EXCERPTS FROM THE ABSTRACTS OF THE XV INTERNATIONAL ORNITHOLOGICAL CONGRESS (held at The Hague 30 August–3 September 1970)

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Part II
Sectional Sessions

F. GUDMUNDSSON–Museum of Natural History, Reykjavik, Iceland

The predator-prey relationship of the Gyrfalcon (Falco rusticolus) and the Rock Ptarmigan (Lagopus mutus) in Iceland

Since 1963 a relatively isolated population of the Rock Ptarmigan has been studied closely on an 800 ha island (Hrisey) in N. Iceland. This work included study of the effects of predation on the ptarmigan population. The work was much simplified by the fact that there were no ground predators on the island and that the Gyrfalcon was the only avian predator there.

In the past most investigations on food selection and predation by birds of prey have been carried out at the eyries of the respective species and have consisted in the collecting of food remains and pellets. The present investigation, however, consisted in ascertaining the effects of predation on a ptarmigan population of known size and how the different sex and age cohorts were affected.

It has previously been shown (Gudmundsson, 1960) that ptarmigan in Iceland are subject to violent population changes and that they fluctuate according to the pattern of a regular 10-year cycle. The year 1966 was a peak year and hence the present study covered the last years of increase before the peak was reached, the peak year itself, and the crash years immediately following the peak.

Despite a heavy predation by Gyrfalcons on Hrisey it is concluded that the regular and predictable population changes in the ptarmigan could in no way be attributed to predator-prey oscillations. But as the ptarmigan is the staple diet of the Gyrfalcon in Iceland it is not surprising that the Gyrfalcon fluctuates with the ptarmigan and that during years of ptarmigan scarcity many Gyrfalcons do not nest at all.

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Sexual dimorphism in harriers

Harriers *(Circus)* form a structurally well defined, and geographically nearly cosmopolitan group. They are long-winged, long-tailed and long-legged birds of prey living in open country. Their methods of flight and hunting are characteristic. With the exception of one species, harriers nest on the ground.

The sexual dimorphism in harriers is exceptional among birds of prey, as many species show differences both in structure and in plumage. In the latter case the females have a cryptic coloration, probably associated with nesting on the ground. The light grey or grey-and-black plumages of the males may be considered to be adaptations to hunting and to display flights.

Sexual dimorphism in the plumage of harriers is considered an adaptation to nesting on the ground. It is an advanced character, as it occurs most frequently in what are probably the most recent faunas of the world (holarctic fauna). If the colour of the male is advantageous for hunting special types of prey, the difference in plumage might induce different food preferences in males and females.

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Mobbing of small passerine birds in response to the song of the Pygmy Owl (Glaucidium passerinum)

The Swiss ornithologist Thonen observed that in areas inhabited by Pygmy Owls, small passerine birds show a mobbing reaction in response to the song of this owl. During the last six years the present author has been studying the biology and the behaviour of the Pygmy Owl. In view of the mobbing behaviour he arrived at the following results:

1. Mobbing in response to the song of the Pygmy Owl is **not** inherited.
2. As the Pygmy Owl is generally a diurnal bird, the small passerines living in its territory learn that the voice comes from an enemy. Therefore tits, chaffinches, tree-creepers etc. show the mobbing reaction only in those areas where Pygmy Owls occur. In forests where this species is absent, the birds do not show this reaction. Mobbing therefore is a good help in finding Pygmy Owls.

3. According to our own observations only the Coal Tit (*Parus ater*) among all other small passerines, seems to show mobbing behaviour in specific response to the Pygmy Owl.
4. By recording mobbing Coal Tits the occupied territory of a Pygmy Owl can be defined. For this purpose the song of the Pygmy Owl has to be imitated at short intervals when walking around the forest. At the border of the owl's territory the reaction becomes weaker and finally ceases.

In order to study the problem of how Coal Tits learn to recognize the song of the Pygmy Owl as the voice of an enemy, some Coal Tits were kept in captivity. Experiments in the field showed that the birds learn to combine the inherited visual scheme of an owl with its song and finally react when only the song is heard without the owl being seen. The most frequent reaction is that one or two Coal Tits start mobbing and that they are followed by more and more birds to do the same. So finally, a large group of small birds fly crying about in the trees, looking for the elusive enemy. When the tits do not meet the owl any longer, they can forget its song and do not react to its imitated song any longer. This may happen after several months, but is more clearly apparent the next year.

By making use of these facts we could establish the decrease of the Pygmy Owl even leading to its total extinction in the Black Forest (S.W. Germany).

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Predation by birds of prey on Tetraonidae populations at Vladimir Station near Moscow, U.S.S.R.

Among factors which influence the population dymanics of Tetraonidae predation by birds of prey seems to have rather a specific significance. Due to exaggeration of its effect, birds of prey seriously suffered from hunters and game keepers in many countries.

One of the main aims of our study at the Vladimir station (about 200 km to the east of Moscow) in 1963-1965 was a quantative estimation of the pressure of predatory birds upon game bird populations. The influence was characterized by an index of predatory pressure (or index of predation). This means the percentage of individuals taken by all predators out of the total number of their potential victims within the area under consideration during a definite period of time.

In order to calculate the index of predatory pressure (X$_d$)

exercised by a predatory species "A" upon the population of a prey species "A" we collected the following data:

(1) The total number of predatory birds of species "A" (N^A) which inhabit the area under consideration. For this purpose the number of breeding pairs was counted and mapped.

(2) The average number of individuals of prey species "a" taken by each predator "A" (P_a^A) within a definite period (usually the breeding season). In order to set reliable data on the composition and number of prey of various species of birds of prey, we made continuous observations from hides built in trees close to occupied nests. We collected samples of the prey brought to the nests for further laboratory examinations.

(3) The total number of individuals of the prey species "A" (n_a) within the study area.

With the help of these data, the index of predatory pressure (X_a^A) for predator "A" and prey "a" has been calculated by the formula:

$$X_a^A = \frac{N^A \cdot P_a^A}{n_a} \quad 100\%$$

The entire population of birds of prey within the Vladimir station (210 sq. km, including 152 sq. km of forests) consisted of 6 species. Their total number fluctuated from 32 breeding pairs in 1965 (15.2 pairs per 100 sq. km) to 40 pairs in 1964 (19.0 pairs per 100 sq. km). They included Buzzard (*Buteo buteo*, from 17 to 23 pairs), Sparrow-Hawk (*Accipiter nisus* 4-6 pairs), Honey Buzzard (*Pernis apivorus*, 0-5 pairs), Black Kite (*Milvus migrans*, 2-3 pairs), Kestrel (*Falco tinnunculus*, 1-4 pairs), and Goshawk (*Accipiter gentilis*, 2 pairs).

The populations of 3 species of Tetraonidae were rather large: 2900-3000 individuals (adults and young) in June. It included 1200-1400 Hazel Grouse (*Tetrastes bonasia*) 1000-1200 Black Grouse (*Lyrurus tetrix*) and 500-600 Capercaillies (*Tetrao urogallus*).

Only goshawks and buzzards fed on game birds. Each breeding season (June-July) the two pairs of goshawks took 110-140 individuals of Tetraonidae mostly young): 50-70 Hazel Grouse, about 20 Black Grouse and about 10 Capercallies (the remaining ones unidentified). So the goshawk's index of predation on the Tetraonidae population fluctuated from 3.7 per cent (1965) to 4.5 per cent. (1964) of the total number of Tetraonidae present. It was 4.2-5.2 per cent. for Hazel Grouse, 1.6-2.1 per cent. for Black Grouse and 1.4-2.0 per cent. for Capercaillies. All buzzards in June-July took only 20-70 individuals of Tetraonidae mostly young of Hazel Grouse. The buzzard's index of predatory pressure upon Tetraonidae depended obviously on the density of rodent populations. It was 0.7 per cent. of the total number of Tetraonidae in 1963 (coordinating with highest level of rodent population) and 1.9-2.3 percent. in 1964

and 1965 (during low numbers of rodents. Its index of predation on Hazel Grouse was 0.4 per cent. in 1963, 1.6 per cent. in 1964 and 4.8 per cent. in 1965.

The entire index of predatory pressure by birds of prey on the Tetraonidae population was estimated as 4.9 per cent. of their total number in the summer of 1963, 6.4 per cent. in 1964 and 6.0 per cent. in 1965. For the Hazel Grouse these figures were 5.4, 6.9 and 9.0 per cent., respectively; for the Black Grouse 2.1, 3.7 and 1.7; for the Capercaillie 1.8, 2.0 and 1.4 per cent.

The above results permitted a more realistic approach to the role of birds of prey in game management. The official attitude towards them was also changed and since 1964 wholesale measures for the control of birds of prey and especially bounty payments for killing any kind of them were banned all over the Soviet Union. Limited control was allowed only for the Goshawk and Marsh Harrier within specific hunting grounds.

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Experiments on prey selection in hawks

The experiments were designed to test the role of the following in prey selection: (1) conspicuousness; (2) oddity, or a difference between a given animal and the majority of prey; and (3) the specific searching image or the tendency to habitually prey on a given kind of animal. White laboratory mice, some of which were dyed grey, were placed on 10 small pedestals equidistant from a tamed hawk on either a grey or white background. In one series of experiments, 9 mice of one color (grey or white) and one of the other color were offered on either a grey or a white background in four combinations of mice and backgrounds. The sequence of presentation of background and mice combinations was randomized. Under this regime, hawks selected odd mice of a particular color. Conspicuousness of the mouse (contrast with background) affected prey selection only until the preference for a color was established. In another series of experiments the hawks were presented with 9 mice of the preferred color and one of the other. After 50 experiments (sufficient to yield statistically significant results), the number of preferred mice was then reduced to eight and the number of the other color to two. The procedure was continued stepwise through almost 200 experiments until the hawks were offered one mouse of the preferred color and 9 of the other color. The hawks selected significantly more of the preferred color throughout the experiment except for the first step or two when the non-preferred color was uncommon or odd. The results are interpreted to indicate

that development of a specific searching image is the most important factor influencing prey selection and that there is also a tendency to take odd prey. These findings have important implications for various concepts of population regulation and evolution.

In addition to the above, I would like to call particular attention to another paper:

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The pair bond and the breeding success in the Kittiwake Gull (Rissa tridactyla)

I suggest that those interested in raptors study this brilliant work—a model for raptor studies!

The proceedings of the XV International Ornithological Congress will be published in book form—limited to the plenary sessions, which I mentioned in Part I. Coulson's paper will be included. The papers I have mentioned in Part II are apt to appear in various periodicals.