Data from records of furs purchased by the Hudson Bay Company
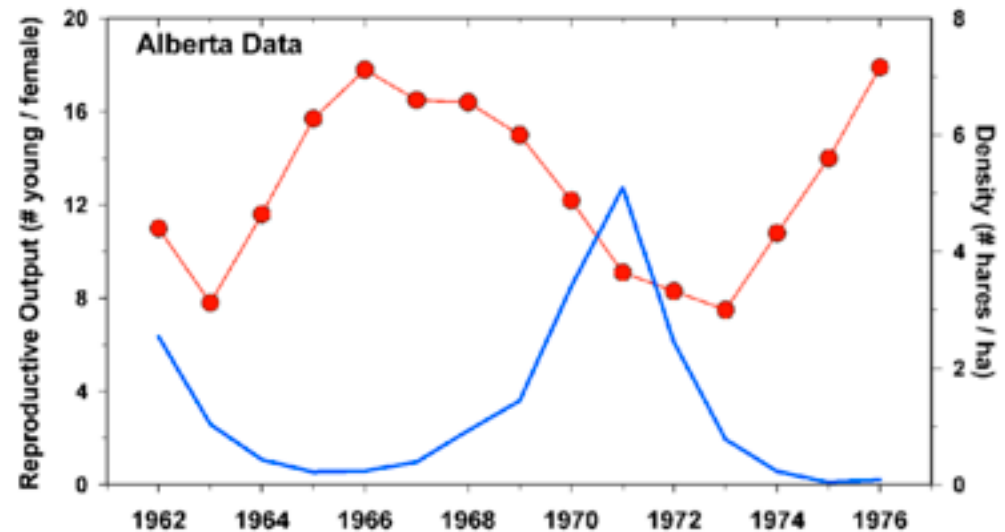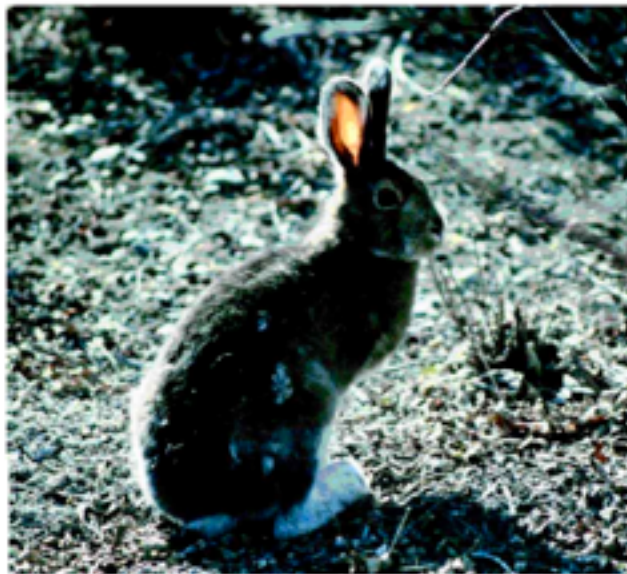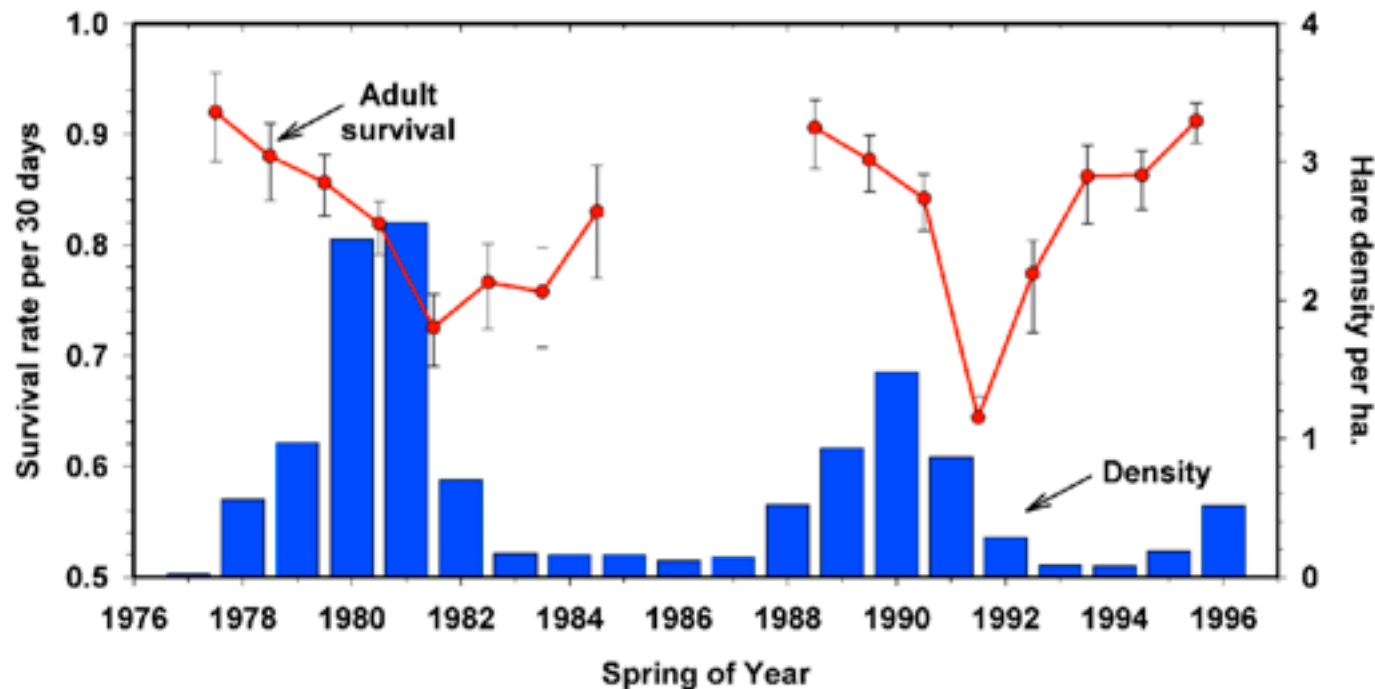
What Drives the 10-year Cycle of Snowshoe Hares?

Figure 2. *Changes in the annual reproductive output of female snowshoe hares in the Rochester area of central Alberta, 1962–1976. Reproductive output was measured in autopsy samples. Data from Cary and Keith (1979). Photo: Alice Kenney.*

What Drives the 10-year Cycle of Snowshoe Hares?

Figure 3. *Changes in adult hare survival rates over the 10-year cycle at Kluane Lake, Yukon, from 1977 to 1996. Hare density (histogram) in spring of year t is plotted along with survival rates averaged from spring of year t to t+1 for radio-collared hares in control areas. Too few hares were captured in 1985–1987 to estimate survival accurately.*
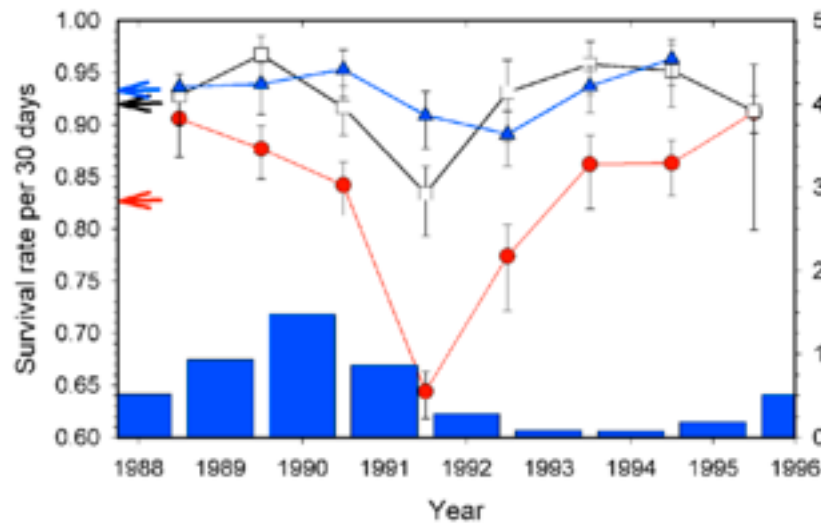
Monday, October 7, 13

Figure 6. Changes in survival rates of snowshoe hare numbers on control and fenced areas during the population cycle of 1988–1996 at Kluane, Yukon. The arrows show the mean survival rate for each treatment. The survival rate per 30 days is averaged over each year, with 90% confidence limits, for radio-collared hares.
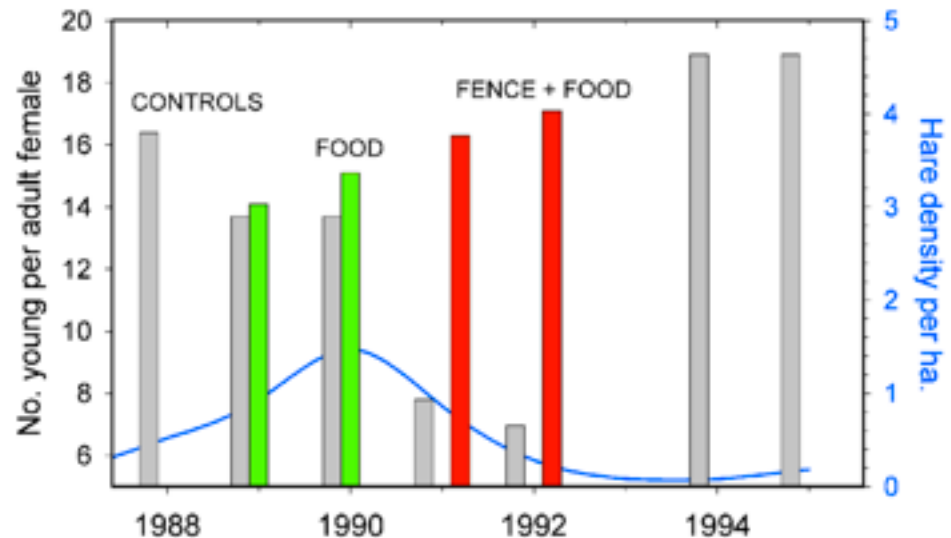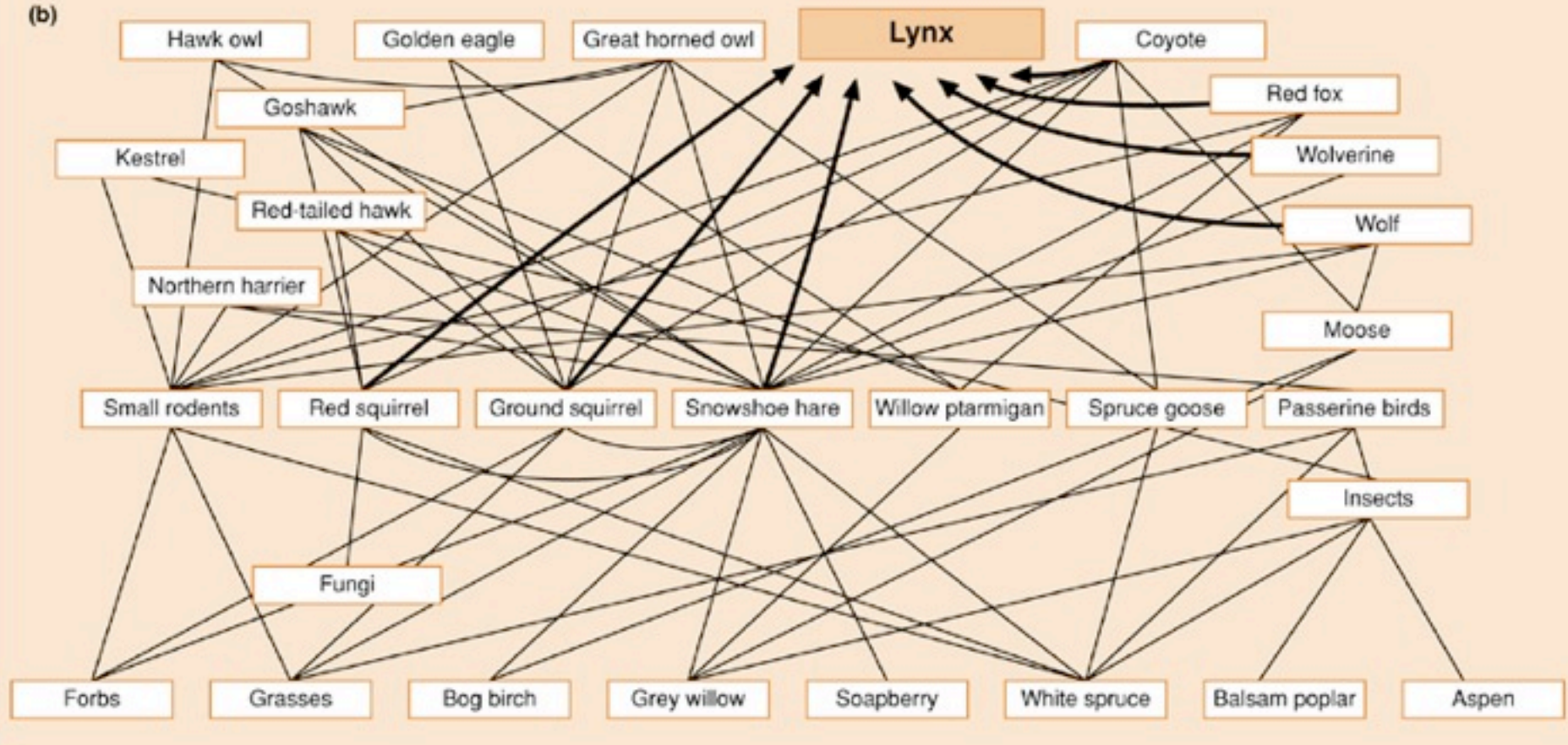

Figure 7. Reproductive output of female snowshoe hares over a population cycle at Kluane Lake, Yukon. The blue line shows hare density in control populations. Supplemental food (green bars) does not affect reproductive output at the peak of the cycle, but in the decline phase of 1991 and 1992 high reproductive output was sustained on the experimental area fenced from mammalian predators and provided with supplemental food (red bars). We were unable to measure reproductive output in every year for all treatments, and thus we do not know for the critical decline years of 1991 and 1992 whether reduced reproductive output is caused by food or predation or both.
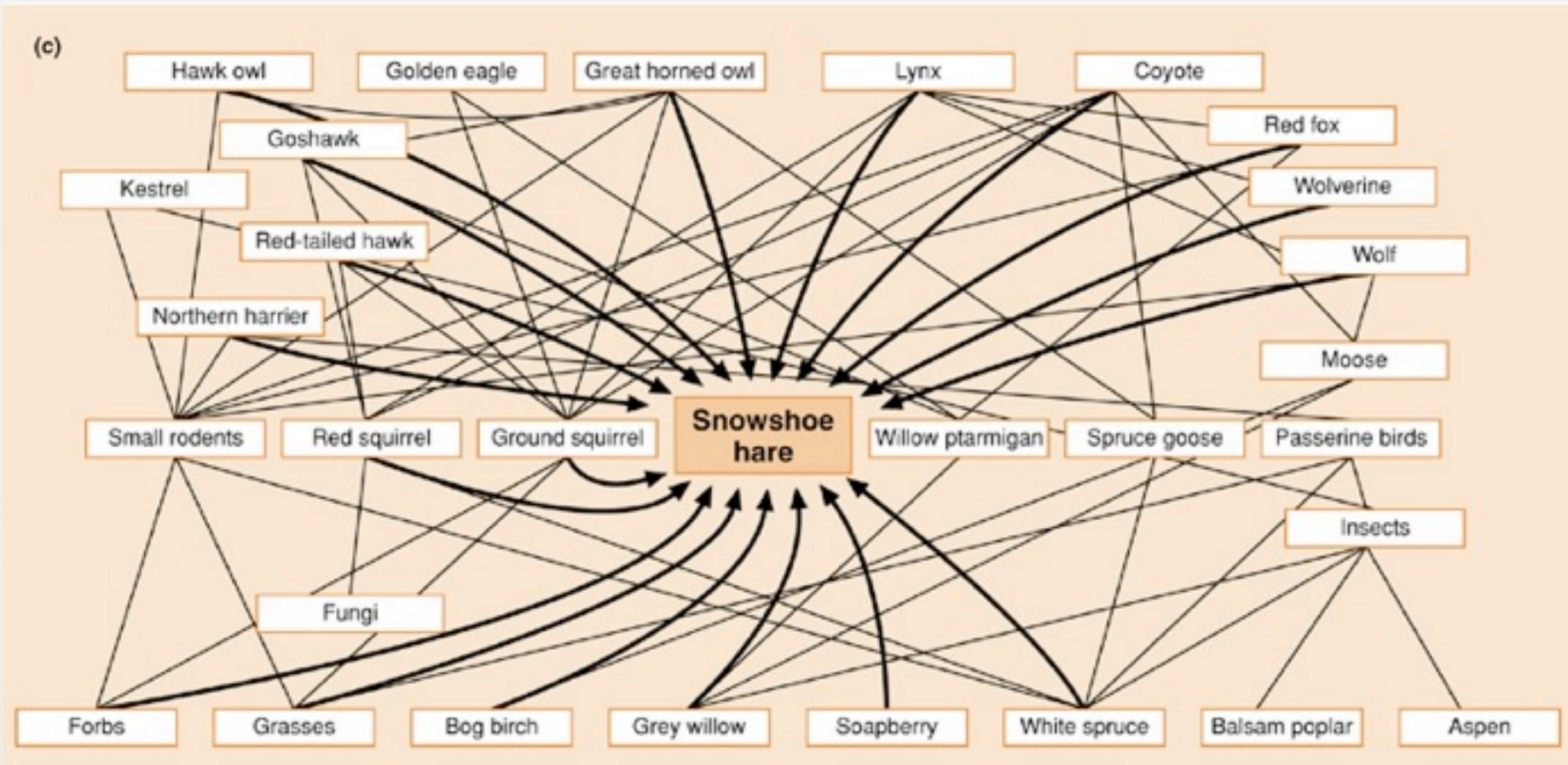
"The 10-year cycle is a result of the interaction between predation and food supplies, but of these two factors, predation is clearly the dominant process. The impact of food is felt largely in winter and it is mostly indirect. Hares do not usually die directly of starvation or malnutrition—the immediate cause of death is virtually always predation. But food quality and quantity affect body condition and in this way may predispose hares to predation, increased parasite loads, and higher levels of chronic stress. These indirect effects of predation and food are the probable cause of reduced reproductive output. Hares in peak and declining populations must trade off safety and food, and these behavioral tradeoffs define the dynamics of the decline (Hik 1995, Hodges 2000b). The result is a time lag in both the indirect effects and the direct effects of predation, which causes the cyclicity. The low phase of the cycle is the combined result of continuing predation mortality and slowly recovering reproductive potential."

—Krebs et a. 2001, p 32

(b)

Hawk owl · Golden eagle · Great horned owl · **Lynx** · Coyote
Goshawk · Red fox
Kestrel · Wolverine
Red-tailed hawk · Wolf
Northern harrier · Moose
Small rodents · Red squirrel · Ground squirrel · Snowshoe hare · Willow ptarmigan · Spruce goose · Passerine birds
Insects
Fungi
Forbs · Grasses · Bog birch · Grey willow · Soapberry · White spruce · Balsam poplar · Aspen

(c)

Hawk owl · Golden eagle · Great horned owl · Lynx · Coyote · Red fox · Goshawk · Wolverine · Kestrel · Wolf · Red-tailed hawk · Northern harrier · Moose · Small rodents · Red squirrel · Ground squirrel · **Snowshoe hare** · Willow ptarmigan · Spruce goose · Passerine birds · Insects · Fungi · Forbs · Grasses · Bog birch · Grey willow · Soapberry · White spruce · Balsam poplar · Aspen

Figure 18.6 C. B. Huffaker's classic experiment tested the parameters of predator–prey coexistence. (a) In each experimental tray, four oranges, half exposed, are distributed at random among the 40 positions in the tray. Other positions are occupied by rubber balls. (b) Each orange is wrapped with paper and its edges sealed with wax. The exposed area has been divided into numbered sections to facilitate counting the mites.

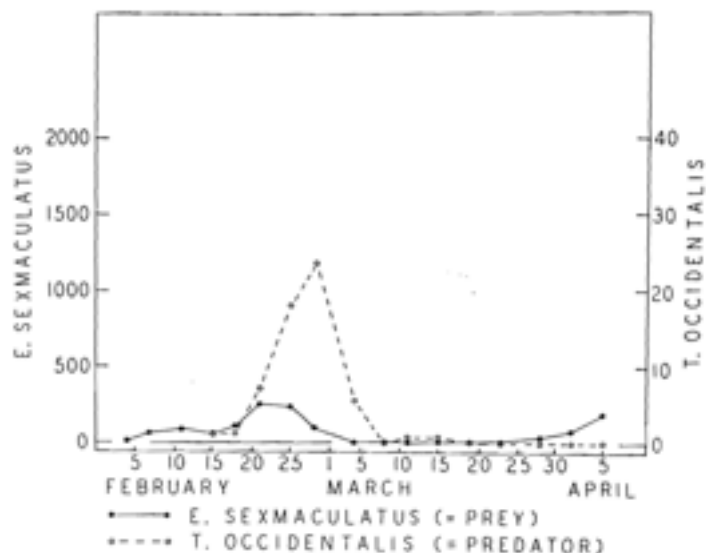Courtesy of C. B. Huffaker, from C. B. Huffaker, *Hilgardia* 27:343–383 (1958).

Fig. 9. Densities per orange-area of the prey, *Eotetranychus sexmaculatus*, and the predator, *Typhlodromus occidentalis*, with 4 large areas of food for the prey (orange surface) grouped at adjacent, joined positions—a 2-orange feeding area on a 4-orange dispersion (see fig. 3 and text, Subsection A, Section II of "Results").
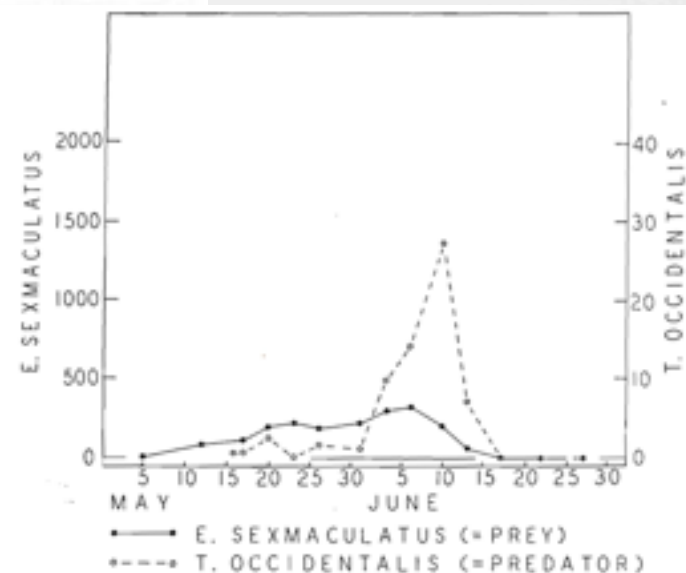

Fig. 17. Densities per orange-area of the prey, *Eotetranychus sexmaculatus*, and the predator, *Typhlodromus occidentalis*, with 120 small areas of food for the prey (orange surface) occupying all 120 positions in a 3-tray universe—a 6-orange feeding area on a 120-orange dispersion, with a simple maze of vaseline partial-barriers utilized (no wooden posts), but with the stocking done in a very restricted manner (see fig. 5 and text, Subsection H, Section II of "Results").
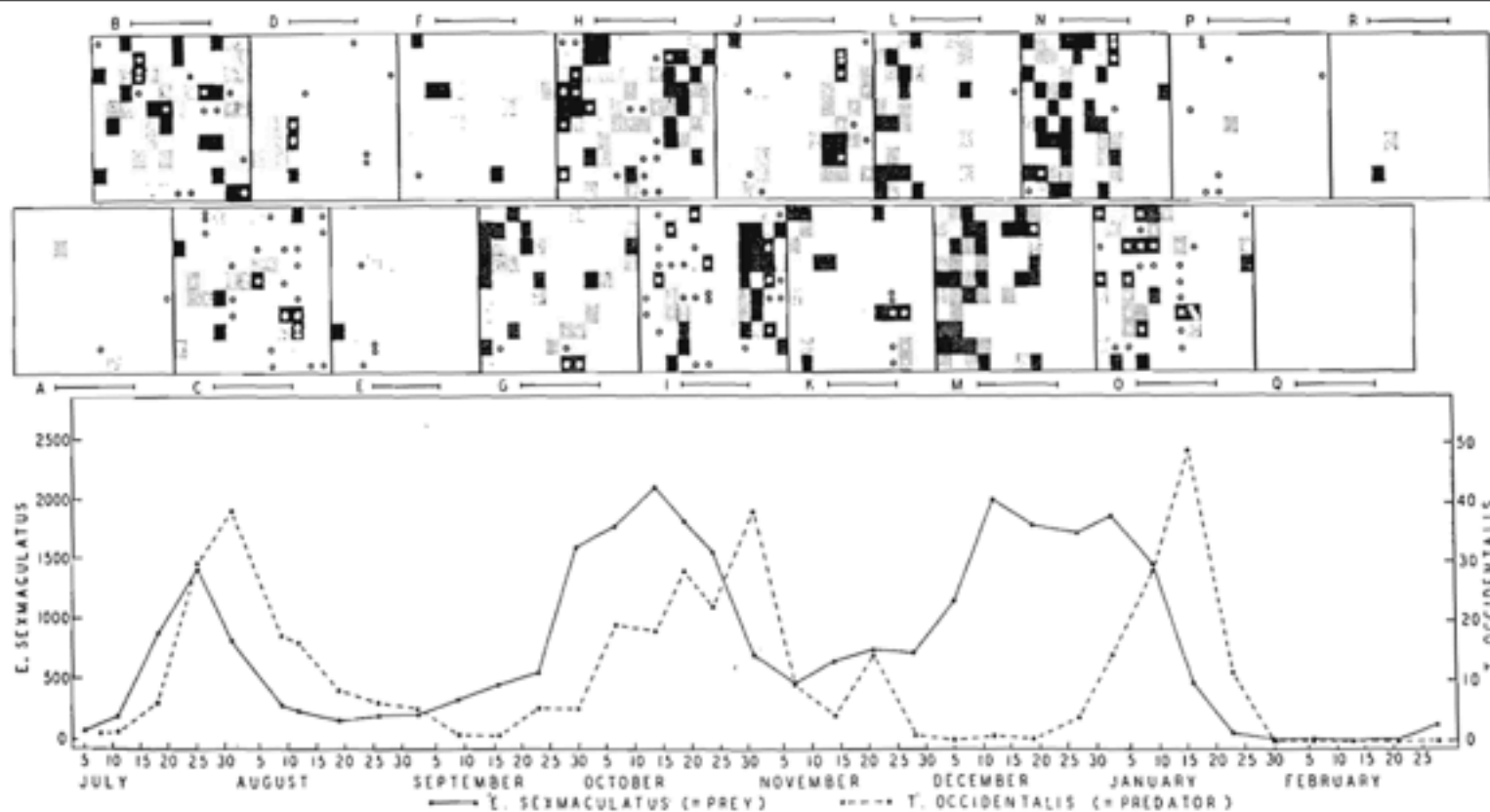
Fig. 18. Three oscillations in density of a predator-prey relation in which the predatory mite, *Typhlodromus occidentalis*, preyed upon the orange feeding six-spotted mite, *Eotetranychus sexmaculatus*.

The graphic record below shows the sequence of densities per orange-are... ...sities and *positions* within the universe. The horizontal line by each lett... ...sented by each chart. A photograph of the arrangement of this universe i... ...partial-barriers in figure 19—a 6-orange feeding area on a 120-orange di...
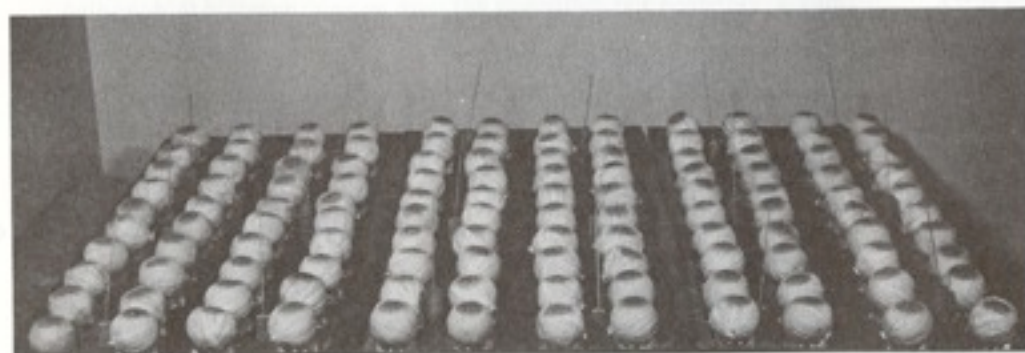

FIGURE 5–18. Universe of 120 oranges used in studies of predator–prey interaction (prey: *Eotetranychus sexmaculatus*; predator: *Typhlodromus occidentalis*). Each orange has $\frac{1}{20}$ of its area exposed. Partial barriers of Vaseline form a complex maze of impediments between the oranges. Wooden dowels allow prey to disperse by climbing on a dowel, dropping on a silken strand, and being carried by an air current into a different area. (From Huffaker, 1958. Photograph by F. E. Skinner.)

Monday, October 7, 13
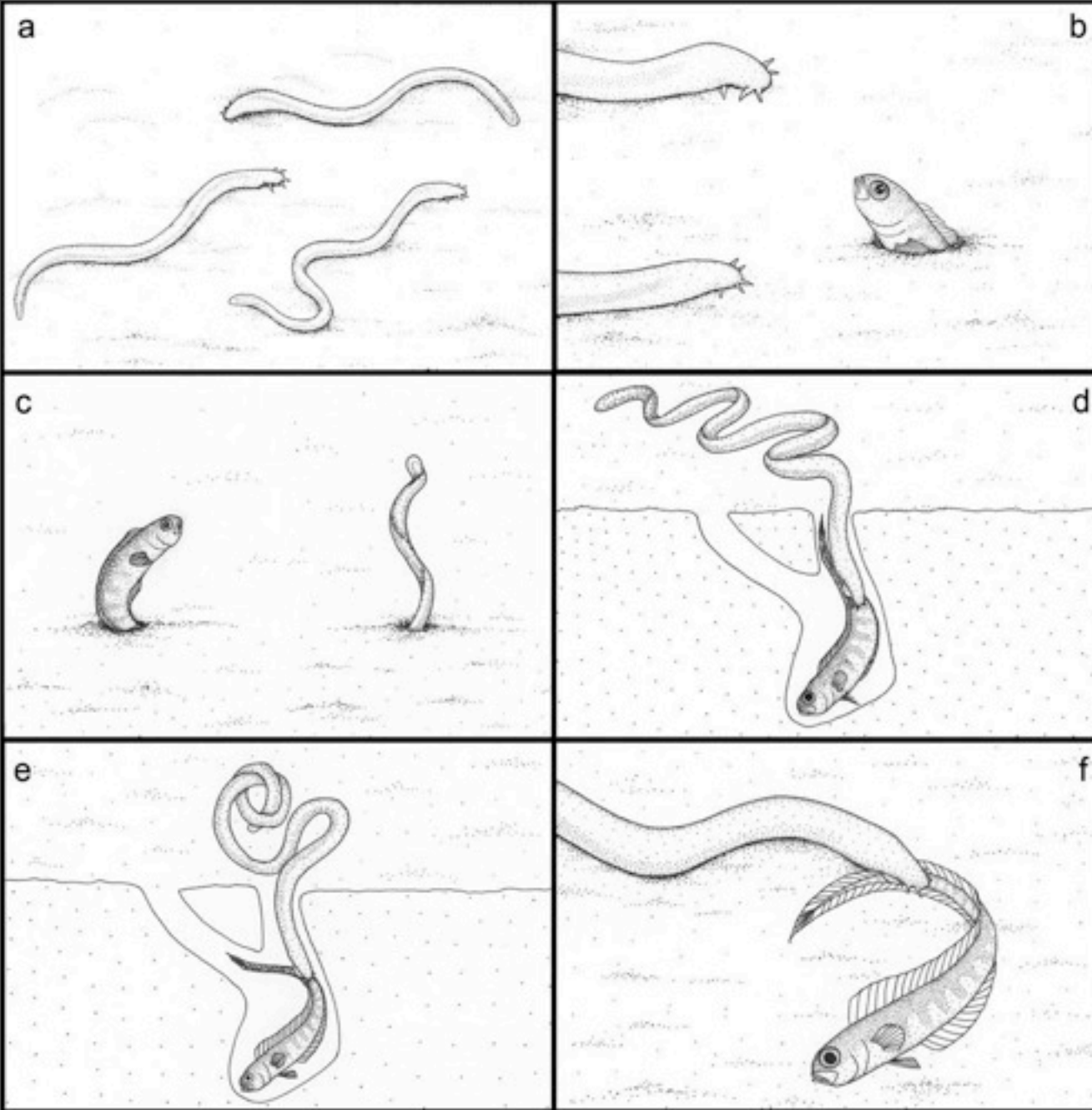
Sequence of events in hagfish predation
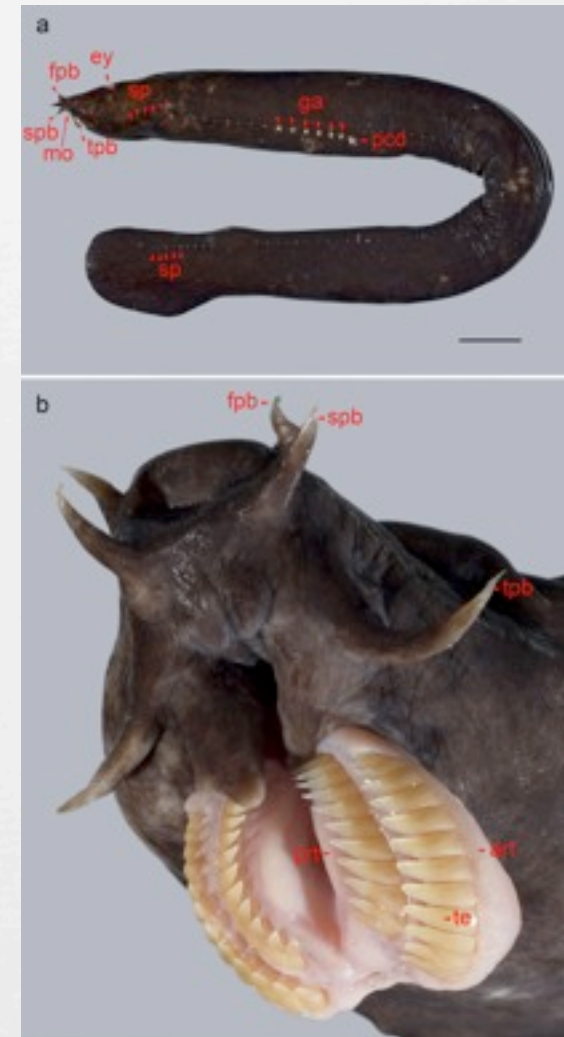
Zintzen, Roberts, Anderson, Stewart, Struthers, and Harvey (2011) Hagfish predatory behaviour and slime defence mechanism. Nature Scientific Reports 1, Article number: 131 doi:10.1038/srep00131

Plectroctena minor
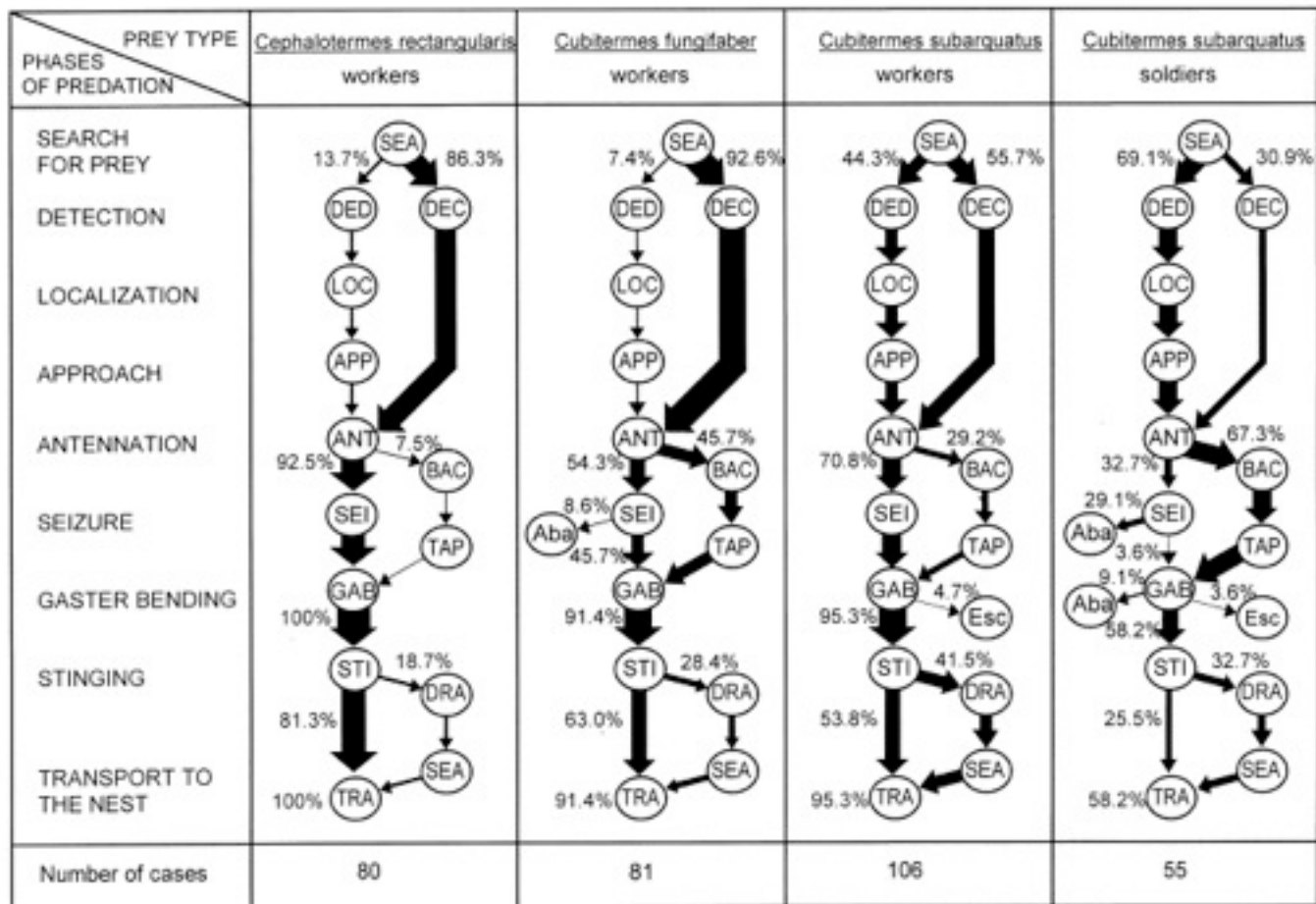
Dejean, A., and R. Fénéron. 1999. Predatory behaviour in the ponerine ant, *Centromyrmex bequaerti*: a case of termitolesty. Behavioural Processes 47:125-133.
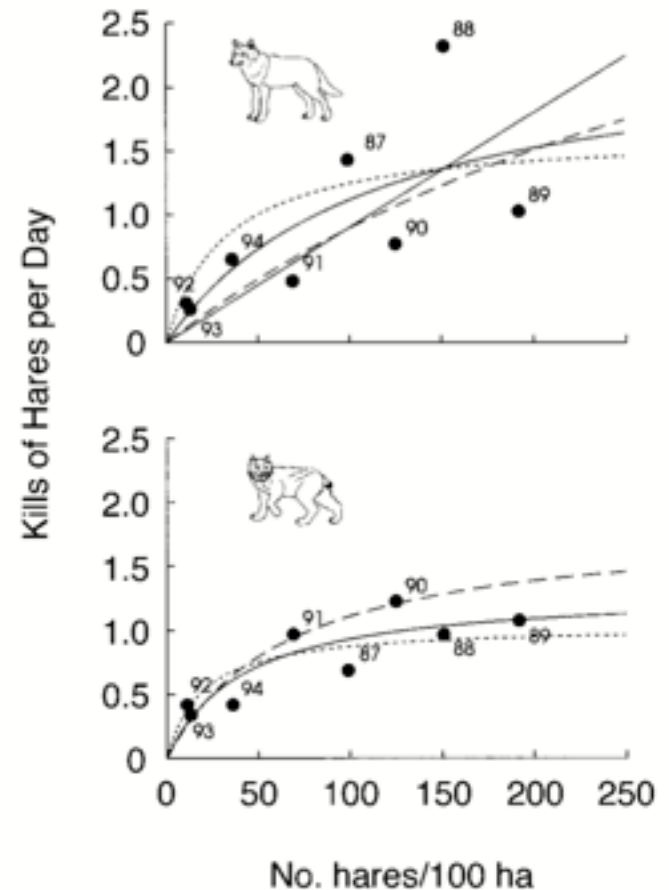
Monday, October 7, 13

FIG. 5. Functional responses of coyotes and lynx (kills per day per predator) to the density of snowshoe hares from 1987–1988 through 1994–1995. The solid lines represent the best fits of the disc equation (Holling 1959a) and, in the case of coyotes, a linear functional response curve, plotting kill rates against the mean over-winter densities of hares. Numbers next to each point indicate the year starting each winter (e.g., 87 = 1987–1988). For comparison, functional responses of predators were also calculated using fall densities of hares and kills by predators from October to December (long-dashed lines), and late winter densities of hares and kills from January to March (short-dashed lines).

FUNCTIONAL RESPONSES OF COYOTES AND LYNX TO THE SNOWSHOE HARE CYCLE

MARK O'DONOGHUE,[1,5] STAN BOUTIN,[2] CHARLES J. KREBS,[1] GUSTAVO ZULETA,[3] DENNIS L. MURRAY,[2,6] AND ELIZABETH J. HOFER[4]