

## Multiple Hunting by Lynx and Red Fox and Utilization of Prey by Some Carnivores

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Three observations on multiple hunting are reported and analysed. Wild lynx *Lynx lynx* Linnaeus, 1758 killed 3 roe deer *Capreolus capreolus* (Linnaeus, 1758) and hurt another one during one night in the forest enclosure. The lynx carefully covered the quarries with grass, litter and dirt and was returning to feed on the cache during 5 consecutive nights. Tamed female red fox *Vulpes vulpes* Linnaeus, 1758 rearing young was observed during a multiple hunt in a farmyard when it killed 5 domestic hens and negligently buried them in sand. The same vixen was observed when it got into the hen house and hurt 5 hens during 1-min hunt. In the first and the second case the predators tried to obtain and secure as much food as the favourable conditions would allow. The multiple hunting was undertaken after the evaluation of promising situation. The third case was the classic example of so-called "hen house syndrome". Therefore, multiple hunting and surplus killing by carnivores cannot be regarded the incidental and instinctive response to superabundant, vulnerable prey which then is not consumed but mainly wasted. Multiple hunting is often an adaptive behaviour, and is undertaken by a predator after the evaluation of a chance to acquire much food at low expense. Surplus food may be valuable or even critical during reproduction period of predator or in unfavourable conditions. Observation on polecat *Mustela putorius* Linnaeus, 1758 showed that the access to superabundant food ensured 14-day maintenance of a predator in winter.

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### 1. INTRODUCTION

Animal foraging behaviour as governed by instinct is thought to be elicited by stimulus situations. The instinctive activity lasts as long as the stimuli acts (Tinbergen, 1951; Ullrich, 1968). An intriguing behaviour of multiple killing by predators (*i.e.* killing several prey during actually one hunt) was often interpreted in terms of instinctive behaviour elicited by the presence of vulnerable prey. Multiple killing was first called "surplus killing" by Kruuk (1972). He stated: "Carnivores may kill a great many more prey animals than they can possibly consume at the time". This means that surplus kills are wasted. On the other hand, many authors reported that carnivores most often utilize their kills as completely as possible (Crisler, 1956; Tinbergen, 1965; Novikov, 1971; Nasimovic, 1973; Grakov, 1981; Hersteinsson & Macdonald, 1982; Goszczyński, 1985).

This paper reports the observations of multiple killing by the lynx *Lynx lynx* Linnaeus, 1758 and the red fox *Vulpes vulpes* Linnaeus, 1758 and utilization of prey by the polecat *Mustela putorius* Linnaeus, 1758. Multiple killing is interpreted as adaptive behaviour, which though governed by instinct, may be modified by both external condition and the predator itself.

## 2. MATERIAL

### 2.1. Lynx Killing Three Roe Deer in Forest Enclosure

In 1976 I started to keep roe deer *Capreolus capreolus* (Linnaeus, 1758) in Białowieża Forest in a large enclosure of 12 ha comprising deciduous forest of different age classes (young plantation, polesized stand and oldgrowth; Kossak, 1981). Five roe deer lived in parts I and II (Fig. 1). During the night on 25/26 September 1978 the lynx entered the enclosure (over a fence 2.3 m high) and killed three roe deer (2 males and a female) and hurt another one (high leg injured). The three killed animals were pulled and carefully covered with grass and dirt scratched from about 10 m<sup>2</sup> around it (Fig. 1). The lynx began to feed on a female roe deer (part of a nape) and bit a male as was indicated by the shred of skin found 6 m apart from the kill. I removed the carcasses of two males from the enclosure and left one carcass of the female to see whether the lynx would return to its kill. Lynx kept returning to feed on a kill on 5 consecutive nights/days. Once it pulled the carcass about 6 m away before covering it with grass again. Lynx fed on its

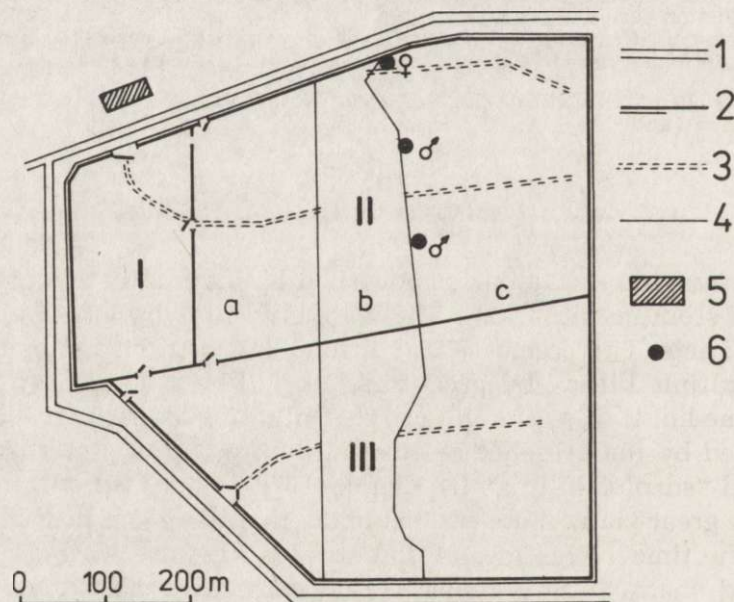


Fig. 1. Map of forest enclosures (I, II, III) where lynx killed three roe deer. 1 — forest road; 2 — fence of enclosure; 3 — clearcut line through the forest; 4 — borders of tree-stand classes: a — timberstand, b — forest plantation, c — polesize stand; 5 — house; 6 — places where lynx cached the killed roe deer.

kill during the day and night and was not disturbed by the traffic on the forest road adjacent to the enclosure. On the sixth day when only a head, one leg and the spinal cord of the deer remained, the lynx deserted its quarry and the female wild boar with her young were attracted to the carcass by an intense odour of decayed meat.

### 2.2. Red Fox Killing Domestic Hens

In 1980 a tamed, hand-reared vixen delivered 3 young in an outdoor enclosure of 250 m<sup>2</sup>. When the kittens started to emerge from the den, the vixen many times attempted to jump out of the enclosure into the farmyard where the poultry lived. Once she succeeded. I began to observe her hunting attempts some 15 minutes after she had got out of the enclosure. All the poultry was already hidden but its alarm noise was still on. No killed hens were seen around. The vixen was very excited, ran over the yard in full speed and penetrated different corners. For some 10 min she was unsuccessfully trying to catch the little hen sitting on a 2.5 m roof and a cock hidden in the service-tree branches 2 m above the ground. Then, still in the same speed, the vixen ran to the place where she had buried one of the killed hens and started to dig it out. However, the tamed wild boar living in the yard disturbed her and I could not see whether the vixen would have brought the kill to her young or not. After I had brought the vixen in the enclosure I found 4 hens buried negligently in places free of grass, *e.g.* in the heap of sand. Judging from the feathers scattered around caches, I supposed that the hens were buried in the place of killing.

In December 1981 the same vixen got into a shed where 6 birds (3 hens and 3 peacocks) stayed for winter. The vixen hunted for 1 min only, she hurt 5 birds, four of which died soon. The vixen was tossing inside the shed, catching a bird with her teeth and immediately releasing it in order to catch another one.

### 2.3. Utilization of Prey by a Polecat

In winter 1985/86 my farmyard became a part of a polecat territory. Its trails and tracks were seen all over the yard. In January 1986 I put the carcasses of two roe deer fawns in the yard. Very soon the carcasses were covered by snow. The polecat restricted its movements and for the next two weeks it was moving only between the carcass and its retreat under the pile of boards, 8 m away. The polecat consumed the fawns completely, only the skin and bones remained, and then it left the yard.

## 3. INTERPRETATION AND DISCUSSION

The behaviour related to acquisition of food by predatory mammals is governed by instinct. The instinctive activities are elicited by a specific stimuli complex and once triggered they take the fixed course and sequence. Stimuli complex is therefore necessary to elicit the instinctive behaviour, not to keep it going. The longer time the instinctive activities were not released, the more stronger animal's tendency to perform them. The more frequent consecutive performances of the instinctive activity, the more difficult it is to elicit it again in an animal (Tinbergen, 1951; Ullrich, 1968).

Craig (1918) hypothesized that the instinctive behaviour has two components: appetitive behaviour and consummatory act. This theory,

modified and developed since Craig's times, says that the appetitive behaviour (*e.g.* searching for prey by predators) is a combination of inherent and learnt behaviours and it is a specific seeking behaviour for a releasing stimulus situation which leads an animals to the desired consummatory act. An animal whose seeking behaviour was caused by hunger, starts searching for prey and continues until it has found prey what forms a stimulus to release the consumatory act. Lorenz (1937) stressed that appetitive behaviour tends exclusively to consummatory act. The latter one is a fixed, fairly simple behavioural act depending on instinct. It ends the elicited series of actions and, under normal conditions, it leads to drive reduction. The performance of consummatory act rapidly decrease the readiness to act.

In the light of this theory the predator having an easy access to numerous prey, *e.g.* in confined situations, is strongly stimulated by the visual, olfactory cues and the movements of prey. Such situation is a key stimulus to release the consummatory act: catching and killing. According to the above theory, the predator continues to kill (up to enormous number of victims) until the key stimuli disappear, *i.e.* until all the potential prey are gone or killed. Below I analyze how my observations on multiple hunting and prey utilization by carnivores conform to this theory.

### 3.1. Lynx and Roe Deer in Forest Enclosure.

Lynx hunts by stalking and a short chase. Novikov (1971) reported that lynx most often hit the prey after the 10 m of chasing, rarely after 30—40 m. The long distance chases were usually unsuccessful. Such a hunting technique and the fact that the roe deer killed in my enclosure were found on the edge of polesize stand and forest plantation, suggest that the lynx hunted by stalking in the polesize stand. The dense cover and diversified structure of the vegetation in the enclosure (Fig. 1) made catching of the three deer an uneasy task for the lynx. The whole action probably lasted for hours. All roe deer were thoroughly covered with grass, spruce litter and dirt, what suggests that the lynx was not in a hurry.

The reconstructed sequence of evens must have been as follows. After the lynx had broken into the enclosure and killed the first roe deer, it started to feed on it, but soon it noticed that the other deer are still close by (and not away as would have happened in natural conditions). Therefore, the lynx interrupted its feeding after having consumed some 0.5 kg of meat (its daily consumption is about 2 kg; Novikov, 1971), covered the quarry and resumed searching and stalking the

other deer. After having killed the buck, the lynx dragged it under the spruce, covered with litter and resumed hunting once more. It is possible that the last hunt that resulted in injuring the fourth deer, was interrupted by the sudden appearance of man in early morning.

It seems therefore that the lynx several times switched from appetitive behaviour (searching for prey and stalking) to consummatory act (attack and killing). It is noteworthy that the consummatory act, *i.e.* the sequence of attack-killing-consumption of meat-covering of remains, was not completed but interrupted and modified. The determination with which the wild animal kept returning to its quarry after the enclosure had been penetrated by a group of people some of which had touched the killed deer, indicated the lynx must have been hungry. Despite hunger and the strong key stimuli (sensory contact with the fresh kill) the lynx did not gorge after it had killed the first deer but carefully covered it and resumed the appetitive behaviour. The lynx readiness to act did not decrease after killing the first prey and it tried to obtain and secure as much food as the favourable conditions would allow.

### 3.2. Multiple Hunting by a Tamed Fox

The first described hunt was in the open and a vixen was satiated (extra food was present in her enclosure). The poultry to which the vixen was accustomed were not a novel attractive stimulus. Most probably the underlying factor was the instinctive behaviour of feeding the young, *i.e.* searching, killing the prey, bringing it to the den, and watching the young feed on it. The food provided by the keeper could not elicit this instinctive behaviour.

The reconstructed course of events was most probably as follows. The vixen ran into the yard, easily caught the clumsy hen and hurriedly buried it in the place of kill. This happened five times. The vixen did not carry the prey to the den with young. Eventually, it was not the lack of potential prey, but the prolonged unsuccessful attempts to catch another hen that caused the vixen quit hunting, return to one of the previously killed hens and dig it out. The multiple hunting by vixen was aimed at exploiting the maximum possible share of superabundant and vulnerable prey. As in the case of lynx, the behaviour of vixen does not fit to the theory of two fixed components of predatory behaviour. The predatory actions undertaken by lynx and vixen were decisions made after the evaluation of promising conditions.

The hunt in the barn took much different course and was determined by the confinement and practically no distance between the vixen and its prey. Fox predatory behaviour was reduced to the instinctive

catch of raving hens. Though this killing behaviour fits the hypothesis about fixed character of the consummatory act, the highly artificial conditions do not allow any reasoning about the predatory behaviour of the fox in the wild. It was a classic example of so-called "hen house syndrome".

### 3.3. Utilization of Surplus Food by Carnivores

The multiple hunting by wild carnivores have not been thoroughly analyzed so far. The literature is dominated by anecdotal reports on "massacres" most often taking place in confines or during unusually favourable conditions, while the most common cases of multiple killing (a whole litter or brood of prey being killed by a predator) are overlooked. The reports on "massacres" (Goethe, 1956) often document that the vastly excessive food was mostly wasted. This casts doubt on the adaptive character of multiple hunting by carnivores and classifies it as undersirable waste of prey.

However, caching of excess prey seems to be common behaviour among carnivores and most probably it serves as a defense against other predators and scavengers. Carnivores often return to the cache to feed. Novikov (1971) reported that the adult male lynx did not get further away from its quarry than 500 m and could spend up to 10 days close to deer carcass and 2 days at hare carcass. Lynx which had killed *Moschatus moschiferus*, stayed for a day and a half on 0.01 km<sup>2</sup> where it had 7 lairs (Matjuskin, after Novikov, 1971). In my observations lynx returned to killed roe deer on 5 consecutive days and the polecat spent 14 days close to fawn carcass. Extensive literature reports the returns to previously cached food by arctic foxes, arctic bears, wolves, coyotes, jackals, hyaenas, lions, tigers, leopards, cougars, and other species. In such cases the excess food is utilized almost fully with only non edible part being left (Braestrup, 1941; Crisler, 1956; Hornocker, 1970; Kruuk, 1972; Hersteinsson & Macdonald, 1982) which confirms the great value of excess prey to predators.

Kruuk (1972) suggested that surplus killing would be a waste of the predator's energy, and the latter might sustain injuries in the process of attacking. However, the costs-gain trade off will differ if we consider that the whole process of searching, attacking and killing prey is very costly. Hunting success of large carnivores is low and the death of predator caused by inanition is not uncommon (reports on lynxes starved to death in Kaplonov, after Novikov, 1971). Therefore, the opportunity to obtain surplus food in multiple killing of several vulnerable prey will be very profitable and will secure enough food for the next several days without energetically costly searching and hunting. The

surplus of food is most probably allocated into building energy reserves (fat) and in extremal conditions may be critical for survival or successful reproduction.

Under natural conditions the multiple hunting occurs most often during the reproductive season of prey when the whole broods or litters are vulnerable prey. The common antipredatory behaviour in prey is the avoidance of staying in clumped groups of young. For instance, within only one hour after birth the roe deer fawns become strongly averse to each other. During the first 8 days of life they stay from several dozen to 400 meters away each from the other. When the locomotory activity of fawns develops the aversion in young ceases and the whole litter becomes close social group. Scientists agree that such a behaviour is an antipredatory defence (Dress, 1952; Zschetzsche, 1959; Bubenik, 1965; Espmark, 1969; Friede, 1975) and, to be precise, it is a defence against the multiple hunting by predators.

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POLOWANIA WIELOKROTNE RYSIA I LISA ORAZ WYKORZYSTYWANIE  
ZDOBYCZY PRZEZ NIEKTÓRE SSAKI DRAPIEŻNE

Streszczenie

Opisano obserwacje polowań wielokrotnych rysia na sarny w zagrodzie leśnej (Ryc. 1) i oswojonego lisa na drób. Przedstawiono też dane na temat wykorzystania nadwyżek pokarmu przez tchórza. Ryś w polowaniu wielokrotnym zabił w ciągu jednej nocy trzy sarny, a czwartą zranił. Wszystkie zabite sarny były ukryte w kopcach trawy, ściółki i igliwia. Tylko jedna sarna była jedzona, lecz w niewielkim stopniu. Ryś powracał do zdobyczy w ciągu pięciu następnych dni. Oswojona lisica zabiła i ukryła w pobliżu miejsca upolowania kolejno 5 kur przebywających na otwartym terenie. Drapieżnik zakończył polowanie, gdy pozostałe przy życiu ptaki znalazły się poza jego zasięgiem. Ta sama lisica w małym pomieszczeniu zamkniętym w ciągu około 1 minuty wyłatchesnie chwyciła i raniła cztery z 6 przebywających tam ptaków.

Szczegółowa analiza przebiegu polowań wielokrotnych rysia i lisa w otwartym terenie wykazała, że w obu przypadkach strategia zastosowana przez drapieżniki była podobna, uwzględniała i miała na celu równocześnie zdobycie i zabezpieczenie jak największych ilości pokarmu. Celowe zachowanie dwu odległych systematycznie gatunków ssaków drapieżnych podważa tezę o sztywności przebiegu aktu konsumacyjnego w warunkach naturalnych. Natomiast teza ta znajduje potwierdzenie w warunkach znacznie odbiegających od naturalnych (brak dystansu między ofiarą a drapieżnikiem, wywołujący wyłącznie instynktowny odruch chwytania poruszającej się zdobyczy). Postępowanie drapieżników z nadwyżkami pokarmu, zabezpieczenie go przed innymi mięsożercami, powracanie do zdobyczy i wysoki stopień wykorzystania, dowodzą niesłuszności określenia polowań wielokrotnych terminem "surplus killing" i twierdzeniu, że jest niepotrzebną stratą energii drapieżnika i marnotrawieniem ofiar. Uznano, że polowania wielokrotne są jednym z wariantów zachowania łowieckiego ssaków, korzystnym dla drapieżnika i jego potomstwa. W środowisku naturalnym polowania wielokrotne nie wpływają w sposób istotny na układ drapieżnik-ofiara, gdyż zdarzają się okazjonalnie i sezonowo, a ich efektywność jest znacznie ograniczona przez zachowanie obronne potencjalnych ofiar.