Passage of Infectious Nuclear Polyhedrosis Virus Through the Alimentary Tracts of Two Small Mammal Predators of the Gypsy Moth, *Lymantria dispar*[1,2]

R. A. LAUTENSCHLAGER AND J. D. PODGWAITE[3]

ABSTRACT

The white-footed mouse, *Peromyscus leucopus* Rafinesque, and the short-tailed shrew, *Blarina brevicauda* Say, 2 small mammal predators of the gypsy moth, have demonstrated the ability to pass significant amounts of infectious nuclear polyhedrosis virus (NPV) through their alimentary tracts. Ninety-five percent of the gypsy moth larvae fed fecal preparations from NPV-challenged mammals died during infectivity tests, whereas only 6% of larvae fed control fecal preparations died. The ability of these mammals to pass large amounts of infectious NPV may be important in the distribution of NPV in the wild.

The nuclear polyhedrosis virus (NPV) of the gypsy moth, *Lymantria dispar* L., is an important regulator in dense populations of the insect and is being developed for use as a control agent. Where it occurs naturally and in areas treated with it, mammals and birds are likely to ingest NPV by consuming infected insects and contaminated vegetation. Bird (1955) and Hostetter and Biever (1970) have shown that certain NPV's remain infectious after passage through the alimentary tracts of birds. Conversely, studies by Smirnoff and MacLeod (1964) and Ignoffo et al. (1970) have indicated that other NPV's are inactivated in the alimentary tracts of laboratory rodents.

Both the white-footed mouse, *Peromyscus leucopus* Rafinesque, and the short-tailed shrew, *Blarina brevicauda* Say, are known to feed on gyspy moth larvae and pupae, and to ingest insects infected with NPV.[4] The survival of NPV in the excrement of these mammals could be important in the dissemination and persistence of NPV in the environment of the host insect.

Materials and Methods

Fourteen white-footed mice were caught and caged in pairs, and 2 short-tailed shrews were caged individually. Eight mice and 1 shrew were treated while 6 mice and 1 shrew served as controls. For each of 3 consecutive days, each pair of treated mice was offered a diet of 20 g of canned dog food into which was blended a mixture of 1.0×10^9 purified polyhedral inclusion bodies[5] (PIB's) of the gypsy moth NPV in 1 g of powdered lactose. The shrew was offered the same PIB-lactose blend mixed in 14 g of dog food. Control animals received similar diets without PIB's. All animals consumed at least 90% of the food offered each day.

On the 4th day, feces were collected from mouse nests and characteristic shrew "dumps". Fecal samples, which ranged in weight from 0.25–0.50 g (wet), were homogenized in 3.0 ml of sterile distilled water and microscopically examined for PIB's using a hemocytometer and phase optics. Each sample was tested for activity against 50 newly-molted 2nd-stage gypsy moth larvae. Each test was replicated 4 times. For each test, 0.1 ml of a feces suspension was applied to the surface of each of 5 blocks of artificial diet (ODell and Rollinson 1966). Each diet block (2.0 cm^3) was placed in a sterile plastic petri dish (15×100 mm) with ten 2nd-stage larvae. Larvae were allowed to feed on the test material for 48 h, after which the treated diet was replaced with untreated artificial diet. All test insects were maintained at 24°C with a 16-h photoperiod. Larvae were examined daily for 15 days and dead insects were examined microscopically to determine the cause of death.

Results and Discussion

Microscopic examination of fecal suspensions from treated animals revealed intact PIB's. Hemocytometer counts of PIB's in these suspensions indicated that 40% (±35 SE) of the PIB's ingested by these mammals had passed through their alimentary tracts. Since the variation among sample counts was high, no detailed statistical analysis was attempted. No PIB's were observed in the fecal suspensions from control animals.

A mean of 94% (±5 SD) of the larvae feeding on the fecal suspensions from treated mice died of nuclear polyhedrosis during the 15-day activity tests, while only 5% (±4 SD) of the larvae feeding

[1] Lepidoptera: Lymantriidae.

[2] Received for publication Mar. 11, 1977.

[3] USDA Forest Service, Northeastern Forest Experiment Station Forest Insect and Disease Laboratory, 151 Sanford Street, Hamden, CT 06514.

[4] Smith, H. R., and R. A. Lautenschlager. The mammalian predators of the gypsy moth (unpublished report; Forest Insect and Disease Laboratory, Hamden, CT 06514).

[5] LC_{50} for 2nd-stage gypsy moth larvae = 3.70×10^4 PIB's/cc diet; unpublished data of W. D. Rollinson, Forest Insect and Disease Laboratory, Hamden, CT 06514.

on fecal suspensions from control mice died. NPV activity in the fecal suspension from the treated shrew was somewhat higher; 99% (±1 SD) mortality in test larvae. Control mortality was 7% (±5 SD).

The results suggest that these small mammals may distribute infectious NPV in the wild. Young, dispersing mice and shrews could introduce NPV into areas previously free of NPV while older, territorial mammals could circulate NPV within their home range by moving it from the soil and litter toward the canopy.

This potential is best exemplified by the white-footed mouse, the most abundant small mammal in northeastern hardwood forests. This mouse commonly climbs to heights of 15 m and often nests under bark flaps and in abandoned bird nests (Burt 1940). It forages mainly on the ground and can ingest NPV by consuming infected larvae or contaminated food. After feeding, it is likely to deposit feces contaminated with NPV on bark and foliage while it is on the tree. Whether NPV so deposited is a source of infection for the insect remains to be determined.

REFERENCES CITED

Bird, F. T. 1955. Virus diseases of sawflies. Can. Entomol. 87: 124–7.

Burt, W. H. 1940. Territorial behavior and populations of some small mammals in southern Michigan. Univ. Mich., Mus. Zool., Misc. Publ. No. 45. 58 pp.

Hostetter, D. L., and K. D. Biever. 1970. The recovery of virulent nuclear polyhedrosis virus of the cabbage looper, *Trichoplusia ni*, from feces of birds. J. Invertebr. Pathol. 15: 173–6.

Ignoffo, C. M., O. F. Batzer, W. M. Baker, and A. G. Ebert. 1970. Fate of *Heliothis* nucleopolyhedrosis virus following oral administration to rats. P. 357–62. *In* Proc. IV Int. Colloq. Insect Pathol. Microbial Control, College Park, MD. Soc. Invertebr. Pathol.

ODell, T. M., and W. D. Rollinson. 1966. A technique for rearing the gypsy moth, *Porthetria dispar* (L.), on an artificial diet. J. Econ. Entomol. 59: 741–2.

Smirnoff, W. A., and C. F. MacLeod. 1964. Apparent lack of effect of orally introduced polyhedrosis virus on mice and of pathogenicity of rodent-passed virus for insects. J. Insect Pathol. 6: 537–8.