



# PREVALENCE OF WEST NILE VIRUS IN RUFFED GROUSE (*BONASA UMBELLUS*) IN PENNSYLVANIA: EVIDENCE OF POPULATION IMPACTS

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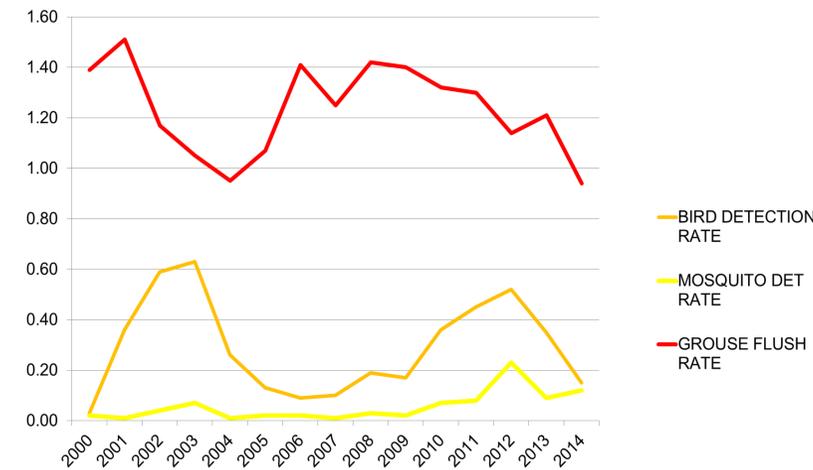
## Background

- The ruffed grouse (*Bonasa umbellus*) is an important gamebird species and the state bird of Pennsylvania (PA).
- West Nile virus (WNV) was introduced to the northeastern U.S. in 1999, and occurred statewide in PA by 2002.
- Grouse populations in PA declined precipitously from 2002-2005. Robust recovery has not occurred.
- Grouse populations show a strong inverse correlation with WNV prevalence ( $r = -0.74$ ;  $p=0.02$ ) (**Fig 1**).
- 7 of 9 years of the lowest flush rates in 50 years of monitoring have occurred since 2002.
- Summer productivity/survival indices are in decline; July 2016 values were the lowest in 36 years of monitoring.
- A 2015 challenge study indicated that WNV may cause significant mortality in infected wild grouse.
- To assess WNV antibody prevalence in wild grouse, blood sampling of hunter-harvested birds was implemented.

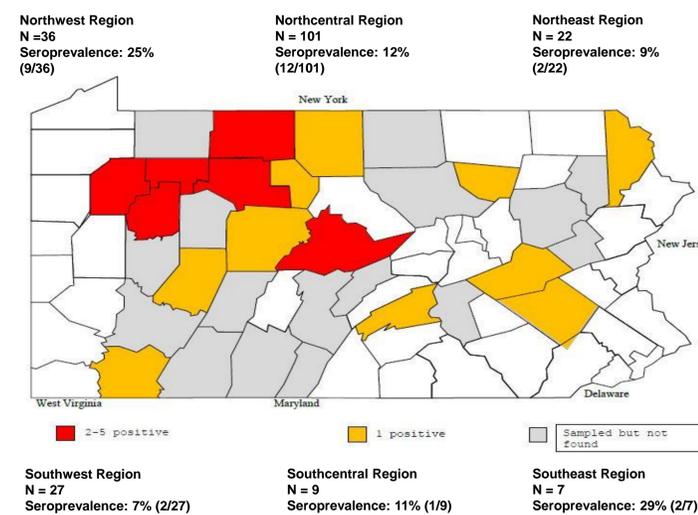
## Methods

- Blood sampling of hunter-harvested ruffed grouse via Nobuto strips began in PA in the 2015 grouse season.
- Participating hunters were selected by recent success in harvesting grouse and region/county of harvest(s) to ensure broad geographic representation.
- Participating hunters received a blood sampling kit (i.e., instructions, Nobuto strips, ziplock bags and postage-paid envelopes).
- Hunters added blood of freshly-harvested birds ( $\leq 30$  minutes of harvest) to Nobuto filter strips, which were air dried and returned by mail.
- Successful hunters submitted blood and feather samples (2 central tail feathers, 5-10 rump feathers, complete wing or 3 outer primary feathers) for each harvested grouse.
- Samples were labeled with name and date, county, township and wildlife management unit of harvest.

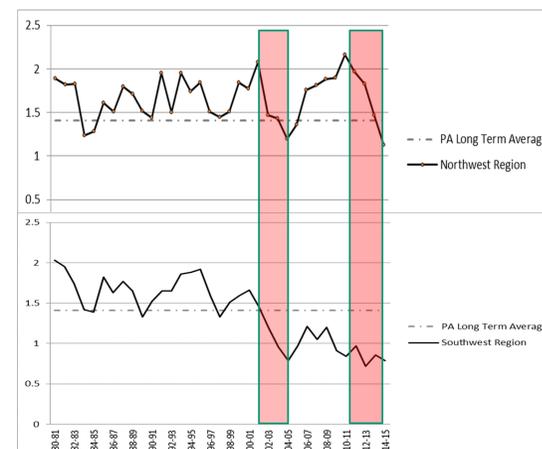
**Figure 1.** Ruffed grouse population trends (index: flushes per hour) and WNV prevalence (index: # positive/# tested), 2000 to 2015, Pennsylvania.



**Figure 2.** Prevalence of WNV+ harvested ruffed grouse, Pennsylvania, 2015-16.



**Figure 3.** Grouse population trends in PA, showing robust recovery between WNV peaks in a region with high-quality and abundant habitat (NW region) and weak recovery in a region with less-abundant, fragmented habitat (SW region). [Red periods represent peak WNV activity years, based on PA DEP surveillance data.]



## Results

- 202 Nobuto filter strips from 32 counties were received in 2015-16.
- 14% of samples were positive for antibodies to WNV. These represent grouse that survived WNV infection.
- Juveniles accounted for 39% of WNV+ birds; adults accounted for 57%. Males accounted for 54% of WNV+ birds; females accounted for 46%.

COHORT	# SAMPLED	% WNV POSITIVE
Adult Female	26	23
Adult Male	60	17
Juvenile Female	50	12
Juvenile Male	63	8

- WNV antibody prevalence ranged from 29% to 7% and varied by PA Game Commission geographic region (**Fig. 2**).
- Seroprevalence was higher in areas of the state characterized by high-quality and abundant habitat (the 'core' of the PA grouse range) (**Fig. 2**).

## Conclusions

- Estimated WNV-associated morbidity and mortality in ruffed grouse, based on experimental infection, is 40% mortality in the short-term (i.e., within 1 week following infection)
- An additional 50% may have compromised longer-term survival (i.e., > 2 weeks post-infection) based on the severity of histologic lesions in the heart and brain.
- Field-collected serologic data reveal variation in the distribution and extent of WNV antibody seroprevalence.
- Preliminary findings suggest grouse populations occupying high-quality and abundant habitat recover more quickly between WNV prevalence peaks than populations in lower-quality habitat (**Fig. 3**).
- Nobuto filter strips are a reliable method for detecting the presence of antibodies to WNV in hunter-harvested grouse. Strips are relatively cheap and easy for hunters to use.
- Focusing habitat restoration efforts in areas where grouse populations are most able to respond can improve cost-benefit returns as well as outcomes for grouse populations.

## Acknowledgments

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