



# **Oregon Grasshopper and Mormon Cricket Survey Summary for 2022**

## **INTRODUCTION**

The 2022 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 19 April to 18 August 2022. This year, the Oregon State Legislature approved Senate Bill 5561 that allocated money to assist private landowners with grasshopper and Mormon Cricket suppression. All data in this report are a combination of both survey programs. In 2022, a total of 6,364 sites were visited, (6,366 include survey for MC, 6,364 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**

The 2021 season was considered one of the worst grasshopper outbreaks in Oregon's history. The 2022 season turned out to be a mixed bag. Grasshopper pressure was heavy in the southern half of eastern Oregon, while pressure in the northern half was considerably light compared to the 2021 season, except for the Keating Valley in Baker County. The cool wet spring weather helped to suppress the grasshopper populations in most of the northern counties, while the southern Counties did not fair as well. This year 42 percent of our stops were at an economic density<sup>1</sup> (Table 2), and for those stops the mean density was 73 GH/yd<sup>2</sup> (Table 2).

Of the total stops made 3,914 were during the period for nymphal grasshopper survey and 2,450 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 239 Common Data Sites (CDS) (standard locations visited each year for year-to-year comparison) were included in the survey.

Approximately 5.3 million acres across 18 counties in eastern Oregon were estimated to contain economically infested locations (Fig. 3, Table 2). Harney County had the most infested acreage at 1.5 million and Malheur County second with 1.3 million. Harney and Malheur County account for half of the total economically infested acreage. (Fig. 6; Table 3; Appendix 1).

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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)).

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.

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
2022	42	36	22
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

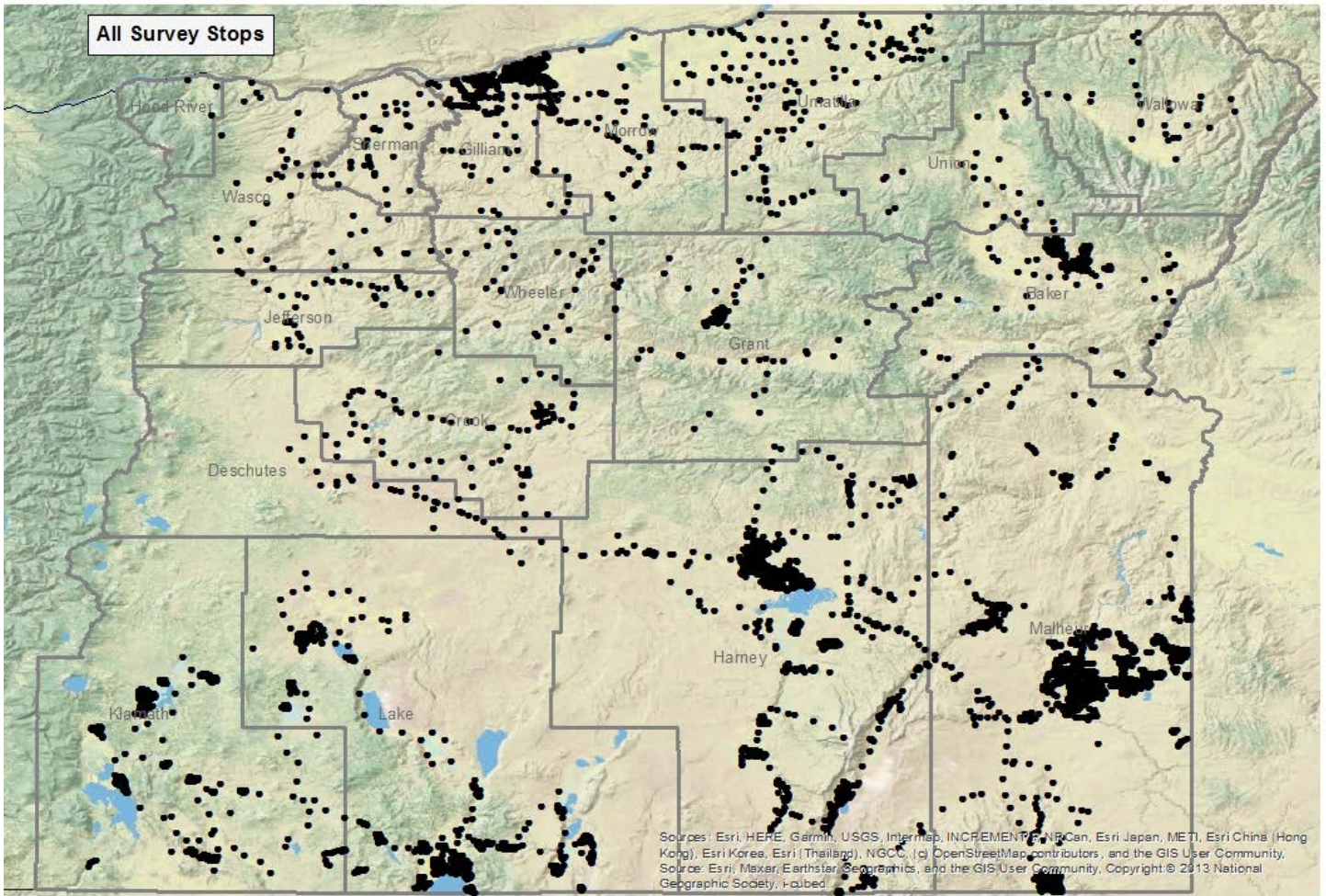
Table 2. Oregon Grasshopper Survey Statistics from 2005 through 2022. Economic infestation ≥ 8 grasshoppers / yd<sup>2</sup>.

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			
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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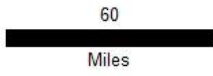


Figure 1. 2022 Grasshopper / Mormon cricket Survey stops distributed across eastern Oregon. (1:2,400k)

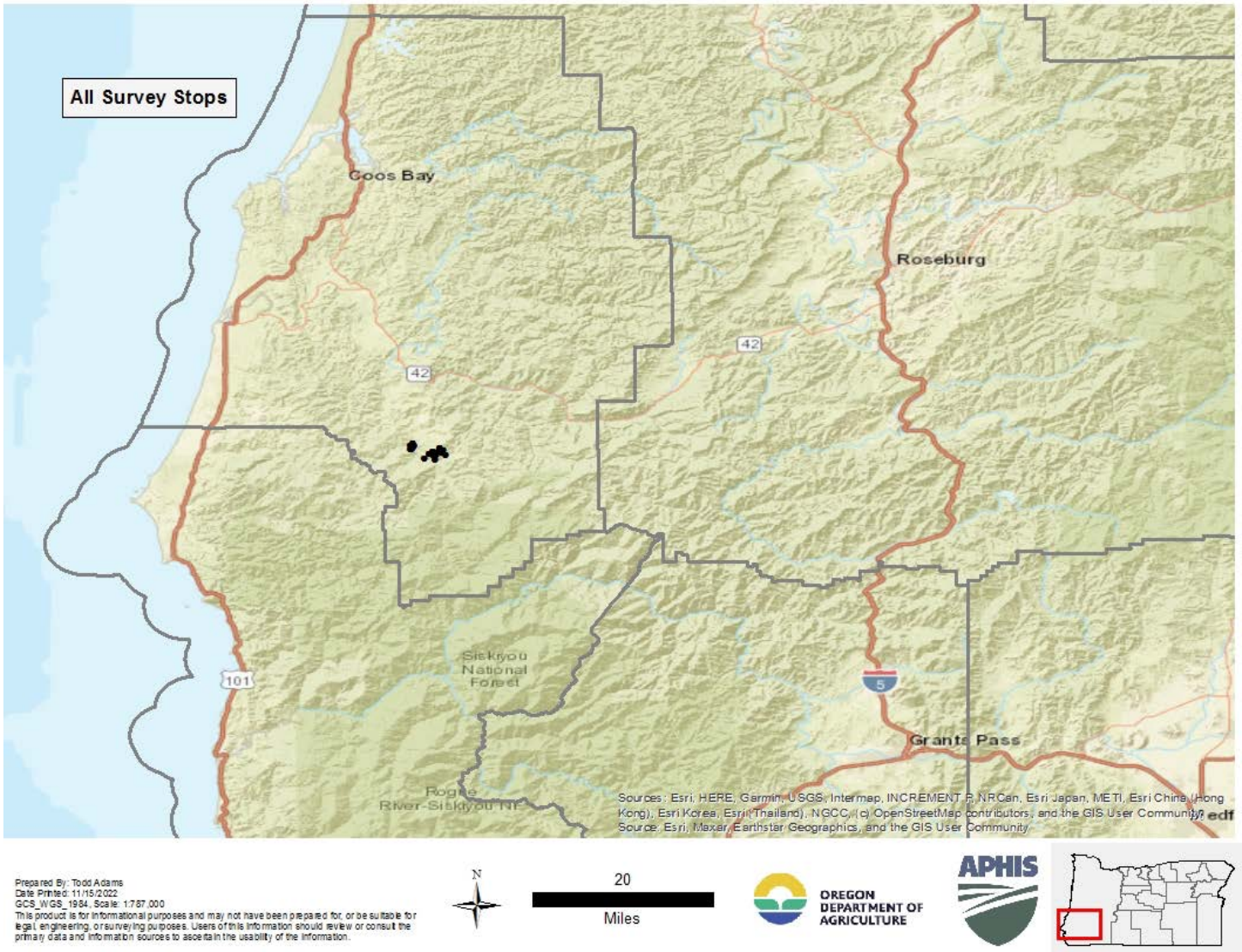


Figure 2. 2022 Grasshopper / Mormon cricket Survey stops in Western Oregon. (1:787k)

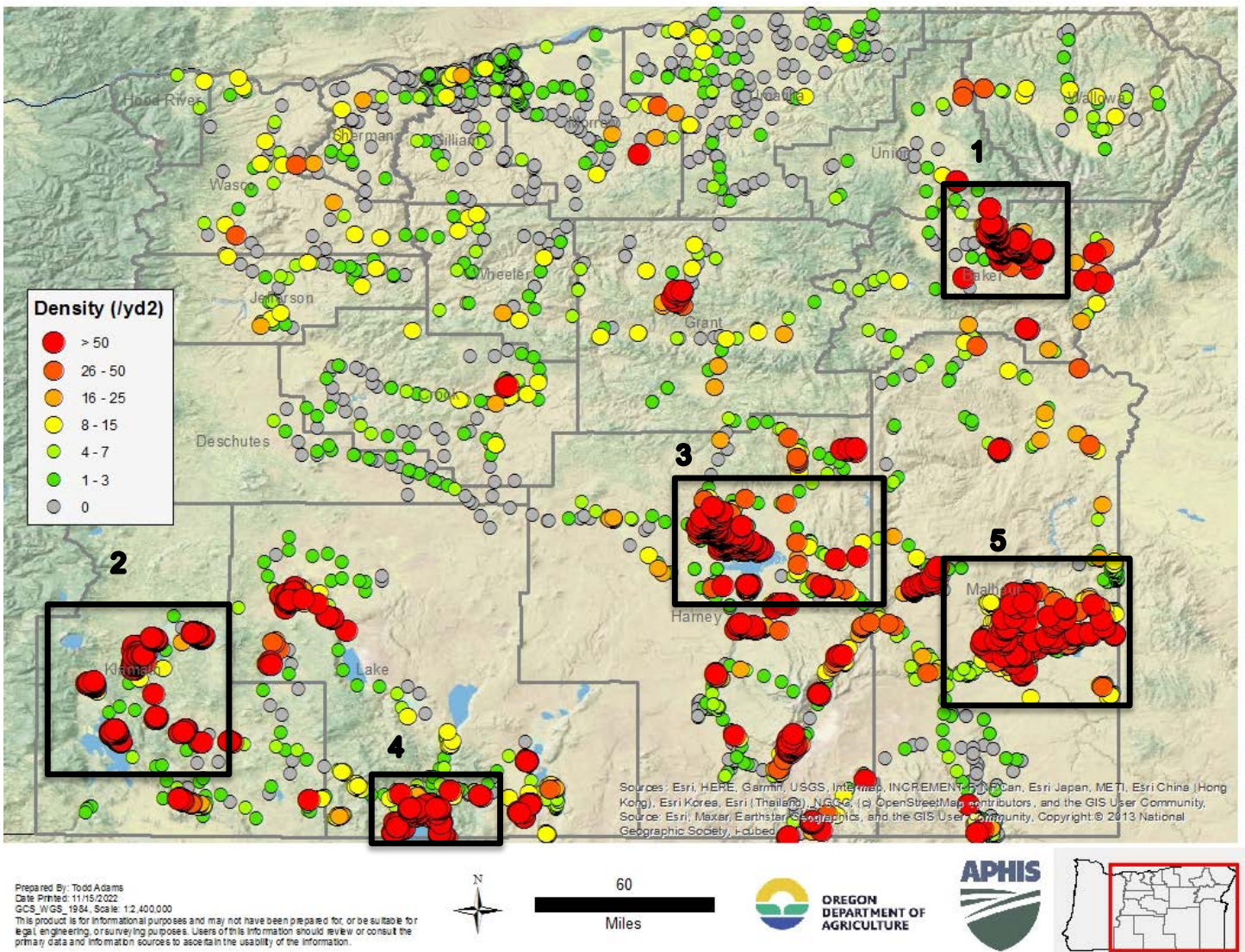
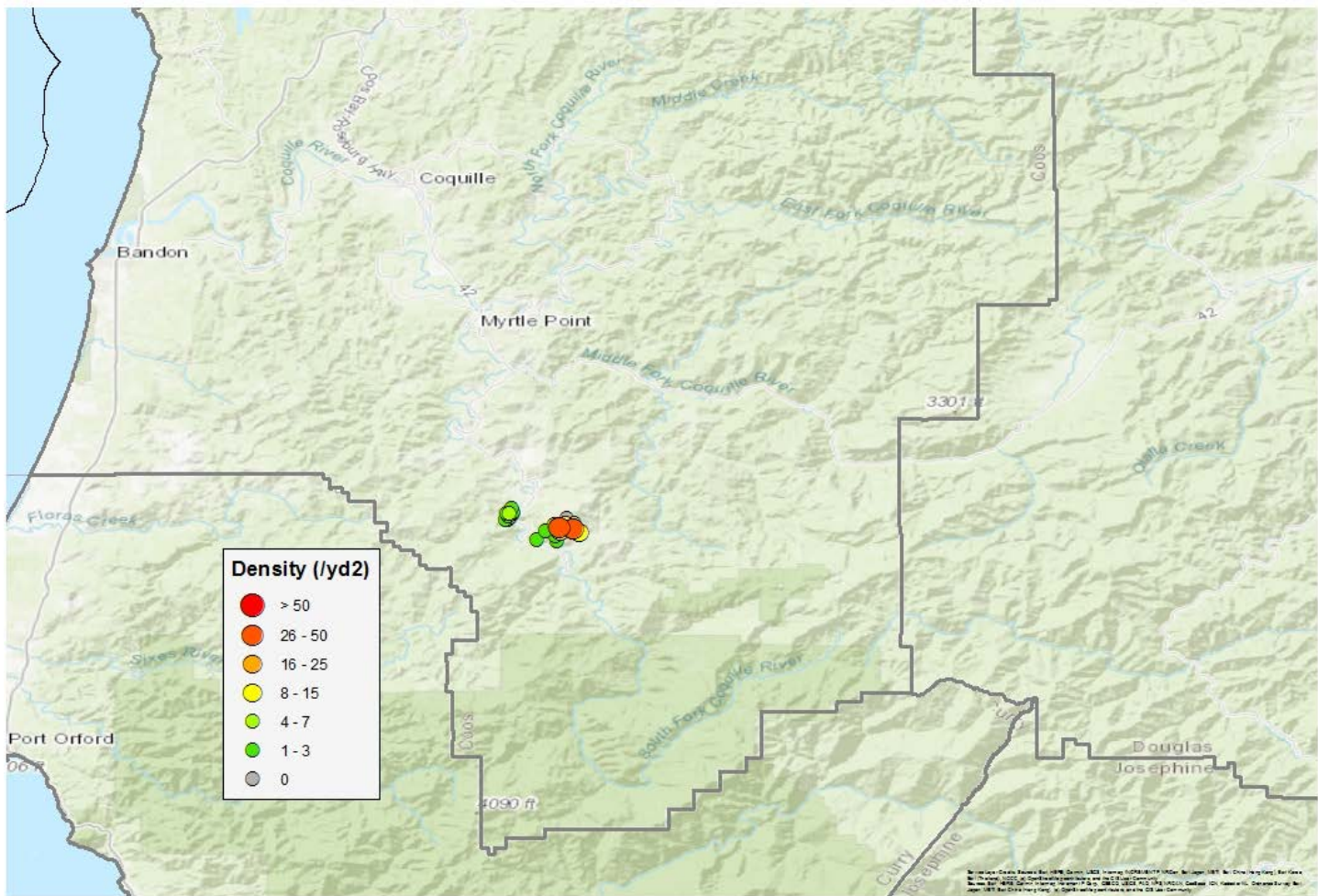


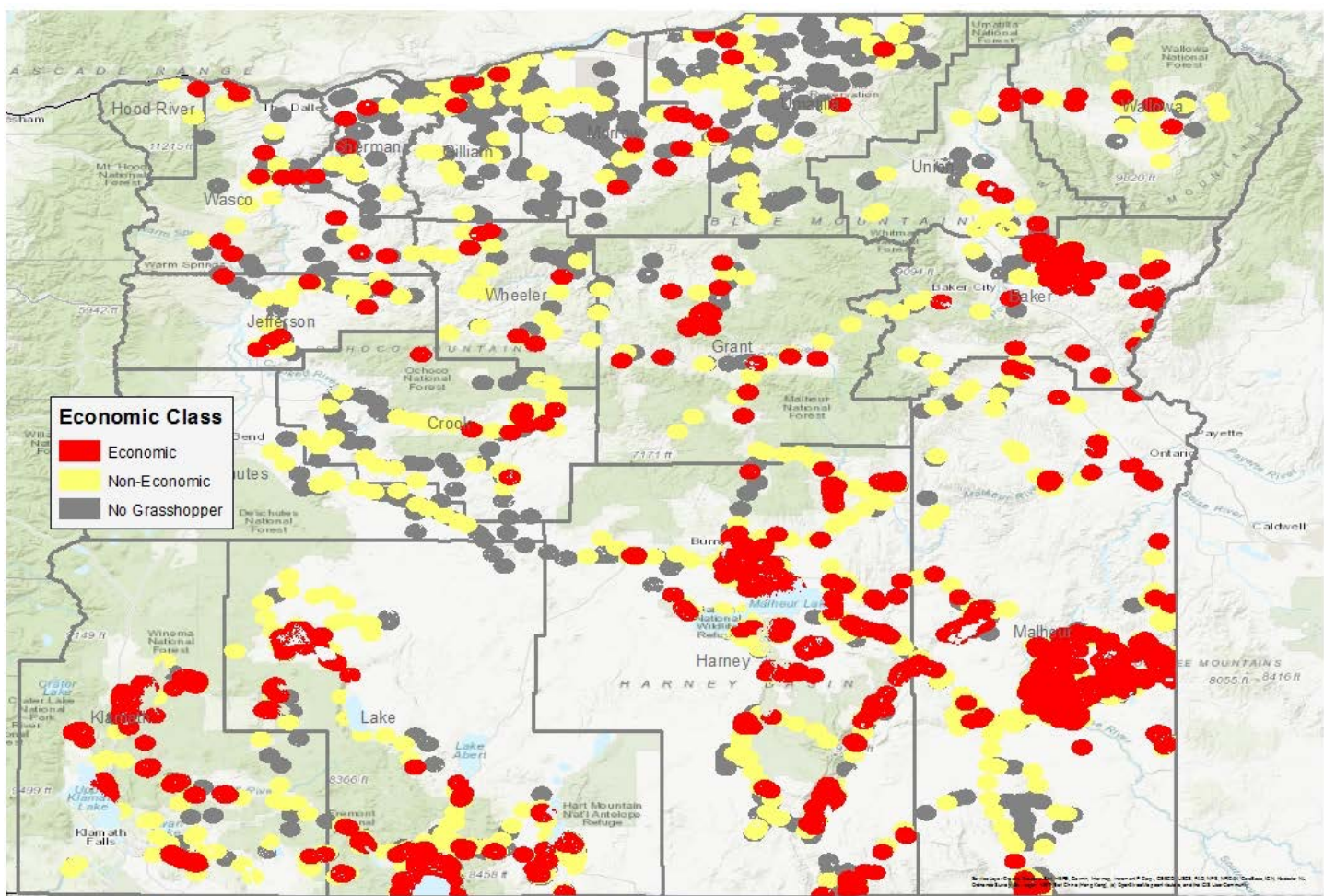
Figure 3. 2022 grasshopper survey densities (/yd<sup>2</sup>) classified to seven levels. Black rectangles indicate areas given a closer examination below. (1:2,400k)



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Figure 4. 2022 grasshopper survey densities (/yd<sup>2</sup>) in Coos County classified to seven levels. (1:399k)



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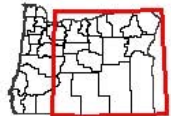
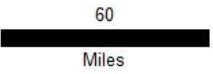


Figure 5. 2022 grasshopper density area estimates (/yd<sup>2</sup>) classified by economic category. (1:2,400k)



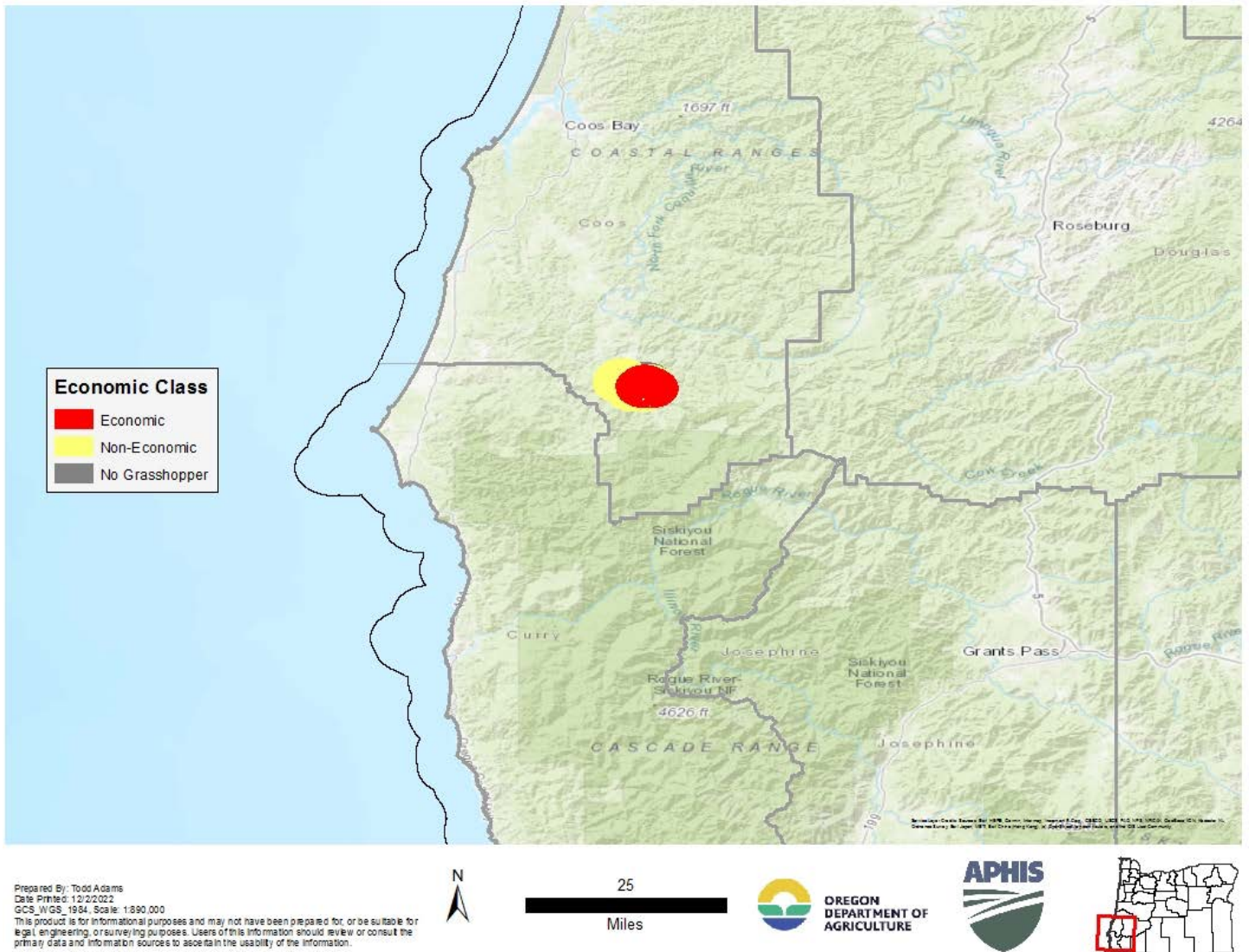


Figure 6. 2022 grasshopper density area estimates (/yd<sup>2</sup>) classified by economic category for Coos County. (1:2,400k)

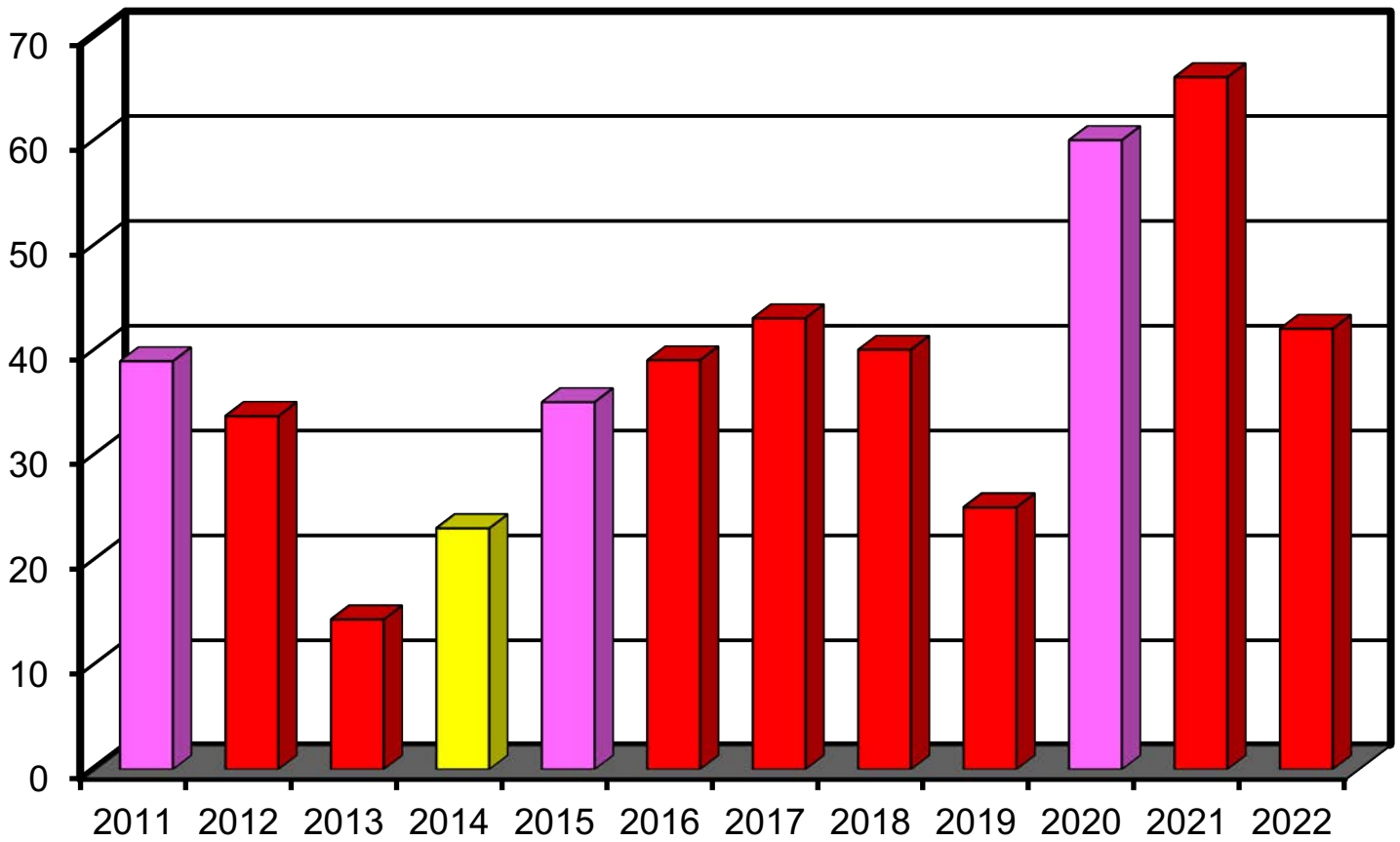


Figure 7. Percentage (within each season) of surveyed area (acres) estimated to have grasshoppers at an economic density.

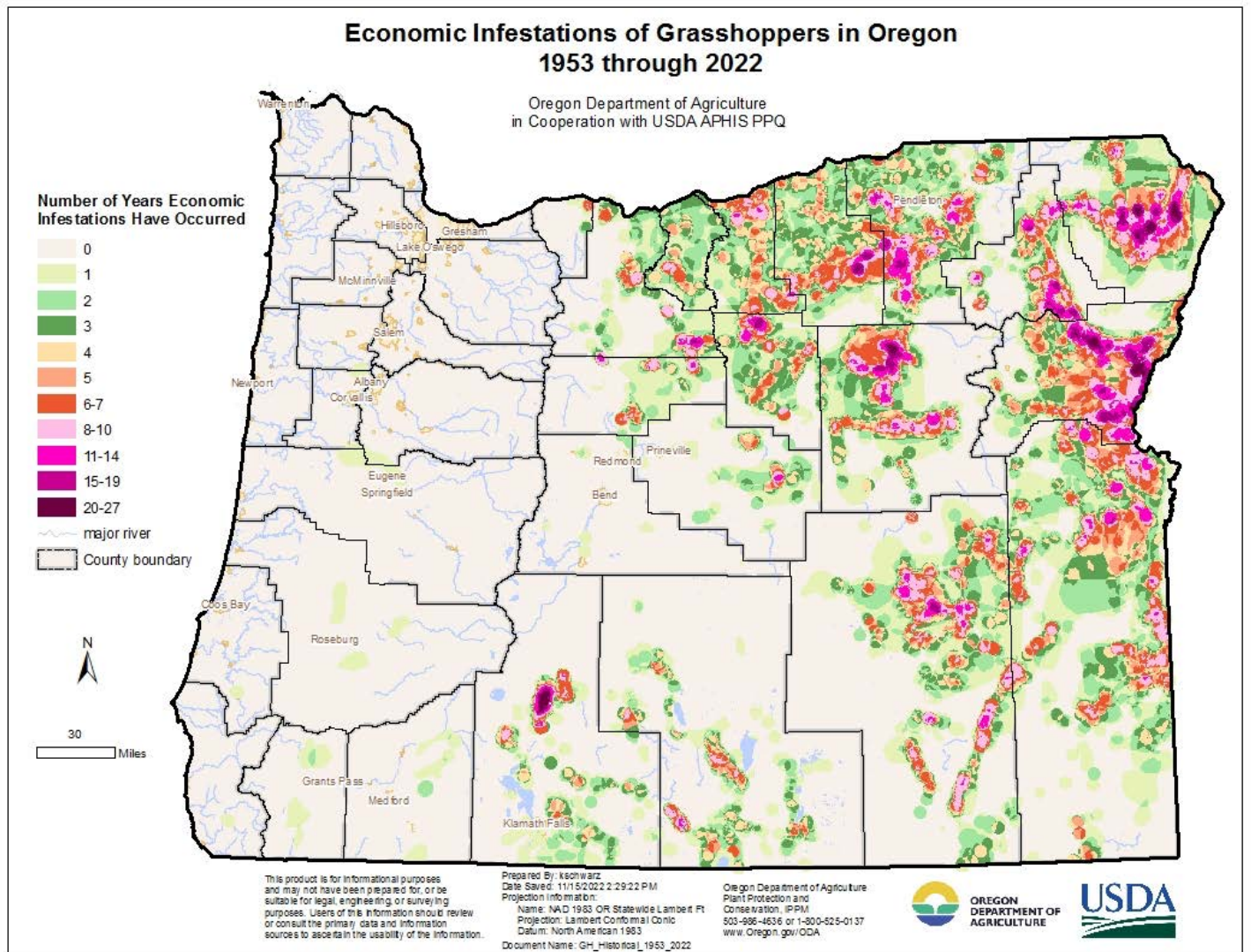
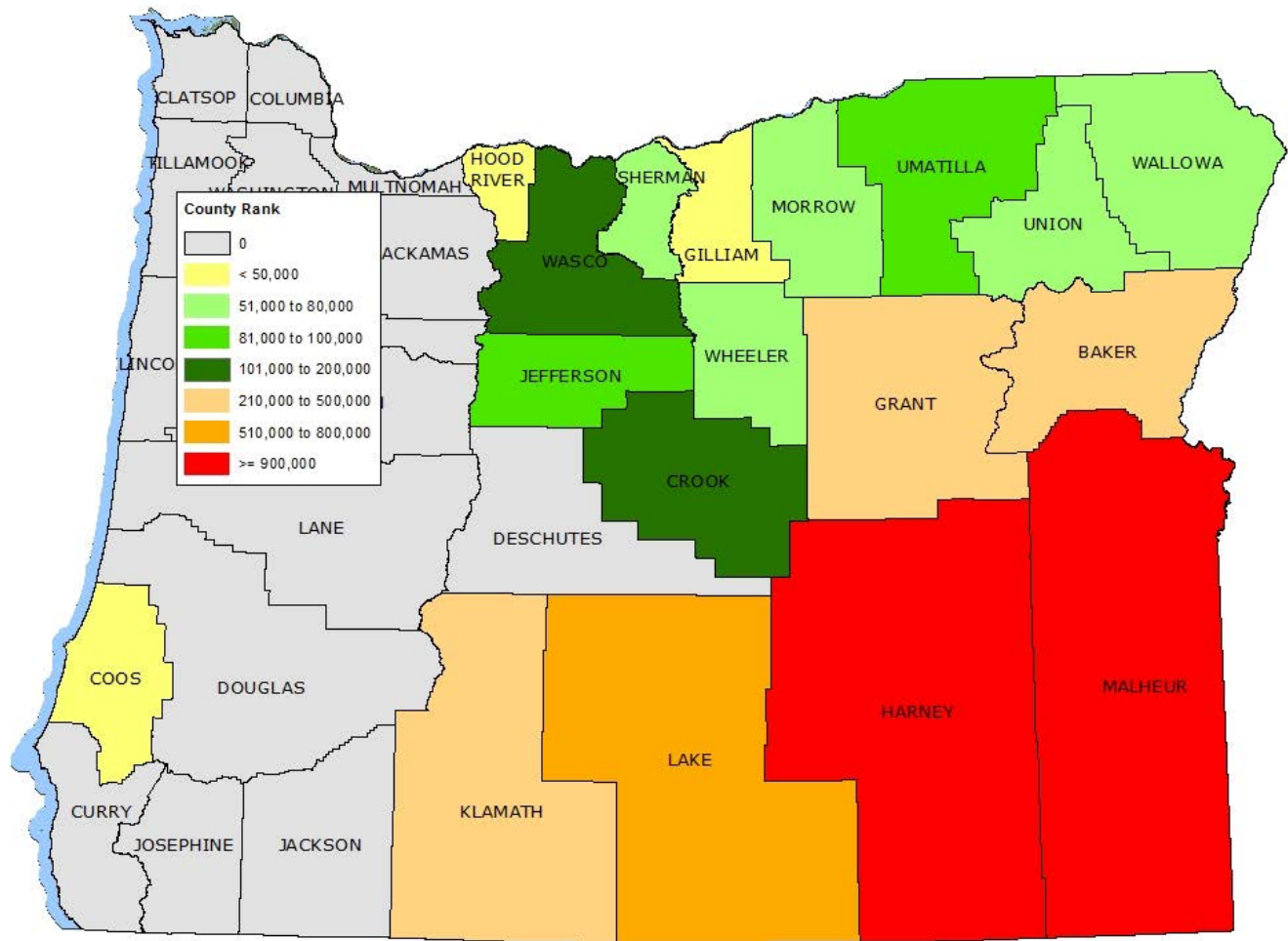


Figure 8. Number of economically infested years for grasshoppers in eastern Oregon 1953 – 2022. (1:2500k)



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 Data Period: 12/2/2020  
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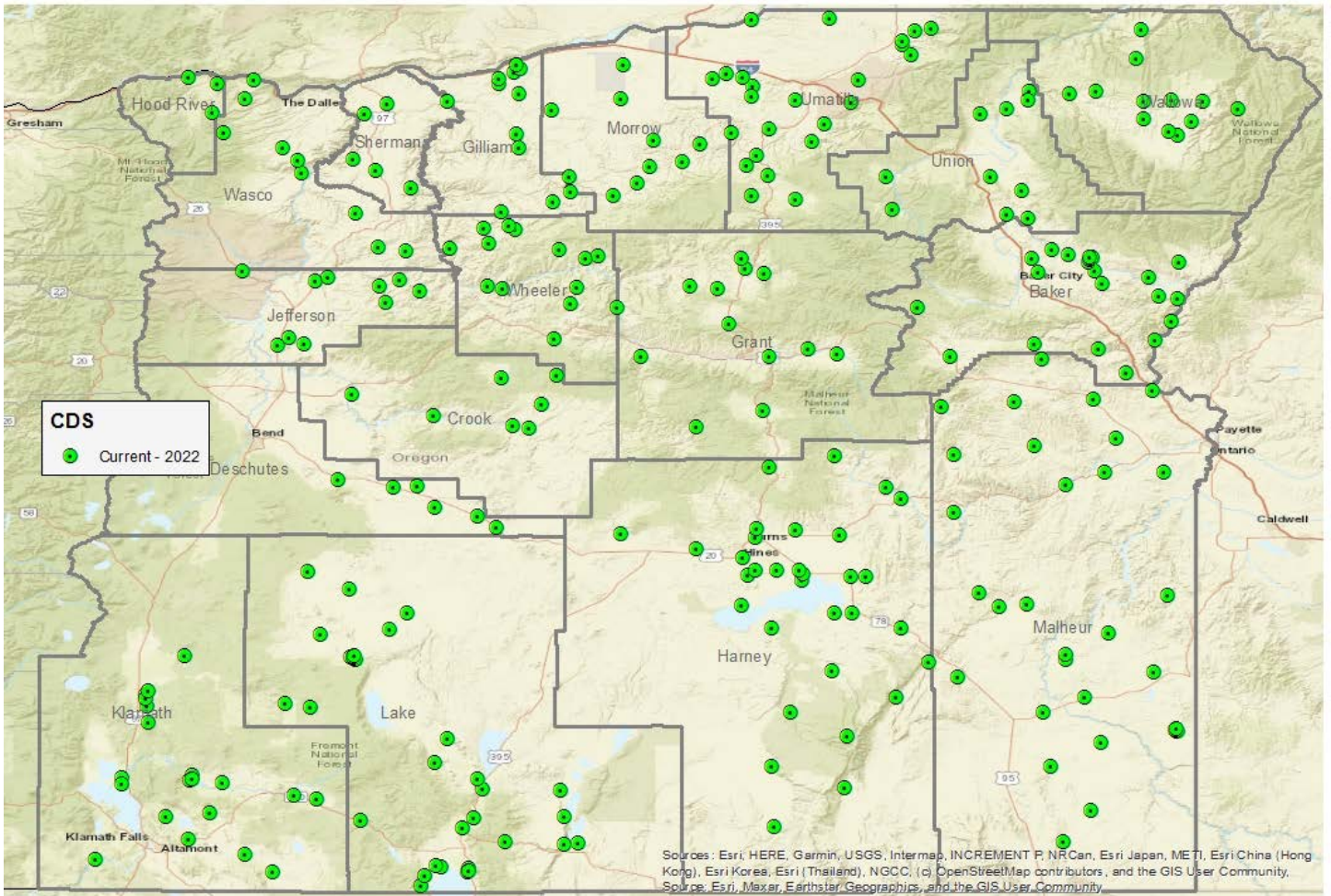
Figure 9. 2022 Grasshopper survey by counties ranked by economically infested acreage. (1:2400k)

Table 3. Surveyed area (ac) density estimates 2022 summarized by economic classification within a county.

County	Economic Classes Summed by County				Economic Classes as % within County		
	Economic	Non-Economic	No GH	Totals	Economic	Non-Economic	No GH
Baker	394,645	153,167	56,241	604,053	65.3	25.4	9.3
Coos	26,550	11,221	316	38,087	69.7	29.5	0.8
Crook	110,532	258,368	238,488	607,388	18.2	42.5	39.3
Deschutes	0	153,630	109,618	263,247	0.0	58.4	41.6
Gilliam	48,548	198,059	190,797	437,404	11.1	45.3	43.6
Grant	218,532	178,357	95,854	492,743	44.4	36.2	19.5
Harney	1,509,247	650,411	212,622	2,372,280	63.6	27.4	9.0
Hood River	9,692	20,774	553	31,018	31.2	67.0	1.8
Jefferson	82,288	138,697	66,266	287,251	28.6	48.3	23.1
Klamath	409,476	388,000	144,102	941,578	43.5	41.2	15.3
Lake	733,657	489,279	150,260	1,373,197	53.4	35.6	10.9
Malheur	1,254,079	683,582	211,854	2,149,515	58.3	31.8	9.9
Morrow	74,133	239,469	258,846	572,448	13.0	41.8	45.2
Sherman	54,712	80,667	139,076	274,455	19.9	29.4	50.7
Umatilla	89,155	363,921	542,734	995,809	9.0	36.5	54.5
Union	61,787	125,352	75,632	262,771	23.5	47.7	28.8
Wallowa	76,706	168,995	51,426	297,127	25.8	56.9	17.3
Wasco	128,449	125,143	149,877	403,468	31.8	31.0	37.1
Wheeler	74,358	198,021	91,602	363,981	20.4	54.4	25.2
<b>Totals</b>	<b>5,356,547</b>	<b>4,625,112</b>	<b>2,786,161</b>	<b>12,767,821</b>	<b>42.0</b>	<b>36.2</b>	<b>21.8</b>

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	1691							
1 - 3	1047	0	123	323	132	74	73	322
4 - 7	793	0	78	293	124	40	52	206
8 - 15	1013	0	68	333	196	56	51	309
16 - 25	469	0	40	130	116	37	28	118
26 - 50	421	0	38	97	98	55	28	105
> 50	930	0	108	358	222	118	38	86
	<b>6364</b>	<b>0</b>	<b>455</b>	<b>1534</b>	<b>888</b>	<b>380</b>	<b>270</b>	<b>1146</b>
<b>Percentages:</b>		<b>0.0</b>	<b>9.7</b>	<b>32.8</b>	<b>19.0</b>	<b>8.1</b>	<b>5.8</b>	<b>24.5</b>



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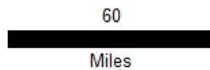


Figure 10. Common Data Sites current locations. (1:2400k)

Table 5. The 239 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	60							
1 - 3	62	0	0	1	2	5	9	45
4 - 7	41	0	0	0	0	6	9	26
8 - 15	38	0	0	0	0	3	9	26
16 - 25	19	0	0	0	0	1	5	13
26 - 50	11	0	0	0	0	0	3	8
> 50	8	0	0	0	0	2	0	6
	239	0	0	1	2	17	35	124
Percentages:		0	0	0.6	1.1	9.5	19.6	69.3

## 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-Keating Valley, Baker County.

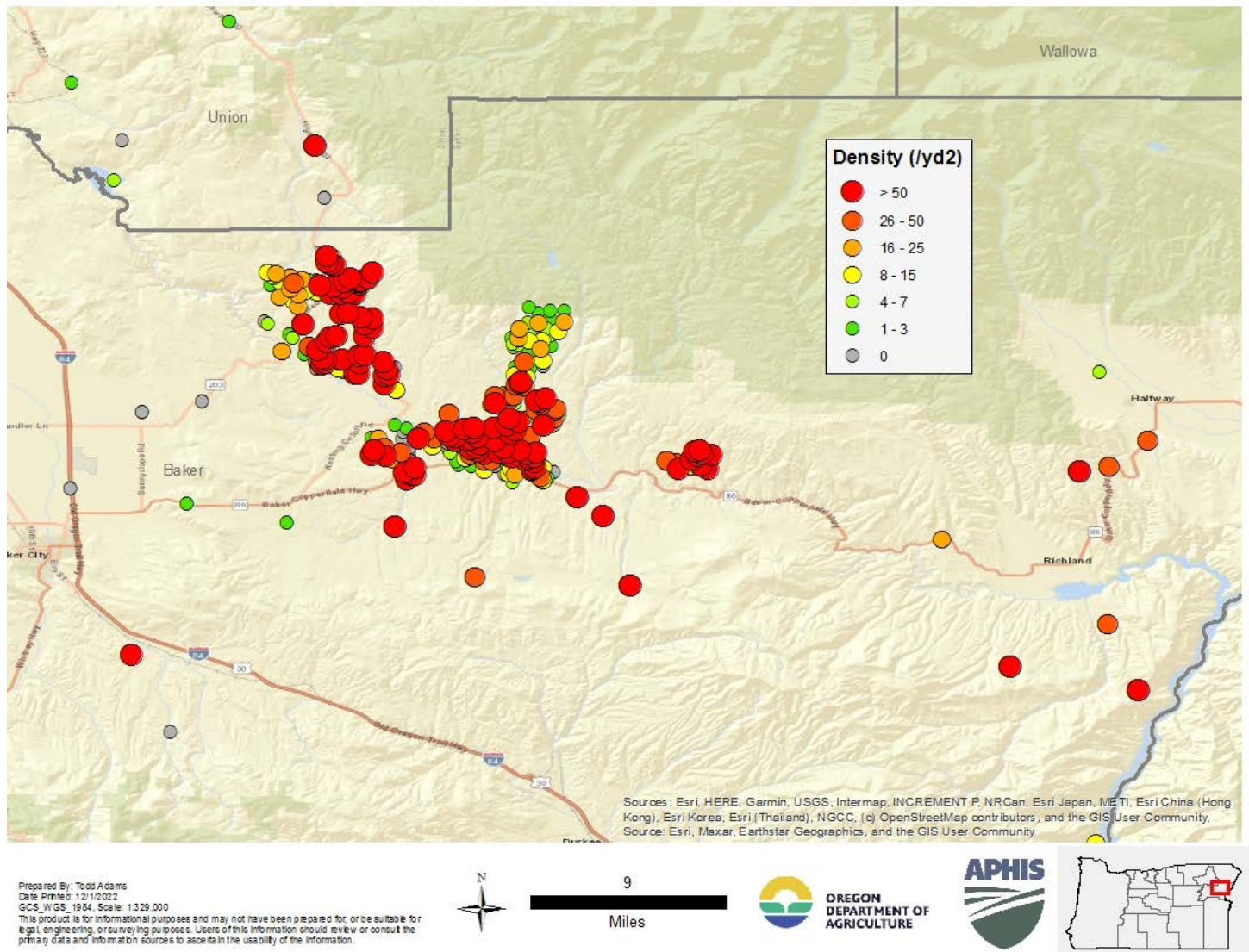


Figure 11. Grasshopper classified densities (GH/yd<sup>2</sup>) at survey locations in Keating Valley in Baker County. (1:329k)

## 2-Central Klamath County.

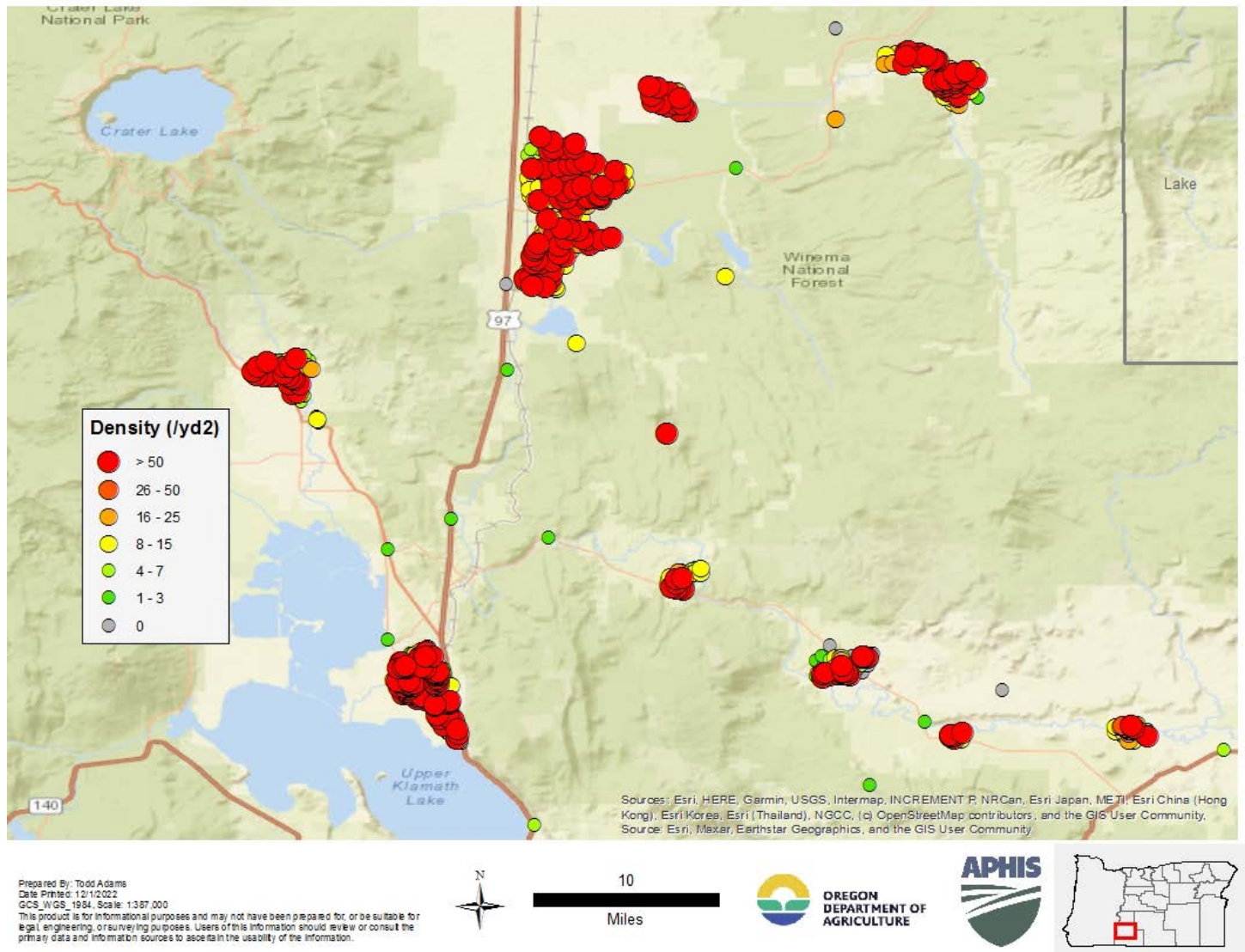


Figure 12. Grasshopper classified densities (GH/yd<sup>2</sup>) at survey locations in Central Klamath County. (1:53k)



### 3-North Harney County.

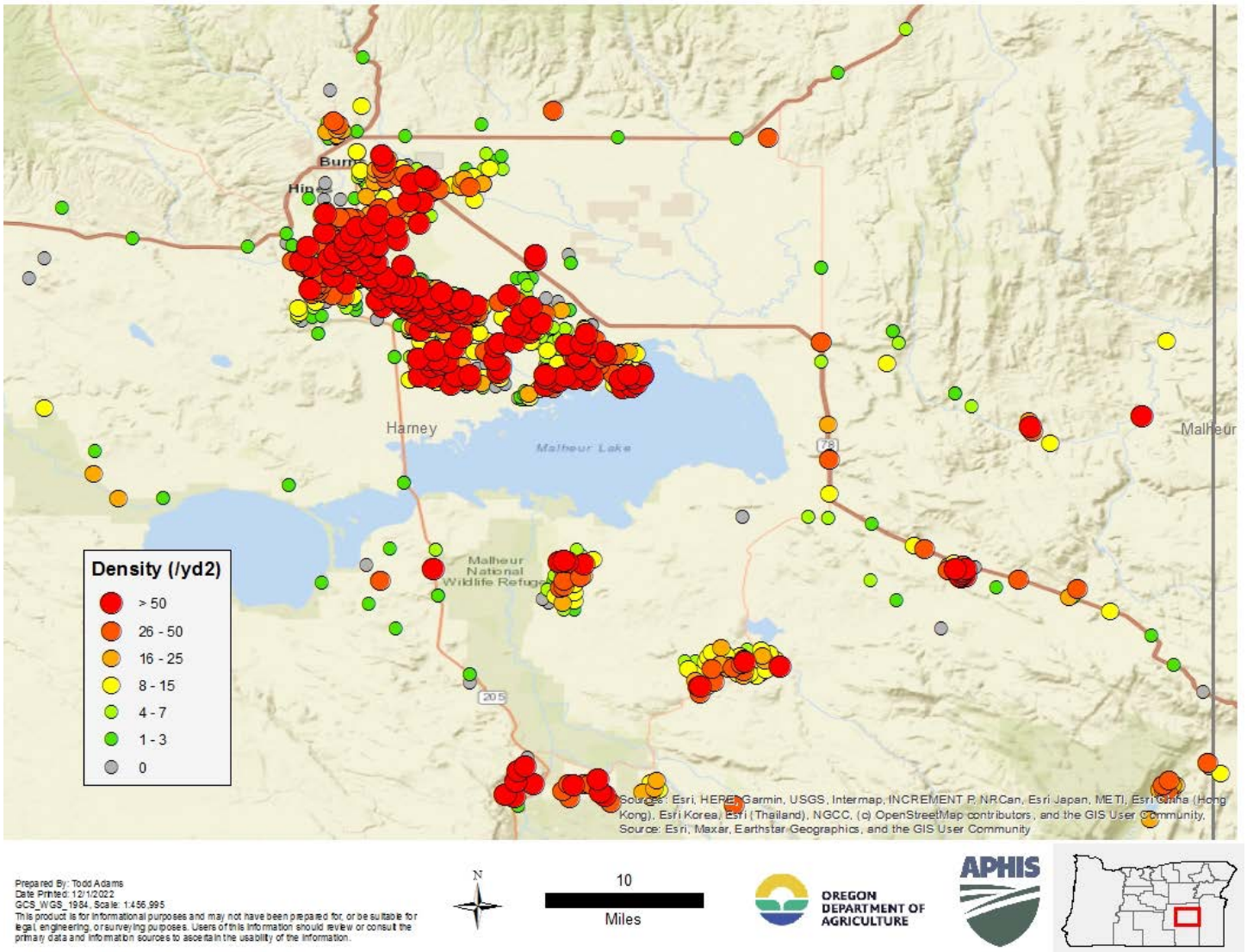


Figure 13. Grasshopper classified densities (GH/yd<sup>2</sup>) in North Harney County. (1:457k)

4-Goose Lake and South Lake County, Lake County.

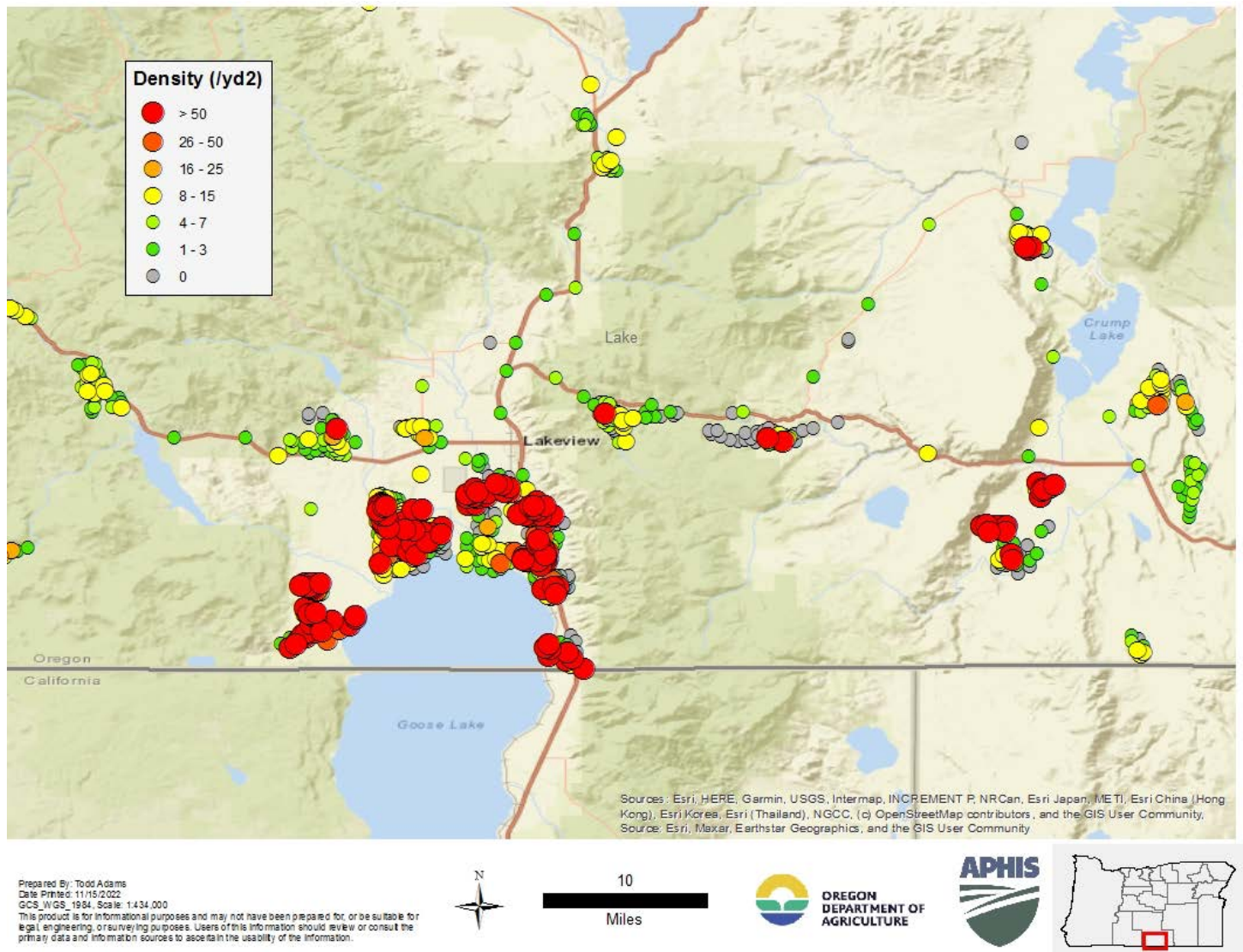


Figure 14. Grasshopper survey classified densities (GH/yd<sup>2</sup>) in Goose Lake and South Lake County, Lake County. (1:434k)

5-Burns Junction – Jordan Valley, Malheur County.

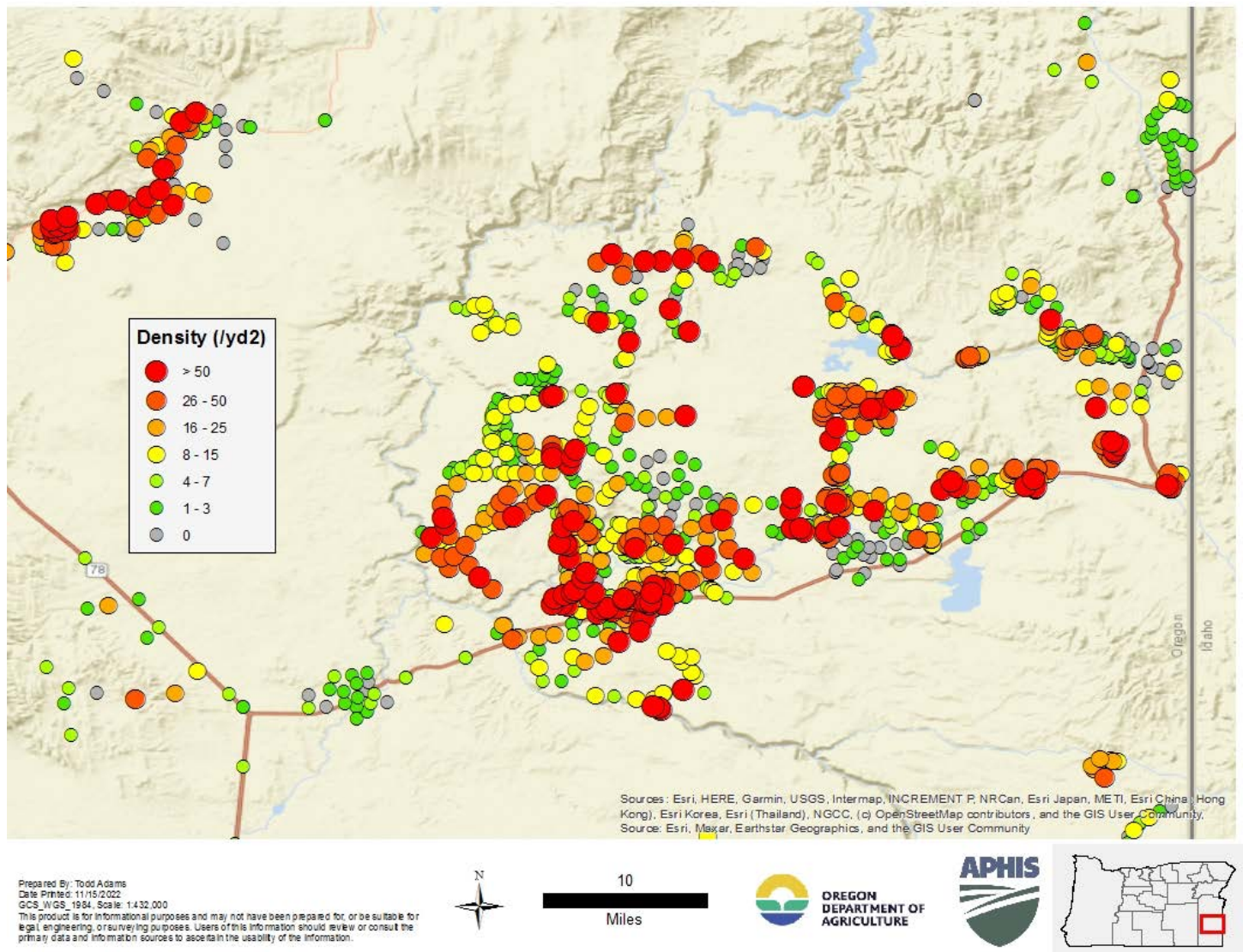


Figure 15. Grasshopper classified densities (GH/yd<sup>2</sup>) and area estimations from the region from Burns Junction to Jordan Valley. (1:432k)

## 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 7).

The largest area including survey density estimates occurred on the Confederated Tribes of the Umatilla Indian Reservation (Fig. 19), followed by acreage on the Confederated Tribes of the Warm Springs Reservation (Fig. 20).

Table 6. 2021 grasshopper survey area estimates intersecting with eastern Oregon tribal lands.

	Economic		Non-Economic		No Grasshoppers	
	Acres	Hectares	Acres	Hectares	Acres	Hectares
Burns Reservation	879	356	0	0	0	0
COQUILLE FOREST	18	7	27	11	0	0
FT McDermitt	0	0	0	0	303	123
FT McDermitt Reservation	2,081	842	1,880	761	2,492	1,008
Indian Camp	0	0	0	0	78	32
Warm Springs Reservation	37,440	15,151	24,121	9,761	51,395	20,799
Umatilla Reservation	12,562	5,084	7,536	3,050	92,033	37,244
Other*	751	304	1	0.4	5,832	2360
Totals	53,731	21,744	33,565	13,583	152,133	61,566
Grand Total All classes	239,429	96,893				

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

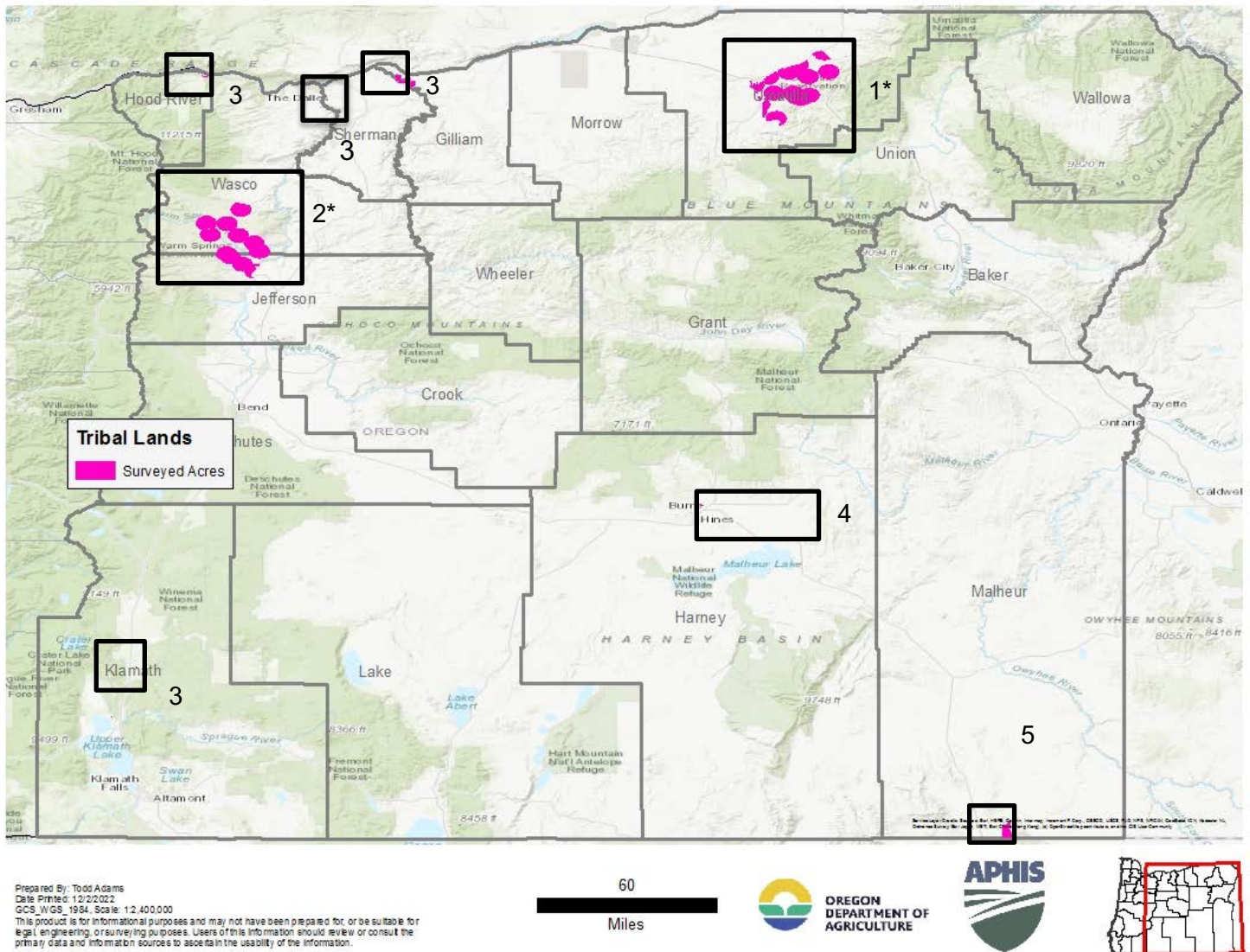
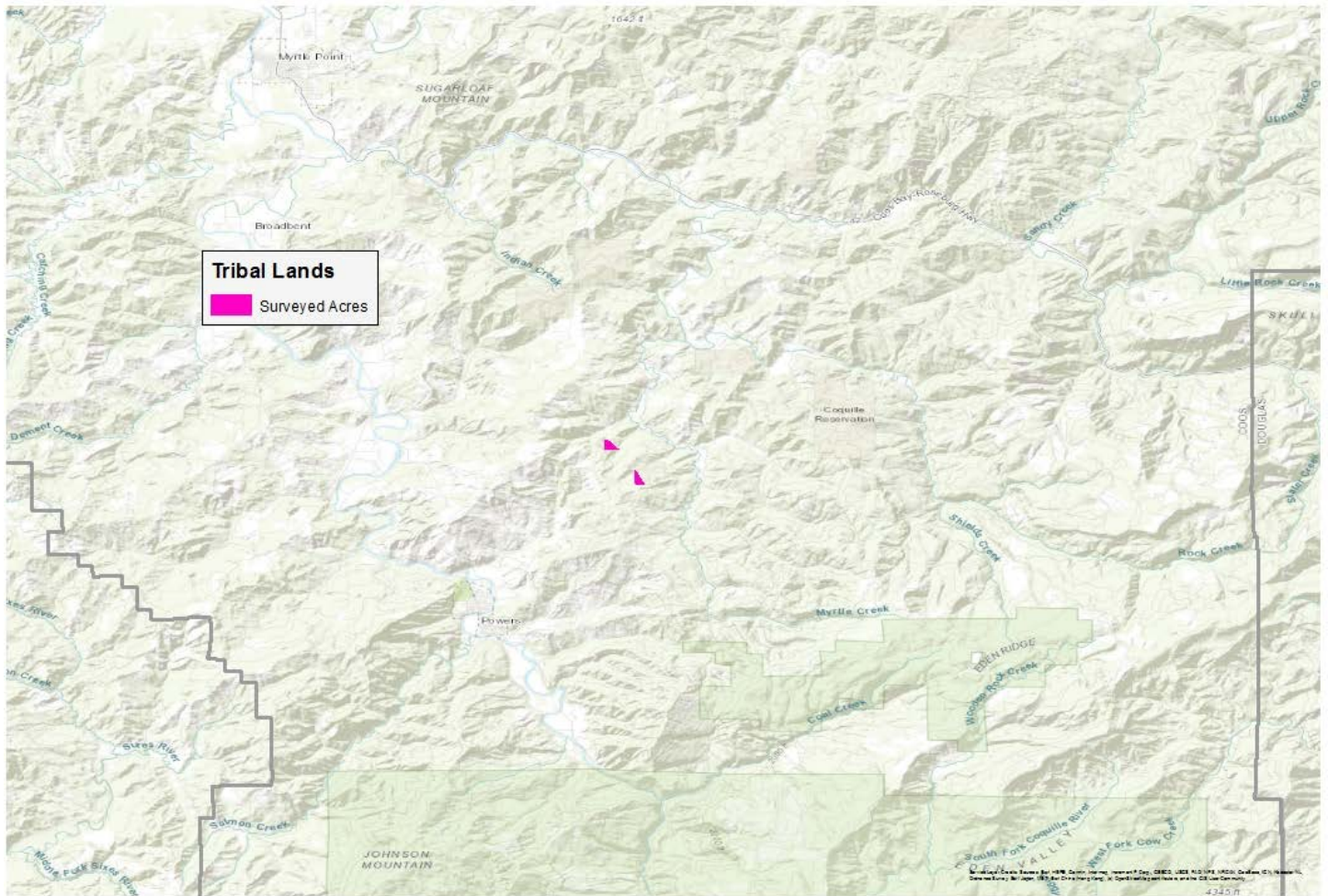


Figure 16. 2021 grasshopper survey areas intersecting tribal lands. Superimposed rectangles indicate the seven geographic areas where this occurred. Black rectangles with an asterisk indicate areas given a closer examination below. 1=CTUIR, 112,131 ac; 2=Warm Springs, 112,956 ac; 3=Other, 6,584 ac; 4=Burns, 879 ac; 5=McDermitt, 6,756 ac. (1:2400k)



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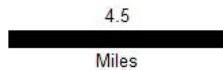
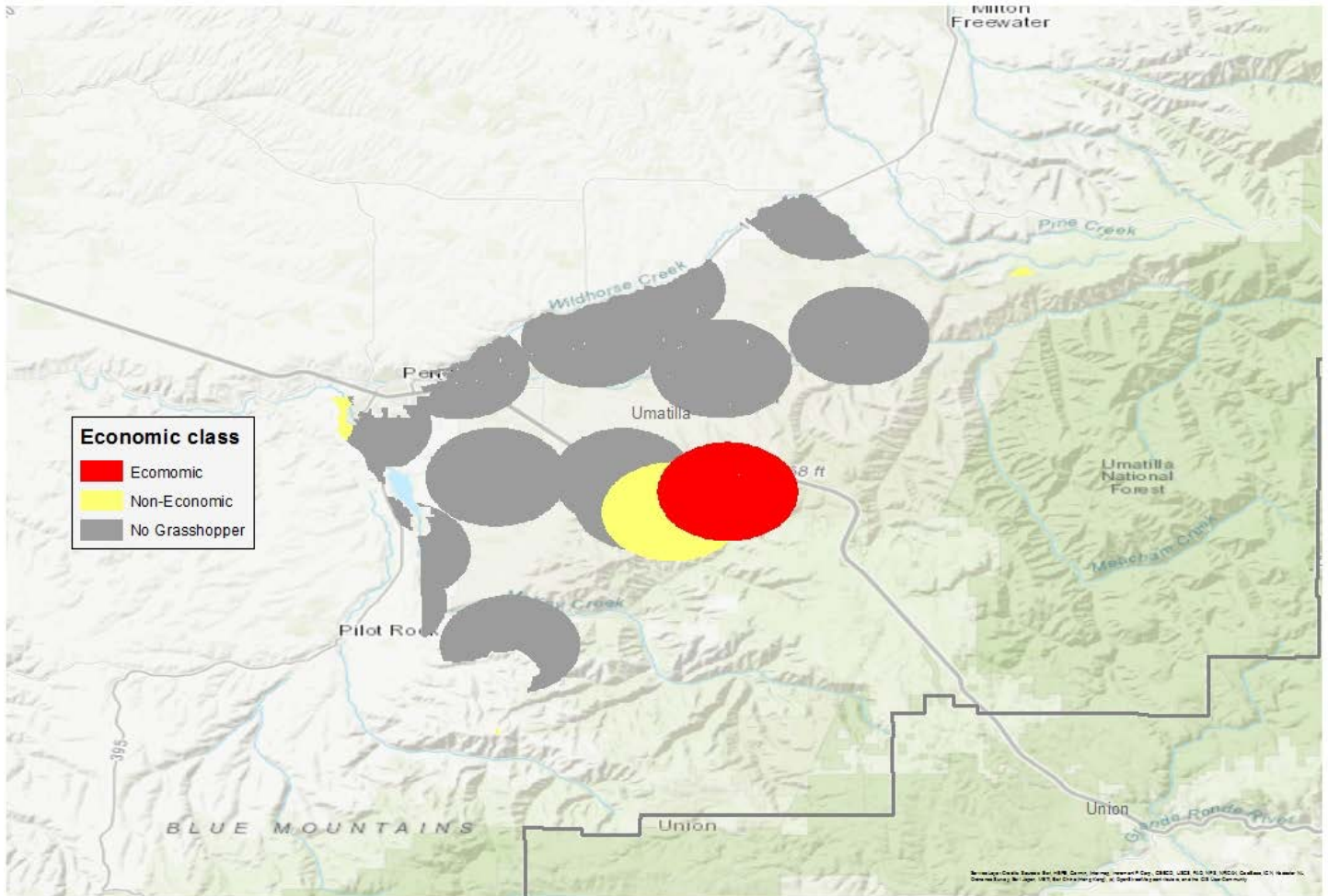


Figure 17. 2022 grasshopper survey areas intersecting tribal lands. Coquille Forest BIA land in Coos County. (1:2400k)

# A Closer Look

## 1-CTUIR Area, Umatilla County.



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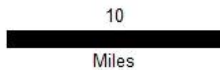


Figure 118. Grasshopper survey areas of economic density intersecting tribal land on the Confederated Tribes of the Umatilla Indian Reservation. Economic density:  $\geq 8$  grasshoppers per square yard. (1:365k)

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

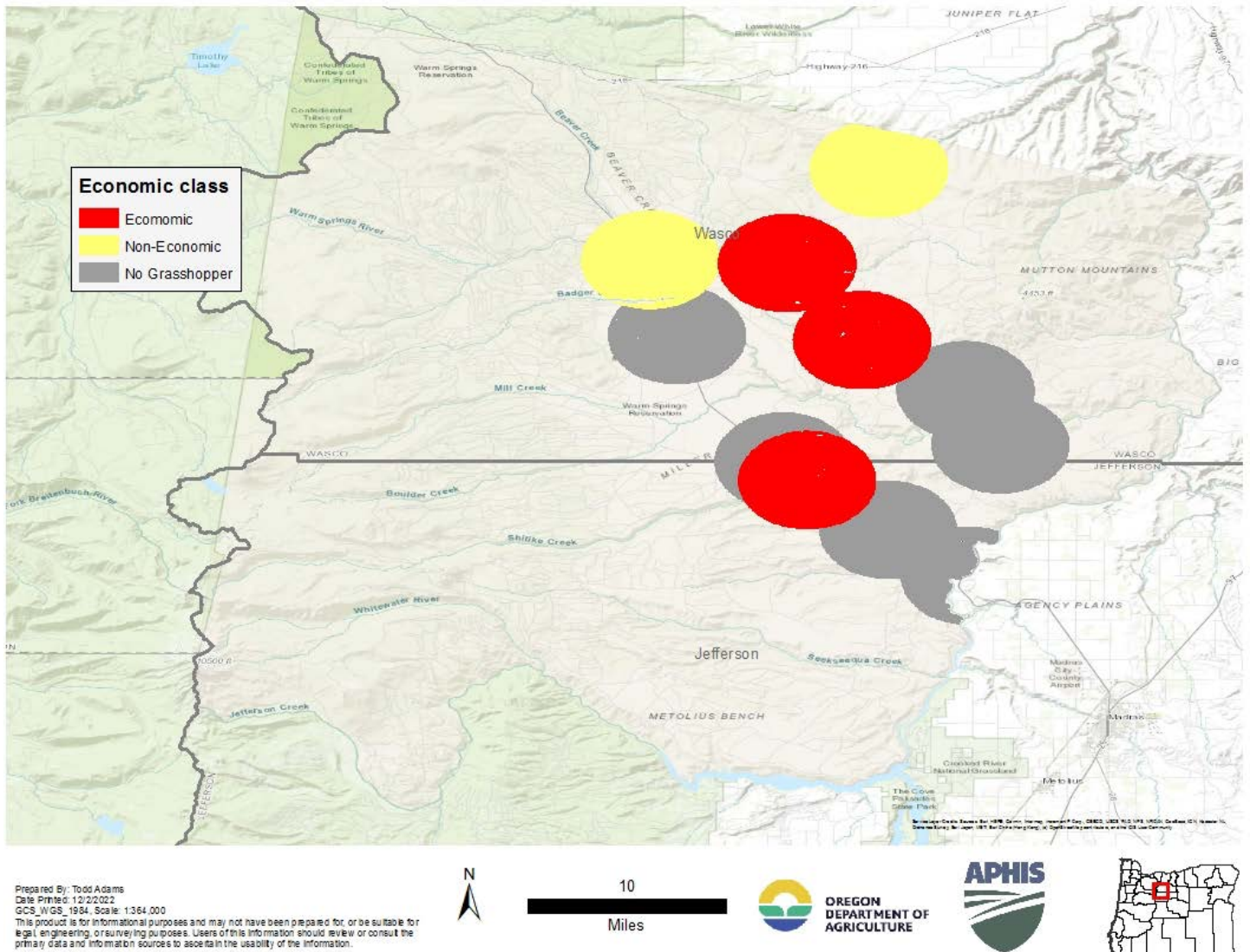


Figure 19. Grasshopper survey areas of economic density intersecting tribal land on the Confederated Tribes of the Warm Springs Indian Reservation. Economic density:  $\geq 8$  grasshoppers per square yard. (1:160k)



## MORMON CRICKETS

A large population of Mormon Crickets were detected on Hwy 95 about 5 miles north of Jordan Valley heading south. Small pockets of Mormon Crickets were detected in Jordan Valley. Mormon Cricket populations continue to move into Oregon from Idaho along more of the state line.

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. A single Mormon Cricket was found in Morrow County this year along Hwy 74 as the Population continues to move east.

In 2021, a new population of Mormon Crickets was spotted in the McDermit area and in an area 15 miles north of town on Hwy 95. This year the Mormon Crickets migrated as far as Burns Junction.

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	6015									
1 - 2	146	0	5	32	35	30	23	11	4	6
3	30	0	0	7	11	5	2	2	2	1
4 - 6	45	0	3	12	13	9	5	1	1	1
7 - 10	22	0	0	6	5	6	3	2	0	0
11 - 25	40	0	0	5	18	12	5	0	0	0
> 25	66	0	0	18	25	11	8	3	0	1
	6364	0	8	80	107	73	46	19	7	9
Percentages:		0.0	2.3	22.9	30.7	20.9	13.2	5.4	2.0	2.6

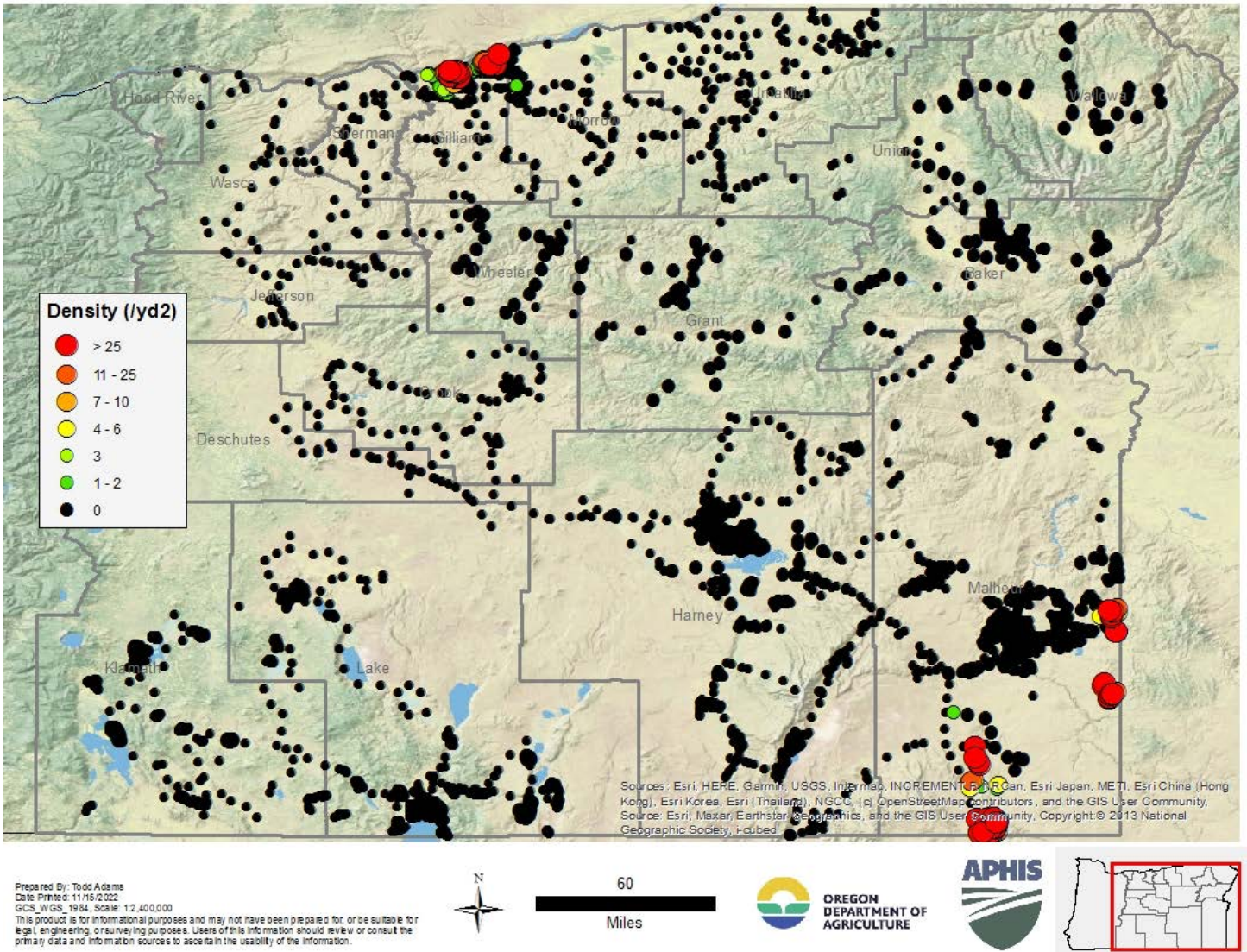


Figure 20. Locations surveyed for Mormon crickets (*Anabrus* sp.) in eastern Oregon classified by density (/yd<sup>2</sup>). (1:2400k)

## 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.

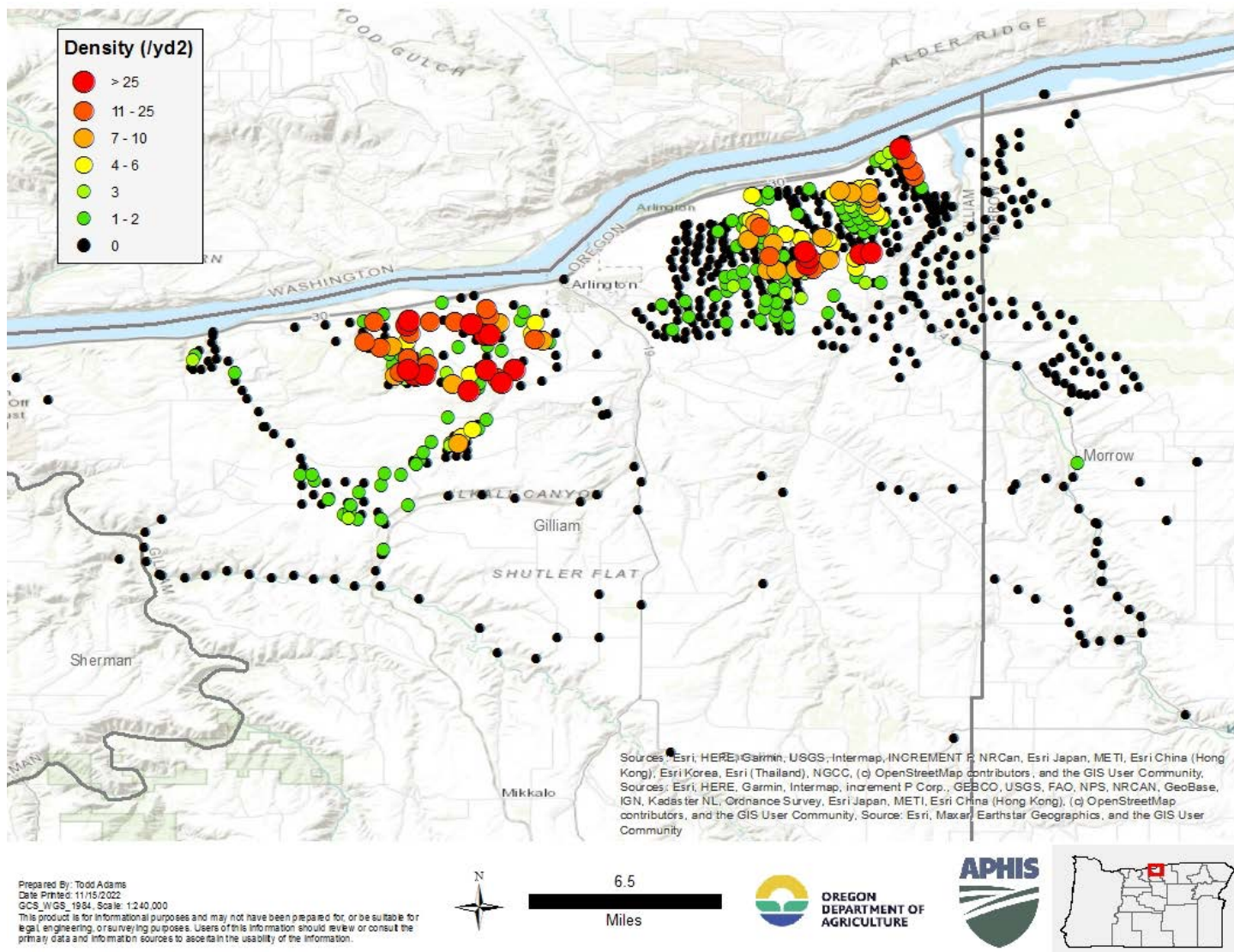


Figure 21. 2022 Mormon cricket survey results in the Arlington area. (1:240k)

2-Jordon Valley Area, Malheur County.

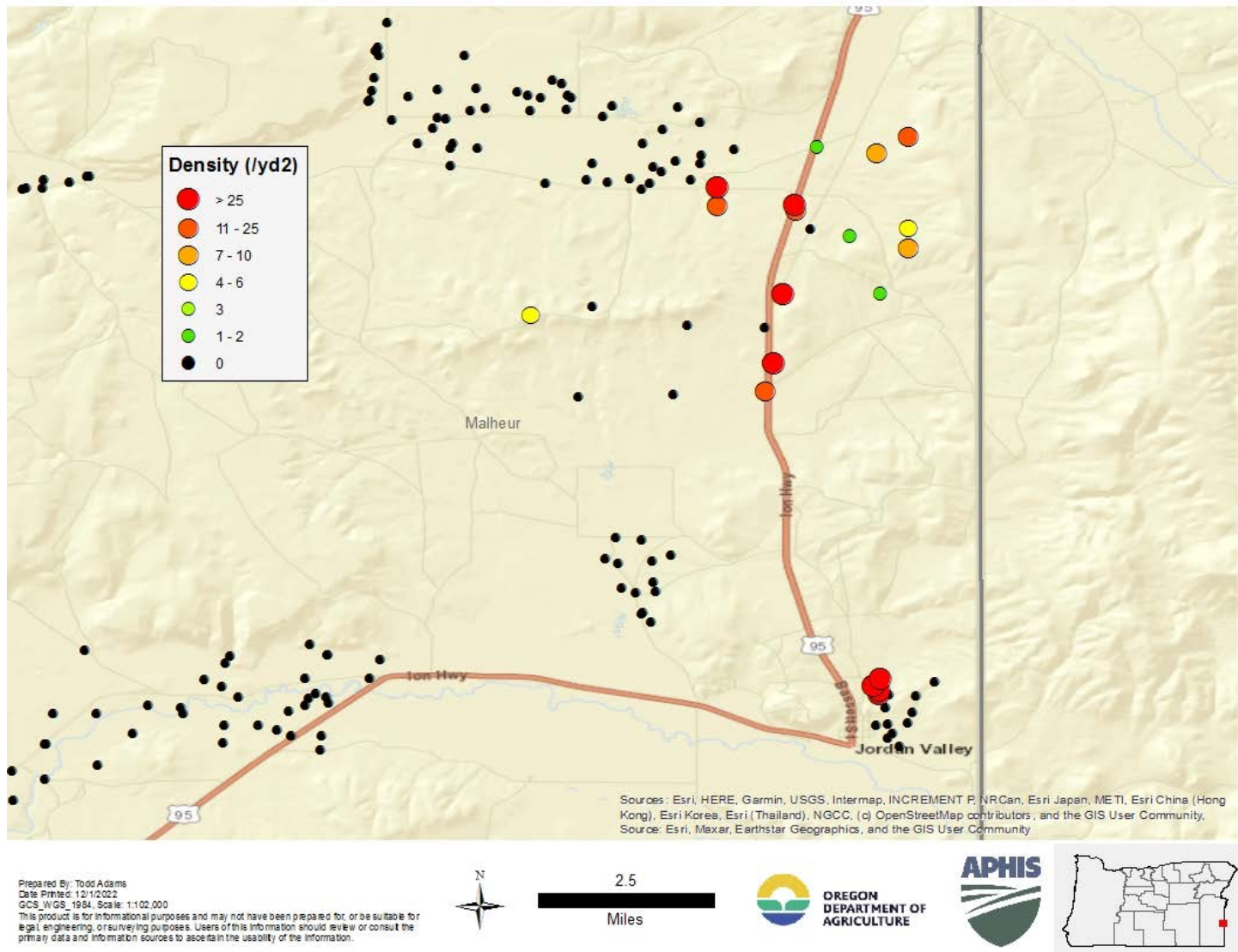


Figure 22. 2022 Mormon cricket survey results in the Jordon Valley area. (1:102k)

### 3-McDermitt Area, Malheur County.

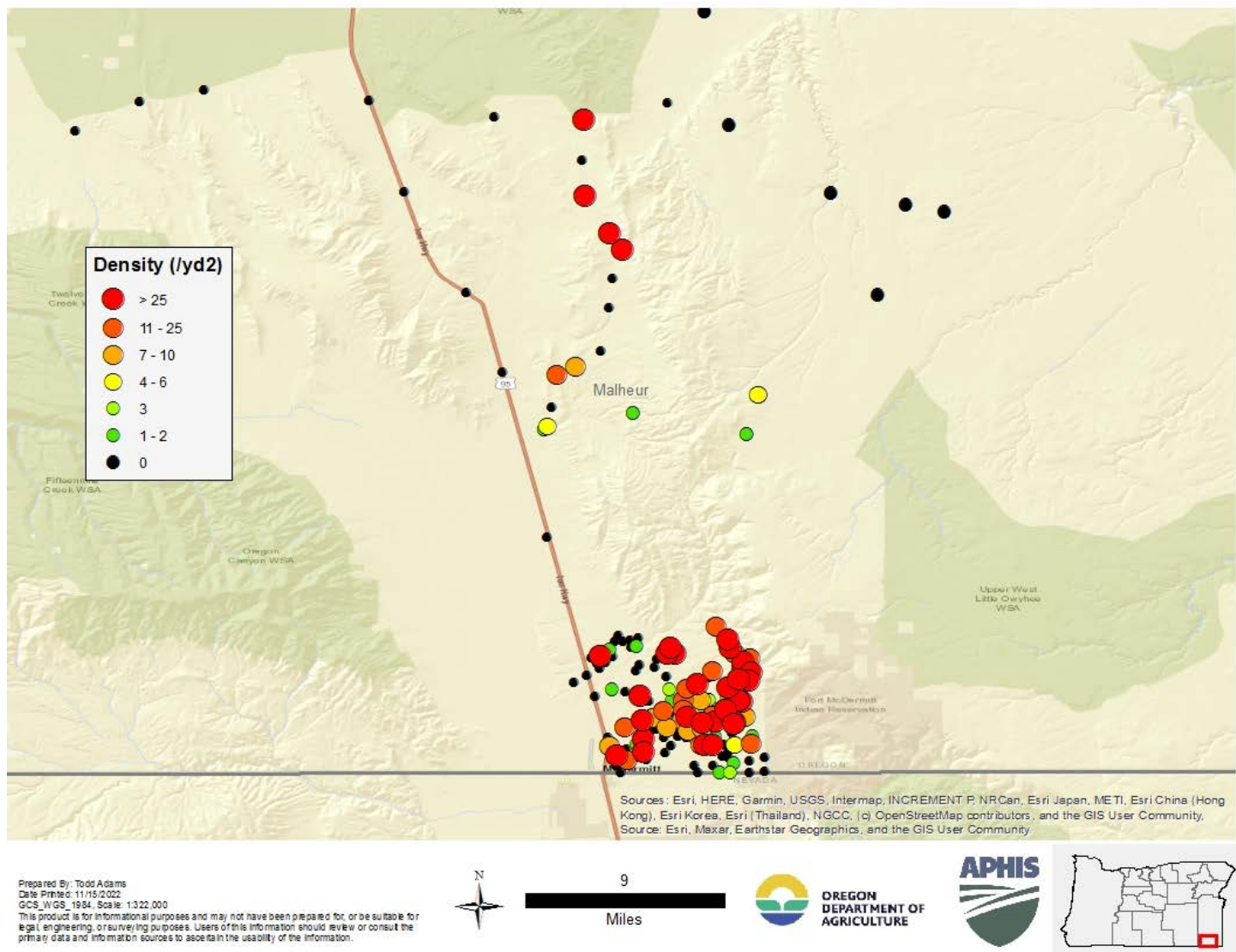


Figure 23. 2022 Mormon cricket survey results in the McDermitt, OR area. (1:322k)

4-Soldier Creek, Malheur County.

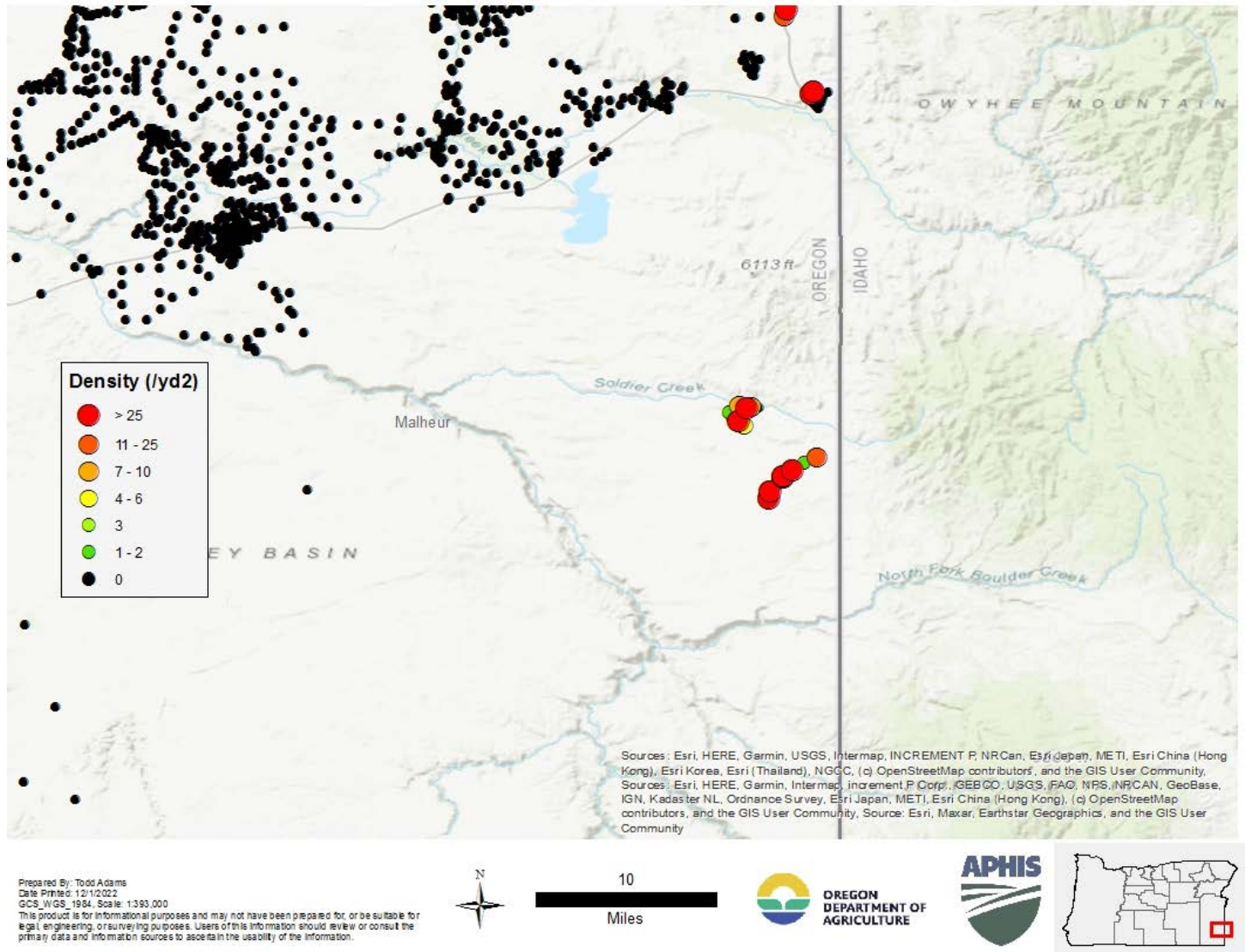


Figure 24. 2022 Mormon cricket survey results in the soldier Creek Area., Malheur County (1:393k)

## 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). In 2022, there was an additional Grasshopper Suppression Program to help private landowners funded by the Oregon State Legislature through Senate Bill 5561.

Grasshopper populations over most of eastern Oregon appear have grown to densities and acreage impacted not seen for many years. Areas of high density were scattered across eastern Oregon, though some counties did have more acreage estimated to have economically significant populations.

During 2022 a total of 6364 sampling locations were visited, 3914 during the nymphal grasshopper survey period and 2450 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 2088 locations (42% 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 2023. If early 2023 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. A new population of Mormon Crickets made its way into Oregon in 2021 from Nevada through McDermitt. This population has now made it to Burns Junction about 25 miles north from where they were discovered in 2021.

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 delimitation-field assessment survey work, providing information and even giving workshops.

### **Todd Adams**

Oregon Department of Agriculture, Hermiston, OR, 503-931-0829, todd.adams@oda.oregon.gov

### **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 2022 survey.**

County	Watershed	Economic Classes Summed by Watershed			Economic Classes Summed by Count		
		Economic	Non-Economic	No Grasshoppers	Economic	Non-Economic	No Grasshoppers
Baker	Alder Creek-Pritchard Creek	1,782	0	0	394,645	153,167	56,241
	Baldock Slough-Powder River	25	8,709	23,883			
	Big Creek	19,628	0	10			
	Big Creek-Burnt River	0	113	231			
	Birch Creek-Snake River	3,786	2,197	0			
	Burnt River	24,406	2,665	0			
	Burnt River Canyon-Burnt River	13	0	0			
	Camp Creek	0	17,880	91			
	Clarks Creek-Burnt River	12,508	774	0			
	Eagle Creek	4,003	42	0			
	Love Creek-Powder River	56,869	0	0			
	Lower Powder River	26,539	0	0			
	Middle Willow Creek	0	687	0			
	North Fork Burnt River	0	30,759	2,839			
	North Powder River	0	569	0			
	Pine Creek	14,796	10,075	0			
	Rock Creek-Powder River	0	17,381	9,363			
	Rock Creek-Snake River	15,574	3,903	0			
	Ruckles Creek-Powder River	189,448	15,596	5,496			
	South Fork Burnt River	0	13,039	3,351			
Sutton Creek-Powder River	12,528	12,518	10,773				
Upper Powder River	10,889	10,764	158				
Upper Willow Creek	34	533	0				
Wolf Creek-Powder River	1,819	4,956	47				
Crook	Bear Creek	0	37,588	30,695	110,532	258,368	238,488
	Buck Creek	0	0	8,283			
	Camp Creek	0	15,571	40,692			
	Chimney Rock-Crooked River	0	10,458	24,136			
	Deep Creek	0	7,411	13,348			

**Appendix 1. Estimate of the acreage with economic levels of grasshopper infestation ( $\geq 8$  grasshoppers / yd<sup>2</sup>) based on the 2022 survey.**

County	Watershed	Economic Classes Summed by Watershed			Economic Classes Summed by Count		
		Economic	Non-Economic	No Grasshoppers	Economic	Non-Economic	No Grasshoppers
	Grindstone Creek	1,872	8,420	0			
	Horse Heaven Creek-Crooked River	2,304	50,132	1,907			
	Lower Beaver Creek	29,215	14,396	2,047			
	Lower Crooked Valley-Crooked River	0	11,503	9,309			
	Lower Dry River	0	29,731	5,744			
	Lower North Fork Crooked River	2,139	89	3,824			
	Lower Ochoco Creek	0	3,772	15,318			
	Lower South Fork Crooked River	12,712	25,040	19,477			
	Paulina Creek	27,563	12,894	544			
	Prineville Reservoir-Crooked River	0	116	18,751			
	Soldiers Cap	0	0	2,732			
	South Fork Beaver Creek	0	0	0			
	Twelvemile Creek	1,048	2,063	14			
	Upper Beaver Creek	4,033	3,371	0			
	Upper Dry River	0	10,558	16,764			
	Upper North Fork Crooked River	0	0	15,727			
	Upper South Fork Crooked River	0	2,035	6,455			
	Watson Creek-Crooked River	17,246	13,218	2,722			
Deschutes	Juniper Butte-Crooked River	0	0	0	0	153,630	109,618
	Soldiers Cap	0	29,055	32,332			
	Upper Dry River	0	79,421	33,156			
	Upper South Fork Crooked River	0	23,988	29,353			
Gilliam	Butte Creek	0	8,976	1,773	48,548	198,059	190,797
	Eightmile Canyon	2,110	23,412	33,280			
	Ferry Canyon-John Day River	0	24,822	1,467			
	John Day River	0	6,106	7,402			
	Lower Lake Umatilla	31,461	58,704	18,473			
	Lower Rock Creek	10,334	26,293	53,765			
	Lower Willow Creek	4,642	24,700	459			
	Scott Canyon-John Day River	0	19,729	26,768			

**Appendix 1. Estimate of the acreage with economic levels of grasshopper infestation ( $\geq 8$  grasshoppers / yd<sup>2</sup>) based on the 2022 survey.**

County	Watershed	Economic Classes Summed by Watershed			Economic Classes Summed by Count		
		Economic	Non-Economic	No Grasshoppers	Economic	Non-Economic	No Grasshoppers
Grant	Thirtymile Creek	0	5,315	21,602			
	Upper Rock Creek	0	0	25,807			
	Bear Creek	5,487	0	0	218,532	178,357	95,854
	Beech Creek	2,711	0	3,100			
	Big Creek-Middle Fork John Day River	257	13,149	3,789			
	Bridge Creek-Middle Fork John Day River	0	11,035	18			
	Camp Creek-Middle Fork John Day River	0	3,869	0			
	Canyon Creek	13,680	8,470	0			
	Cottonwood Creek	94,961	1,068	4,097			
	Eight Mile Creek-Middle Fork John Day River	11,438	2,021	217			
	Fields Creek-John Day River	14,148	4,771	7,670			
	Grub Creek-John Day River	23,922	12,697	472			
	Headwaters Silvies River	7,028	20,093	0			
	John Day River-Johnson Creek	0	11,750	1,135			
	Kahler Creek-John Day River	0	645	1,229			
	Laycock Creek-John Day River	1,120	15,556	17,693			
	Long Creek	14,971	19,761	12,813			
	Lower North Fork John Day River	6,798	4,077	19,975			
	Lower South Fork John Day River	11,331	738	6			
	Middle South Fork John Day River	0	2,927	0			
	Murderers Creek	0	0	0			
	Potamus Creek-North Fork John Day River	0	0	15,119			
	Reynolds Creek-John Day River	9,497	10,612	0			
	Rock Creek	0	778	0			
	South Fork Beaver Creek	0	0	0			
	Upper Beaver Creek	0	0	0			
	Upper Middle John Day	1,183	3,594	19			
	Upper Silvies River	1	17,981	4,780			
Upper South Fork John Day River	0	9,519	0				
Wall Creek	0	0	3,104				

**Appendix 1. Estimate of the acreage with economic levels of grasshopper infestation ( $\geq 8$  grasshoppers / yd<sup>2</sup>) based on the 2022 survey.**

County	Watershed	Economic Classes Summed by Watershed			Economic Classes Summed by Count		
		Economic	Non-Economic	No Grasshoppers	Economic	Non-Economic	No Grasshoppers
Harney	Alvord Lake	152,256	6,798	15,571	1,509,247	650,411	212,622
	Big Alvord Creek	12,021	996	58			
	Big Alvord Creek	21,202	13,644	10,022			
	Big Stick Creek	0	0	0			
	Buck Creek	0	0	319			
	Buckaroo Lake	0	0	0			
	Buzzard Creek	0	0	0			
	Chain Lakes-Sunset Valley	201	6,536	1,131			
	Cottonwood Creek-Frontal Pueblo Valley	67,423	12,336	16,911			
	Crane Creek	26,360	13,985	0			
	Griffin Creek-Upper Malheur River	36,203	39,709	0			
	Harney Lake-Malheur Lake	92,679	25,855	6,584			
	Headwaters Malheur River	4,544	2,633	0			
	Home Creek-Garrison Lake	16,560	22,850	3,430			
	Jackass Creek	840	256	0			
	Kiger Creek-Diamond Canal	30,764	7,795	3			
	Little Tank Creek-Big Tank Creek	0	0	0			
	Lower Donner und Blitzen River	42,158	22,891	2,599			
	Lower North Fork Malheur River	0	0	0			
	Lower Silver Creek	41,018	8,955	22,638			
	Lower Silvies River	387,762	9,398	2,136			
	Lower South Fork Malheur River	17,186	404	0			
	Malheur Gap	21,159	9,668	2,863			
	Malheur Slough	18,844	27,477	134			
	Middle Donner und Blitzen River	46,048	21,650	864			
	Middle Silver Creek	19,994	48,730	17,578			
	Middle Silvies River	3,706	0	2,293			
	North Basin	59,502	27,610	16,387			
Otis Creek	43,334	4,332	668				
Pine Creek	36,859	9,054	190				

**Appendix 1. Estimate of the acreage with economic levels of grasshopper infestation ( $\geq 8$  grasshoppers / yd<sup>2</sup>) based on the 2022 survey.**

County	Watershed	Economic Classes Summed by Watershed			Economic Classes Summed by Count		
		Economic	Non-Economic	No Grasshoppers	Economic	Non-Economic	No Grasshoppers
	Quail Creek	30,637	3,004	1,872			
	Riddle Creek	39,478	788	152			
	Rincon Creek	0	155	23			
	Sage Hen Creek	36,915	24,618	353			
	Shallow Lake-Slickey Lake	0	21,368	4,612			
	Skull Creek	4,012	40,350	11,463			
	Squaw Lake-Capehart Lake	0	1,005	2,649			
	Stinkingwater Creek	2,366	27,356	1,058			
	Summit Creek-Storehouse Canyon	87,912	6,332	2,984			
	Upper Donner und Blitzen River	3,239	17,870	0			
	Upper Silvies River	8,826	0	19,175			
	Upper South Fork Crooked River	0	0	899			
	Upper South Fork Malheur River	39,384	29,823	6,396			
	Walls Lake Reservoir	28,862	77,849	22,589			
	Warm Springs Reservoir-Upper Malheur River	0	4,911	1,958			
	Wheatgrass Lake	0	0	14,062			
	Whitehorse Creek	2,357	639	0			
	Willow Creek	17,066	11,627	0			
	Wilson Creek	0	0	0			
	Wolf Creek	9,568	39,152	0			
Hood River	East Fork Hood River	0	619	0	9,692	20,774	553
	Hood River	5,207	10,521	0			
	Mill Creek-Columbia River	0	8	493			
	Mosier Creek-Columbia River	4,485	9,625	0			
Jefferson	Antelope Creek	0	187	2	82,288	138,697	66,266
	Hay Creek	5,217	4,673	1,595			
	Juniper Butte-Crooked River	9,451	1,785	0			
	Lower Crooked Valley-Crooked River	0	0	1,491			
	Lower Trout Creek	7,314	5,568	5,368			
	Mill Creek	0	0	8			

**Appendix 1. Estimate of the acreage with economic levels of grasshopper infestation ( $\geq 8$  grasshoppers / yd<sup>2</sup>) based on the 2022 survey.**

County	Watershed	Economic Classes Summed by Watershed			Economic Classes Summed by Count		
		Economic	Non-Economic	No Grasshoppers	Economic	Non-Economic	No Grasshoppers
Klamath	Mud Springs Creek	22	30,215	4,089			
	Muddy Creek-John Day River	8,351	18,190	10,080			
	Potter Canyon-Deschutes River	1,744	510	0			
	Shitike Creek-Deschutes River	9,227	12,681	25,649			
	Upper Trout Creek	16,761	39,698	5,458			
	Willow Creek	24,200	25,191	11,669			
	Crater Lake-Williamson River	40,567	1,579	874	409,476	388,000	144,102
	Fishhole Creek	1,398	3,734	19,306			
	Gerber Reservoir-Miller Creek	16,037	27,628	7,361			
	Hog Creek-Williamsno River	44,151	24,803	998			
	Jack Creek-Williamson River	38,691	15,491	4,823			
	Lake Ewauna-Klamath River	0	4,052	0			
	Langell Valley-Lost River	0	28,513	8,481			
	Long Lake Valley-Upper Klamath Lake	5,166	4,860	64			
	Lower Sycan River	24	9,185	11,016			
	Mills Creek-Lost River	2,691	10,725	179			
	North Fork Sprague River	0	13,486	14,946			
	Rock Creek-Lost River	0	191	0			
	South Fork Sprague River	0	28,940	7,178			
	Sprague River	86,803	35,024	18,176			
Swan Lake Valley	2,363	46,066	2,665				
Wood River	28,027	9,816	0				
Yonna Valley-Lost River	109,466	99,356	37,267				
Lake	Anna River-Summer Lake	11,099	37,381	0	733,657	489,279	150,260
	Buck Creek	0	0	1,569			
	Buckaroo Lake	0	0	0			
	Campbell Lake	0	277	11,276			
	Christmas Lake Valley	0	0	224			
	Crooked Creek	35,960	20,488	0			
	Crump Lake	86,254	92,942	2,977			

**Appendix 1. Estimate of the acreage with economic levels of grasshopper infestation ( $\geq 8$  grasshoppers / yd<sup>2</sup>) based on the 2022 survey.**

County	Watershed	Economic Classes Summed by Watershed			Economic Classes Summed by Count		
		Economic	Non-Economic	No Grasshoppers	Economic	Non-Economic	No Grasshoppers
	Deep Creek	61,023	32,616	9,928			
	Drews Creek	136,300	28,516	0			
	Dry Creek-Fort Rock Valley	0	26,116	4,576			
	Dry Creek-Frontal Goose Lake	44,221	987	42			
	Duncan Creek-Silver Lake	22,914	3,389	0			
	Fishhole Creek	196	808	0			
	Goose Lake	56	0	0			
	Honey Creek	1,243	10,674	383			
	Little Tank Creek-Big Tank Creek	0	0	0			
	Lower Chewaucan River	28,558	21,639	31,871			
	Middle Chewaucan River	0	972	0			
	Pine Lake-Devils Garden	0	11,671	0			
	Post Lake	0	1,327	7,217			
	Rock Creek-Buck Creek	4,117	14,421	0			
	Sand Canyon-Lake Abert	716	0	1,494			
	Silver Creek	106,580	15,878	5,590			
	South Fork Sprague River	3,947	3,058	4,186			
	Thomas Creek	62,987	47,186	3,747			
	Thorn Lake	8,026	95,227	10,495			
	Tired Horse Lake	0	0	15,963			
	Upper South Fork Crooked River	0	0	26,579			
	Wheatgrass Lake	0	0	350			
	Willow Creek-Frontal Goose Lake	59,560	1,810	1,876			
Malheur	Antelope Creek	0	12,822	9,763	1,254,079	683,582	211,854
	Birch Creek-Snake River	8,580	0	0			
	Burnt River	0	0	0			
	Camp Creek	0	311	0			
	Clarks Creek-Burnt River	0	0	0			
	Clover Creek	0	21,911	150			
	Cottonwood Creek	1,959	3,645	0			

**Appendix 1. Estimate of the acreage with economic levels of grasshopper infestation ( $\geq 8$  grasshoppers / yd<sup>2</sup>) based on the 2022 survey.**

County	Watershed	Economic Classes Summed by Watershed			Economic Classes Summed by Count		
		Economic	Non-Economic	No Grasshoppers	Economic	Non-Economic	No Grasshoppers
	Cow Creek	0	16,866	3,769			
	Crowley Creek	117,244	32,200	12,728			
	Dry Creek	15,823	8,932	119			
	Dry Creek-Jordan Creek	162,906	17,288	507			
	Hog Creek-Lower Malheur River	16,163	11,798	205			
	Hunter Creek-Lower Malheur River	0	380	56			
	Jackson Creek-Owyhee River	119,383	3,595	1,427			
	Jacobsen Gulch-Snake River	0	0	0			
	Johnston Gulch Reservoir-Lower Malheur River	15,922	2	0			
	Jordan Creek-Sheep Spring Creek	132,583	4,947	304			
	Juniper Basin Creek-Upper Malheur River	0	19,350	0			
	Little Malheur River	0	3,891	9,142			
	Little Sandy Reservoir-Lower Malheur River	13,478	6,299	212			
	Locket Gulch-Snake River	6,618	86	0			
	Lower Bully Creek	13,977	3,676	0			
	Lower Cow Creek	114,037	5,746	27			
	Lower Crooked Creek	37,981	86,369	608			
	Lower North Fork Malheur River	0	16,630	15,829			
	Lower South Fork Malheur River	12,904	12,265	0			
	Lower Succor Creek	20,947	31,196	2,041			
	Lower Willow Creek	5,676	5,064	0			
	Middle Willow Creek	12,484	42,316	9,777			
	Moore's Hollow-Snake River	0	0	0			
	North Alkali Creek-Snake River	6,481	0	0			
	Oregon Canyon Creek	54,980	44,179	27,794			
	Otis Creek	0	0	0			
	Quail Creek	32,659	1,278	10			
	Rattlesnake Creek	0	46,947	48,515			
	Ryegrass Creek-Owyhee River	79,872	16,692	387			
	Sand Hollow Creek	2,080	4,041	0			



**Appendix 1. Estimate of the acreage with economic levels of grasshopper infestation ( $\geq 8$  grasshoppers / yd<sup>2</sup>) based on the 2022 survey.**

County	Watershed	Economic Classes Summed by Watershed			Economic Classes Summed by Count		
		Economic	Non-Economic	No Grasshoppers	Economic	Non-Economic	No Grasshoppers
Morrow	Sand Hollow Creek-Owyhee River	14,010	2	0			
	Skull Creek-Owyhee River	51,371	6,549	0			
	Soldier Creek	42,182	2,556	301			
	Three Fingers Gulch-Owyhee River	6,641	1,862	10,058			
	Trout Creek-Jordan Creek	891	0	0			
	Upper Bully Creek	0	23,402	0			
	Upper Cow Creek	97,247	2,845	539			
	Upper Crooked Creek	0	66,605	40,461			
	Upper Dry Creek	0	2,597	0			
	Upper South Fork Malheur River	0	2,235	744			
	Upper Succor Creek	13,794	37,313	222			
	Upper Willow Creek	21,049	20,650	1,670			
	Warm Springs Reservoir-Upper Malheur River	0	0	0			
	West Tub Mountain Reservoir	0	0	0			
	Whitehorse Creek	300	20	6,142			
	Eightmile Canyon	0	9,383	12,994	74,133	239,469	258,846
	Hunt Ditch-Umatilla River	3,946	12	292			
	Juniper Canyon	0	31,724	52,761			
	Lower Butter Creek	10,015	4,834	12,915			
	Lower Lake Umatilla	0	11,198	7,059			
	Lower Rock Creek	0	8,529	8,982			
	Lower Willow Creek	0	50,889	16,123			
	Middle Lake Umatilla	0	7,443	1,444			
	Middle Willow Creek	2,600	5,812	39,600			
	Rhea Creek	12,559	9,608	20,732			
	Sand Hollow	6,448	4	29,617			
	Sixmile Canyon	0	56,894	7,793			
	Upper Butter Creek	20,814	18,047	3,523			
Upper Lake Umatilla	0	10,371	0				
Upper Rock Creek	0	0	28,009				

**Appendix 1. Estimate of the acreage with economic levels of grasshopper infestation ( $\geq 8$  grasshoppers / yd<sup>2</sup>) based on the 2022 survey.**

County	Watershed	Economic Classes Summed by Watershed			Economic Classes Summed by Count		
		Economic	Non-Economic	No Grasshoppers	Economic	Non-Economic	No Grasshoppers
Sherman	Upper Willow Creek	17,752	14,720	16,998	54,712	80,667	139,076
	Buck Hollow Creek	9,538	15,801	27,551			
	Cedar Island-Deschutes River	18,101	10,846	7,460			
	Ferry Canyon-John Day River	0	7,050	6,839			
	Grass Valley Canyon	10,282	26,843	51,288			
	John Day River	0	9,964	11,381			
	Lower Lake Umatilla	0	0	0			
	Pine Hollow	0	5,505	7,651			
	Scott Canyon-John Day River	0	1,095	4,525			
	Spanish Hollow-Columbia River	16,791	3,563	22,380			
Umatilla	Alkali Canyon-Umatilla River	0	61,147	36,420	89,155	363,921	542,734
	Birch Creek	0	35,041	59,570			
	Cold Springs Canyon	17,627	34,611	40,970			
	Headwaters Umatilla River	0	0	6,397			
	Hunt Ditch-Umatilla River	912	11,657	26,013			
	Lookingglass Creek	0	0	629			
	Lower Butter Creek	0	5,514	5,945			
	Lower Camas Creek	0	50,336	25,461			
	Lower Lake Wallula	19,595	24,134	15,504			
	Lower Walla Walla River	0	561	18,219			
	McKay Creek	6,524	3,140	19,410			
	Meadow Creek	0	0	58			
	Middle Walla Walla River	0	23,298	6,390			
	Mission Creek-Umatilla River	6,038	7,152	52,712			
	Pine Creek	7,301	48,523	32,035			
	Sand Hollow	0	0	1,442			
	Stage Gulch	4,858	25,871	26,719			
	Upper Butter Creek	21,034	10,632	37,807			
Upper Camas Creek	0	0	29,902				
Upper Lake Umatilla	0	0	941				

**Appendix 1. Estimate of the acreage with economic levels of grasshopper infestation ( $\geq 8$  grasshoppers / yd<sup>2</sup>) based on the 2022 survey.**

County	Watershed	Economic Classes Summed by Watershed			Economic Classes Summed by Count		
		Economic	Non-Economic	No Grasshoppers	Economic	Non-Economic	No Grasshoppers
Union	Upper Walla Walla River	5,265	20,216	21,493			
	Wildhorse Creek	0	2,089	77,921			
	Beaver Creek-Grande Ronde River	0	10,646	13	61,787	125,352	75,632
	Big Creek	15,369	0	2,877			
	Birch Creek	0	0	0			
	Cabin Creek-Grande Ronde River	16,851	2,957	0			
	Five Points Creek-Grande Ronde River	0	0	11,173			
	Indian Creek-Grande Ronde River	1,161	10,277	4,463			
	Ladd Creek	59	9,807	17,711			
	Lower Catherine Creek	3,256	971	19,777			
	Lower Wallowa River	1,953	0	0			
	McKay Creek	0	0	0			
	Meadow Creek	0	1,427	11,965			
	Minam River	3,589	0	286			
	North Powder River	0	4,039	0			
	Rock Creek-Powder River	0	0	0			
	Wallowa	Upper Catherine Creek	19,540	15,572	0		
Upper Grande Ronde River		0	18,035	3,019			
Willow Creek		0	11,364	0			
Wolf Creek-Powder River		10	40,258	2,731			
Chesnimnus Creek		2,885	5,504	6,251	76,706	168,995	51,426
Lostine River		0	0	0			
Lower Big Sheep Creek		10,029	23,419	18,474			
Lower Grande Ronde River		0	1,357	8,904			
Lower Imnaha River		0	13,573	0			
Lower Joseph Creek		0	5,822	1,763			
Lower Wallowa River		23,780	13,227	0			
Middle Imnaha River		0	5,495	0			
Middle Wallowa River		16,698	2,722	1,764			
Minam River	362	0	592				

**Appendix 1. Estimate of the acreage with economic levels of grasshopper infestation ( $\geq 8$  grasshoppers / yd<sup>2</sup>) based on the 2022 survey.**

County	Watershed	Economic Classes Summed by Watershed			Economic Classes Summed by Count			
		Economic	Non-Economic	No Grasshoppers	Economic	Non-Economic	No Grasshoppers	
Wasco	Mud Creek-Grande Ronde River	2,486	20,824	1,502				
	Upper Big Sheep Creek	0	432	0				
	Upper Joseph Creek	19,188	37,231	813				
	Upper Wallowa River	1,276	39,390	11,363				
	Antelope Creek	18,056	6,434	24,482	128,449	125,143	149,877	
	Bakeoven Creek	10,781	637	7,720				
	Beaver Creek	21,426	7,020	0				
	Buck Hollow Creek	2,446	4,000	10,143				
	Cedar Island-Deschutes River	1,680	487	7,819				
	Clarno Rapids-John Day River	4,764	9,086	1,809				
	Eightmile Creek	0	2,491	20,954				
	Fifteenmile Creek	12,205	17,759	8,522				
	Hood River	0	10	0				
	Mill Creek	0	0	654				
	Mill Creek-Columbia River	10,818	11,273	5,810				
	Mosier Creek-Columbia River	11,700	7,171	0				
	Muddy Creek-John Day River	1,725	1,466	522				
	Pine Hollow	247	2,076	4,260				
	Wheeler	Shitike Creek-Deschutes River	3,318	0	3,496			
		Tygh Creek	9,766	3,081	4,569			
Upper Trout Creek		0	13	1,587				
Warm Springs River		3,468	6,915	27,677				
White Horse Rapids-Deschutes River		8,209	30,106	1,716				
White River		7,839	15,117	12,061				
Bridge Creek		814	24,692	1,401	74,358	198,021	91,602	
Butte Creek		27,775	22,451	4,319				
Clarno Rapids-John Day River		0	3,722	0				
Deep Creek		0	4,599	40				
John Day River-Johnson Creek	0	8,753	1,717					
Kahler Creek-John Day River	12,412	26,289	52,559					

**Appendix 1. Estimate of the acreage with economic levels of grasshopper infestation ( $\geq 8$  grasshoppers / yd<sup>2</sup>) based on the 2022 survey.**

County	Watershed	Economic Classes Summed by Watershed			Economic Classes Summed by Count		
		Economic	Non-Economic	No Grasshoppers	Economic	Non-Economic	No Grasshoppers
	Lower Beaver Creek	0	4,490	0			
	Mountain Creek	23,957	26,414	12,440			
	Muddy Creek-John Day River	5,337	22,433	301			
	Rock Creek	0	8,783	0			
	Service Creek-John Day River	0	44,322	8,461			
	Thirtymile Creek	4,063	5	4,345			
	Upper Middle John Day	0	1,069	0			
Totals for Economic Class		10,147,416	3,394,859	1,720,588			
Grand Total of Surveyed Acres		15,262,863					

## 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 Paul Blom 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.