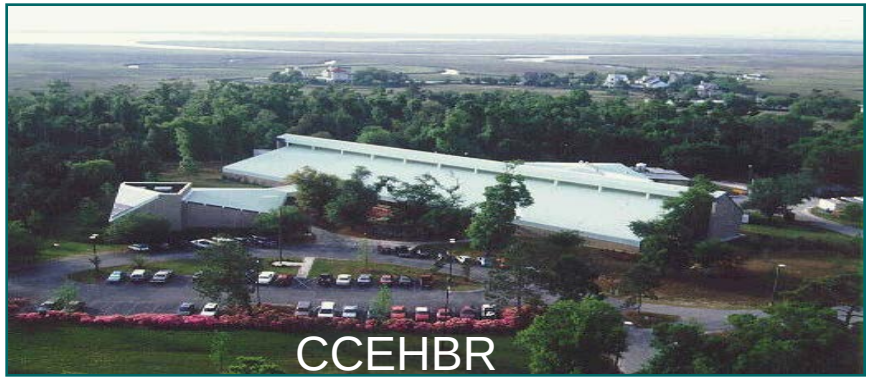
“Overview of South Atlantic Alliance, Clean Coastal Waters Team Activities: Pesticide Decision Making Tool”



Geoff Scott

NOAA/NOS National Centers for Coastal Ocean Science

Director, Center for Coastal Environmental Health and Biomolecular Research

and

Lisa C Wickcliffe and Dwayne Porter

Arnold School of Public Health

Univ. of South Carolina

SAA Clean Coastal and Ocean Waters: 2012 Activities

- **Clean Coastal and Ocean Waters Top 2 Priority Actions- November 2011**
- **CCOW 1A:** Establish a regional technical level work group for the purpose of sharing watershed water quality improvement processes.
- **CCOW 1C:** Develop recommendations on processes & protocols to transfer knowledge/implement BMPs for point & non-point source controls, & to encourage smart growth & green infrastructure (including monitoring-based performance measures).
- **POTENTIAL FOCUS – TMDLs**

SAA Clean Coastal and Ocean Waters: 2012 Activities

- **CCOW 3A: Establish a regional level monitoring workgroup to address compatibility among states.**
- **CCOW 3B: Catalog and describe existing near shore and offshore monitoring programs, designs, and data accessibility.**

SAA FY13 Activities for CCOW

- ***Snap Shot 1:*** *Clean Water Act Implementation Process Analysis: How are states implementing and are there opportunities for improved efficiencies?*
- *CCOW 1A Implementation: Step 1) Develop the ability to transfer the knowledge about modeling and process development between states to enhance the water quality improvement process; and Step 2) Identify and utilize resources for developing and implementing water quality improvement processes in shared watersheds that would lead to enhanced water quality on a large watershed scale.*
- ***Snap Shot 2:*** *Data acquisition and analysis to support understanding of climate change impacts to water quantity and water quality.*
- *CCOW 2A Implementation Step 1) Acquire contiguous datasets and catalog regionally mapped data and initiatives (i.e. LiDAR) to identify gaps on regionally contiguous datasets that may be useful in modeling climate changes impacts; Step 2) Map regional hotspots for saltwater intrusions and other high priority water quality issues; and Step 3) Use existing GIS layers to model climate change impacts on land cover for proximal watersheds of coastal waters and tributaries in the South Atlantic Region.*
- ***Snap Shot 3:*** *Support for establishment of a regional water quality monitoring workgroup to identify opportunities for standardization*.
- *CCOW3A: Establish a regional level monitoring workgroup to address compatibility among states.*

The Development of User-friendly Tools for Improved Pesticide Usage Decision-making

Lisa C. Wickliffe
Department of Environmental Health Sciences
Arnold School of Public Health
University of South Carolina

UNIVERSITY OF SOUTH CAROLINA

Sea Grant
S.C. Sea Grant Consortium

The LowCountry Institute

SECOORA
Southeast Coastal Ocean Observing Regional Association

CLEMSON EXTENSION

Governors' South Atlantic Alliance
North Carolina • South Carolina • Georgia • Florida

Why Pesticides?

- **Pesticides** – Economically justified poisons which will affect both target (pests) as well as non target (estuarine/marine and humans) species unless properly used
- ***Most toxic class of chemicals*** with some compounds exhibiting toxicity in the sub parts per trillion range (pyrethroids) versus parts per billion (Petroleum Hydrocarbons) and parts per millions (trace metals) range
- **Pesticide Decision-Making Tool -** aimed at better information for the public in urban pesticide use so that pesticide label restrictions are followed = ***Safe Use***

Major Classes of Pesticides

Pesticide usage has supported decrease in vector-borne diseases and an increase in food production. In residential scenarios, pesticides increase overall comfort by decreasing pests in and around homes, provide structural protection, etc.

- **There are 5 major classes of AI pesticides**:
- **Herbicides**: used to mitigate nuisance plant species (example: atrazine, 2,4-D)
- **Insecticides**: used to mitigate nuisance insect species (example: malathion)
- **Fungicides**: used to mitigate nuisance fungal species (example: azoxystrobin)
- **Biocides**: used to mitigate nuisance viral, bacterial, and protozoan species (example: disinfectants)
- **Rodenticides**: used to mitigate nuisance rodent species (example: warfarin)

Project Rationale: Main Issues

- Pesticides by nature bring chance of adverse effects on non-target species as they are designed to kill living organisms when exposed
- US EPA ensures pesticides do not pose unreasonable adverse risk
- Over 1 billion lbs. used annually
- Sparse (infrequent, with coarse geographic coverage) data
- Population growth and coinciding urban expansion increases the probability of residential pesticide application

"Develop and implement an easily understandable system for residential pesticide applicators so they may make more informed pesticide decisions"

EPA, 2011; EPA 2005; Gilliom et al. 2006; Aspelin & Grube 2006

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Pesticide Knowledgebase

Tool 1: Blueprint, Design, and Use of Pesticide Tool

Tool 2: Site-specific Spatial Implementation

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Pesticide Knowledgebase

•LCI's **Pesticide knowledgebase** is designed to assist residents in three South Carolina counties: Beaufort, Jasper, and Hampton. This database will be instrumental in making informed decisions about pesticide use while sustaining healthy coastal ecosystems.

•The goal of this website is to:

a) Assist residents in determining if they have a pest problem
b) Determine if a pesticide is necessary to treat the pest problem, and
c) Evaluate commonly used pesticides using EPA's toxicity values.

The information provided will aid residents in choosing pesticides that will effectively treat pests in a safe manner.

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Pesticide Knowledgebase

•Pesticides are often beneficial in producing agricultural products, protecting residential and commercial lands and ensuring public health and safety. Areas for pesticide use include farms, gardens, golf courses, yards and right of ways.

•All currently used pesticides are registered by the US EPA Office of Pesticides. This organization reviews the safety of each pesticide and provides label information for proper use in the environment. Therefore, all pesticides currently registered for use in the US are deemed safe. Safety is a relative term and there are differing degrees of safety associated with the use of each pesticide related to the complexity of the natural environment. It is critically important to understand the interactions of each pesticide with the environment to make informed choices that best protect ecosystems and public health.

Open Panel

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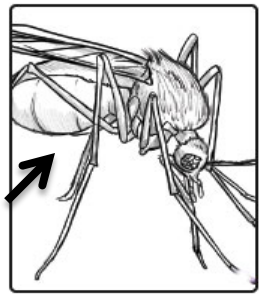
Pesticide Knowledgebase



deciding on a pesticide: a decision-making tool

to begin, select an option below



I know my pest...

I don't know my pest...

I have a pesticide – is it safe?

User 1

Open Panel

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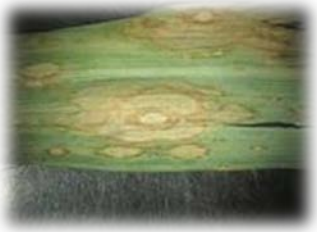
Pesticide Knowledgebase

What category does your pest fall into?

Weeds

Insect

Disease or Blight



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Pesticide Knowledgebase

Where is your insect problem?

In my yard

In my garden

In my house

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Pesticide Knowledgebase

Determining the relative degree of safety for different commonly used pesticides

Classification is based on 4 equally weighted parameters:

1) Accumulation in Food Web → Kow
2) Persistence in Environment → half-life (water or soil -which ever is longest)
3) Immediate Toxicity → acute toxicity (LC50 or LD50 – most conservative values used for all tested organisms
4) Delayed Toxicity → chronic toxicity (LC50 or LD50 – most conservative values used for all tested organisms

❖ In order to simplify the toxicological data used in determining the relative ranking process, we devised a color-coded relative ranking scheme designed to *simply rank safety for use*. Threshold values were determined for each parameter considered and for the cumulative ranking. A cumulative frequency distribution of final values for each compound in the final ranking.

NEXT

Relative Cumulative Ranking System– Data Mining

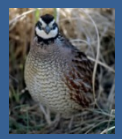
- All endpoint data were derived from EPA documents to maintain consistency with the current regulatory framework.
- Endpoints were chosen in an effort to reflect what was deemed important to the public and to take a relatively complex group of values and develop an easily-understandable ranking system that can be implemented by everyone.

Data were gathered from US EPA REDs, IREDs, and the US National Library of Medicine's Toxicology Data Network (http://toxnet.nlm.nih.gov/index.html).

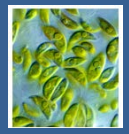
Data were used from the OCSPP (EPA) harmonized guideline assays of each AI pesticide:

- Mammals (GLN #: 870.1100 ; 870.4100) – Acute (oral)/(dietary)Chronic Rodent Studies
- Avian Species (GLN #: 850.2100 ; 850.2200) – Acute (oral)/Chronic (Dietary)
- Honey Bees (GLN #: 850.3020) – Acute Honey Bee Contact Toxicity
- Aquatic Invertebrates (GLN #: 850.1010; 850.1300) – Acute/Chronic Daphnid
- Aquatic Vertebrates (GLN #: 850.1075 ; 850.1400) – Fish Acute/Chronic (early life-stage)
- Aquatic Plants (GLN #: 850.5400) – Algae Toxicity Test







(EPA 2013)

Relative Cumulative Ranking System: Endpoint Thresholds and Normalization

I. Acute Aquatic Organism Toxicity (ppm)

(invertebrates and fish)

10 = $LC_{50} \leq 1$ (very highly to highly toxic)

5 = $LC_{50} > 1 < 10$ (moderately toxic)

1 = $LC_{50} \geq 10$ (slightly to practically non-toxic)

II. Chronic Aquatic Organism Toxicity (ppm)

10 = NOAEC ≤ 1 (very highly to highly toxic)

5 = NOAEC > 1< 10 (moderately toxic)

1 = NOAEC ≥ 10 (slightly to practically non-toxic)

III. Acute Avian Toxicity (mg/kg)

10 = $LD_{50} \leq 50$ (very highly toxic to highly toxic)

5 = $LD_{50} > 2000 < 50$ (moderately to slightly toxic)

1 = $LD_{50} \geq 2000$ (practically non-toxic)

IV. Chronic Avian Toxicity (mg/kg)

10 = NOAEL ≤ 500 (very highly toxic to highly toxic)

5 = NOAEL > 5000 < 500 (moderately to slightly toxic)

1 = NOAEL ≥ 5000 (practically non-toxic)

V. Acute Mammalian Toxicity (mg/kg)

10 = $LD_{50} \leq 50$ (very highly toxic to highly toxic)

5 = $LD_{50} > 2000 < 50$ (moderately to slightly toxic)

1 = $LD_{50} \geq 2000$ (practically non-toxic)

VI. Chronic Mammalian Toxicity (ppm)

10 = NOAEL ≤ 500 (very highly toxic to highly toxic)

5 = NOAEL > 5000 < 500 (moderately to slightly toxic)

1 = NOAEL ≥ 5000 (practically non-toxic)

VII. Acute Honey Bee Toxicity (µg/bee)

10 = $LD_{50} \leq 2$ (highly toxic)

5 = $LD_{50} > 2 < 11$ (moderately to slightly toxic)

1 = $LD_{50} \geq 11$ (practically non-toxic)

VIII. Plant Phytotoxicity (ppb)

10 = EC50 ≤ 1100 (complete control)

5 = EC50> 1100 < 10000 (complete to selective control)

1 = EC50 ≥ 10000 (practically non-toxic)

IX. Bioaccumulation Potential

10 = log $K_{ow} \geq 4$ (high bioaccumulation potential)

5 = log $K_{ow} > 2 < 4$ (moderate bioaccumulation potential)

1= log $K_{ow} \leq 2$ (low bioaccumulation potential)

X. Estimated Half Life (days)

10 = $t_{1/2} \geq 180$ (persistent)

5 = $t_{1/2} > 45 < 180$ (moderately persistent)

1 = $t_{1/2} \leq 45$ (nonpersistent to slightly persistent)

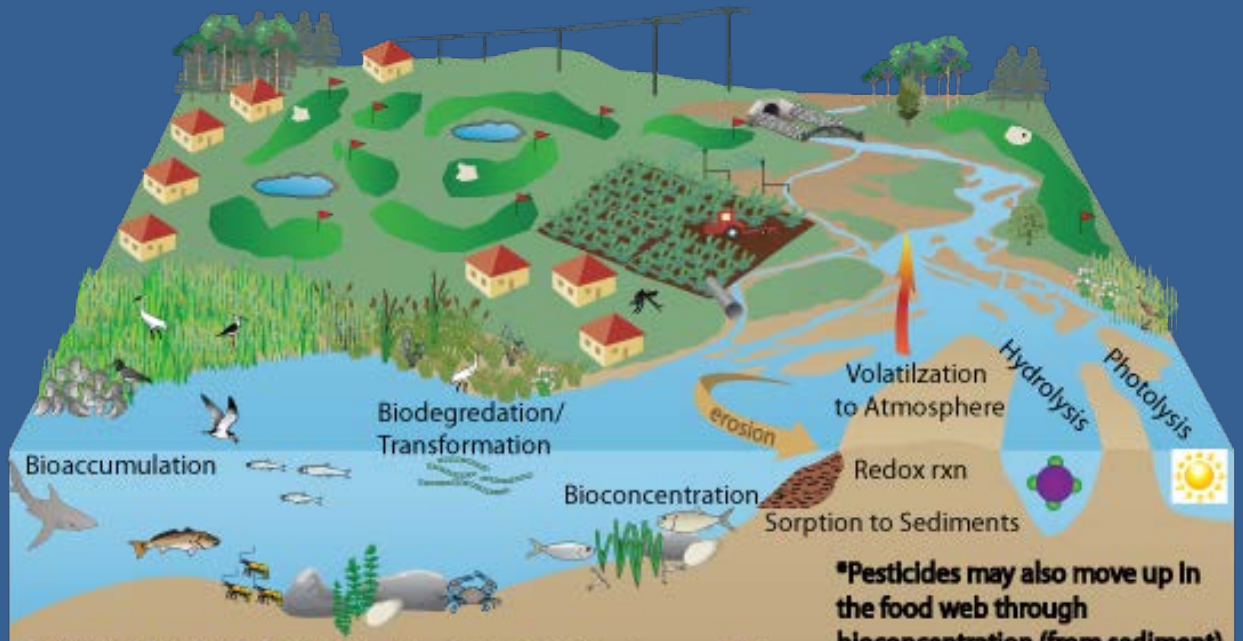
XI. Soil/Water Mobility (ml/g_{oc})

10 = $K_{oc} \leq 1000$ (highly to moderately mobile)

5 = $K_{oc} > 1000 < 10000$ (slightly mobile)

1= $K_{oc} \geq 10000$ (hardly mobile to immobile)

Relative Cumulative Ranking System: Use Categories



Potential Pesticide Sources:

Residential Areas:

Golf Courses:

Farms:

Ponds:

Right-of-Way:

Vector Control:

Pesticide Partitioning and Fates: All or a portion may go through

Photolysis = solar breakdown

Volatilzation to Atmosphere = wind, spray drift, evaporation

Biodegredation/Transformation = biological breakdown to different chemical species

Sorption (stick to) to Sediments

Hydrolysis = pesticide forms chemical bonds to water molecules

Oxidation-reduction (redox) Reactions = electrons are transferred between chemical species, changing the oxidation states

***Pesticides may also move up in the food web through bioconcentration (from sediment) or bioaccumulation (increase in toxicity moving up trophic levels)**

University of Maryland
Center for Environmental Science

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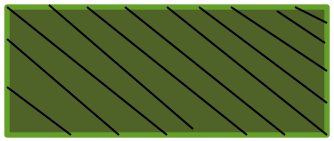
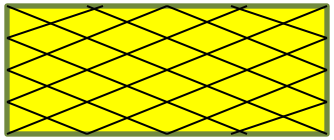
PDMT Color Code:

The color-coded scheme of final relative safety allows for easy ID for products that are safe to use in and around homes. *



Highly safe

Moderately safe

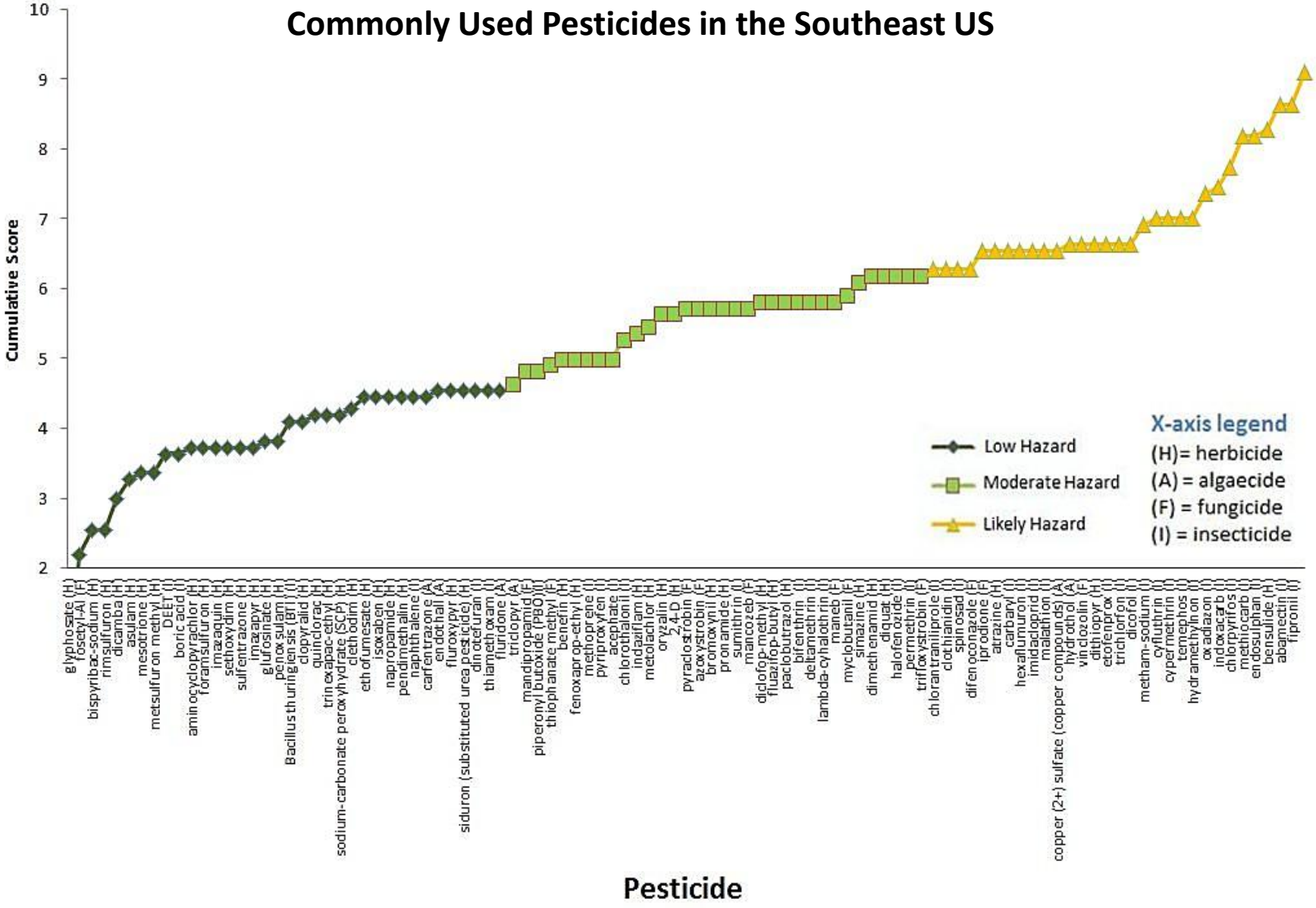


Marginally safe

* Please click here for a detailed explanation of how relative safety ratings were derived for the pesticides covered

NEXT

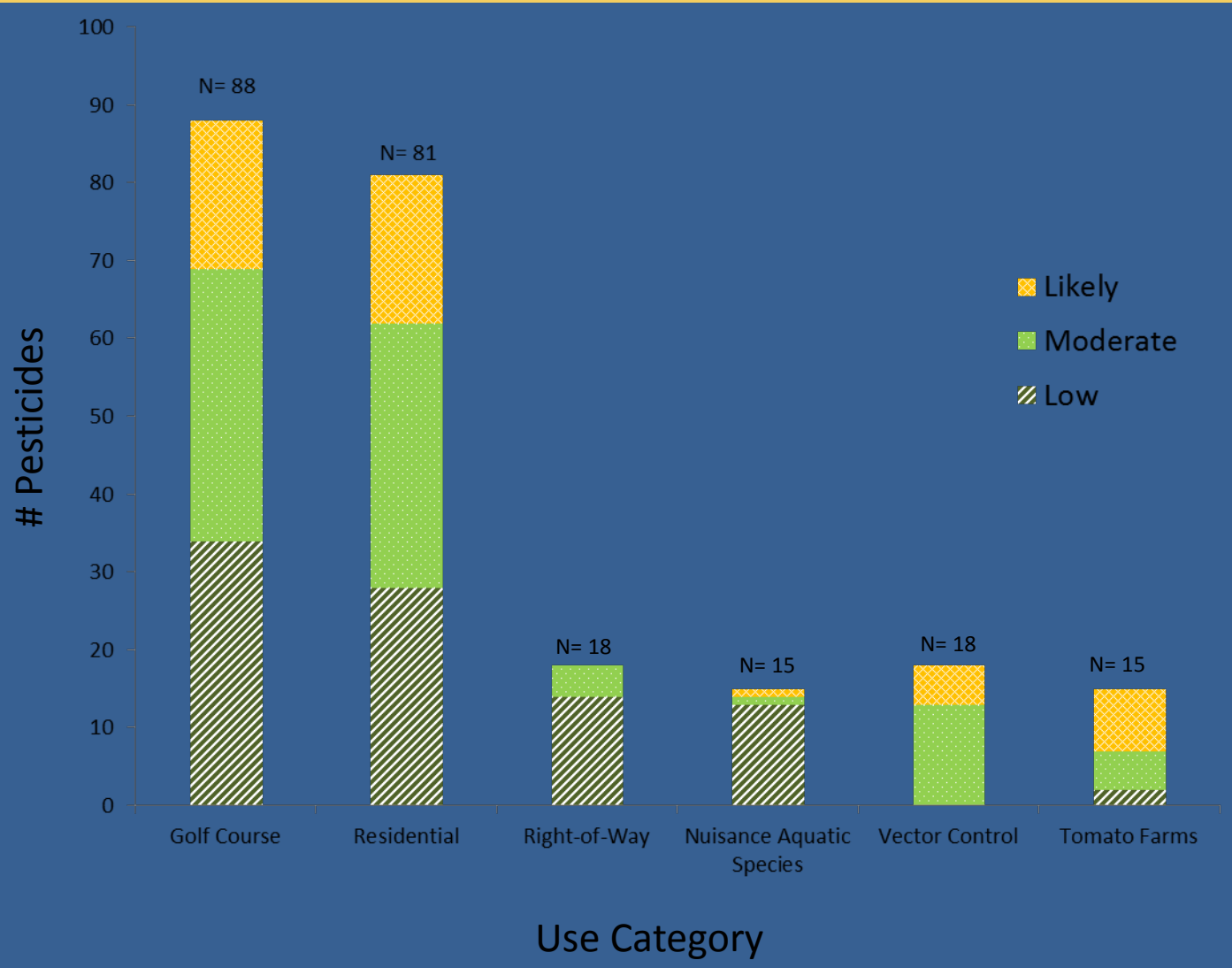
Cumulative Distribution of the Safety of the 100 Most Commonly Used Pesticides in the Southeast US



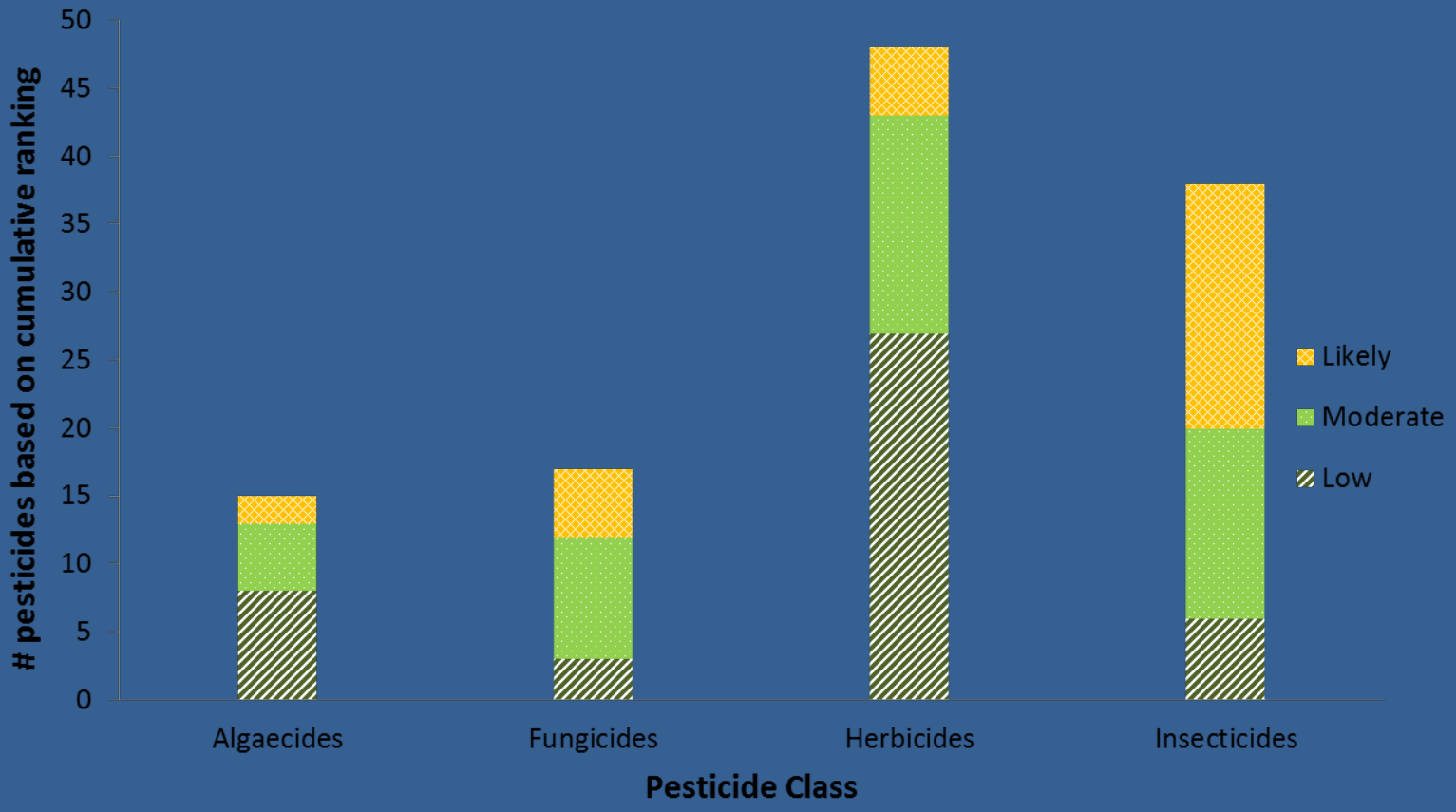
Relative Cumulative Ranking System– Results

Low	Likely
Glyphosate	**Fipronil**
Fosetyl-AL	Abamectin
Bispyribac-sodium	Bensulide (H)
Rimsulfuron	**Endosulfan**
Dicamba	Methiocarb
Asulam	**Chlorpyrifos**
Metasulfuron methyl	Indoxacarb
DEET (I)	Oxadiazon (H)
Boric acid	Hydramethylnon
Aminocyclopyrachlor	**Temephos**

Relative Cumulative Ranking System– Results



Relative Cumulative Ranking System – Results



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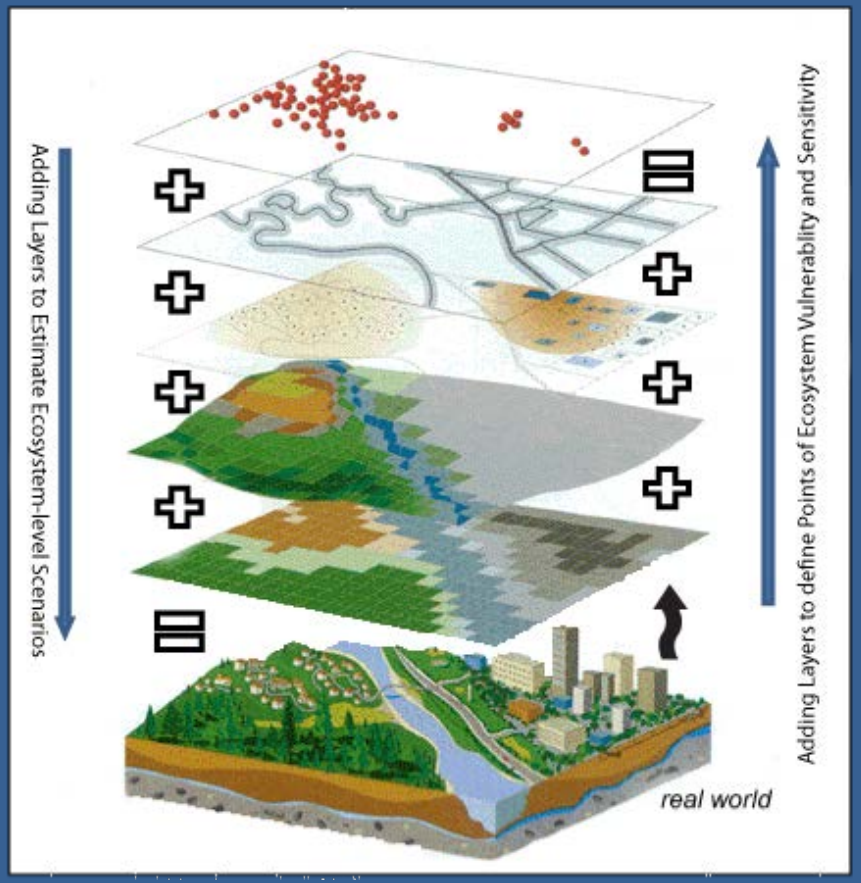
Part 2: Site-specific Spatial Implementation

NEXT

Geospatial Models: Pesticide Application



(USGS)'s topographical maps (http://topomaps.usgs.gov/)

NLCD (2006) 16-class Land Cover Classification Scheme

(USDA-NRCS) Soil Survey Geographic (SSURGO) Database

FEMA Flood-risk Zones Data

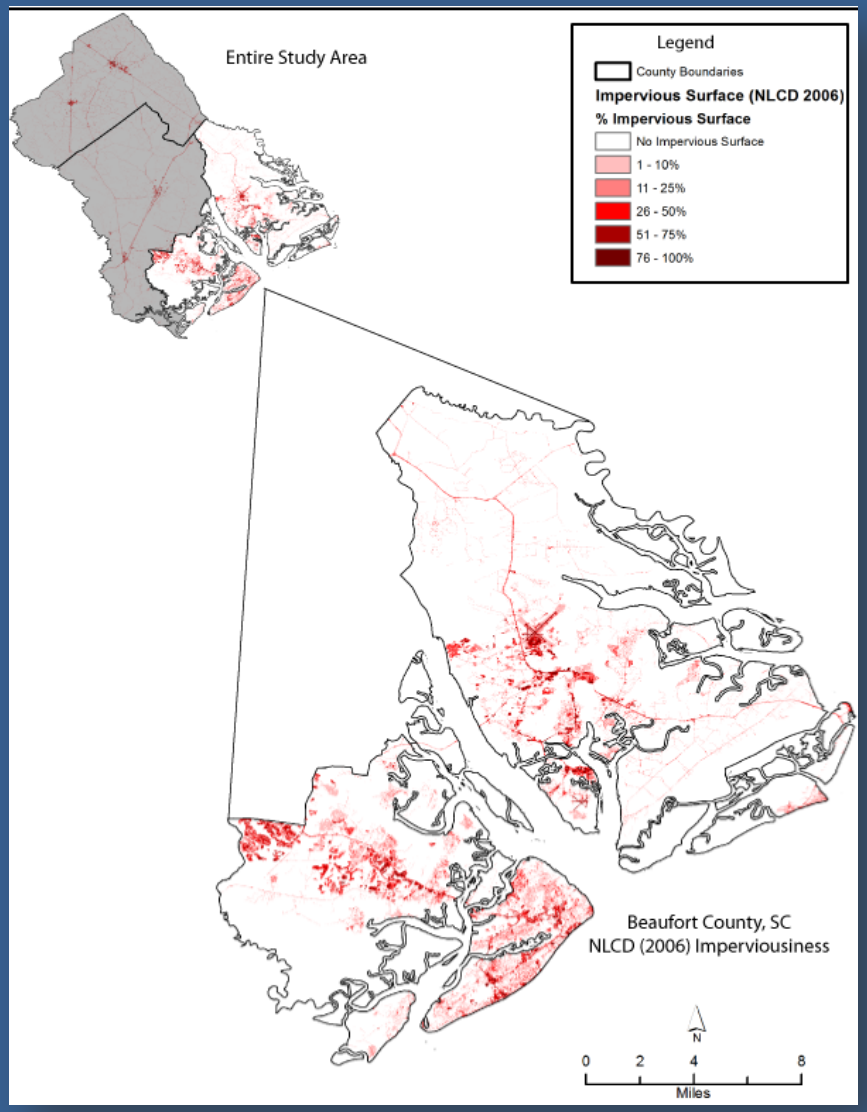
NLCD (2006) Percent Imperviousness

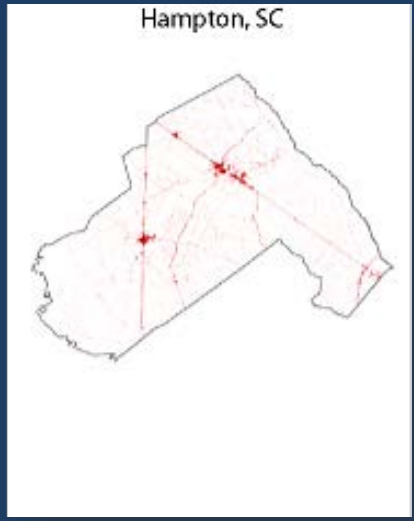
Revised Universal Soil Loss Equation (RUSLE)

NOAA *In Situ* Data

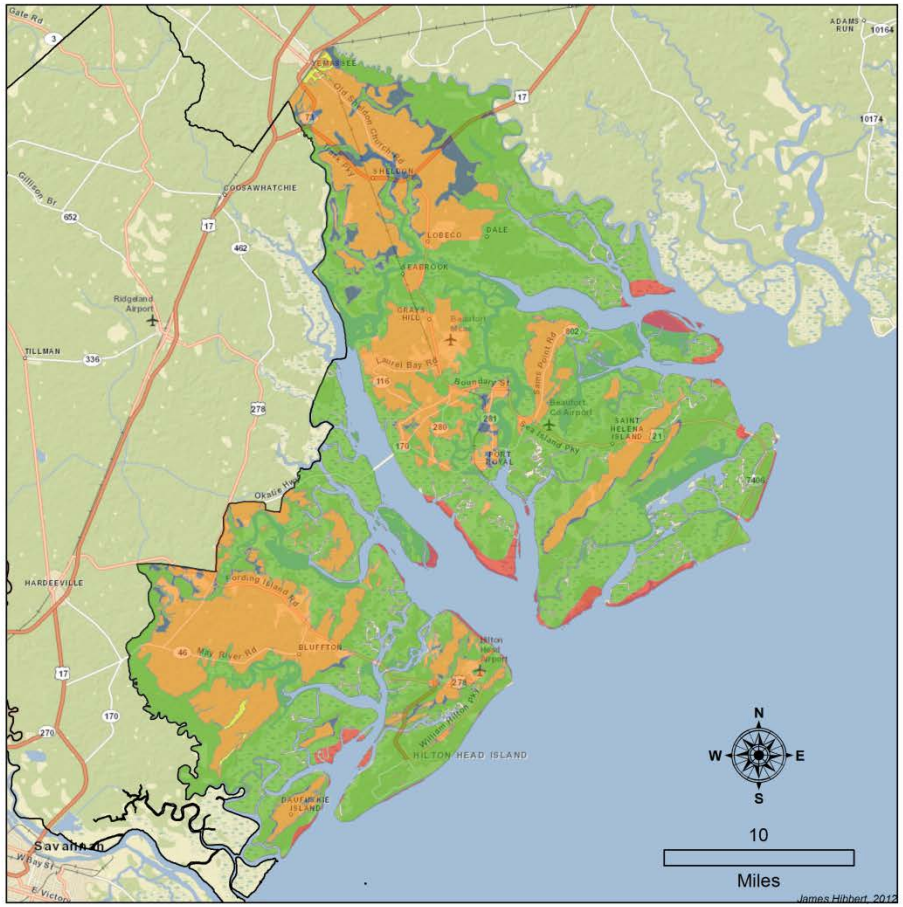
SC DHEC Fish Kill, Mammal Strandings, and Phytoplankton Data

Geospatial Models –NLCD (2006): Imperviousness





Geospatial Models –FEMA Flood Risk Zones



Legend

Beaufort Q3 Flood Zones

Zone

- A
- AE
- VE
- X
- X500

Zone Definitions

A: An area inundated by 100-year flooding, for which no BFEs have been determined.

AE: An area inundated by 100-year flooding, for which BFEs have been determined.

VE: An area inundated by 100-year flooding with velocity hazard (wave action); BFEs have been determined.

X: An area that is determined to be outside the 100- and 500-year floodplains.

X500: An area inundated by 500-year flooding; an area inundated by 100-year flooding with average depths of less than 1 foot or with drainage areas less than 1 square mile; or an area protected by levees from 100-year flooding.

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Okay, so your problem is with adult mosquitoes in your yard.

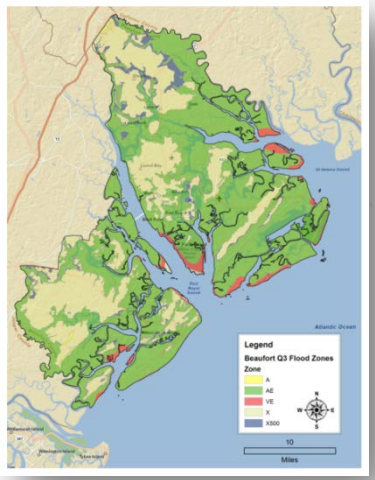
First, consider this:

A) Have items in the yard that collect water where mosquitoes could breed?

- If so, make sure all sources that could collect rain water are removed from the yard or dumped regularly during summer months. Also, if you have a pond then larval mosquito treatment may be needed.

B) Live within 100 feet of a large body of water?

- Please look at the floodplain maps to make sure your yard/property you are applying pesticides is not within the floodplain area. If it does fall in this zone, then please click here for pesticides less toxic to aquatic organisms



If you do not live in the floodplain, please click Next to continue

NEXT

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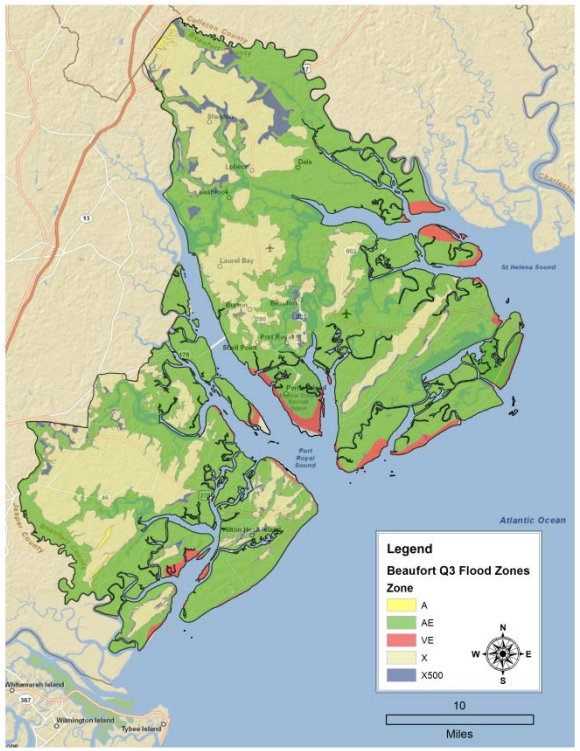
Are you in the floodplain?

Enter Your Address:

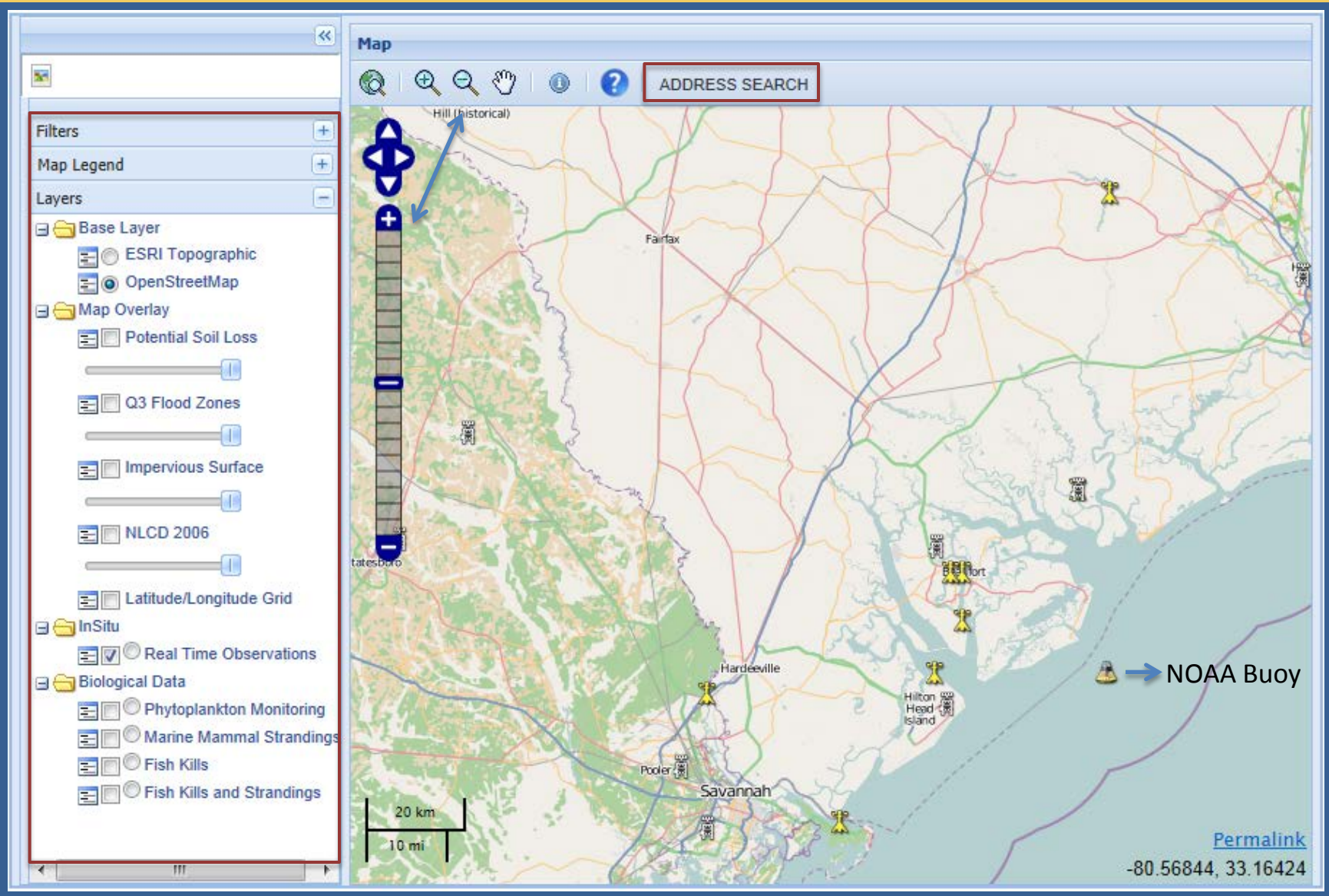
Enter Your Pesticide:

Future work on the spatial part of this project will match up pesticide label information, home address and local flood plain maps to predict vulnerable areas where certain pesticides should not be used based on pesticide label restrictions

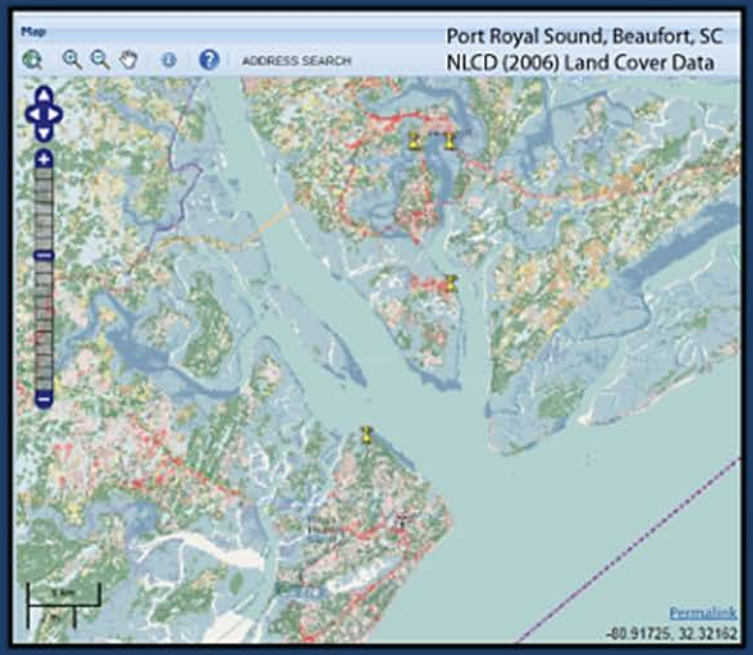


NEXT

sccoastalpesticides.org – Env. Surveillance Network Data Portal Framework



sccoastalpesticides.org – Env. Surveillance Network Data Portal

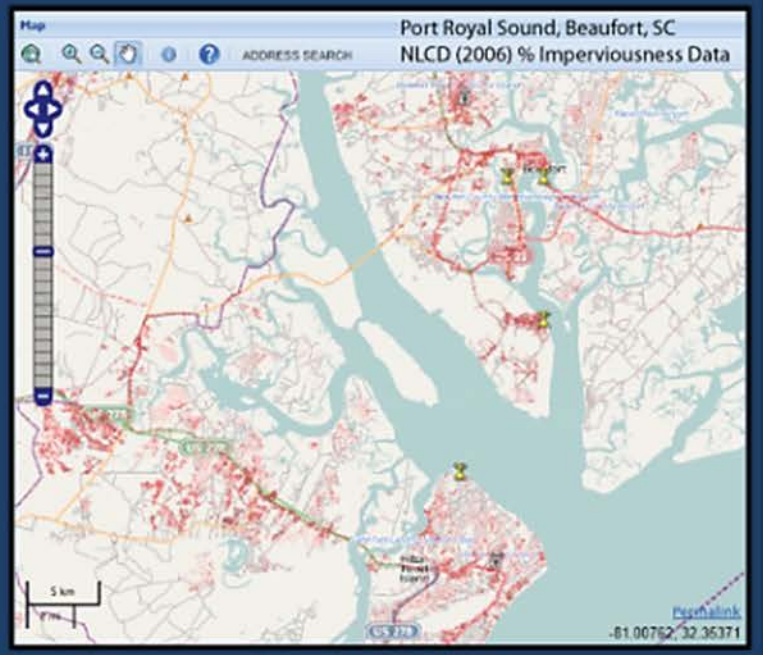


Legend

NLCD Land Cover Classification Legend
11 Open Water
12 Perennial Ice/ Snow
21 Developed, Open Space
22 Developed, Low Intensity
23 Developed, Medium Intensity
24 Developed, High Intensity
31 Barren Land (Rock/Sand/Clay)
41 Deciduous Forest
42 Evergreen Forest
43 Mixed Forest
51 Dwarf Scrub*
52 Shrub/Scrub
71 Grassland/Herbaceous
72 Sedge/Herbaceous*
73 Lichens*
74 Moss*
81 Pasture/Hay
82 Cultivated Crops
90 Woody Wetlands
95 Emergent Herbaceous Wetlands
* Alaska only

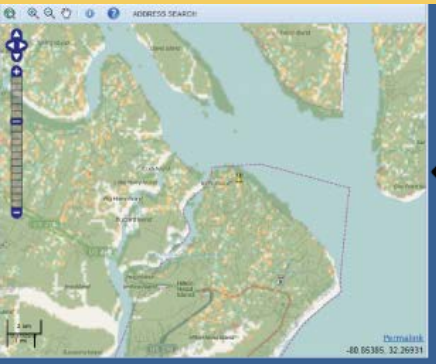
Legend

% Impervious Surface
No Impervious Surface
1 - 10%
11 - 25%
26 - 50%
51 - 75%
76 - 100%

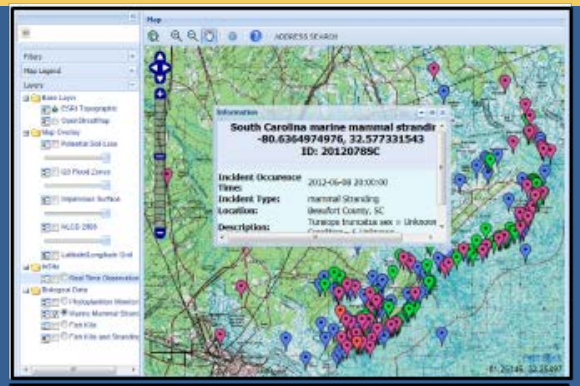


sccoastalpesticides.org
Env. Surveillance Network

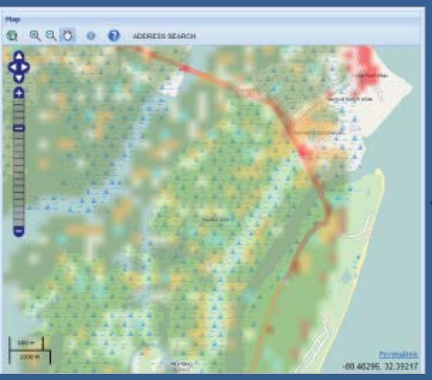
RUSLE Equation Coupled Information



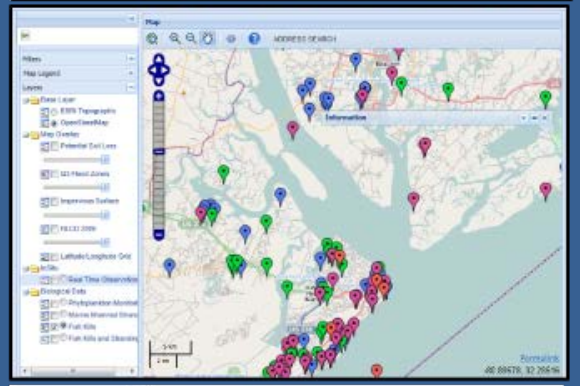
View of the Port Royal Sound
RUSLE Soil Loss and NOAA Real Time Climatic Data



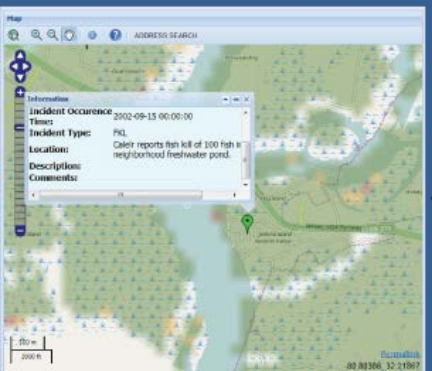
NOAA Mammal Stranding Data (by year)



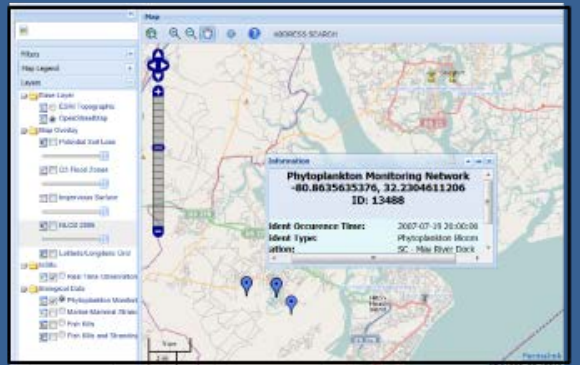
View of a Barrier Island
RUSLE Soil Loss and % Imperviousness



NOAA Fish Kill Data (by year)

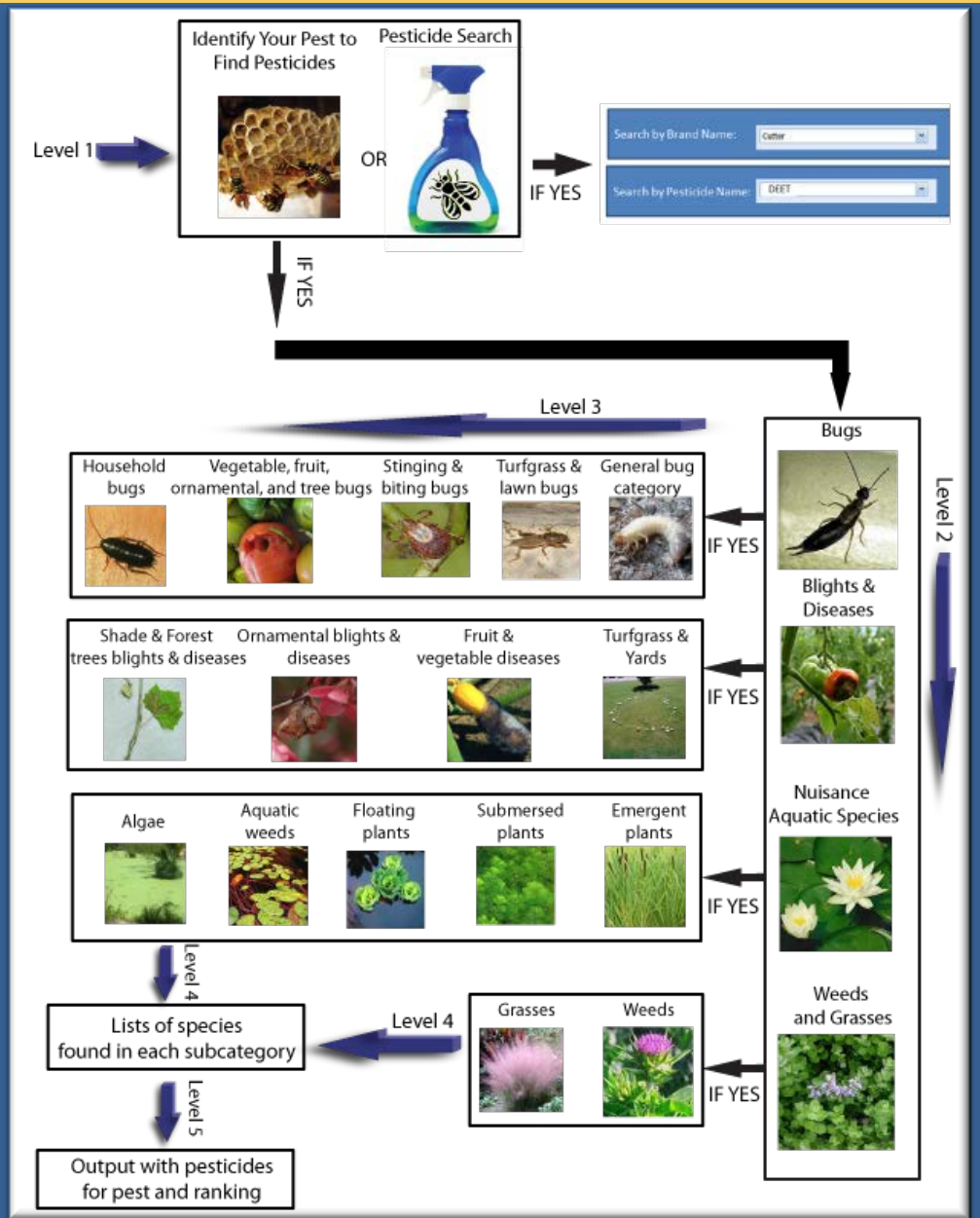


View of a Tidal Creek
RUSLE Soil Loss and NOAA Fish Kill Data



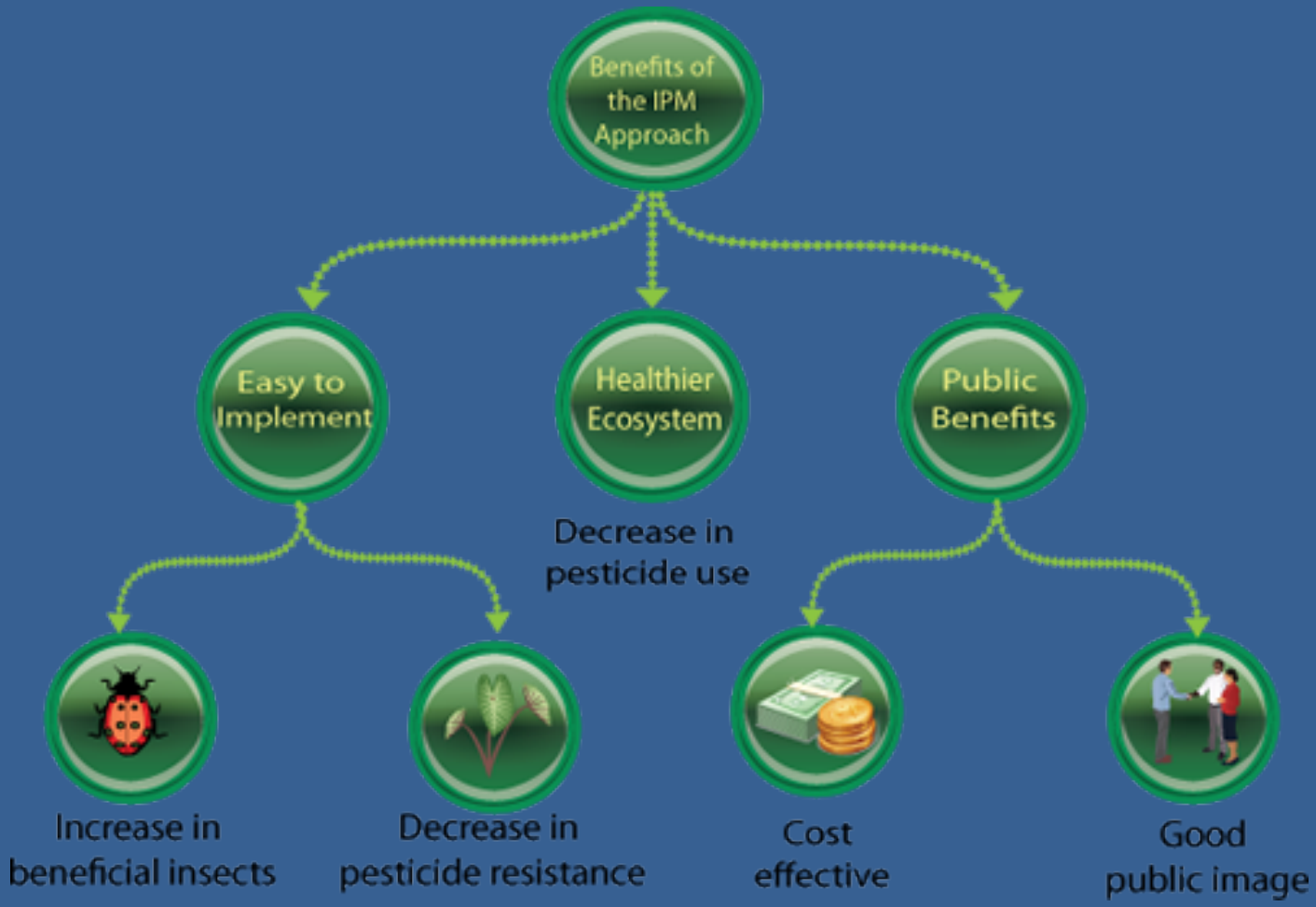
NOAA Phytoplankton Monitoring Data

sccoastalpesticides.org – Decision-Support Tool



Discussion:

Integrated Pest Management (IPM)



Next Steps

- Complete Web Site and Go Live
- Met with Dr. Steve Bradbury, Director of EPA's Office of Pesticides in May, 2013 and they would like to be involved in the further and future development of the Tool.
- Follow-up Discussions with EPA in late July, 2013 regarding this. Dr. Bradbury plans to visit SC in Feb. - March, 2014
- **Future:** Follow-Up Meetings Hosted with Sea Grant with Golf Course, Pond Management, Vector Control and Power Company (Right of Ways) User Groups
- Roll Out in GOMA: Perdido Bay (NCDDC)