Histological sections of an infertile rat testicle: 1 empty seminiferous tubes, 2 loose interstitial space.

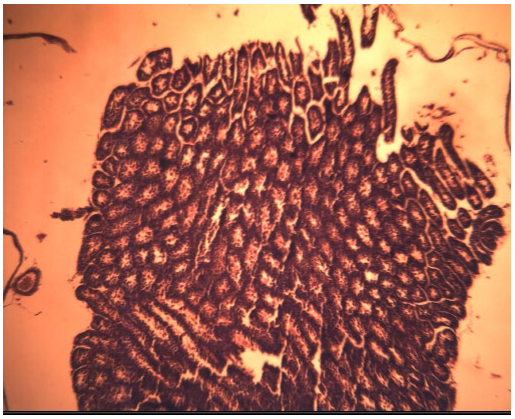

Figure 6. Histological sections of a testis of a very fertile subject.

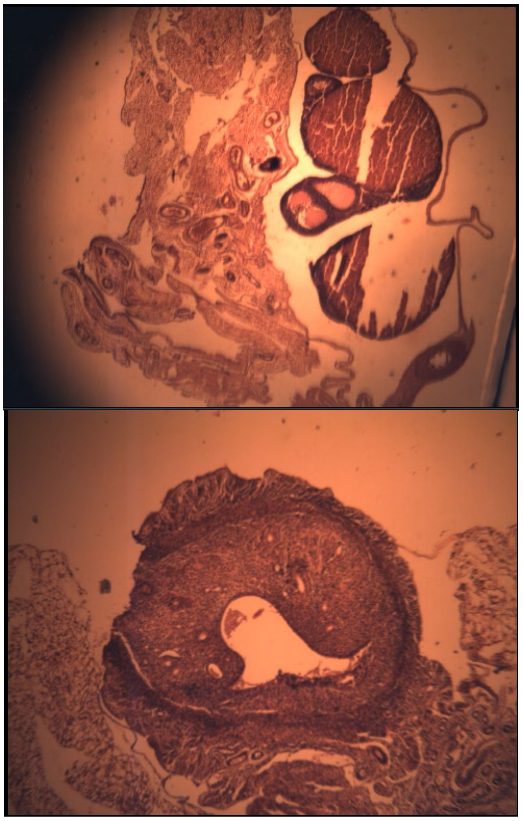

Figure 7. Histological sections of a diseased ovary, corpus luteum (1: luteal cyst).

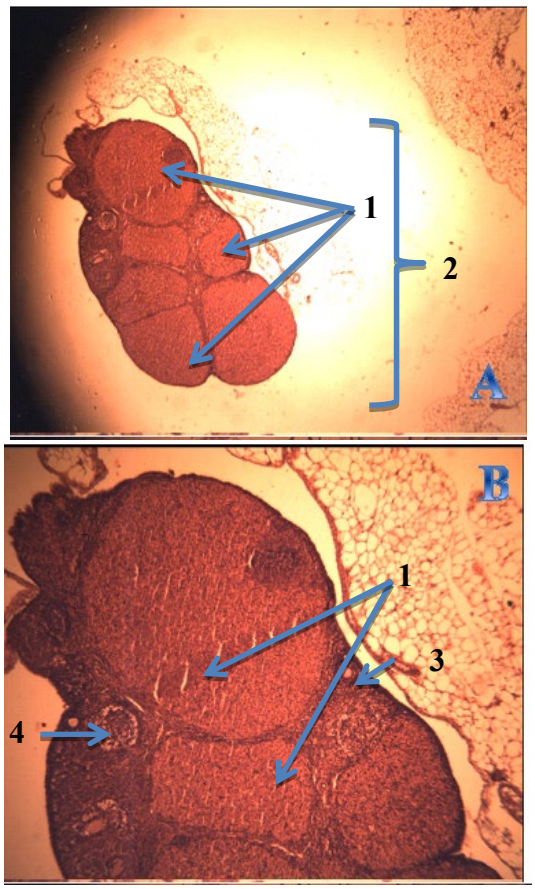

Figure 8. histological sections of a fertile ovary (1: healthy corpus luteum, 2: ovarian follicles at different stages of development, 3: primary follicle, 4: secondary follicle).

Another pathology has been identified. The following figure represents a female subject having luteal cysts (Fig. 7): the ovary of this female has yellow corpus luteum, the crack in the yellow bodies denote cysts. This slide has been compared with that of a healthy ovary (Fig. 8).

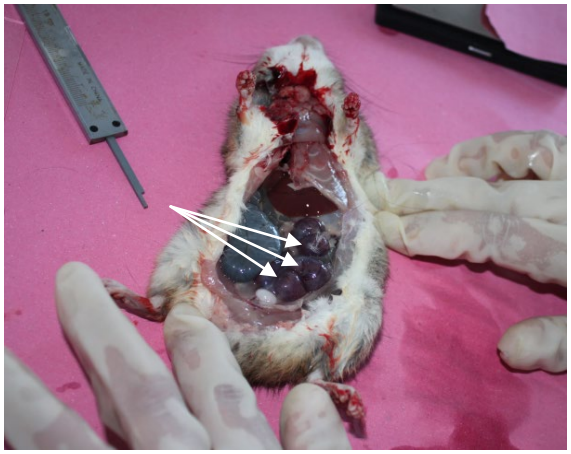

Figure 9. Pregnant black rat.

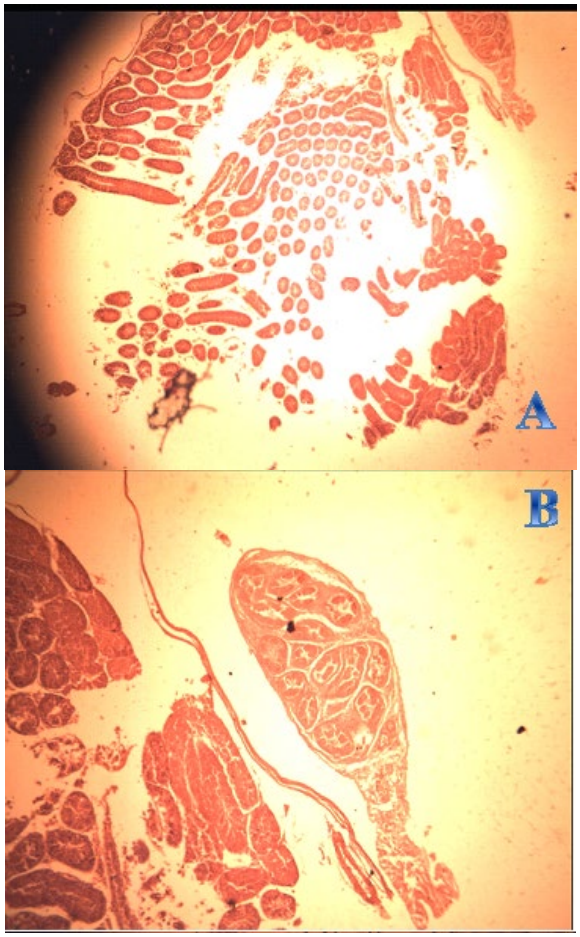

Figure 10. Histological sections of differentiated embryonic tissue (*Rattus rattus* raccoon) (A: X4 magnification, B: X10 magnification).

Every month, because of female cycles, normal microcysts are formed in the ovaries. This is the ovule preparation for ovulation. If the formations persist after the ovulation we get what is called a corpus luteum. They make ovulation, the corpus luteum stops working,

causing the menstrual cycle, and all that disappears. There are no more microcysts. Sometimes, the microcysts do not disappear, they persist, and each month continue to grow. They end up measuring several inches and could be painful [10], [11].

The female can have up to ten pups per coverage [6]. in the present study we sacrificed a pregnant female and we checked the development of the fetuses by histological sections (Fig. 9). Finally, we could not identify abnormalities in recovered fetuses, because the histological section shows a very normal development of embryonic tissues (Fig. 10)

IV. Conclusion

The treatment of twenty-three samples, has not shown a single actual pathology, with the exception of the wounded ovary by a luteal cyst, which is not a true pathology because it could be functional. This could partly explain the cosmopolitan character (in: urban environment, sand dune, forest, agricultural land, scrubland, meadow, wetland) of the species despite of the high parasitic load that it carries [6]. Small rodents sneak everywhere helped by a good genetic heritage, that help them to be adapted to various types of environments or living conditions [12]. The following concept map could summarize our results (Fig. 11).

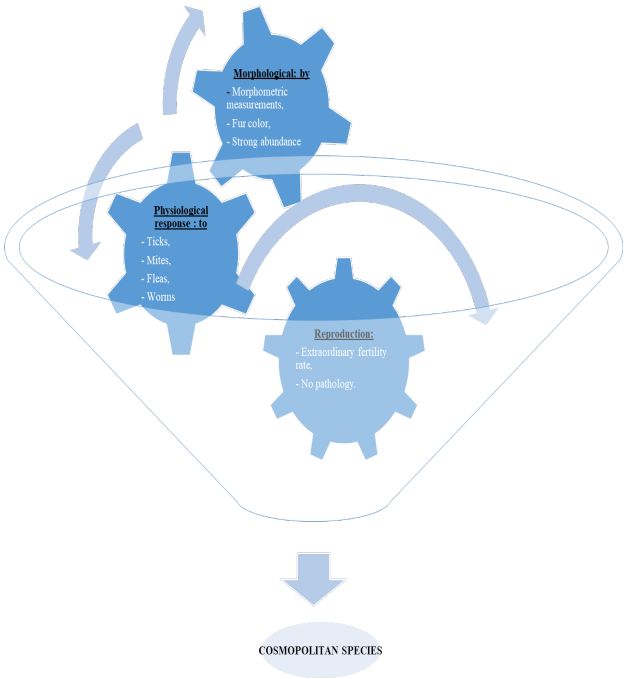

Figure 11. Mind map summarizing the ecological equilibrium [6], [7], [12].

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

This work was the subject of the academic master of Hadjira HANNACHI, directed by Farida BECIR.

BECIR Farida made the wild specimen's catch, the identification, the sacrifice and the removal of organs, the reading of the sections and wrote the paper. Hadjira HANNACHI attended all the stages and made the histological sections.

All authors had approved the final version.

References

[1] W. S. Lee, F. Otsuka, R. K. Moore, and S. Shimasaki, "Effect of bone morphogenetic protein-7 on folliculogenesis and ovulation in the rat," *Biology of Reproduction*, vol. 65, no. 4, pp. 994-999, October 2001.

[2] P. Orihuela and H. Croxatto, "Acceleration of oviductal transport of oocytes induced by estradiol in cycling rats is mediated by nongenomic stimulation of protein phosphorylation in the oviduct," *Biology of Reproduction*, vol. 65, no. 4, pp. 1238-1245, October 2001.

[3] C. Thibault and M. C. Levasseur, *La reproduction chez les mammifères et l'Homme*, France: INRA, 2001, p. 929.

[4] A. Stevens and J. Lowe, *Histologie*, ed. Pradel, Gower Medical Pub, 1992, p. 378.

[5] F. Becir, "Biodiversité des micromammifères du Parc National d'El-Kala,"Thèse Doc. Sci., Univ. Annaba, Algeria, p. 119, 2016.

[6] S. Benyacoub, "Ecologie de l'avifaune forestière nicheuse de la région d'El-Kala (Nord-Est algérien)," Thèse Univ. De Bourgogne. Dijon, p. 287, 1993.

[7] F. Becir, L. Bitam, H. Hannachi, Ch. M'barek, and Z. Bouslema, "*Rattus rattus* parasits of El-Kala National Park (Algeria)," in *Proc. International Conference on Applied Life Sciences*, 2012, pp. 265-268.

[8] A. Stevens and J. Lowe, "Histology Picture Tests," Gower Medical Pub, 1992, p. 144.

[9] P. Ganter & G. Jolles, *Histochimie normale et pathologique, tome 1 et 2*, Ed. Dunod, 1972.

[10] J. R. Duperie, E. Moya, I. S. Blagbrough, and M. M. Usowicz, "Department of Pharmacology, University of Bristol, U.K. Neuropharmacology," *U.S. Gov't*, vol. 35, no. 1, pp. 1-11, 1996.

[11] S. Bensser, " Kyste dermoide de l'ovaire chez la fille (à propos de 7 cas)," Thèse Doc. En Médecine, N148, Univ. Mohamed V–Souissi, 2014, p. 121.

[12] S. Aulagnier, P. Haffner, A. J. Mitchell Jones, F. Moutou, and J. Zima, *Guide des mammifères d'Europe, d'Afrique du Nord et du Moyen-Orient*, France: Delachaux et Niestlé, 2008, p. 271.

Farida BECIR received a B. Ing. in Ecology and environment Sciences from Annaba University, Annaba, Algérie in 2002, Magister in population-habitat relationships from Annaba University in 2005, and PhD in animal biology in 2016. She also did research on wild mammals, birdlife, parasitism, human and animal health and balance of the natural environment. She had become a professor of biology, Department of biological sciences since 2005 at El-Tarf University (Algeria) where she is currently titular Senior Lecturer.