



# **Oregon Grasshopper and Mormon Cricket Survey Summary for 2023**

## **INTRODUCTION**

The 2023 Oregon Grasshopper (GH) and Mormon cricket (MC) Survey season, conducted by the Oregon Department of Agriculture (ODA) in cooperation with the United States Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) Plant Protection and Quarantine (PPQ) State Plant Health Director's office, spanned from 01 May to 18 August 2023. In 2023, a total of 1,654 sites were visited, (1,654 include survey for MC, 1,654 survey for GH; Fig. 1, Fig. 2). Location of survey stops is based both on our standard search for and assessment of GH and MC populations and response to requests for assistance with delimitation.

## **GRASSHOPPERS**

This season did have the widespread grasshopper outbreaks that was seen in 2021 and 2022. The outbreak areas were in the usual problem areas. This year 29 percent of survey stops were at an economic density<sup>1</sup> (Table 2), and for those stops the mean density was 63 GH/yd<sup>2</sup> (Table 2).

Of the total stops made 894 were during the period for nymphal grasshopper survey and 780 during the adult period (Table 2). Nymphal survey takes place early in the season and is used to locate potential outbreak areas for response during the current year. Adult survey (this year 5 July – 18 August) is used by ODA and APHIS to make predictions for the following season, considering economic levels as 8 or more grasshoppers per square yard. The 236 Common Data Sites (CDS) (standard locations visited each year for year-to-year comparison) were included in the survey.

Approximately 2.3 million acres across 15 counties in eastern Oregon were estimated to contain economically infested locations (Fig. 2; Table 2). Harney County had the most infested acreage at 545,536 and Malheur County second with 536,603. Harney and Malheur County account for close to half of the total economically infested acreage. (Fig. 9; Table 3; Appendix 1).

Survey resources have been reduced since 2011 (Sites Surveyed, No. of Surveyors, Table 2) so the percent of economically infested acreage to the total surveyed acreage may be more useful for comparing the between year trend in population density.

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<sup>1</sup> Note: 'Economic density' is a term used in this report and in historical survey data to indicate a population level of 8 grasshoppers per square yard or greater. This is considered a minimum population level for potentially damaging impacts to occur. The actual rate of damage will vary by season, species complex, climate, and the combined ecological and agronomical features of the site. Economic density should therefore not be considered a functional threshold for recommending treatment, but rather an indication that a closer look may be warranted. For help in determining if a grasshopper population meets a site specific minimum threshold for economically justifying treatment, please refer to the Decision Support Tools section of APHIS' Grasshopper Integrated Pest Management User Handbook ([www.sidney.ars.usda.gov/grasshopper/Handbook/index.htm](http://www.sidney.ars.usda.gov/grasshopper/Handbook/index.htm)).

Table 1. A comparison of grasshopper (GH) infestation densities (/ yd<sup>2</sup>) adjusted for effort (percentage of total surveyed acres within each year).

Year	Percent of Total Surveyed Acres		
	Economic	Non-Econ	No GH
2023	29	47	24
2022	36	38	26
2021	66	22	12
2020	60	26	14
2019	26	43	31
2018	40	37	23
2017	43	36	21
2016	39	42	19
2015	35	40	25
2014	23	39	38
2013	14	39	47
2012	34	47	20
2011	39	43	18

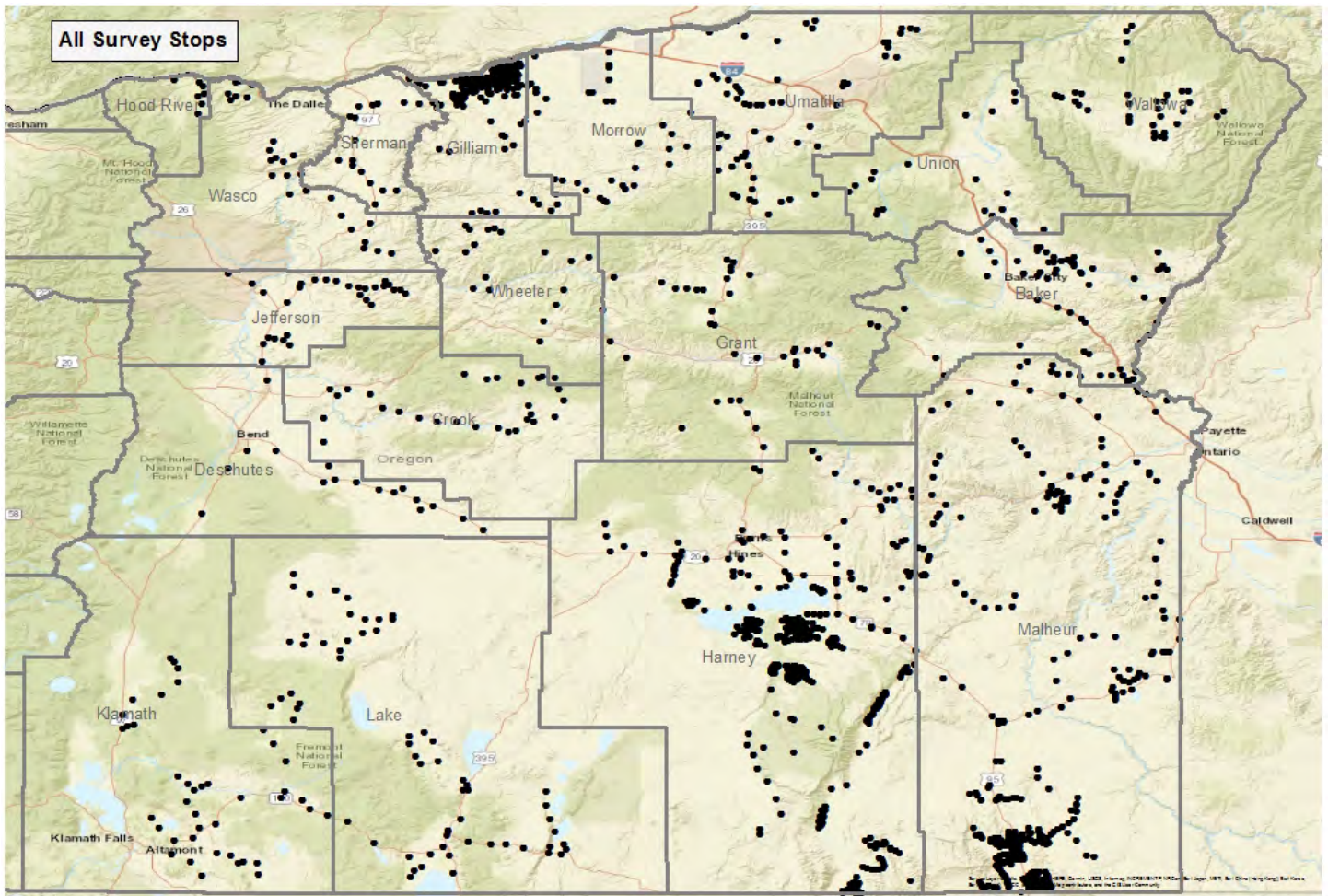
Table 2. Oregon Grasshopper Survey Statistics from 2005 through 2023. Economic infestation ≥ 8 grasshoppers / yd<sup>2</sup>.

Year	Number Counties Infested	Acres of Econ. Infest.	Grasshopper Sites Surveyed				Samples w/Econ Density	Mean GH / yd <sup>2</sup> *	Number of GH Surveyors
			Total	Nymph	Adult	Treatment			
2023	15	2,252,230	1654	894	760	0	342	63	3
2022	18	5,356,547	6364	3914	2450	0	2833	73	7
2021	18	10,147,416	2379	1634	745	0	1045	65	3
2020	18	4,804,265	1,436	501	935	0	810	57	2
2019	17	2,364,191	1,620	674	946	0	399	33	2.5
2018	18	3,838,637	2,183	1,147	1,036	0	748	44	2.5
2017	17	3,314,742	1,657	769	888	0	653	58	2.5
2016	18	2,980,051	1,381	507	874	0	484	21	2
2015	17	2,495,073	1,712	803	909	0	437	25	3
2014	19	1,031,673	1,767	914	853	0	333	29	2.5
2013	15	869,857	1,489	462	935	92	280	50	2.5
2012	17	1,178,872	1,135	387	748	34	526	34	2.5

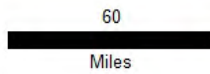
2011	18	2,888,455	3,139	1880	914	345	1093	20	6
2010	12	1,910,222	1,905	795	750	360	488	21	6
2009	11	151,974	998	491	507		108	18	4
2008	12	1,129,820	2,722	1116	1606		360	29	6
2007	13	798,358	1,585	706	870		298	18	6
2006	14	97,399	1,368	750	618		100	16	6
2005	9	64,751	859	306	423		115	15	5

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\*Mean of economically infested samples



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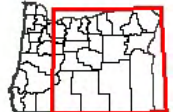
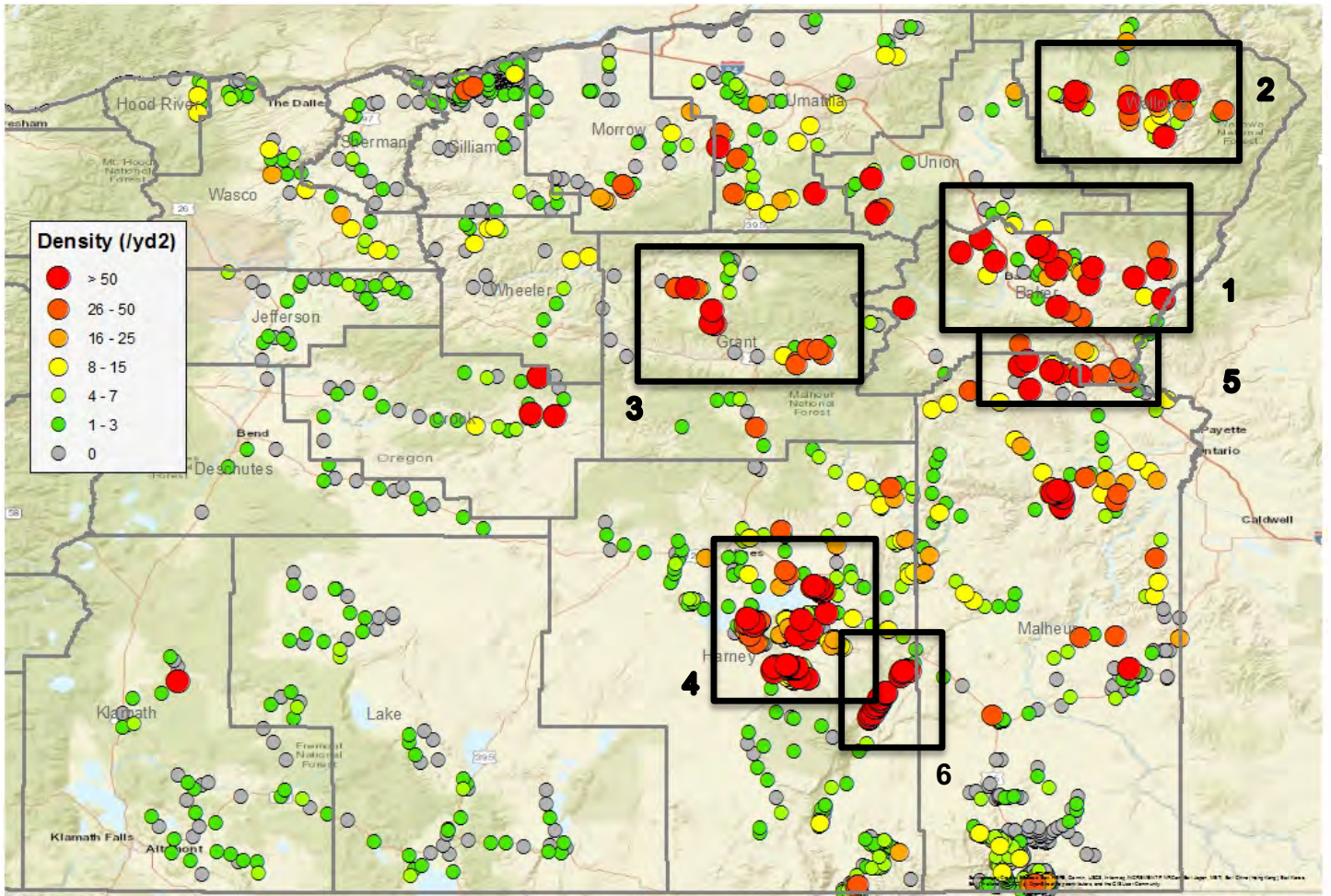


Figure 1. 2023 Grasshopper / Mormon cricket Survey stops distributed across eastern Oregon. (1:2,400k)





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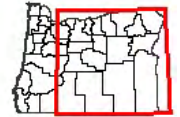
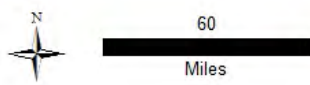
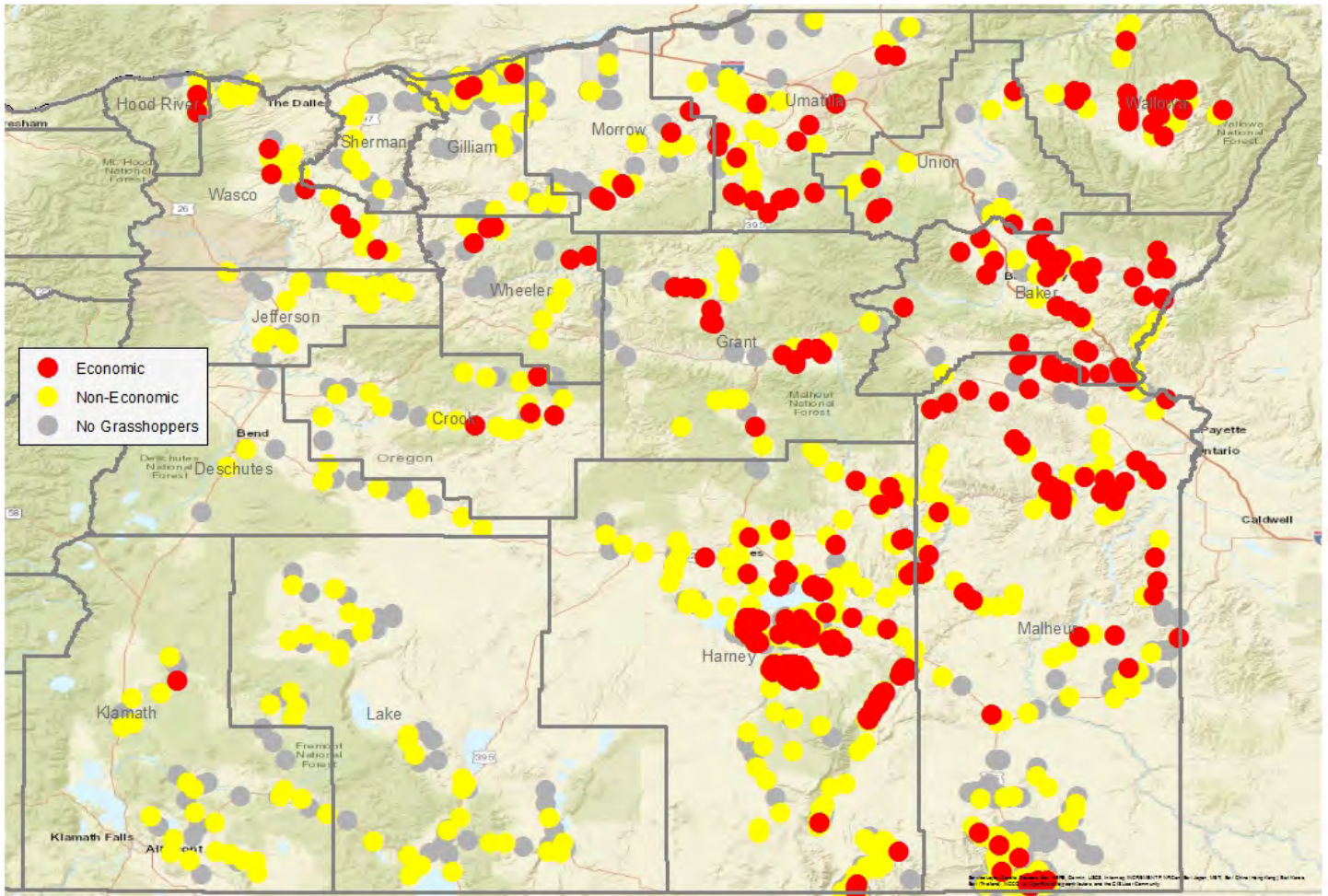


Figure 2. 2023 grasshopper survey densities (/yd<sup>2</sup>) classified to seven levels. Black rectangles indicate areas given a closer examination below. (1:2,400k)





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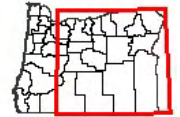


Figure 3. 2023 grasshopper density area estimates (/yd<sup>2</sup>) classified by economic category. (1:2,400k)

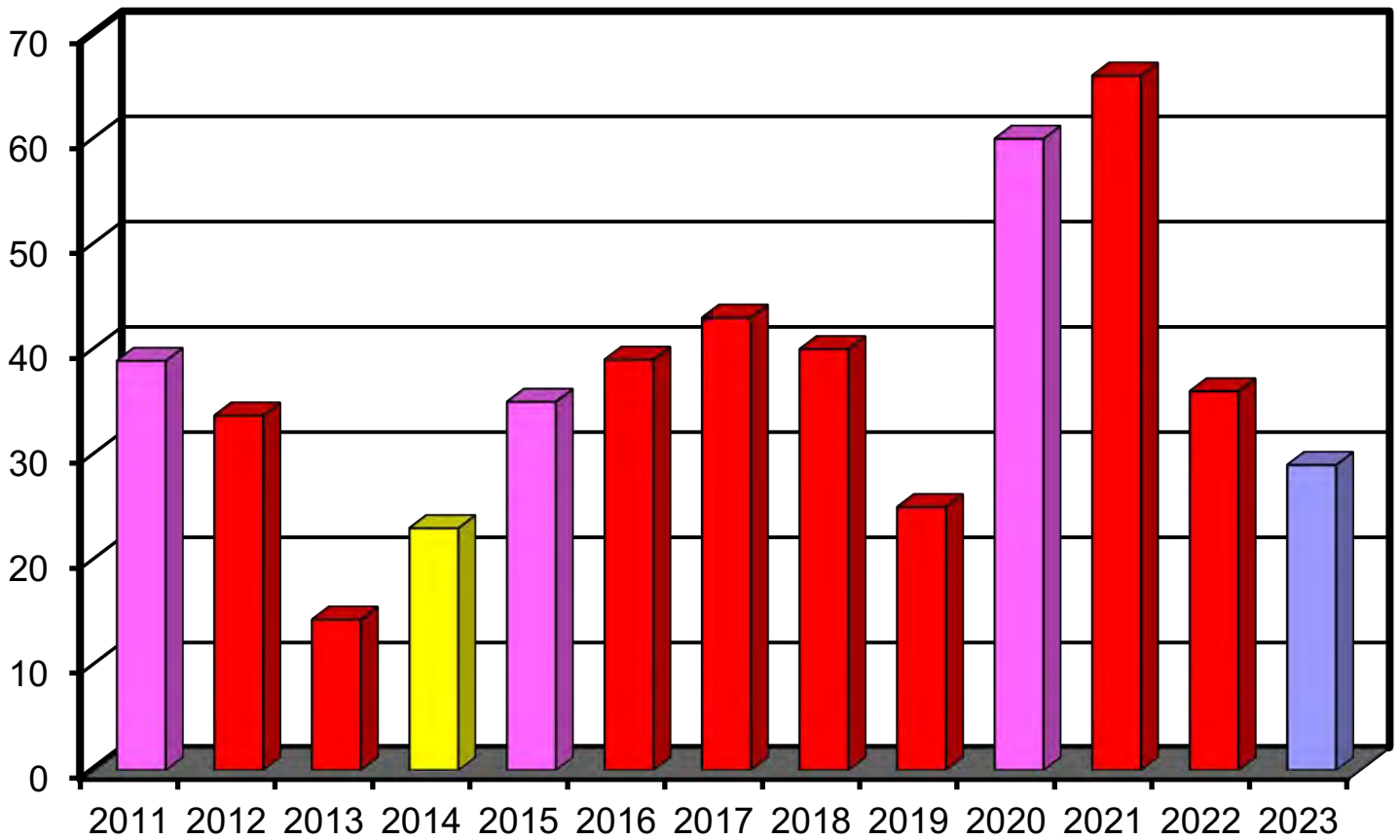


Figure 4. Percentage (within each season) of surveyed area (acres) estimated to have grasshoppers at an economic density.

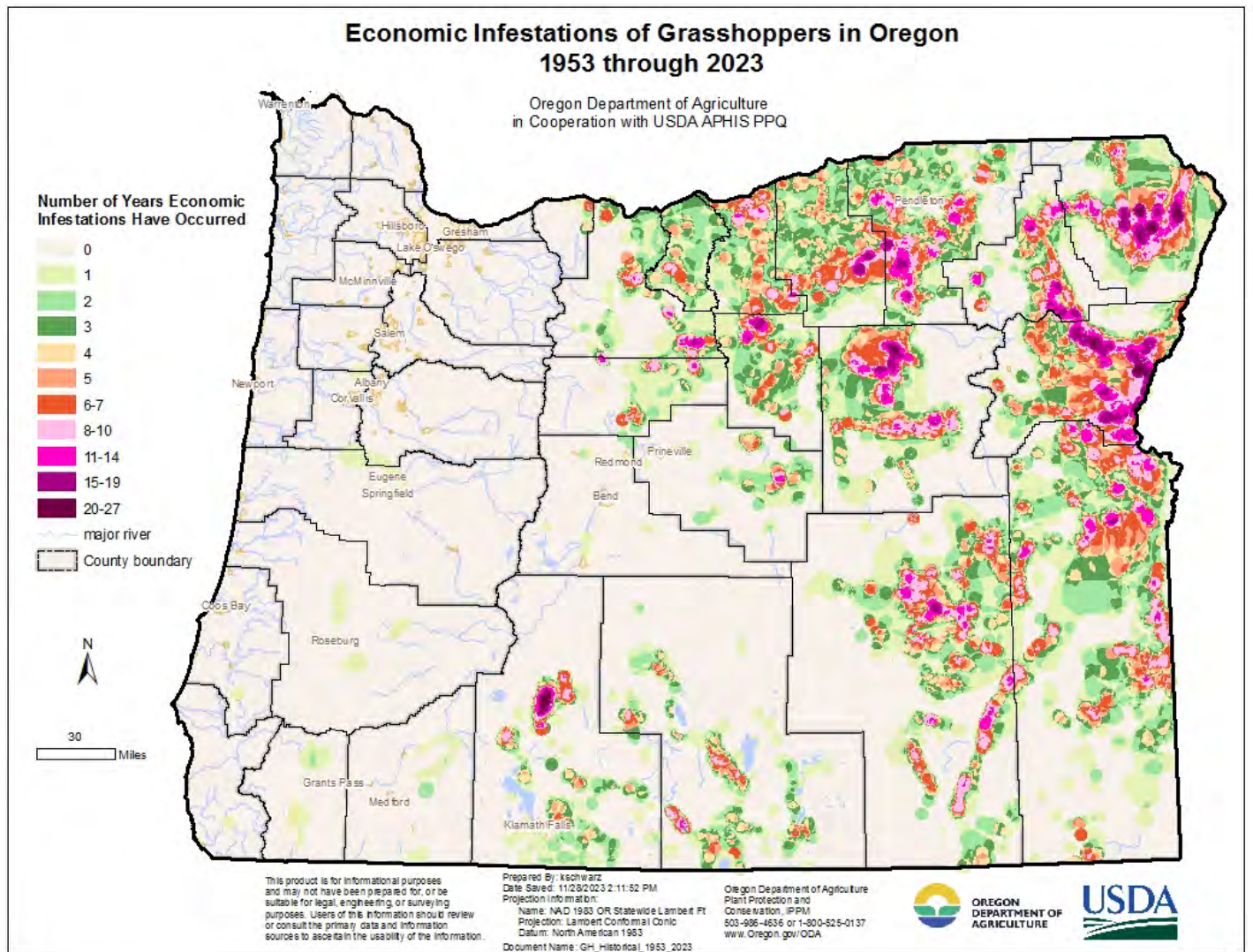
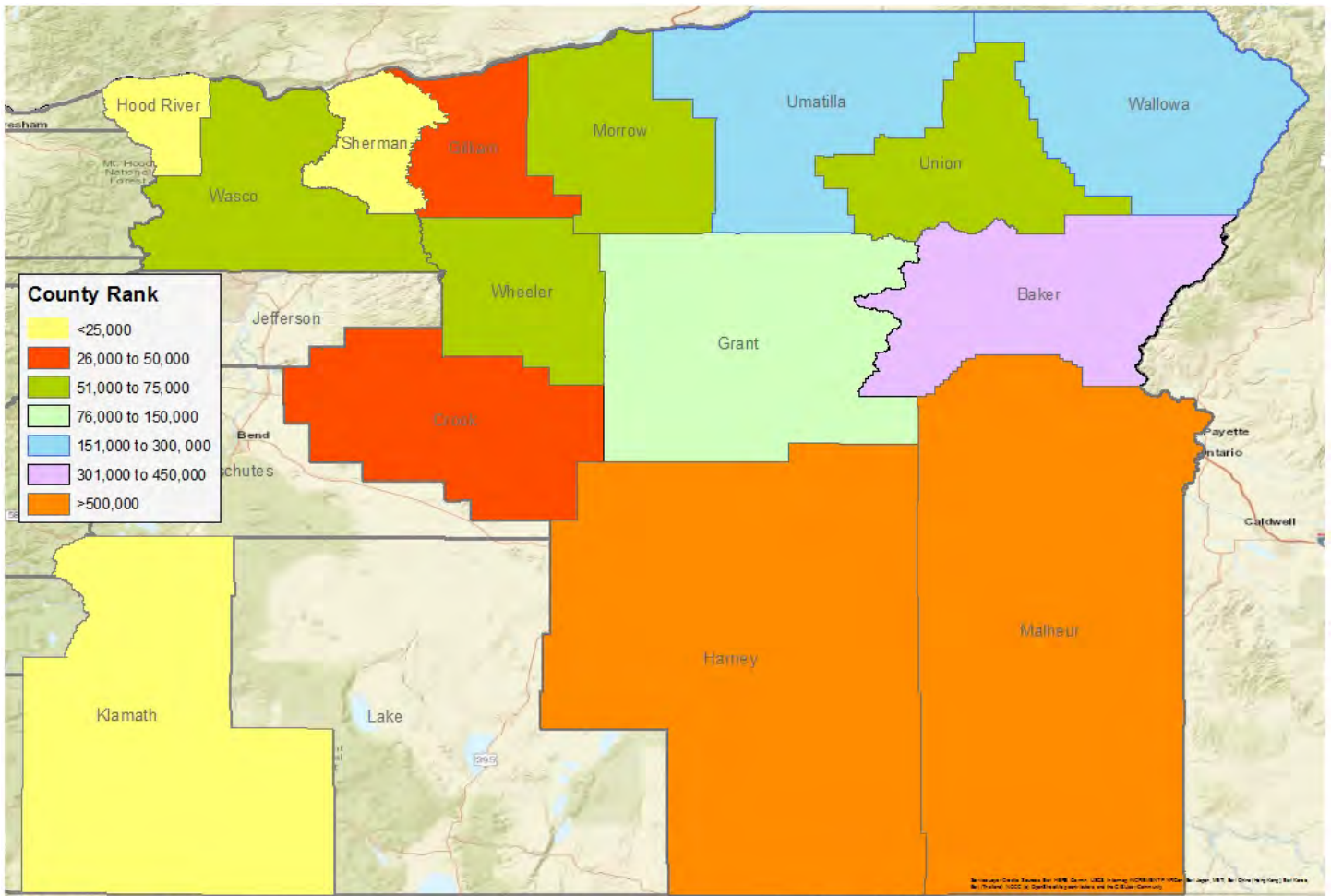


Figure 5. Number of economically infested years for grasshoppers in eastern Oregon 1953 - 2023. (1:2500k)





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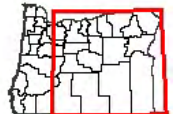
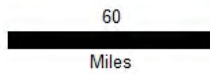


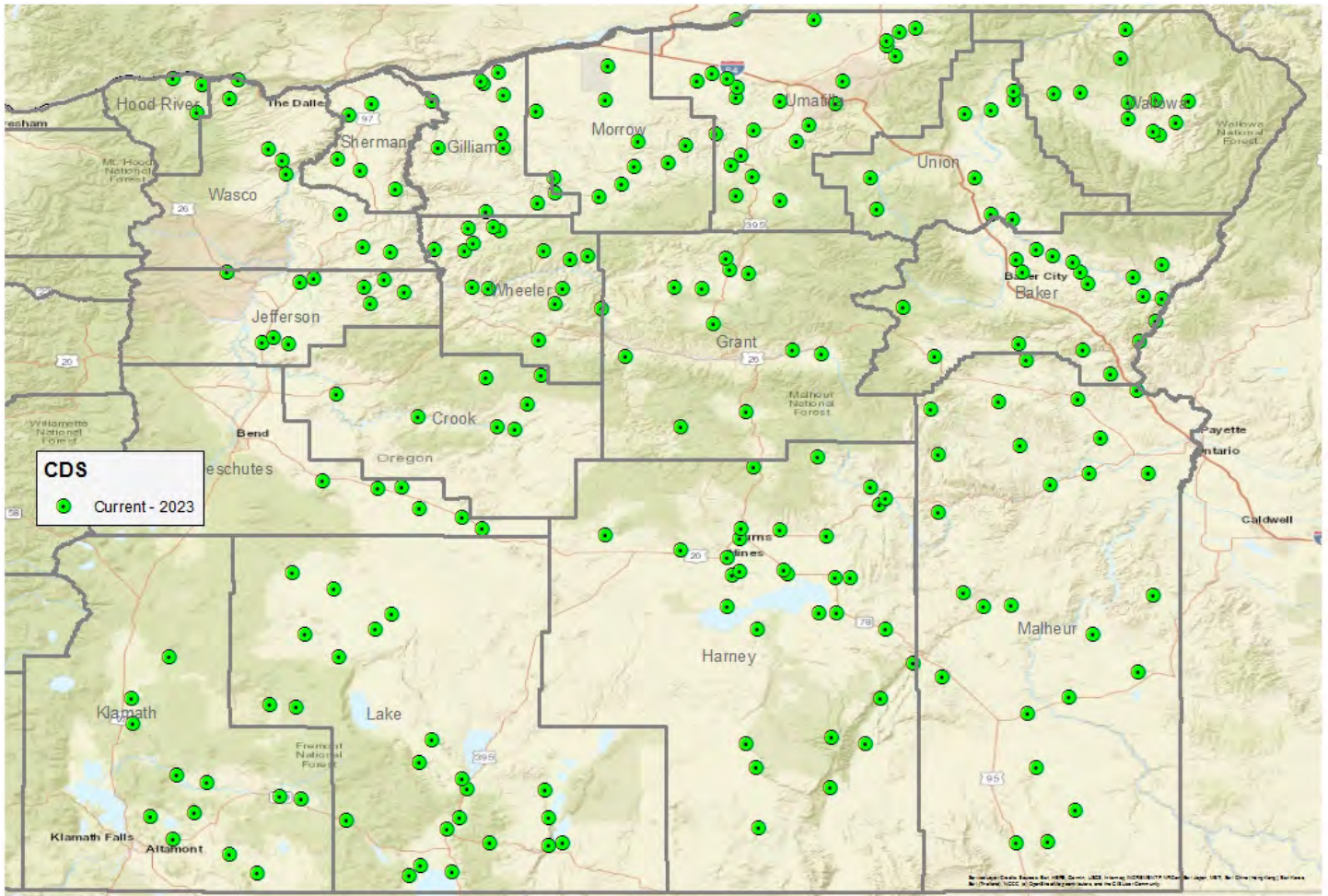
Figure 6. 2023 Grasshopper survey by counties ranked by economically infested acreage. (1:2400k)

Table 3. Surveyed area (ac) density estimates 2023 summarized by economic classification within a county.

	Economic Classes Summed by County				Economic Classes as % within County		
	Economic	Non-Economic	No Grasshoppers	Totals	Economic	Non-Economic	No Grasshoppers
Baker	331,113	89,435	23,416	443,964	74.6	20.1	5.3
Crook	49,835	167,834	65,061	282,730	17.6	59.4	23.0
Deschutes	0	104,206	82,164	186,370	0.0	55.9	44.1
Gilliam	30,827	177,050	113,964	321,841	9.6	55.0	35.4
Grant	116,626	128,356	109,081	354,063	32.9	36.3	30.8
Harney	545,536	782,345	145,742	1,473,623	37.0	53.1	9.9
Hood river	23,492	13,168	9,686	46,346	50.7	28.4	20.9
Jefferson	0	155,206	57,154	212,359	0.0	73.1	26.9
Klamath	12,566	246,124	156,040	414,730	3.0	59.3	37.6
Lake	0	375,576	243,511	619,088	0.0	60.7	39.3
Malheur	536,603	620,902	345,892	1,503,398	35.7	41.3	23.0
Morrow	61,404	115,948	139,115	316,466	19.4	36.6	44.0
Sherman	2,804	90,878	75,323	169,006	1.7	53.8	44.6
Umatilla	178,717	218,161	95,222	492,101	36.3	44.3	19.4
Union	62,271	80,139	44,357	186,767	33.3	42.9	23.7
Wallowa	173,279	83,840	2,764	259,883	66.7	32.3	1.1
Wasco	73,796	133,364	26,232	233,393	31.6	57.1	11.2
Wheeler	53,361	75,023	86,657	215,040	24.8	34.9	40.3
Totals	2,252,230	3,657,557	1,821,382	7,731,168	29.1	47.3	23.6

Table 4. The number of grasshopper stops by Density Category (/yd<sup>2</sup>) and Dominant Life Stage encountered across the entire season.

Density	Totals	Dominant Developmental Stage						
		Egg	1	2	3	4	5	Adult
0	691							
1 - 3	436	0	50	72	13	20	42	239
4 - 7	185	0	23	51	8	15	16	72
8 - 15	115	0	13	39	9	8	11	35
16 - 25	61	0	11	15	7	5	3	20
26 - 50	75	0	6	22	5	5	4	33
> 50	91	0	15	23	6	9	1	37
	1654	0	118	222	48	62	77	436
Percentages:		0.0	12.3	23.1	5.0	6.4	8.0	45.3



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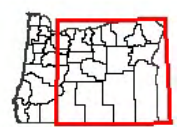
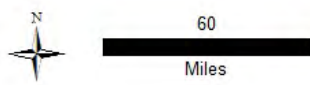


Figure7. Common Data Sites current locations. (1:2400k)

Table 5. The 236 grasshopper survey stops at the Common Data Sites showing Density Category (/yd<sup>2</sup>) by Dominant Developmental Stage over the entire Season.

Density	Totals	Dominant Developmental Stage						
		Egg	1	2	3	4	5	Adult
0	62							
1 - 3	84	0	0	0	0	5	10	69
4 - 7	46	0	0	0	0	3	6	37
8 - 15	17	0	0	0	0	3	2	12
16 - 25	9	0	0	0	0	2	1	6
26 - 50	9	0	0	0	0	0	0	9
> 50	9	0	0	0	0	0	0	9
	<b>236</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>13</b>	<b>19</b>	<b>142</b>
<b>Percentages:</b>		<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>7.5</b>	<b>10.9</b>	<b>81.6</b>



## A CLOSER LOOK

In the following section we zoom in on 5 areas to give a little closer picture of where the densities were greatest. Local managers and landowners may wish to use these maps to put early season scouting into their 2023 plans.

### 1- Baker County.

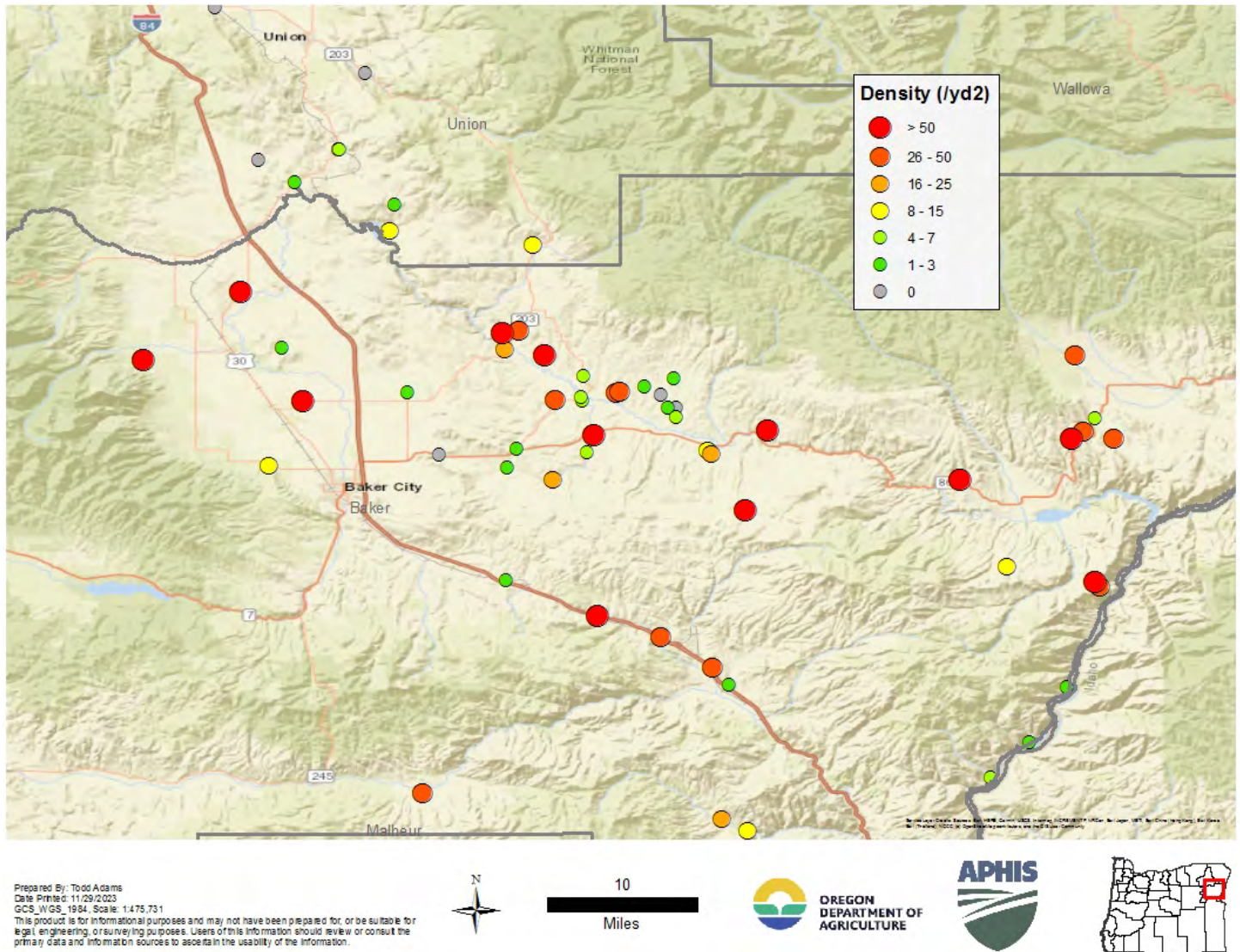


Figure 8. Grasshopper classified densities (GH/yd<sup>2</sup>) at survey locations in Baker County.

## 2-Wallowa County.

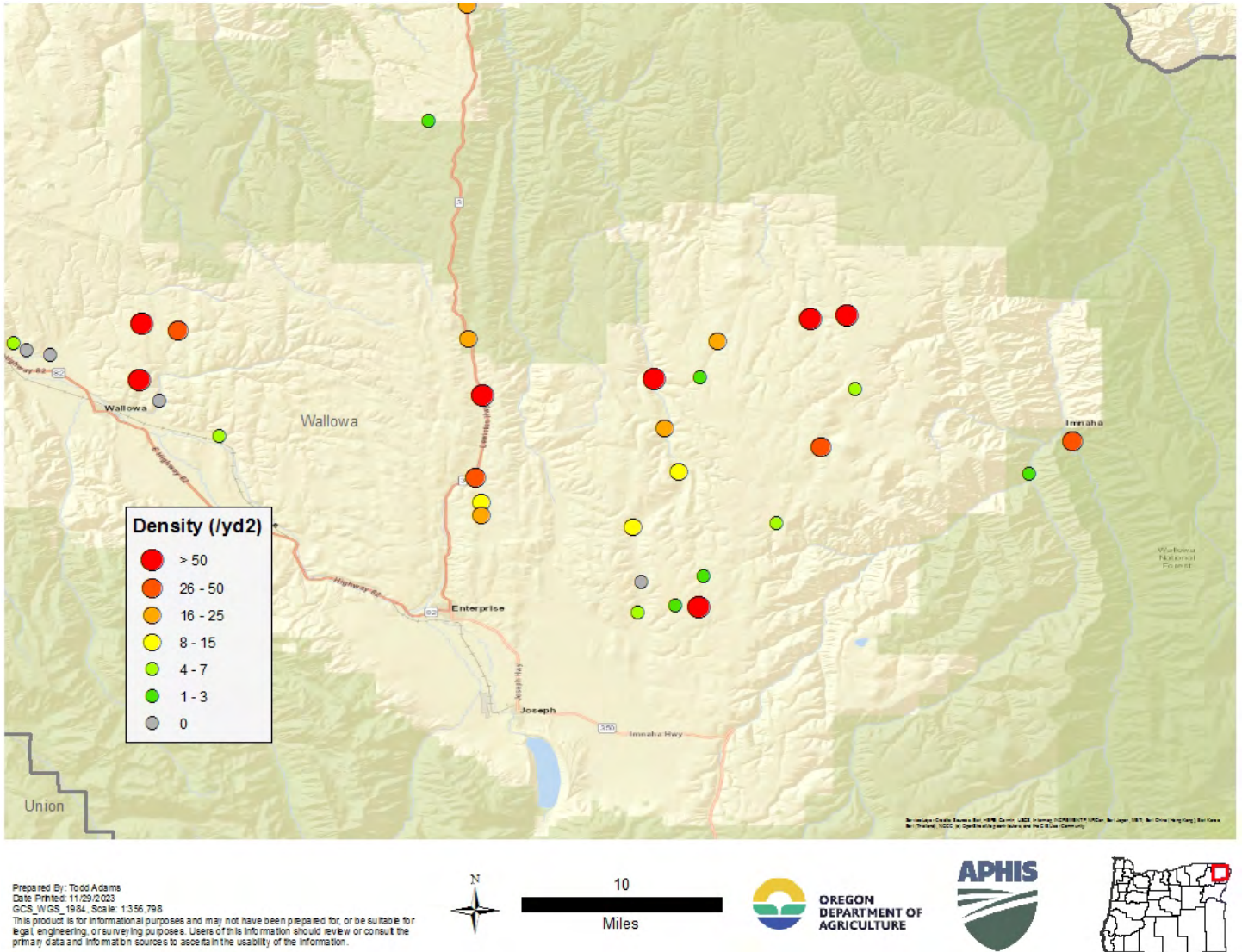


Figure 9. Grasshopper classified densities (GH/yd<sup>2</sup>) at survey locations in Wallowa County.



### 3-Central Grant County.

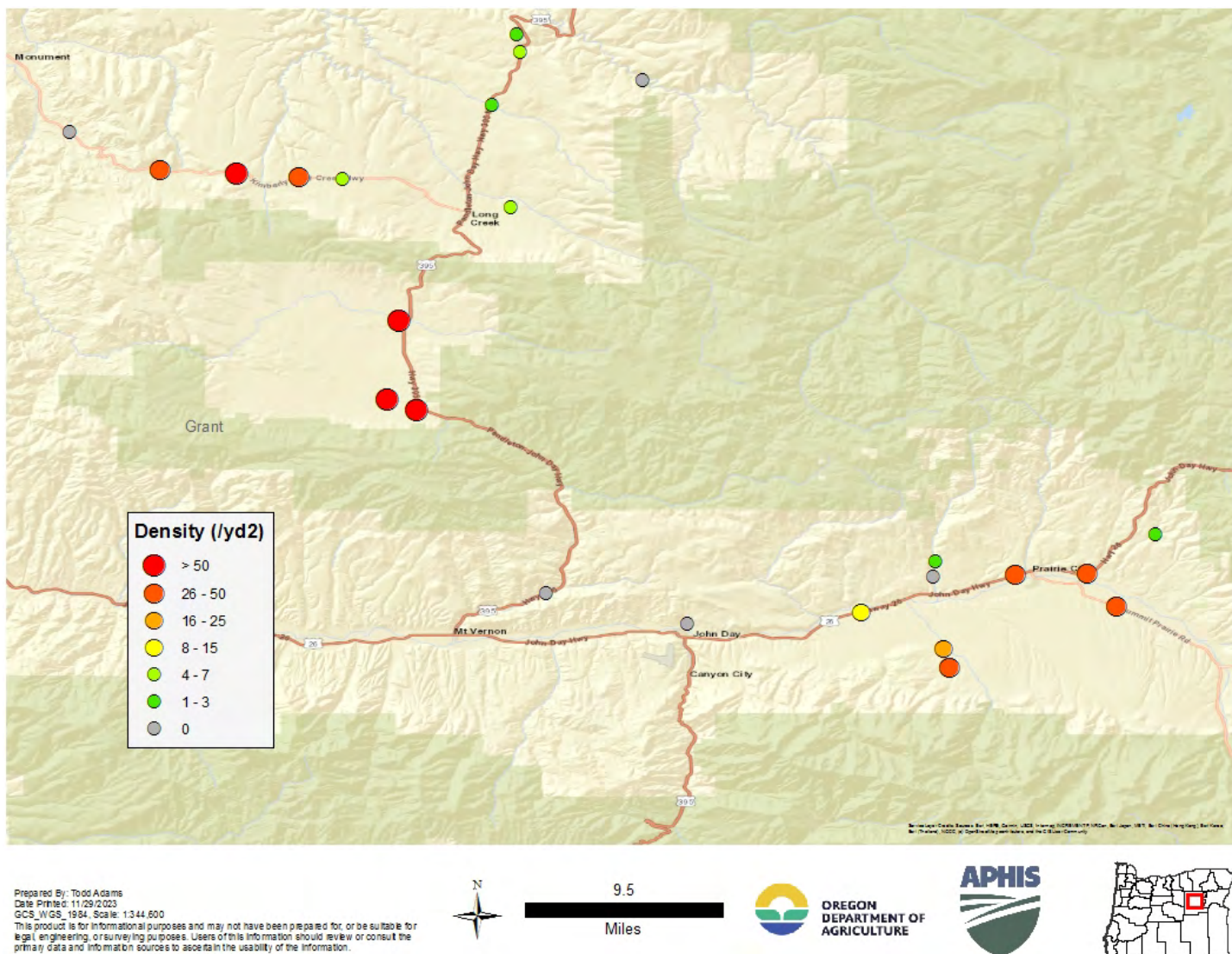
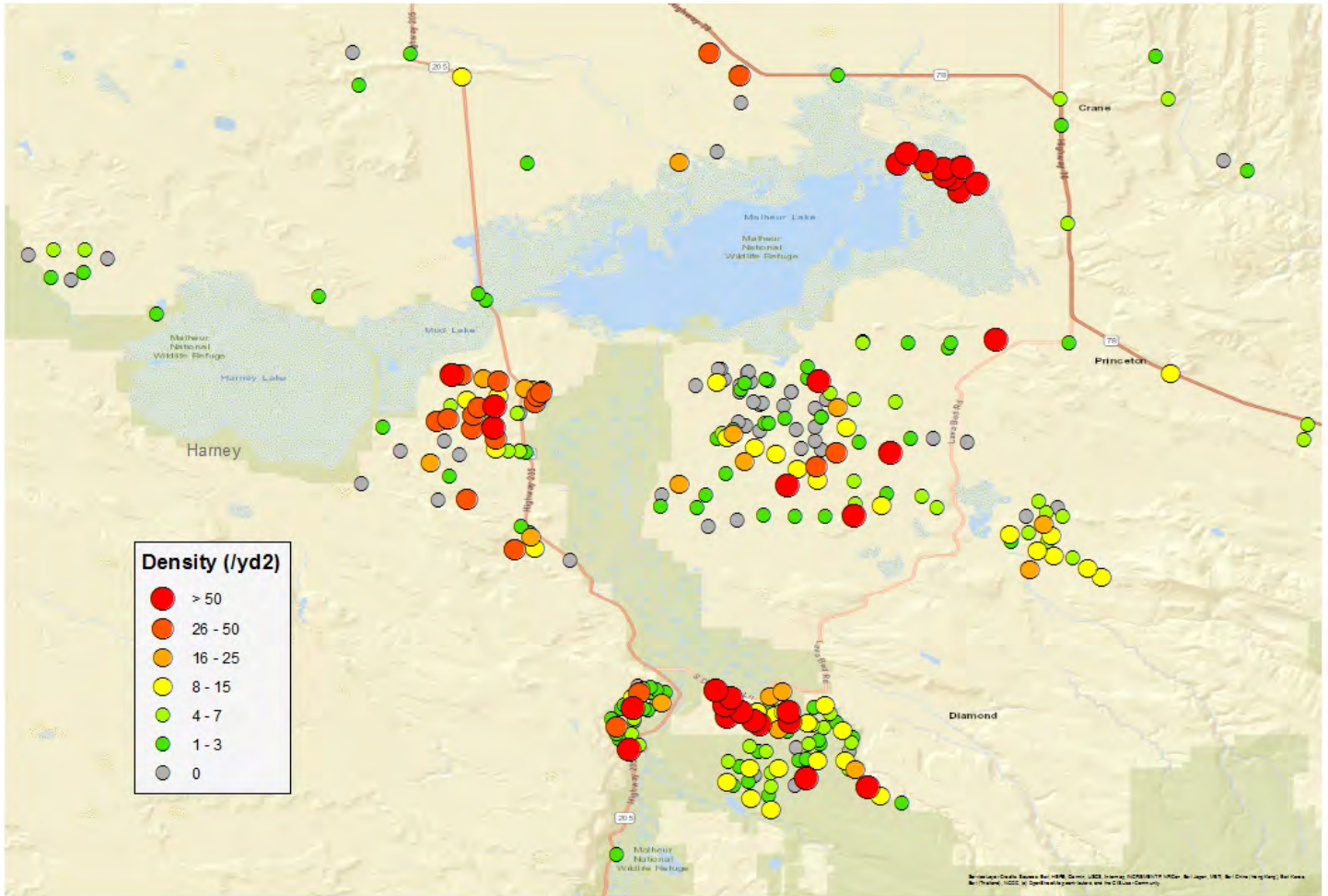


Figure 10. Grasshopper classified densities (GH/yd<sup>2</sup>) in Central Grant County.



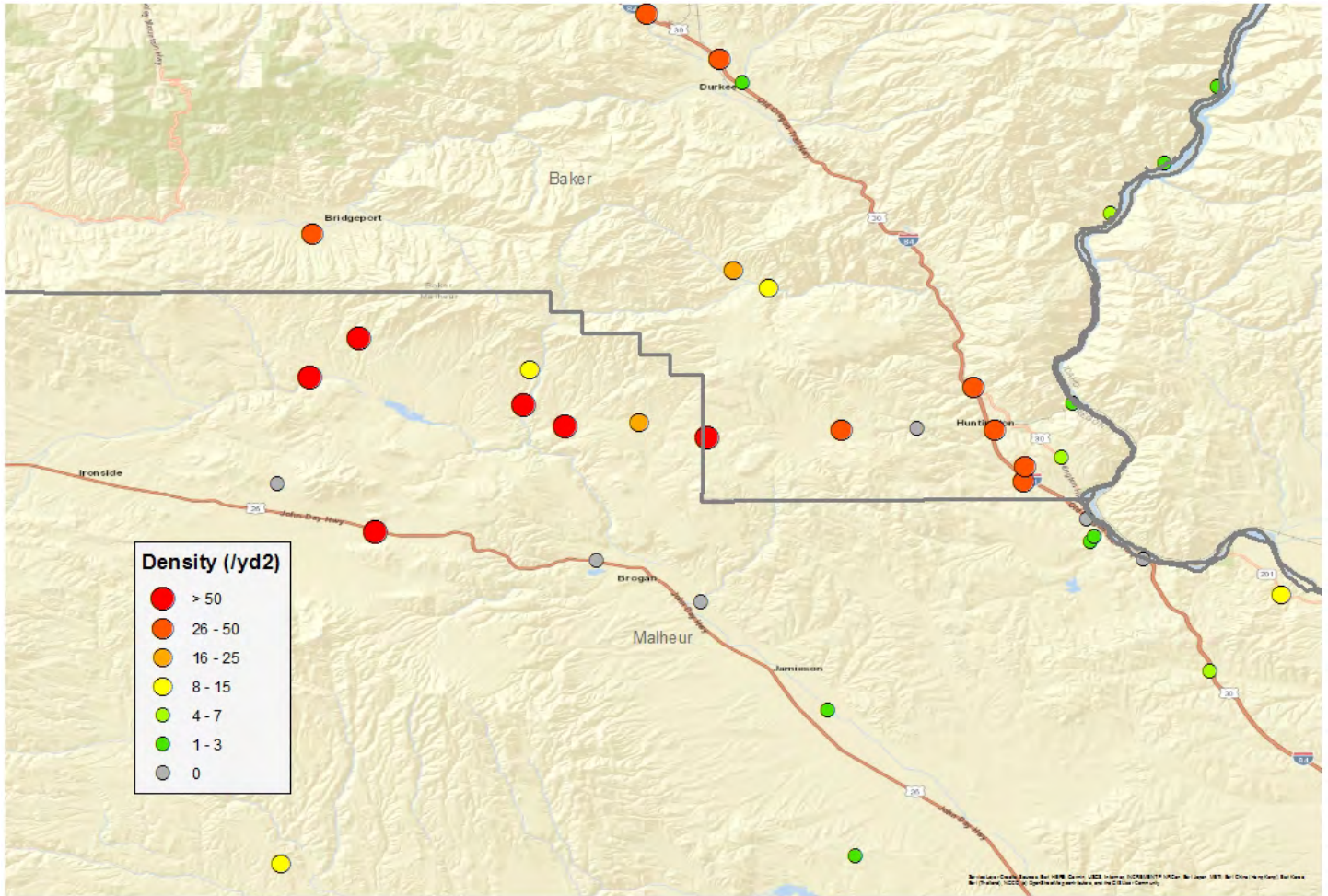
#### 4-Malheur National Wildlife Refuge, Harney County.



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Figure 11. Grasshopper survey classified densities (GH/yd<sup>2</sup>) in Malheur National Wildlife Refuge, Harney County

## 5-Malheur/Baker County Line.



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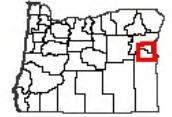
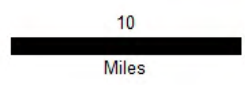


Figure 12. Grasshopper classified densities (GH/yd<sup>2</sup>) and area estimations from the region from Malheur/Baker County Line



6-East Steens, Harney County.

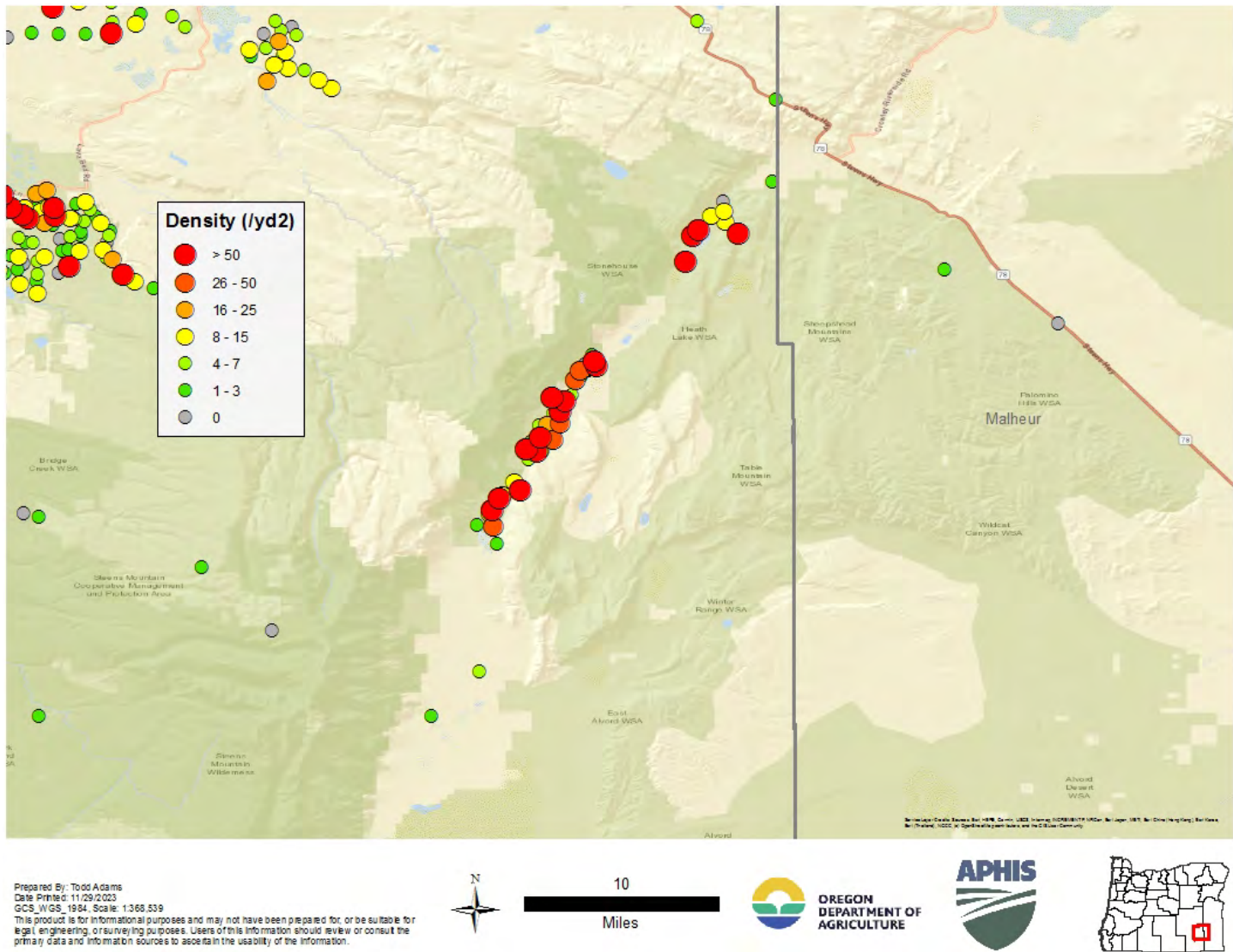


Figure 13. Grasshopper classified densities (GH/yd<sup>2</sup>) and area estimations from the region from East Steens, Harney County.



## TRIBAL LANDS

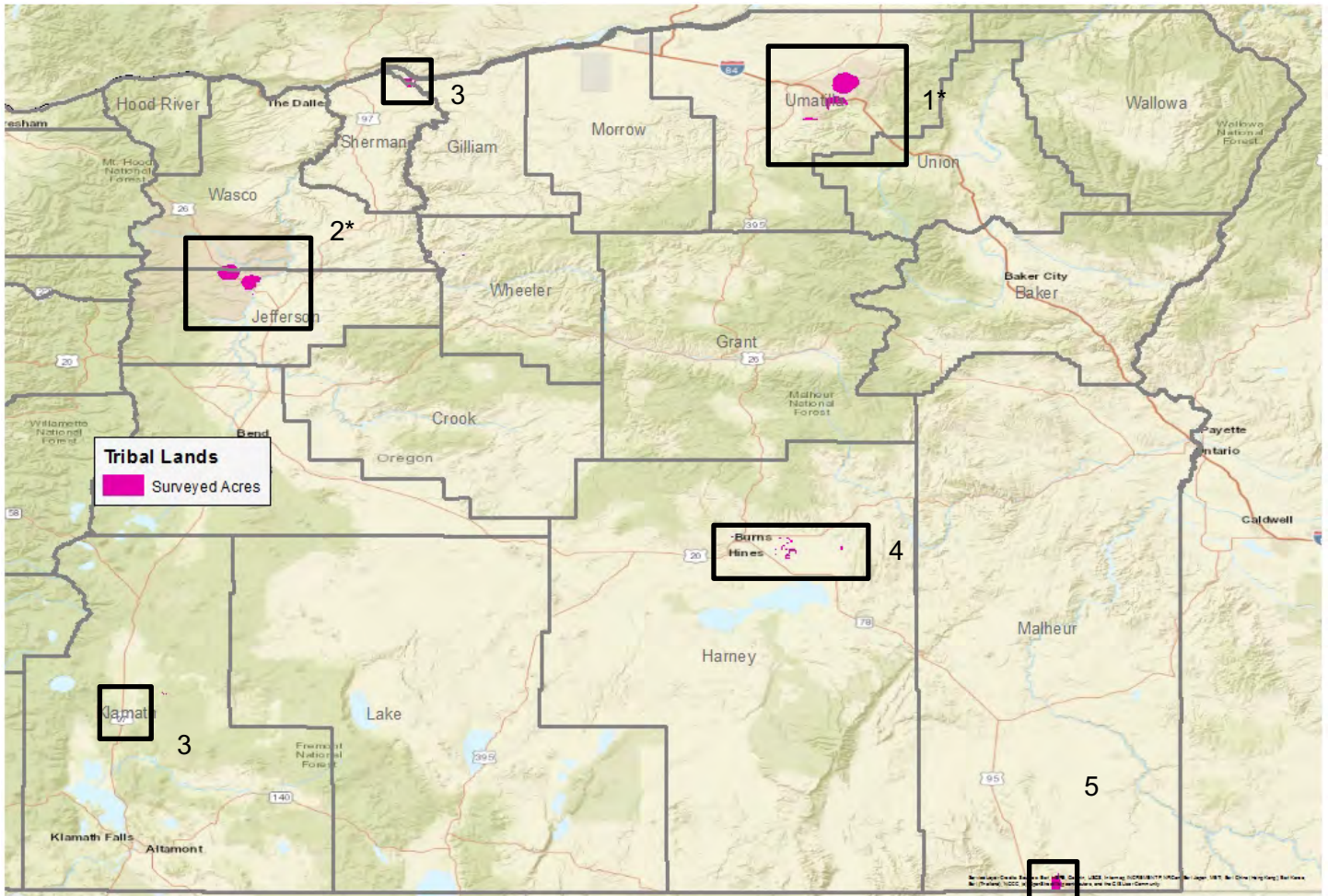
The grasshopper survey intersected tribal holdings at several locations across eastern Oregon (~239,429 ac; 96,893 ha), including the Umatilla and Warm Springs Reservations (Fig. 18). Area estimates on the Umatilla and Warm Springs Reservations contained both Economic and Non-economic densities (Table 6).

The largest area including survey density estimates occurred on the Confederated Tribes of the Warm Springs Reservation (Fig. 19) followed by acreage on the Confederated Tribes of the Umatilla Indian Reservation (Fig. 18).

Table 6. 2022 grasshopper survey area estimates intersecting with eastern Oregon tribal lands.

	Economic		Non-Economic		No Grasshoppers	
	Acres	Hectares	Acres	Hectares	Acres	Hectares
Burns Paiute Reservation	0	0	203	82	0	0
Fort McDermitt Reservation	5,225	2,114	16,426	6,647	6,257	2,532
Other	0	0	0	0	0	0
Umatilla Reservation	9,866	3,992	29,751	12,040	0	0
Warm Springs Reservation	40	16	12,566	5,085	10,332	4,181
Totals	15,131	6,122	58,946	23,854	16,589	6,713
Grand Total	90,666	36,689				

\*BIA lands not identified with a particular tribe or confederation in GIS resources available to ODA.



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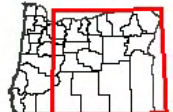


Figure 14. 2021 grasshopper survey areas intersecting tribal lands. Superimposed rectangles indicate the seven geographic areas where this occurred. Black rectangles with an asterisk indicate areas given a closer examination below. 1=CTUIR, 39,617ac; 2=Warm Springs, 22,938 ac; 3=Other, 0 ac; 4=Burns, 203 ac; 5=McDermitt, 27,908 ac. (1:2400k)

# A Closer Look

## 1-CTUIR Area, Umatilla County.

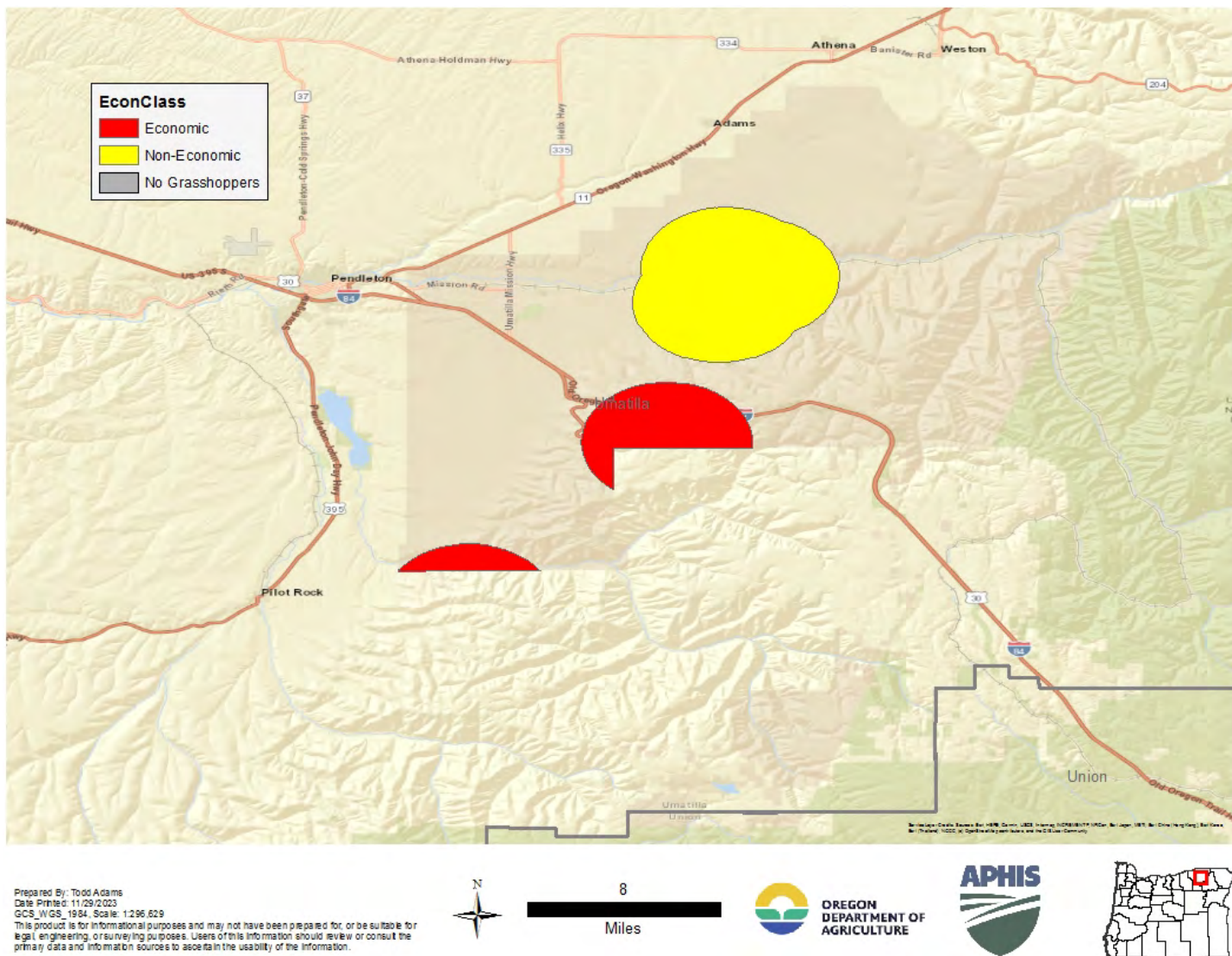


Figure 15. Grasshopper survey areas of economic density intersecting tribal land on the Confederated Tribes of the Umatilla Indian Reservation. Economic density:  $\geq 8$  grasshoppers per square yard.



## 2-Warm Springs Area, Jefferson and Wasco Counties.

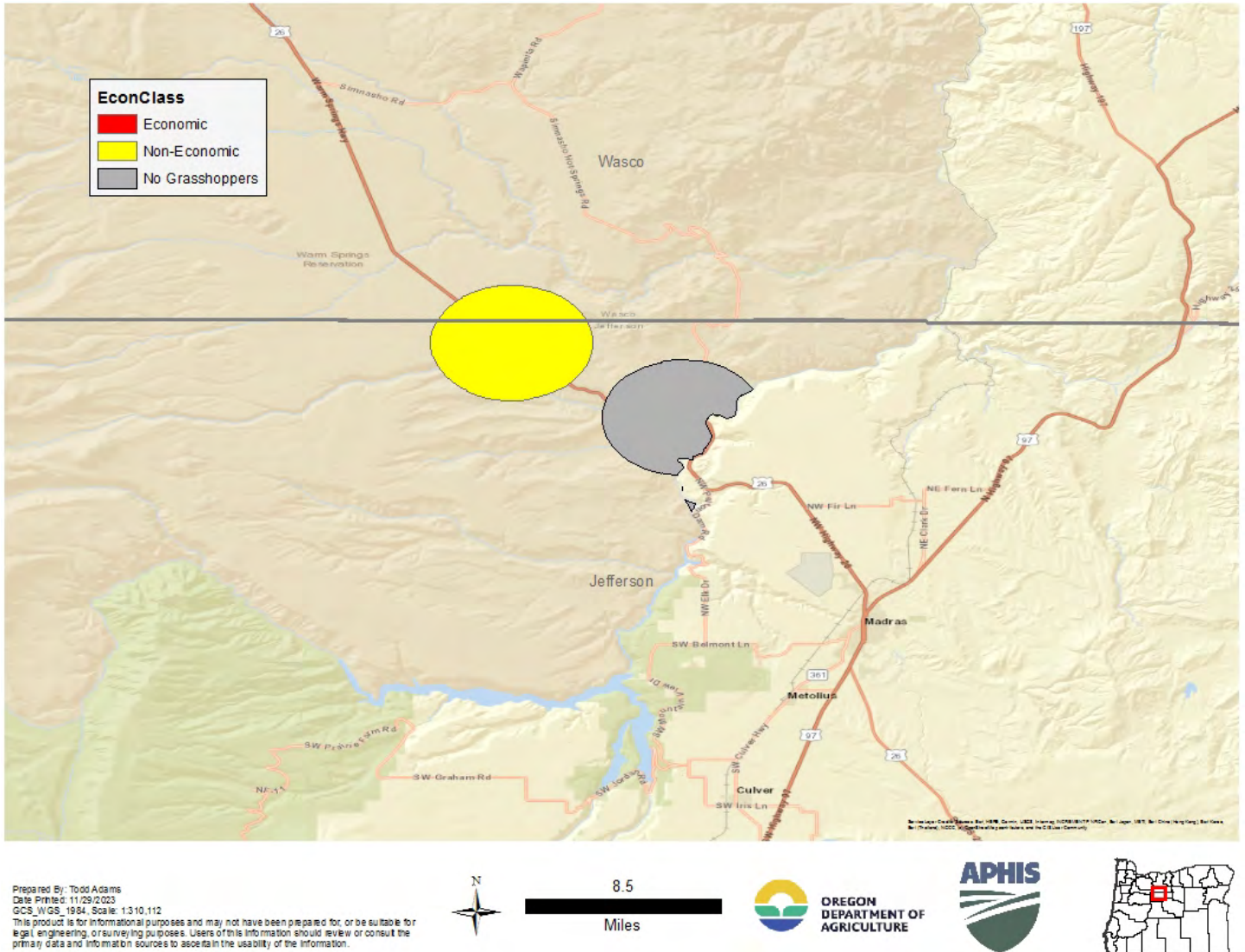


Figure 16. Grasshopper survey areas of economic density intersecting tribal land on the Confederated Tribes of the Warm Springs Indian Reservation. Economic density:  $\geq 8$  grasshoppers per square yard.

## MORMON CRICKETS

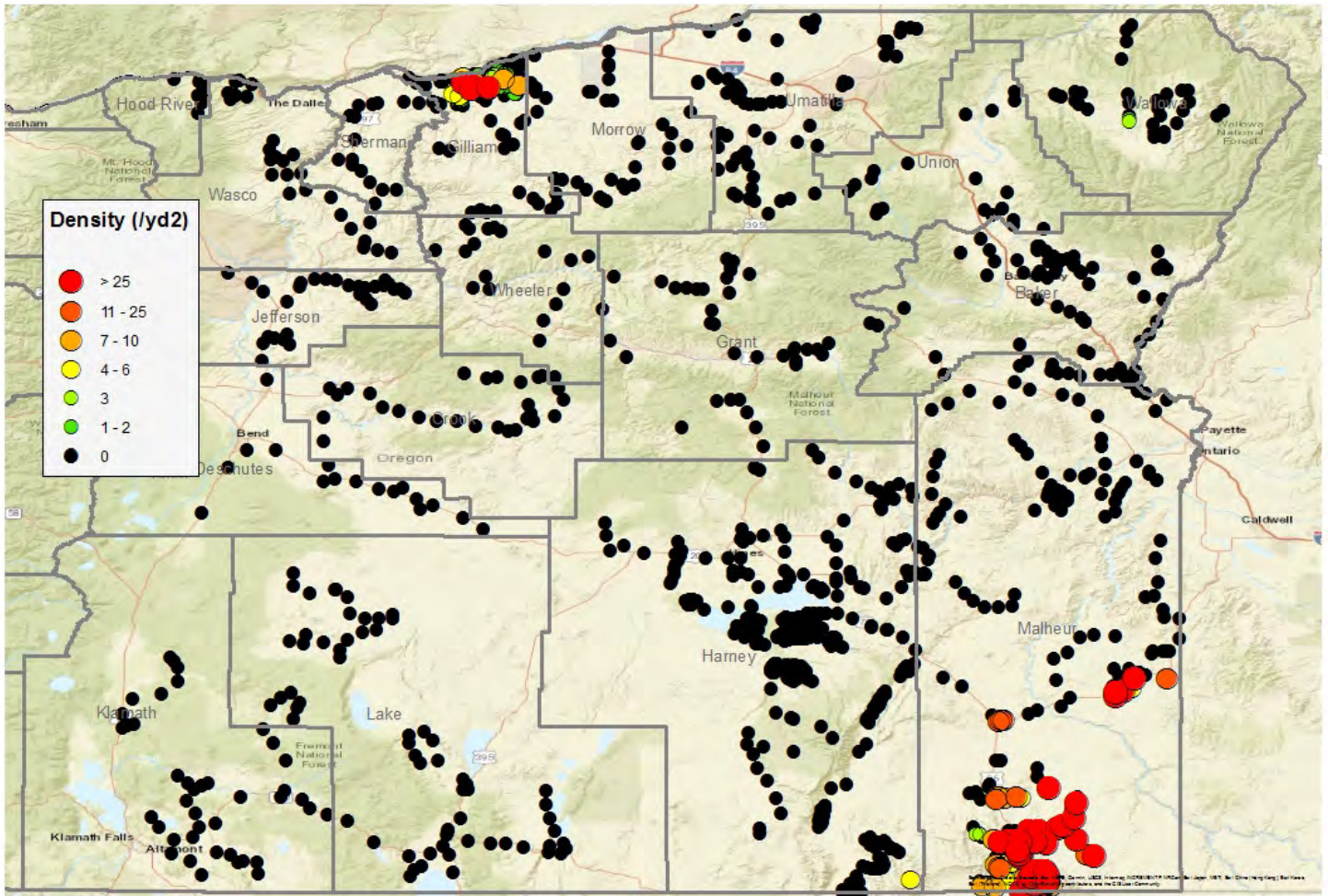
Mormon Crickets continue to move farther west from Idaho making to the Arock area along HWY 95. Populations continue to build and move north from McDermitt, Nevada. This year Mormon crickets were detected in the SE corner of Harney County up to Whitehorse Ranch Rd. Mormon crickets were found around Burns Junction again this year.

Significant numbers continued to be found in the area around Arlington (Gilliam County) and local efforts made several targeted suppressions to discourage development of excessive densities and subsequent banding and movement. Again, this year bands did not enter into the town of Arlington. No Mormon Crickets were found in Morrow County this year.

Support was provided for Robert Srygley (USDA, ARS, Sidney, MT), as he continues his research on Mormon cricket egg development and delayed hatch ('hedge betting') in the Arlington and Blalock Canyon area. All hope that Bob's work will help anticipate population outbreaks and assist in planning the long-term local response which is needed now and will be in the future.

Table 7. The number of Mormon cricket stops by Density Category (/yd<sup>2</sup>) and Dominant Life Stage encountered across the entire season.

Density	Totals	Dominant Developmental Stage								
		Egg	1	2	3	4	5	6	7	Adult
0	1427									
1 - 2	68	0	9	23	6	5	6	1	0	18
3	19	0	3	4	1	2	4	0	0	5
4 - 6	28	0	1	6	1	4	7	1	0	8
7 - 10	18	0	0	6	3	4	1	0	0	4
11 - 25	24	0	3	4	4	5	4	0	0	4
> 25	70	0	4	17	18	7	16	0	0	8
	1654	0	20	60	33	27	38	2	0	47
Percentages:		0.0	8.8	26.4	14.5	11.9	16.7	0.9	0.0	20.7



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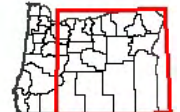
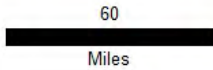


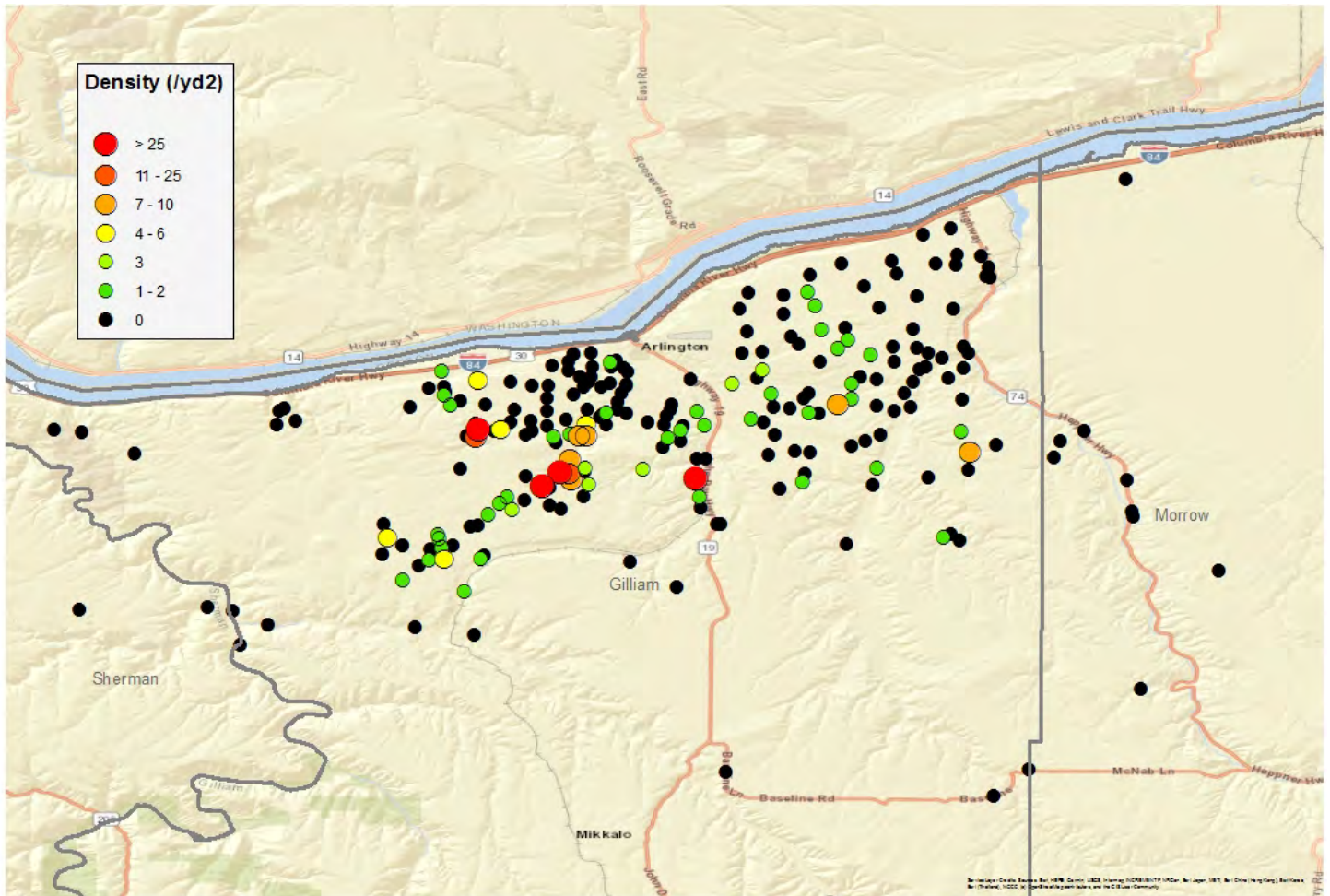
Figure 17. Locations surveyed for Mormon crickets (*Anabrus* sp.) in eastern Oregon classified by density (/yd<sup>2</sup>). (1:2400k)



## A CLOSER LOOK

### 1-Arlington Area, Gilliam County.

Mormon crickets continue to spread eastward from Blalock Canyon/Arlington making it to Morrow County this year.



Prepared By: Todd Adams  
Date Printed: 11/28/2023  
GCS\_NAD83\_1984, Scale: 1:266,667  
This product is for informational purposes and may not have been prepared for, or be suitable for, legal engineering, or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information.

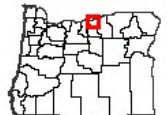
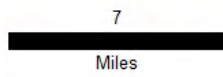


Figure 18. 2023 Mormon cricket survey results in the Arlington area.

## 2- Malheur/Harney County.

Mormon Crickets made it into the SE corner of Harney County this year up to Whitehorse Ranch Rd.

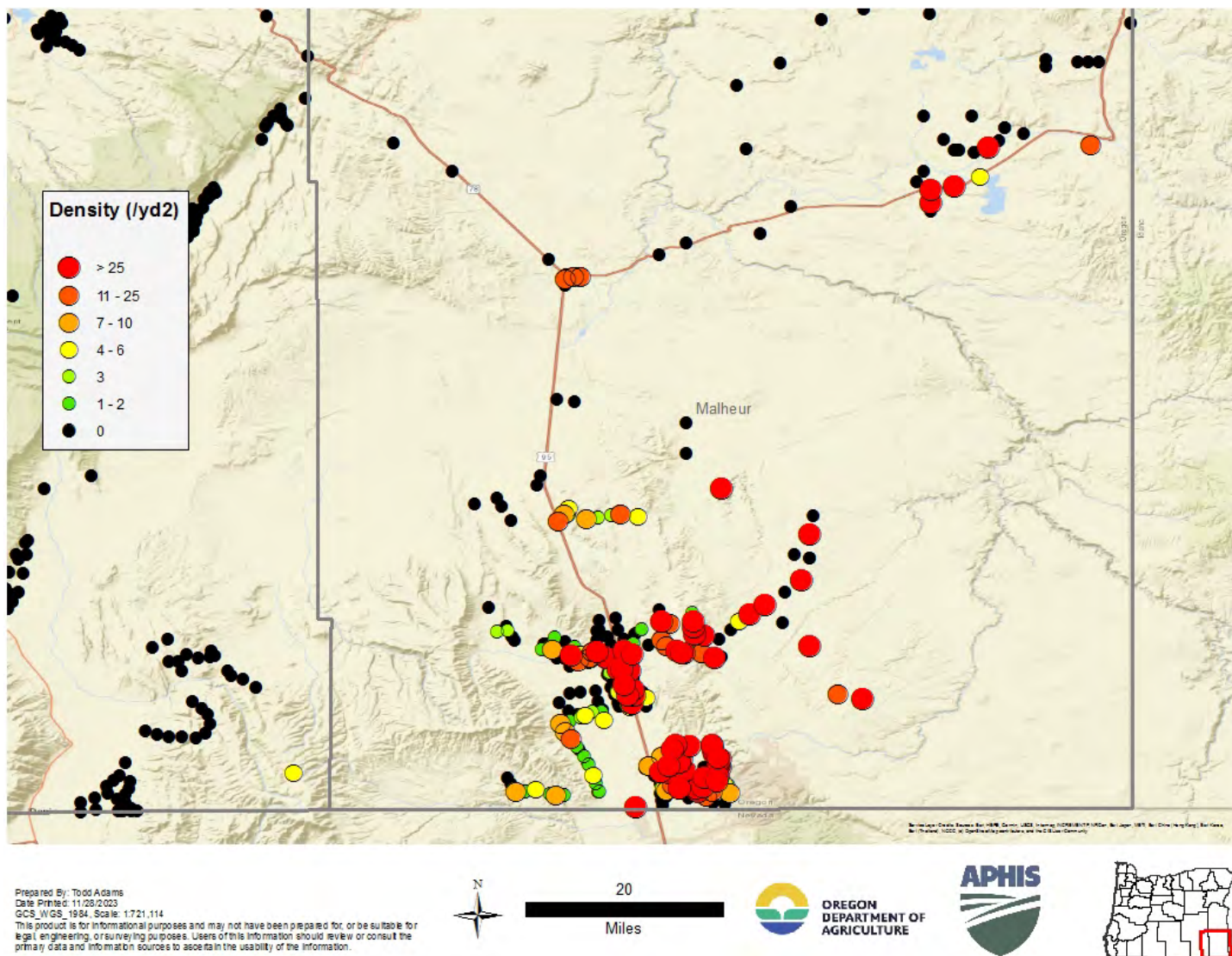


Figure 19. 2023 Mormon cricket survey results in Malheur/Harney County.

## SUMMARY

The Oregon Grasshopper and Mormon cricket Survey is conducted by the Oregon Department of Agriculture (ODA) in cooperation with the United States Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) Plant Protection and Quarantine (PPQ) State Plant Health Director office (Portland, OR).

Grasshopper populations over most of eastern Oregon appear to have decreased in acreage, but those areas economically impacted; densities still remain high with an average of 63 /yd<sup>2</sup> across all economically infested areas.

During 2023 a total of 1654 sampling locations were visited, 894 during the nymphal grasshopper survey period and 760 during the adult period (starting on 5 July). Nymphal survey takes place early in the season and is used to locate potential outbreak areas for response during the current year. Adult survey is used by ODA and APHIS to make predictions for the following season, considering economic levels as 8 or more grasshoppers per square yard. This season there were 342 locations (29% of all sampled acres) that were estimated to have densities of  $\geq 8$  grasshoppers / yd<sup>2</sup>. Land managers located within or near regions of high density should focus on early detection (hatch) in 2024. If early 2024 populations appear to be of significant density it is both fiscally and environmentally advantageous to intervene early in the grasshopper life cycle.

There are three areas in eastern Oregon known for Mormon cricket populations: the Arlington-Blalock Canyon area of Gilliam County, the region around Jordon Valley (primarily an Idaho population) in Malheur County and NW Wallowa County. In the last few years significant populations have plagued the Arlington and Jordon Valley area. Both may be on the decline now though only time will tell. Certainly, Arlington and vicinity continues to have had less pressure this past season, a trend likely encouraged by the coordinated management efforts of local city, county and private interests. The new population of Mormon Crickets that made its way into Oregon in 2021 from Nevada through McDermitt continues to spread into Oregon in all directions and made it into Harney County this year.

If you have encountered grasshopper or Mormon cricket issues and could benefit from information or assistance (non-treatment) please contact us (below). We are happy to help with providing information and even giving workshops.

### **Todd Adams**

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### **Colin Park**

USDA-APHIS-PPQ, Portland, OR, 503-730-7622, Colin.G.Park@usda.gov

For more information on USDA programs to protect US Rangeland from Grasshoppers and Mormon Crickets, including Cost Sharing for Grasshopper Suppression Treatment, please consult our factsheet:

[https://www.aphis.usda.gov/aphis/ourfocus/planthealth/plant-pest-and-disease-programs/pests-and-diseases/grasshopper-mormon-cricket/ct\\_grasshopper\\_mormon\\_cricket](https://www.aphis.usda.gov/aphis/ourfocus/planthealth/plant-pest-and-disease-programs/pests-and-diseases/grasshopper-mormon-cricket/ct_grasshopper_mormon_cricket)

Or visit our full program website:



<https://oda.fyi/GrasshopperMormonCricket>

**ARS resource page for grasshopper and Mormon Cricket:**

<https://www.ars.usda.gov/plains-area/sidney-mt/northern-plains-agricultural-research-laboratory/pest-management-research/pmru-docs/grasshoppers-their-biology-identification-and-management/grasshopper-site-highlights/>

<https://oda.direct/IPPMGrasshoppersCrickets>

**Appendix 1. Estimate of the acreage with economic levels of grasshopper infestation ( $\geq 8$  grasshoppers / yd<sup>2</sup>) based on the 2021 survey.**

County	Watershed	Economic Classes Summed by Watershed			Economic Classes Summed by County		
		Economic	Non-Economic	No Grasshoppers	Economic	Non-Economic	No Grasshoppers
Baker	Alder Creek-Pritchard Creek	29,200	8,115	0	331,113	89,435	23,416
	Baldock Slough-Powder River	20,361	15,003	7,914			
	Big Creek	4,324	0	0			
	Big Creek-Burnt River	0	0	117			
	Birch Creek-Snake River	20,738	2,076	1,287			
	Burnt River Canyon-Burnt River	2,407	227	0			
	Camp Creek	0	7,239	10,858			
	Clarks Creek-Burnt River	12,588	0	0			
	Daly Creek-Powder River	20,464	0	0			
	Dixie Creek-Burnt River	39,131	4,306	596			
	Eagle Creek	2,370	0	0			
	Love Creek-Powder River	35,442	0	5			
	Middle Willow Creek	809	0	0			
	North Fork Burnt River	12,566	0	0			
	North Powder River	122	0	0			
	Pine Creek	23,723	1,497	0			
	Rock Creek-Powder River	29,390	6,040	0			
	Rock Creek-Snake River	4,436	16,526	0			
	Ruckles Creek-Powder River	68,772	21,372	1,052			
	South Fork Burnt River	0	0	1,588			
South Willow Creek	0	702	0				
Sutton Creek-Powder River	260	4,585	0				
Upper Willow Creek	255	0	0				
Wolf Creek-Powder River	3,756	1,748	0				
Crook	Bear Creek	0	0	207	49,835	167,834	65,061
	Camp Creek	0	3,136	0			
	Chimney Rock-Crooked River	0	12,446	0			
	Deep Creek	8,925	6,757	0			
	Grindstone Creek	3,484	0	0			
	Horse Heaven Creek-Crooked River	2,801	25,820	21,866			

**Appendix 1. Estimate of the acreage with economic levels of grasshopper infestation ( $\geq 8$  grasshoppers / yd<sup>2</sup>) based on the 2021 survey.**

County	Watershed	Economic Classes Summed by Watershed			Economic Classes Summed by Count			
		Economic	Non-Economic	No Grasshoppers	Economic	Non-Economic	No Grasshoppers	
	Lone Pine Creek-Crooked River		0	13,451	6,961			
	Lower Beaver Creek		8,440	18,612	9,109			
	Lower Dry River		0	3,724	12,758			
	Lower North Fork Crooked River		2,417	1,902	1,289			
	Lower Ochoco Creek		0	8,768	3,019			
	Lower South Fork Crooked River		0	2,220	0			
	Paulina Creek		14,380	12,783	144			
	Prineville Reservoir-Crooked River		0	9,202	603			
	Upper Beaver Creek		1,872	4,888	122			
	Upper Dry River		0	1,428	1,664			
	Upper North Fork Crooked River		0	24,994	5,590			
	Upper South Fork Crooked River		0	1,169	0			
	Watson Creek-Crooked River		7,516	16,534	1,728			
Deschutes	Bear Creek		0	0	655	0	104,206	82,164
	Juniper Butte-Crooked River		0	0	9,865			
	Lone Pine Creek-Crooked River		0	0	151			
	Lower Dry River		0	0	11,339			
	Lower Little Deschutes River		0	0	10,467			
	Mayfield Pond-Central Oregon Canal		0	795	1,227			
	McKenzie Canyon-Deschutes River		0	8,526	3,540			
	North Unit Diversion Dam-Deschutes River		0	12,309	0			
	Soldiers Cap		0	22,550	13,968			
	Upper Dry River		0	36,125	30,950			
	Upper South Fork Crooked River		0	23,902	0			
Gilliam	Butte Creek		0	211	8,713	30,827	177,050	113,964
	Eightmile Canyon		4,599	30,988	15,104			
	Ferry Canyon-John Day River		0	0	7,418			
	John Day River		0	8,956	5,390			
	Lower Lake Umatilla		17,571	39,952	28,900			
	Lower Rock Creek		758	40,671	18,757			



**Appendix 1. Estimate of the acreage with economic levels of grasshopper infestation ( $\geq 8$  grasshoppers / yd<sup>2</sup>) based on the 2021 survey.**

County	Watershed	Economic Classes Summed by Watershed			Economic Classes Summed by Count		
		Economic	Non-Economic	No Grasshoppers	Economic	Non-Economic	No Grasshoppers
Grant	Lower Willow Creek		7,899	6,835	2,357		
	Scott Canyon-John Day River		0	2,094	13,567		
	Thirtymile Creek		0	23,894	6,295		
	Upper Rock Creek		0	23,449	7,465		
	Bear Creek	2,444	0	4,677	116,626	128,356	109,081
	Beech Creek	2,734	0	8,706			
	Big Creek-Middle Fork John Day River	0	2,270	12,938			
	Bridge Creek-Middle Fork John Day River	0	12,566	6,237			
	Canyon Creek	0	307	613			
	Cottonwood Creek	28,974	2	9,399			
	Eightmile Creek-Middle Fork John Day River	0	13,462	169			
	Fields Creek-John Day River	135	0	0			
	Franks Creek-John Day	0	0	11,856			
	Grub Creek-John Day River	38,741	6,175	5,424			
	Headwaters Silvies River	21	27,823	6,808			
	Johnson Creek-John Day River	0	0	7,548			
	Kahler Creek-John Day River	469	0	1,756			
	Laycock Creek-John Day River	23	0	8,169			
	Long Creek	14,698	32,250	1,021			
	Lower South Fork John Day River	0	0	11,283			
Middle South Fork John Day River	0	2,928	0				
Outlet North Fork John Day River	7,539	0	11,809				
Reynolds Creek-John Day River	11,157	8,482	0				
Rock Creek	0	0	667				
Upper Silvies River	9,691	12,566	0				
Upper South Fork John Day River	0	9,524	0				
Harney	Alvord Lake	18,626	75,537	11,617	545,536	782,345	147,745
	Big Alvord Creek	0	29,964	287			
	Chain Lake	0	7,834	0			
	Claw Creek	0	0	5,391			

**Appendix 1. Estimate of the acreage with economic levels of grasshopper infestation ( $\geq 8$  grasshoppers / yd<sup>2</sup>) based on the 2021 survey.**

County	Watershed	Economic Classes Summed by Watershed			Economic Classes Summed by Count		
		Economic	Non-Economic	No Grasshoppers	Economic	Non-Economic	No Grasshoppers
	Cottonwood Creek-Frontal Pueblo Valley	13,410	29,399	4,267			
	Crane Creek	0	34,760	468			
	Griffin Creek-Malheur River	20,375	14,952	0			
	Harney Lake-Malheur Lake	77,677	75,288	7,747			
	Headwaters Malheur River	0	4,541	0			
	Home Creek-Garrison Lake	0	23,715	2,483			
	Jackass Creek	1,679	2,034	2,848			
	Kiger Creek-Diamond Canal	26,605	5,485	3,584			
	Lower Donner und Blitzen River	55,475	7,774	7,036			
	Lower North Fork Malheur River	213	4,123	0			
	Lower Silver Creek	0	54,740	2,640			
	Lower Silvies River	34,599	41,720	1,319			
	Lower South Fork Malheur River	10,655	13,495	0			
	Malheur Gap	23,134	7,630	2,303			
	Malheur Slough	14,147	25,589	11,642			
	McDermitt Creek	0	0	3,921			
	Middle Donner und Blitzen River	38,520	34,488	402			
	Middle Silver Creek	0	41,992	13,767			
	Middle Silvies River	0	0	3,723			
	Otis Creek	8,290	11,561	0			
	Pine Creek	0	5,308	0			
	Poison Creek	21,555	31,689	0			
	Quail Creek	12,764	5,233	545			
	Riddle Creek	44,161	4,797	770			
	Rincon Creek	0	1,269	0			
	Sage Hen Creek	15,093	21,766	2,265			
	Shallow Lake-Slickey Lake	0	18,426	0			
	Skull Creek	0	10,684	10,925			
	Squaw Lake-Capehart Lake	0	0	1,194			
	Stinkingwater Creek	7,334	13,320	0			

## Appendix 1. Estimate of the acreage with economic levels of grasshopper infestation ( $\geq 8$ grasshoppers / yd<sup>2</sup>) based on the 2021 survey.

County	Watershed	Economic Classes Summed by Watershed			Economic Classes Summed by Count		
		Economic	Non-Economic	No Grasshoppers	Economic	Non-Economic	No Grasshoppers
	Summit Creek	53,372	4,363	0			
	Upper Donner und Blitzen River	0	28,101	8,319			
	Upper Silver Creek	0	0	3,260			
	Upper Silvies River	0	0	13,187			
	Upper South Fork Malheur River	16,234	26,625	201			
	Walls Lake Reservoir	0	22,269	15,110			
	Warm Springs Reservoir-Malheur River	25,111	6,268	1,362			
	Whitehorse Creek	0	0	1,426			
	Willow Creek	6,507	10,309	1,733			
	Wolf Creek	0	25,297	0			
Hood river	East Fork Hood River	658	0	0	23,492	13,168	9,686
	Hood River	16,190	7,385	3,065			
	Mill Creek-Columbia River	9	0	0			
	Mosier Creek-Columbia River	6,635	5,783	6,621			
Jefferson	Hay Creek	0	6,130	5,185	0	155,206	57,154
	Juniper Butte-Crooked River	0	7,774	9,808			
	Lower Trout Creek	0	10,413	7,163			
	McKenzie Canyon-Deschutes River	0	0	227			
	Mud Springs Creek	0	21,571	0			
	Muddy Creek-John Day River	0	23,783	2,300			
	Potter Canyon-Deschutes River	0	3,251	0			
	Shitike Creek-Deschutes River	0	10,319	23,319			
	Upper Trout Creek	0	45,765	3,650			
	Willow Creek	0	26,200	5,501			
Klamath	Crater Lake-Williamson River	0	16,339	8,140	12,566	246,124	156,040
	Fishhole Creek	0	556	2,897			
	Gerber Reservoir-Miller Creek	0	6,351	0			
	Hog Creek-Williamson River	0	21,055	3,035			
	Jack Creek-Williamson River	12,566	21,975	11,143			
	Langell Valley-Lost River	0	38,996	2,783			



## Appendix 1. Estimate of the acreage with economic levels of grasshopper infestation ( $\geq 8$ grasshoppers / yd<sup>2</sup>) based on the 2021 survey.

County	Watershed	Economic Classes Summed by Watershed			Economic Classes Summed by Count		
		Economic	Non-Economic	No Grasshoppers	Economic	Non-Economic	No Grasshoppers
	Lower Sycan River		0	0	17,369		
	Middle Sycan River		0	54	3,553		
	Mills Creek-Lost River		0	5,807	7,797		
	North Fork Sprague River		0	5,415	12,410		
	South Fork Sprague River		0	28,344	6,495		
	Sprague River		0	27,447	37,680		
	Swan Lake Valley		0	20,264	12,249		
	Yonna Valley-Lost River		0	53,522	30,488		
Lake	Anna River-Summer Lake		0	3,602	0	0	375,576
	Campbell Lake		0	0	11,461		
	Christmas Lake Valley		0	0	217		
	Crooked Creek		0	17,185	1,399		
	Crump Lake		0	39,793	23,834		
	Deep Creek		0	26,758	25,411		
	Drews Creek-Frontal Goose Lake		0	36,399	7,289		
	Dry Creek-Fort Rock Valley		0	3,016	2,086		
	Dry Creek-Frontal Goose Lake		0	7,500	0		
	Duncan Creek-Silver Lake		0	22,244	89		
	Fishhole Creek		0	0	44		
	Goose Lake		0	2,176	0		
	Honey Creek		0	531	2,031		
	Lower Chewaucan River		0	40,765	39,600		
	Lower Sycan River		0	0	1,218		
	Middle Chewaucan River		0	1,039	0		
	Middle Sycan River		0	35,973	6,778		
	Pine Lake-Devils Garden		0	2,728	9,332		
	Post Lake		0	0	8,580		
	Rock Creek-Buck Creek		0	1,276	0		
	Sand Canyon-Lake Abert		0	1,026	1,495		
	Silver Creek		0	35,645	10,388		

**Appendix 1. Estimate of the acreage with economic levels of grasshopper infestation ( $\geq 8$  grasshoppers / yd<sup>2</sup>) based on the 2021 survey.**

County	Watershed	Economic Classes Summed by Watershed			Economic Classes Summed by Count		
		Economic	Non-Economic	No Grasshoppers	Economic	Non-Economic	No Grasshoppers
Malheur	South Fork Sprague River		0	2,695	5,233		
	Thomas Creek		0	21,030	33,481		
	Thorn Lake		0	61,775	52,546		
	Upper South Fork Crooked River		0	63	0		
	Upper Sycan River		0	1,964	0		
	Willow Creek-Frontal Goose Lake		0	10,394	999		
	Big Antelope Creek		0	24,340	39,192	536,603	620,902
	Birch Creek-Snake River		6,944	8,039	3,505		
	Camp Creek		0	308	0		
	Clover Creek		14,434	1,176	0		
	Cottonwood Creek		26,179	12,531	0		
	Cow Creek		20,637	0	5,625		
	Crooked Creek		12,566	20,433	11,655		
	Crowley Creek		21,779	35,254	0		
	Dry Creek		0	1,228	335		
	Dry Creek-Jordan Creek		0	24,352	15,046		
	Hog Creek-Malheur River		23,516	7,587	0		
	Hunter Creek-Malheur River		0	7,890	0		
	Jackson Creek-Owyhee River		3,616	20,124	0		
	Jacobsen Gulch-Snake River		0	548	0		
	Johnston Gulch Reservoir-Malheur River		20,529	905	0		
	Juniper Basin Creek-Malheur River		13,633	19,310	0		
	Little Malheur River		11,113	0	0		
	Little Sandy Reservoir-Malheur River		13,006	23,039	730		
	Locket Gulch-Snake River		6,280	54	0		
	Lone Star Reservoir		0	31,178	46,749		
	Lower Bully Creek		666	22,065	0		
	Lower Cow Creek		28,381	13,140	10,483		
Lower North Fork Malheur River		512	53,517	0			
Lower South Fork Malheur River		23,111	4,972	3,765			

**Appendix 1. Estimate of the acreage with economic levels of grasshopper infestation ( $\geq 8$  grasshoppers / yd<sup>2</sup>) based on the 2021 survey.**

County	Watershed	Economic Classes Summed by Watershed			Economic Classes Summed by Count		
		Economic	Non-Economic	No Grasshoppers	Economic	Non-Economic	No Grasshoppers
	Lower Succor Creek	34,430	8,141	8,363			
	Lower Willow Creek	24	18,247	0			
	McDermitt Creek	0	12,044	6,597			
	Middle Willow Creek	26,011	0	23,893			
	Moores Hollow-Snake River	6,315	10,052	0			
	North Alkali Creek-Snake River	0	4,744	0			
	Oregon Canyon Creek	79,269	80,035	44,781			
	Otis Creek	0	1,563	0			
	Quail Creek	2,042	9,165	0			
	Rattlesnake Creek	0	29,819	43,779			
	Ryegrass Creek-Owyhee River	0	11,056	5,962			
	Sand Hollow	39,448	15,804	73			
	Sand Hollow Creek-Owyhee River	24,713	4,835	91			
	Sheep Spring Creek-Jordan Creek	5,655	28,905	23,259			
	Skull Creek-Owyhee River	0	3,308	15,679			
	Soldier Creek	0	208	0			
	South Willow Creek	25,074	4,318	0			
	Three Fingers Gulch-Owyhee River	2,721	7,389	0			
	Twelvemile Creek-Coyote Lake	0	1,324	754			
	Upper Bully Creek	10,226	2,974	0			
	Upper Cow Creek	4,098	11,447	10,647			
	Upper Dry Creek	0	12,419	0			
	Upper South Fork Malheur River	0	2,689	0			
	Upper Succor Creek	2,527	0	15,966			
	Upper Willow Creek	25,368	0	5,692			
	Warm Springs Reservoir-Malheur River	1,782	8,062	398			
	West Little Owyhee River	0	0	2,873			
	West Tub Mountain Reservoir	0	365	0			
Morrow	Eightmile Canyon	0	6,968	11,315	61,404	115,948	139,115
	Hunt Ditch-Umatilla River	980	0	0			



**Appendix 1. Estimate of the acreage with economic levels of grasshopper infestation ( $\geq 8$  grasshoppers / yd<sup>2</sup>) based on the 2021 survey.**

County	Watershed	Economic Classes Summed by Watershed			Economic Classes Summed by Count			
		Economic	Non-Economic	No Grasshoppers	Economic	Non-Economic	No Grasshoppers	
Sherman	Juniper Canyon		0	20,039	26,372			
	Lower Butter Creek		8,886	13,936	7,165			
	Lower Lake Umatilla		0	520	8,261			
	Lower Rock Creek		0	0	856			
	Lower Willow Creek		45	22,328	9,284			
	Middle Lake Umatilla		0	1,663	9,754			
	Middle Willow Creek		0	2,791	292			
	Rhea Creek		26,125	15,330	10,289			
	Sand Hollow		267	5,478	4,832			
	Sixmile Canyon		0	7,778	9,127			
	Upper Butter Creek		14,483	3,687	6,738			
	Upper Rock Creek		10,617	5,162	12,127			
	Upper Willow Creek		0	10,268	22,703			
	Buck Hollow Creek		2,804	16,997	16,484	2,804	90,878	75,323
	Cedar Island-Deschutes River		0	12,997	8,636			
	Ferry Canyon-John Day River		0	6,487	6,152			
	Grass Valley Canyon		0	26,929	12,120			
	John Day River		0	4,978	8,558			
	Pine Hollow		0	5,201	9,202			
	Scott Canyon-John Day River		0	1,715	1,143			
Spanish Hollow-Columbia River		0	15,574	13,030				
White Horse Rapids-Deschutes River		0	0	0				
Umatilla	Alkali Canyon-Umatilla River		12,566	52,776	11,507	178,717	218,161	95,222
	Birch Creek		16,151	52,349	568			
	Cold Springs Canyon		0	0	24,648			
	Headwaters Grande Ronde River		0	20	0			
	Hunt Ditch-Umatilla River		1,156	4,479	0			
	Lower Camas Creek		48,497	18,431	0			
	Lower Lake Wallula		0	0	19,128			
	Lower Walla Walla River		0	8,503	7,808			

**Appendix 1. Estimate of the acreage with economic levels of grasshopper infestation ( $\geq 8$  grasshoppers / yd<sup>2</sup>) based on the 2021 survey.**

County	Watershed	Economic Classes Summed by Watershed			Economic Classes Summed by Count		
		Economic	Non-Economic	No Grasshoppers	Economic	Non-Economic	No Grasshoppers
Union	McKay Creek	15,128	3,931	332			
	Meadow Creek	0	305	0			
	Middle Walla Walla River	0	8,312	6,752			
	Mission Creek-Umatilla River	6,905	16,318	3,614			
	Pine Creek	18,917	10,763	222			
	Stage Gulch	0	4,693	4,669			
	Upper Butter Creek	35,588	20,792	6,814			
	Upper Camas Creek	22,847	2,517	0			
	Upper Walla Walla River	0	11,409	8,835			
	Wildhorse Creek	961	2,566	326			
	Beaver Creek-Grande Ronde River	0	12,931	0	62,271	80,139	44,357
	Big Creek	10,437	0	0			
	Cabin Creek-Grande Ronde River	8,285	7,488	890			
	Headwaters Grande Ronde River	21,867	291	0			
	Indian Creek-Grande Ronde River	0	11,068	340			
	Ladd Creek	0	0	9,225			
	Lower Catherine Creek	0	0	1,199			
	Lower Wallowa River	1,840	0	0			
	Meadow Creek	9,987	20,627	0			
	Minam River	945	1,850	0			
North Powder River	0	0	0				
Upper Camas Creek	19	1,305	0				
Upper Catherine Creek	0	4,019	14,709				
Willow Creek	0	0	11,336				
Wolf Creek-Powder River	8,891	20,560	6,658				
Wallowa	Bear Creek	154	0	0	173,279	83,840	2,764
	Chesnimnus Creek	27,750	3,585	0			
	Lostine River	0	1,508	0			
	Lower Big Sheep Creek	16,309	18,432	0			
	Lower Imnaha River	3,031	0	0			

**Appendix 1. Estimate of the acreage with economic levels of grasshopper infestation ( $\geq 8$  grasshoppers / yd<sup>2</sup>) based on the 2021 survey.**

County	Watershed	Economic Classes Summed by Watershed			Economic Classes Summed by Count		
		Economic	Non-Economic	No Grasshoppers	Economic	Non-Economic	No Grasshoppers
Wasco	Lower Joseph Creek	5,822	2,462	0			
	Lower Wallowa River	14,589	12,058	1,218			
	Middle Imnaha River	5,452	419	0			
	Middle Wallowa River	15,684	9,693	1,073			
	Minam River	203	0	0			
	Mud Creek-Grande Ronde River	7,864	10,485	0			
	Outlet Grande Ronde River	1,353	12,993	0			
	Upper Big Sheep Creek	429	1,935	0			
	Upper Joseph Creek	50,932	4,329	291			
	Upper Wallowa River	23,708	5,941	183			
	Antelope Creek	17,208	14,616	0	73,796	133,364	26,232
	Bakeoven Creek	18,118	10,130	3,148			
	Buck Hollow Creek	10,002	11,950	830			
	Cedar Island-Deschutes River	0	8,321	0			
	Clarno Rapids-John Day River	0	4,811	246			
	Fifteenmile Creek	12,225	12,179	8,519			
	Hood River	10	0	0			
	Mill Creek-Columbia River	175	21,008	429			
	Mosier Creek-Columbia River	1,456	19,646	5,916			
	Wheeler	Muddy Creek-John Day River	0	1,733	338		
Pine Hollow		1,512	7,229	0			
Shitike Creek-Deschutes River		0	3,327	0			
Tygh Creek		5,118	7,036	0			
Warm Springs River		0	3	0			
White Horse Rapids-Deschutes River		208	8,805	6,808			
White River		7,764	2,570	0			
Bridge Creek		0	0	333	53,361	75,023	86,657
Wheeler	Butte Creek	20,387	17,707	4,032			
	Clarno Rapids-John Day River	0	0	2,126			
	Deep Creek	411	2,032	2,705			



**Appendix 1. Estimate of the acreage with economic levels of grasshopper infestation ( $\geq 8$  grasshoppers / yd<sup>2</sup>) based on the 2021 survey.**

County	Watershed	Economic Classes Summed by Watershed			Economic Classes Summed by Count		
		Economic	Non-Economic	No Grasshoppers	Economic	Non-Economic	No Grasshoppers
	Franks Creek-John Day		0	0	564		
	Johnson Creek-John Day River		0	1	5,513		
	Kahler Creek-John Day River	23,178	18,796	12,566			
	Lower Beaver Creek	20	273	4,137			
	Mountain Creek	0	31,469	0			
	Muddy Creek-John Day River	5,301	0	19,207			
	Rock Creek	0	0	799			
	Service Creek-John Day River	0	0	33,685			
	Thirtymile Creek	4,065	4,745	137			
	Upper Rock Creek	0	0	852			
Totals for Economic Class		2,252,233	3,657,562	1,821,383			
Grand Total of Surveyed Acres		7,731,178					

## Appendix 2. Methodology for Area Estimation.

1. Grasshopper and Mormon cricket density (count/yd<sup>2</sup>) is estimated at survey locations.
2. The density at each point is placed into two classification systems: a density classification (7 levels) and an economic classification with 3 groupings (Economic [ $\geq 8$ /yd<sup>2</sup>], Non-economic [1-7/yd<sup>2</sup>], or No Grasshoppers/Mormon crickets).
3. To generate area each point location is buffered with a 2.5 mile radius.

For the economic classes:

4. Resulting areas are merged by Economic Class.
5. Intersecting areas of water (e.g. rivers, lakes, etc.) and city limits are removed.
6. Overlapping Economic Classes are 'clipped' so that:
  - Non-economic area is preserved over a classification of No Grasshoppers.
  - Economic area is preserved over either a Non-Economic or a No Grasshopper classification.
7. Calculation of area in each Economic Class is then enabled by Union with any desired geographic boundaries (e.g. counties, various federal lands, etc.).

## Appendix 3. General Information about Maps in this Report.

These maps were prepared by Todd Adams of the Oregon Department of Agriculture (ODA) in the WGS84 Datum using data sources from ESRI, OR Geospatial Data Clearinghouse and ODA field survey. The maps are for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information.