Use of *Bacillus thuringiensis israelensis* (*Bti*) by the Pennsylvania Black Fly Suppression Program

PA Department of Environmental Protection
Division of Vector Management
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PA-DEP Uses *Bti* To Control Black Flies

- Adult females (gnats) are important medical pests of humans, livestock and wildlife by biting, swarming, crawling
- Females feed on blood and can transmit diseases, such as river blindness (onchocerciasis), in some parts of the world

- Black flies in PA are medical, nuisance, and economic pests
- Eggs, larvae, and pupae live in clean, flowing streams and rivers

What is *Bti*?

- *Bacillus thuringiensis* subspecies *israelensis*
- Natural soil bacterium
- Not a harmful man-made chemical
- Used as a microbial insecticide to:

  1) manage insect pest species

  2) control the spread of vector-borne diseases

  3) protect public health
- Species-specific for black flies and mosquitoes

How Does *Bti* Work?

- Specific for black flies and mosquitoes due to high pH mid-gut, specific enzymes and receptor sites
- *Bti* spores and crystals activate only in alkaline digestive tract of black flies and mosquitoes
- Nontoxic in acidic digestive systems of most animals
- *Bti* must be eaten by black fly larvae in order to work (no contact effects)
- Mode of Action: stomach poison. Stops feeding, causes breakdown of mid-gut, results in paralysis and mortality of black fly and mosquito larvae.

Does *Bti* Harm Fish and Other Non-Target Organisms?

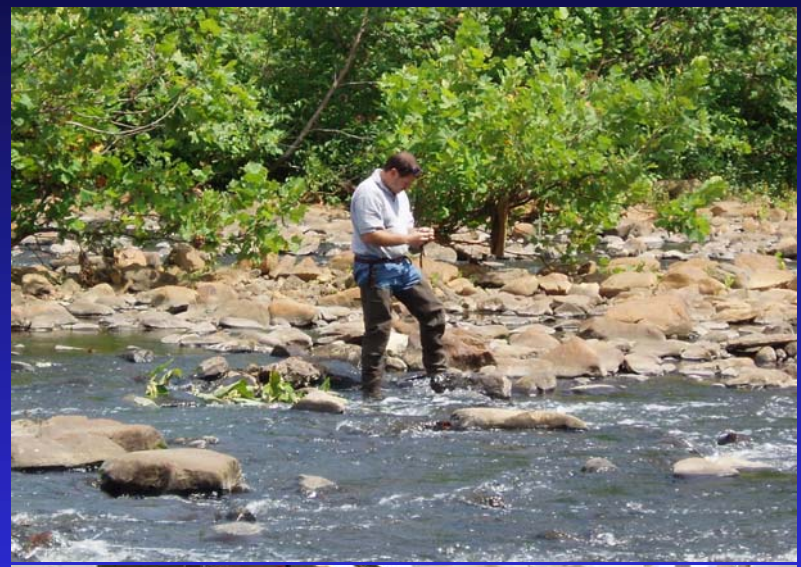
- No, *Bti* is safe for non-target organisms when carefully applied at label rate for black fly control
- Extensively tested and registered by EPA in 1983
- Research proved that *Bti* is non-toxic to humans, mammals, birds, fish, plants, and most invertebrates when properly applied
- Rapid environmental breakdown, does not persist
- Used worldwide to control black flies and mosquitoes without harming non-target organisms

The PA Black Fly Program Uses VectoBac 12AS (Aqueous Suspension)

- EPA Reg. No. 73049-38
- Manufactured for Valent BioSciences, Inc. by Abbott Laboratories
- Same FDA quality control standards as anti-biotics and pharmaceutical drugs
- Every lot used by PA-DEP is bio-assayed for potency and tested for bio-burden

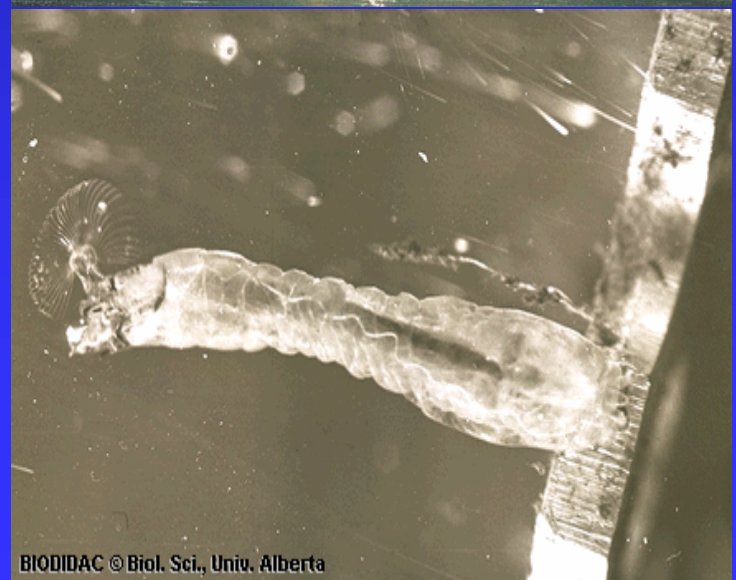
How Does DEP Decide When to Treat?

- 8,000 Samples Per Year
- 50 Rivers and Streams
- Susquehanna, Juniata, Allegheny,Delaware,Yough.
- Sample April to October
- Samples Identified in DEP Vector Management Lab
- Look for *Simulium jenningsi* species group black flies
- Treat for only 4 of 53 Pennsylvania species

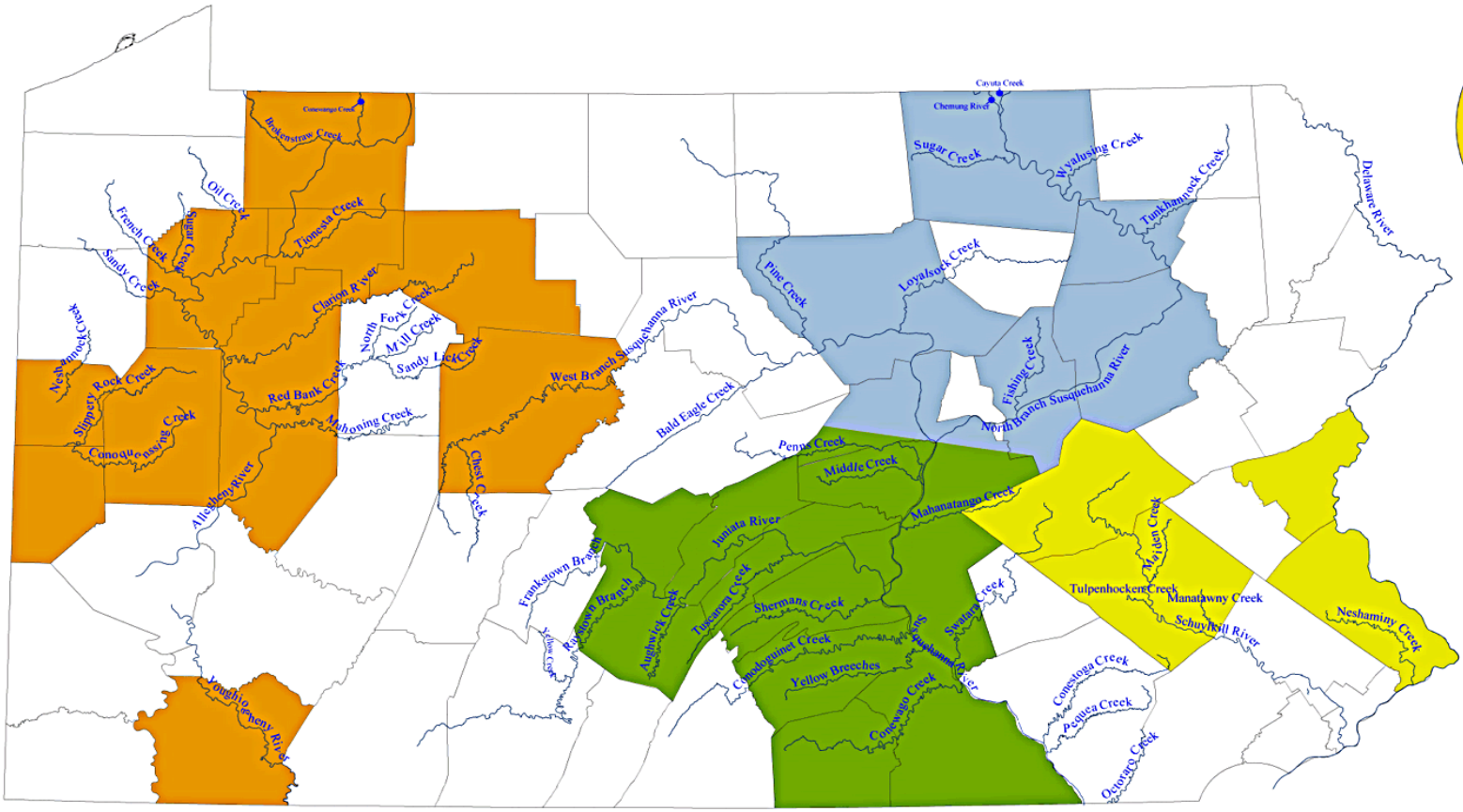


How Is VectoBac 12AS Applied?

- Aerially applied by helicopter
- Riffle/Run production areas of rivers and streams
- 11.5 parts per million (Label Rate is 25.0 ppm)
- Treat only when pest species (*S. jenningsi* group) are present
- Black fly larvae must filter the *Bti* with cephalic fans and eat it
- Treat April to September
- Spray *Bti* every 10-14 days, as needed, based on sample results



Pennsylvania Black Fly Suppression Program
2005 Surveyed Stream Contracts



BLACK FLY
Suppression Program

Legend

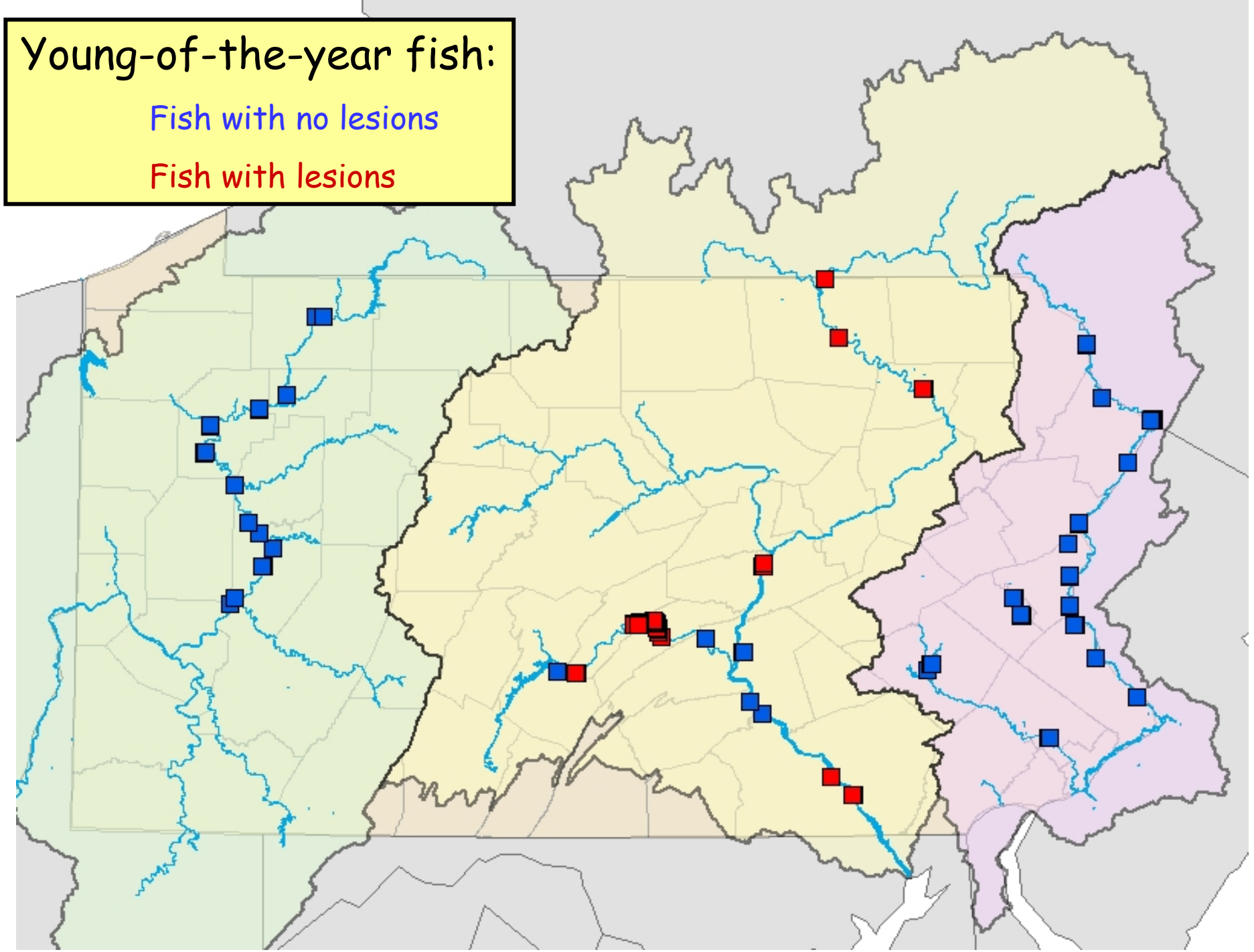
- Streams
- Contract 12
- Contract 3
- Contract 4
- Contract 56

N
W E
S

0 12.5 25 50 75 100 Miles

NOTE: In most cases, spraying will only occur in a portion of the stream shown.

October 31, 2005


Young-of-the-year fish:
Fish with no lesions
Fish with lesions

Could *Bti* Have Caused The Mortality in Smallmouth Bass This Summer?

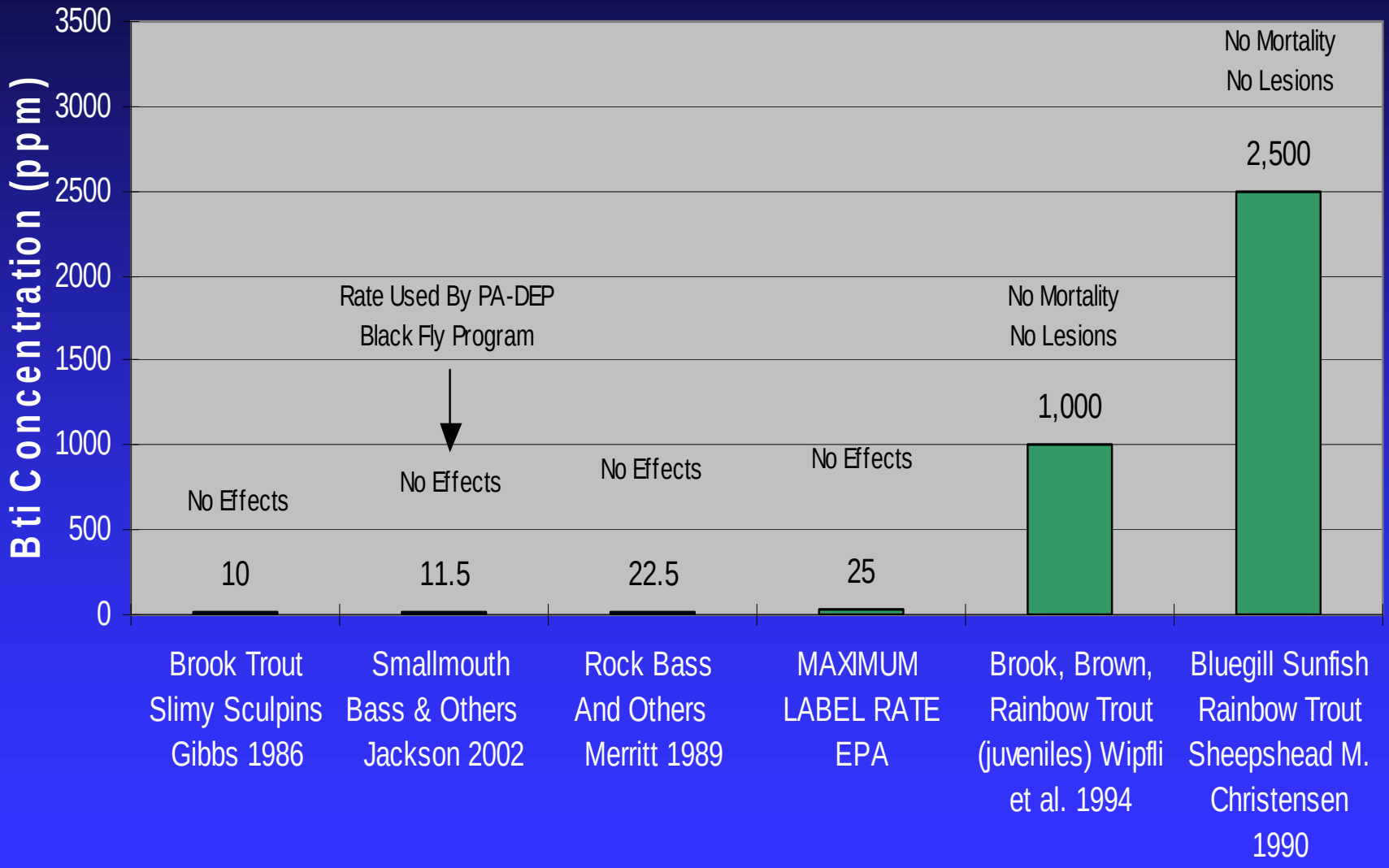
- The Susquehanna River Basin has been treated with *Bti* for black fly control every year since 1985-1986
- No fish illnesses or fish mortality from *Bti* were ever reported during that entire 20-year period

- No fish illnesses or mortality were reported in the other river systems (Allegheny, Clarion, Delaware, Schuylkill, Youghiogheny) treated with *Bti* this year
- SMB mortality was reported this year in streams, or sections of streams, that were not sprayed with *Bti*, including the North Branch Susq. River in New York

Some Studies Examining The Effects of *Bti* on Fish

- Brook Trout, Slimy Sculpins, 10 ppm, No effects on survival, growth or diet (Gibbs et al. 1986)
- Smallmouth Bass and other species, 11.5 ppm, No effect on growth, condition, abundance (Jackson et al. 2002)
- Rock Bass, 22.5 ppm, No effect (Merritt et al. 1989)
- Brook, Brown, and Rainbow Trout (juveniles) 1,000 ppm, No mortality and no lesions (Wipfli et al. 1994)
- Bluegill Sunfish, Rainbow Trout, Sheepshead Minnow 2,500 ppm to 12,500 ppm (100-500X label rate), No mortality and no lesions (Christensen 1990)

Studies Examining The Effects of Bti on Fish



Academy of Natural Sciences of Phila. & Stroud Water Research Center Study

- Non-target study designed to evaluate PA BF Program
- 5-Year Study (1989-1997)
- North Branch Susquehanna River at PA/NY border
- Control and Treatment Sites
- Examined *Bti* effects on:
  - -Fish Community
  - -Aquatic Invertebrates
  - -Entire Aquatic Ecosystem

Results from ANSP-SWRC Study

- Fish diet, growth, condition, abundance, and species composition were not affected by *Bti* treatments
- Fish studied: smallmouth bass, rock bass, bluegill, channel catfish, margined madtom, white sucker, northern hogsucker, fallfish, creek chub, banded, tesselated, shield and greenside darters, longnose and blacknose dace, mottled sculpin, spotfin, spottail, common, mimic and rosyface shiners, other fish species
- Non-target macroinvertebrate richness, diversity, population density and drift were not affected by *Bti*
- The Susquehanna River warmwater fishery ecosystem was not significantly impacted by black fly treatments

Summary

- After analyzing all available information, it is highly unlikely that *Bti* treatments were in any way responsible for the *columnaris* disease and juvenile mortality observed in smallmouth bass in the Susquehanna River Basin in 2005
- All available data indicate that black fly treatments with *Bti* can be carefully and safely conducted, with no significant impacts to fish, macroinvertebrates and aquatic ecosystems in the Commonwealth of Pennsylvania