

References

- v. Haartman, L. 1969: Nest-site and Evolution of Polygamy in European Passerine Birds. — *Ornis Fennica* 46: 1–12.
 Murton, R. K. & Westwood, N. J. 1977: Avian breeding cycles. — 594 pp. Oxford.

- Pulliainen, E. & Hietajärvi, T. 1980: Sirittäjä *Phylloscopus sibilatrix* pesivänä Sallan pohjoiskärjessä. — *Lintumies* 15: 176–177.

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Optimal foraging theory and food selection by the Grey Partridge *Perdix perdix* in captivity

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An often-invoked assumption in connection with the optimal foraging theory is that natural selection favours individuals that maximize their net rate of energy intake (e.g. Schoener 1971). In this sense it can be expected firstly that food species should be strictly ranked. Secondly, it can be predicted that large food would be preferred to small, and thirdly, that calorie-rich foods would be preferred to calorie-poor foods. Among a number of alternatives, these are predictions which can be tested with the Grey Partridge, *Perdix perdix*, which actively selects with its bill those food items which it wishes to accept and discards the others. The present paper is a reinvestigation of some data on food selection in this seed-eating gallinaceous bird species (Pulliainen 1965), the gut of which has evolved for the utilization of this kind of food (Pulliainen 1984b).

The first prediction appeared to be valid in a series of trials in which four kinds of grain were offered initially in addition to green leaves, and then the favourite grain was taken away, and so on. The results obtained were as follows (in ml):

No. of trials	Wheat	Rye	Barley	Oats	Green leaves
22	315.1	16.1	5.4	2.7	364.6
7	–	83.2	6.6	4.2	411.5
7	–	–	93.7	17.0	677.6
5	–	–	–	78.1	788.8

In the second series of trials both the shape (length/breadth index) and the size of the seeds (wheat and hemp) were taken into account as follows (shape indices in parentheses): Size class No. 6 (= the largest seeds: 1.55), No. 7 (1.70), No. 8 (1.85) and No. 10 (2.00). The following combinations (of wheat grains) were offered to two partridges (a male and a female): 6, 7, 8 and 10, 6 and 7, 8 and 10, and 7, 8 and 10. In all cases (as measured by weight and volume consumed) the seeds characterized by larger size and smaller length/breadth index were preferred, i.e. the preferred seeds were at the same time larger and more spherical than the less favoured ones. The next trials were carried out with spherical hemp seeds by using three size classes 6, 7 and 8. The results were as follows:

Size class	Weight (g)	Seeds taken	Volume (ml)
6	20.2	878	24.3
7	19.3	972	23.1
8	23.5	1944	40.0

Thus the highest figures by weight, number and volume were recorded in the smallest size class. The same finding was obtained with the alternatives 6 and 7.

The crude fat content of seeds can be used as a rough indicator of their calorific value. The results of the trials with seeds possessing different fat contents are shown in the following tabulation.

	Flax	<i>Galeopsis</i> spp.	Hemp	Wheat
Fat content, %	38–45	35–40	30–32	2
Consumption in 20 trials, ml	18.7	35.0	161.6	7.6

Thus the two most fatty seeds were not the most readily consumed ones, but the spherical hemp seeds were clearly preferred (72.5 %).

Using tetraonid hybrids as examples, Pulliainen (1982) showed that the basic food selection of tetraonids is genetically determined. Interspecific differences in the digestive ability indices (Pulliainen 1984b) suggest that this is relevant in the case of partridges, too, even though partridges do not eat foods typical of woodland grouse, nor are they able to digest these foods.

There is no doubt that the optimal foraging strategy works to some extent for partridges, and it is also worthwhile for them to have a strict rank order of food items, which really seems to exist on the basis of captivity studies (the present data) and studies carried out in nature (Pulliainen 1965, 1984a). The fat-rich seeds of *Galeopsis* spp. are highly preferred in nature, but took only second place to hemp seeds, which contain less fat, in the food selection trials. The most fatty seeds (flax) took only third place. These latter two food items are not available naturally in Finland, however. The spherical shape of the hemp seeds apparently explains their attraction in these trials. In fact the shape and size of the seeds appeared to affect the food selection of the Grey Partridges to such an extent that they can be said not to have acted in accordance with the optimal foraging theory. It is also worth remembering in this context that a change in the physical condition of these birds (e.g. in oedema cases) may alone totally alter their food intake (Pulliainen 1965).

Due to their sympatric existence *Galeopsis* spp. have become important food items of the Grey Partridge in the northern part of their European range. Due to their relatively high fat content, the seeds of *Galeopsis* spp. are worth eating when the Grey Partridge are living in an area with a cold climate. The present data suggest that if the availability situation in nature were different, the composition of the diet of the species might also be quite different.

Selostus: Tarhapeltopyiden ravinnonvalinnasta optimaalisen ravinnonoton teorian valossa

Kirjoitus perustuu kirjoittajan aiemmin julkaiseman aineiston (Pulliainen 1965) uudelleenkäsittelyyn. Koesarjassa tarhapeltopyille tarjottiin valintalaatikoissa eri lajeihin kuuluvien kasvien eri kokoisia ja muotoisia siemeniä ja saksilla sopivan kokoisiksi leikattuja rukiinoraan lehden kapaleita. Peltopyyt näyttävästi valitsivat, minkä nokkaansa ottamansa kohteen nielaisivat ja minkä taas hylkäävät.

Peltopyyt "asettavat" ravintokohteet selvään tärkeysjärjestykseen; kun suosituin siemenaines pudotetaan tarjonasta pois, seuraavana oleva tulee sen paikalle ja niin edelleen. Tässä siis peltopyy käyttäytyy tutkittavan teorian mallin mukaisesti.

Toisessa koesarjassa peltopyyt söivät halukkaimmin sellaisia siemeniä, jotka olivat samalla suurempia ja pallonmuotoisempia kuin toiset. Mutta jatkotutkimukset eri kokeisilla hampunsiemenillä osoittivat, että kun muoto pysyy samana, peltopyyt valitsivatkin pienemmät siemenet. Tämä on vastoin tutkittavan teorian ajatusta kuten myös se, että peltopyyt eivät valinneet rasvapitoisimpia siemeniä. Peltopyyt söivät halukkaimmin pallonmuotoisia hampunsiemeniä, joiden rasvapitoisuus oli vasta kolmanneksi korkein tarjotuista.

Työssä tähdennetään sitä, että Suomen luonnossa pillikkeiden siemenet ovat peltopyiden todella haluttua siemen-

ravintoa. Pillikkeiden ja peltopyiden sympatrisen esiintyminen on johtanut tähän predaatiosuhteeseen. Tehtyjen kokeiden valossa jokin toinen siemenlaji voisi olla aivan yhtä hyvin pillikkeiden paikalla. Nyt kokeissa "menestynyttä" hamppuahan ei Suomen luonnossa ole saatavilla.

References

- Pulliainen, E. 1965: Studies on the weight, food and feeding behaviour of the partridge (*Perdix perdix*) in Finland. — *Ann. Acad. Sci. Fenn. A IV* 93:1–76.
- Pulliainen, E. 1982: Food selection in the tetraonid hybrids *Lyrurus tetrrix* x *Tetrao urogallus*, *Lyrurus tetrrix* x *Lagopus lagopus* and *Tetrao urogallus* x *Lagopus lagopus*. — *Ornis Fennica* 59:170–174.
- Pulliainen, E. 1984a: Changes in the composition of the autumn food of *Perdix perdix* in West Finland over 20 years. — *J. Appl. Ecol.* 21:133–139.
- Pulliainen, E. 1984b: On the gut size and chemical composition of the food of the partridge (*Perdix perdix*) in Finland (Finnish with English summary). — *Suomen Riista* 31:13–18.
- Schoener, T.W. 1971: Theory of feeding strategies. — *Ann. Rev. Ecol. Syst.* 2:369–404.
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Tervapääskyjen viipyminen syksyllä 1986 – De sena tornsvalorna hösten 1986 i Finland

Pyydämme niitä ornitologeja, joilla vielä on merkittäviä tervapääskyhavaintoja (1.11. jälkeen tai pohjoisesta, elo-syyskuun määrät, säämuutot, suuret määrät, pesinnän onnistuminen, poikasten lentoonlähtö), lähettämään ne ystävällisesti meille mitä pikimmin.

Vi bör de ornitologer, som ännu har viktiga observationer av tornsvalor (efter 1.11. eller från Norra Finland, antalen i augusti-september, väderflyttning, stora antal, häckningens framgång, ungarnas avfärd), att sända dem vänligtvis till oss snarast möjligt. Observationerna från övriga nordiska länderna är också välkomna.

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