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## Introduction

Italian ryegrass (*Lolium multiflorum* L.) and mayweed chamomile (*Anthemis cotula* L.) are two well adapted weed species common in the PNW small grain production region (Figure 1). Both species are summer annuals with emergence occurring in the spring. While mayweed chamomile emergence occurs at the start of the spring growing season, Italian ryegrass can continue to emerge throughout the spring and summer if adequate soil moisture is available. Italian ryegrass and mayweed chamomile are pernicious competitors with crops and can severely reduce yield.

An increased use of conservation tillage practices in the PNW has favored both weed species as management now relies almost exclusively on herbicides. Mayweed chamomile management, particularly in pulse crops, requires well timed herbicide applications and competitive stand establishment as there are no effective postemergence herbicides for use in pulses. Italian ryegrass is considered one of the worst weeds globally in the context of herbicide resistance and is resistant to several commonly used herbicide modes of action in the PNW.

Italian ryegrass and mayweed chamomile are major pests currently in the PNW and projected changes in climate over the next several decades may lead to expanded ranges for both species.

Little is known about the relationship between climate, management, and distribution of the two species. To address the gap in knowledge, a grower survey was conducted that, in part, included questions about mayweed chamomile and Italian ryegrass distribution and management.

## Methods and Materials

To better understand the relationship between climate, management practices, and distribution of pests; a producer survey was conducted.

- In November of 2012-March 2013 a mail survey was administered to growers in the PNW small grain production region.
- 2000 surveys were sent out to producers who grew more than 50 acres of wheat.
- The full Dillman method was employed, including four mailings and a postcard.
- The mailing included a survey of perceptions of climate change, management practices, and demographics; maps on which to mark all parcels farmed.
- The respondents identified multiple field sites, and for each site they were asked which weeds were found, and the degree to which they were controlled.
- We received 900 completed and eligible surveys, four non-deliverable surveys, and 38 ineligible recipients resulting in an overall response rate of 45%. The majority of respondents completed the mapping data with accuracy (n= 700; 35%).

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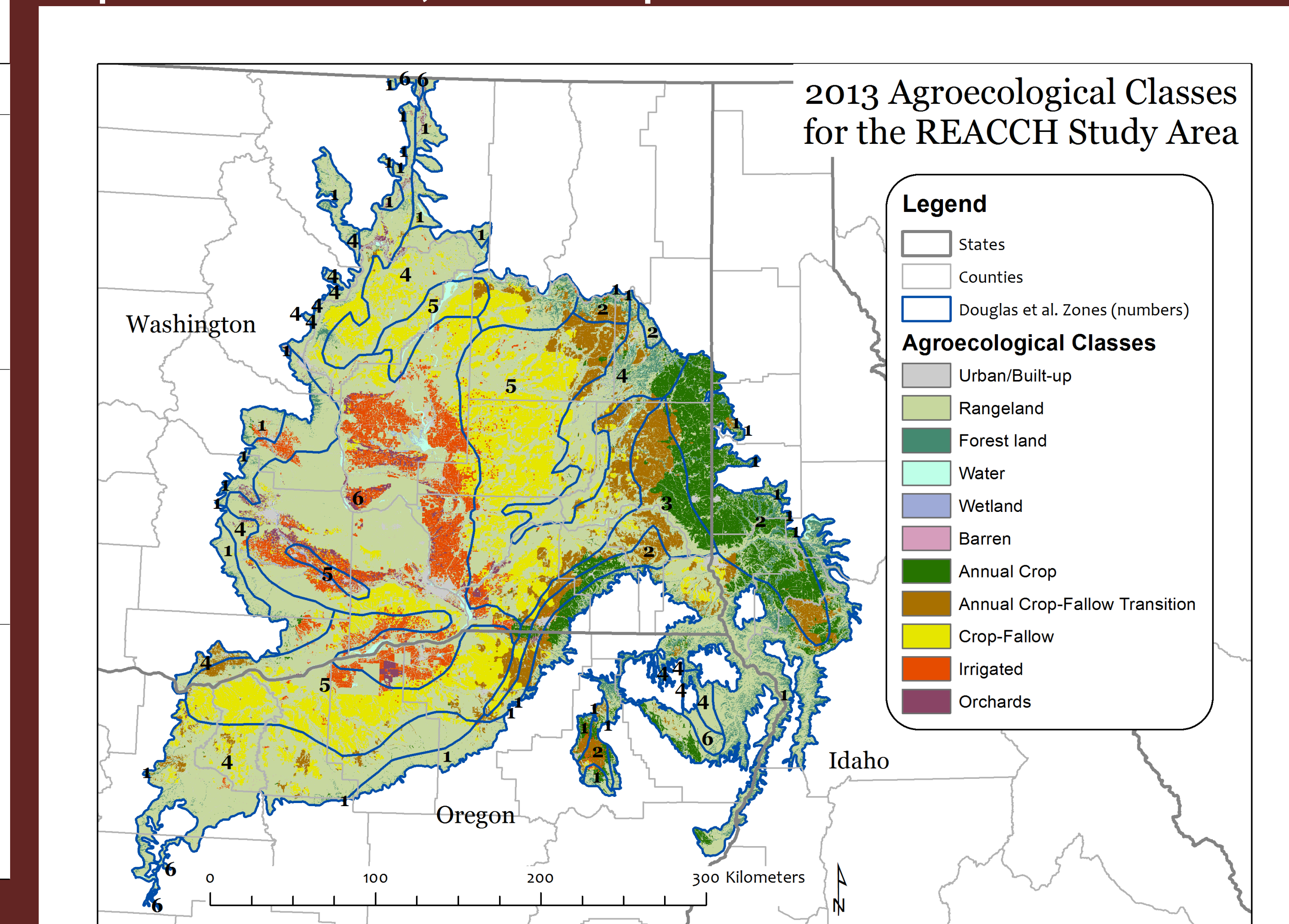
Table 1. Producer observation of Italian ryegrass interference based on climate and management practices. Conventional, conservation, and no-till refer to grower self-classification of approach to tillage, and the three zones refer to the agroecological zones in Figure 1.

	Conventional	Conservation	No-till	Average
<b>Crop-Fallow</b>				
Not Observed	82	70	58	70
Not Treated	6	2	4	4
Treated, Not Controlled	7	12	4	8
Treated, Controlled	6	16	34	19
<b>Intermediate Cropping</b>				
Not Observed	45	63	62	57
Not Treated	1	7	3	4
Treated, Not Controlled	26	6	14	15
Treated, Controlled	28	24	20	24
<b>Annual Cropping</b>				
Not Observed	41	26	27	31
Not Treated	2	5	7	5
Treated, Not Controlled	24	19	28	24
Treated, Controlled	33	50	38	41

Table 2. Producer observation of mayweed chamomile interference based on climate and management practices. Conventional, conservation, and no-till refer to grower self-classification of approach to tillage, and the three zones refer to the agroecological zones in Figure 1.

	Conventional	Conservation	No-till	Average
<b>Crop-Fallow</b>				
Not Observed	82	83	82	82
Not Treated	6	9	8	8
Treated, Not Controlled	7	7	5	6
Treated, Controlled	6	2	5	4
<b>Intermediate Cropping</b>				
Not Observed	27	47	41	38
Not Treated	7	6	11	8
Treated, Not Controlled	45	14	17	25
Treated, Controlled	21	33	31	28
<b>Annual Cropping</b>				
Not Observed	20	8	11	13
Not Treated	3	6	1	4
Treated, Not Controlled	29	24	23	25
Treated, Controlled	47	62	65	58

Figure 1. Agroecological classes in the small grain production region of the PNW. The three zones of focus are the annual crop, annual crop-fallow transition, and the crop fallow.



## Results

- Observation of Italian ryegrass by cropping system is likely a result of increased annual precipitation.
- Seventy percent of respondents from the crop-fallow production system did not observe Italian ryegrass, whereas, 57 and 31% of respondents from the intermediate and annual cropping systems did not observe Italian ryegrass (Table 1).
- A similar trend was observed with mayweed chamomile (Table 2).
- In the crop-fallow production system Italian ryegrass was observed more often in areas where no-till was used.
- The presence of Italian ryegrass in the no-till areas of the crop-fallow production systems may be a consequence of greater soil moisture retention or a more stable seed bed.
- The observation of Italian ryegrass in the intermediate and annual cropping systems was not as variable by tillage practices as in the crop-fallow system, however control of Italian ryegrass was variable by tillage practices. Respondents from intermediate and annual cropping system who used conservation tillage rather than conventional tillage or no-till practices reported greater control of Italian ryegrass.

## Discussion

- Mayweed chamomile is much less common in the crop-fallow production system, likely due to moisture.
- In the intermediate cropping zone, mayweed chamomile is more common in tillage systems, and also more difficult to control.
- The opposite is true in the annual cropping system zone, where mayweed is less commonly observed in systems that use tillage.
- No-till and conventional tillage practices differ considerably in the reliance not only on tillage but also herbicide use.
- The greater control of Italian ryegrass observed when conservation tillage practices were used may reflect increased flexibility in tillage and herbicide use allowing growers to better adapt their practices for difficult to control weeds.
- Finally, it appears that Italian ryegrass and mayweed chamomile are useful species as climate indicators, and that grower surveys can be useful tools for assessing, indirectly, climate effects on indicator species like these two weeds.