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Development of Food Habits in Roe-Deer

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Kossak S., 1981: Development of food habits in roe-deer. Acta theriol., 26, 33: 483—494 [With 1 Table & 6 Figs.].

Development of food habits was examined from the 1st to the 90th day of life of these animals by means of direct observations of 5 tame feeding fawns. During the studies the roe-deer lived within an enclosure in a mixed forest. A description is given of the quantitative and species composition of the fawns' diet at different ages. The animals were observed to crop and swallow plant food for the first time on the 5th day of life. As the animals' age increases the number of plant species eaten increases, as does also the amount of food consumed during one activity period, counted between two resting periods, and the average amount of food consumed during 5 minutes activity. The duration of the activity period does not, however, increase. The fawns' diet includes both herb layer plants, grasses and sedges, and also trees, bushes and shrubs. To start with they consume the soft parts (leaves and buds), then the non-ligneous annual growth of ligneous plants. The mechanism by means of which the fawns' diet is established is discussed in the light of material collected on the way in which these animals try out different plants as food at different ages.

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1. INTRODUCTION

Literature on the roe-deer's diet does not contain data on the composition of the food and food preferences of fawns during the first few months of the postnatal period, or of qualitative and quantitative changes in food taking place as the fawns grow up. A very considerable part of each roe-deer population consists of individuals which have not yet completed the first year of life. As stated by Kurt (1968), the average size of a litter from one doe is 1.8 fawns, barren does over three years old not being found to occur. Assuming that the average age of a primapara doe is two years, it can be considered that about 1/3 of the population consists of fawns in the first year of life. As shown by Strandgaard's studies (1972) the proportion of the population formed by fawns may be as much as 47%. With so high a percentage their food requirements significantly contribute to the picture of the population's food situation.

In view of the foregoing an attempt has been made at examining the course taken by formation of food habits in this age group of roe-deer.

2. MATERIAL AND METHODS

Five roe-deer (3 males and 2 females) obtained from the wild state at the age of 1 to 7 days were used for the studies. The fawns were artificially fed on full cow's milk and powdered milk. Both the daily doses of milk and length of the whole feeding period depended on the animals' individual requirements (Kossak, 1981). The fawns were not given any additional food apart from milk. The course of individual development was examined by means of periodical measurements of weight and body dimensions.

On account of the different times at which the mothers dropped their fawns, the latter differed from each other in respect of age. The maximum difference was 20 days, and consequently the youngest fawns reached the age of 90 days on September 10th, whereas the oldest reached this age on 20th August.

Observations were made over 5-minute periods, registering on a tape recorder data on the behaviour and feeding of the fawns over the full activity cycle. The time between two resting phases in these fawns was taken as one cycle of activity. Observations were made at different times of the day, morning hours predominating. From one to two sessions were held each day, endeavour being made to watch a different individual each time. A total of 66 sessions took place, giving a total of 719 5-minute periods (60 hours).

The method of recording contacts was used to determine the composition of the roe-deer's food. A single instance of cropping and swallowing by a fawn of a part or the whole of a plant of a given species was considered as 1 contact. Cases were also recorded in which the fawn very evidently (smelling, licking, cropping and spitting out) decided against eating the given plant. A total number of 10,945 contacts was obtained.

During the study period the roe-deer lived in a 0.84 ha enclosure situated in a mixed forst. Within the enclosure there was 0.57 ha of young tree plantation, with trees of varying ages and 0.25 wasteland.

3. RESULTS

Changes in the fawns' diet taking place as the animals' age increased are shown in Fig. 1. All three parameters taken into account (number of species consumed and maximum and average number of contacts taking place in one activity cycle) show a distinct increase in value. The process of enlarging the diet by more species takes place most rapidly: by the 11th-15th day the animals crop parts of plants belonging to 13 species and by about the 31st-40th day of life they feed on 32 species. Increase in the number of contacts takes place far more slowly: up to the 40th day of life the average number of contacts does not exceed 50 in one activity cycle. As from the 41st day of the fawns' life there is a distinct increase in the average number of contacts, to reach the number of approx. 400 between the 80th and 90th day.

The fawns' feeding intensity on different species of plants, expressed by means of contacts, is shown in Fig. 2 and 3. The cropping and swallowing of plant food was observed for the first time about the

5th day of the fawns' life. The food consisted of parts of *Salix caprea* leaves. During the subsequent five days the fawns cropped small, chiefly soft, parts of 9 plant species, leaves of grasses, *Plantago lanceolata and Salix caprea* predominating. About the 11th day of life *Fragaria vesca* appeared in their diet, and during the following 20 days formed from 22—25% of all contacts. As from the 31st day the importance of *Fragaria vesca* decreased, although it remained in their diet as a constant and important element. Grasses and sedges are cropped by 6—10 day old fawns, most intensively from the 21st-25th day, but

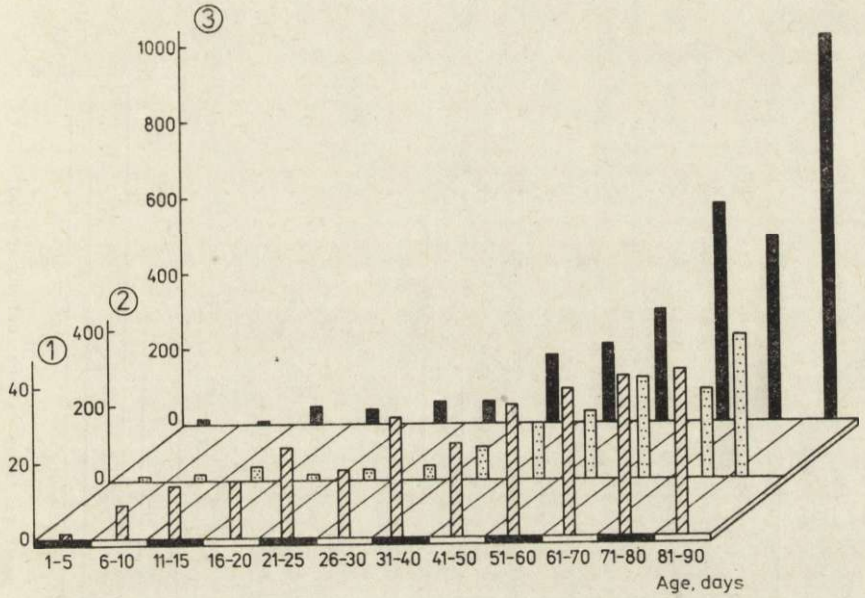

Fig. 1. Course taken by variations in the fawns' feeding habits.
1. Number of species, 2. Average number of contacts/activity period, 3. Maximum number of contacts/activity period.

their importance greatly decreases in the diet of older animals. Fawns begin to feed on ligneous plants very early (*Salix caprea* has already been mentioned). At the age of about 10 days they consume *Carpinus betulus, Populus tremula* and *Quercus robur*, and the importance of trees in their diet constantly increases with the passage of time. During the first 90 days of the fawns' life the species most often cropped among herb layer plants are *Fragaria vesca* and *Plantago lanceolata*, and among trees *Carpinus betulus* and *Quercus robur*, although the proportion of none of them exceeds 30% of all contacts observed in the given age group of these animals.

Up to about the 40th day herb layer plants, with grasses and sedges, predominate (54.5 to 91.5% of contacts). From the 41st day trees and

shrubs begin to predominate (52.0 to 61.7% of contacts) (Fig. 3). The increase in the proportion of ligneous plants in the fawns' diet is connected with the appearance in their diet of the non-ligneous annual growth of twigs (Fig. 4) of *Salix caprea*, and then *Betula verrucosa* and *Populus tremula*. Twigs of *Quercus robur* appear last. Maximum percentage of twigs in the fawns' contacts with ligneous plants was observed

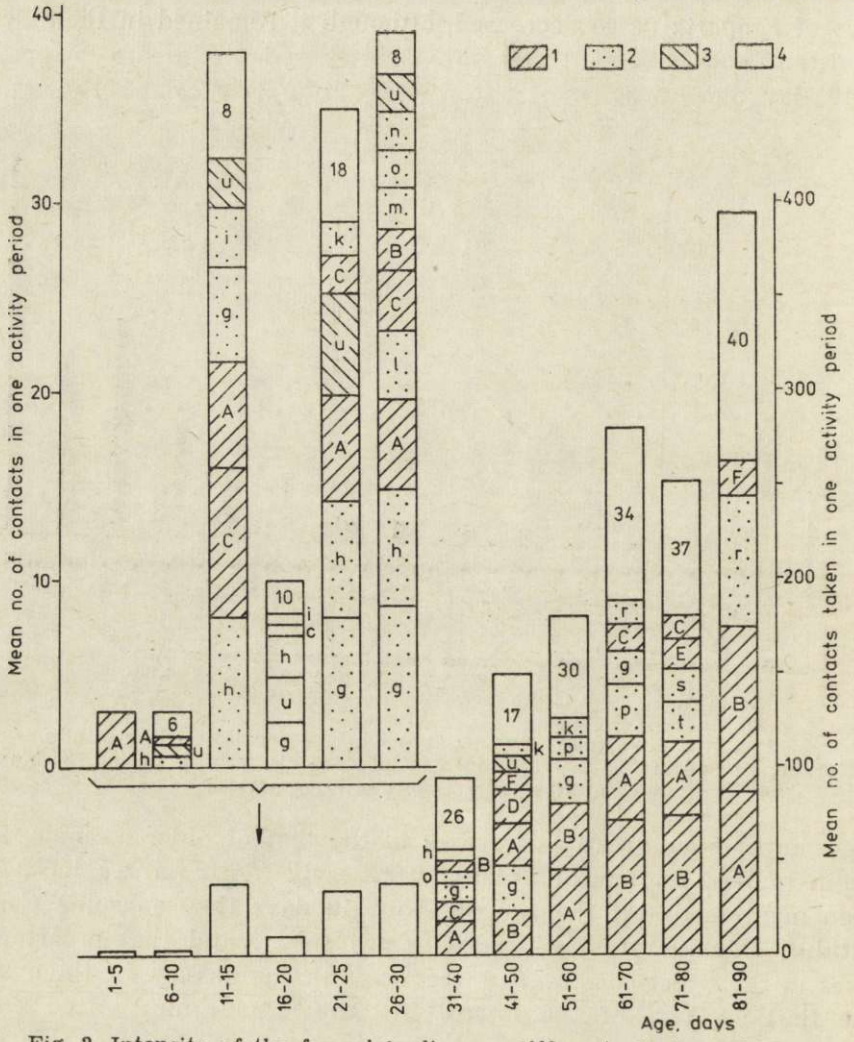

Fig. 2. Intensity of the fawns' feeding on different plant species.

1. Trees, 2. Herb layer plants, 3. Grasses and sedges, 4. Number of other species of plants. A — *Salix caprea*, B — *Carpinus betulus*, C — *Quercus robur*, D — *Betula pubescens*, E — *Populus tremula*, F — *Betula verrucosa*, g — *Fragaria vesca*, h — *Plantago lanceolata*, i — *Potentilla erecta*, k — *Lotus corniculatus*, l — *Convolvulus arvensis*, m — *Stellaria holostea* n — *Melandrium album*, o — *Vicia* sp., p — *Oxalis acetosella*, r — *Achillea millefolium*, s — *Galium*, sp., t — contacts with trees made by roe-deer during the growing

in the diet of animals from 60—80 days old. The fawns then most readily cropped twigs of *Betula pubescens* (maximum approx. 20% of contacts with this species). In the case of the remaining trees this percentage did not exceed 10% of contacts.

As shown above, the fawns' diet changes in time, consisting in increase in the range of species cropped and increase in the amount of food consumed. This gradual development of their diet, progressing with their increasing age, results in a change of the fawns' attitude to the plants occurring in the area and forming potential food.

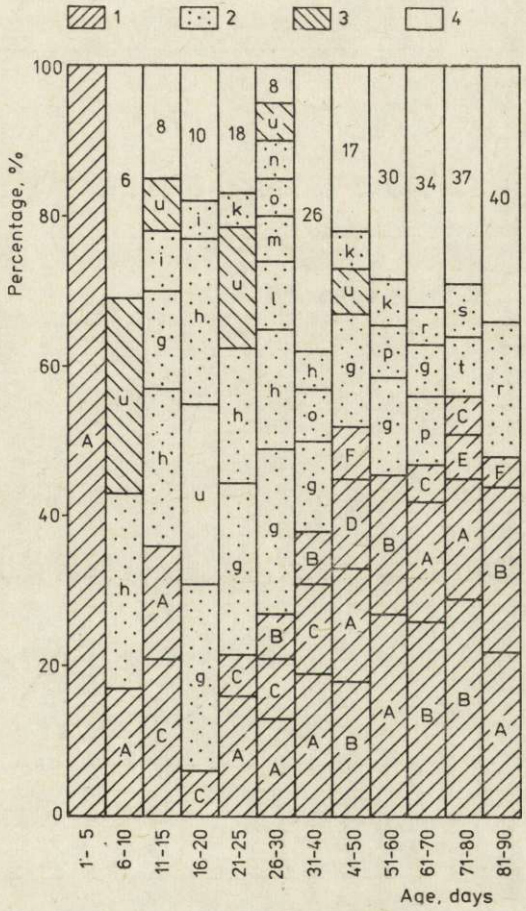

Fig. 3. Percentage of plants in contacts made by fawns of different age. Description of figure included with Fig. 2.

Figure 5 has been drawn up on the basis of the material obtained on attempts at consuming plants made by fawns of different age and on the times at which successive plants enter into the composition of their diet. Cases in which the roe-deer smelt the given plant, or licked

or cropped it and then spat it out, but did not consume it, were taken as "testing plants". In all, over a period of 90 days of life, the fawns "introduced" into their diet and consumed 66 species of plants (up to the 40th day — 43 species, from the 41st-90th day a further 23 species). Generally "introduction" of a plant into the diet is preceded by a short testing period, or possibly without previous trials, as is shown by the

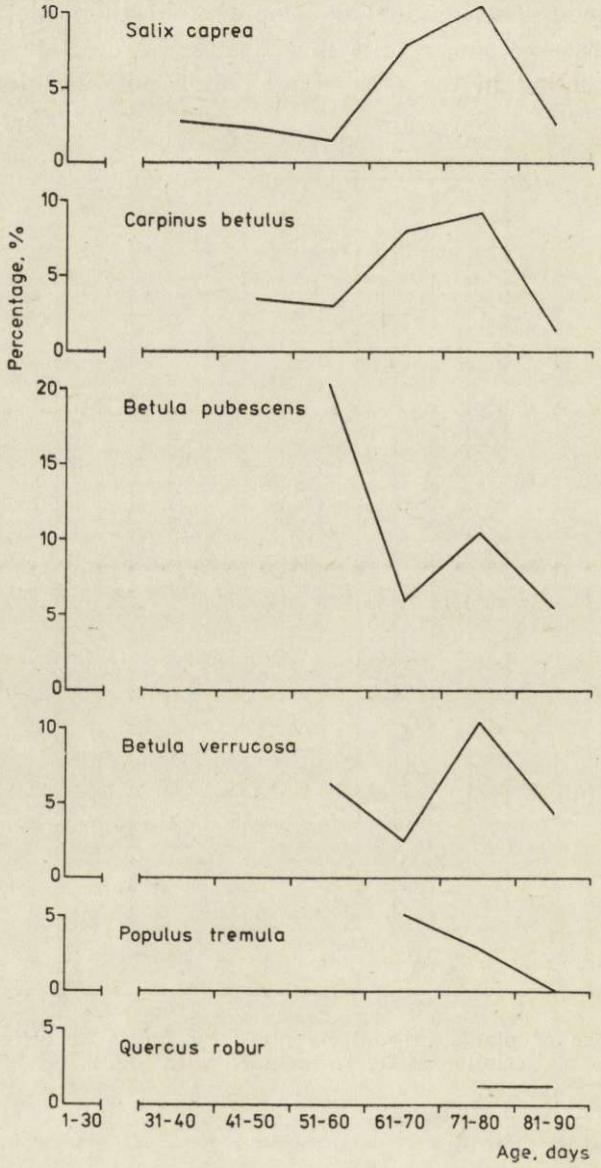

Fig. 4. Percentage formed by twigs in contacts with trees cropped by fawns of different ages.

fact that no cases were found of testing 50 species, but with the subsequent 9 species tests occurred almost simultaneously with their appearance in the fawns' diet. The longest period of tests was preceded by consumption of *Betula verrucosa* and *Prunella vulgaris*. Two species of coniferous trees: *Pinus silvestris* and *Picea excelsa*, failed to be included in the fawns' diet even after a long period of testing. In the

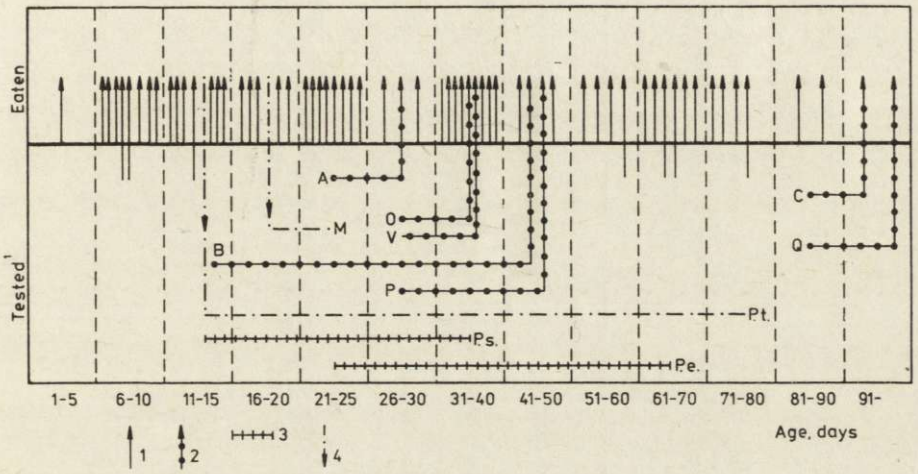

Fig. 5. Attitude of fawns of different ages of plant food.

1. Species included in their diet, not described by name. Arrows starting from the axis dividing "testing" and "eating" indicate that attempts at eating were not observed, while arrows extending beyond the axis indicate that attempts at eating were observed in the same age interval of the fawns as eating.

2. Species tested by younger fawns, eaten by older fawns. Arrows begin in the age interval in which the first tests were observed, while the axis is intersected by them in the age interval of the fawns in which consumption of the given species was observed for the first time.

3. Species tested, but not eaten by the fawns. The line indicating the species begins in the age interval in which the first tests were observed, and ends in the interval in which tests ended.

4. Species eaten by younger fawns, tested by older fawns. In order to illustrate the "exclusion" from the diet of certain species the arrows run in the opposite direction to that in 1. and 2.

A — *Anemone nemorosa*, O — *Oxalis acetosella*, V — *Veronica chamaedrys*, B — *Betula verrucosa*, P — *Prunella vulgaris*, C — *Corylus avellana*, Q — *Quercus robur*, P.s. — *Pinus silvestris*, P.e. — *Picea excelsa*, Pt — *Pteridium aquilinum*, M —*Musci*.

[1] Tested: licking, cropping and spitting out.

case of *Pteridium aquilinum* and mosses the reverse phenomenon to that described above occurred: they appeared for a short time in the diet of 10—20 day old fawns, soon afterwards were omitted and after a testing period (lasting in the case of *Pteridium aquilinum* up to the 80th day of the animals' life) no case was found of the roe-deer having taken an interest in them.

Comparison was made of the duration of one activity period for fawns of different ages and the number of contacts made. As can be seen from Fig. 6, the number of contacts made (B), increasing as the animals grow older, are not connected with prolongation of the activity period (A), this applying both to average and maximum values.

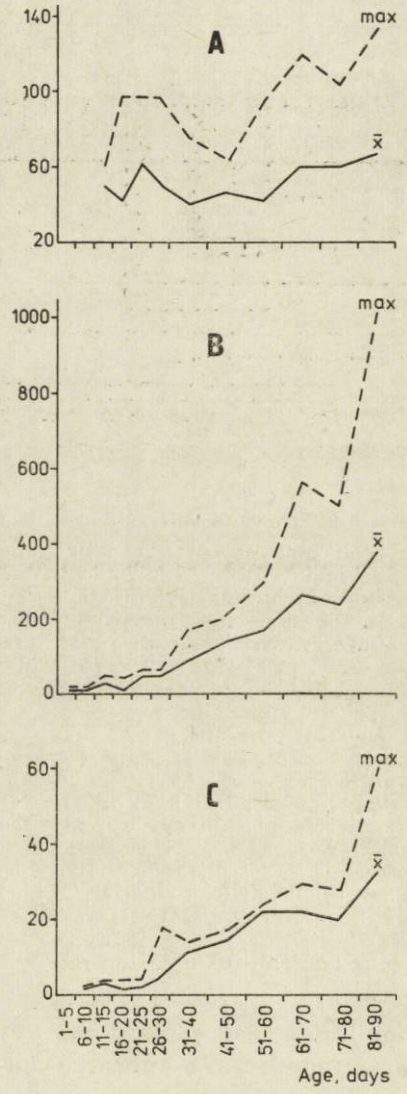

Fig. 6. Intensity of feeding by fawns of different age.

A. Activity period (min.) combined with feeding, B. Number of contacts made during one activity period, C. Number of contacts made during five minutes' activity combined with feeding.

Intensity of feeding (C), however, increases, expressed in the number of contacts made per 5 minutes of the roe-deer's activity, this applying both to average and maximum values for the given age.

4. DISCUSSION

It can be seen from the material presented that at the age of several days the fawns consume plant food from both herb layer and ligneous plants. Widening of the range of plants consumed takes place relatively rapidly (*e.g.* at the age of about 1 month the roe-deer are already feeding on 32 species of plants). It may therefore be said that during the first months of life it is chiefly the anatomic and morphological properties of plants which determine the fawns' choice of food; the softest parts: leaf buds and young leaves, flowers and the tips of the youngest blades of grass and sedge are eaten. The non-ligneous annual growths of ligneous plants appear in the animals' food about the 30th day of life (the soft juicy twigs of *Salix caprea*). At the age of approx. 70 days

Table 1

Percentage of twigs in contacts with trees cropped by roe-deer of two different age groups

Species	Up to 5 months	1 year and older[1]
Acer platanoides	0.0	0.0— 1.5
Betula pubescens	5.7	0.0— 45.0
Betula verrucosa	2.5	36.1—100.0
Carpinus betulus	7.6	77.4— 91.9
Populus tremula	0.5	36.4—100.0
Salix caprea	2.8	61.8— 67.0
Sorbus aucuparia	0.0	8.9— 22.5
Quercus robur	1.8	7.5— 96.4

[1] Use has been made of the author's own data (Kossak, in prep.) but they relate to the percentage of twigs in contacts with trees made by roe-deer during the growing season, in different age classes of a mixed forest.

the fawns feed on the twigs of the majority of trees and shrubs, but their proportion in the whole of the food is several times lower than in the food of adult individuals (Kossak, in prep.). It is clear from the data given in Table 1 that during the growing season the fawns crop chiefly the leaves from ligneous plants, while twigs form a small addition to their diet. Thus until the leaves begin to fall, when the fawns' diet becomes similar to the diet of adult animals, this age group in the roe-deer population is not responsible for any possible economic damage done to tree stands.

Inclusion of any given plant species in the animals' diet is often preceded by a trial period. Bubenik (1965) also observed attempts at consuming plants made by 9—10 day old fawns. The leaves were cropped several times and spat out, and only the following day chewed and swallowed. It can be seen from Fig. 5 that the fawns exhibit a differing attitude, varying with age, to plants forming potential food. An explanation of this may be that: (1) Instinctive action (testing) slightly precedes, or is simultaneous with physiological readiness[1] of the organism to make use of the given plant (consumption). This phenomenon occurs most often — applies to 57 species of plant. (2) Instinctive action greatly precedes the state of physiological readiness, as in the case of, *inter alia, Betula verrucosa* and *Anemone nemorosa,* (3) Instinctive action is not connected with physiological readiness — this applies to *Pinus silvestris* and *Picea excelsa.* Both these species may theoretically be included in the composition of the roe-deer's food, and even form a considerable proportion of it, but they are not preferred species. It may be concluded that a condition for their entry into the animals' diet is the occurrence of a deficiency of more suitable food, causing the organism to demand given food substances and resulting in the appearance of physiological readiness to eat *Pinus silvestris* and *Picea excelsa.* As the roe-deer had an abundant and varied food supply in the study area, this readiness did not appear. (4) Disappearance of physiological readiness to consume given plants. This may apply to mosses and ferns (and presumably many other plants) consumed by young, and avoided by older animals. It may be that these plants contain certain substances of use to the young animals for normal development during the first period of life. The correctness of the above assumption is borne out by the transitional consumption by fawns of soil and sand, and also the faeces of adult individuals, for the purpose of activating the alimentary tract and introducing microorganisms facilitating normal digestion (Bubenik, 1965; Espmark, 1969; Kossak, 1981).

The element of the animals learning to eat different plant food occurs during formation of food habits. After the introduction into their diet of the given plant species, it is recognized by these animals in a visible way (by sight, smell and taste) and cropped without testing. After a certain time test eating of plants which were not found in their food cease, while species consumed by younger fawns and later avoided,

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[1] Physiological readiness — by this is meant a state permitting the animal to make use of different kinds of food, and is the result of the degree of development of the digestive system and the organism's requirements for given food substances.

are still tested by them for a certain time. Contrary to the imprinting which occurs in roe-deer (Kossak, 1981) the roe-deer's remembering plants "suitable for" or "not suitable for" consumption most certainly is not a single or final act. All changes in the food supply and in the organism's need for a given food involve changes in the species compositions of the roe-deer's diet.

It is an important research problem to discover the essential nature of the mechanisms forming the roe-deer's food habits, together with their plastic character and conditionings, and is directly connected with the "food blocks" reported by Kossak (1976). The results of studies made on this problem will be of assistance in determining the food situation of roe-deer in different ecosystems and, in consequence of this, with correct management of this species.

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ROZWÓJ WYBIÓRCZOŚCI POKARMOWEJ SAREN

Streszczenie

Przy zastosowaniu metody bezpośrednich obserwacji żerowania 5 oswojonych saren *Capreolus capreolus* (Linnaeus, 1758) prześledzono rozwój wybiórczości pokarmowej od 1 do 90-go dnia życia zwierząt. Podczas całego okresu badań sarny przebywały w zagrodzie zlokalizowanej na terenie Puszczy Białowieskiej w lesie mieszanym świeżym. W celu określenia składu pokarmu saren zastosowano metodę liczenia kontaktów. Za 1 kontakt przyjęto zgryzienie i przełknięcie przez koźlę fragmentu lub całej rośliny. Notowano również przypadki, gdy zwierzę w sposób widoczny, zrezygnowało ze zjedzenia danej rośliny. Obserwacje prowadzono w odcinkach 5-cio minutowych, notując na taśmie magnetofonowej dane o zachowaniu się i żerowaniu koźląt w ciągu pełnego okresu aktywności. Łącznie w ciągu 719 odcinków 5-cio minutowych zebrano 10.945 kontaktów koźląt z roślinami.

Pierwsze zgryzienie i przełknięcie żeru roślinnego zauważono około 5-go dnia życia koźląt. Proces bogacenia się diety koźląt w gatunki postępuje szybko; 11—15-to dniowe zwierzęta zgryzają fragmenty roślin 13 gatunków a około 31—40-go dnia żerują już na 32 gatunkach. Znacznie wolniej postępuje wzrost ilości kontaktów: do 40-go dnia życia, w jednym cyklu aktywności, przeciętna ilość kontaktów nie przekracza 50. Od 41-go dnia następuje wyraźny wzrost przeciętnej ilości kontaktów, by między 80 a 90-tym dniem osiągnąć około 400.

W pierwszych dniach życia koźlęta zgryzają miękkie części traw, *Plantago lanceolata* i *Salix caprea*. Około 11-go dnia pojawiają się *Fragaria vesca, Carpinus betulus, Populus tremula* oraz *Quercus robur*. Do około 40-go dnia w kontaktach przeważają rośliny zielne wraz z trawami i turzycami (54 do 91% kontaktów). Od 41-go dnia zaczyna się dominacja roślin drzewiastych (52 do 62%). Zwiększanie się udziału tej grupy roślin łączy się z pojawieniem w diecie koźląt niezdrewniałych pędów tegorocznego przyrostu *Salix caprea* a następnie *Betula verrucosa* i *Populus tremula*. Jako ostatnie pojawiają się w diecie pędy *Quercus robur*. Opierając się na zaobserwowanych próbach zjadania roślin, podejmowanych przez koźlęta w różnym wieku oraz na terminach wejścia kolejnych roślin do pokarmu saren, prześledzono i przedyskutowano mechanizm kształtowania się diety saren.