



Sustainable Conservation



# Results of PlantRight 2014 Spring Retail Nursery Survey

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**September 2014**

**Prepared For**

Sustainable Conservation

**Prepared By**

Learning for Action



Learning for Action enhances the impact and sustainability of social sector organizations through highly customized research, strategy development, and evaluation services.

## About PlantRight

In 2004, Sustainable Conservation brought together a group of leaders in the horticulture industry, academia, botanical gardens, environmental groups and government agencies to form the California Horticultural Invasives Prevention (Cal-HIP) partnership. Recognizing that invasive plants are still introduced through California's horticultural trade and prevention is the most effective way to combat their spread, they created the PlantRight campaign in 2005 to stop the propagation, distribution, and sale of invasive plants in California.

PlantRight is using a collaborative, voluntary process to identify and pursue actions that reduce the introduction of horticultural invasive plants in an environmentally sound and economically viable manner. Ultimately, the program will contribute to the protection of California's natural plant and animal communities as well as the state's economic well-being, as California spends upwards of \$82 million annually on controlling and eradicating invasive plants that contribute to flooding, fires, and crop losses.

On a quarterly basis, Sustainable Conservation continues to convene meetings with Cal-HIP, which acts as a steering committee for the PlantRight campaign. Cal-HIP agreed upon a list of invasive plants commonly sold by nurseries that could be replaced with safe alternatives. Today, the PlantRight Campaign, with oversight from Cal-HIP, is working in partnership with the nursery industry to stop the sale of 15 invasive species and find ways to screen new horticultural plants for invasiveness with the help of a plant risk evaluation (PRE) tool. Every spring, PlantRight surveys California's retail nurseries for horticultural invasive plants with the help of volunteers from University of California Cooperative Extension's Master Gardener Program, as well as other gardening and conservation groups. The annual spring survey helps PlantRight measure its impact, update its plant list, and inform its strategies.

## About this Report

Learning for Action, a professional third-party evaluation firm, was engaged to (1) assist in the development of a sampling plan for the annual spring survey, and (2) analyze the results of the 2014 Spring Nursery Survey, in comparison to past years' results. This report focuses on the results of the survey. For details of the sampling plan, please see the In-Depth Methods in Appendix A.

## About Learning for Action

Established in 2000 and with offices in San Francisco and Seattle, Learning for Action (LFA) provides highly customized research, strategy, and evaluation services that enhance the impact and sustainability of social sector organizations across the U.S. and beyond. LFA's technical expertise and community-based experience ensure that the insights and information we deliver to nonprofits, foundations, and public agencies can be put directly into action. In the consulting process, we build organizational capacity, not dependence. We engage deeply with organizations as partners, facilitating processes to draw on strengths, while also providing expert guidance. Our high quality services are accessible to the full spectrum of social sector organizations, from grassroots community-based efforts to large-scale national and international foundations and initiatives.

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# I. Methods

## Data Collection Methods

PlantRight uses an annual Spring Nursery Survey to track the retail market for invasive plants.<sup>1</sup> The survey is conducted using a sample of California retail nurseries, and is administered at individual stores by volunteers. After conducting a pilot survey of 73 stores in 2010, PlantRight has conducted the survey annually for four years: 2011 (226 stores surveyed), 2012 (238 stores surveyed), 2013 (223 stores surveyed), and 2014 (226 stores surveyed). The goal of the Spring Nursery Survey is to provide annual snapshots of the statewide prevalence of invasive plants in nurseries. With this data, PlantRight can track trends in the prevalence of invasive plants over time.<sup>2</sup>

In 2013, and then again in 2014, PlantRight revised the list of invasive plant species tracked by the Spring Nursery Survey. In 2010, 2011, and 2012, the PlantRight survey tracked nineteen plants (Arundo/giant reed, blue gum eucalyptus, bridal veil broom, capeweed, Chinese tallow tree, crystalline iceplant, French broom, green fountain grass, highway iceplant, jubata grass, Myoporum, pampas grass, periwinkle, Portuguese/striated broom, Russian olive, saltcedar, scarlet wisteria, Scotch broom, and Spanish broom).

For the 2013 survey, PlantRight decided to remove seven plants from the list because they were so rarely found for sale (Arundo/giant reed, blue gum eucalyptus, bridal veil broom, jubata grass, Portuguese/striated broom, saltcedar, and scarlet wisteria).

The remaining 12 plants, plus an additional six plants (Mexican feathergrass, water hyacinth, yellow water iris, Brazilian peppertree, flowering rush, and Victorian box) were included in the 2013 survey.

This list of 18 plants was further modified in the 2014 survey; eight plants were removed (capeweed, crystalline iceplant, myoporum, Russian olive, Spanish broom, Brazilian peppertree, flowering rush, and Victorian box) and four were added (Brazilian waterweed, grassland sedge, ox-eye daisy, and southern catalpa). These changes are summarized in Exhibit 1, below, with the plants listed in alphabetical order.

**Exhibit 1. Plant Species in Each Year's Survey List**

Common Name	2010, 2011, and 2012 Surveys	2013 Survey	2014 Survey
Arundo/giant reed	✓		
Blue gum eucalyptus	✓		
Brazilian peppertree		✓	

<sup>1</sup> PlantRight currently tracks invasive plants that are among the most impactful and commonly sold by the nursery industry in California. While the nursery industry sells more invasive plants, this survey tracks only a select set of plants, which are listed in Appendix D.

<sup>2</sup> This survey tracks the prevalence of plants for sale, not the volume of plants for sale. Some stores may sell many species of invasive plants, but only have a few plants of each species for sale. Others may only sell one type of invasive plant, but have large numbers of that species available. In short, not all stores have an equal impact on the prevalence of invasives; a small decrease in stores that sell large quantities of invasives could have a larger effect than a large decrease in stores that sell small quantities of invasives.

**Exhibit 1. Plant Species in Each Year's Survey List**

Common Name	2010, 2011, and 2012 Surveys	2013 Survey	2014 Survey
Brazilian waterweed			✓
Bridal veil broom	✓		
Capeweed	✓	✓	
Chinese tallow tree	✓	✓	✓
Crystalline iceplant	✓	✓	
Flowering rush		✓	
French broom	✓	✓	✓
Grassland sedge <sup>3</sup>			✓
Green fountain grass	✓	✓	✓
Highway iceplant	✓	✓	✓
Jubata grass	✓		
Mexican feathergrass		✓	✓
Myoporum	✓	✓	
Ox-eye daisy			✓
Pampas grass	✓	✓	✓
Periwinkle	✓	✓	✓
Portuguese broom	✓		
Russian olive	✓	✓	
Saltcedar	✓		
Scarlet wisteria	✓		
Scotch broom	✓	✓	✓
Southern catalpa			✓
Spanish broom	✓	✓	
Victorian box		✓	
Water hyacinth		✓	✓
Yellow water iris		✓	✓

Given these changes over time, and in order to focus on cross-year analyses, Learning for Action (LFA) and PlantRight agreed that this year's report should focus on the 10 plants that were included in **both** the 2013 and 2014 survey (Chinese tallow tree, French broom, green fountain grass, highway iceplant, Mexican feathergrass, pampas grass, periwinkle, Scotch broom, water hyacinth, and yellow water iris). This list is the subject of three sections of the "Results" chapter of the report:

- What percentage of stores carries one or more species of invasive plant?

<sup>3</sup> Also known as European grey sedge or Berkeley sedge.

- Specifically for plants invasive in the climate zones where they were found for sale, what percentage of stores carries one or more species of invasive plants?
- What is the average number of invasive species carried by all stores?

The four plants that were new to this year’s survey (Brazilian waterweed, grassland sedge, ox-eye daisy, and southern catalpa) are not included in these three sections of the “Results” chapter.

However, these plants are included in two other sections of the “Results” chapter:

- How has the overall rate of invasive species for sale changed for those species continuously included in the survey since 2011? How has the overall rate changed for those species included in the survey since 2013? What was the overall rate of sale for species added to the survey this year?
- For each invasive species separately, what percentage of stores carries that species?

In order for the annual snapshots to provide accurate information about the prevalence of invasive plants, PlantRight needs to be confident that it can draw valid inferences from the survey results. There are several approaches that PlantRight employed to ensure the collection of high quality survey data:

- **Developing a rigorous sampling plan.** LFA created a tailored sampling plan to support the goal of maximizing the extent to which the nurseries in the survey represent the retail nursery industry in California as a whole. The sampling plan was also crafted so that stores of each store type (Box Retailers, Chain Retailers, and Independent Retailers), and stores within each county, were adequately represented.
- **Recruiting and training highly skilled surveyors.** PlantRight recruited Master Gardener volunteers – surveyors who already have extensive plant recognition skills – and, as needed, volunteers from other gardening and conservation groups. To prepare them for this particular survey, PlantRight trained the volunteers to further hone their skills in carrying out this survey and recognizing the invasive plants on PlantRight’s list. In 2014, 121 volunteers participated in the survey, with each volunteer spending an average of 49 minutes surveying a nursery. A substantial portion of volunteers – 47% – surveyed more than one store.
- **Conducting a quality assurance review on the results.** Survey volunteers were asked to take pictures of the plants that they identified as invasive species. PlantRight staff then reviewed the pictures to verify the results that volunteers submitted.

For details about each of these approaches, please consult [Appendix A](#).

## Methods of Data Analysis

Because a rigorous sample was drawn based on the sampling plan, it is possible to infer population characteristics from the sample. Thus LFA used frequency distributions to describe the full sample and sample subgroups.<sup>4</sup> The frequency distributions for the sample provide unbiased estimates<sup>5</sup> of the frequency distributions within the population (and population subgroups).

This report presents the results of t-tests and chi-squares: two statistical tests designed to show the level of confidence in specific types of between-group comparisons. T-tests and chi-squares are

<sup>4</sup> Prior to analysis, LFA weighted the data. For details on weighting, see Appendix A.

<sup>5</sup> To say an estimate is *unbiased* does not mean that the true population characteristic *perfectly matches* the estimate. Rather, the estimate exists within a specific range called the “confidence interval.”

designed to test for difference across multiple groups (e.g. the prevalence of invasive species in a set of stores, when those stores are grouped by climate zone).

## II. Results

The PlantRight campaign commissioned the 2014 Annual Spring Nursery Survey in order to answer the following research questions:

1. How has the overall rate of invasive species for sale changed for those species continuously included in the survey since 2011? How has the overall rate changed for those species included in the survey since 2013?
2. What percentage of stores carries one or more species of invasive plants on PlantRight's list?
3. What percentage of stores carries one or more species of plants that are locally invasive in the region where they are being sold?
4. What is the average number of invasive species carried by all stores?
5. Considering each invasive species separately, what percentage of stores carries that species?

For the second through fifth research questions, PlantRight also wanted to know:

- How do these results vary by climate zone?
- How do these results vary by store type?

As mentioned previously, the list of invasive plants that PlantRight monitors has changed over time. This flexibility has allowed PlantRight to exclude plants that are rarely or never found as well as to add plants that have recently become a concern. Given these changes, the plant list for the 2014 survey is organized into three categories:

- **Cohort 1:** This cohort includes seven plants that have continuously been on PlantRight's list since 2011 – Chinese tallow tree, French broom, green fountain grass, highway iceplant, pampas grass, periwinkle, and Scotch broom.
- **Cohort 2:** This cohort includes three plants that were added to the list in 2013 and remained on the list in 2014 – Mexican feathergrass, water hyacinth, and yellow water iris.
- **Cohort 3:** This cohort includes four plants that were added to the list in 2014 – Brazilian waterweed, grassland sedge, ox-eye daisy, and southern catalpa.

As explained in Exhibit 2, Cohort 1 plants have been included in the survey since 2011, Cohort 2 plants have been included since 2013, and Cohort 3 plants were added in 2014.

**Exhibit 2. Breakdown of Plants into Cohorts**

Common Name	Cohort 1 Plants (Surveyed Since 2011)	Cohort 2 Plants (Surveyed in 2013 and 2014)	Cohort 3 Plants (Surveyed in 2014 Only)
Chinese tallow tree	✓		
French broom	✓		
Green fountain grass	✓		
Highway iceplant	✓		
Pampas grass	✓		
Periwinkle	✓		

### Exhibit 2. Breakdown of Plants into Cohorts

Common Name	Cohort 1 Plants (Surveyed Since 2011)	Cohort 2 Plants (Surveyed in 2013 and 2014)	Cohort 3 Plants (Surveyed in 2014 Only)
Scotch broom	✓		
Mexican feathergrass		✓	
Water hyacinth		✓	
Yellow water iris		✓	
Brazilian waterweed			✓
Grassland sedge <sup>6</sup>			✓
Ox-eye daisy			✓
Southern catalpa			✓

For the first and fifth research questions listed above, LFA used data from all three cohorts (when it existed) to compare 2014 data to the 2011, 2012, and 2013 results. For the second, third, and fourth research questions, LFA chose to analyze data only for Cohorts 1 and 2, and to only compare the 2014 data to 2013 data. LFA made this choice in order to ensure the results were comparable over time.

The remainder of this section contains the survey results, organized by research question. All results concern the prevalence of invasive plants for sale, not the volume of plants for sale at any individual store. Some stores may sell many species of invasive plants but only have a few plants of each species for sale. Others may only sell one type of invasive plant but have large numbers of that species available.

For information that focuses specifically on the 2011, 2012, or 2013 statistical findings, please see LFA's reports from each of those years. Survey results are also available for 2010, but this report does not seek to use the 2010 data to establish five years of an over-time trend. LFA, in partnership with PlantRight, made this decision because the 2010 survey does not include sufficient data to confidently draw meaningful conclusions about California's retail nursery industry. Thus, 2010 is considered a pilot year and is not strictly comparable to the 2011-2014 results.

For a full list of statistically significant results, please see [Appendix F](#). Statistically significant findings are called out in the text. Findings that are not called out as statistically significant can be assumed not to be.

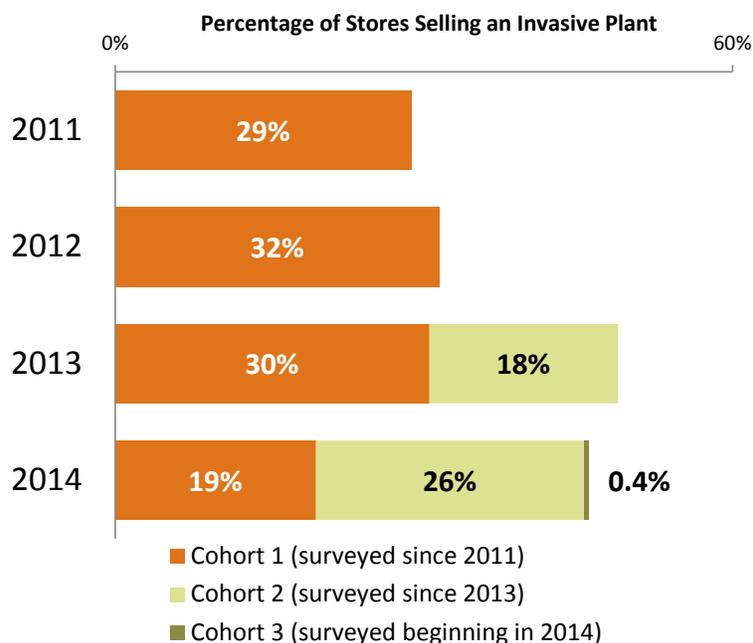
<sup>6</sup> Also known as European grey sedge or Berkeley sedge.

## 1. How has the overall rate of invasives for sale for Cohort 1 plants (included in the survey since 2011) and Cohort 2 plants (included in the survey since 2013) changed?

The chart below shows the prevalence of invasive plants found in each cohort for each of the four years of the survey. If a store had any plants from Cohort 1, it was considered to be Cohort 1, even if Cohort 2 and/or Cohort 3 plants were also found. If a store had any plants from Cohort 2 and no plants from Cohort 1, it is considered Cohort 2 even if Cohort 3 plants were present. For this reason, the chart does not show the absolute prevalence for Cohorts 2 and 3. Instead, it shows the additional percentage of stores selling invasive species specifically due to Cohort 2 and Cohort 3.

Excitingly, Cohort 1 plants were found in 2014 at a statistically significantly lower rate than they were in all other years. While about 30% of stores had a Cohort 1 plant for sale each year from 2011 to 2013, only 19% of stores had Cohort 1 plants for sale in 2014. This substantial decrease represents a major victory for PlantRight and should be celebrated.

**Exhibit 3. 2011-2014 Results: Invasive Plants by Cohort**



This good news is somewhat offset by the increase in Cohort 2 plants, which rose from being found in 32% of stores to 40% of stores. (These figures are different than those in the chart above because stores with both Cohort 1 and Cohort 2 plants were categorized as Cohort 1 in the chart.) This increase may be partially explained by the fact that Cohort 2 plants were added to PlantRight's list relatively recently, and therefore stores have not yet been educated about their invasive status. Cohort 3 plants were found at 5% of stores in 2014.

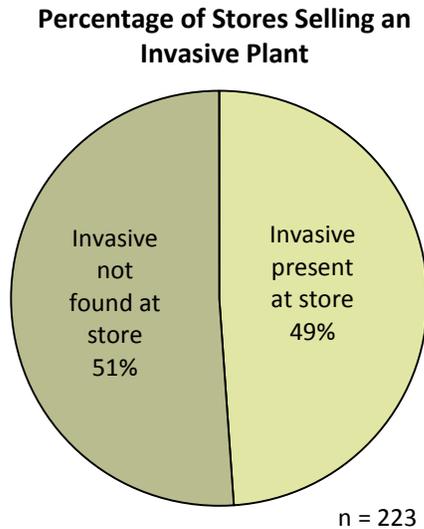
For a detailed look at how the three cohorts of plants do or do not overlap, please see [Appendix E](#). That appendix includes Venn diagrams depicting the various cohorts for 2013 and 2014.

Remaining results in this section focus on just Cohort 1 and Cohort 2 plants (with the exception of the results by individual species, which include all three cohorts).

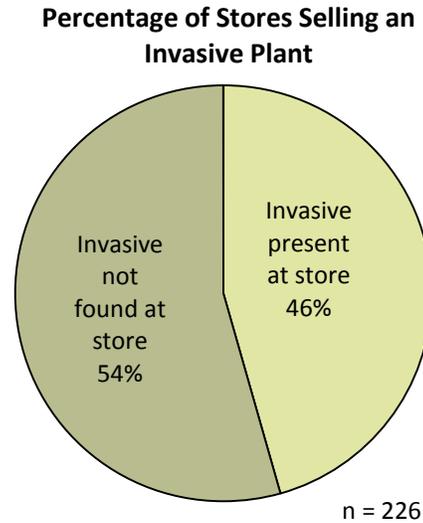
## 2. What percentage of stores carries one or more species of invasive plants?<sup>7</sup>

In 2014, 46% of the 226 surveyed stores carried one or more species of Cohort 1 or 2 invasive plants. This was very much in line with the findings in 2013, when the rate of stores carrying one or more species of invasive plants was 49%. These differences are not statistically significant, and therefore the proportion of stores with invasive plants for sale should be considered essentially stable across these two years of the survey.

**Exhibit 4. 2013 Results: Overall Prevalence**



**Exhibit 5. 2014 Results: Overall Prevalence**

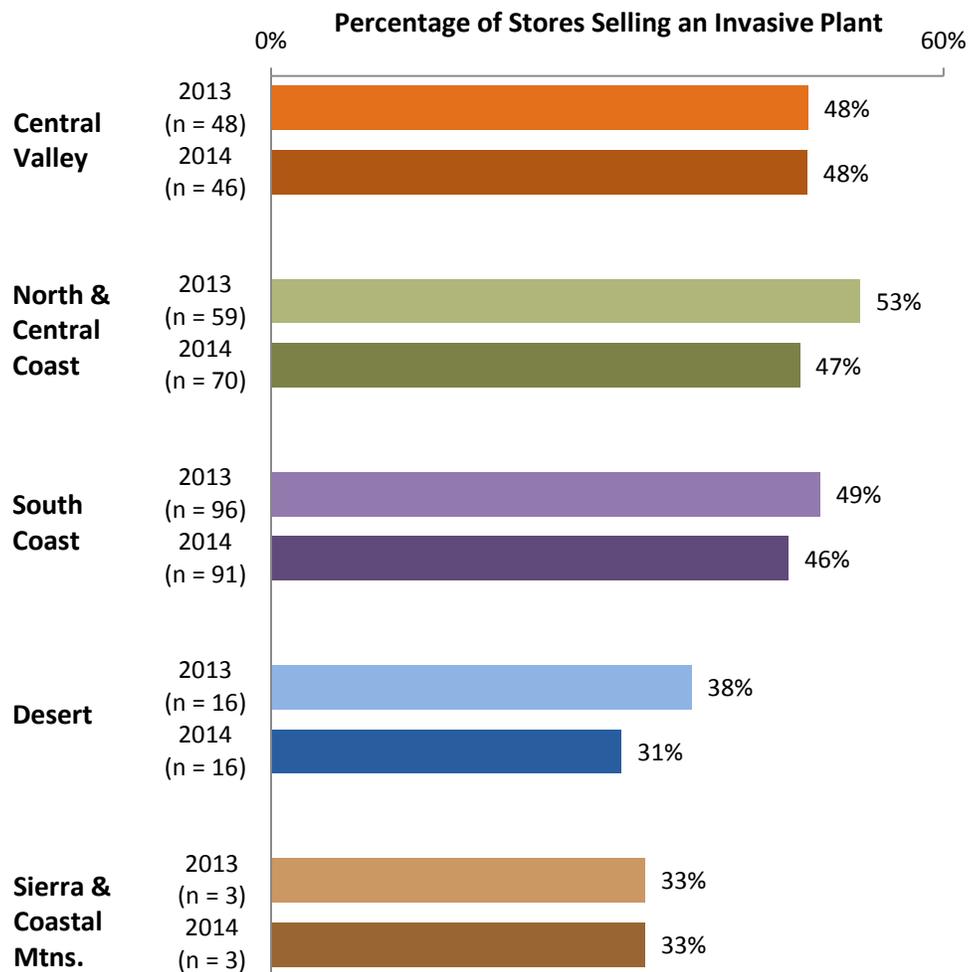


<sup>7</sup> Note: As previously discussed, this only includes plants that were included in both the 2013 and 2014 survey (Cohort 1 and 2 plants). They are: Chinese tallow tree, French broom, green fountain grass, highway iceplant, Mexican feathergrass, pampas grass, periwinkle, Scotch broom, water hyacinth, and yellow water iris.

## By Climate Zone

Prevalence of Cohort 1 and 2 invasive plants for sale in stores varies by climate zone, as summarized in Exhibit 6. Stores in the Central Valley, North & Central Coast, and South Coast were similarly likely to sell at least one type of invasive plant. The regions had 48%, 47%, and 46% of stores having at least one type of invasive plant for sale, respectively. These numbers remained relatively constant from 2013 to 2014. The Desert and Sierra & Coastal Mountains climate zones have lower rates of plants for sale; however, their sample sizes are also much smaller, so it can be difficult to draw meaningful conclusions from these findings.

**Exhibit 6. 2013-2014 Results: Invasive Plants by Climate Zone**

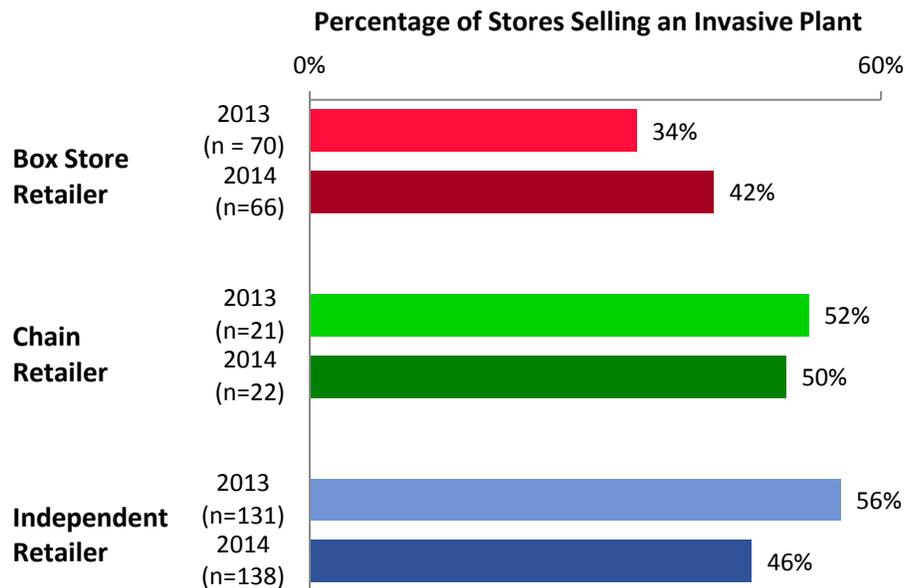


## By Store Type

Prevalence of invasive species for sale also varies by store type. Stores were categorized by PlantRight as Box Stores (Lowe's, Home Depot, and Wal-Mart); Chain Retailers (Armstrong Garden Centers, Orchard Supply Hardware, etc.); or Independent Retailers (independently- or locally-owned stores, usually with just one location).

Chain Retailers were the store type that was most likely to sell an invasive species, with 50% of surveyed stores selling at least one species of invasive plants. Not far behind were Independent Retailers, with 46% of stores offering at least one invasive species for sale.

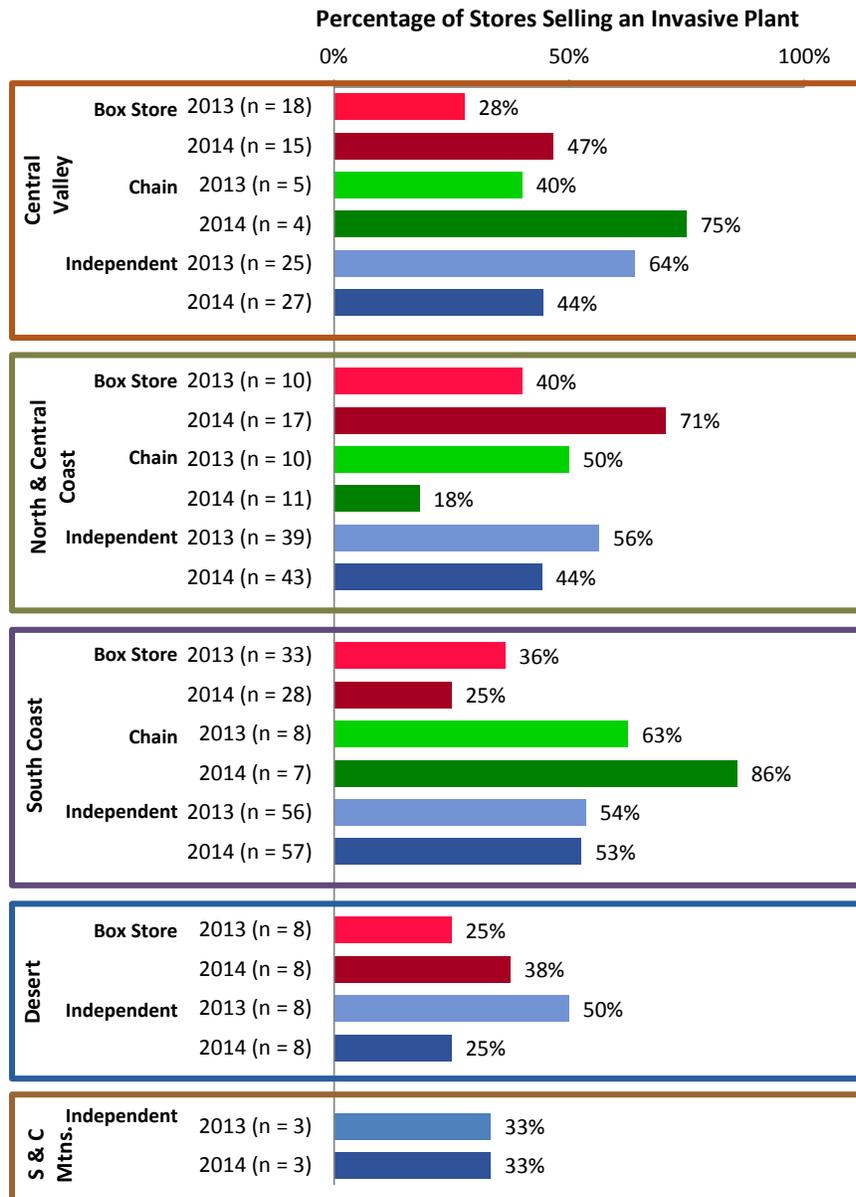
**Exhibit 7. 2013-2014 Results: Invasive Plants by Store Type**



## By Climate Zone and Store Type

When the results are viewed by both climate zone and store type together, it is noteworthy that Chain Retailers in the South Coast and the Central Valley climate zones were very likely to have a species of invasive plant for sale (86% and 75%, respectively). Chain Retailers in both of these climate zones also saw a large jump in prevalence of invasive species from 2013 to 2014. In contrast, Chain Retailers in the North & Central Coast climate zone decreased their sales of invasive plants substantially, from 50% in 2013 to only 18% in 2014. That said, when the results are viewed at this level of detail, the sample sizes for most of these categories become quite small. It is therefore difficult to draw meaningful conclusions from these patterns.

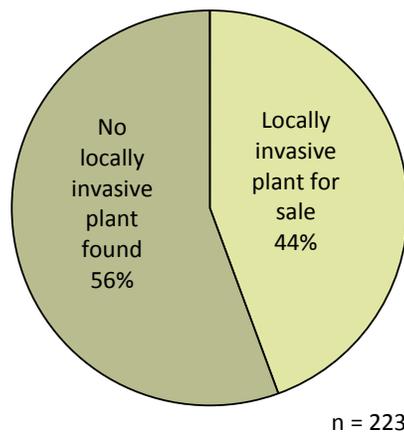
**Exhibit 8. 2013-2014 Results: Invasive Plants by Climate Zone and Store Type**



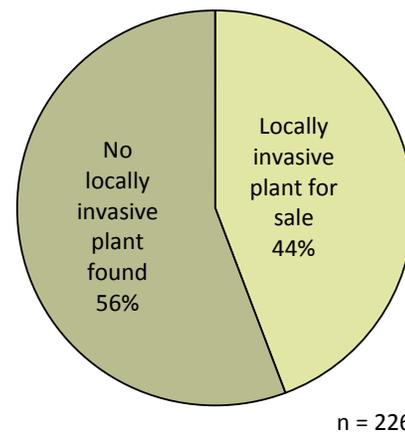
### 3. What percentage of stores carries one or more species of plants that are locally invasive in the region where they are being sold?<sup>8</sup>

California is a large and geographically diverse state. Because of the wide variation in climate zones, certain plants are invasive in some parts of California but not in others. For example, periwinkle is invasive in all climate zones of California except the Desert. (For information on which plant species are considered invasive in which climate zones, please see [Appendix C.](#)) The percent of stores selling one or more species of *locally* invasive plants in 2014 was 44% – exactly the same rate as in 2013. The count of locally invasive plants found was nearly identical: 99 stores were selling locally invasive plants in 2013 vs. 100 stores in 2014.

**Exhibit 9. 2013 Results:**  
**Overall Prevalence of Locally Invasive Plants**  
**Percentage of Stores Selling a Locally Invasive Plant**



**Exhibit 10. 2014 Results:**  
**Overall Prevalence of Locally Invasive Plants**  
**Percentage of Stores Selling a Locally Invasive Plant**

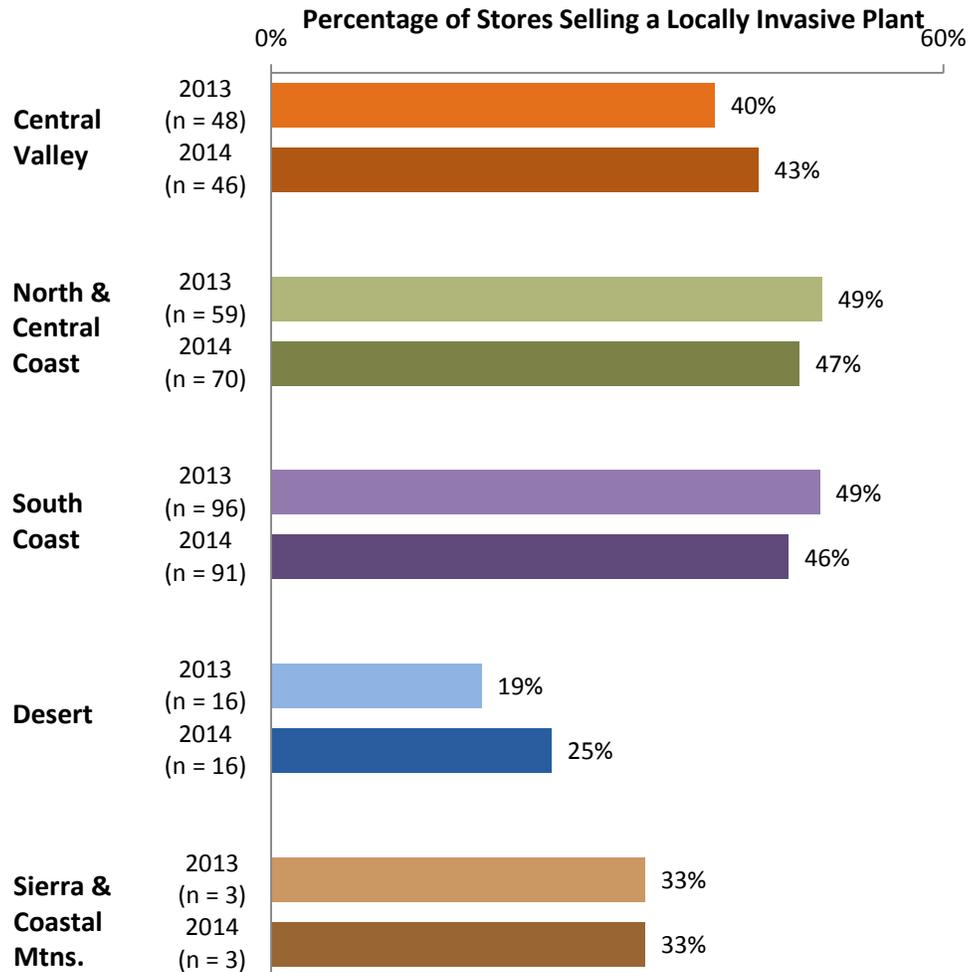


<sup>8</sup> Note: As previously discussed, this only includes plants that were included in both the 2013 and 2014 survey (Cohort 1 and 2 plants). They are: Chinese tallow tree, French broom, green fountain grass, highway iceplant, Mexican feathergrass, pampas grass, periwinkle, Scotch broom, water hyacinth, and yellow water iris.

## By Climate Zone

Locally invasive plants were most often found in the North and Central Coast (47%), South Coast (46%), and Central Valley (43%) climate zones. These numbers have stayed relatively constant over time: none of these proportions have increased or decreased more than 3% from their equivalents in 2013.

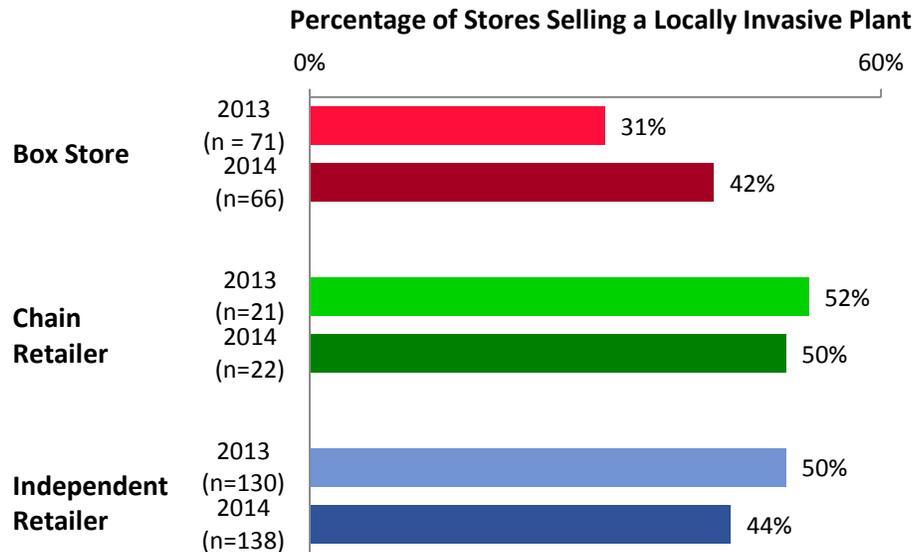
**Exhibit 11. 2013-2014 Results: Locally Invasive Plants by Climate Zone**



## By Store Type

Chain Retailers were most likely to sell locally invasive plants, with 50% of stores selling them. While Chain Retailers and Independent Retailers saw a small drop in the prevalence of stores that were selling invasive plants, Box Stores saw an increase from 31% of stores selling locally invasive plants in 2013 to 42% in 2014. (This increase was not statistically significant.) This increase is mostly driven by Mexican feathergrass, which has become more popular with Box Store retailers since 2013. (For more information on Mexican feathergrass, please see pages 22-23.)

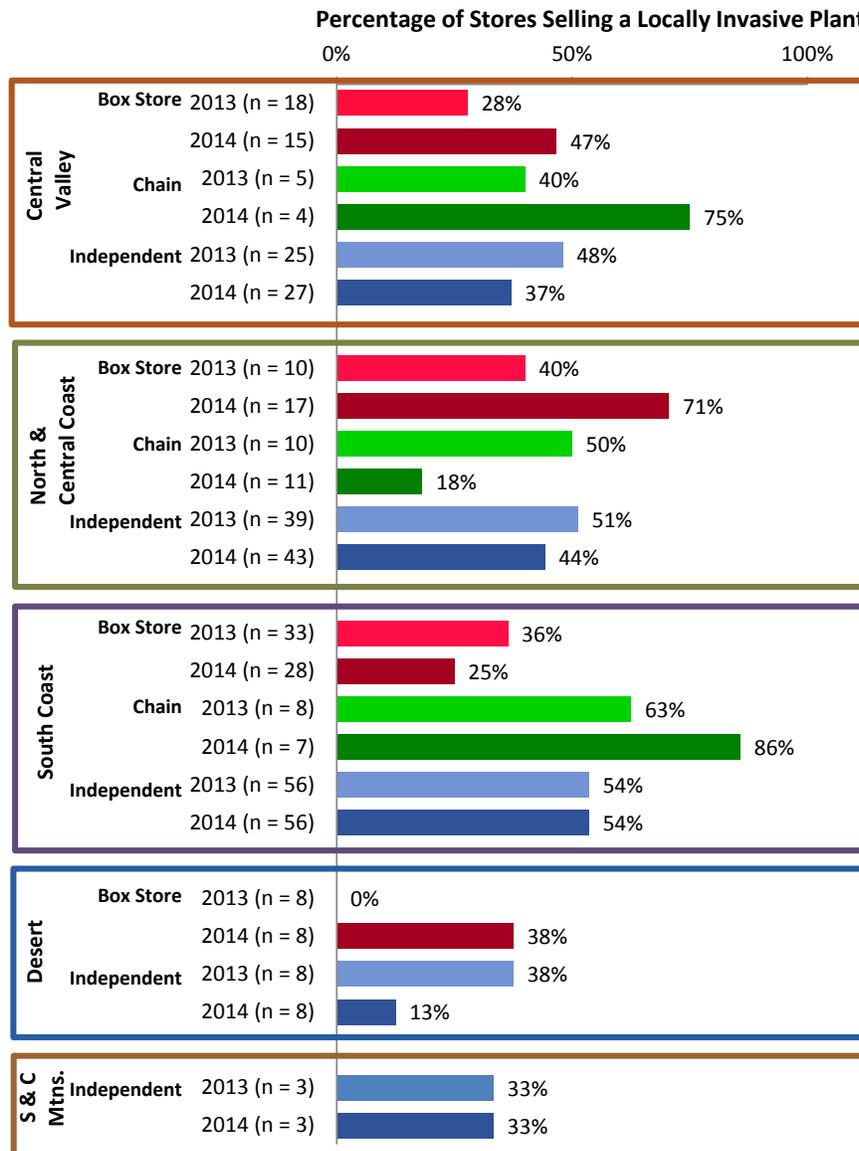
**Exhibit 12. 2013-2014 Results: Locally Invasive Plants by Store Type**



## By Climate Zone and Store Type

Locally invasive plants were most likely to be found for sale at Chain Retailers in the South Coast and Central Valley climate zones (86% and 75%, respectively). Locally invasive plants were also likely to be found at Box Stores in the North & Central Coast climate zone (found in 71% of stores). Again, it is worth remembering that these are small sample sizes –therefore, these numbers may not be indicative of a larger pattern.

**Exhibit 13. 2013-2014 Results: Locally Invasive Plants by Climate Zone and Store Type**



## 4. What is the average number of invasive species carried by all stores?<sup>9</sup>

Overall, the average number of invasive species carried by all the surveyed stores was 0.70 species of plants per store (n=226). This is a very slight – and not statistically significant – decrease from 2013, in which the average number of invasive species carried by all the surveyed stores was 0.75 species of plants per store (n=223).

Of the 103 stores that were carrying invasive species, 39% (40 stores) were carrying more than one invasive species. In 2013, this figure was also 39% (43 of 109). Among the 103 stores in 2014 where at least one plant was found, the average number of species present was 1.52, compared with 1.54 in 2013.

In 2014, the maximum number of species found at any store was four. Three stores had four invasive species present.

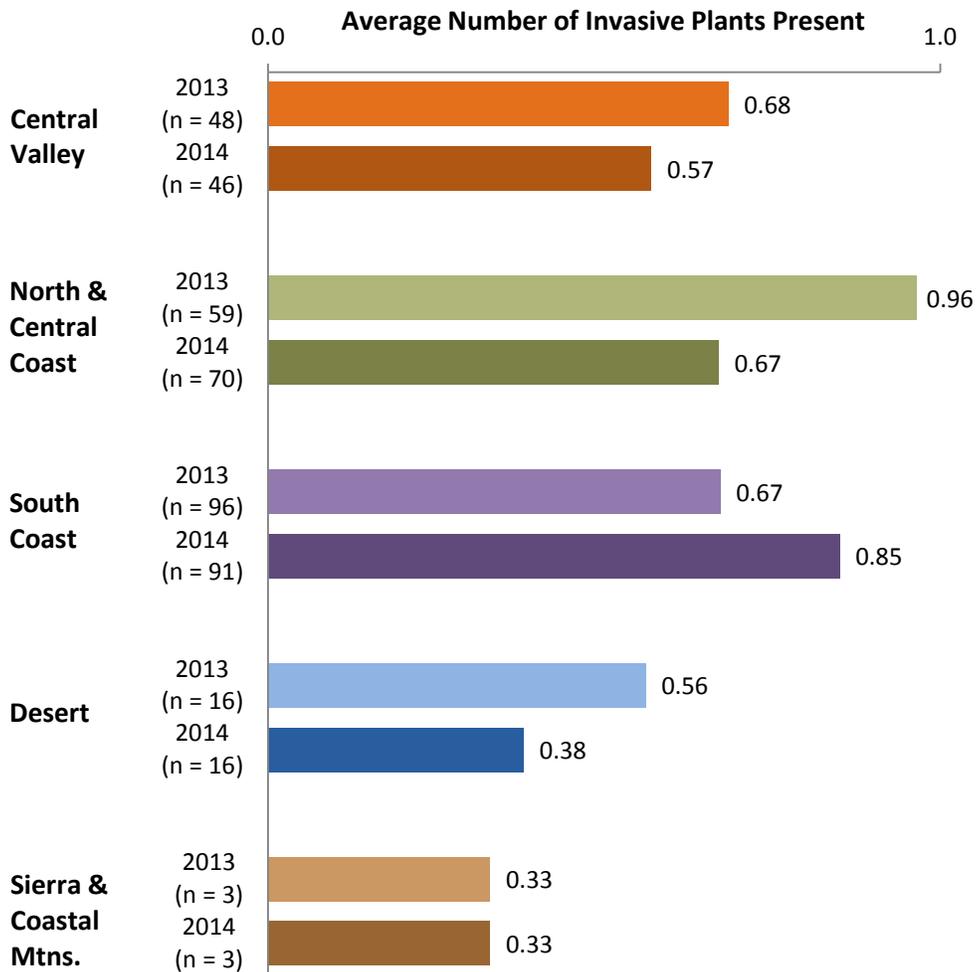
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<sup>9</sup> Note: As previously discussed, this only includes plants that were included in both the 2013 and 2014 survey (Cohort 1 and 2 plants). They are: Chinese tallow tree, French broom, green fountain grass, highway iceplant, Mexican feathergrass, pampas grass, periwinkle, Scotch broom, water hyacinth, and yellow water iris.

## By Climate Zone

The average number of invasive species sold per store was highest in the South Coast climate zone, with an average of 0.85 plant species per store. For the South Coast, this rate represents an increase from 2013, when the average number of invasive species sold per store was 0.67. The next highest average number of invasive species for sale was in the North & Central Coast climate zone, with an average of 0.67 plants per store.

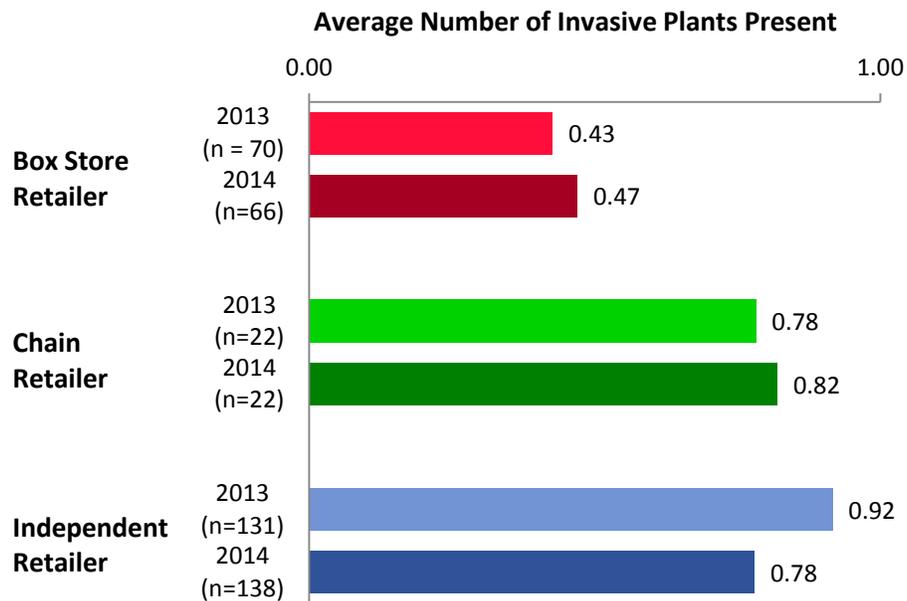
**Exhibit 14. 2013-2014 Results: Average Number of Species by Climate Zone**



## By Store Type

Chain Retailers had the highest average number of invasive species per store, at 0.82 species of plants per store. This average was higher than that of Box Stores (0.47 species per store) and Independent Retailers (0.78 species per store). There was one statistically significant difference in the 2014 results: Box Stores had a lower average number of invasive species for sale than Independent Retailers did. Chain Retailers did not have a statistically significant difference when compared to the other two store types, which may be due to the smaller sample size of this store type.

**Exhibit 15. 2013-2014 Results: Average Number of Species by Store Type**



## 5. Considering each invasive species separately, what percentage of stores carries that species?

While the previous section included results for only the 10 plants that have been tracked over the last two years of the survey (Cohorts 1 and 2), the following section includes results for all 14 plants included in the 2014 Nursery Survey.

Volunteers searched for 14 different invasive species, of which they found 11 in at least one store. Those 11 are: Brazilian waterweed, Chinese tallow tree, grassland sedge, green fountain grass, highway iceplant, Mexican feathergrass, pampas grass, periwinkle, southern catalpa, water hyacinth, and yellow water iris. Results for all plant species are summarized in Exhibits 16 and 17.

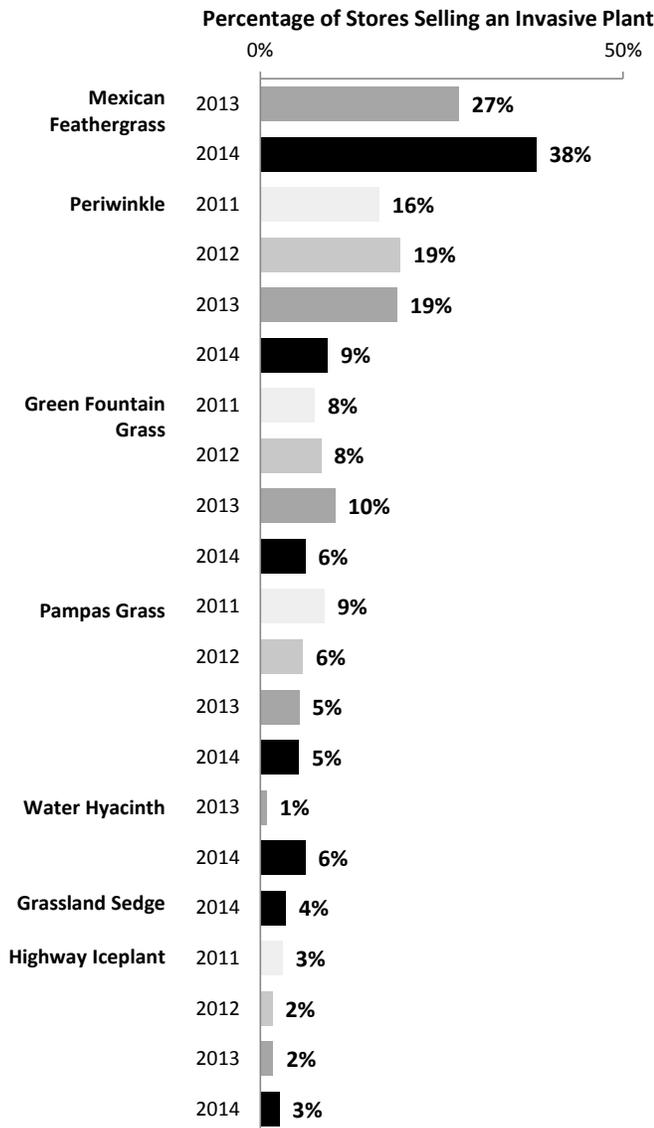
Mexican feathergrass and periwinkle were, by a substantial percentage, the most prevalent invasive species. Because these two species were so prevalent, this section contains an in-depth view of the climate zones and store types where Mexican feathergrass and periwinkle were found.

For the same level of detail about each of the other plant species, please see [Appendix B](#).

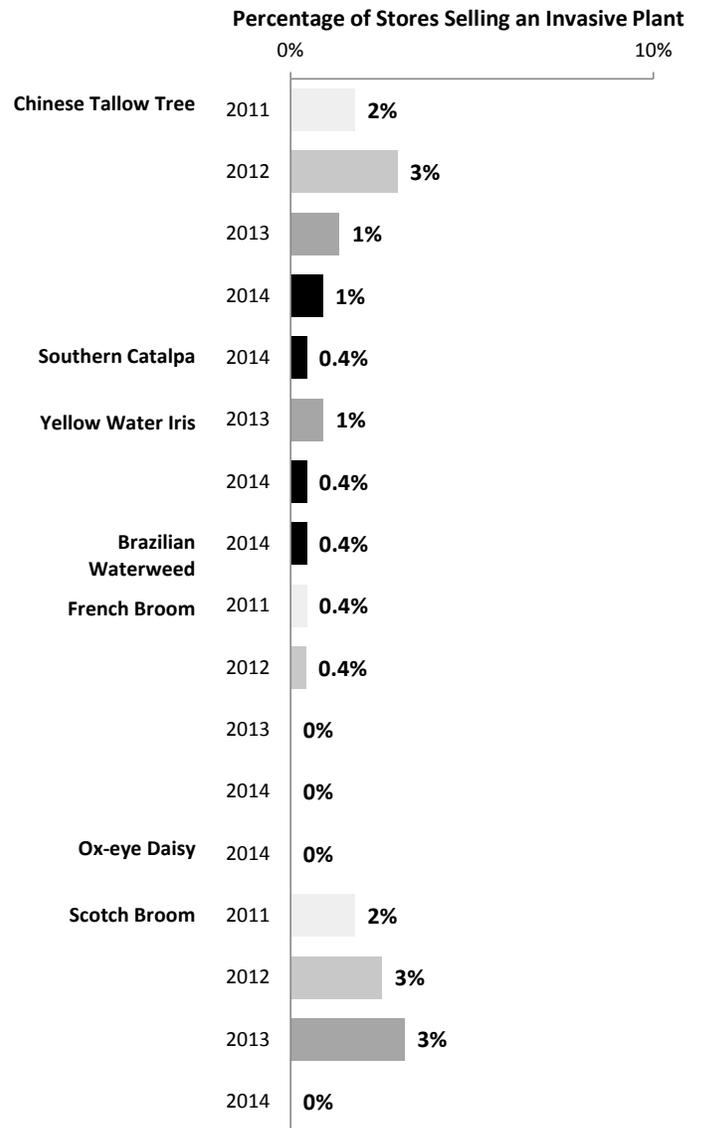
## Prevalence of Each Plant Species

The most frequently found invasive species were (in descending order), Mexican feathergrass, periwinkle, green fountain grass, pampas grass, and water hyacinth. For ease of reading, these results have been split into two charts, each with seven of the fourteen plants found. Please note that the scales on the two charts are different from each other in order to best reflect the differences in the prevalence of invasive plant species.

**Exhibit 16. Frequencies of Plant Species Found: Seven Most Commonly Found Plants**



**Exhibit 17. Frequencies of Plant Species Found, Seven Least Commonly Found Plants**



The sample size for each year is as follows:

- 2011: 226 stores
- 2012: 238 stores
- 2013: 223 stores
- 2014: 226 stores

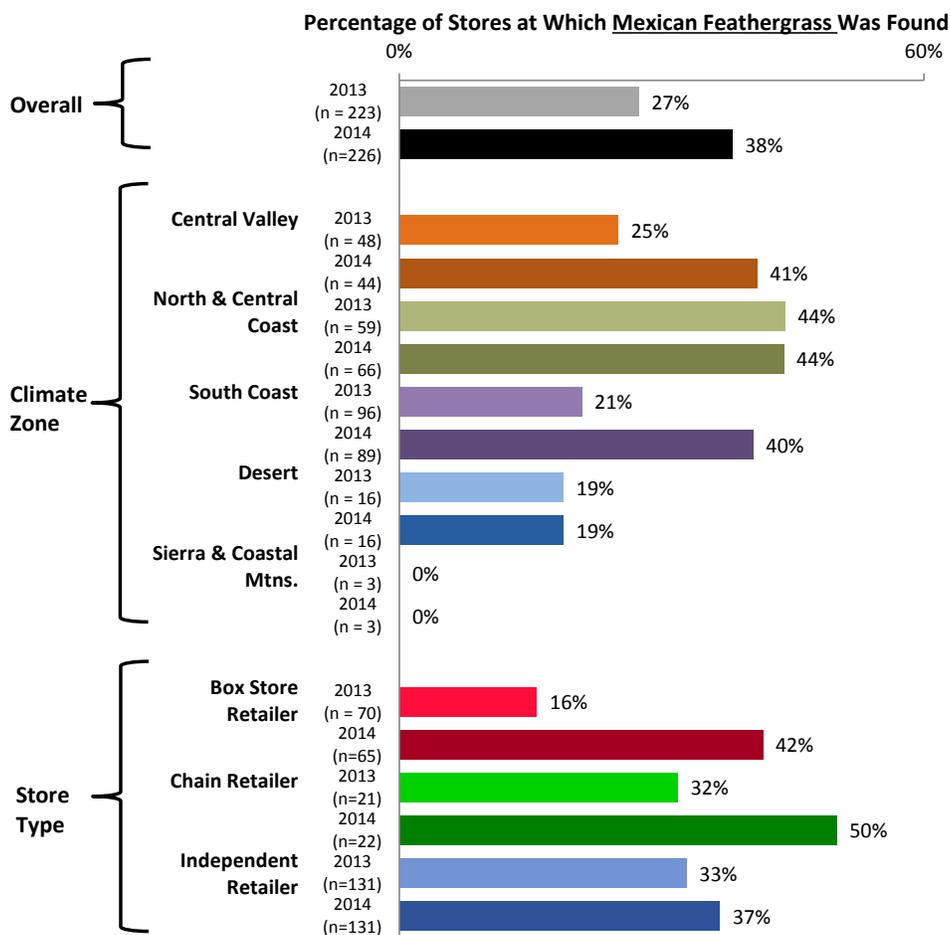
## Mexican Feathergrass– By Climate Zone and by Store Type

The rate of stores selling Mexican feathergrass increased statistically significantly, from 27% in 2013 to 38% in 2014.

Mexican feathergrass was found most often in the North & Central Coast climate zone (in 44% of stores) and at Chain Retailers (in 50% of stores).

Due to the plant’s high level of popularity, PlantRight has been working to focus its efforts on slowing the spread of Mexican feathergrass. For example, PlantRight led an information and fundraising campaign to purchase and destroy Mexican feathergrass directly from one of the state’s largest growers. Through this campaign, PlantRight worked to remove 14,000 plants from the nursery pipeline.<sup>10</sup>

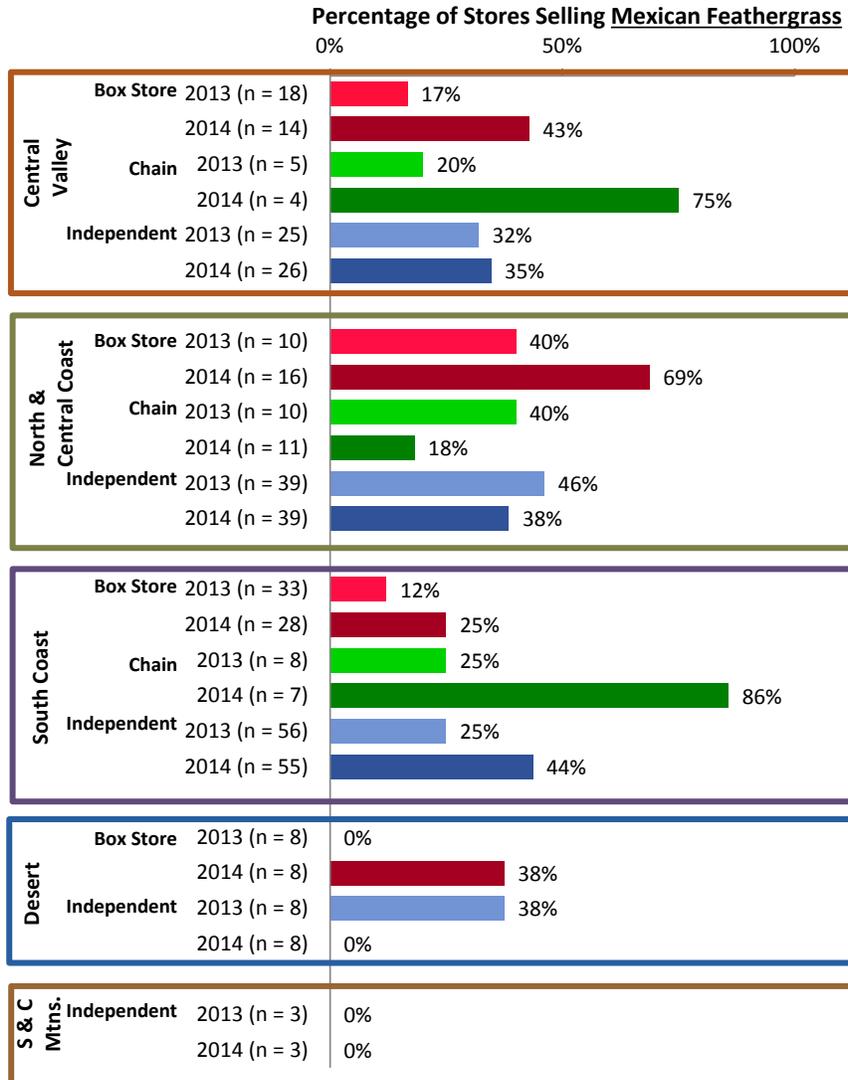
**Exhibit 18. 2013-2014 Results: Mexican Feathergrass by Climate Zone and Store Type**



<sup>10</sup> Joan Morris, “Stopping invasive plants,” Mercury News, 3 July 2014.  
<http://blogs.mercurynews.com/pets/2014/07/03/stopping-invasive-plants/>

When these results are viewed by both climate zone and store type, Mexican feathergrass is most often found at Chain Stores in the Central Valley and South Coast climate zones.

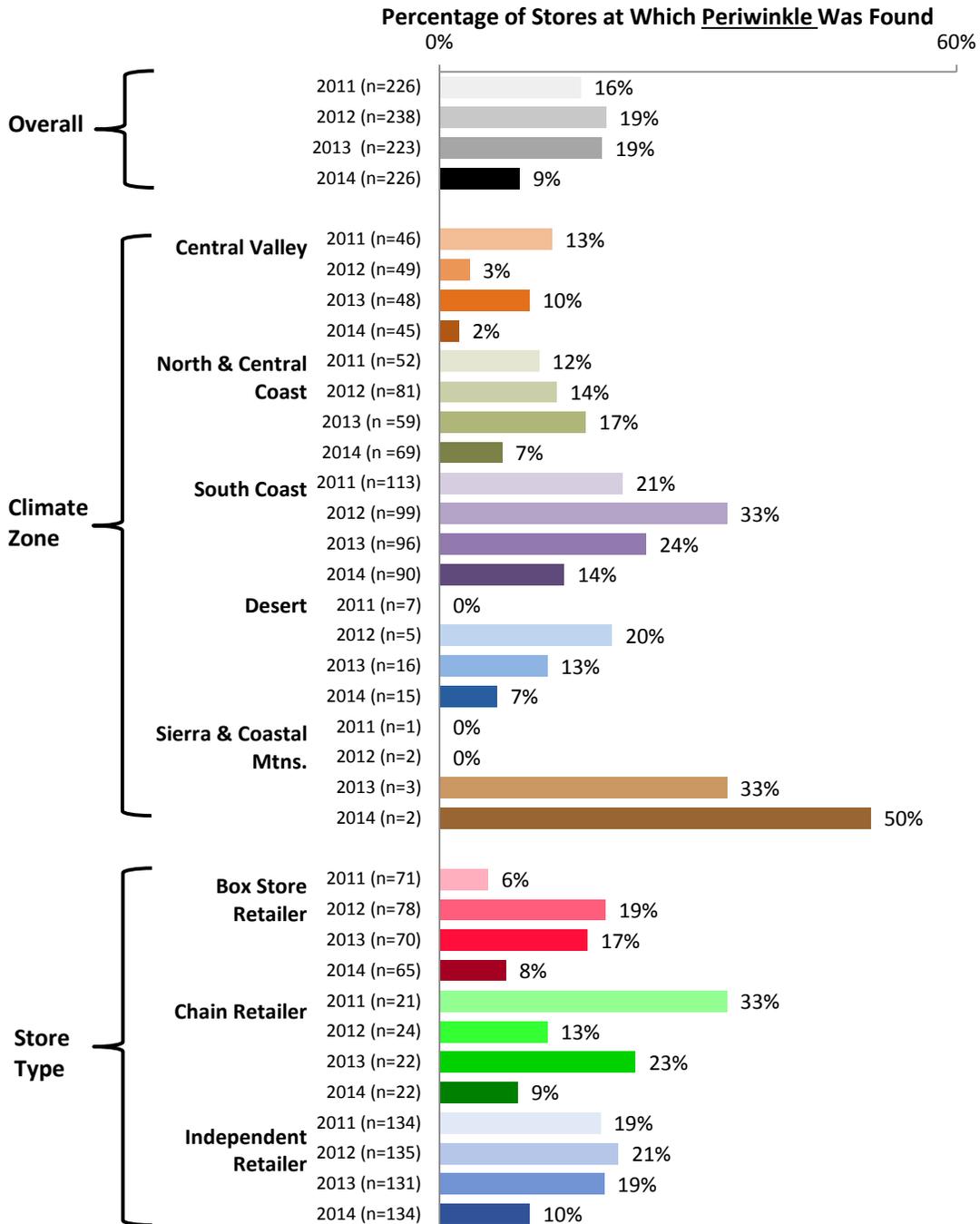
**Exhibit 19. 2013-2014 Results: Mexican Feathergrass by Climate Zone and Store Type**



## Periwinkle – By Climate Zone and by Store Type

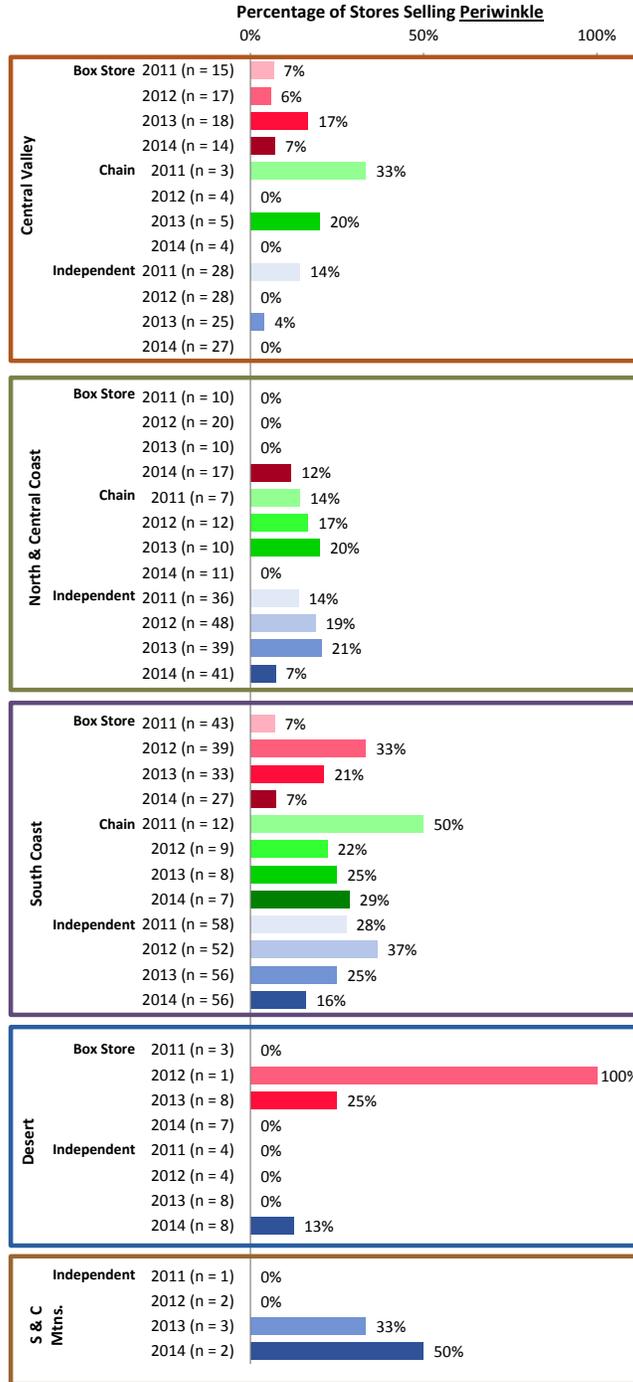
Stores in 2014 were statistically significantly less likely to have periwinkle for sale than stores in any other year to date. This represents an important victory for PlantRight, since periwinkle has historically been quite popular and widely sold. Periwinkle was most frequently found on the South Coast (in 14% of stores) and at Independent Retailers (in 10% of stores). (While periwinkle was found at 50% of stores in the Sierra & Coastal Mountains, this finding is not meaningful due to the small number of stores surveyed there.)

**Exhibit 20. 2011-2014 Results: Periwinkle by Climate Zone and Store Type**



When these results are viewed by climate zone and store type (and stores in the Desert and Sierra & Coastal Mountains are excluded, due to their small sample sizes), periwinkle is most commonly found in the South Coast at Chain Retailers (29% of stores carried periwinkle) and Independent Retailers (16% did so).

**Exhibit 21. 2011-2014 Results: Periwinkle by Climate Zone and Store Type**



## III. Conclusions and Recommendations

The following section includes conclusions and recommendations drawn from the 2014 PlantRight Nursery Survey.

### Conclusions

#### Cohort 1 Plants (including Periwinkle) Found at a Lower Rate in 2014 than in Previous Years

The data show that Cohort 1 plants, which have been the focus of PlantRight efforts since 2006, were found at a significantly lower rate in 2014 than in previous years: 19% of stores in 2014 had a Cohort 1 invasive plant for sale, compared to 29%-32% in past years of the survey. In addition, a statistically significantly lower number of stores were selling periwinkle, a popular and widely sold Cohort 1 plant: only 9% in 2014, compared to 16-19% in past years. This suggests that: (1) PlantRight's efforts are reaching retailers and growers, and (2) efforts to educate these populations may take years to create impact. This is helpful context for PlantRight to keep in mind when reviewing the results of ongoing campaigns.

#### Cohort 2 Plants (including Mexican Feathergrass) Found at a Higher Rate in 2014 than in Previous Years

The prevalence of Cohort 2 plants for sale has grown from 32% in 2013 to 40% in 2014. Mexican feathergrass, a Cohort 2 plant, contributes significantly to this growth: 27% of stores were selling Mexican feathergrass in 2013, compared to 38% in 2014 – a difference that was statistically significant. Due to Mexican feathergrass' increasing popularity, PlantRight is focusing its efforts on eradicating this plant in particular.<sup>11</sup> As noted above, this focus on Mexican feathergrass and the other Cohort 2 plants may take time to make an impact on growers and sellers.

#### Chinese Tallow Tree and Highway Iceplant are Highly Localized by Store Type and Region

As evidenced by the charts in Appendix B, two plants are particularly localized to store type and region: Chinese tallow tree and highway iceplant. Over the four years of the survey, Chinese tallow tree has almost exclusively been found in the Central Valley climate zone (the only climate zone where it is considered locally invasive) at Independent Retailers. Highway iceplant has almost always been found in the North & Central Coast and South Coast climate zones (again, the only climate zones where it is considered locally invasive) at Independent Retailers. These plants are being sold in a very specific area, and may be sold by a small number of growers to a subset of retailers. Focusing on Independent Retailers in those two climate zones may therefore have an outsized effect on the eradication of those two invasive species.

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<sup>11</sup> Craig Regelbrugge, "California group takes new approach against an invasive plant," Nursery Management, 3 July 2014, <http://www.nurserymag.com/plantright-trying-to-stop-sale-of-invasive-mexican-feathergrass.aspx>

## Recommendations

### Apply “Lessons Learned” Regarding the Steep Drop in Prevalence of Cohort 1 Plants

As discussed previously, Cohort 1 plants – periwinkle in particular – have dropped sharply in prevalence. PlantRight staff may want to take this opportunity to reflect on their successes and lessons learned with these plants, and determine how to apply those lessons to future campaigns. For example, what strategies or messaging has been associated with this drop? Could the drop be due to external factors? PlantRight may want to investigate these questions by surveying growers and store owners, or by simply having a facilitated discussion among staff who have been involved with this campaign.

### Continue to Focus on Mexican Feathergrass to Substantially Reduce the Number of Invasives Sold

Of all the species surveyed, Mexican feathergrass presents the largest problem by a substantial margin – these plants are found at 38% of the stores surveyed. The next most frequently found plant (periwinkle) was present at just 9% of surveyed stores.

Curtailing the sale of Mexican feathergrass would have a substantial impact on the number of invasive plants sold in California. It would also most likely reduce the *volume* of plants sold by a large margin, because Mexican feathergrass is often sold at Box Stores – which tend to sell much larger volumes of plants than other store types.

### Continue to Build in Flexibility to the Plant List

PlantRight’s current approach to the plant list, where plants can be added or removed based on a set of criteria and standardized process, allows for flexibility. LFA staff worked with PlantRight to develop the cohort approach (used in this report) to analyzing the data, which facilitates rigorous year over year analysis. These combined approaches allow PlantRight staff to respond to changing conditions while drawing meaningful conclusions from the survey results. LFA recommends continuing to use this system for future years of the evaluation.

## Appendix A: In-depth Methods

The goal of the Spring Nursery Survey is to provide annual snapshots of the statewide prevalence of invasive plants in nurseries. With this data, PlantRight can track trends in invasive plants' prevalence over time. In order for the annual snapshots to provide accurate information about the prevalence of invasive plants, PlantRight needs to be confident that it can draw valid inferences from the survey results. There are several approaches that PlantRight employed to ensure the collection of high quality survey data:

- **A rigorous sampling plan.** LFA created a tailored sampling plan to support the goal of maximizing the extent to which the nurseries in the survey represent the retail nursery industry in California as a whole. The sampling plan was also crafted so that stores of each store type, and stores within each county, were adequately represented.
- **Recruiting and training highly-skilled surveyors.** PlantRight recruited Master Gardener volunteers – surveyors who already have extensive plant recognition skills. To build their skills for this particular survey, PlantRight trained the volunteers to further hone their skills in carrying out this survey and recognizing the invasive plants on PlantRight's list.
- **Conducting a quality assurance review on the results.** Survey volunteers were asked to take pictures of the plants that they identified as invasive species. PlantRight staff then reviewed the pictures to verify the results that volunteers submitted. When plants were unidentifiable from the photos, a conservative approach was taken and the plants were not counted as being invasive.

Each of these approaches is described in this appendix. The sampling plan section includes an addendum for how sampling looked in practice, in those cases where it was not feasible to conduct sampling exactly as designed. Following these descriptions, the appendix explains an important step taken in the analysis: weighting the data.

### Sampling Plan

#### Overview of Sampling Approach

There are over 2,000 plant nurseries (or stores with nurseries) in California. Without the resources available to conduct a census, PlantRight's survey makes use of a sample that is designed to be as representative as possible of the state as a whole. This section of the sampling plan discusses: (1) strategies for maximizing sample representativeness; (2) working within resource constraints; and (3) creative possibilities for expanding sample size.

#### Methods for Maximizing Sample Representativeness

The more representative the sample, the more confident Sustainable Conservation can be that the description of the nurseries reflects the actual nursery population in California. The sampling plan incorporates several strategies to maximize representativeness, and these are explained below.

## *Collecting Data Statewide*

Ideally, the PlantRight survey would cover all 58 counties (or rather, the 57 counties that have plant nurseries). The sampling plan, therefore, takes this “coverage” goal into account and calculates the sub-samples to be drawn from each county.

## *Drawing a Random Sample*

Random samples are needed to enable the analysts to use the data to confidently describe the population as a whole. Random samples avoid bias: the systematic over- or under-representation of specific subgroups.

## *Stratified Random Sampling*

Stratified random sampling is a specific type of random sampling. In stratified random sampling, the population is divided into groups (called strata), and random samples are then drawn from within these strata. Stratified random sampling offers several advantages over simple random sampling:

- It provides greater precision (a higher likelihood of statistically significant findings) with the same sample size.
- It helps avoid an “unrepresentative” sample (for example, if a simple random sample were drawn from all nurseries in the state, it would likely produce a sample without representation from several counties – however, if the data is stratified by county, all counties will be represented).

This sampling plan will employ stratified random sampling along two dimensions: county (each county is a stratum), and three different store types. The store types are:

- **Box Stores:** Big box stores with nursery or garden centers, e.g. Home Depot, Lowe’s, and Wal-Mart.
- **Chain Retailers:** Large retailers with multiple locations. They include stores such as Green Thumb Nursery and Orchard Supply Hardware (OSH).
- **Independent Retailers:** Independent nurseries and garden stores unique to certain communities, e.g. Yamagami’s, Roger’s Gardens, Berkeley Hort, etc.

In the 2010 survey, Sustainable Conservation surveyed CVS and Rite-Aid stores as part of the Chain Retailers category, and Costco as part of the Box Stores category. All three of these chains have licenses to sell plants, and are widespread in California. However, these stores do not have a dedicated plant section and are generally inconsistent with regard to whether they offer plants or whether they know when and for how long the plants will be in stock. In 2010, none of the CVS, Rite-Aid, or Costco stores surveyed had invasive plants present. For all these reasons, these stores were left out of the 2011, 2012, 2013, and 2014 surveys.

## *Multi-Stage Sampling*

Because the goals are to optimize representation of each stratum, as well as to have statewide coverage (include as many counties as possible), the stratified sample was drawn in two stages. First, the sample was divided (stratified) according to store type. Then, within store type, the data was stratified by county. When this stratification is completed, stores are uniquely assigned to a store type/county combination (e.g. all Box Stores in Los Angeles County).

## Resource Constraints

If there were no resource constraints, Sustainable Conservation would conduct a survey in which the prevalence of invasive species could be estimated with great precision not only for the state as a whole, but also for sub-samples. However, the sample size needed for making such precise estimates for subgroups is not feasible given available resources (Master Gardener volunteers).

In advance of the survey, the projected number of volunteers was 125, and the number of stores they could survey was 223.

### *Disproportionate Stratified Sampling*

The first efficient use made of the full sample was to use disproportionate rather than proportionate stratified sampling when stratifying by county. In using proportionate stratified sampling, the units in every stratum have the same probability of selection (e.g. one out of 200 for the subsample of box retailers, dominant large retailers, etc.). In using disproportionate sampling, the probabilities of being selected in different strata are allowed to vary. By allowing the probabilities to vary, we can choose the optimal percentage of stores in each stratum, thus making better use of limited resources.

### *Using “Surplus Volunteers” from Neighboring Counties*

PlantRight staff members recruit Master Gardeners as expert volunteer surveyors. They are recruited within each county that has nurseries to survey. In advance of the survey, PlantRight staff has projected numbers of how many volunteers are in each county. Using those numbers, in conjunction with the per-county sample size, it can be determined where there are surpluses and deficits of surveyors. PlantRight staff deployed “surplus volunteers” in neighboring counties where there is a “volunteer deficit.” This maximized the probability that PlantRight would reach its target number of surveys for each county.

## Description of Sampling Procedure

### *Step One: Generate a List of Retail Nurseries in California*

PlantRight used the Directory of Licensed Nurseries, updated by the California Department of Food and Agriculture (CDFA), to identify 8,461 licensed nursery retailers operating in California. An image of the search field, with checks in the boxes we selected as search filters, is shown below. The search was conducted in December 2013.

California Department of Food and Agriculture  
**Directory of Licensed Nurseries**

[CDFA Home](#) [CDFA Nursery](#)

Show Location Details

Search by Nursery and/or License number, County, City

Nursery: <input type="text"/>	Search Type: Starts With <input type="button" value="v"/>	County: <input type="button" value="v"/>	Location City: <input type="text"/>
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Search by any of the above and/or Type of Business

C Cut flowers <input type="checkbox"/>	L Landscaper <input type="checkbox"/>
I Incidental Retailer <input checked="" type="checkbox"/>	P Producer <input type="checkbox"/>
J Jobber Merchant <input checked="" type="checkbox"/>	R Retailer <input checked="" type="checkbox"/>

Search by any of the above and/or Type of Stock

1 Coniferous evergreens <input type="checkbox"/>	A Deciduous fruit and nut trees <input type="checkbox"/>
2 Broad-leaved evergreens <input type="checkbox"/>	B Grapevines and kiwi plants <input type="checkbox"/>
3 Deciduous shade trees <input type="checkbox"/>	C Citrus fruit trees <input type="checkbox"/>
4 Deciduous shrubs <input type="checkbox"/>	D Other subtropical and tropical fruit trees <input type="checkbox"/>
5 Rose plants <input type="checkbox"/>	E Strawberry and bushberry, etc. <input type="checkbox"/>
6 Herbaceous ornamental plants <input type="checkbox"/>	F Vegetable plants <input type="checkbox"/>
7 Bulbs, corms, rhizomes, pips, etc <input type="checkbox"/>	G Sod (turfgrass) <input type="checkbox"/>
8 Decorative plants <input type="checkbox"/>	H Groundcover <input type="checkbox"/>
9 Cacti and succulents <input type="checkbox"/>	J Palms <input type="checkbox"/>

The invasive plants on PlantRight’s list fall under the following categories above: 1,2,3,4,6,8,9,A & H. Because key retail businesses did not classify their plants as falling under any of the 18 categories of “stock” listed above, however, the search included vendors of all plant types, even those PlantRight is not interested in (as shown above by the lack of check-marks in the lower level fields).

PlantRight staff then removed retailers from the list that did not meet the criteria, based on their familiarity with the company (e.g. 99 Cent Stores) and the companies’ names (e.g. Richie’s Wholesale Florist). As a rule, they took out orchid merchants, cut flower sellers, landscapers, grocery stores, department stores, individuals, and producers of other non-plant goods. PlantRight staff also removed stores that had been included in previous years’ samples but had failed to meet the requirements of the survey (as determined by PlantRight staff upon calling the store). The final number of stores that met the criteria was 1,817.

**Step Two: Determine the Projected Full Sample Size**

To determine the sample size, LFA began with the known (or estimated) constraint: the projected number of stores the volunteers would be able to survey. In January 2014, PlantRight staff projected the total number of volunteers to be around 125, and that many volunteers would choose to visit more than one store (based on last year’s average number of stores surveyed per volunteer: 1.8). Based on these numbers and on last year’s total stores surveyed, we estimated that these volunteers would be able to survey 223 stores.

### Step Three: Using Disproportionate Stratified Sampling in the First Stage, Calculate the Sample Size for each Stratum on the “Store Type” Dimension

The Sample Planning Wizard at the Stat Trek website was used to enter parameters and calculate the sample sizes for each store type stratum. The parameters needed to calculate the sub-sample sizes are:

- **Maximum sample size (for the full sample).** As discussed in step two, this is equal to the projected number of nurseries expected to be surveyed (223) by our projected number of volunteers (125).
- **Population size for each stratum.** This was provided by PlantRight staff, and the values are shown in Exhibit 22 below.
- **Confidence level.** The confidence level is the probability that the *true* value lies between two values: the sample percentage *minus* the margin of error, and the sample percentage *plus* the margin of error. By convention, this is set to 0.95.

Inputting these values of the required parameters into the Sample Planning Wizard, and not constraining the sampling to be proportionate, the following sub-sample sizes were calculated (shown in the far right column):

**Exhibit 22. Sample Size Per Stratum, Given Population Size**

Stratum (Store Type)	Population Size	Sample Size per Stratum
Box Stores	533	65
Chain Retailers	175	14
Independent Retailers	1,109	144

### Step Four: Using Proportionate Stratified Sampling in the Second Stage, Calculate the Sample Sizes for Each County, within Each Store Type Stratum

Proportionate sampling is appropriate for the second stage of sampling. With no specific information about variation differences among counties, there is no additional information to use disproportionate sampling. With proportionate stratified sampling, each store has an equal probability of being selected into the sub-sample, no matter which county the store is in. Please see Exhibit 23 (on the following page) for the target number of nurseries to be surveyed in each county.

Due to rounding, the number of surveys calculated for each stratum was slightly off the suggested total number of surveys in the stratum. For example, while the sample planning software calculated that 144 surveys of Independent Retailers should be surveyed, with rounding our allocation came to 148 surveys total. To compensate for these errors, surveys were added or subtracted from specific counties, as follows:

- One survey of a Box Store was added to three counties (Monterey, San Joaquin, and Shasta).
- One survey of a Chain Retailer was added to three counties (Fresno, Kern, and Ventura).
- One survey of an Independent Retailer was subtracted from four counties (Amador, Colusa, Madera, and Siskiyou).

These counties were chosen because – before rounding – they were closest to adding (or subtracting, in the case of the Independent Retailers) one more store to the suggested number. For example, the formula may have calculated that the correct number of Box Stores to be surveyed in this county was 1.49. This was rounded down to 1 store, but when “extra” stores needed to be distributed, this county would be an obvious choice to “absorb” an extra store.

### Final Sampling Plan: Goals for Number of Surveys in Each County

The table below shows the number of surveys that the sampling plan recommends for PlantRight volunteers to conduct in each county.

**Exhibit 23. Target Number of Surveys, by County and Store Type**

County	Box Store	Chain Retailer	Independent Retailer
Alameda	3	1	4
Amador	0	0	0
Butte	1	0	2
Calaveras	0	0	1
Colusa	0	0	0
Contra Costa	2	1	3
Del Norte	0	0	0
El Dorado	0	0	2
Fresno	2	1	4
Glenn	0	0	0
Humboldt	0	0	3
Imperial	1	0	1
Inyo	0	0	1
Kern	2	1	4
Kings	0	0	1
Lake	0	0	1
Lassen	0	0	0
Los Angeles	12	2	20
Madera	0	0	0
Marin	0	1	2
Mariposa	0	0	0
Mendocino	0	0	3
Merced	1	0	2
Modoc	0	0	0
Mono	0	0	0
Monterey	1	0	1
Napa	1	0	1
Nevada	0	0	2
Orange	5	1	6

County	Box Store	Chain Retailer	Independent Retailer
Placer	1	0	2
Plumas	0	0	1
Riverside	5	0	11
Sacramento	3	0	2
San Benito	0	0	1
San Bernardino	5	0	5
San Diego	6	2	16
San Francisco	0	0	2
San Joaquin	2	0	3
San Luis Obispo	1	1	3
San Mateo	1	0	3
Santa Barbara	1	0	3
Santa Clara	3	2	3
Santa Cruz	0	0	3
Shasta	1	0	2
Sierra	0	0	0
Siskiyou	0	0	0
Solano	1	0	1
Sonoma	1	0	6
Stanislaus	1	0	2
Sutter	0	0	0
Tehama	0	0	1
Trinity	0	0	1
Tulare	1	0	2
Tuolumne	0	0	1
Ventura	1	1	4
Yolo	0	0	1
Yuba	0	0	1
<b>Total</b>	<b>65</b>	<b>14</b>	<b>144</b>

## Sampling in Practice

### *Randomly Selecting Stores*

Using the full list of stores in the population, LFA used the “RAND” function in Excel to assign a random number to each of the stores. The full list was then grouped into county, and separate lists for each county were made for each store type. The stores were listed from lowest to highest by their randomly generated number. The number of stores to be surveyed of a particular store type within the county was used to “pull” the sample for that particular stratum. (For example, 20 was the target sample size for Independent Retailers in Los Angeles. For this stratum, the 20 stores with the lowest random number were identified for surveying.)

### *Deviations from the Originally Selected Sample*

The stores designated for the sample were not always included in practice. This could be for one of three reasons:

- Upon calling the store prior to administering the survey, PlantRight determined that the store did not sell plants that met its criteria (e.g. outdoor, perennial plants) or did not sell these plants at a retail level.
- The stores identified for the sample were further away from the homes of the volunteers than they could feasibly travel; and
- The volunteers visited the stores and found out that they did not conform to the original criteria by which the stores were included in the population (e.g. it was discovered they were wholesalers rather than retailers).

When a store had to be removed from the sample for any of these three reasons, PlantRight simply substituted the next store on the random list for that stratum. There is no reason to believe that removal of these stores from the sample and replacing them with the “next random store” introduced any systematic bias into the sample.

The stores in the final sample deviated from the original for a second reason: sometimes the number of volunteers in a county did not match the number of stores in the sampling plan. For some counties, this meant fewer stores were sampled than were identified; for other counties, this meant that *more* stores were sampled than were identified. Again, there is no reason to believe that this deviation introduced any bias into the sample. The “next store added” was always the next on the randomly selected list.

For information on how many stores were surveyed in each county, please see Exhibit 25.

**Exhibit 24. Map of Surveyed Stores**



**Exhibit 25. Count of Surveyed Stores, by County**

County	Stores Surveyed
Alameda	8 of 8
Butte	2 of 3
Calaveras	1 of 1
Contra Costa	7 of 7 (+1) <sup>†</sup>
El Dorado	0 of 2
Fresno	10 of 10 (+3) <sup>†</sup>
Humboldt	0 of 3
Imperial	2 of 2
Inyo	4 of 4 (+1) <sup>†</sup>
Kern	5 of 9 (+2) <sup>†</sup>
Kings	0 of 1
Lake	1 of 1
Los Angeles	32 of 35 (+1) <sup>†</sup>
Marin	3 of 3
Mendocino	0 of 3
Merced	3 of 3
Mono	2 of 2
Monterey	2 of 2
Napa	6 of 6 (+4) <sup>†</sup>
Nevada	0 of 3 (+1) <sup>†</sup>
Orange	12 of 12
Placer	3 of 4 (+1) <sup>†</sup>
Plumas	0 of 1
Riverside	13 of 16
Sacramento	10 of 11 (+6) <sup>†</sup>
San Bernardino	11 of 11 (+1) <sup>†</sup>
San Diego	23 of 25 (+1) <sup>†</sup>
San Francisco	4 of 4
San Joaquin	5 of 5
San Luis Obispo	5 of 5
San Mateo	5 of 5 (+1) <sup>†</sup>
Santa Barbara	4 of 4
Santa Clara	13 of 17 (+9) <sup>†</sup>
Santa Cruz	1 of 3
Shasta	0 of 3
Solano	2 of 3 (+1) <sup>†</sup>
Sonoma	13 of 17 (+10) <sup>†</sup>
Stanislaus	3 of 3
Tehama	0 of 1
Trinity	0 of 1
Tulare	3 of 3
Tuolumne	1 of 1
Ventura	6 of 6
Yolo	1 of 1
Yuba	0 of 1
<b>TOTAL</b>	<b>226 of 271 (+43)<sup>†</sup></b>

## Recruiting and Training Highly-Skilled Surveyors

### Participant Recruitment

Recognizing the importance of obtaining statistically significant survey data in 2014, PlantRight actively recruited participants for the survey in winter 2013-2014. Calls were made to confirm the participation of Master Gardener programs in counties across California, and where Master Gardener groups did not exist or decided not to participate, outreach was conducted to other plant enthusiast or conservation groups. Examples include Weed Management Areas, Resource Conservation Districts, collegiate horticulture programs and California Native Plant Society chapters. In addition to phone calls and emails, a PlantRight representative gave a presentation to the Master Gardener group in Santa Clara County, which helped to boost survey participation levels.

## Survey Procedure

All participants in PlantRight's 2014 Spring Nursery Survey viewed a prerequisite webinar containing educational information about invasive plants and a training module for how to complete the survey.

The live webinar was conducted in late February for Southern California participants and in mid-April for those in Northern California (divided by the northern border of San Luis Obispo, Kern and San Bernardino counties). A recording of the webinars was also made available for later viewing. After watching the webinar, survey participants took the following steps:

- Created an account on [www.plantright.org](http://www.plantright.org),
- Passed an online quiz to verify they watched the webinar,
- Signed up to survey one or more of the randomly selected nurseries,
- Downloaded and printed a set of instructions, a survey form, and a plant identification guide,
- Visited the nursery to collect information and take pictures of invasive plants they found, and
- Submitted the information and pictures online.

For all invasive plants found at stores, volunteers submitted information about the company that grew the plant, its price and container size, its common and scientific name, the number for sale at that time and also took a picture of the plant and its label for verification purposes.

## Conducting a Quality Assurance Review of the Survey Results

By the end of the survey period in late June, PlantRight collected the data and pictures submitted by its volunteers and reviewed the results for accuracy. Each picture submitted was cross-referenced with the written data for the plant and a determination was made whether the plant being sold was an invasive from PlantRight's list. This was especially important for plants with many cultivars or with limited labeling.

### Procedure for Verifying Plants' Identification

No standard for the labeling of plant tags and containers exists in California and, as a result, it can be difficult to determine the identity of horticultural plants at retail nurseries. Identification is especially challenging when plants are found without labels, or with labels that are damaged or inaccurate.

Because poor labeling can make identification of horticultural plants challenging, survey participants were provided with a "plant identification guide" with pictures of the 14 invasive plants included in PlantRight's 2014 survey. This allowed surveyors to visually identify plants at stores, and cross reference their findings with the provided pictures.

Participants were encouraged to submit data for all plants they felt could be an invasive plant on PlantRight's list, with the thinking that too much data would be better than too little. In addition to submitting recorded data, survey participants submitted pictures of each plant and its label(s). Using the surveyors' pictures and the contracted help of an independent plant expert, PlantRight staff verified the identity of each plant found during the nursery survey. When pictures were not submitted, PlantRight was unable to confirm whether the store was selling a plant that was invasive. In those instances, data from the store was not counted in this year's analysis; a handful of surveyed stores were removed from the analysis for this reason.

## Weighting the Data

Weighting a sample is necessary when two things are the case:

- The sample over- or under-represents specific sub-groups (strata) relative to the frequency with which units from that subgroup appear in the population; *and*
- The goal of using the data is to accurately *describe* the population characteristics.

Weighting the data is necessary, in the case of the PlantRight survey, because the frequency of particular store types in the sample does not match the frequency of particular store types in the population. The sample is not perfectly representative for two reasons: (1) the sampling plan used *disproportionate sampling* (see the sampling plan above for an explanation); and (2) not all stores included in the sample were reached, while some additional stores in particular counties were included in the final sample.

Box Stores and Chain Retailers were slightly over-represented relative to their presence in the population (so they needed to be “weighted down”), while Independent Retailers were under-represented (so they needed to be “weighted up”). The weights ultimately assigned are shown in Exhibit 26.

**Exhibit 26. Weights Used for Analyzing Store Types**

Store Type	Weight Assigned
Box Stores	0.95
Chain Retailers	0.99
Independent Retailers	1.03

The sample sizes reported in the report are actually weighted sample sizes, rather than *actual* (unweighted) sample sizes. Attention is not called to this in the report because it is not necessary in order to understand the results, and is likely to raise more questions than it answers. Note that weighting *does not change the final sample size*. The full sample size remains at 226.

## Appendix B: Results by Plant Species

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Volunteers searched for 14 different invasive species; they found 11 of the 14 in at least one store. Those 11 are: Brazilian waterweed, Chinese tallow tree, grassland sedge, green fountain grass, highway iceplant, Mexican feathergrass, pampas grass, periwinkle, southern catalpa, water hyacinth, and yellow water iris. For nine of these 11 species, information on which climate zone and in which type of store those plants were found is summarized in the pages that follow, in Exhibits 27 through 35. (The other two species – Mexican feathergrass and periwinkle – are included in the main body of the report. Please see pages 22-25 for more information on those two species.)

Where it is known, information on where each species of plant is considered locally invasive is also included with the results (and is summarized in [Appendix C](#)).<sup>12</sup> This information is available for Cohort 1 and Cohort 2 plants; however, it is not available for the four Cohort 3 plants that were added to the list in 2014. This information is not available for the four new plants because Sustainable Conservation uses a variety of data sources and engages in extensive research to determine where specific species of plants are locally invasive. Because these plants were added to the list so recently, it has not yet been determined where they are locally invasive.

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<sup>12</sup> Because nursery customers may buy plants in one region that they plan to plant in another, information on where plants are locally invasive is not a perfect proxy for tracking which plants will become invasive.

## Brazilian Waterweed – By Climate Zone and by Store Type

Brazilian waterweed was found just once: in the South Coast climate zone at a Chain Retailer.<sup>13</sup>

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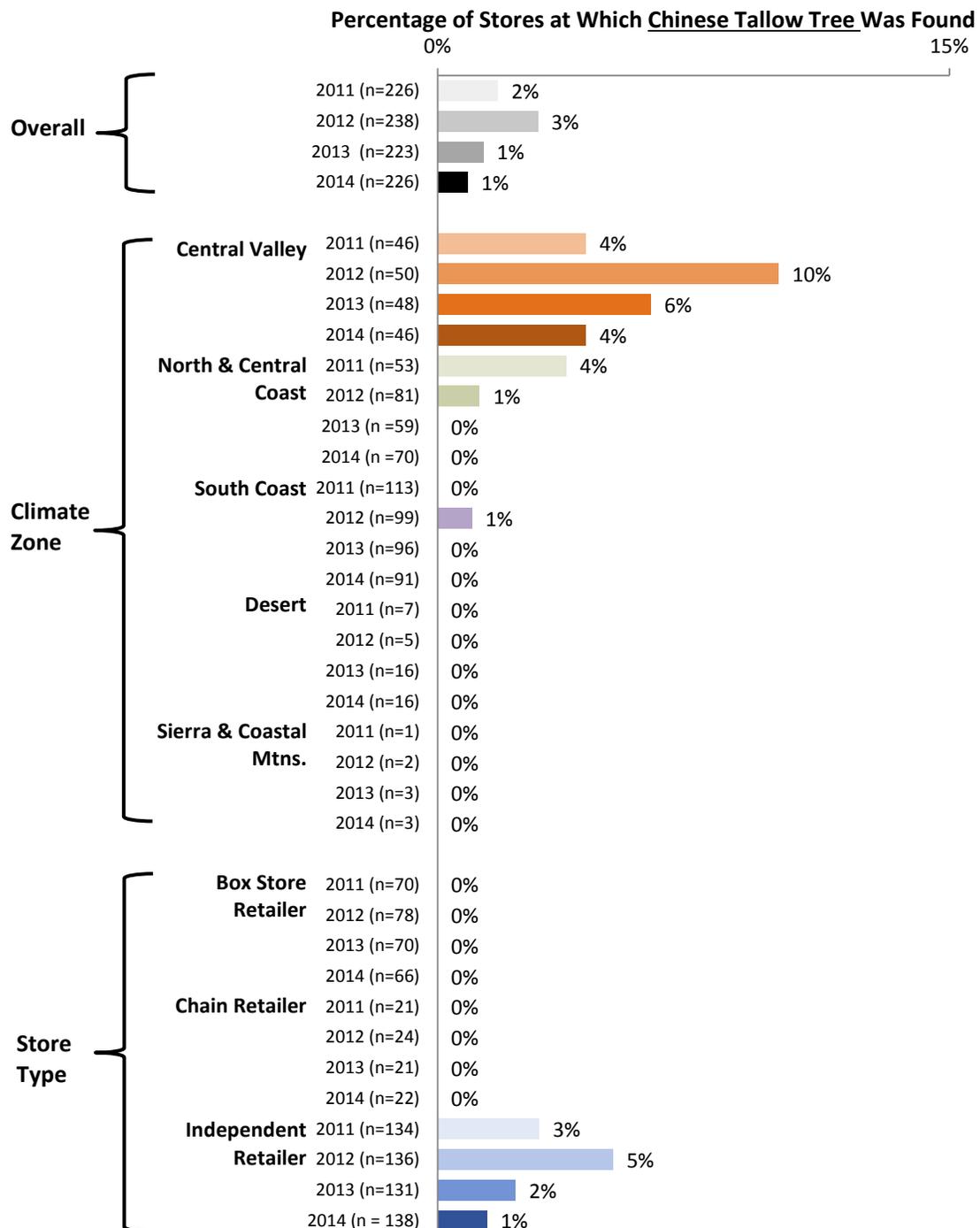
<sup>13</sup> Since this plant was found only once, a chart is not included.

## Chinese Tallow Tree – By Climate Zone and by Store Type

Chinese tallow tree was found just twice, and both times were at Independent Retailers in the Central Valley climate zone. There was a statistically significant relationship between Chinese tallow tree and climate zone: Central Valley stores were more likely to have Chinese tallow trees for sale than stores in other regions were.

Chinese tallow tree is locally invasive only in the Central Valley climate zone.

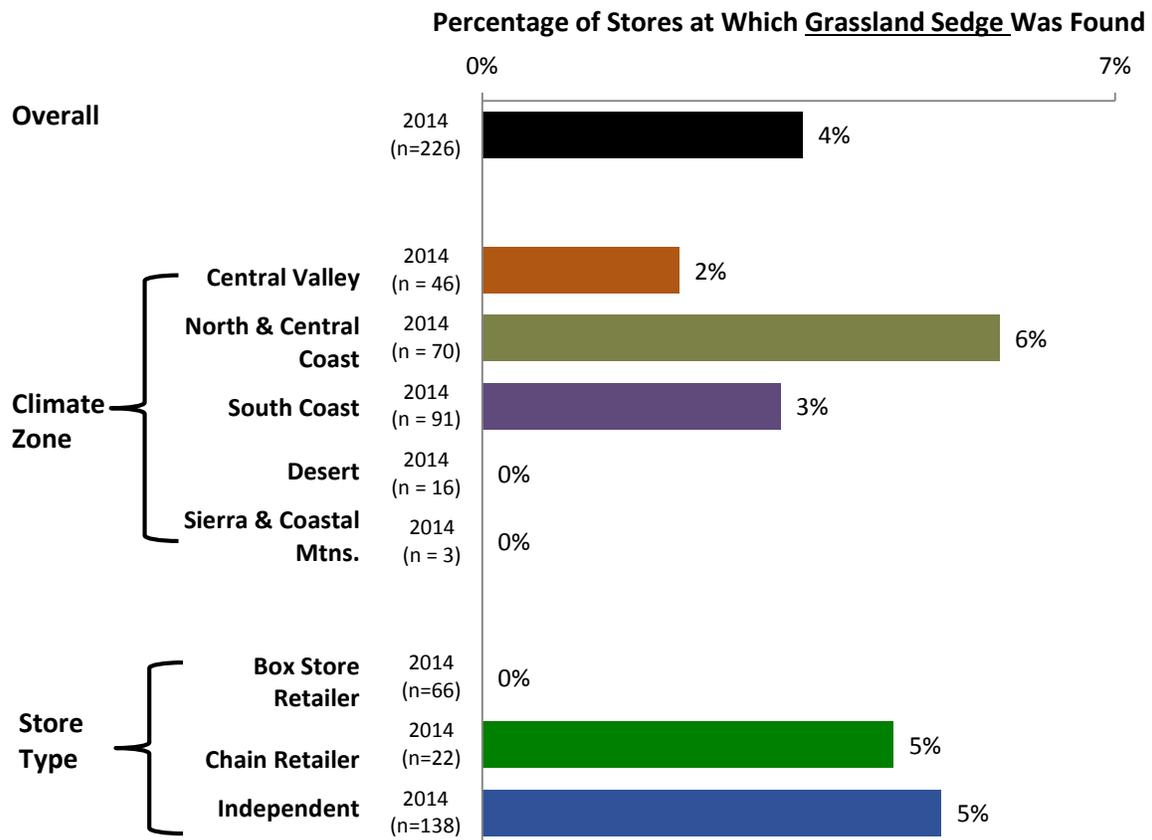
**Exhibit 27. 2011-2014 Results: Chinese Tallow by Climate Zone and Store Type**



## Grassland Sedge – By Climate Zone and by Store Type

Grassland sedge was found to be most prevalent in nurseries in the North & Central Coast (in 6% of stores) and at Chain and Independent Retailers (in 5% of stores of both store types). It is interesting to note that grassland sedge (*Carex divulsa*) is widely sold mistakenly as the native Berkeley sedge (*Carex tumulicola* Hort).<sup>14</sup> Volunteers looked for plants under either of these names, and both are included in the results below.

**Exhibit 28. 2014 Results: Grassland Sedge by Climate Zone and Store Type**



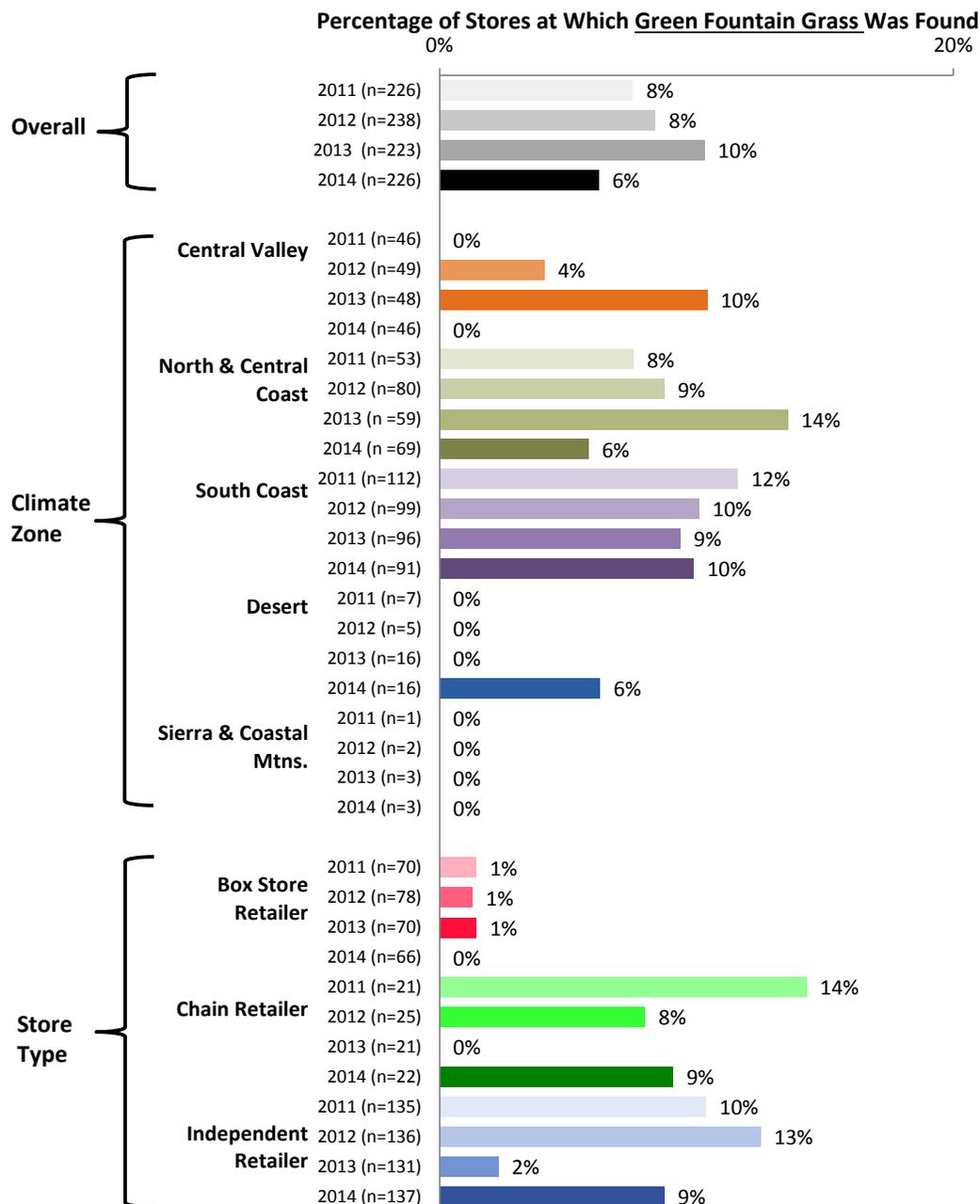
<sup>14</sup> Michael Curto, *Pacific Horticulture* 2006: [http://www.smgrowers.com/info/Carex\\_divulsa\\_tumulicola.pdf](http://www.smgrowers.com/info/Carex_divulsa_tumulicola.pdf)

## Green Fountain Grass – By Climate Zone and by Store Type

Green fountain grass was the third most frequently found invasive species for sale (after Mexican feathergrass and periwinkle). It was most consistently found at Chain and Independent Retailers (both 9%) and in the South Coast climate zone (10%). There was a statistically significant relationship between green fountain grass and store type: Independent Stores were more likely to have green fountain grass for sale than other store types, and Box Stores were less likely to have green fountain grass for sale than other store types.

Green fountain grass is locally invasive in the North & Central Coast, South Coast, Desert, and Sierra & Coastal Mountains climate zones.

**Exhibit 29. 2011-2014 Results: Green Fountain Grass by Climate Zone and Store Type**

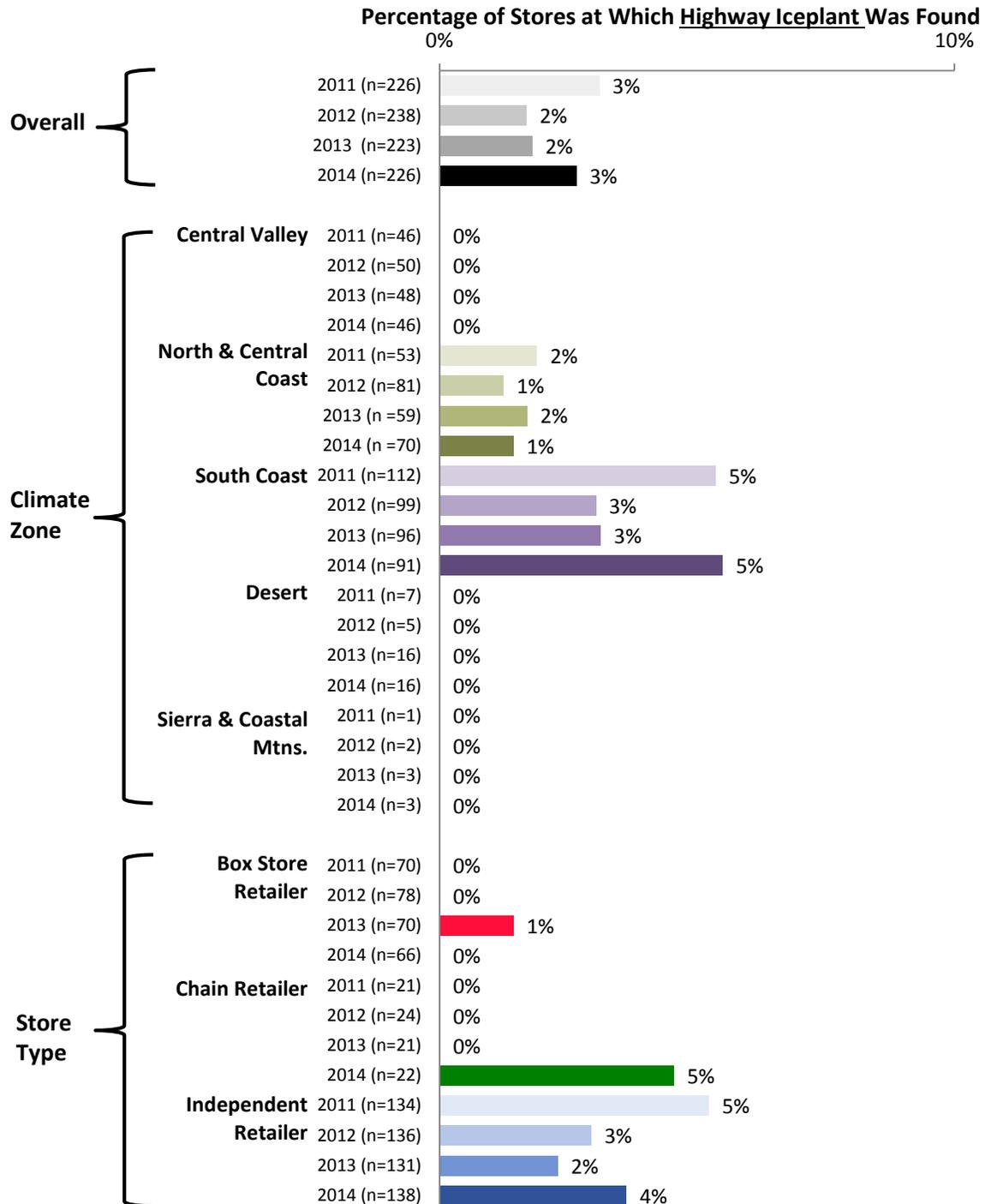


## Highway Iceplant – By Climate Zone and by Store Type

Highway iceplant was found to be most prevalent in nurseries in the South Coast (in 5% of stores) and at Chain Retailers (in 5% of stores).

Highway iceplant is locally invasive in the North & Central Coast and South Coast climate zones.

**Exhibit 30. 2011-2014 Results: Highway Iceplant by Climate Zone and Store Type**

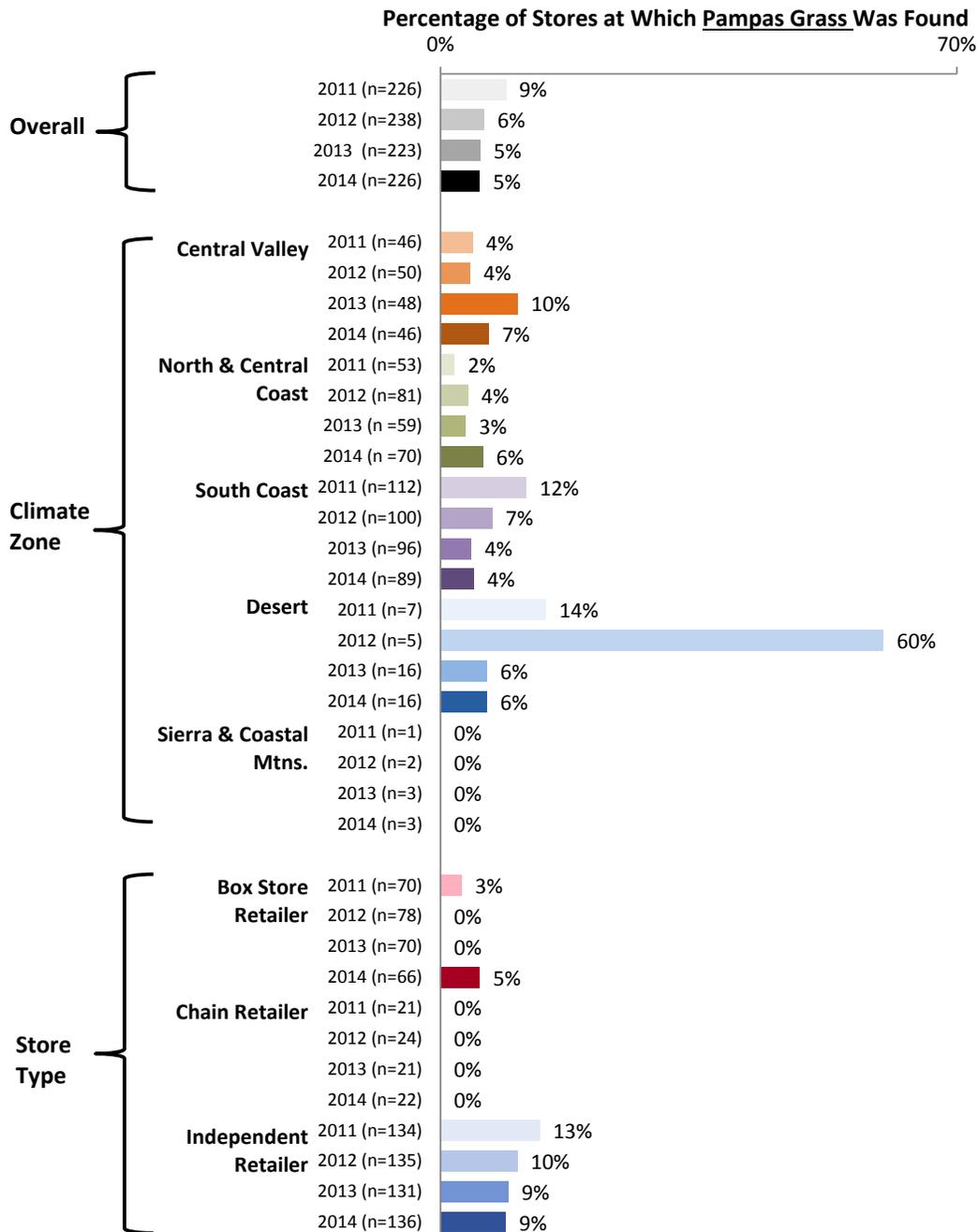


## Pampas Grass – By Climate Zone and by Store Type

Pampas grass was found in 7% of the stores surveyed in the Central Valley climate zone, and in 9% of Independent Retailers surveyed. There was a statistically significant relationship between pampas grass and store type: Independent Retailers were more likely to have pampas grass for sale than other store types were, and Box Stores were less likely to have pampas grass for sale than other store types were.

Pampas grass is locally invasive in the Desert, North & Central Coast, and South Coast climate zones.

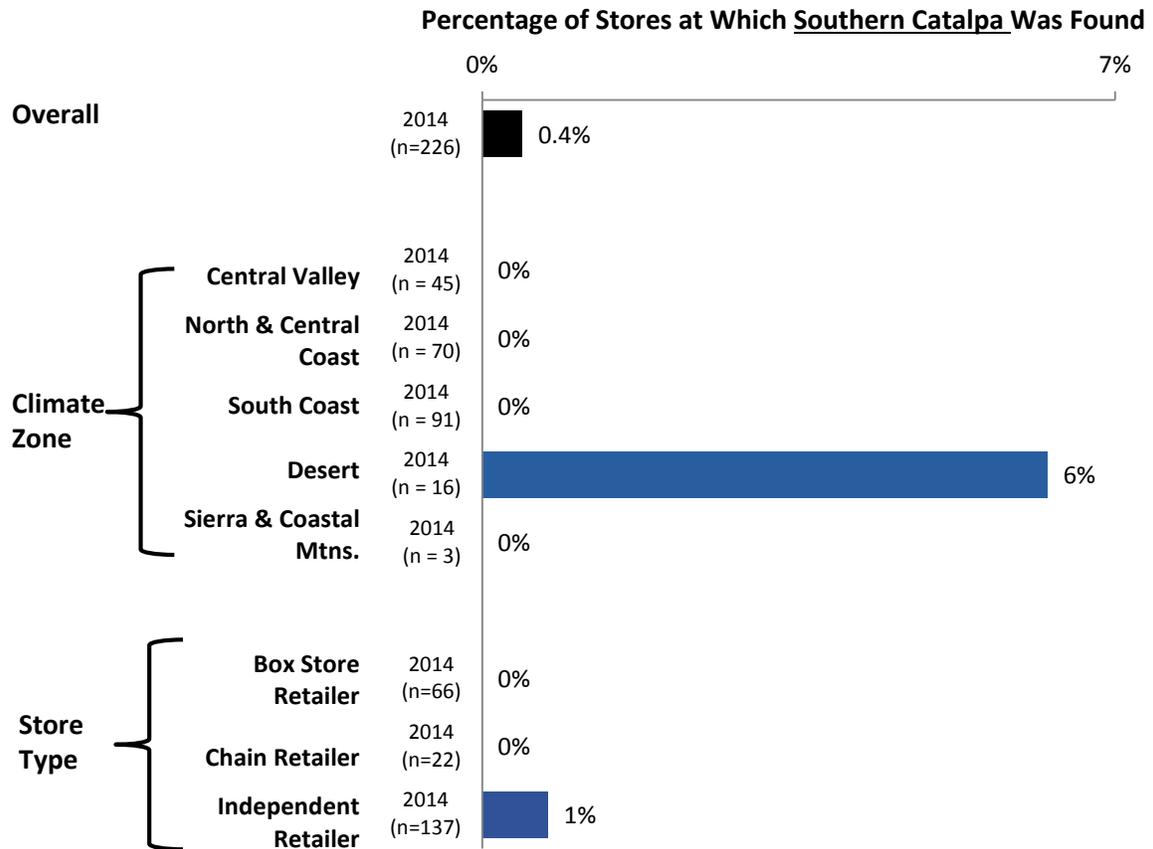
**Exhibit 31. 2011-2014 Results: Pampas Grass by Climate Zone and Store Type**



## Southern Catalpa – By Climate Zone and by Store Type

Southern catalpa was found just once: at an Independent Retailer in the Desert climate zone.

**Exhibit 32. 2014 Results: Southern Catalpa by Climate Zone and Store Type**

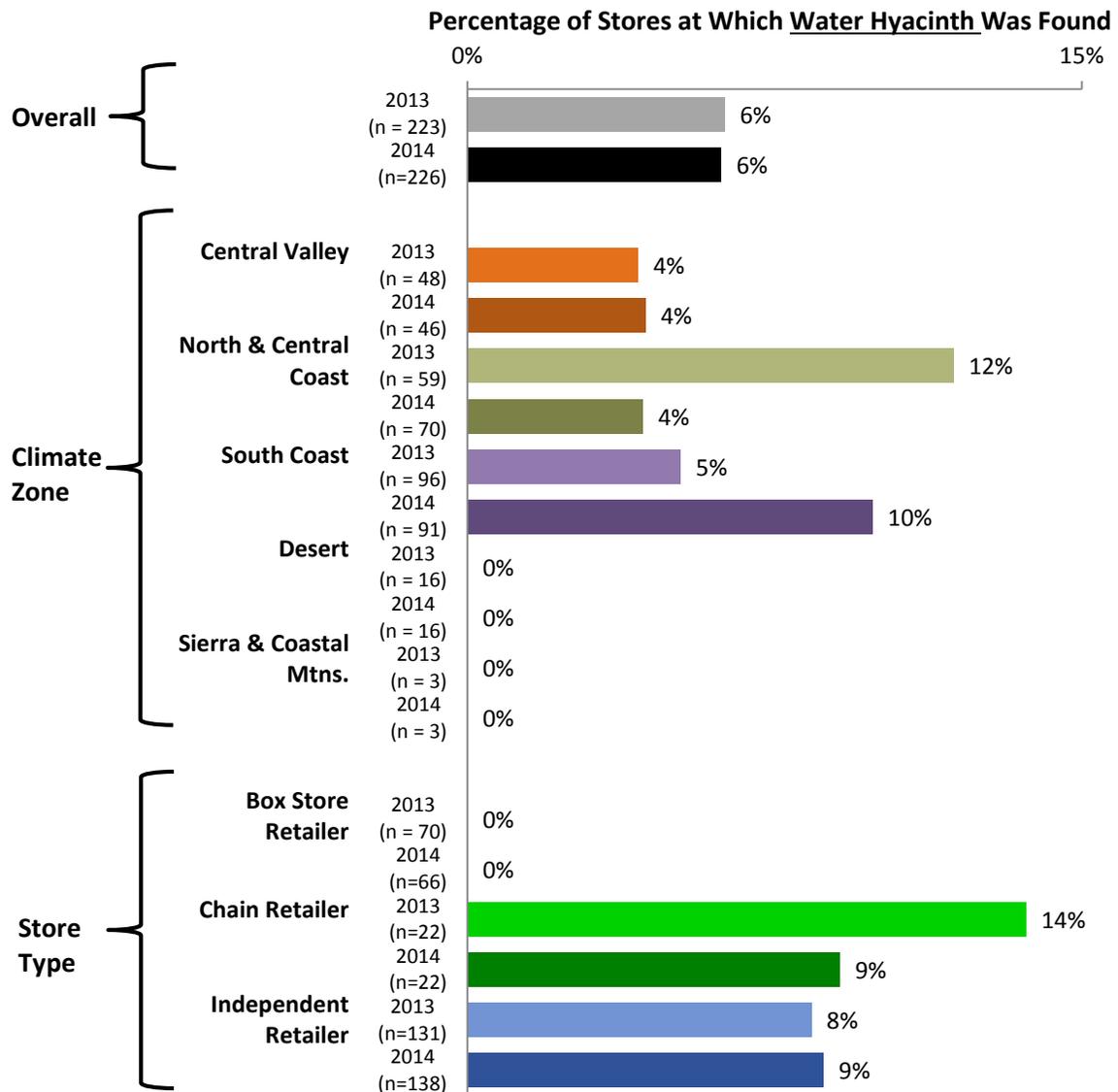


## Water Hyacinth – By Climate Zone and by Store Type

Water hyacinth was found most frequently in the South Coast climate zone (in 10% of stores) and at Chain and Independent Retailers (in 9% of both store types). There was a statistically significant relationship between water hyacinth and store type: Independent Retailers were more likely to have water hyacinth for sale than other store types, and Box Stores were less likely to have water hyacinth for sale than other store types were.

Water hyacinth is locally invasive in the Central Valley, North & Central Coast, and South Coast climate zones.

**Exhibit 33. 2013-2014 Results: Water Hyacinth by Climate Zone and Store Type**

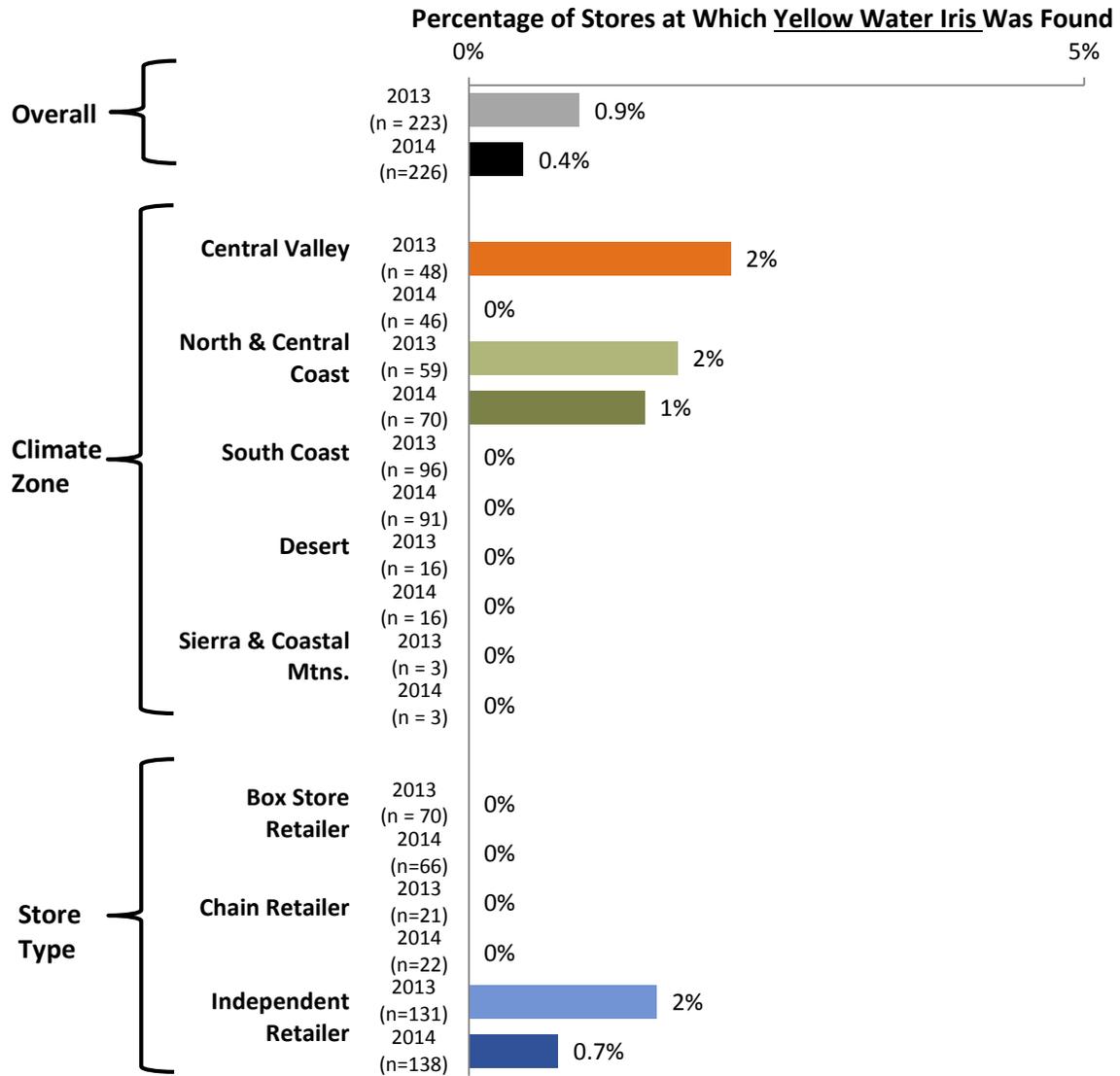


## Yellow Water Iris – By Climate Zone and by Store Type

Yellow water iris was found just once: at an Independent Retailer in the North & Central Coast climate zone.

Yellow water iris is locally invasive in the Central Valley, North & Central Coast, and South Coast climate zones.

**Exhibit 34. 2013-2014 Results: Yellow Water Iris by Climate Zone and Store Type**



## Appendix C: Locally Invasive Plants by Climate Zone

California is a large and geographically diverse state. Because of the wide range in climate zones, some plants are invasive in some parts of California but not in others. Exhibit 35 summarizes which species are invasive in which climate zones.

**Exhibit 35. Climate Zones in Which Plant Species are Invasive**  
(check mark indicates plant is considered invasive in that climate zone)

	Central Valley	Desert	North & Central Coast	Sierra & Coastal Mountains	South Coast
Chinese tallow tree	✓				
French broom	✓		✓	✓	✓
Green fountain grass		✓	✓	✓	✓
Highway iceplant			✓		✓
Mexican feathergrass	✓	✓	✓	✓	✓
Pampas grass		✓	✓		✓
Periwinkle	✓		✓	✓	✓
Scotch broom	✓		✓	✓	✓
Water hyacinth	✓		✓		✓
Yellow water iris	✓		✓		✓

## Appendix D: Common and Scientific Plant Names

The table below provides the common and scientific names of the plants included in the Spring Nursery Survey over the last four years.

**Exhibit 36. Common and Scientific Names for Plants included in Annual Surveys**

Common Name	Scientific Name	2010, 2011, & 2012 Surveys	2013 Survey	2014 Survey
Arundo/giant reed	<i>Arundo donax</i>	✓		
Blue gum eucalyptus	<i>Eucalyptus globulus</i>	✓		
Brazilian peppertree	<i>Schinus terebinthifolius</i>		✓	
Brazilian waterweed	<i>Egeria densa</i>			✓
Bridal veil broom	<i>Retama monosperma</i>	✓		
Capeweed	<i>Arctotheca calendula</i>	✓	✓	
Chinese tallow tree	<i>Sapium sebiferum</i>	✓	✓	✓
Crystalline iceplant	<i>Mesembryanthemum crystallinum</i>	✓	✓	
Flowering rush	<i>Butomus umbellatus</i>		✓	
French broom	<i>Genista monspessulana</i>	✓	✓	✓
Grassland sedge <sup>15</sup>	<i>Carex divulsa</i> ( <i>C. tumulicola</i> Hort.)			✓
Green fountain grass	<i>Pennisetum setaceum</i>	✓	✓	✓
Highway iceplant	<i>Carpobrotus edulis</i>	✓	✓	✓
Jubata grass	<i>Cortaderia jubata</i>	✓		
Mexican feathergrass	<i>Nassella tenuissima</i>		✓	✓
Myoporum	<i>Myoporum laetum</i>	✓	✓	
Ox-eye daisy	<i>Leucanthemum vulgare</i>			✓
Pampas grass	<i>Cortaderia selloana</i>	✓	✓	✓
Periwinkle	<i>Vinca major</i>	✓	✓	✓
Portuguese broom	<i>Cytisus striatus</i>	✓		
Russian olive	<i>Elaeagnus angustifolia</i>	✓	✓	
Saltcedar	<i>Tamarix ramosissima</i>	✓		
Scarlet wisteria	<i>Sesbania punicea</i>	✓		
Scotch broom	<i>Cytisus scoparius</i>	✓	✓	✓
Southern catalpa	<i>Catalpa bignonioides</i>			✓
Spanish broom	<i>Spartium junceum</i>	✓	✓	
Victorian box	<i>Pittosporum undulatum</i>		✓	
Water hyacinth	<i>Eichhornia crassipes</i>		✓	✓
Yellow water iris	<i>Iris pseudacorus</i>		✓	✓

<sup>15</sup> Also known as European Grey Sedge or Berkeley Sedge.

## Appendix E: Cohort Plants by Year

As explained on pages 5-6, LFA placed the 14 species of plants on the 2014 survey into three categories:

- **Cohort 1:** This cohort includes the seven plants that have continuously been on PlantRight's list since 2011 – Chinese tallow tree, French broom, green fountain grass, highway iceplant, pampas grass, periwinkle, and Scotch broom.
- **Cohort 2:** This cohort includes the three plants that were added to the list in 2013 and remained on the list in 2014 – Mexican feathergrass, water hyacinth, and yellow water iris.
- **Cohort 3:** This cohort includes the four plants that were added to the list in 2014 – Brazilian waterweed, grassland sedge, ox-eye daisy, and southern catalpa.

A single store could sell plants from any combination of the three cohorts. Exhibit 37, below, shows the overlap between the three cohorts in the 2014 survey. Of the 226 stores surveyed in the 2014 survey, 122 had no invasive plants present.

When numbers are separated by cohort (in contrast to the numbers presented in the main body of this report), 19% of all stores surveyed carried at least one species of plant from Cohort 1, 40% carried at least one species of plant from Cohort 2, and 5% carried at least one species of plant from Cohort 3.

Exhibit 37. 2014 Results: Cohort Overlap (n = 226)<sup>16</sup>

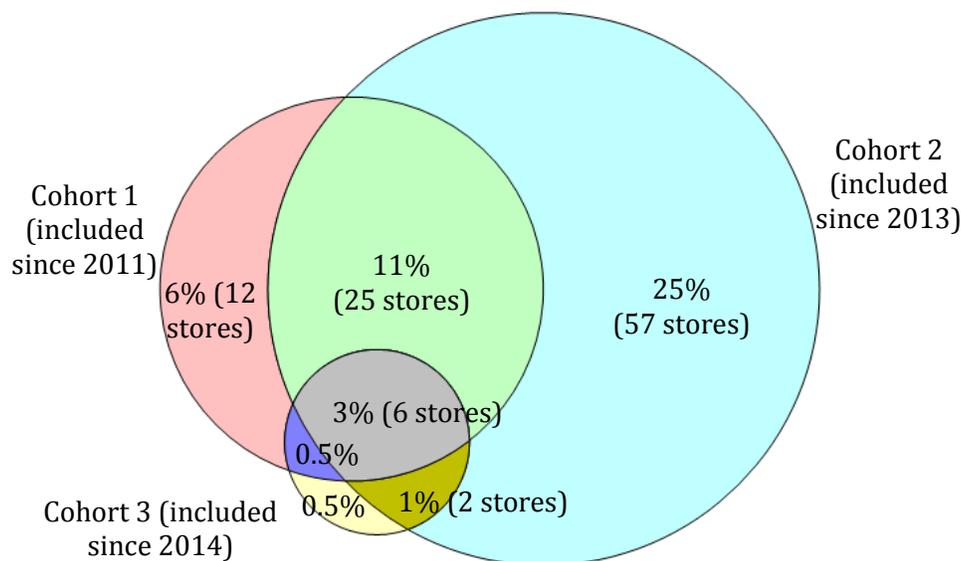
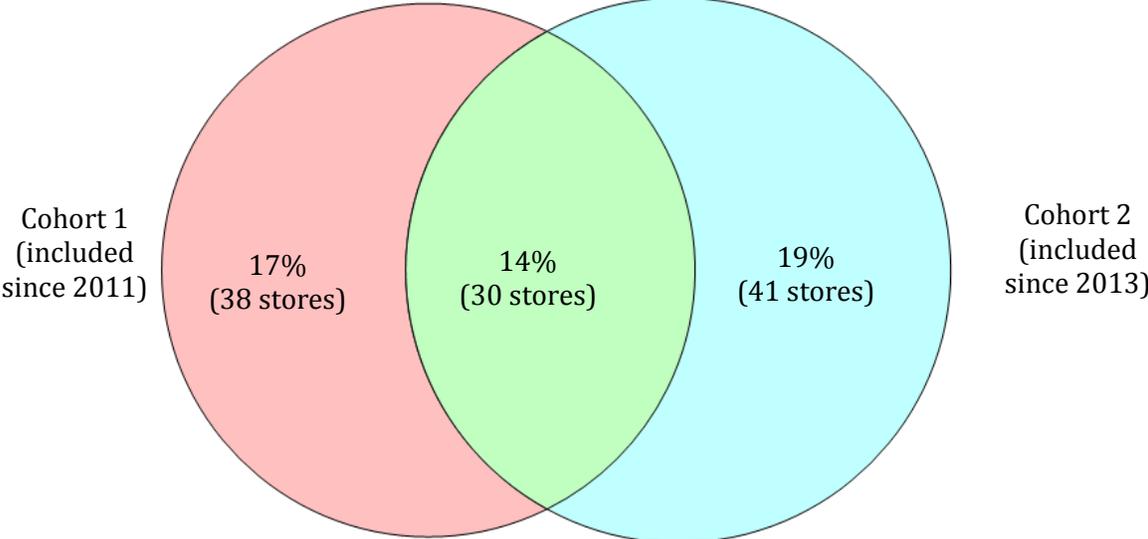


Exhibit 38 on the following page shows the same information for 2013. This chart does not include Cohort 3 because Cohort 3 plants were not included in the 2013 survey. Of the 223 stores surveyed in the 2014 survey, 114 had no invasive plants present.

In 2013, 30% of stores carried at least one species of plant from Cohort 1 and 32% carried at least one species of plant from Cohort 2.

<sup>16</sup> Note: Only one store had at least one plant for sale from Cohort 1 and at least one plant for sale from Cohort 3. Another store had at least one plant from each of the three Cohorts. Due to space considerations, this is not included in the chart above.

Exhibit 38. 2013 Results: Cohort Overlap (n = 223)



## Appendix F: Summary of Statistically Significant Results

For the first four questions below, LFA conducted analyses within the 2013 data and across two years of data (2013 and 2014). For question 5, LFA conducted analyses on all available data. The results are summarized below, with statistically significant findings in **bold**.

- 1) How has the overall rate of invasives for Cohort 1 plants (included in the survey since 2011) and Cohort 2 plants (included in the survey since 2013) changed?
  - Cohort 1: **Cohort 1 plants were found in 2014 at a lower rate than all other years.**
  - Cohort 2: No significant differences between 2013 and 2014.
- 2) What percentage of stores carries one or more species of invasive plants?
  - 2014 data: No significant differences between regions or store types.
  - Cross-year analysis: No significant differences between 2013 and 2014.
- 3) What percentage of stores carries one or more species of invasive plants – for plants that are only invasive in specific regions?
  - 2014 data: No significant differences between regions or store types.
  - Cross-year analysis: No significant differences between 2013 and 2014.
- 4) What's the average number of invasive plants carried by all stores?
  - 2014 data: **Box Stores had a lower number of invasive species for sale than Independent Stores.**
  - Cross-year analysis: No significant differences between 2013 and 2014.
- 5) For each invasive species separately, what percentage of stores carries that species?

### Cohort 1 (Surveyed since 2011):

- a) Chinese tallow tree:
  - 2014 data: **Central Valley stores were more likely to have Chinese tallow trees for sale than stores in other regions.**
  - Cross-year analysis: No significant differences across the four years.
- b) French broom:
  - 2014 data: None found in survey.
  - Cross-year analysis: No significant differences across the four years.
- c) Green fountain grass:
  - 2014 data: **Independent stores were more likely to have green fountain grass for sale than other store types. Box Stores were less likely to have green fountain grass for sale than other store types.**
  - Cross-year analysis: No significant differences across the four years.
- d) Highway iceplant:
  - 2014 data: No significant differences between regions or store types.
  - Cross-year analysis: No significant differences across the four years.
- e) Pampas grass:
  - 2014 data: **Independent stores were more likely to have pampas grass for sale than other store types. Box Stores were less likely to have pampas grass for sale than other store types.**
  - Cross-year analysis: No significant differences across the four years.

- f) Periwinkle:
  - 2014 data: No significant differences between regions or store types.
  - Cross-year analysis: **Stores in 2014 were less likely to have periwinkle for sale than stores in any other year.**
- g) Scotch broom:
  - 2014 data: No significant differences between regions or store types.
  - Cross-year analysis: No significant differences across the four years.

Cohort 2 (Surveyed since 2013):

- h) Mexican feathergrass:
  - 2014 data: No significant differences between regions or store types.
  - Cross-year analysis: **Stores in 2014 were more likely to have Mexican feathergrass for sale than stores in 2013.**
- i) Water hyacinth:
  - 2014 data: **Independent stores were more likely to have water hyacinth for sale than other store types. Box Stores were less likely to have water hyacinth for sale than other store types.**
  - Cross-year analysis: No significant differences between 2013 and 2014.
- j) Yellow water iris:
  - 2014 data: No significant differences between regions or store types.
  - Cross-year analysis: No significant differences between 2013 and 2014.

Cohort 3 (Only surveyed in 2014):

- k) Brazilian waterweed:
  - 2014 data: **Large stores were more likely to have Brazilian waterweed for sale than other store types** (note: only one store in the survey sample was found to be selling Brazilian waterweed).
- l) Southern catalpa:
  - 2014 data: **Desert stores were more likely to have southern catalpa for sale than other store types** (note: only one store in the survey sample was found to be selling southern catalpa).
- m) Grassland sedge:
  - 2014 data: No significant differences between regions or store types.
- n) Ox-eye daisy
  - 2014 data: None found in survey.