Quantifying surface disturbances related to oil production in West Florida, USA

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Introduction

• Oil history in Florida
  – 1901: first wells near Pensacola (West Florida)
  – 1910-1939: 87 wells West and Southwest Florida
  – 1939: state offered $50,000 for 1st oil discovery
  – 1943: Humble Oil strikes oil (Collier county)
  – 1945: regulation in FL (drilling and production)
  – 1947: taxing oil and gas
  – 1948: 650,000 barrels
  – 1970: Jay field discovery (Santa Rosa/Escambia)- FL’s largest
  – 1979:
    • FL oil production peaks (48 m barrels)- ranked 8th nationally
    • Jay production peaks (36 m barrels ~99k b/d)
  – 1980: Blackjack Creek production peaks (6 m barrels ~17k b/d)
  – 1988: McClellan production peaks (64 k barrels)
  – 2014: Florida ranks 23 and 24 in gas and oil production- BUT substantial offshore deposits in eastern Gulf of Mexico
Introduction cont.

• Jay field: 46.05 km² (Santa Rosa & Escambia)
• 1 billion barrels (original estimate; about half has been produced)
• Proved reserves: 10-15 million barrels
• Production:
  – 1979: 100,000 b/d FL
  – 2013:
    • 6,300 b/d FL
    • 3,673 b/d Jay (90% oil, 10% natural gas liquids).
• Jay = 62% of FL production
• Florida GDP
  – Real estate = 17%
  – Leisure & hospitality (tourism) = 6-13%
  – Natural resource & mining = 1%
**Context:** HSE, E&P, Geospatial and Sustainability

- Question: Do E&P activities necessarily lead to large-scale landscape disturbances— and how do we manage this?
  - WHO: HSE- Reducing environmental alterations related to E&P
  - HOW: Geospatial- data and methods: “accounting from above”- mapping and monitoring
  - WHERE: Upstream E&P
  - WHY: Develop environmental performance standards- sustainability (E&P +)
  - WHY ELSE?
Context cont.

1. Conservationist View:
   Oil and gas E&P create permanent landscape disturbances that lead to large-scale land-use and land-cover change.

2. Industry Challenges:
   Environmental (risk) management practices (SPE):
   - Reducing surface footprint
   - Provide relevant, reliable and comparable (investor) information.
   - Sustainability reporting.
Objective:

Determine environmental performance/sustainability of oil and gas operations in West Florida.

A. Quantify and map landscape disturbances based on infrastructure features.
B. Identify leading cause of landscape change.
C. Rank env performance/sust.
D. Report findings (sust reporting).
Study Area: West Florida, Santa Rosa County

- Santa Rosa Oil Fields: 175 (53%)
- Santa Rosa County Wells: 333
Approach (Data & Methods)

• Surface footprint accounting
  – Geospatial (Earth observation and GIS) and landscape ecology techniques.
  – Measure and map surface disturbances related to visible infrastructure features: “accounting from above” (Mathieu, 2010).
Data

• 1949, 1965 and 1973 historical B&W air photos (georectified)
• 2004 and 2007 orthoquad air photos (LABINS)
• 2013, 2014 satellite imagery (ESRI)
• Florida roads (FGDL, FDOT)
• Florida counties (FGDL)
• Land-use Land-cover (Santa Rosa; NASS)
• Santa Rosa county 6 oilfields- georectified and digitized from Lloyd (1991)
• Oil wells (FGS)
Methods cont.

• Identifying all infrastructure features: datasets, editing and digitizing.

• Assign size (weight)/ standards:
  – US Bureau of Land Management (BLM) E&P disturbance measures
  – DOT
  – Canad Stand Assoc (CSA)
  – European Env Agency
  – PHMSA
  – Roads/Infra/E&P lit
Measurements (Landscape and Road Ecology)

1. Wells
2. Well density (# wells/oilfield km²)
3. Infrastructure length (km)
4. Infrastructure density (km/km²)
5. Direct effects
   - Infrastructure: oil roads, wells, CPFs, non-oil roads
6. Indirect (Edge) effects
   - Infrastructure: oil roads, wells, CPFs, non-oil roads
7. Core Areas
8. Land-use land-cover
Historical Landscape
Historical Landscape
Findings

Oil wells and well density

• Florida = 1,388 wells
• Santa Rosa = 333 wells
  – 24% of Florida’s oil wells = Santa Rosa (#1 county)
  – 53% of Santa Rosa oil wells = 6 oilfields
    • 91% = Jay oilfield
  – 38% are wildcat wells
Infrastructure: oil and non oil

- Santa Rosa Oil Fields
  - Oil Roads = 85.44 km
  - Non Oil Roads = 166.66 km
Infrastructure: oil and non oil

- Road density: 0.1 in remote regions to 40.0 in urban areas.
Land Use

- Santa Rosa Oil Field Wells = 175 (53%)
- Santa Rosa County Wells = 333

- Santa Rosa Oil Fields
- Santa Rosa County, FL

NASS LULC 2012

- Agriculture = 11.45%
- Barren = 0.42%
- Forest = 53.60%
- Shrubland Grasslands = 8.40%
- Urban = 11.63%
- Water = 0.76%
- Wetlands = 13.63%
- No Data = 0.12%
Land Use

NASS LULC 2012

- Agriculture = 34.60%
- Barren = 0.47%
- Forest = 32.78%
- Shrubland Grasslands = 7.65%
- Urban = 7.35%
- Water = 0.52%
- Wetlands = 16.63%

Santa Rosa Oil Fields
Core Areas

Mt Carmel Core Areas = 0.43 km² (35.22%)

Coldwater Creek Core Areas = 1.48 km² (64.64%)

Jay Core Areas = 20.71 km² (44.98%)
Blackjack Creek Core Areas = 11.54 km² (61.80%)
Core Areas

McClellan Core Areas = 1.78 km² (85.88%)

Sweetwater Creek Core Areas = 1.23 km² (84.84%)
## Environmental Performance

<table>
<thead>
<tr>
<th>OILFIELD</th>
<th>RANK</th>
</tr>
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<tbody>
<tr>
<td>Coldwater Creek</td>
<td>1</td>
</tr>
<tr>
<td>Sweetwater Creek</td>
<td>2</td>
</tr>
<tr>
<td>McClellan</td>
<td>3</td>
</tr>
<tr>
<td>Mt Carmel</td>
<td>4</td>
</tr>
<tr>
<td>Blackjack Creek</td>
<td>5</td>
</tr>
<tr>
<td>Jay</td>
<td>6</td>
</tr>
</tbody>
</table>
Conclusion/Discussion

• Agriculture: main driver of landscape change.
• Oil activities contributed a small amount of disturbance in each oil field- 10% max.
• Core areas range from 35 – 86% of oilfields.
• Based on current disturbance patterns, future E&P should create limited alterations.

• Comparison: Florida and Colorado
Future work:

• Examine oil E&P landscape disturbances in:
  – Ecuador
  – South Florida
  – Southern Alabama
  – Colorado
  – Western Argentina

• Use raster data throughout project


Questions?

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Source: http://www.hess.com/operations/shale-energy/environment