THE OVERLOOKED INTERFACE
Agricultural Fires and Rural Communities

JEREMY A. KELLER, CF GISP
Ohio Fire Chiefs’ Association
and Bellefontaine Fire & EMS
Reasons for this Study

Define the Fire Environment
- Are trends in agriculture driving an increase in the numbers of field fires?
- “More fires today due to no-till and CRP” ... anecdotally from local firefighters
- Other potential impacts: Tile drainage, crop hybrids, residue removal

Define the wildfire hazard for communities not traditionally considered “WUI”
- Are potential wildfire hazards overlooked simply because they are so diffuse?
- Or because of a lack of understanding of modern agriculture?

Improve firefighter safety on wildland fires in areas without a perceived “wildfire problem”
- Personal observations, known incidents and anecdotal discussion of unsafe practices; complacency and lack of training/experience
- Time to bring local fire service on board with current wildland practices?
- 30 county area
- 13,057 square miles
- Northwest 1/3 of state
- Fairly uniform topography of rolling plains
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Grain Crops</td>
<td>62.9%</td>
<td>68.2%</td>
<td>+ 695 sq mi</td>
</tr>
<tr>
<td>Hayland</td>
<td>0.7%</td>
<td>1.7%</td>
<td>+ 130 sq mi</td>
</tr>
<tr>
<td>Developed: High &amp; Medium Intensity</td>
<td>1.2%</td>
<td>1.7%</td>
<td>+ 62 sq mi</td>
</tr>
<tr>
<td>Developed: Low-Intensity &amp; Open Areas</td>
<td>12.6%</td>
<td>9.0%</td>
<td>- 471 sq mi</td>
</tr>
<tr>
<td>Grass &amp; Pasture</td>
<td>10.5%</td>
<td>8.6%</td>
<td>- 247 sq mi</td>
</tr>
<tr>
<td>Forest</td>
<td>10.0%</td>
<td>8.5%</td>
<td>- 200 sq mi</td>
</tr>
</tbody>
</table>
Fire Incident Data

National Fire Incident Reporting System (NFIRS)

- All reports from the 30-county study area from 2003-2014 (all available years with quality data)
- All vegetative cover fires, including incidents in the following categories:
  - 140 Series: Wildland fires (grass, brush, forest)
  - 170 Series: Field fires (agricultural land)
- Total of 15,100 incidents reported by local fire departments
  - 79% wildland fires (11,932 incidents)
  - 21% field fires (3,168 incidents)
Data Issues

- Incomplete NFIRS reporting from 2000-2002
- No specific location data: location limited to county and fire department which limited geographic analysis

Quality issues:
- Fire Cause:
  - 43% of incidents reported “undetermined” heat source
- Fire Size:
  - 71% incidents reported 0.0 acres
  - 11% had no size reported at all (unknown or blank)
  - Available numbers seemed unrealistic in many cases
314 Fire Departments
(411 fire stations)

- Wildland fire is very much a local responsibility
- Very little state or federal agency presence or assistance
The “Average” Fire Year: 2003-2014

Average Vegetative Cover Fires by Month, 2003-2014 (NFIRS reporting)

The “Average” Fire Year: 2003-2014

Average Fires per Month

- Agricultural Fires
- Brush/Grass/Woods Fires

Month: Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec

Average Fires per Month: 0, 10, 20, ... 200

Year: 2003-2014
Wildland & Field Fire Trends: 2003-2014

NFIRS data show the following trends in the study area
95% confidence level

All Vegetative Cover Fires
- Increase in total annual incidents, but not statistically significant
- Significant decrease in April fires

Wildland Fires
*NFIRS 140 series: Brush, grass, and forest fires*
- No statistically significant trends in annual fire load
- Significant monthly increase in May
- Significant monthly decrease in April

Agricultural Fires
*NFIRS 170 series: Crop field fires*
- No statistically significant trends in annual or monthly fire loads

Interpretation:
- Annual fire load is increasing, possibly by about 3% per year on average (although there is annual variation)
- May and June fire loads are increasing the fastest
- *Take with a grain of salt:* Data quality is somewhat suspect and requires further assessment
Actual Fire Occurrence: 2003-2014

Total Vegetative Cover Fires by Month, 2003-2014 (NFIRS reporting)

- March 2009
- July 2012
- October 2010
Fire Density – Grass/Brush Fires (2003-2014)
Fuels Data

Land Cover Data
- Most reliable source was CropScape
- NASS farm operator surveys not consistent
- Conservation tillage acres estimated from USDA and CTIC studies

NFIRS Fuels Data
- Wildland fuels can be derived from incident type (forest, grass or brush)
- Possibly some quality issues with interpretation of fuel category
- Possibly some overlap between field fires and wildland fires, if data misinterpreted or entered incorrectly

<table>
<thead>
<tr>
<th>Fuel Factors Analyzed</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Factor</strong></td>
<td></td>
</tr>
<tr>
<td>Corn, soybean, wheat and hay acres (current &amp; preceding year)</td>
<td>USDA NASS CropScape (remote sensing) USDA NASS Operator Surveys</td>
</tr>
<tr>
<td>Conservation Reserve Program (CRP) acres</td>
<td>USDA FSA data</td>
</tr>
<tr>
<td>Conservation tillage (no-till/reduced till) acres</td>
<td>USDA and CTIC estimates, extrapolated to cover study period</td>
</tr>
<tr>
<td>General wildland fuels</td>
<td>USDA NASS CropScape NFIRS incident type (grass, brush, forest)</td>
</tr>
</tbody>
</table>
Field Fire Seasons

<table>
<thead>
<tr>
<th>Spring Field Fire Season</th>
<th>Summer Field Fire Season</th>
<th>Fall Field Fire Season</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Mar/Apr)</td>
<td>(July)</td>
<td>(Oct/Nov)</td>
</tr>
<tr>
<td>Includes April, the busiest overall month for vegetative fires</td>
<td><em>Driven by the winter wheat harvest (late July)</em></td>
<td><em>Driven by the corn and soybean harvest</em></td>
</tr>
<tr>
<td><strong>Fuels:</strong> Weathered corn residue from previous years (with some wheat)</td>
<td><strong>Fuels:</strong> Standing wheat crop and wheat residue (current year)</td>
<td><strong>Fuels:</strong> Standing corn and soybeans; corn/bean residue (current year); weathered corn residue (previous years)</td>
</tr>
<tr>
<td><strong>Ignitions:</strong> Debris burning by residents neighboring fields</td>
<td><strong>Ignitions:</strong> Equipment (harvest operations)</td>
<td><strong>Ignitions:</strong> Equipment (harvest operations)</td>
</tr>
</tbody>
</table>
Field Fires vs. Fuels

<table>
<thead>
<tr>
<th>More of this...</th>
<th>Correlates with...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter Wheat (this year)</td>
<td>Fewer fires in June</td>
</tr>
<tr>
<td></td>
<td>More fires in August</td>
</tr>
<tr>
<td>Winter Wheat (last year)</td>
<td>More fires on an annual basis</td>
</tr>
<tr>
<td></td>
<td>More fires in July</td>
</tr>
<tr>
<td>Soybeans (this year)</td>
<td>Nothing</td>
</tr>
<tr>
<td>Soybeans (last year)</td>
<td>Fewer fires on an annual basis</td>
</tr>
<tr>
<td></td>
<td>Fewer fires in August &amp; October</td>
</tr>
<tr>
<td>Corn (this year)</td>
<td>Fewer fires in August and November</td>
</tr>
<tr>
<td>Corn (last year)</td>
<td>Fewer fires in April and July</td>
</tr>
</tbody>
</table>

Soybean harvest, Champaign County OH (Sept. 2015)
Conservation tillage (no-till, etc.) accounted for 67% of all farmed land in study area in 2014.
Conventional Tillage = No Fuel Remaining
Conservation Tillage = Plenty of Fuel
## Estimated Dead Fine Fuel Loading for No-Till Fields (tons/acre)

<table>
<thead>
<tr>
<th>Field Fire Season</th>
<th>Corn</th>
<th>Soybeans</th>
<th>Wheat</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring</td>
<td>1.4 – 4.6 tons/ac</td>
<td>0.4 – 1.1 tons/ac</td>
<td>1.1 – 2.0 tons/ac</td>
<td>0.4 – 4.6 tons/ac</td>
</tr>
<tr>
<td>Summer - Standing</td>
<td>N/A</td>
<td>N/A</td>
<td>3.6 – 4.5 tons/ac</td>
<td>3.6 – 4.5 tons/ac</td>
</tr>
<tr>
<td>Summer - Residue</td>
<td>N/A</td>
<td>N/A</td>
<td>1.3 – 2.1 tons/ac</td>
<td>1.3 – 2.1 tons/ac</td>
</tr>
<tr>
<td>Fall - Standing</td>
<td>4.8 – 10.1 tons/ac</td>
<td>1.9 – 3.0 tons/ac</td>
<td>N/A</td>
<td>1.9 – 10.1 tons/ac</td>
</tr>
<tr>
<td>Fall - Residue</td>
<td>1.8 – 4.8 tons/ac</td>
<td>0.6 – 1.3 tons/ac</td>
<td>1.3 – 2.1 tons/ac</td>
<td>0.6 – 4.8 tons/ac</td>
</tr>
</tbody>
</table>

## Recommended Fuel Models (Rothermel, 1983 – GTR INT-143)

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Fuel Model</th>
<th>Fuel loading (1-hr fuels)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residue (“stubble”)</td>
<td>FM 1 Short Grass</td>
<td>0.74 tons/acre</td>
</tr>
<tr>
<td>Standing grain crops</td>
<td>FM 3 Tall Grass</td>
<td>3.00 tons/acre</td>
</tr>
</tbody>
</table>
Conservation Tillage

*Identified anecdotally as a source of new wildfires*

- No statistical correlation between conservation tillage acres and field fire activity *during the study period* (2003-2014)
- Most rapid increase in adoption in 1990s, rate of increase steady but less dramatic in 2000s
- Changes to fire load prior to 2003 may have been missed due to lack of NFIRS data
- We are likely operating in the “new normal”

**Fraction of Farmed Land in Western Lake Erie Basin in Conservation Tillage, 1989-2014**

*(USDA & Conservation Tillage Information Center)*
Consolidation of Farming Operations

Total farmed acres by farm size class in NW Ohio, 1997-2012
(USDA Census of Agriculture)

Larger continuous fields with fewer fuel breaks
Conservation Reserve Program (CRP)

Identified anecdotally as a source of new wildfires

Active CRP Enrollments (1000 acres)

200,000 ac = 2.4% of study area
Conservation Reserve Program (CRP)

Identified anecdotally as a source of new wildfires

- No statistical correlation between CRP acres and fire activity *during the study period* (2003-2014)
- CRP acres have been relatively stable during this period; increases prior to 2003 may have been missed due to lack of NFIRS data
- We are likely operating in the “new normal”
**Improved Corn Hybrid Varieties**

- Modern corn hybrids produce more grain, but also have stronger stalks to resist wind damage.
- Tougher stalk materials degrade less over winter, especially when part of a reduced-till system.
- More fuel in spring, and more carry-over of fuel from year to year.

Residual corn stalks from two years prior.
Cover Crops

- Sowing of cover crops post-harvest is a growing trend
  - Add nutrients to soil, retain existing nutrients, improve soil health, etc.
  - Designed to die over winter or killed by spring herbicide application
- Creates additional spring fuel loads; diversity of cover crops and lack of data make true impact difficult to estimate
Removal of Crop Residues

- Baling and removal of corn and wheat residues
- Used for fodder and ethanol feedstock
- May remove up to 40% of residue post-harvest
- Obviously reduces fuel load, but magnitude is not understood (acres or rate removed)
Tile Drainage

- Subsurface drainage lines to remove excess soil moisture
  - Allows earlier field work by drying soil in spring
  - Could extend spring fire season; fuels dry earlier
- Practice is widespread in NW Ohio: More than 50% of cropland in most counties (USDA estimate, but true extent is unknown)
Wildland Fires by Fuel Type, 2003-2014 (NFIRS 140 series)

- Fuel category derived from incident type
- Fires predominantly occur in light fuels (grass and brush)
- Forest fires are very minimal
Daily Weather Observations

- Obtained daily weather observations from six National Weather Service reporting stations
- Developed weighted average of stations based on Thiessen polygon coverage of study area
Weather is the Key

No Surprises Here...

- Daily fire load very strongly correlated with minimum daily relative humidity ... more so than any other factor
- Makes sense given preponderance of fine fuels

### Daily Weather Factors Analyzed

<table>
<thead>
<tr>
<th>Factor</th>
<th>Correlated with...</th>
<th>Fire Behavior Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Relative Humidity</td>
<td>More fires</td>
<td>Fuel moisture Probability of ignition</td>
</tr>
<tr>
<td>(daily min value)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Higher Temperature</td>
<td>More fires</td>
<td>Fuel moisture Probability of ignition</td>
</tr>
<tr>
<td>(daily max value)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased Visibility</td>
<td>More fires</td>
<td>Atmospheric stability Fire growth</td>
</tr>
<tr>
<td>(daily min value)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased Cloud Cover</td>
<td>Fewer Fires</td>
<td>Atmospheric stability Fire growth</td>
</tr>
<tr>
<td>(daily max value)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased Wind Speed</td>
<td>No correlation</td>
<td>Atmospheric stability Fire growth</td>
</tr>
<tr>
<td>(daily max value)</td>
<td>(fire size data suspect)</td>
<td></td>
</tr>
</tbody>
</table>

Additional finding: Daily **maximum** relative humidity decreased over time; potentially less opportunity for fuel moisture recovery overnight leading to earlier start for daily burning periods
Ignitions Data

Drawn entirely from NFIRS fire reports submitted by departments

Ignitions Trends Observed

- “Hot/smoldering object” and “open flame/smoldering” object were dominant heat sources all year
- Small spike in “explosives/fireworks” associated with July 4th
- Distinctive trends in “operating equipment” ignitions associated with farming activities
- Lightning (“natural causes”) not a major cause
- About 40% of fire reports were “undetermined”
All Vegetative Cover Fires by Heat Source (excluding “undetermined”), 2003-2013

- Operating Equipment
- Natural Source
- Explosives or Fireworks
- Spread from Another Fire
- Hot or Smoldering Object
- Open Flame or Smoking
Wildland Fire Ignitions by Heat Source (excluding “undetermined”), 2003-2013

Average Fires per Month

- Operating Equipment
- Natural Source
- Explosives or Fireworks
- Spread from Another Fire
- Hot or Smoldering Object
- Open Flame or Smoking
Soybean harvest
(Logan County, Ohio 2014)
Typical Residential Development

- Farm operator sells off strip of home sites along road
- Large yards generally protect actual homes
  - Distance from farm operations: Machinery, dust, chemicals, manure, etc.
  - Defensible space is coincidentally created
- Outbuildings are primary direct flame exposure for field fires
  - Also fences, propane tanks, vehicles, etc.
  - Propensity for firebrands not known
Home construction on small lot in crop field

(Logan County, Ohio 2015)
Farm outbuilding with crop field exposure
(Madison County, Ohio 2015)
Outbuilding & propane tank with crop field exposure

(Logan County, Ohio 2014)
Oil storage tank surrounded by crop field

(Hardin County, Ohio 2015)
Other Exposures

- Mobile farm equipment
  - Combines, grain buggies, trucks, etc.
- Loss of standing crops

Corn harvest operations (Logan County, Ohio; November 2015)
Other Exposures

- Damage to conservation tillage systems
  - Removal of crop residue
  - Soil compaction due to firefighting operations

Ruts from brush truck after March field fire
(Logan County, Ohio; March 2015)
"Official" WUI Areas
USDA Forest Service, 2010

Area:
- 159 square miles
  1.22% of study area

Population:
- 45,719
  2.2% of study area
  6.4% of rural population
Problems with the USFS WUI Study

Focus on Forests
- Oak savanna areas around Toledo are fire-adapted, but...
- Western Ohio forests are mostly residual beech-maple stands with long fire-return intervals (1000+ years)

Dismissal of “Cultivated Land”
- Fire occurrence may be low compared to “traditional” wildland, but significant periods of fire potential exist each year
**SITUATIONAL AWARENESS**

Recommendations to Improve Firefighter Situational Awareness

- Educate firefighters regarding the fire threat
- Increase awareness and understanding of fire weather forecast and warning products
- Tailor available NWS products to fire trends as shown in NFIRS reporting
FIRE DANGER -- Midewin Winter/Spring

Maximum, Average, and 90th Percentile, based on 11 years data

Fire Danger Area:
- Midewin
- ILZ2022
- Midewin Tallgrass
  * Meets NWCG Wx Station Standards

Fire Danger Interpretation:
- **EXTREME** -- Use extreme caution
- **Caution** -- Watch for change
- **Moderate** -- Lower Potential, but always be aware

Maximum -- Highest Burning Index by day for 2002 - 2013
Average -- shows peak fire season over 11 years (687 observations)
90th Percentile -- Only 10% of the 687 days from 2002 - 2013 had an Burning Index above 47

Local Thresholds - Watch out: Combinations of any of these factors can greatly increase fire behavior:
- 20' Wind Speed over 15 mph, RH less than 25%,
- Temperature over 75, 1-Hour Fuel Moisture less than 6

Years to Remember: 2005 2012

BARN FIRE
SOUTH ARSENAL FIRE
LORENZO FIRE

Fuel Model: L - Western Perennial Grasses

Remember what Fire Danger tells you:
- Burning Index gives day-to-day fluctuations calculated from 2 pm temperature, humidity, wind, daily temperature & rh ranges, and precip duration.
- Wind is part of BI calculation.
- Watch local conditions and variations across the landscape -- Fuel, Weather, Topography.
- Listen to weather forecasts -- especially WIND.

Past Experience:
- 20ft winds greater than 15mph, RH less than 25% can lead to rapid fire growth in grass fuel types.
- Moderate to Severe Drought.
- Dry winters and low herbaceous fuel moistures.

Responsible Agency: USFS - J. Martina
Design by NWCG Fire Danger Working Team
In an average year there are 1,258 wildfires in NW Ohio.

**Wildfire Activity – Northwest Ohio**

**NW Ohio Wildland Fire Conditions**
- Fires occur mostly in fine fuels: Grass, brush & crop fields
- Low relative humidity (<35%) is most reliable predictor of high fire activity
- What key weather factors tell you:
  - **Low Relative Humidity (RH):** Drier fuels, easier ignitions
  - **High Wind Speed:** Rapid fire spread

**Monthly Wildfire Activity Interpretation**

- **Very High:** Activity well above average (APR)
- **High:** Above average activity (MAR, JUL, OCT, NOV)
- **Moderate:** Average activity (MAY, JUN, AUG, SEP)
- **Low:** Below average activity (JAN, FEB, DEC)

**Years to Remember**
In an average year there are 1,258 wildfires in NW Ohio.

**Red Flag Conditions**
- Expect fires to start easily, spread rapidly, and be difficult to control
- **Relative Humidity** 25% or less
- **Wind Speed** 15 mph or more

**Be alert any time forecast Relative Humidity is 35% or less**

**Common Denominators on Tragedy Wildfires**

- **Fatalities & Near-Misses**
  - On relatively small fires
  - In relatively light fuels: Grass and light brush
  - Unexpected shift in wind direction and/or speed

**These conditions are common on wildland fires in NW Ohio**

**How to Fight Fire Aggressively, Providing for Safety First**
- Use class A foam on all wildland and field fires
- Use full wildland PPE – not bunker gear – to avoid heat stress
- Always attack from the burned area (“Attack from the Black”)
- All firefighters in secure position during mobile attack

**Red Flag Conditions Chart**

<table>
<thead>
<tr>
<th>Conditions</th>
<th>RH</th>
<th>Wind (mph)</th>
<th>Rate of Spread (ft/min)</th>
<th>Flame Length (ft)</th>
<th>Fire Size (acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6 min</td>
</tr>
<tr>
<td>Moderate</td>
<td>45%</td>
<td>5</td>
<td>81</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>High</td>
<td>35%</td>
<td>10</td>
<td>270</td>
<td>7.5</td>
<td>19</td>
</tr>
<tr>
<td>Red Flag</td>
<td>25%</td>
<td>15</td>
<td>327</td>
<td>8</td>
<td>23</td>
</tr>
</tbody>
</table>

**National Weather Service Fire Weather Forecast Offices**
- General Fire Weather: www.srh.noaa.gov/ridge2/fire
- NWS North Webster, IN (IWX) www.weather.gov/iwx/fireweather
- NWS Cleveland, OH (CLE) www.weather.gov/cle/fireweather
- NWS Wilmington, OH (ILN) www.weather.gov/iln/fireweather
RECOMMENDATIONS: RESPONSE PLANNING & PREPAREDNESS

Training:
- Tailor entry and refresher training to the wildland fire environment in which the firefighter will operate
- Develop training specific to operations in fine fuels (standard NWCG curriculum is not appropriate for all situations)

Mutual Aid:
- Thin resources and staffing issues make mutual aid a necessity
- Improve mutual aid systems and pre-incident planning to ensure adequate response

Resources:
- Increase staffing during periods of predicted fire danger at career departments
- Consider paying volunteers to staff brush units during high fire danger periods
- Consider staging staffed brush units at shared locations during high fire danger periods
RECOMMENDATIONS: RESPONSE EFFECTIVENESS & SAFETY

Tactics:
- There is rarely a life safety issue on wildland fires; firefighters can create one through improperly aggressive tactics
- Promote safer and more effective wildland techniques (“Attack from the Black”)

Foam:
- Promote universal use of Class A foam to enhance effectiveness of limited wildland units and water supply (reduce scene time and prevent rekindles)

Personal Protective Equipment:
- Ensure appropriate wildland PPE is available; avoid using structural PPE
- Standard “yellows & greens” are usually not appropriate for volunteer departments; promote use of “turnout” style PPE (overgarments); maintain NFPA 1977 compliance
- Educate firefighters on proper wear and importance of its use; require in SOPs
CASE STUDY: BELLEFONTAINE FIRE & EMS (LOGAN COUNTY, OHIO)

Provider of fire and EMS services for the City of Bellefontaine and two rural townships

- Total protected population: 15,668 (2,232 in rural areas)
- Total protected area: 40.8 square miles
- Only career department in county
  11 x vol. fire dept. & 3 x EMS-only providers

2014 Call Volume: 2,473 total runs (6.8/day)

- 77% EMS; 23% fire and other
- 7% of runs are providing mutual aid

Apparatus:

- 1 x Aerial Ladder (L-21)
- 2 x Engine (Type 1) (E-21/22)
- 1 x Engine (Type 6) (G-21)
- 1 x Water Tender (Type S-3) (T-21)
- 3 x Ambulance (M-21/22/23)

Staffing:

- 1 x Department Chief (full time)
- 3 x Asst. Chief (Shift Supervisor) (full time)
- 14 x Firefighter/Paramedic (full time)
- 5 x Auxiliary FF/EMT (volunteer)
  Typical shift: 1 x AC + 4-5 FF (24/48)

Average Wildland Fire Load

- Bellefontaine: 6.3 / yr
- Logan County: 48.5 / yr

Bellefontaine FD Grass Rig (G-21)
Mutual Aid Study

Mutual Aid Partners:
- 20 Fire Departments within 15 miles; mostly volunteer staffing
- 23 x Brush Trucks (Type 6 Engines... more or less)

Response Time Modeling:
- Actual road travel time (minutes, using ArcGIS Network Analyst)
- Travel delays due to intersections, railroad crossings, etc.
- Average response time delays based on 9-1-1 dispatch records

Results:
- Table of response times for each brush unit vs. center or each wildland fuel block
- Ranked list of first 10 arriving units for each potential fire site
**Fire Response Study: Weather & Fire Environment**

- **Initial Attack Modeling:**
  - Using response time estimates, NFIRS fire reports, and NWS weather data
  - Ran BehavePlus simulations of most dangerous and most likely fire situations

- **“Most Dangerous” Scenarios:**
  Weather and fire environment conditions occurring on each of:
  - **W1:** Most active day for fire activity in NW Ohio (3/24/2009; 82 fires)
  - **W10:** Average of 10 most active days
  - **W100:** Average of 100 most active days

- **“Most Likely” Scenarios:**
  Average conditions prevailing in the three most active fire months in NW Ohio: April, July and November

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Mean No. Fires / day</th>
<th>Max. Temp.</th>
<th>Min. Relative Humidity</th>
<th>Max. 20-ft Wind Speed</th>
<th>Fine Dead Fuel Moisture</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>82</td>
<td>63 F</td>
<td>20%</td>
<td>19 mph</td>
<td>5%</td>
</tr>
<tr>
<td>W10</td>
<td>64.2</td>
<td>67 F</td>
<td>29%</td>
<td>22 mph</td>
<td>6%</td>
</tr>
<tr>
<td>W100</td>
<td>33.1</td>
<td>70 F</td>
<td>30%</td>
<td>18 mph</td>
<td>6%</td>
</tr>
<tr>
<td>April</td>
<td>10.1</td>
<td>62 F</td>
<td>44%</td>
<td>19 mph</td>
<td>7%</td>
</tr>
<tr>
<td>July</td>
<td>5.4</td>
<td>84 F</td>
<td>48%</td>
<td>14 mph</td>
<td>7%</td>
</tr>
<tr>
<td>November</td>
<td>6.0</td>
<td>50 F</td>
<td>55%</td>
<td>16 mph</td>
<td>10%</td>
</tr>
</tbody>
</table>

**Standard conditions for all simulations:**
- Fuel Model 1 (Short Grass) with 0% slope and no shading
- Fire reported at 0.1 hours from ignition
- Line production rate of 30 ch/hr using mobile direct (head) attack (based on 1989 Fried and Gilless study for CalFire)
Fire Response Study: Resource Scenarios

- **Resource Scenarios:**
  All fire environment scenarios run against the following resource scenarios:
  - **Current:** Existing situation
  - **BFD-Plus:** Add one brush unit to BFD
  - **VFD-Plus:** Add full-time staffing to three volunteer mutual aid departments
  - **Max-Plus:** Both enhancements

- All times based on average response times throughout BFD coverage area
Results:
- No successful containment for any resource configuration against W1, W10, W100 or April average conditions ("Escaped" fire in BehavePlus)
- Fire had "escaped" at 0.4 hrs (24 minutes) from time of report, with 5 or 6 engines on scene

Interpretation:
- Having a fire truly "escape" in NW Ohio is unlikely given fragmented landscape
- Failure to achieve containment indicates that offensive actions have no real effect on outcome
- When conditions indicate containment is unlikely, focus on defensive action

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Rate of Spread (ch/hr)</th>
<th>Flame Length (ft)</th>
<th>Size at Report (ac)</th>
<th>Size at Initial Attack (ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>188.1</td>
<td>6.4</td>
<td>11.0</td>
<td>43.9</td>
</tr>
<tr>
<td>W10</td>
<td>239.6</td>
<td>7.1</td>
<td>16.0</td>
<td>63.9</td>
</tr>
<tr>
<td>W100</td>
<td>159.5</td>
<td>5.9</td>
<td>8.2</td>
<td>32.8</td>
</tr>
<tr>
<td>April</td>
<td>167.7</td>
<td>5.9</td>
<td>8.7</td>
<td>34.9</td>
</tr>
</tbody>
</table>

IC should not put firefighters at risk with offensive attack strategy when outcome is unlikely to be influenced
**Fire Response Study: Contained Fire Scenarios**

- **Results:**
  - Containment achieved under all scenarios for July and November average conditions.

- **July Simulations**
  - Containment at 120-146 acres at 0.8 to 1.1 hours (48-66 minutes).
  - A minimum of 6 engines required to achieve containment.

- **November Simulations**
  - Fires contained at 23-39 acres at 0.6 to 0.8 hours (36-48 minutes).
  - A minimum of 5 engines required to achieve containment.

- **Interpretation:**
  - Under less severe conditions, fire size may be limited by use of offensive tactics.
  - Average weather conditions for each month were used, actual tactics must be based on conditions prevailing at the time of the fire (regardless of month).

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Rate of Spread (ch/hr)</th>
<th>Flame Length (ft)</th>
<th>Size at Report (ac)</th>
<th>Size at Initial Attack (ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>July</td>
<td>90.9</td>
<td>4.5</td>
<td>3.2</td>
<td>12.7</td>
</tr>
<tr>
<td>November</td>
<td>64.8</td>
<td>3.2</td>
<td>1.5</td>
<td>6.1</td>
</tr>
</tbody>
</table>

*IC should recognize when fire weather conditions will allow for successful offensive interventions.*
Prevention & Mitigation

Expand Prevention & Mitigation Efforts

- Improve quality of incident reporting for wildland fires; better data = better analysis
- Tailor prevention efforts to observable trends in fire data and predicted fire weather
- Promote adoption of FireWise Community concepts

**Example:** Integrated program of prevention, mitigation and preparedness (following slide)
### Northwest Ohio Wildland Fire Preparedness Matrix (Brush, Grass, Woods and Field Fires)

<table>
<thead>
<tr>
<th>Season</th>
<th>Threat</th>
<th>Prevent &amp; Mitigate</th>
<th>Prepare</th>
<th>Respond</th>
</tr>
</thead>
<tbody>
<tr>
<td>WINTER</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>December</td>
<td>Minimal fire load&lt;br&gt;Less active fire behavior</td>
<td>▪ Educate: Continual messaging on debris burning in preparation for spring&lt;br&gt;▪ Mitigate: Promote FireWise and NFPA 1141 measures for rural residents and subdivisions&lt;br&gt;▪ Mitigate: Identify and pre-plan areas at greatest risk for wildfire</td>
<td>▪ Schedule heavy maintenance of brush units for this period&lt;br&gt;▪ Schedule annual wildfire refresher training in preparation for spring&lt;br&gt;▪ Make purchases of tools, PPE, foam, etc.&lt;br&gt;▪ Update mutual aid agreements and response plans as needed</td>
<td>▪ Less active fire behavior may allow for more aggressive tactics</td>
</tr>
<tr>
<td>January</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>February</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPRING</td>
<td>Peak season for brush, grass and field fires&lt;br&gt;Large fire load, especially during April&lt;br&gt;Fires start easily, spread rapidly, and are difficult to contain</td>
<td>▪ Educate: Focus on debris/trash burning by rural residents&lt;br&gt;▪ Enforce: Target illegal outdoor burning</td>
<td>▪ Monitor fire weather forecasts daily and keep crews informed&lt;br&gt;▪ Consider augmented staffing of brush units&lt;br&gt;▪ Expand resources: Consider outfitting utility vehicles as brush trucks with skid units&lt;br&gt;▪ Participate in prescribed burning with natural resources agencies to increase wildfire experience</td>
<td>▪ Expect very dangerous fire behavior and fast-moving fires&lt;br&gt;▪ Offensive attack may be ineffective on many days&lt;br&gt;▪ Focus on defensive tactics: Protect exposures and do not unnecessarily put firefighters at risk</td>
</tr>
<tr>
<td>March</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>April</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>May</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUMMER</td>
<td>Brush fires continue, but fire load is lower due to seasonal vegetation green-up&lt;br&gt;Field fires pick up in late July due to wheat harvest&lt;br&gt;Fire behavior generally less intense, but extended dry periods can intensify severity</td>
<td>▪ Educate: Focus on farm workers in advance of wheat harvest&lt;br&gt;▪ Educate/Enforce: Focus on fireworks around July 4th; target illegal fireworks for enforcement&lt;br&gt;▪ Mitigate: Train farm workers in appropriate action and incipient fire control for field/combine fires</td>
<td>▪ Monitor fire weather forecasts daily when dry conditions prevail and during the wheat harvest&lt;br&gt;▪ Consider increased brush unit staffing during periods when higher fire activity is likely</td>
<td>▪ Less active fire behavior may allow for more aggressive tactics&lt;br&gt;▪ Be alert for periods of higher fire danger when a switch to defensive tactics may be wise</td>
</tr>
<tr>
<td>June</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>July</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>August</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FALL</td>
<td>Brush fire activity picks up as vegetation cures, especially after first hard frost&lt;br&gt;Field fire activity escalates due to soybean and corn harvest&lt;br&gt;Fire behavior generally less intense, but periods of warm, dry weather can increase severity</td>
<td>▪ Educate: Focus on farm workers in advance of corn/soybean harvest&lt;br&gt;▪ Mitigate: Train farm workers in appropriate action and incipient fire control for field/combine fires</td>
<td>▪ Monitor fire weather forecasts daily when dry conditions prevail and during the wheat harvest&lt;br&gt;▪ Consider increased brush unit staffing during periods when higher fire activity is likely&lt;br&gt;▪ Participate in prescribed burning with natural resources agencies to increase wildfire experience</td>
<td>▪ Less active fire behavior may allow for more aggressive tactics&lt;br&gt;▪ Be alert for periods of higher fire danger when a switch to defensive tactics may be wise</td>
</tr>
<tr>
<td>September</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>October</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>November</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
THANKS FOR ATTENDING!