Spatial approaches to refine agricultural chemical use areas for endangered species assessments: Study with California Tiger Salamander

Raghu Yamshi1, Joshua Amos1, Christopher Holmes1, Vivienne Seed1, Matt Kern1, JiSu Bang2  1Waterborne Environmental, Inc., Leesburg, VA, USA.  2Syngenta Crop Protection, LLC, Greensboro, NC, USA.

Objectives

- Conduct a geospatial analysis of a threatened and endangered species risk assessment with a tiered approach to characterize the potential exposure of the California Tiger Salamander (CTS) to an herbicide use.
- Obtain best available geospatial data for species habitat, pesticide use, crop, vegetation, hydrology and wetlands, and incorporate them in a step-wise manner to represent realistic spatial relationships.
- Identify the herbicide use within all California counties and narrow to co-occurring counties and Public Land Survey System (PLSS) sections based on U.S. Fish and Wildlife Service (FWS) CTS critical habitat definitions.
- Conduct proximity analysis to identify the closest distance of a potential pesticide use area to CTS critical habitat location.
- Spatially refine the CTS critical habitat locations using the species biological information to identify areas that spatially represent the species habitat range.

Best Available Data at the State Level

CTS Habitat and Biology

- Listed as threatened and endangered species1
- Biophysical life cycle (Figure 1):
  - aquatic phase - breeding, larval and metamorphosis
  - terrestrial phase - juvenile and adult migration and reproduction
- Species range in central CA:
  - grasslands and foothills
  - vernal pools and seasonal ponds (within grasslands & oak savanna) (Figure 2)
- Critical habitat2 (CH) locations are distributed in 21 counties in CA (Figure 3)

Historic Herbicide Use

- Historically, the herbicide was used3 in 35 counties from 2001-2010
- All historic uses of the herbicide were considered, irrespective of current label restrictions (Figure 4)

All Potential Use Sites

- Crop classes by EPA4 were used and some classes were refined to separate out major crops (e.g., orchards class was separated into citrus, grapes, ground fruit and ground nut classes)
- For all California, potential use sites were developed by creating a 4-year (2008-2011) composite of NASS-CDL5 data to include all potential crop use areas
- For example, the 4-year composite consisted of 1,090,156 acres of grape production across the state (Figure 5)

Best Available Data at the County Level

Study herbicide use and CTS critical habitat locations were examined for co-occurrence at county and PLSS section level

County Level Co-occurrence

- At the county level, of the 35 counties with historic herbicide use, 16 show co-occurrence with CTS CH locations (Figure 6)
- This represents 0.38% of all historic use sections

Co-occurrence at County and PLSS Section Level

- Further examining the 35 counties for herbicide use at PLSS section level, only 7 counties have reported use in the preceding 10 years
- Within these 7 counties, only 15 PLSS sections contained both CTS critical habitat and herbicide use (Figure 7)
- This represents 0.38% of all historic use sections

Proximity Analysis of All Potential Use Sites at the Local Level

- Geospatial analysis was conducted to determine the proximity of CTS critical habitat locations in relation to all potential herbicide use locations. An example of grapes is shown in Figure 8.
- Listed as threatened and endangered species (e.g., RegDISP) was used to determine a distance to identify CTS CH locations, for further refinement in consideration of potential effects (e.g.: 100 ft was selected for demonstration purpose)
- Proximity distance was calculated along the perimeter of CTS CH locations to the nearest potential use site
- Each CTS CH location and potential use site was characterized individually

Proximity Results – Species Location

- <5% of all potential grape use sites is within 100 ft of a CTS CH location (Figure 9)
- 17 of 44 (39%) original critical habitat locations were found completely outside 100 ft of potential grape use areas

Example of Spatial Refinement using Biological Information

- Identify static waterbodies6 & vernal pools/seasonal ponds7 within CH boundary that represent CTS breeding pools
- Create spatial buffer based on the adult CTS movement distance range (1.3 mile). Within the spatial buffer, identify land cover8 (forest & grassland) that is suitable habitat for adult CTS movement that represents the “refined” habitat.
- The large original CH location polygons were separated into several smaller CTS “refined” habitat polygons.
- Spatial refinement reduced the total CTS critical habitat area by 19%, but varies for each habitat location (Figure 10)

Proximity Results – Refined Species Location

- In the CTS critical habitat example (Figure 11), area was reduced from a single polygon of 4,136 acres to 1,927 acres comprising 135 smaller refined polygons - 53% reduction
- Of the 135 refined polygons, 109 were found outside 100 ft of potential grape use areas, which represents 59% reduction from the original habitat area (Figure 12)
- 19 of the original 44 critical habitat locations (43%) were found outside 100 ft of potential grape use areas, and the subdivision into refined critical habitat locations reduced the area potentially affected (e.g., by 59% in the example shown)

Summary

- The geospatial analyses were performed in a programmed, documented and transparent way, allowing for full retrieval of all details.
- The proximity analysis results show that understanding spatial distribution of use sites and its proximity to species habitat was integral to assess potential exposure.
- Spatial refinements of critical habitat using ecological and biological information helped identify relevant areas of species habitat for evaluation of the exposure potential.
- The tiered approach offers a step-wise refinement to quantify the potential overlap of herbicide use with widely distributed species locations from state-wide to field scale.
- The study showed that geographical specific use information should be considered to refine potential use areas. In addition, the species-specific habitat characteristics and requirements (i.e., vegetation type, migration route and timing, and specific dietary preferences) could be considered for further refinement.

References

3 Laverack, D. 2006. California Department of Fish and Game, California tiger salamander (Ambystoma tigrinum). California Department of Fish and Game, Sacramento, CA.
8 For more info, contact: Raghu Yamshi (yamshir@waterborne.com). (703) 897-5000  897-5000

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Figure 1: EPA ES factsheet on CTS
Figure 4: Study herbicide use distribution at PLSS sections
Figure 5: 4-year composite NASS-CDL representing potential grape use areas
Figure 6: County level co-occurrence of CTS CH with herbicide use
Figure 7: PLSS section level co-occurrence of CTS CH with herbicide use
Figure 8: Grapes use sites showing overlap or proximity to CTS CH locations.
Figure 9: Potential CTS CH proximity to grapes
Figure 10: Cumulative reduction in CTS critical habitat area due to spatial refinement
Figure 11: Grape use sites in proximity to smaller “refined” CTS CH locations. Example shows simple large CH polygon split into smaller refined polygons, reducing proximity of species locations and grape use areas.
Figure 12: Reduction in CTS Habitat area potentially affected (100 ft) from grape use sites (example from Figure 10)