The saprotrofic food chain in terrestrial ecosystems: Wood Decomposition

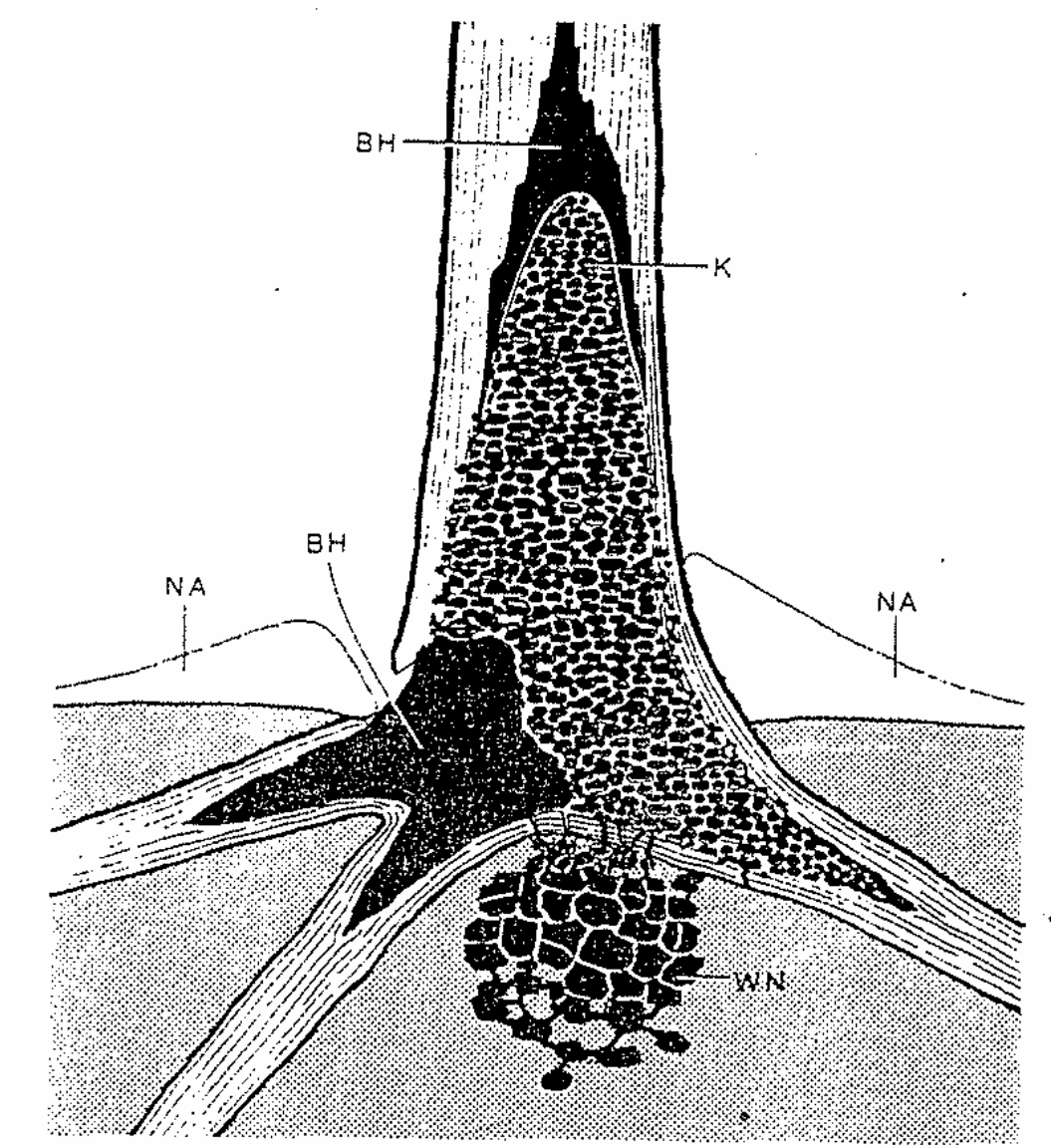


Abb. 1: Nest der Glänzendschwarzen Holzameise (Lasius fuliginosus). BH: Baumhöhle, K: Kartonnest, NA: ausgeworfenes Material, WN: Winternest. Aus: MASCHWITZ und HÖLLDOBLER, Z. vergl. Physiol. 66, 1970.

Nest of the ant *Lasius fuliginosus*:

BH – Tree cavity, K – Carton Nest,
NA – debris thrown out of the nest,
WN – Winter Nest

The saprotrofic food chain in terrestrial ecosystems: Wood Decomposition

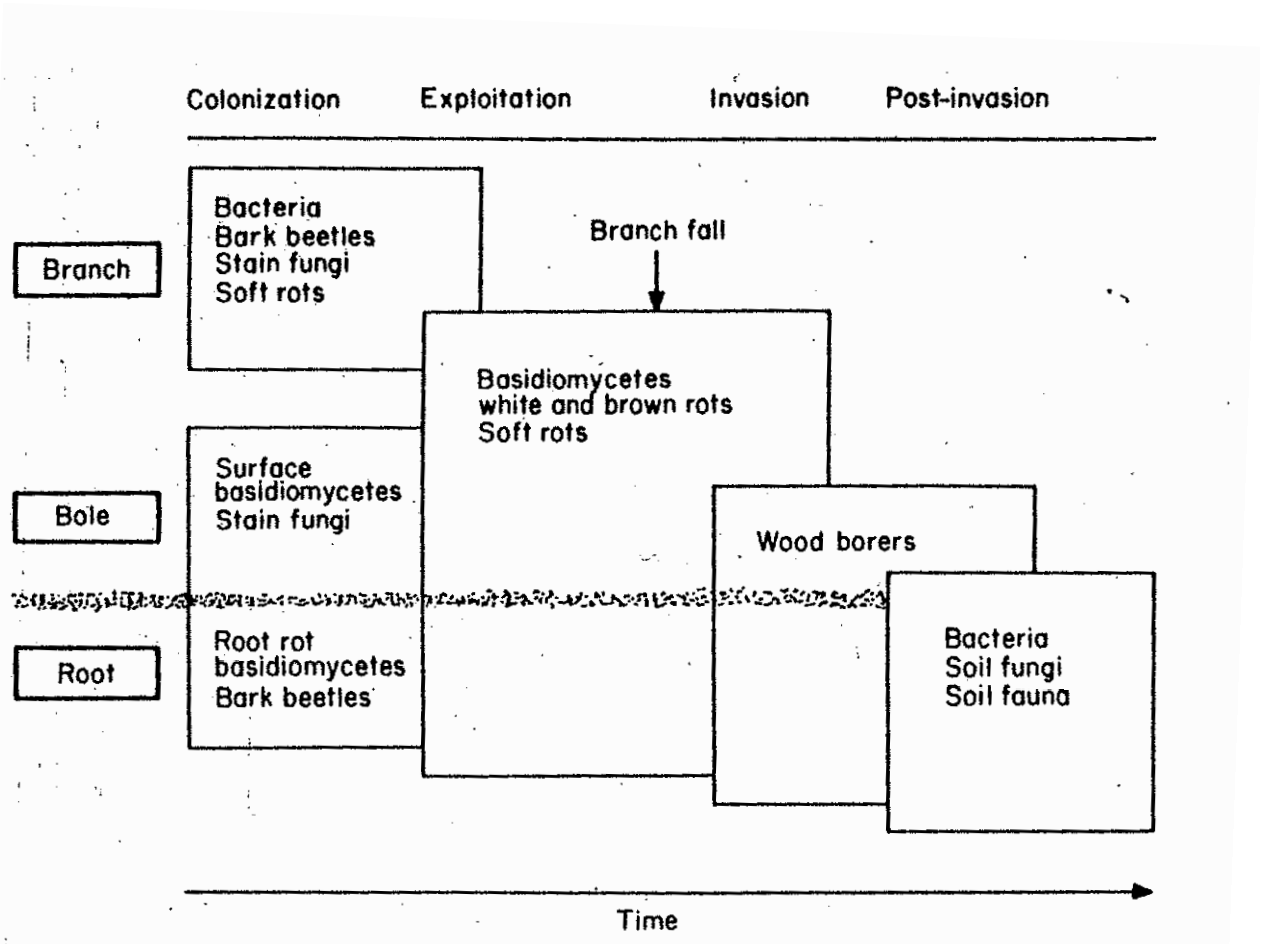


FIG. 4.16. Patterns of succession in decomposing branch and stump wood. The dominant organisms during the four major stages of the decomposition of 'typical' resources in a British woodland are indicated. The succession in any one branch or stump may differ markedly from the above pattern; some of the groups mentioned may never appear or entirely different ones dominate or the sequence may be substantially altered. Within this high degree of heterogeneity the above pattern is, however, the predominant one (from Swift 1977a).

The saprotrofic food chain in terrestrial ecosystems: Decomposition of Faeces

Histeridae: *Hololepta plana*
- under bark

Histeridae: *Hister quadrimaculatus*
- in dung, on carrion

The saprotrofic food chain in terrestrial ecosystems: Decomposition of Faeces

Consumption of vertebrate faeces:

Resource quality of **carnivore faeces** low
- high efficiency of ingestion (≥ 80 %)

Carnivores rarer than herbivores
- less faeces – less opportunities to specialize on this resource

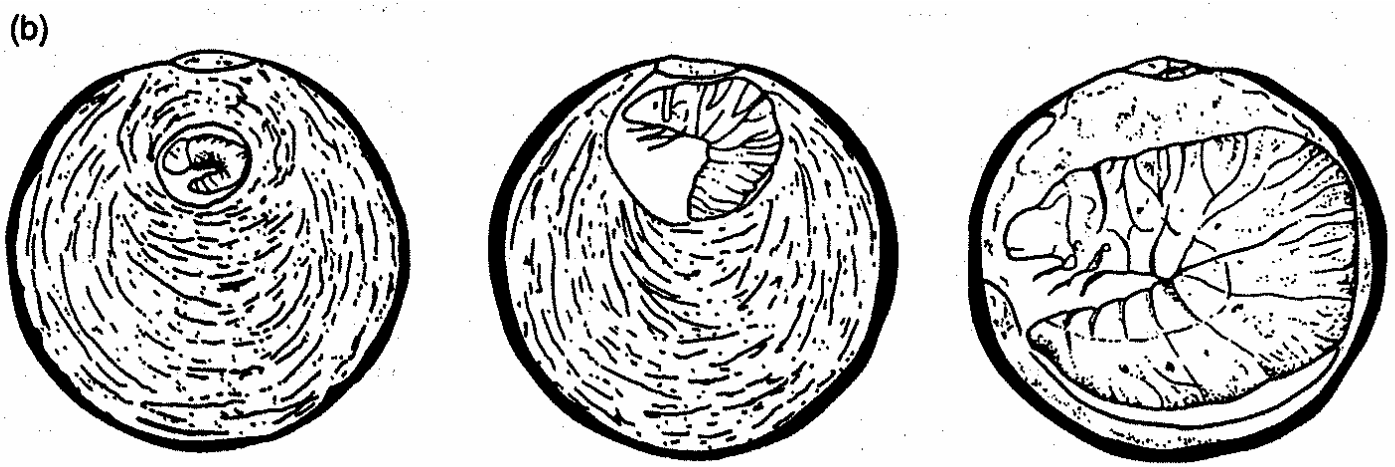
Consequence: no specialized coprophagous fauna, carnivore faeces mostly decomposed by bacteria and fungi.

Resource quality of **herbivore faeces (dung)** higher
- high content of organic matter

Herbivore faeces more abundant

Consequence: existence of specialized, distinct dung fauna including facultative and obligatory **coprophages**.

The saprotrofic food chain in terrestrial ecosystems: Decomposition of Faeces



Obrázek 11.14. (a) Africký chrobák valící kouli lejna. (Fotografie: Heather Angelová) (b) Larva chrobáka *Heliocopris* se živí uvnitř koule, a tak vyhlodává dutinu. (Kingston & Coe, 1977)

African dung beetle (*Heliocopris* sp.; Scarabaeidae) larvae live inside balls of dung burried below ground. They feed on the dung as well as on their own faeces.

Decomposition of elephant dung:

In the rain season colonisation by dung beetles (e.g. *Heliocopris dilloni*).
Up to 100 % of dung may be dissappear within 24 hours due to the activity of various scarabeid beetle species alone.
In the dry season little colonisation by beetles; some microbial decomposition - slowing down as the dung is drying out, dung may be preserved for over 2 years.

The saprotrofic food chain in terrestrial ecosystems: Decomposition of Faeces

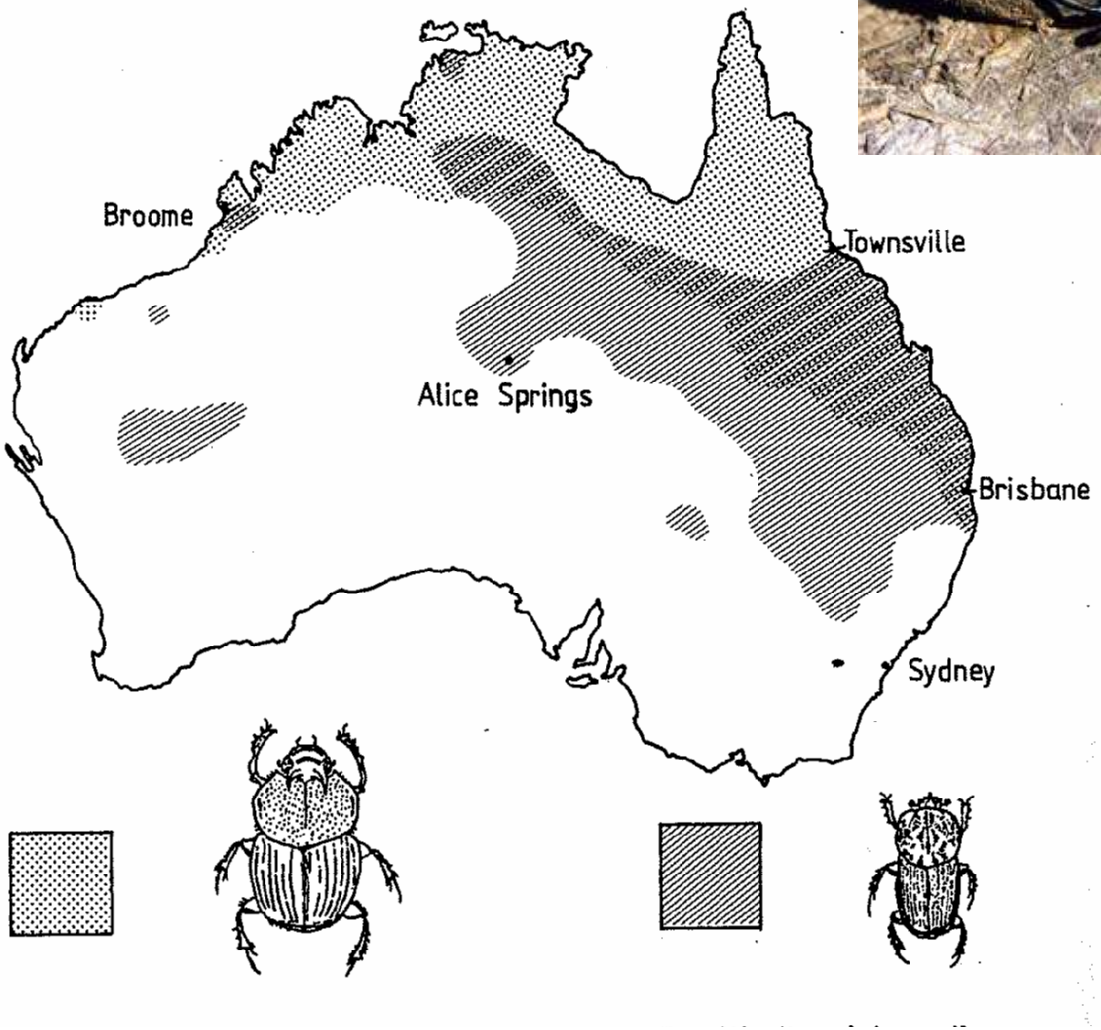
Problem with decomposition of cattle dung in Australia:

Cattle population rose from 0 (7 introduced in 1788) to 30 million.

Daily ca 2.5 million ha are covered by cattle dung. Loss of cca 400 m^2 per year of pasture land per 1 individual of cattle.

No native coprophages capable of efficient decomposition of cattle dung.

Increase in molesting native species of Diptera-Brachycera (*Musca vetustissima* and *Haematobia irritans exigua*) able to develop in cattle dung (6 days from egg to pupa).



Range of two African dung beetles introduced to Australia

The saprotrofic food chain in terrestrial ecosystems: Decomposition of Faeces

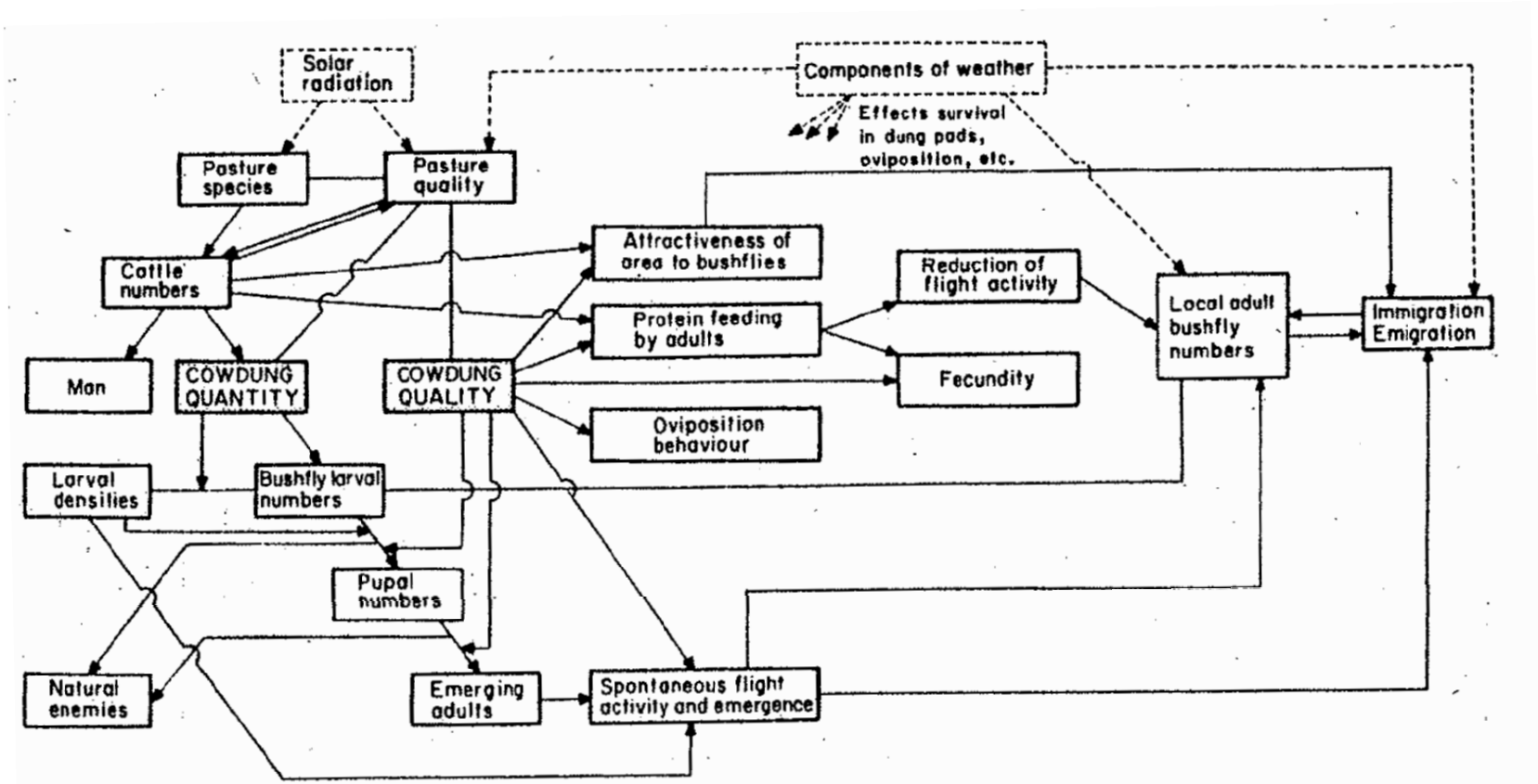


FIG. 4.11. Synopsis of the influence that food quality and quantity, acting through population density, have on the life system of the Australian Bushfly. Dung pad deposition rates are more or less constant throughout the year but resource quality shows marked seasonal variation. Food quality not only affects the survival and reproduction of the adults but also their flight activity: the flies remaining longer in areas with high-quality food and dispersing from areas where the food quality is low (Hughes & Walker 1970).

The saprotrofic food chain in terrestrial ecosystems: Decomposition of Faeces

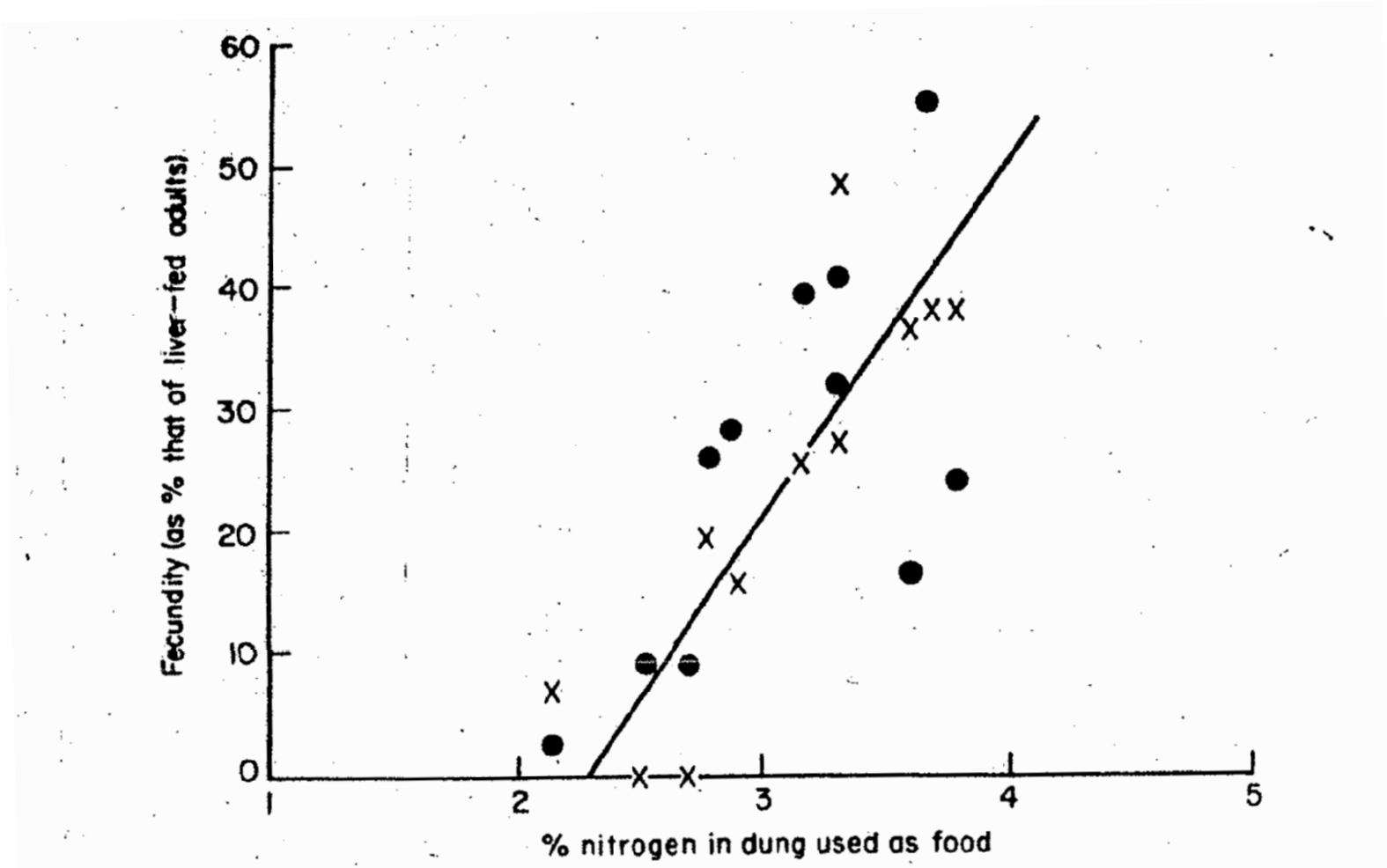


FIG. 4.10. The relationship between fecundity and the nitrogen content of dung used as adult food by the Australian Bushfly. The cultures were set up with (●) 400 or (×) 800 larvae per litre of cow dung. The emergent flies feed on the dung before oviposition and were compared with the fecundity of flies fed on an optimum quality diet of liver. The generally linear relationship of egg numbers to dung quality is apparent, though the high density series (shown by the regression line) indicates that there is some reduction in fecundity of flies reared at high density (Hughes & Walker 1970).

The saprotrofic food chain in terrestrial ecosystems: Decomposition of Carrion

The saprotrofic food chain in terrestrial ecosystems: Decomposition of Carrion

Chemical composition of carrion feeders (scavangers, necrophages) is completely different from that of other saprophages.

- low activity of carbohydrases
- high activity of proteases and lipases

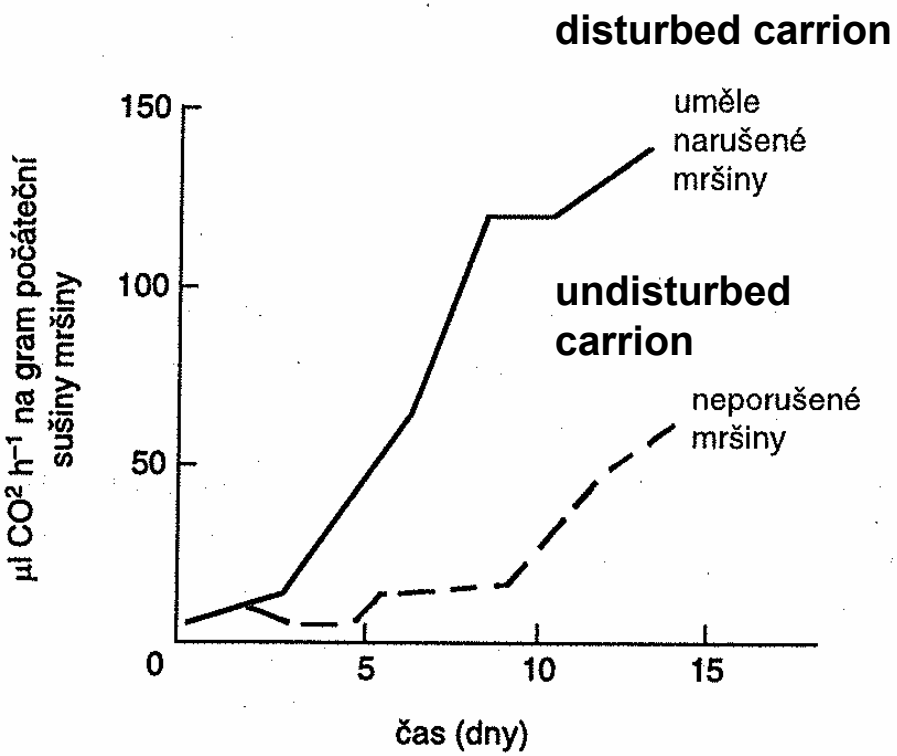
Enzymes available to carrion feeders identical to that of carnivores (predators). Many carnivores are opportunistic carrion feeders.

Vertebrate scavangers are often able to eat all of the carrion, leaving nothing to other organisms.

The saprotrofic food chain in terrestrial ecosystems: Decomposition of Carrion

The role of microorganisms and animals in carrion decomposition

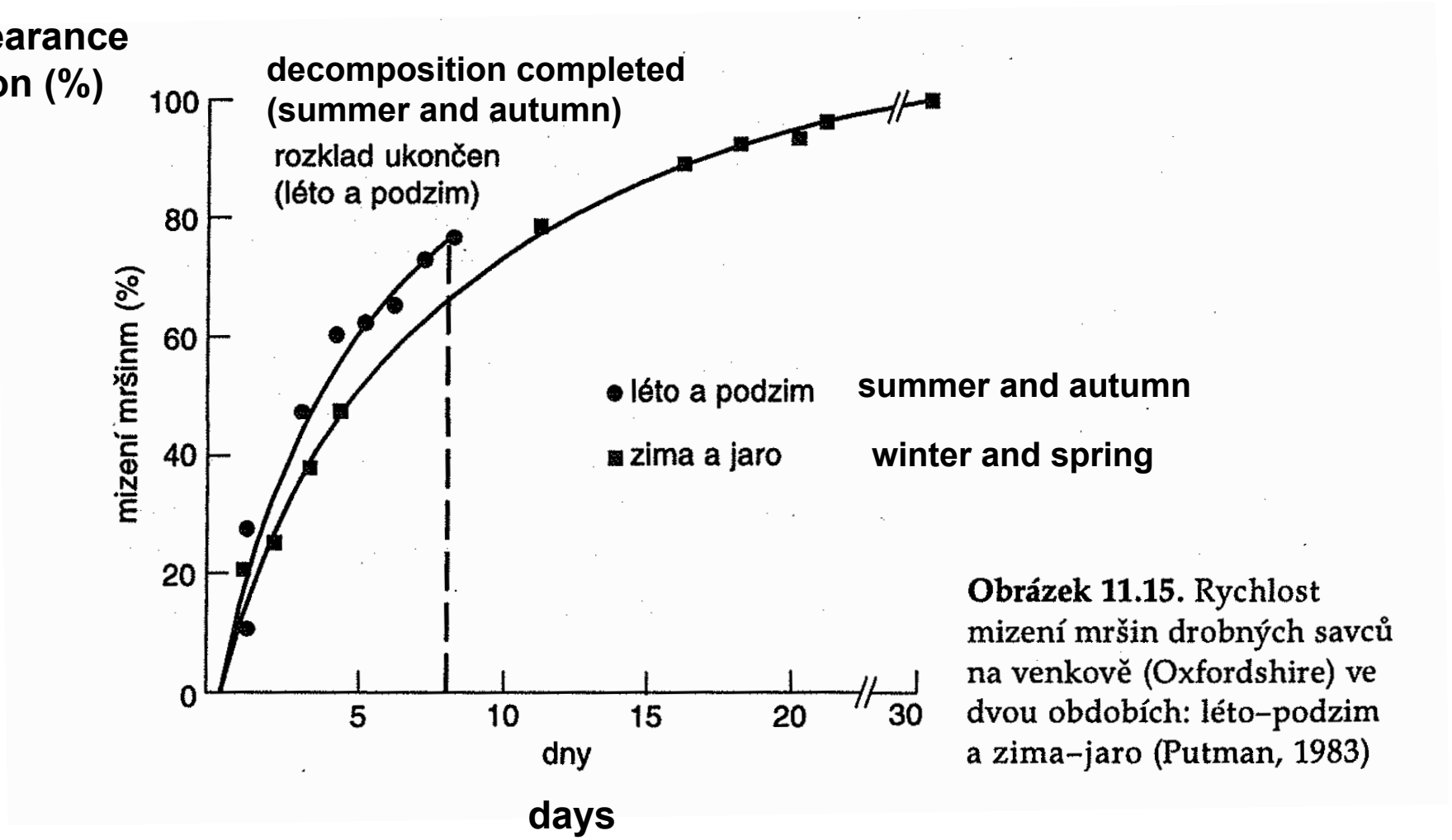
µl CO_2 h^{-1} per g initial dry weight of carrion



Obrázek 11.10. Uvolňování CO_2, jež je mírou mikrobiální činnosti, z mršin malých savců umístěných v respiračních válcích a chráněných před napadením ze strany hmyzu. Jeden soubor mršin zůstal nedotčen, druhý byl opakovaně napichován pitevní jehlou, aby se tak napodobilo provrtávání chodbiček larvami masařky. (Putman, 1978a)

CO_2 release (reflecting microbial activity) from carrion of small mammals placed In respiration vessels and protected from colonization by insects. One set of Samples remained undisturbed, in the other the carrion was treated by repeatedly punctured by a needle to simulate borowing activity of sarcophagid larvae.

The saprotrofic food chain in terrestrial ecosystems: Decomposition of Carrion

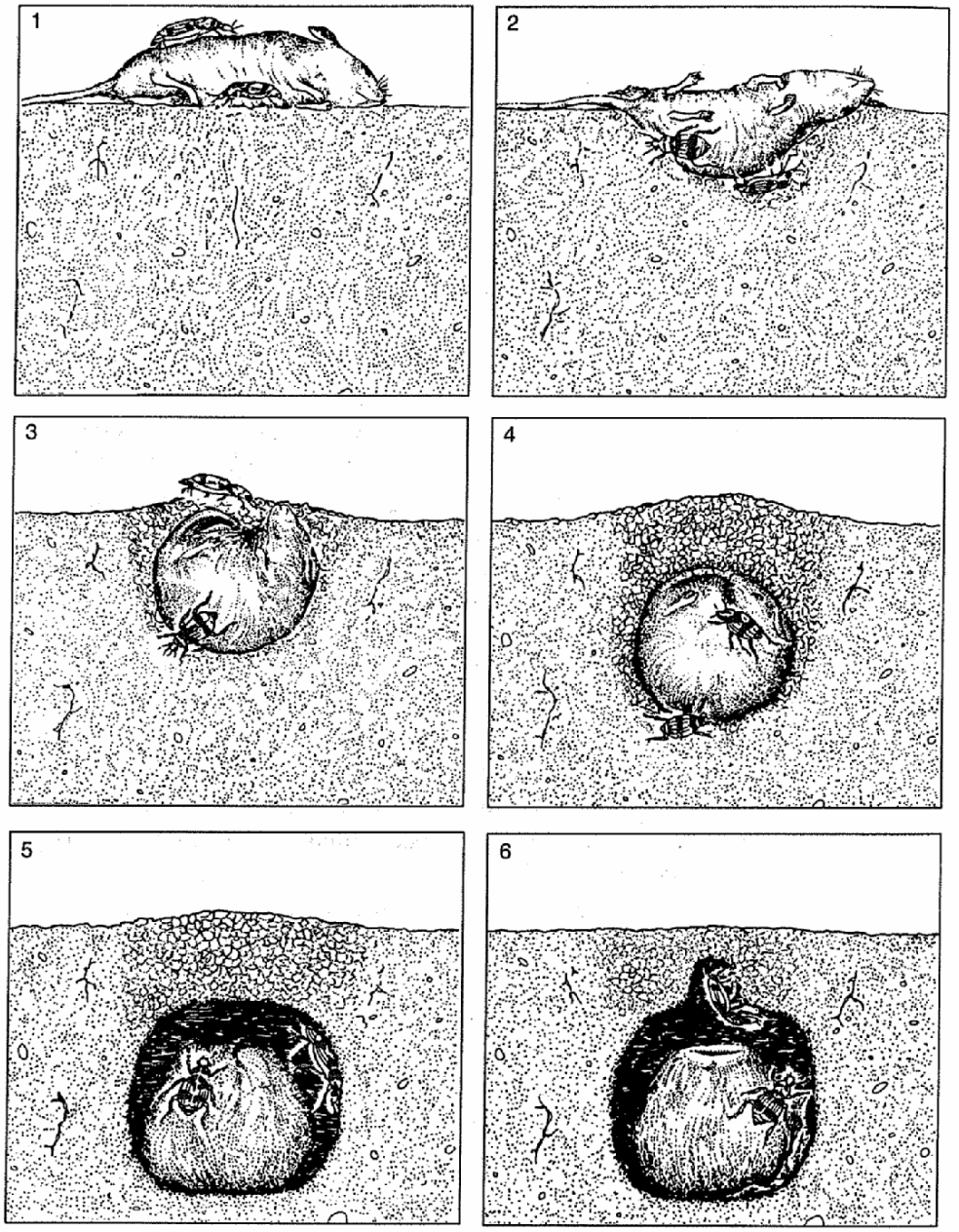


Obrázek 11.15. Rychlost mizení mršin drobných savců na venkově (Oxfordshire) ve dvou obdobích: léto–podzim a zima–jaro (Putman, 1983)

Speed of the disappearance of carrion of small mammals in the English countryside (Oxfordshire) in two times of the year

The saprotrofic food chain in terrestrial ecosystems: Decomposition of Carrion

Burrying of a dead mouse
by a pair of carrion beetles
(*Nicrophorus* sp.)



Obrázek 11.16. Pohřbívání myši párem hrobaříků (*Nicrophorus*) (Milne & Milne, 1976)

The saprotrofic food chain in terrestrial ecosystems: Decomposition of Carrion

The saprotrofic food chain in terrestrial ecosystems: Decomposition of Faeces

Nicrophorus vespillo

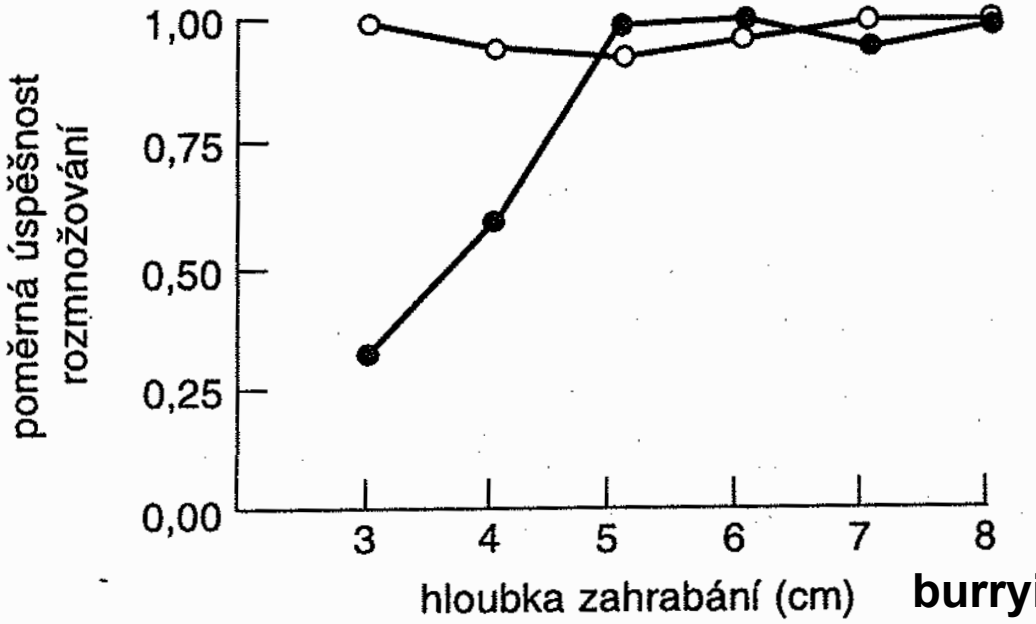
Oiceoptoma thoracica

Silpha tristis

Phosphuga atrata

The saprotrofic food chain in terrestrial ecosystems: Decomposition of Carrion

Relative reproduction success



burrying depth (cm)

Obrázek 11.17. Když jsou na pohřbené mršině roztoči *Poecilochirus necrophori* (prázdné kroužky), je úspěšnost rozmnožování hrobaříka *Nicrophorus tomentosus* vysoká. Experimentální odstranění roztočů (plné kroužky) nemělo na rozmnožování žádný vliv u mršin pohřbených hluboko, ale mělo za následek nízké přežití snůšek brouka v mršinách, které byly pohřbeny jen do hloubky 4 cm či méně. (Podle: Wilson, 1986)

The reproduction success of the carrion beetle *Nicrophorus tomentosus* is high when The burried carrion is colonized by the mite *Poecilochirus necrophori* (empty rings). Experimental removal of mites (full rings) decreased survival of *Nicrophorus* offspring in carrion burried at a depth of 4 cm or less.

The saprotrofic food chain in terrestrial ecosystems: Decomposition of Carrion

Vertebrate Scavangers in East Africa: Assemblage at large carrion

Trigonoceps occipitalis – White-headed Vulture

Torgos tracheliotus – Lappet Vulture / Sup ušatý

Hunt themselves, *T. tracheliotus* also steals from birds of prey, both prefer carrion, approach fresh carrion, open it up by ripping skin and mussels

The saprotrofic food chain in terrestrial ecosystems: Decomposition of Carrion

Vertebrate Scavangers in East Africa: Assemblage at large carrion

The saprotrofic food chain in terrestrial ecosystems: Decomposition of Carrion

Vertebrate Scavangers in East Africa: Assemblage at large carrion

Gyps africanus – White-backed Vulture / Sup africký

Gyps rüppelii – Rüppel's Griffon Vulture / Sup krahujovitý

Prefer intestines, enter dead body by natural openings as the anus, widen these openings.

The saprotrofic food chain in terrestrial ecosystems: Decomposition of Carrion

Vertebrate Scavangers in East Africa: Assemblage at large carrion

Necrosyrtes (= Neophron) monachus
- Hooded Vulture / Sup kapucín / hnědý

Neophron percopterus
- Egyptian Vulture / Sup mrchožravý

Feed on left-overs from larger scavangers, faeces, human waste, hunt insects, eggs

The saprotrofic food chain in terrestrial ecosystems: Decomposition of Carrion

Vertebrate Scavangers in East Africa: Assemblage at large carrion

Leptoptilos crumeniferus – Marabou / Čáp Marabu

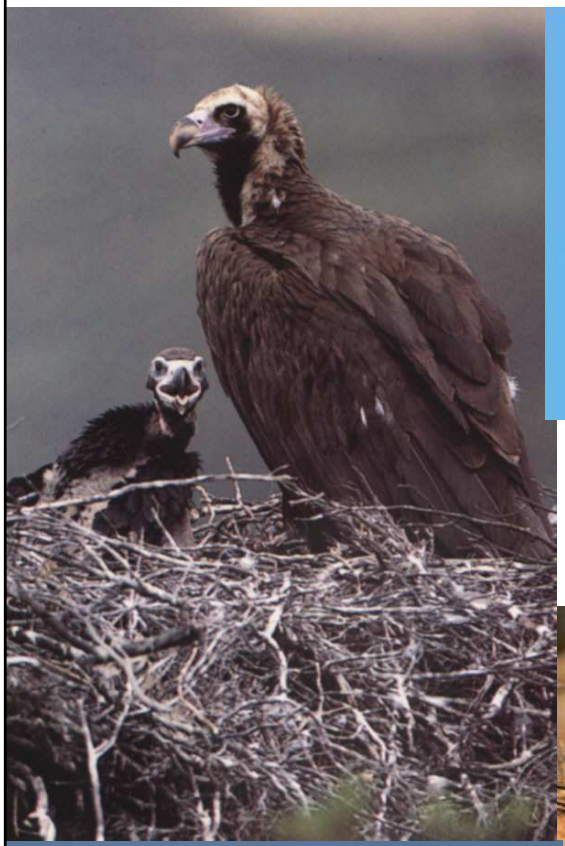
Crocuta crocuta – Spotted Hyena / Hyena skvrnitá

Canis mesomelas – Black-backed Jackal / Šakal čabrakový

Hyaena hyaena – Striped Hyena / Hyena žíhaná (pouze v sev. Africe a Asii)

The saprotrofic food chain in terrestrial ecosystems: Decomposition of Carrion

Vertebrate Scavangers in Southern Europe: Assemblage at large carrion



Aegypius monachus
- Monk Vulture / Sup hnědý

Gypaetus barbatus - Bearded Vulture / Orlosup bradatý

Gyps fulvus - Euroasian Griffon Vulture / Sup bělohlavý

Neophron percopterus
- Egyptian Vulture / Sup mrchožravý

The saprotrofic food chain in terrestrial ecosystems: Decomposition of Carrion

Gypaetus barbatus
- Bearded Vulture /
Orlosup bradatý

The saprotrofic food chain in terrestrial ecosystems: Decomposition of Carrion

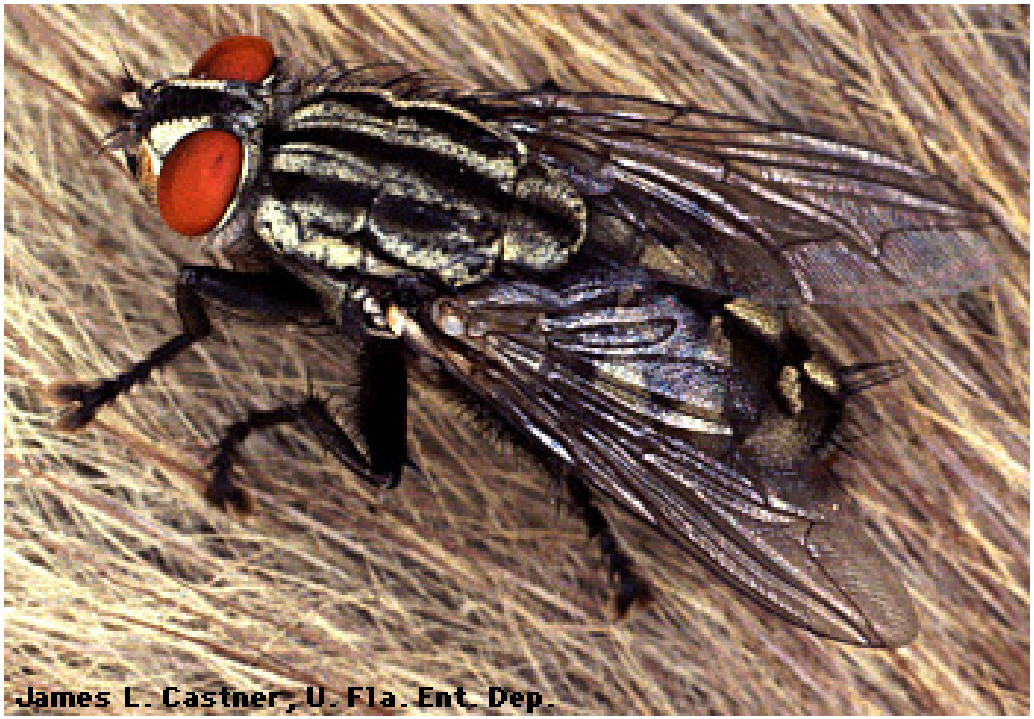
The saprotrofic food chain in terrestrial ecosystems: Decomposition of Carrion

Stage 2: Initial decay (0 to 3 days after death)

Blow fly -*Chrysomya* sp. (Calliphoridae)

The saprotrofic food chain in terrestrial ecosystems: Decomposition of Carrion

Calliphoridae (Diptera-Brachycera)
Blow Flies



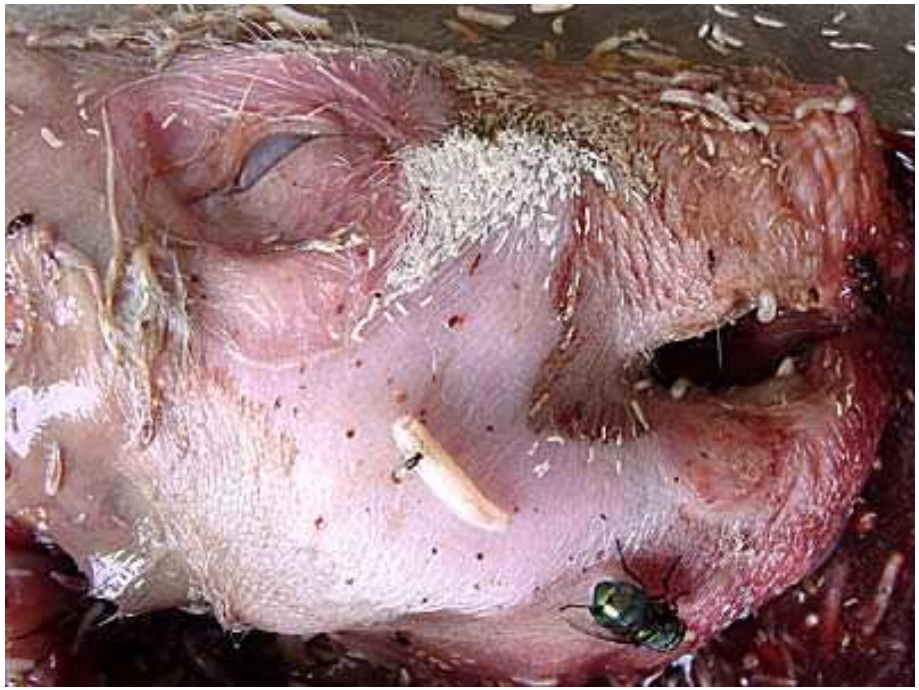
Sarcophagidae (Diptera-Brachycera)
Flesh Flies

The saprotrofic food chain in terrestrial ecosystems: Decomposition of Carrion

Stage 3: Putrefaction
(4 to 10 days after death)

The pig has become bloated from the build up of gases within the body.

The saprotrofic food chain in terrestrial ecosystems: Decomposition of Carrion



Stage 4: Black putrefaction (10 to 20 days after death)

The pig's body has collapsed with black exposed surfaces and creamy flesh.

Ham Beetle -*Necrobia ruficollis* (Cleridae)

Diptera larva (prepupa)

The saprotrofic food chain in terrestrial ecosystems: Decomposition of Carrion

Stage 5: Butyric fermentation (20 to 50 days after death)

Hide Beetles – larvae (Dermestidae)

Carcass Beetles (Trogidae)

The saprotrofic food chain in terrestrial ecosystems: Decomposition of Carrion

Dermestidae (Coleoptera)

The saprotrofic food chain in terrestrial ecosystems: Decomposition of Carrion

Stage 6: Dry decay
(50-365 d after death)

Tineidae
feed on dry hair

The pig has been reduced to hair and bone

Rostrozetes
sp. (Oribatida)
feeds on dry
skin