



Sustainable Conservation



# Results of PlantRight 2013 Spring Retail Nursery Survey

---

**August 2013**

**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 19 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 the 19 invasive plants 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 California Cooperative Extension's Master Gardener Program, as well as other gardening and conservation groups. The annual spring survey helps PlantRight measure its impact 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 2013 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 section in the appendix.

## About Learning for Action

Established in 2000 and with offices in San Francisco, Southern California, 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.

Learning for Action  
170 Capp Street Suite C  
San Francisco, CA 94110  
(415) 392-2850  
[www.LFAGroup.com](http://www.LFAGroup.com)

# Table of Contents

---

<b>I. Methods .....</b>	<b>1</b>
Data Collection Methods	1
Methods of Data Analysis	2
<b>II. Results.....</b>	<b>3</b>
What percentage of stores carry one or more species of invasive plants?	4
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?	9
What is the average number of invasive species carried by all stores?	13
For each of the 18 invasive species separately, what percentage of stores carries that species?	17
<b>III. Conclusions and Recommendations .....</b>	<b>24</b>
Conclusions	24
Recommendations	25
<b>IV. Appendix A: In-depth Methods .....</b>	<b>27</b>
Sampling Plan	27
Recruiting and Training Highly-Skilled Surveyors	34
Conducting a Quality Assurance Review of the Survey Results	35
Weighting the Data	36
<b>V. Appendix B: Results by Plant Species.....</b>	<b>37</b>
<b>VI. Appendix C: Locally Invasive Plants by Climate Zone.....</b>	<b>48</b>
<b>VII. Appendix D: Common and Scientific Plant Names.....</b>	<b>49</b>
<b>VIII. Appendix E: Summary of Statistically Significant Results .....</b>	<b>51</b>

# 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 three years: 2011 (226 stores surveyed), 2012 (238 stores surveyed), and 2013 (223 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, 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 Ice Plant, French Broom, Green Fountain Grass, Highway Ice Plant, Jubata Grass, Myoporum, Pampas Grass, Periwinkle, Portuguese/Striated Broom, Russian Olive, Saltcedar, Scarlet Wisteria, Scotch Broom, and Spanish Broom. Consistently, seven plants were found very rarely or not at all: Arundo/Giant Reed, Blue Gum Eucalyptus, Bridal Veil Broom, Jubata Grass, Portuguese/Striated Broom, Saltcedar, and Scarlet Wisteria. PlantRight decided to remove these plants from the list because they were so rarely found for sale. The remaining 12 plants were included in the 2013 survey. This list of 12 plants is the subject of the first three sections of the “Results” chapter of the report:

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

PlantRight also added six new plants to the 2013 survey: Brazilian Peppertree, Flowering Rush, Mexican Feather Grass, Victorian Box, Water Hyacinth, and Yellow Water Iris. These plants were included for the purpose of reviewing them as potential additions to PlantRight’s official list. In order to allow for cross-year analyses, these plants are not included in the first three sections of the “Results” chapter. However, these plants are included in the analysis that focuses on each species of invasive plant individually, which makes up the fourth section of the “Results” chapter and Appendix B.

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.** Learning for Action (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

<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.

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 2013, 136 volunteers participated in the survey, with each volunteer spending an average of 56 minutes surveying a nursery. A substantial portion of volunteers – almost 40% – 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 detail 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>3</sup> The frequency distributions for the sample provide unbiased estimates<sup>4</sup> of the frequency distributions within the population (and population subgroups).

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

---

<sup>3</sup> Prior to analysis, LFA weighted the data. For details on weighting, see Appendix A.

<sup>4</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.”

## II. Results

---

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

- What percentage of stores carry one or more species of invasive plants?
- For plants that are invasive only in the climate zones where they are being sold, what percentage of stores carries one or more species of these invasive plants?
- What is the average number of invasive species carried by all stores?
- For each invasive species separately, what percentage of stores carries that species?

For each research question, PlantRight also wanted to know:

- How do these results vary by climate zone?
- How do these results vary by store type?
- How do the 2013 results compare to the 2012 and 2011 results?

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.

The first three research questions address cross-year findings, which include only the 12 plants that have been tracked across all three years of the survey. The fourth research question, which evaluates each plant species separately, includes all 18 plants that were tracked in the 2013 survey.

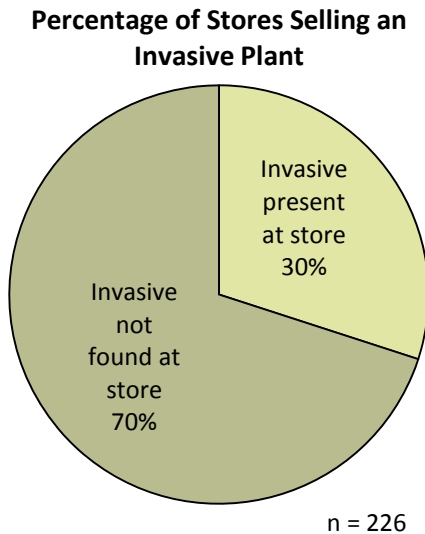
The focus of this report is on the 2013 results and how these results compare to the 2012 and 2011 findings. For information that focuses specifically on the 2011 or 2012 statistical findings, please see the 2011 report and 2012 reports.

Survey results are also available for 2010, but this report does not seek to use the 2010 data to establish three years of an over-time trend. LFA, in partnership with PlantRight, made this decision due to the fact that the 2010 survey includes insufficient data from which to confidently draw meaningful conclusions about California's retail nursery industry as a whole. Thus, 2010 is being considered a pilot year and is not strictly comparable to the 2011-2013 results.

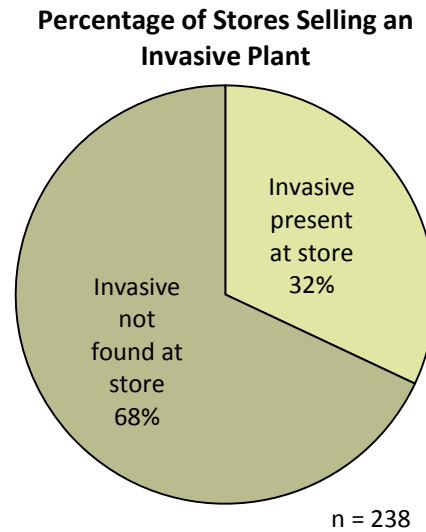
## What percentage of stores carry one or more species of invasive plants?

In 2013, 31% of the 223 surveyed stores carried one or more species of invasive plants. This was very much in line with the findings in 2011 and 2012, when the rates of stores carrying one or more species of invasive plants were 30% and 32%, respectively. These differences are not statistically significant, and therefore the proportion of stores with invasive plants for sale should be considered essentially stable across the three years of the survey.

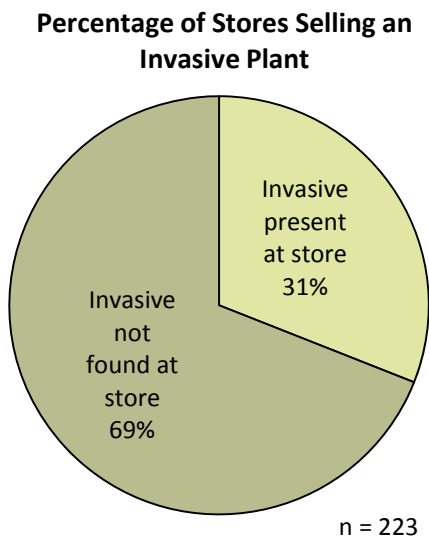
**Exhibit 1. 2011 Results: Overall Prevalence**



**Exhibit 2. 2012 Results: Overall Prevalence**



**Exhibit 3. 2013 Results: Overall Prevalence**



Another indication of stability from year to year is present in a subgroup of the stores: those stores that were in the 2013 random sample and had also previously been selected into the random sample in either 2011 or 2012. Of the 223 stores surveyed in 2013, 48 had been previously surveyed in 2011 and 51 had been surveyed in 2012. These stores show very little change in whether or not they sold invasives (see Exhibit 4 below). However, it is critical to note that this sample is *not* representative of the population as a whole: it is simply the group of stores that happened to appear in the randomly drawn samples more than once over the three years.

**Exhibit 4. Previously Surveyed Stores<sup>5</sup>**

		2011		2012	
		No Invasive Present	Invasive Present	No Invasive Present	Invasive Present
2013	No Invasive Present	28	5	24	8
	Invasive Present	7	8	10	9
Total		48 (of which 25% are Box Stores, 8% are Chain Retailers, and 67% are Independent Retailers)		51 (of which 25% are Box Stores, 10% are Chain Retailers, and 65% are Independent Retailers)	

These findings reveal little “churn.” In other words, most stores retained their “invasive selling behavior” – if they were not selling invasives in the past, they tend to continue not selling them (and the same is true for those selling invasives). From the two previous years, 75% and 65% of stores (respectively) retained the same “invasive selling behavior” over time.

Eight stores were surveyed in all three years. Of these eight stores, five stores retained the same selling behavior, with three stores carrying invasives all three years and two stores not carrying invasives in any year. Seven of the eight stores were Independent Retailers, and one was a Box Store.

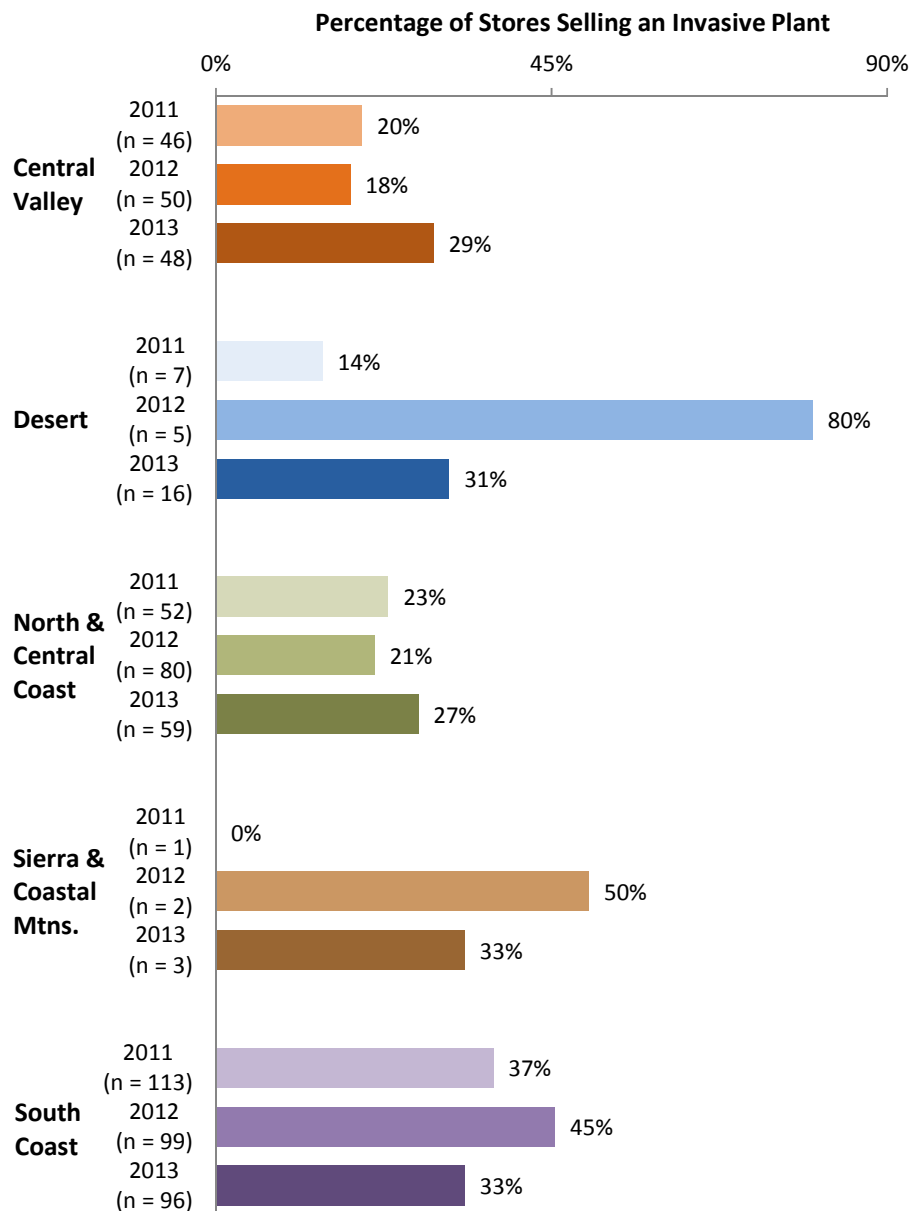
<sup>5</sup> Please note this data is unweighted, unlike the rest of the data presented in this report. Please see Appendix A for more information on weighting.



## By Climate Zone

Prevalence of invasive plants for sale in stores varies by climate zone, as summarized in Exhibit 5. The Desert and Sierra & Coastal Mountains climate zones show dramatic swings in selling behavior over the three years; however, this is a result of their small sample sizes (because a small change can result in a significant change in results). When the survey findings are analyzed excluding those two regions (due to their sample sizes), stores in the South Coast climate zone have consistently been most likely to carry at least one species of invasive plant over the three years of the survey. While the prevalence of invasive plants in South Coast stores is not significantly higher than other regions this year, the fact that it has consistently been the highest suggests that PlantRight should consider focusing resources on nurseries in the South Coast region.

**Exhibit 5. 2011-2013 Results: Invasive Plants by Climate Zone**



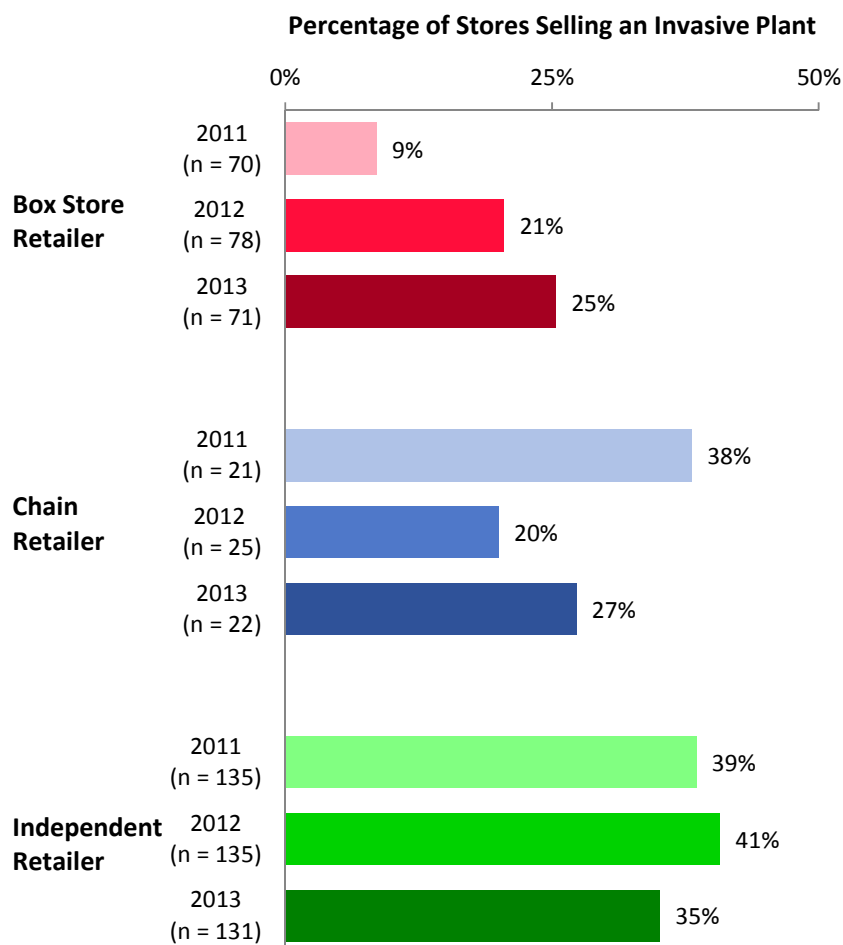
## By Store Type

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). There were no significant differences in the rate of stores selling invasive species by store type.

As was the case in 2011 and 2012, Independent Retailers in 2013 are most likely to sell an invasive species, with 35% of surveyed stores selling at least one species of invasive plants. The proportion of Chain Retailers selling invasive plants went up, from 20% in 2012 to 27% in 2013, but this was not a statistically significant difference.

There was one statistically significant difference that appeared over the course of the three-year survey: Box Stores were significantly more likely to be selling an invasive plant species in 2013 than in 2011 ( $p < .05$ ). This increase is mostly due to the increased sale of Periwinkle. When Periwinkle is removed, the percent of Box Stores selling other invasive species was 4% in 2011, 1% in 2012, and 10% in 2013. Without Periwinkle, the over-time increase for Box Stores is not statistically significant. For more information, please see the Periwinkle section of this report (page 21).

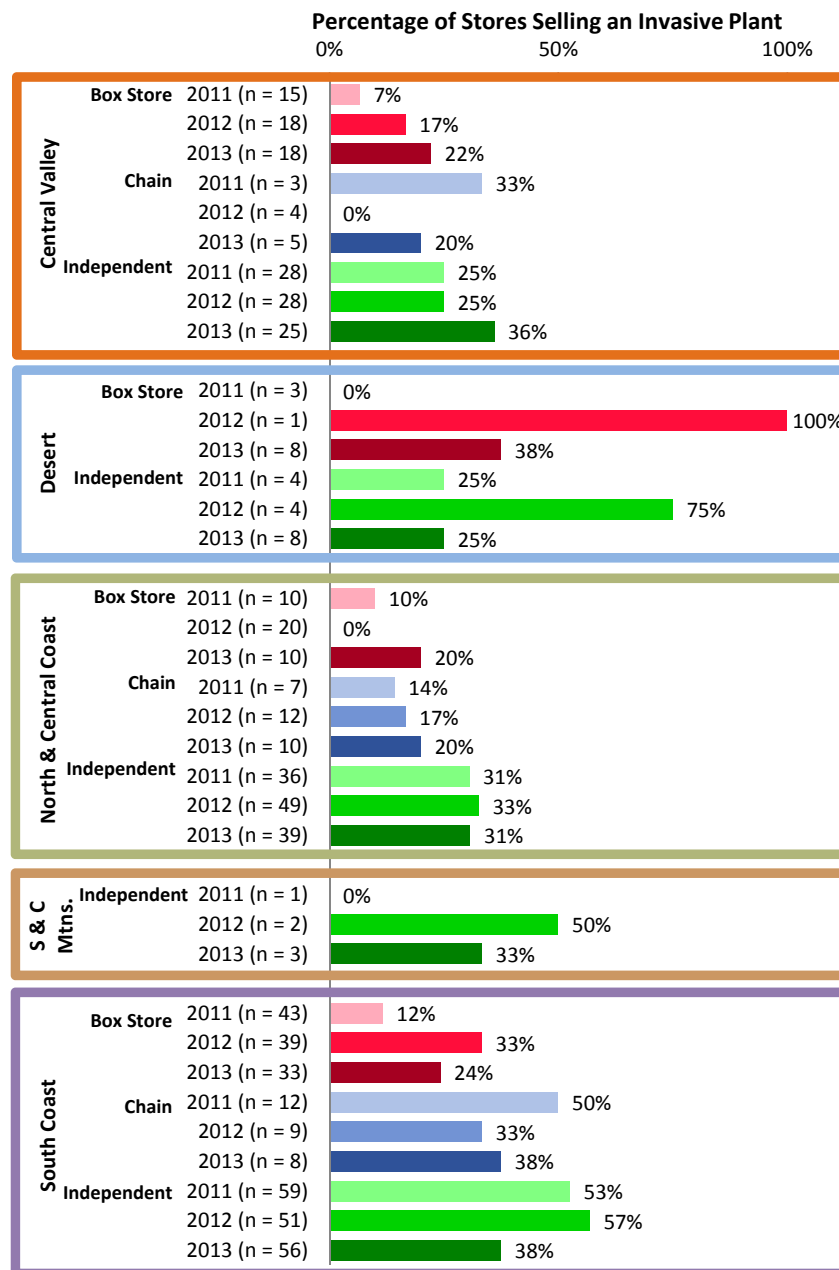
**Exhibit 6. 2011-2013 Results: Invasive Plants by Store Type**



## By Climate Zone and Store Type

When the results are viewed by both climate zone and store type together, it is noteworthy that the percentage of Independent Retailers in the South Coast climate zone selling an invasive species has dropped over time. The rate in 2013 is 33% – a substantial drop from previous years (53% in 2011 and 57% in 2012). This is notable because, when the climate zones with a small number of stores are ignored (Desert and Sierra & Coastal Mountains), Independent Retailers in the South Coast are most likely to have at least one invasive species for sale (followed closely by those in the Central Valley). It is also noteworthy that both Box Stores and Independent Retailers in the Central Valley were more likely to carry at least one species of invasive plant in 2013 than 2011 and 2012.

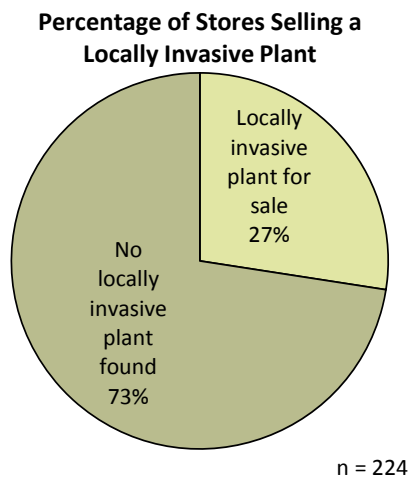
**Exhibit 7. 2011-2013 Results: Invasive Plants by Climate Zone and Store Type**



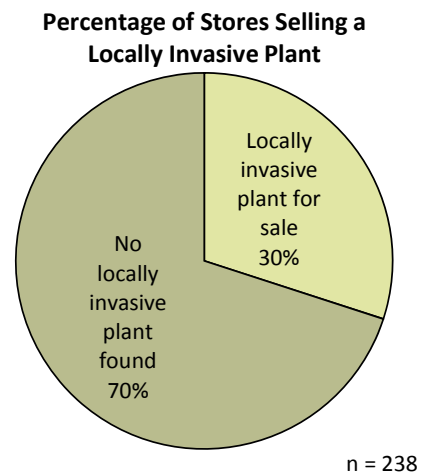
## Specifically for plants invasive in the climate zones where they were found for sale, what percentage of stores carries one or more species of invasive plants?

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 2013 was 26%.<sup>6</sup> This was very much in line with the findings in 2011 and 2012, when the rates of stores carrying one or more species of locally invasive plants were 27% and 30%, respectively. Since these differences are not statistically significant, the proportion of stores with locally invasive plants for sale was essentially stable across the three years of the survey.

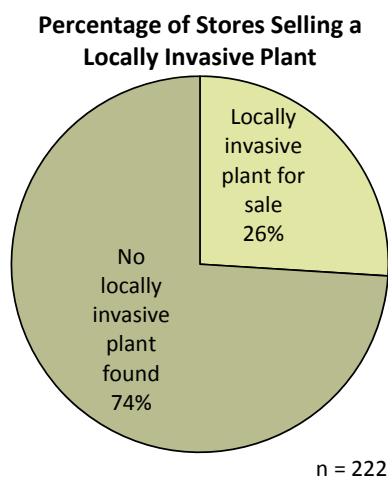
**Exhibit 8. 2011 Results:**  
Overall Prevalence of Locally Invasive Plants



**Exhibit 9. 2012 Results:**  
Overall Prevalence of Locally Invasive Plants



**Exhibit 10. 2013 Results:**  
Overall Prevalence of Locally Invasive Plants

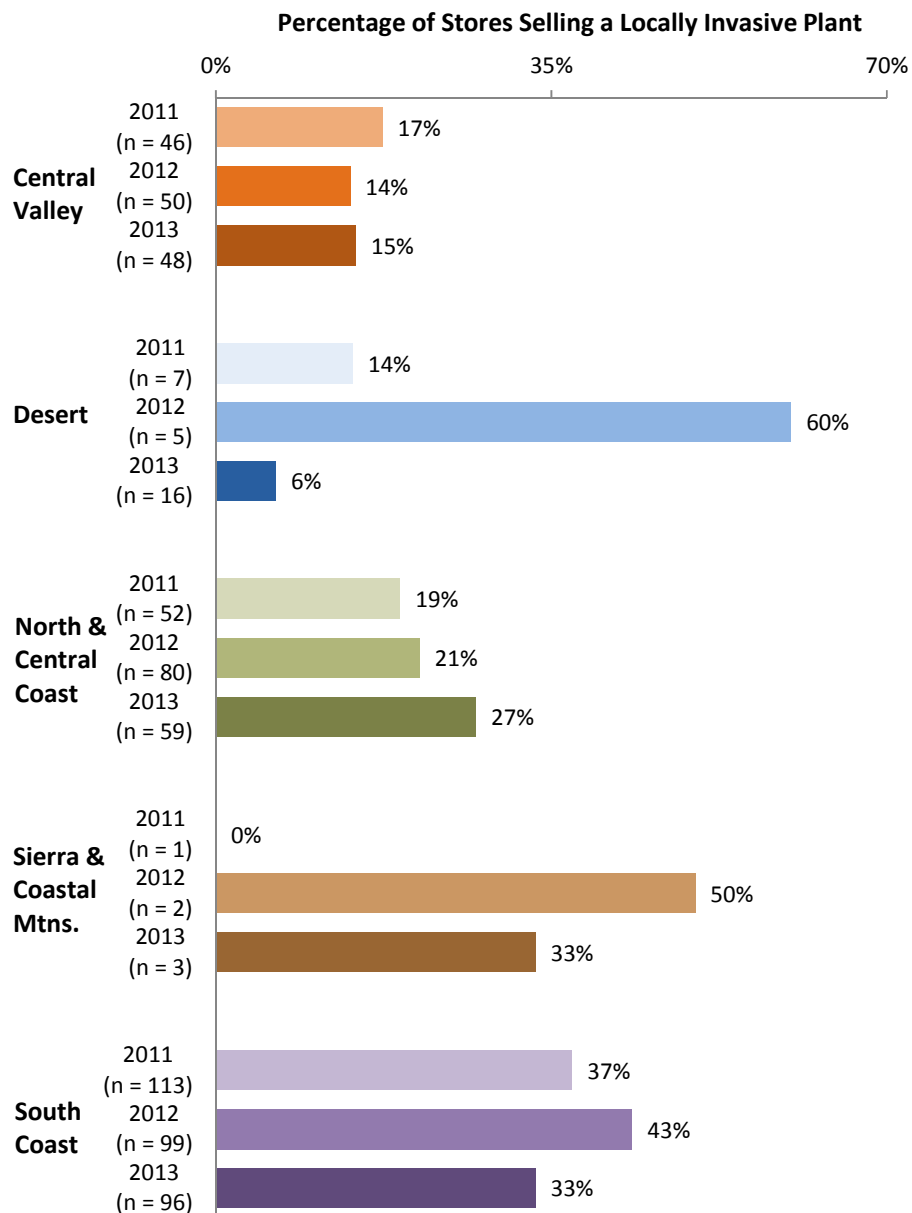


<sup>6</sup> Because plant buyers may buy plants in one region that they plan to plant in another, information on where plants are locally invasive is not a perfect proxy for tracking which plants will become invasive.

## By Climate Zone

Ignoring the climate zones with a low number of surveyed stores, locally invasive plants have consistently been found most frequently in the South Coast climate zone. Compared to the Central Valley and North & Central Coast climate zones (15% and 27%, respectively), the percentage of stores selling a locally invasive plant is higher in the South Coast climate zone (33%). This difference is not statistically significant. Over time, the South Coast climate zone did see a decrease in the number of stores selling at least one species of locally invasive plant from 43% in 2012 to 33% in 2013.

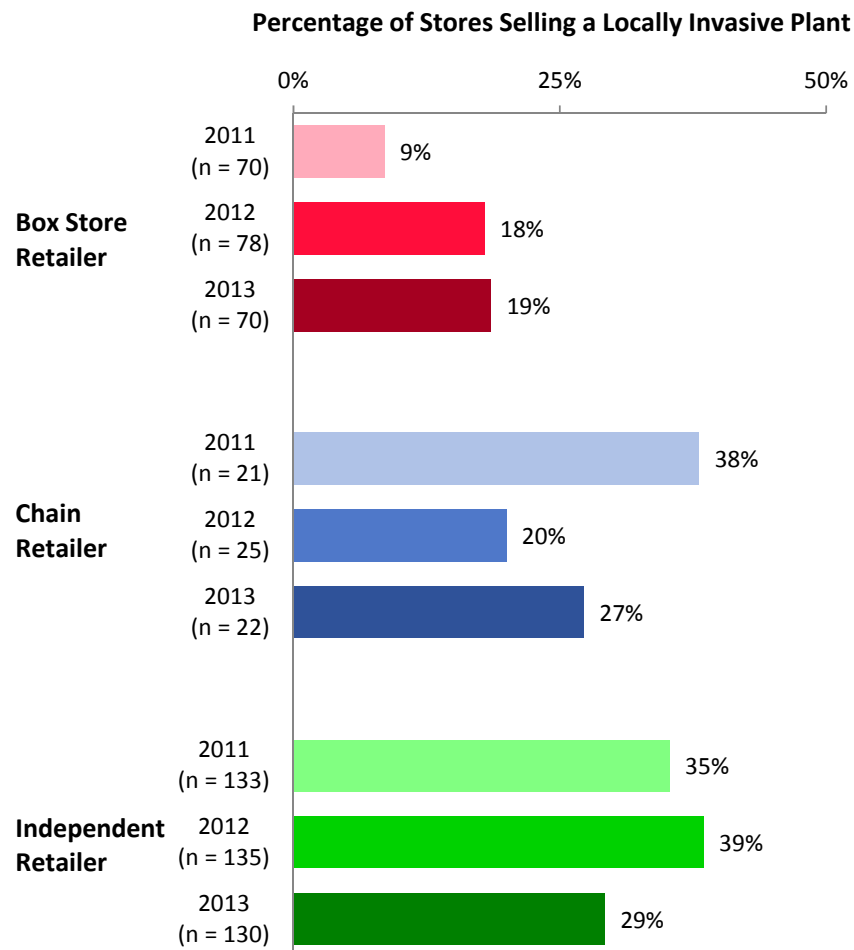
**Exhibit 11. 2011-2013 Results: Locally Invasive Plants by Climate Zone**



## By Store Type

Independent Retailers were most likely to sell locally invasive plants, with 29% of stores selling them. They were only slightly more likely to do so than Chain Retailers, with 27% of stores selling locally invasive plants. The fact that these figures are so similar to each other (29% vs. 27%) is a notable change from 2012, in which the two figures were quite different from each other (39% vs. 20%).

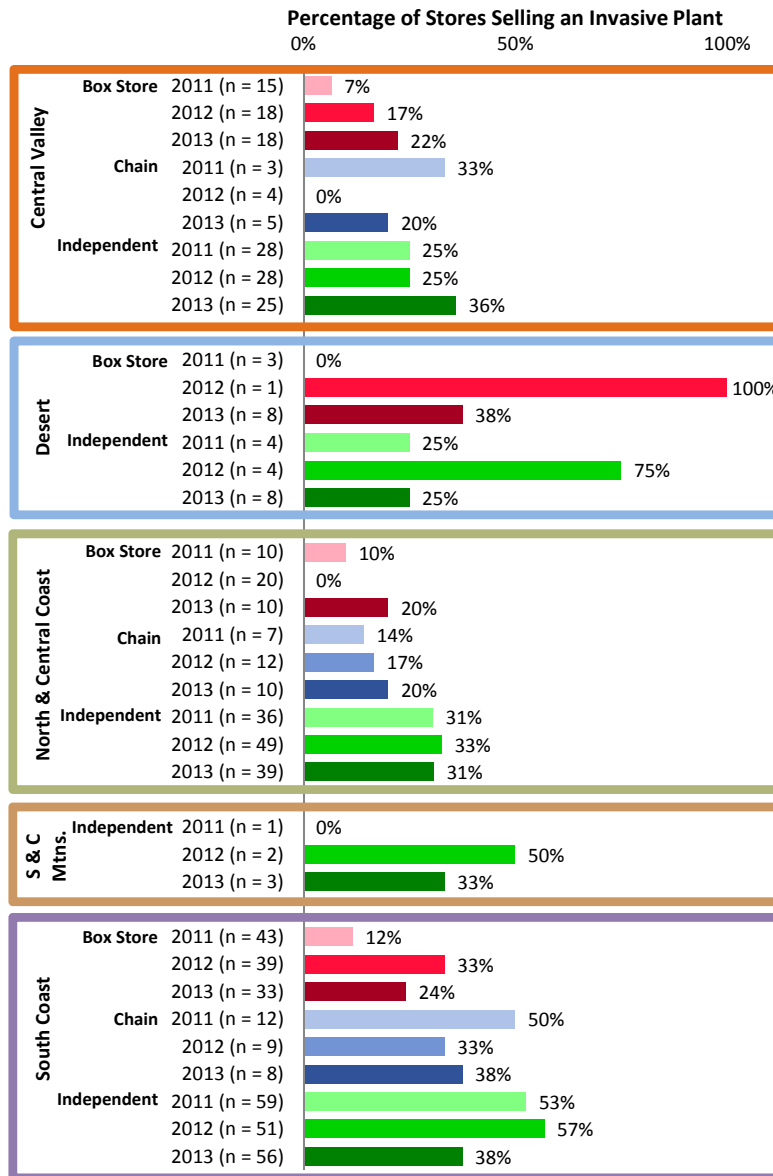
**Exhibit 12. 2011-2013 Results: Locally Invasive Plants by Store Type**



## By Climate Zone and Store Type

Locally invasive plants were most likely to be found for sale in the South Coast climate zone in both Chain and Independent Retailers (found in 38% of both store types). Locally invasive plants were also likely to be found in Independent Retailers in the Central Valley climate zone (found in 36% of stores) and in the North & Central Coast climate zone (found in 31% of stores).

**Exhibit 13. 2011-2013 Results: Locally Invasive Plants by Climate Zone and Store Type**



## What is the average number of invasive species carried by all stores?

Overall, the average number of invasive species carried by all the surveyed stores was .41 species of plants per store (n=223). This is a very slight – and not statistically significant – decrease from 2011 and 2012 (.43 species/store for both years).

Of the 69 stores that were carrying invasive species, 28% (19 stores) were carrying more than one invasive species. In 2012, this figure was 24% (18 of 77). In 2011, it was 34% (23 of 67). Among those stores where at least one plant was found, the average number of species present was 1.33. The comparable figure was 1.34 in 2012 and 1.43 in 2011.

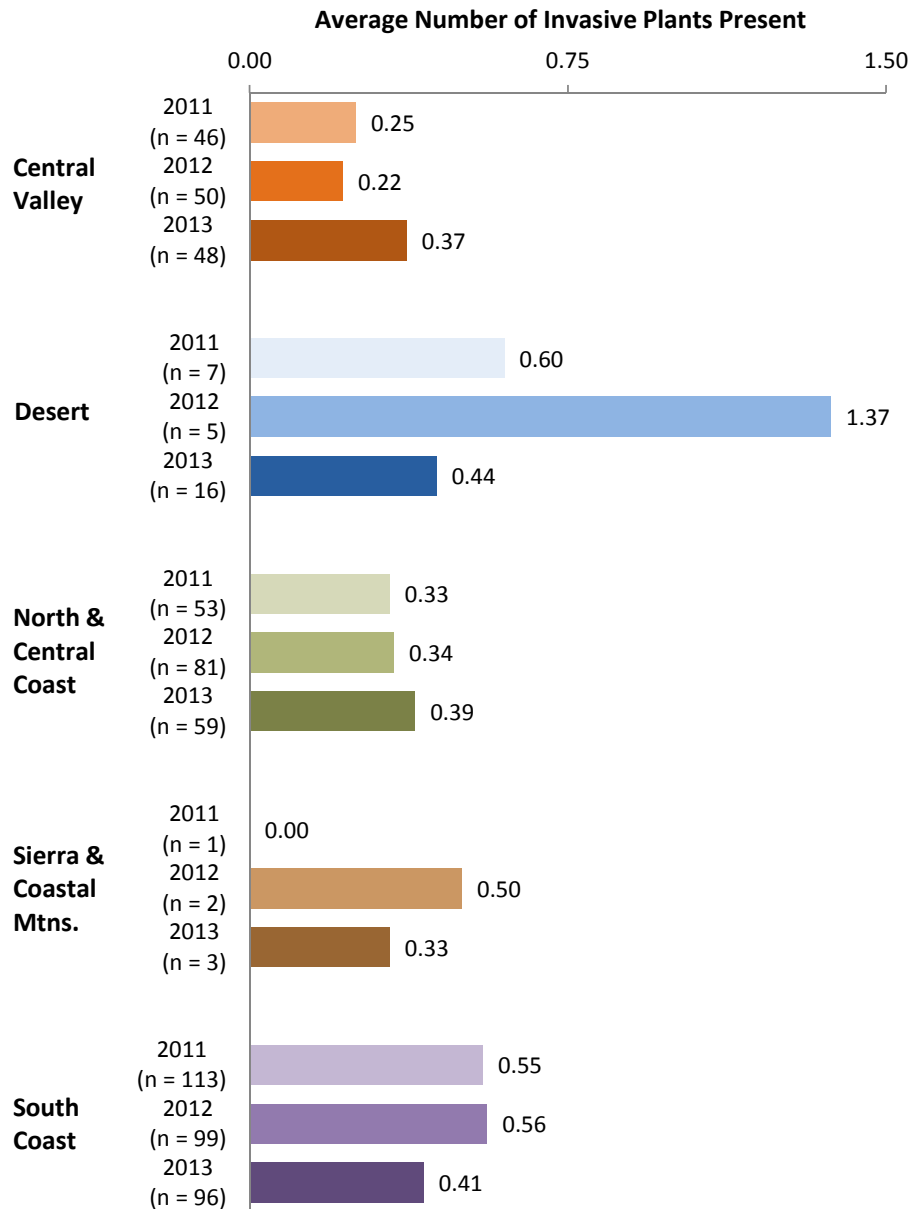
Of the 12 species carried over from past years, the maximum number found at any store in 2013 was three. A total of four stores had three of the 12 invasive species present.



## By Climate Zone

The average number of invasive species sold per store was highest in the Desert climate zone, with an average of .44 plant species per store. The next highest average number of invasive species for sale was in the South Coast climate zone, with an average of .41 plants per store. For the South Coast, this rate represents a decrease from 2011 and 2012, when it was .55 and .56, respectively.

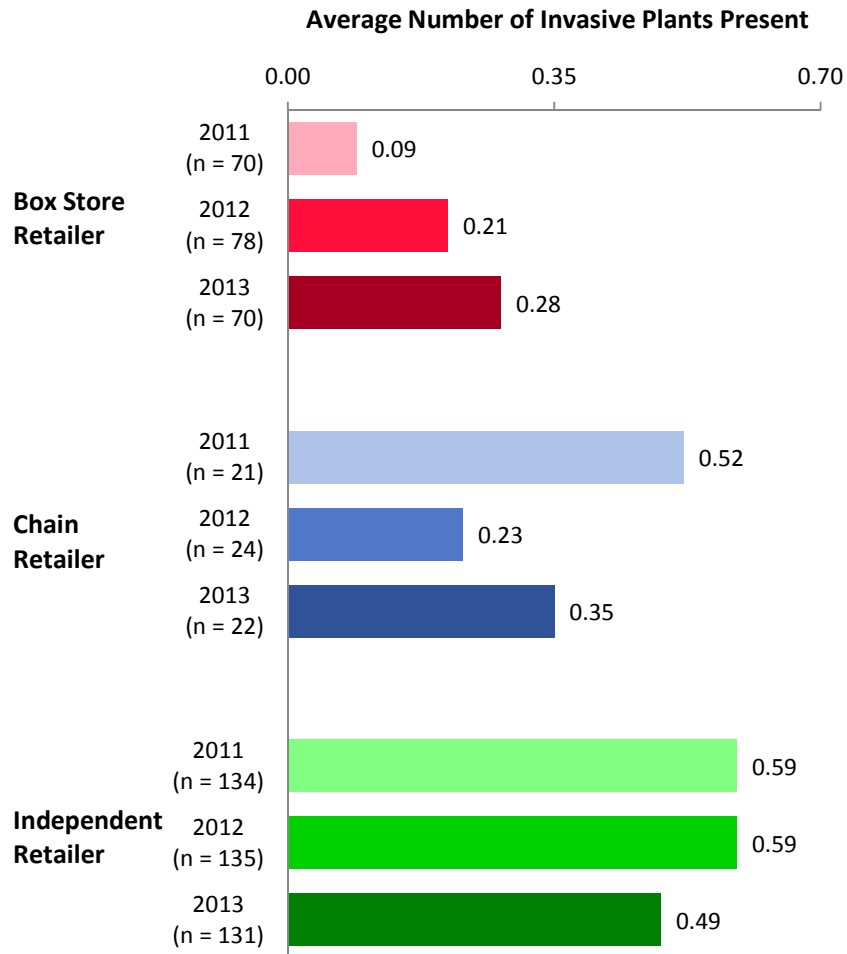
**Exhibit 14. 2011-2013 Results: Average Number of Species by Climate Zone**



## By Store Type

Independent Retailers had the highest average number of invasive species per store, at .49 species of plants per store. This average was higher than that of Box Stores (.28 species per store) and Chain Retailers (.35 species per store). In fact, 15 of the 19 stores that carried more than one species of invasive plant were Independent Retailers.

**Exhibit 15. 2011-2013 Results: Average Number of Species by Store Type**



There was a statistically significant increase in the average number of invasive species for sale at Box Stores from 2011 (.09 species per store) to 2013 (.28 species per store) ( $p < .05$ ). Exhibit 16, below, summarizes the number of species found at Box Stores across the three years of the survey. This year was the first year that any Box Store was found selling more than one species of invasive plants.

**Exhibit 16. Number of Species Found at Box Stores, Across the Years**

Number of Species Found	Number of Box Stores		
	2011	2012	2013
0	64	62	53
1	6	16	15
2	0	0	2

The two Box Stores that were selling more than one species of invasive plant were both selling Periwinkle and Scotch Broom. Both stores were located in the Desert climate zone.

Exhibit 17, below, summarizes the kinds of plants found at Box Stores across the years.

**Exhibit 17. Percent of Box Stores Selling Each Species**

Species	Percent of Box Stores		
	2011	2012	2013
Green Fountain Grass	1%	1%	4%
Highway Ice Plant	0%	0%	1%
Pampas Grass	3%	0%	0%
Periwinkle	6%	19%	17%
Scotch Broom	0%	0%	3%
Spanish Broom	0%	0%	1%

The following plants were not found at Box Stores in all three years of the survey: Capeweed, Crystalline Ice Plant, French Broom, Myoporum, Russian Olive, and Chinese Tallow Tree.

## **For each of the 18 invasive species separately, what percentage of stores carries that species?**

While the previous section included results for only the 12 plants that have been tracked over all three years of the survey, the following section includes results for all 18 plants that appeared on the 2013 plant list.

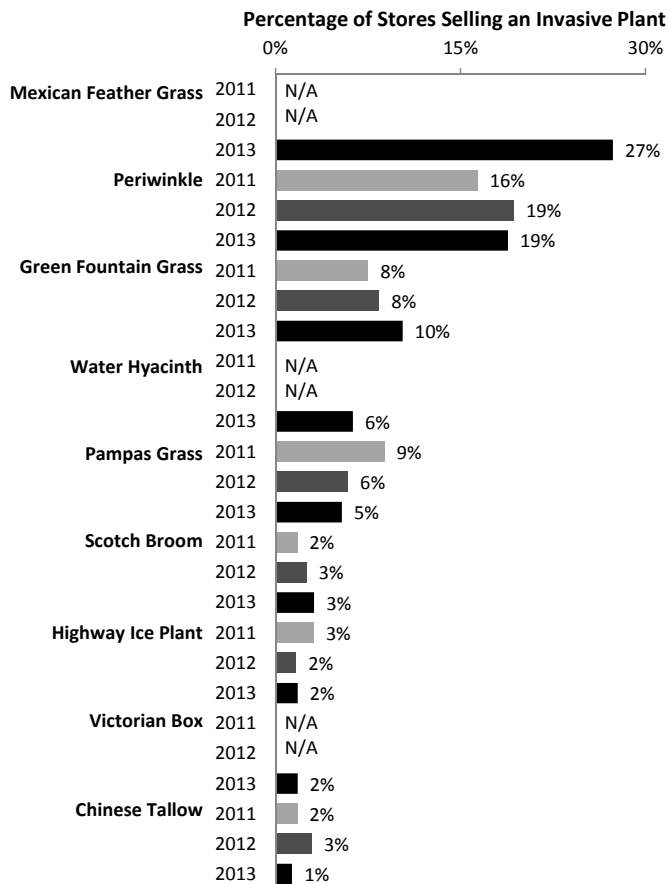
Volunteers searched for 18 different invasive species, of which 12 were found in at least one store: Brazilian Peppertree, Chinese Tallow Tree, Green Fountain Grass, Highway Ice Plant, Mexican Feather Grass, Pampas Grass, Periwinkle, Scotch Broom, Spanish Broom, Victorian Box, Water Hyacinth, and Yellow Water Iris. Results for all plant species are summarized in Exhibits 18 and 19.

Mexican Feather Grass 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 Feather Grass and Periwinkle were found. For the same level of detail about each of the other plant species, please see Appendix B.

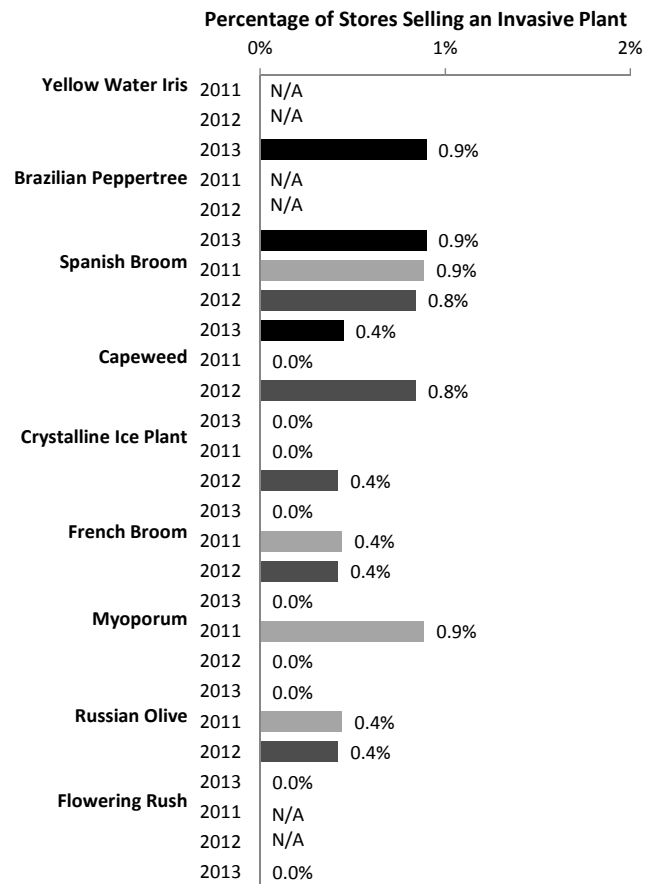
## Prevalence of Each Plant Species

The most frequently found invasive species were (in descending order), Mexican Feather Grass, Periwinkle, Green Fountain Grass, Pampas Grass, and Water Hyacinth. For ease of reading, these results have been split into two charts, each with nine of the eighteen plants found.<sup>7</sup> 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 18. Frequencies of Plant Species Found, Nine Most Commonly Found Plants**



**Exhibit 19. Frequencies of Plant Species Found, Nine Least Commonly Found Plants**



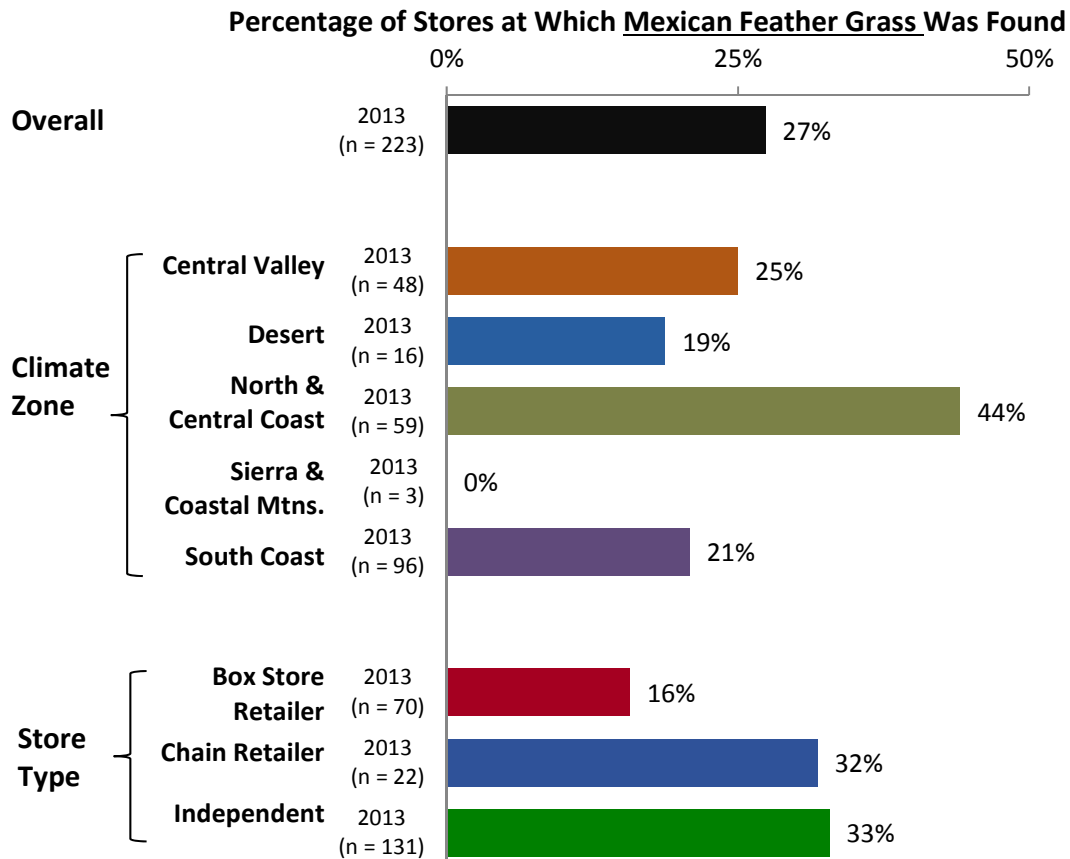
2011 (n = 226); 2012 (n = 238); 2013 (n = 223)

<sup>7</sup> Please see Appendix D for a complete list of the plants included on the 2013 survey, as well as a list of the plants included on the 2011 & 2012 surveys.

## Mexican Feather Grass– By Climate Zone and by Store Type

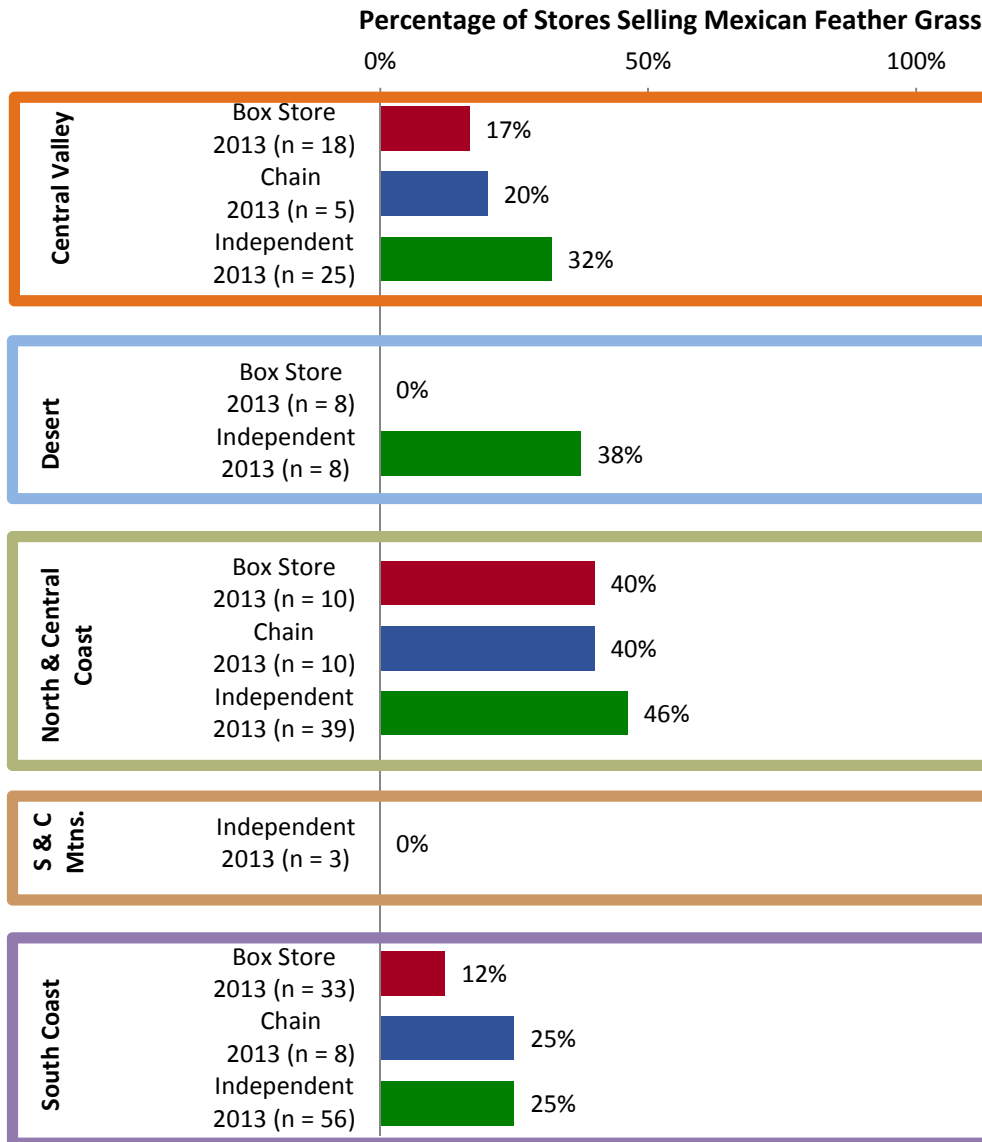
Mexican Feather Grass was found most often in the North & Central Coast climate zone (in 44% of stores). There was a statistically significant relationship between Mexican Feather Grass and climate zone: a higher percentage of stores in the North & Central Coast climate zone were carrying Mexican Feather Grass than would be anticipated if region had no bearing on how many stores carry Mexican Feather Grass ( $p < .05$ ). Mexican Feather Grass is also much more likely to be found at Independent Retailers (in 33% of stores) than Box Stores (16% of retailers) ( $p < .05$ ).

**Exhibit 20. 2013 Results: Mexican Feather Grass by Climate Zone and Store Type**



When these results are viewed by both climate zone and store type, Mexican Feather Grass is most often found at all three store types in the North & Central Coast climate zone.

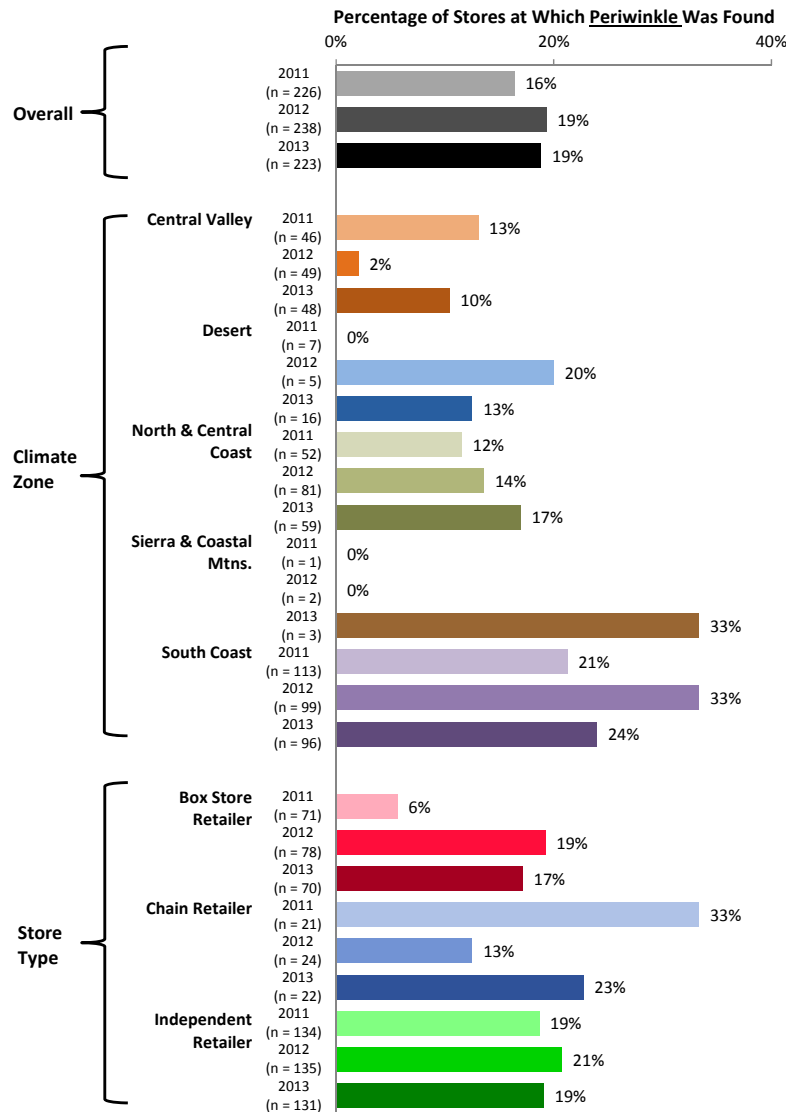
**Exhibit 21. 2013 Results: Mexican Feather Grass by Climate Zone and Store Type**



## Periwinkle – By Climate Zone and by Store Type

Periwinkle was most frequently found on the South Coast (in 24% of stores) and at Chain Retailers (in 23% of stores). (While Periwinkle was found at 33% of stores in the Sierra & Coastal Mountains, this finding is not meaningful due to the small number of stores surveyed there). Compared to 2011 Box Stores, a significantly higher portion of 2012 Box Stores were selling Periwinkle.

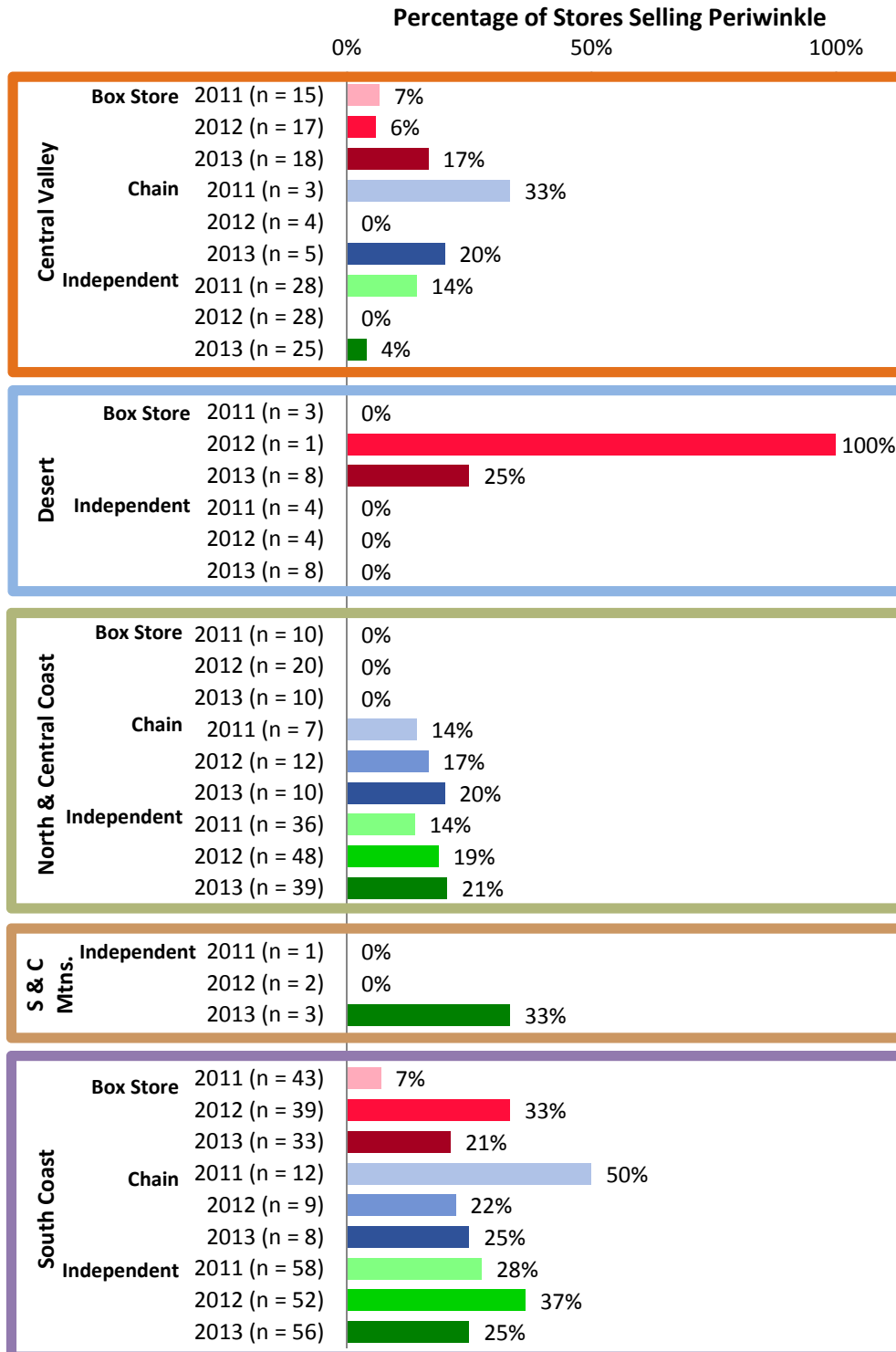
**Exhibit 22. 2011-2013 Results: Periwinkle by Climate Zone and Store Type**





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 Chain Retailers and Independent Stores in the South Coast. Periwinkle was found in 25% of those two South Coast store types.

**Exhibit 23. 2011-2013 Results: Periwinkle by Climate Zone and Store Type**



As previously mentioned, the percentage of Box Stores selling Periwinkle showed a dramatic rise from 2011 to 2012, from 6% to 19% (p<.05). It has since decreased a small amount to 17%. The increase from 2011 to 2012 was explored in depth in the 2012 report. The basic conclusions from 2012 remain valid: Periwinkle is clearly a significant part of the problem in most climate zones and in all types of stores. Periwinkle comprises a high proportion of the invasive plants found in the South Coast climate zone and in Box Stores. Its presence in Box Stores is especially concerning since Box Stores tend to sell higher volumes of plants than other store types.

**Exhibit 24. 2011-2013 Results: With or Without Periwinkle by Climate Zone and Store Type**

		2011		2012		2013	
		With Any Invasive Present	With Any Invasive <u>Except Periwinkle</u> Present	With Any Invasive Present	With Any Invasive <u>Except Periwinkle</u> Present	With Any Invasive Present	With Any Invasive <u>Except Periwinkle</u> Present
<b>By Climate Zone</b>	North & Central Coast	23% (n=52)	17% (n=52)	21% (n=80)	15% (n=80)	27% (n=59)	17% (n=59)
	Central Valley	20% (n=46)	9% (n=46)	18% (n=50)	16% (n=50)	29% (n=48)	21% (n=48)
	South Coast	37% (n=113)	25% (n=113)	45% (n=99)	18% (n=99)	33% (n=96)	17% (n=96)
	Sierra & Coastal Mtns.	0% (n=1)	0% (n=1)	50% (n=2)	50% (n=2)	33% (n=3)	0% (n=3)
	Desert	14% (n=7)	14% (n=7)	80% (n=5)	60% (n=5)	31% (n=16)	31% (n=16)
<b>By Store Type</b>	Indep. Retailer	39% (n=135)	28% (n=135)	41% (n=135)	28% (n=135)	35% (n=131)	24% (n=131)
	Chain Retailer	38% (n=21)	18% (n=21)	20% (n=25)	8% (n=25)	27% (n=22)	14% (n=22)
	Box Store	9% (n=70)	4% (n=70)	21% (n=78)	1% (n=78)	25% (n=71)	10% (n=71)
<b>Total</b>		30% (n=226)	20% (n=226)	32% (n=238)	18% (n=238)	31% (n=223)	19% (n=223)

## III. Conclusions and Recommendations

The results of PlantRight's 2013 Spring Nursery Survey are, by and large, quite similar to the results of the 2011 and 2012 surveys. For that reason, many of the conclusions and recommendations included below are similar to those made in the 2011 and 2012 reports.

### Conclusions

#### Changes Occurred by Store Type

The overall rate at which stores are carrying invasive plants is essentially unchanged since 2011. However, some differences do appear when the results are viewed by store type. These include:

- Box Stores are much more likely to carry invasive species from 2011 to 2013 (the proportion rose from 9% of stores in 2011 to 25% in 2013,  $p < .05$ ).
  - For Box Stores, the most dramatic rise took place in the Central Valley climate zone (from 7% to 22%).
  - Most of this increase is due to increased sales of Periwinkle. When Periwinkle is excluded, the proportion of Box Stores selling invasive species rose a small amount, from 4% in 2011 to 10% in 2013.
- The proportion of Independent Retailers selling invasive species dropped slightly (from 39% in 2011 to 35% in 2013). In past years of the survey, Independent Retailers have been markedly more likely to carry species of invasive plants when compared to the two other store types. While Independent Retailers are still the most likely of all three store types to sell invasive plants, the fact that they were less likely to do so over time is a move in the right direction. This is not a statistically significant change.

#### Changes by Climate Zone

The prevalence of invasive species decreased slightly among stores in the South Coast – from 37% in 2011 to 33% in 2013. As in 2011 and 2012, the South Coast is the climate zone with the highest proportion of stores with invasives for sale (after excluding the Sierra & Coastal Mountains climate zones, which had too few stores to confidently reflect nursery behavior in these regions). The fact that South Coast stores were less likely to have invasive plants for sale is promising, as it may suggest a decrease in the stock of invasive plants for sale in the region.

The Central Valley climate zone has seen an increase regarding the prevalence of invasive plants for sale – from 20% in 2011 to 29% in 2013. While this is a marked difference, this change is not statistically significant, which suggests that this difference may just be due to natural variation in the population of sampled stores and is not the result of an underlying change in the percentage of all Central Valley stores carrying invasive plants.

In past years, the sample size of the Desert climate zone was too low to accurately draw conclusions about the prevalence of locally invasive plants. In 2013, more Desert stores were randomly selected into the sample. Therefore, the 31% prevalence rate of invasive plants found this year may paint a more accurate picture of that climate zone than rates found in previous years (80% in 2012 and 14% in 2011). Interestingly, the prevalence rate of *locally* invasive plants in the Desert climate zone was only 6%, which is much lower than the overall rate of 31%.

## Recommendations

### Focus on Mexican Feather Grass and Periwinkle to Substantially Reduce the Number of Invasives Sold

Of all the species surveyed, Mexican Feather Grass and Periwinkle present the largest problem by a substantial margin – these plants are found at 27% and 19% of the stores, respectively. If Periwinkle is removed from the survey results, the prevalence of stores with an invasive declines from 31% to 19%. It should be noted that Mexican Feather Grass was not included in the overall rate of invasive plants, as it was not part of the list of the original 12 plants that have been tracked over the three years of the survey.

Curtailling the sale of Mexican Feather Grass and Periwinkle 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 both plants are sold at Box Stores – which tend to sell much larger volumes of plants than other store types.

While focusing eradication and education efforts on Mexican Feather Grass and Periwinkle would potentially have the largest impact, it is also the case that Mexican Feather Grass and Periwinkle represent significant sources of revenue for the nursery industry. Therefore, it may be challenging to reduce or eliminate the sale of this plant. In contrast, the relatively rare Highway Ice Plant, Chinese Tallow Tree, and Scotch Broom may be easier to remove from circulation. The data from this survey, in combination with PlantRight's knowledge of the nursery industry and the relative threat posed by each species, will allow PlantRight to craft an informed strategy – allocating efforts to specific invasive species in the most efficient way.

### Focus on Box Stores to Reduce Volume of Plants Sold and to Halt a Harmful Trend

In 2011, Box Stores had invasives for sale at just 9% of the surveyed stores – substantially less than Chain Retailers or Independent Retailers. That number has jumped to 25% ( $p < .05$ ). This is especially concerning because Box Stores are thought to sell higher volumes of plants than do Chain Retailers or Independent Retailers. Reducing the volume of plants sold at Box Stores can potentially provide an effective leverage point for reducing the quantity of invasive plants in California. As a result, PlantRight should focus efforts on Box Stores.

### Focus on the South Coast and Central Valley to Deploy Resources Efficiently

The South Coast climate zone has the largest number of nurseries and the highest rate of invasives for sale. PlantRight may want to focus its education campaign on that region in order to use its resources as efficiently as possible. While both Box Stores and Independent Retailers in the South Coast are excellent targets for education campaigns, it may be more fruitful to focus specifically on the sale of Mexican Feather Grass and Periwinkle in Box Stores due to the fact that these plants represent the species most frequently found for sale.

The percentage of stores selling invasive plants in the Central Valley has also increased over the three years of the survey (from 20% to 29%). PlantRight should continue to monitor this trend and may choose to focus education efforts on Central Valley stores.

### Monitor the Impact of Other Efforts Led by PlantRight

In 2013, PlantRight has embarked on a pilot project with the goal of reducing the number of invasive plants sold. PlantRight is reaching out to landscaping professionals and nursery employees in order to train them to recognize invasive plants and to be able to recommend desirable non-

invasive options to customers. In turn, better-informed customers will use this knowledge to seek out plants that are not invasive. PlantRight staff should continue to track where these efforts are implemented in order to best analyze the results of the annual survey in coming years. Results of future years of the PlantRight survey might contain a variable for stores that are part of PlantRight projects so that the evaluation team can monitor the outcome of PlantRight's work with those stores.

## IV. 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.

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 3000 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 56 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 Costcos surveyed had invasive plants present. For all these reasons, these stores were left out of the 2011, 2012, and 2013 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 282.

### *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.

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 8,597 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 2012.



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"/>
----------------------------------	--	---	--

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 1,667.

**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 volunteers and associated number of stores they would be able to survey. In January 2013, PlantRight staff projected the total number of volunteers to be 282 and that each volunteer would visit one store.

**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 volunteers (282).
- **Population size for each stratum.** This was provided by PlantRight staff, and the values are shown in the Exhibit 25 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 .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 25. Sample Size Per Stratum, Given Population Size**

Stratum (Store Type)	Population Size	Sample Size per Stratum
Box Stores	525	79
Chain Retailers	163	25
Independent Retailers	979	178

*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 26 (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 178 surveys of Independent Retailers should be surveyed, with rounding our allocation came to 177 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 six counties (Butte, San Luis Obispo, Santa Barbara, Shasta, Stanislaus, and Tulare).
- One survey of a Large Retailer was added to three counties (Los Angeles, San Joaquin, and Santa Barbara).
- One survey of an Independent Retailer was added to Riverside County.

These counties were chosen because – before rounding – they were closest to adding 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 26. Target Number of Surveys, by County and Store Type**

County	Box Store	Chain Retailer	Independent Retailer
Alameda	3	1	5
Amador	0	0	0
Butte	2	0	3
Calaveras	0	0	1
Colusa	0	0	0
Contra Costa	2	2	4
Del Norte	0	0	0
El Dorado	0	0	2
Fresno	2	1	5
Glenn	0	0	0
Humboldt	0	0	2
Imperial	1	0	1
Inyo	0	0	0
Kern	2	0	5
Kings	0	0	1
Lake	0	0	1
Lassen	0	0	0
Los Angeles	14	6	24
Madera	0	0	0
Marin	0	1	3
Mariposa	0	0	1
Mendocino	0	0	3
Merced	1	0	3
Modoc	0	0	0
Mono	0	0	1
Monterey	1	0	1
Napa	0	0	2
Nevada	0	0	3
Orange	6	2	7

County	Box Store	Chain Retailer	Independent Retailer
Placer	1	0	3
Plumas	0	0	1
Riverside	6	0	16
Sacramento	4	1	3
San Benito	0	0	1
San Bernardino	6	0	6
San Diego	7	1	17
San Francisco	0	0	2
San Joaquin	2	2	4
San Luis Obispo	2	2	4
San Mateo	1	1	3
Santa Barbara	2	2	4
Santa Clara	3	3	4
Santa Cruz	0	0	4
Shasta	2	0	2
Siskiyou	0	0	0
Solano	1	0	1
Sonoma	1	0	8
Stanislaus	3	0	4
Sutter	0	0	0
Tehama	0	0	1
Trinity	0	0	1
Tulare	3	0	3
Tuolumne	0	0	1
Ventura	1	0	5
Yolo	0	0	1
Yuba	0	0	1
<b>Total</b>	<b>79</b>	<b>25</b>	<b>178</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, 24 was the target sample size for Independent Retailers in Los Angeles. For this stratum, the 24 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:

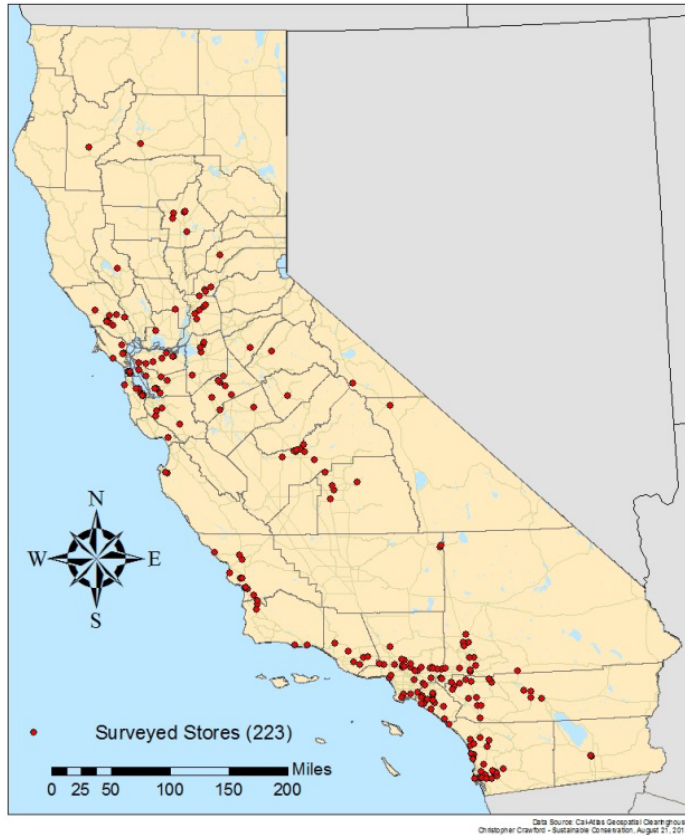
- Upon calling the store prior to administering the survey, PlantRight determined that the store did not sell plants that met its criteria (e.g. outdoor, perennial plants) or did not sell these plants at a retail level.
- The stores identified for the sample were further away from the homes of the volunteers 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 27.

**Exhibit 27. Count of Surveyed Stores, by County**



County	Stores Surveyed
Alameda	8 of 9
Amador	0 of 0
Butte	5 of 5
Calaveras	1 of 1
Contra Costa	6 of 8
El Dorado	0 of 3
Fresno	8 of 8
Humboldt	0 of 2
Imperial	2 of 2
Inyo	2 of 3
Kern	2 of 10 (+3) <sup>†</sup>
Kings	0 of 1
Lake	1 of 1
Los Angeles	28 of 43
Marin	4 of 4
Mariposa	1 of 1
Mendocino	0 of 3
Merced	1 of 3
Mono	1 of 2
Monterey	2 of 4 (+2) <sup>†</sup>
Napa	0 of 2
Nevada	1 of 3
Orange	15 of 15
Placer	3 of 4
Plumas	0 of 1
Riverside	19 of 20
Sacramento	6 of 8
San Benito	0 of 1
San Bernardino	14 of 14 (+2) <sup>†</sup>
San Diego	23 of 25
San Francisco	3 of 3 (+1) <sup>†</sup>
San Joaquin	5 of 9
San Luis Obispo	12 of 16
San Mateo	8 of 9
Santa Barbara	6 of 11 (+3) <sup>†</sup>
Santa Clara	4 of 10
Santa Cruz	1 of 4
Shasta	1 of 4
Siskiyou	0 of 3
Solano	1 of 2
Sonoma	8 of 10
Stanislaus	7 of 7
Sutter	0 of 0
Tehama	0 of 1
Trinity	1 of 1
Tulare	5 of 6
Tuolumne	1 of 1

## Recruiting and Training Highly-Skilled Surveyors

### Participant Recruitment

Recognizing the importance of obtaining statistically significant survey data in 2013, PlantRight actively recruited participants for the survey in winter 2012-2013. 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 presentations to Master Gardener groups in several strategic climate zones of the state, which helped to boost survey participation levels in those counties.

## Survey Procedure

All participants in PlantRight's 2013 Spring Nursery Survey viewed a prerequisite webinar containing educational information about invasive plants and a training module for how to complete the survey.

County	Stores Surveyed
Ventura	6 of 6
Yolo	1 of 1
Yuba	0 of 1
<b>TOTAL</b>	<b>223 of 311 (+11)</b>

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 18 invasive plants included in PlantRight's 2013 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, 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 28.

**Exhibit 28. Weights Used for Analyzing Store Types**

Store Type	Weight Assigned
Box Stores	.99
Chain Retailers	.95
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 223.

## V. Appendix B: Results by Plant Species

---

Volunteers searched for 18 different invasive species; they found 12 of the 18 in at least one store. Those 12 are: Brazilian Peppertree, Chinese Tallow Tree, Green Fountain Grass, Highway Ice Plant, Mexican Feather Grass, Pampas Grass, Periwinkle, Scotch Broom, Spanish Broom, Victorian Box, Water Hyacinth, and Yellow Water Iris. For 10 of these 12 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 29 through 38. (The other two species – Mexican Feather Grass and Periwinkle – are included in the main body of the report. Please see pages 19-23 for more information on those two species.)

Information on where each species of plant is locally invasive is also included below (and is summarized in Appendix C).<sup>8</sup> This information is available for the plants that have been on the survey list for the past three years; however, it is not available for the six plants that were added to the list in 2013. This information is not available for the six 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.

---

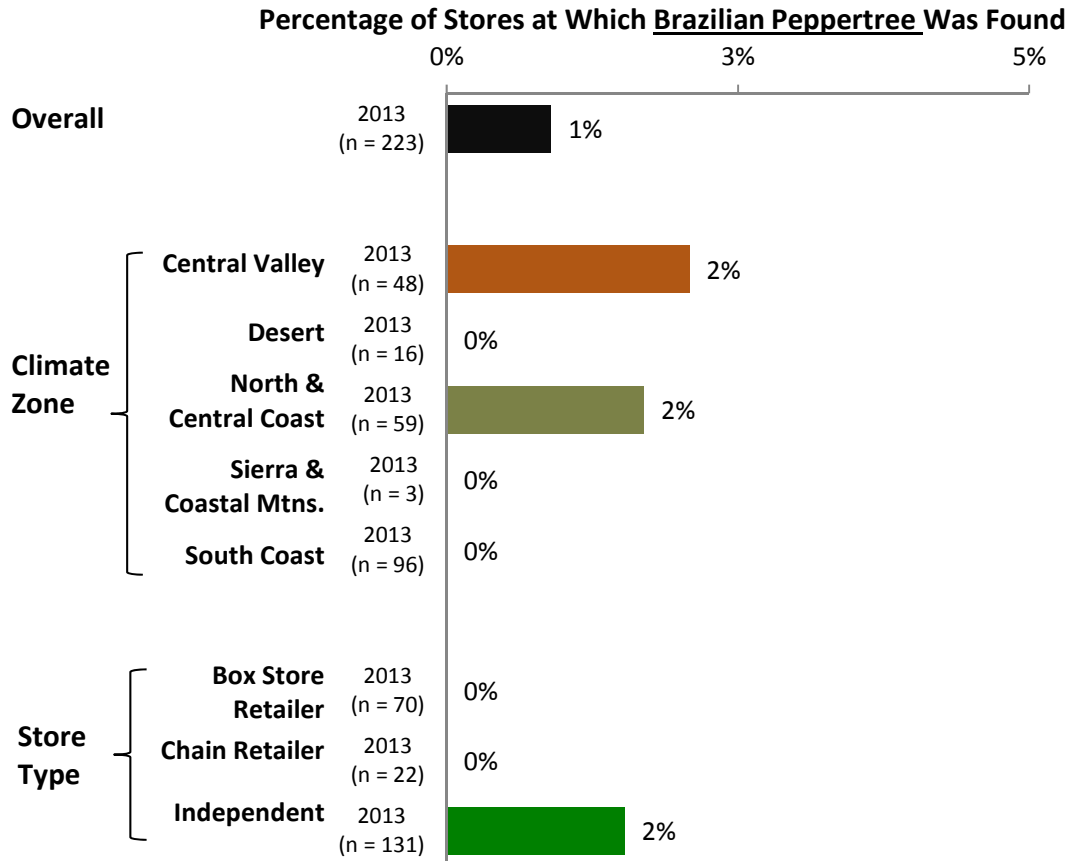
<sup>8</sup> Because plant buyers may buy plants in one region that they plan to plant in another, information on where plants are locally invasive is not a perfect proxy for tracking which plants will become invasive.



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

Brazilian Peppertree was found just twice: once in the Central Valley climate zone and once in the North & Central Coast climate zone. It was found at an Independent Retailer both times.

**Exhibit 29. 2013 Results: Brazilian Peppertree by Climate Zone and Store Type**

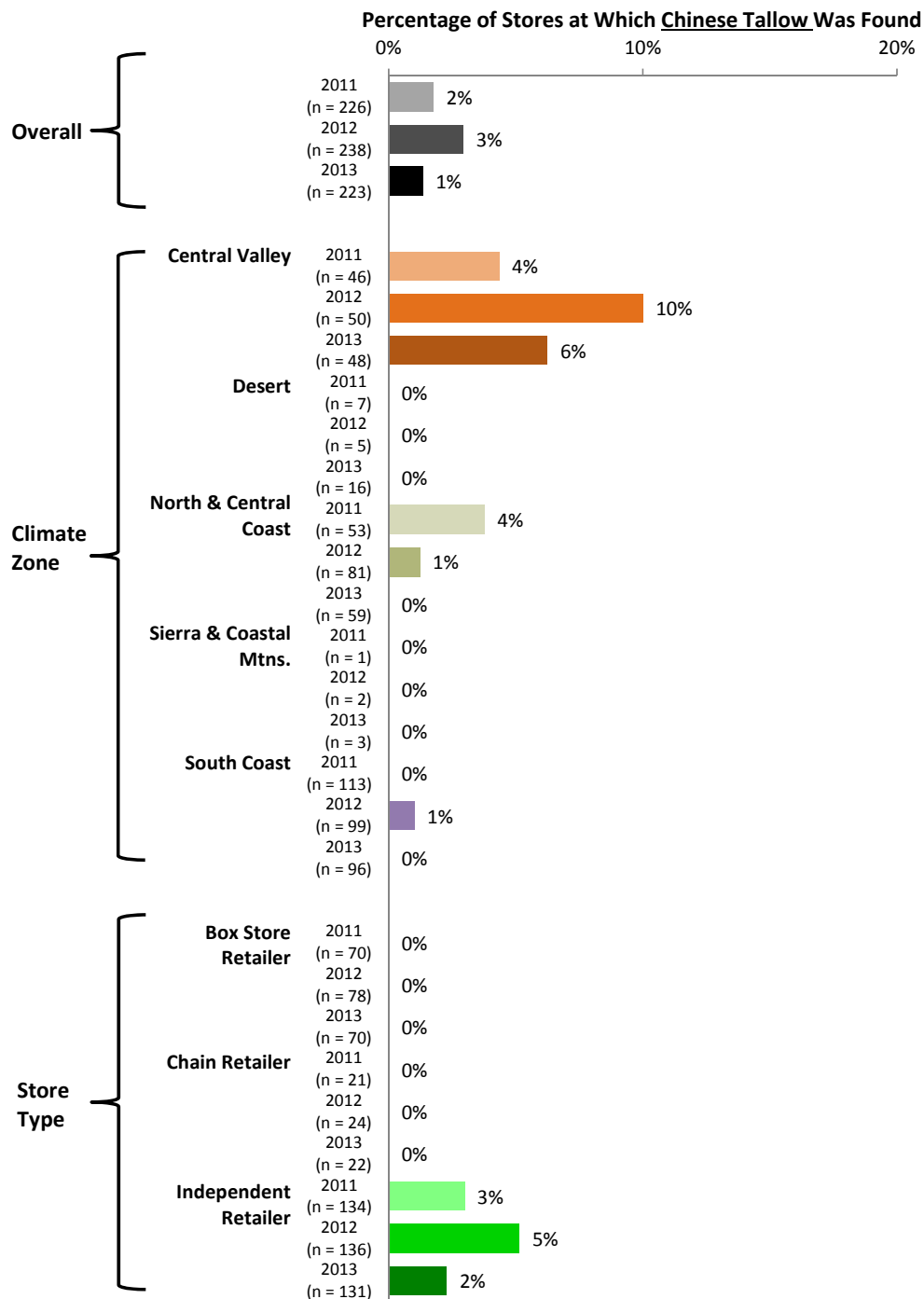


## Chinese Tallow Tree – By Climate Zone and by Store Type

Chinese Tallow Tree was found most consistently at Independent Retailers, and in the Central Valley. There was a relationship between Chinese Tallow Tree and climate zone: the higher percentage of stores in the Central Valley carrying Chinese Tallow Tree was statistically significant ( $p < .05$ ). The Central Valley is the only region in CA where Chinese Tallow Tree is invasive.

Chinese Tallow Tree is locally invasive only in the Central Valley climate zone.

**Exhibit 30. 2011-2013 Results: Chinese Tallow Tree by Climate Zone and Store Type**

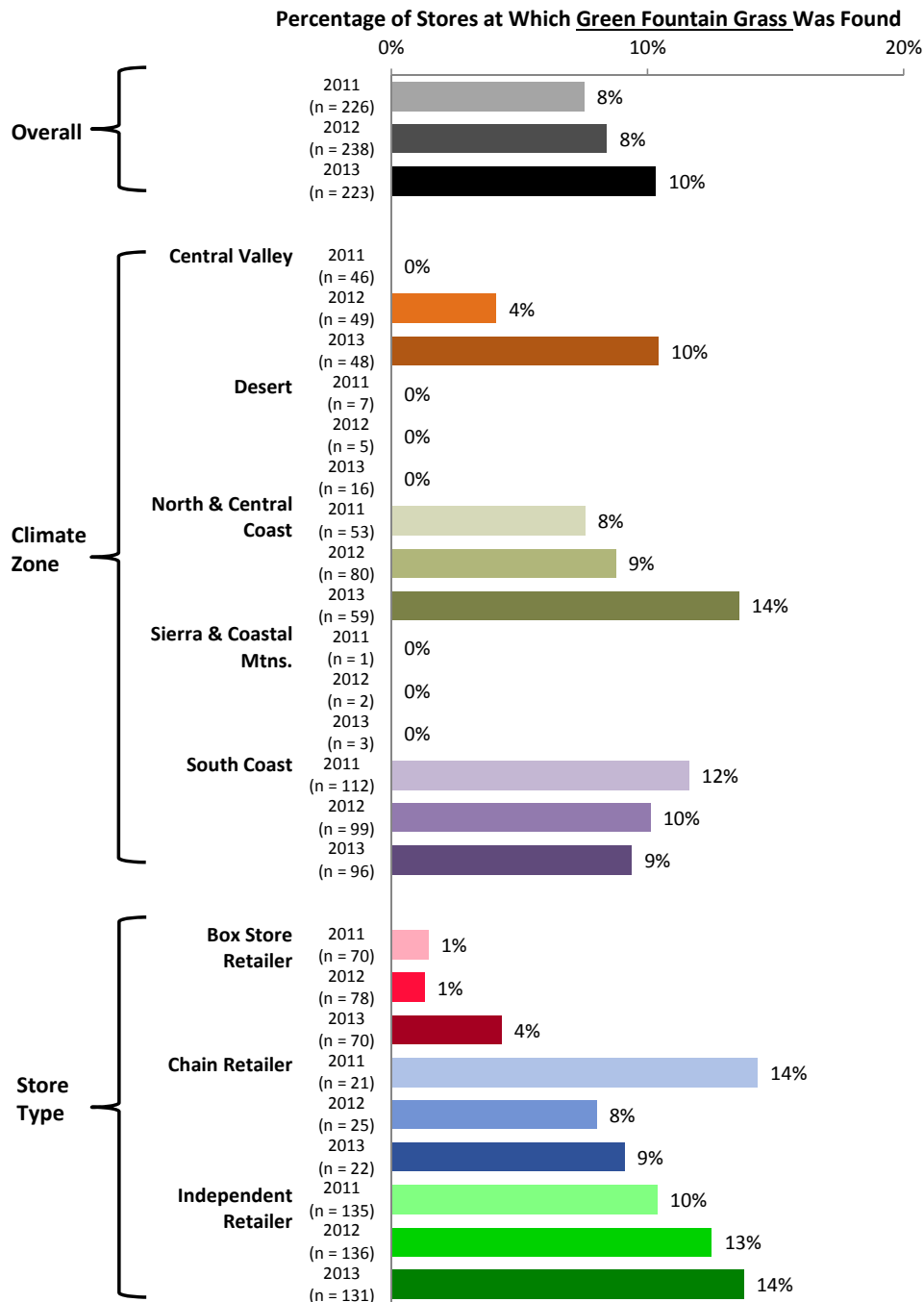


## Green Fountain Grass – By Climate Zone and by Store Type

Green Fountain Grass was the third most frequently found invasive species for sale (after Mexican Feather Grass and Periwinkle). It was most consistently found at Independent Retailers (14%) and in the North & Central Coast climate zone (14%). Purple and red varieties of this species were not counted as invasive.

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

**Exhibit 31. 2011-2013 Results: Green Fountain Grass by Climate Zone and Store Type**

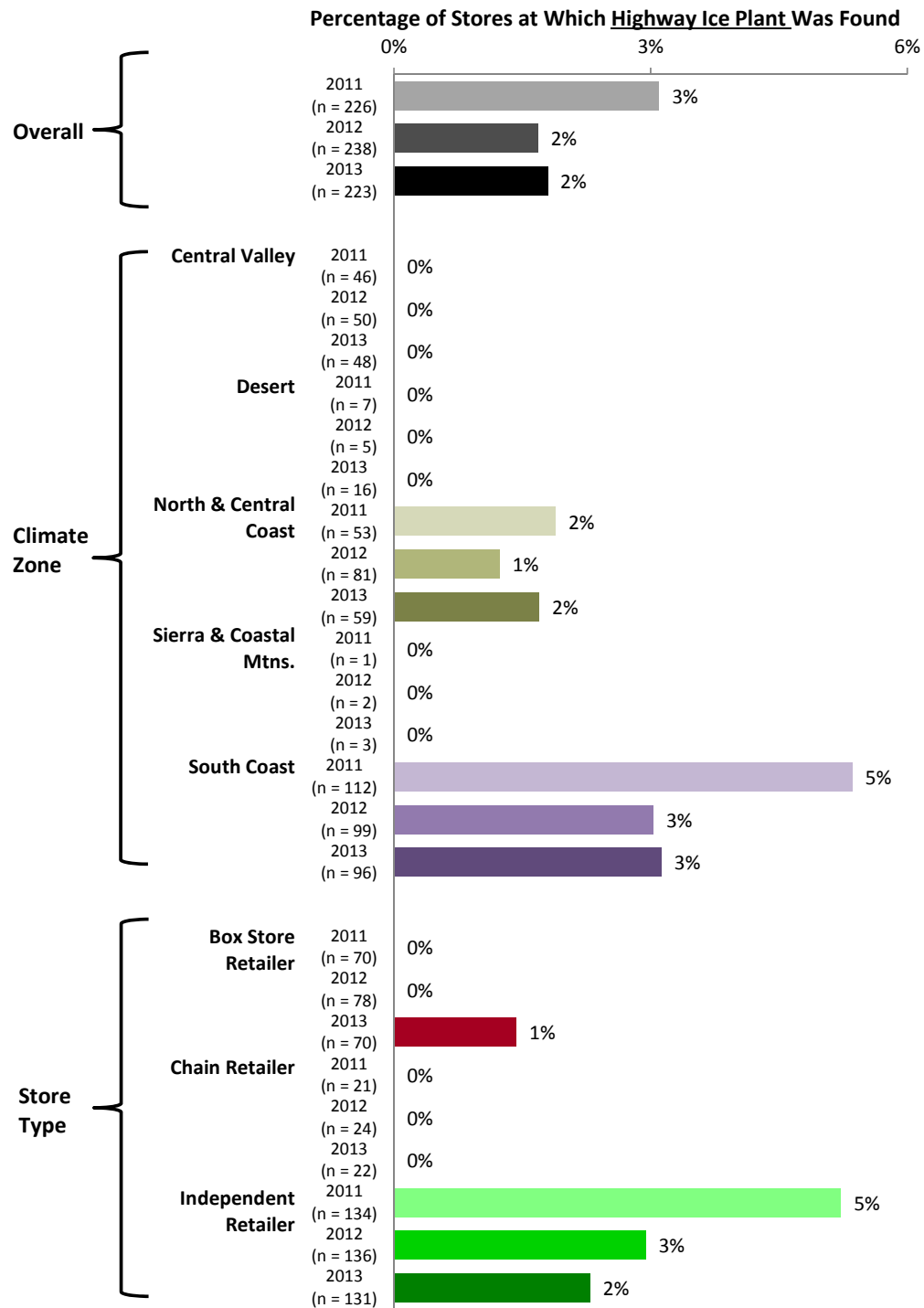


## Highway Ice Plant – By Climate Zone and by Store Type

Highway Ice Plant was found to be most prevalent in nurseries in the South Coast (in 3% of stores) and at Independent Retailers (in 2% of stores).

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

**Exhibit 32. 2011-2013 Results: Highway Ice Plant by Climate Zone and Store Type**

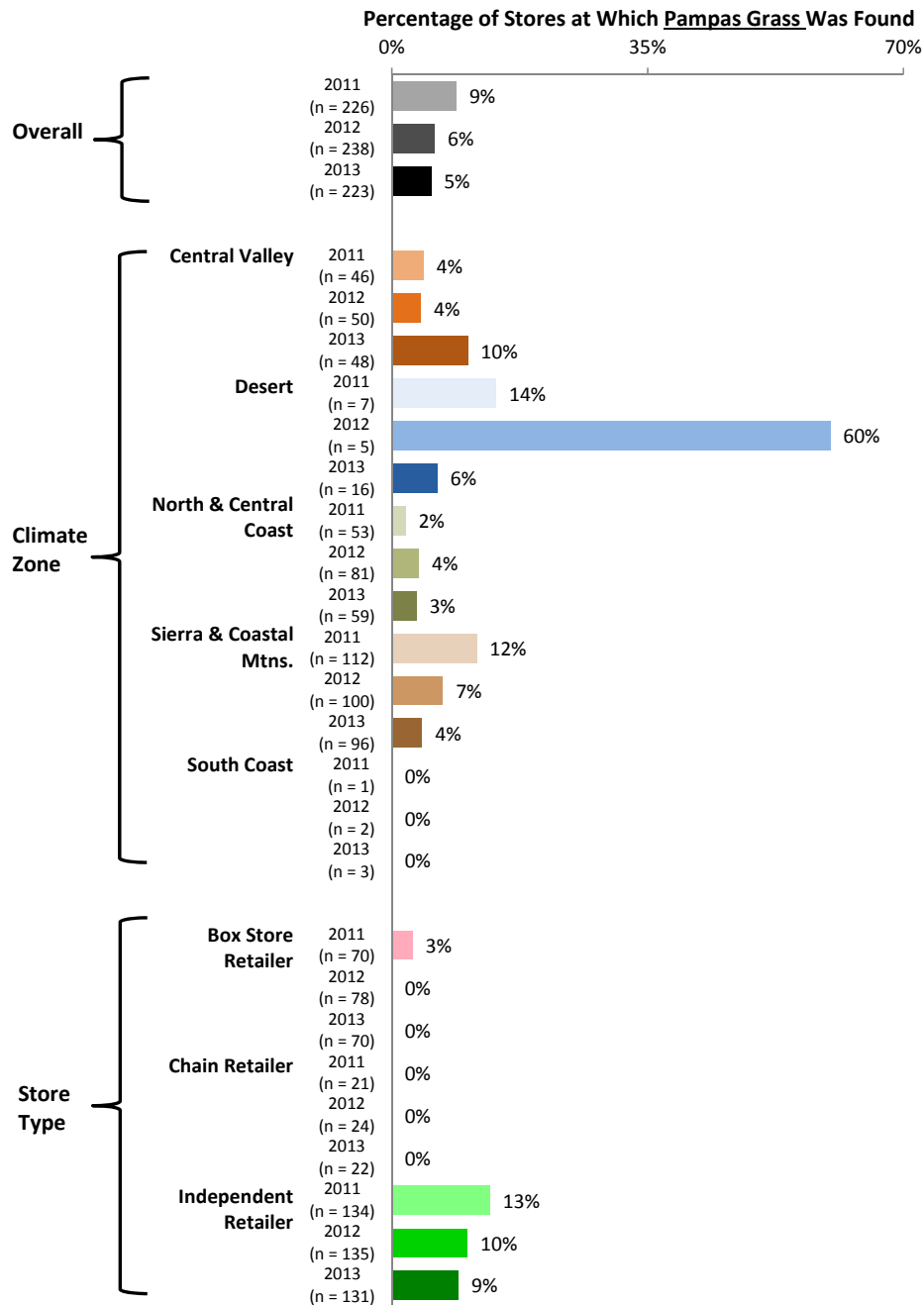


## Pampas Grass – By Climate Zone and by Store Type

Pampas Grass was found in 6% of the stores surveyed in the Desert climate zone, and in 9% of Independent Retailers surveyed. There was a relationship between Pampas Grass and store type: the higher percentage of Independent Retailers and the lower percentage of Box Stores carrying Pampas Grass was statistically significant ( $p < .05$ ).

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

**Exhibit 33. 2011-2013 Results: Pampas Grass by Climate Zone and Store Type**

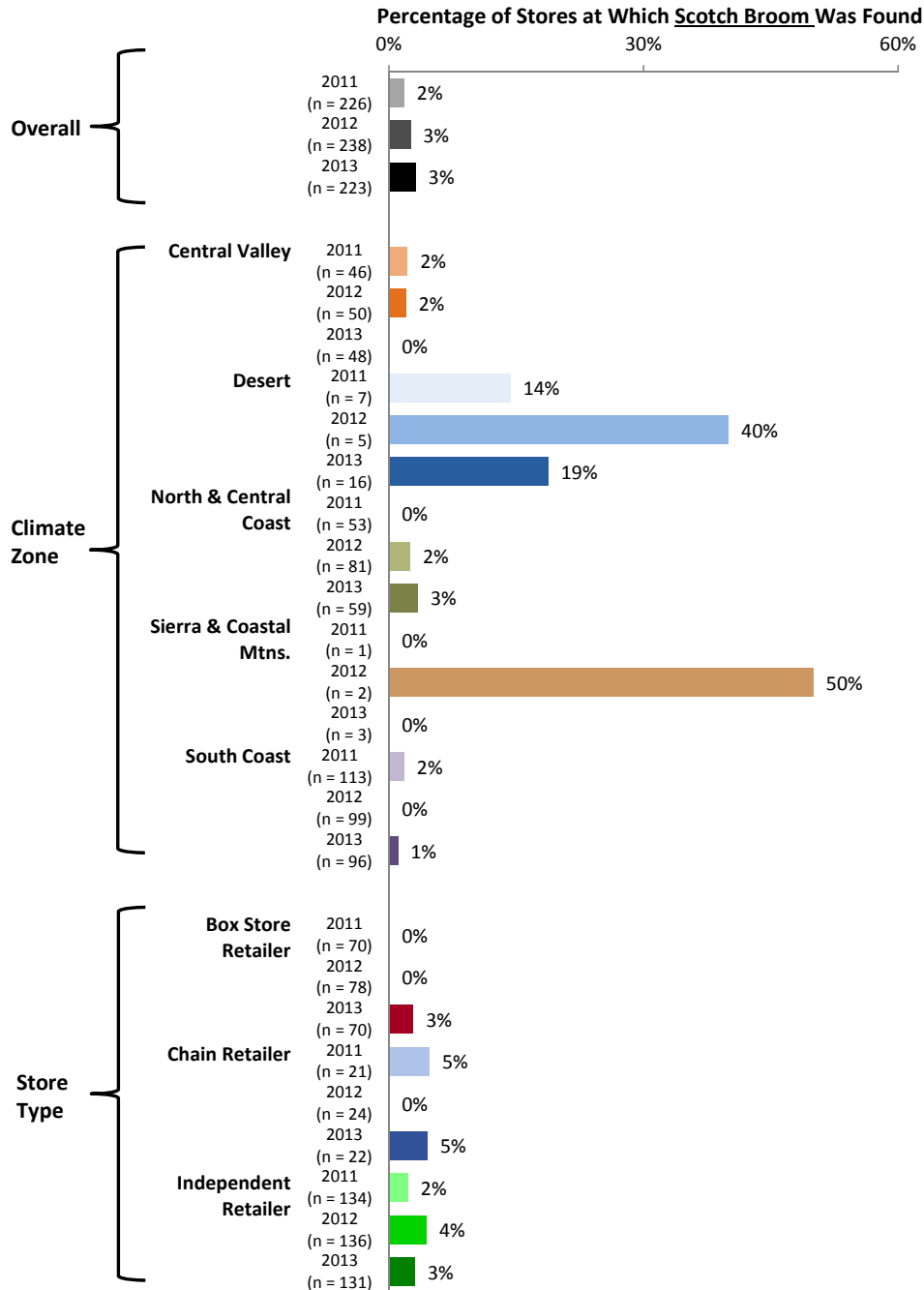


## Scotch Broom – By Climate Zone and by Store Type

Scotch Broom was found most frequently in the Desert climate zone (in 19% of stores) and at Chain Retailers (in 5% of stores). There was a relationship between Scotch Broom and climate zone: the higher percentage of stores in the Desert climate zone carrying Scotch Broom was statistically significant ( $p < .05$ ).

Scotch Broom is locally invasive in the Central Valley, North & Central Coast, Sierra & Coastal Mountains, and South Coast climate zones.

**Exhibit 34. 2011-2013 Results: Scotch Broom by Climate Zone and Store Type**

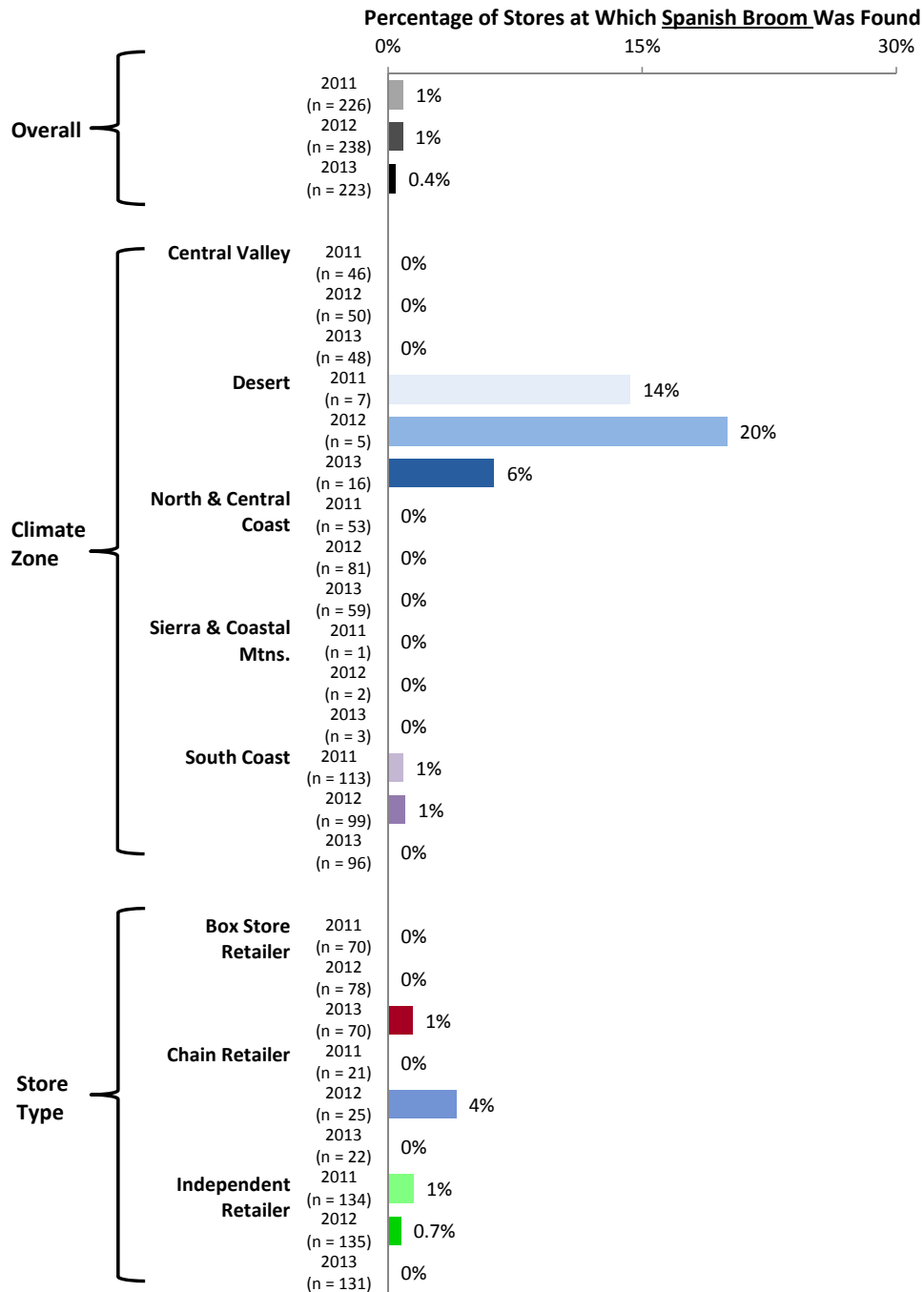


## Spanish Broom – By Climate Zone and by Store Type

Spanish Broom was found once, at a Box Store in the Desert climate zone.

Spanish Broom is locally invasive in the Central Valley, North & Central Coast, Sierra & Coastal Mountains, and South Coast climate zones.

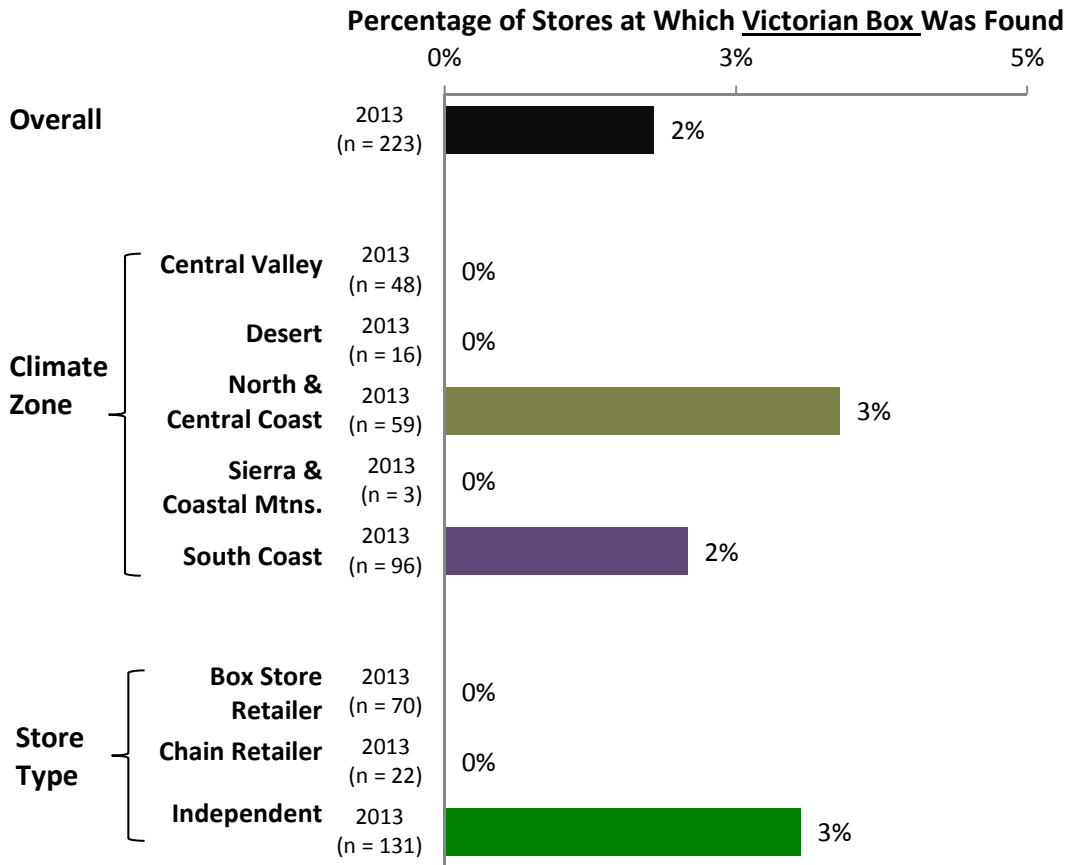
**Exhibit 35. 2011-2013 Results: Spanish Broom by Climate Zone and Store Type**



## Victorian Box – By Climate Zone and by Store Type

Victorian Box was found most frequently in the North & Central Coast and South Coast climate zones (in 3% and 2% of stores, respectively) and at Independent Retailers (in 3% of stores).

**Exhibit 36. 2013 Results: Victorian Box by Climate Zone and Store Type**

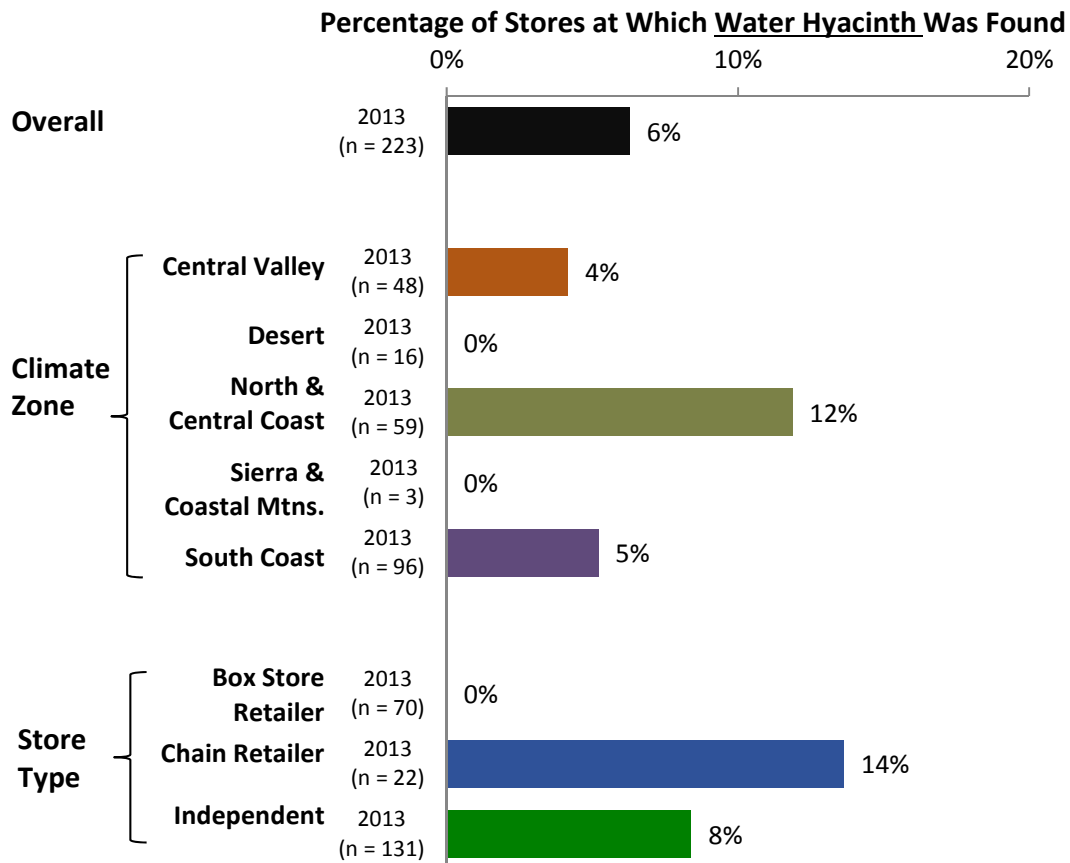




## Water Hyacinth – By Climate Zone and by Store Type

Water Hyacinth was found most frequently in the North & Central Coast climate zone (in 12% of stores) and at Chain Retailers (in 14% of stores). There was a relationship between Water Hyacinth and store type: the lower percentage of Box Stores carrying Water Hyacinth was statistically significant ( $p < .05$ ).

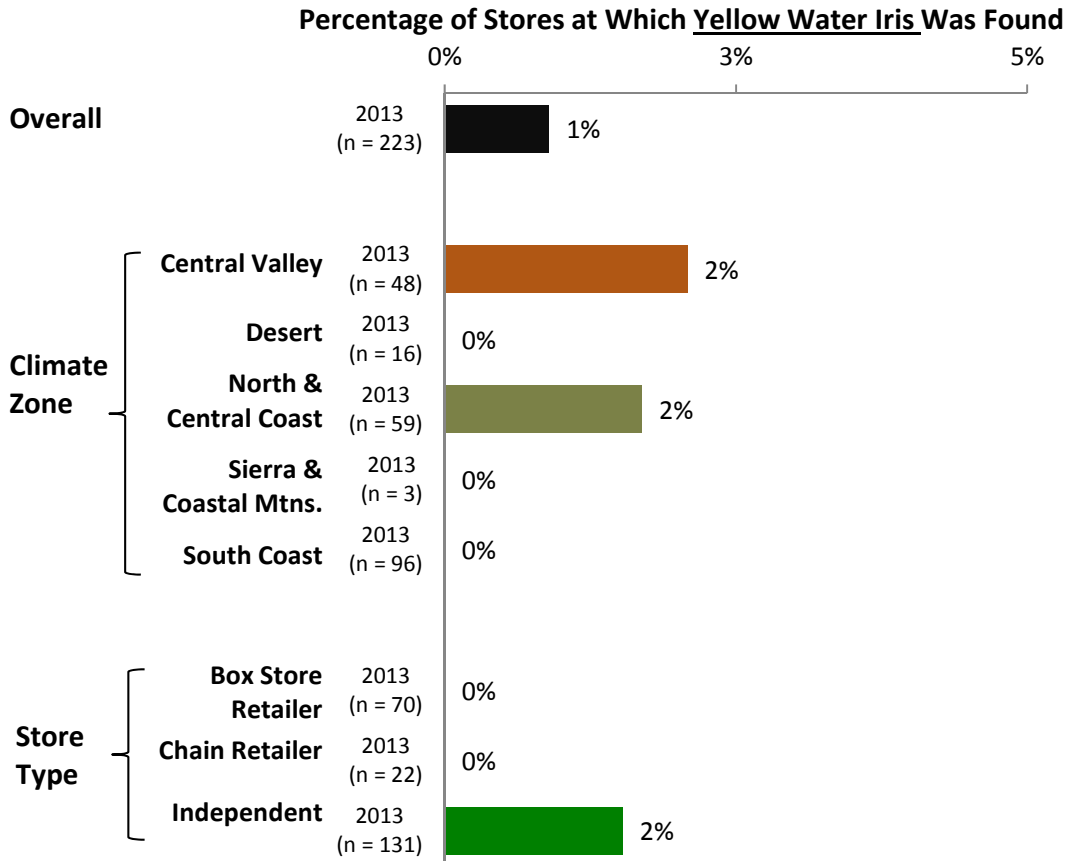
**Exhibit 37. 2013 Results: Water Hyacinth by Climate Zone and Store Type**



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

Yellow Water Iris was found just twice: once in the Central Valley climate zone and once in the North & Central Coast climate zone. It was available at Independent Retailers both times.

**Exhibit 38. 2013 Results: Yellow Water Iris by Climate Zone and Store Type**



## VI. 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 39 summarizes which species are invasive in which climate zones.

**Exhibit 39. Climate Zones in Which Plant Species are Invasive**  
(check mark indicates plant is considered invasive in that climate zone)

	South Coast	Desert	Central Valley	Sierra & Coastal Mountains	North & Central Coast
Capeweed					✓
Chinese Tallow Tree			✓		
Crystalline Ice Plant	✓				✓
French Broom	✓		✓	✓	✓
Green Fountain Grass	✓	✓		✓	✓
Highway Ice Plant	✓				✓
Myoporum	✓				✓
Pampas Grass	✓	✓			✓
Periwinkle	✓		✓	✓	✓
Russian Olive		✓	✓		✓
Scotch Broom	✓		✓	✓	✓
Spanish Broom	✓		✓	✓	✓

## VII. Appendix D: Common and Scientific Plant Names

The tables below provide the common and scientific names of the plants included in the Spring Nursery Survey over the last three years. Exhibit 40 lists the 19 plants included in the 2011 and 2012 surveys, and Exhibit 41 lists the 18 plants included in the 2013 survey.

**Exhibit 40. Plants included in 2011 & 2012 Surveys**

Common Name	Scientific Name
Arundo, Giant Reed	<i>Arundo donax</i>
Big Leaf Periwinkle	<i>Vinca major</i>
Blue Gum Eucalyptus	<i>Eucalyptus globulus</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>
French Broom	<i>Genista monspessulana</i>
Green Fountain Grass	<i>Pennisetum setaceum</i>
Highway Iceplant	<i>Carpobrotus edulis</i>
Jubata Grass	<i>Cortaderia jubata</i>
Myoporum	<i>Myoporum laetum</i>
Pampas Grass	<i>Cortaderia selloana</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>
Spanish Broom	<i>Spartium junceum</i>

**Exhibit 41. Plants included in 2013 Survey**

Common Name	Scientific Name
Big Leaf Periwinkle	<i>Vinca major</i>
Brazilian Peppertree	<i>Schinus terebinthifolius</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>
Green Fountain Grass	<i>Pennisetum setaceum</i>

**Exhibit 41. Plants included in 2013 Survey**

<b>Common Name</b>	<b>Scientific Name</b>
Highway Iceplant	<i>Carpobrotus edulis</i>
Mexican Feather Grass	<i>Nassella tenuissima (Stipa tenuissima)</i>
Myoporum	<i>Myoporum laetum</i>
Pampas Grass	<i>Cortaderia selloana</i>
Russian Olive	<i>Elaeagnus angustifolia</i>
Scotch Broom	<i>Cytisus scoparius</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>

## VIII. Appendix E: Summary of Statistically Significant Results

This appendix is meant to serve as an at-a-glance summary of all the instances where LFA found a statistically significant finding. This appendix does not include information on the size of the difference. Please see the body of the report for that information.

For each of the four questions below, LFA conducted analyses within the 2013 data and across the three years of data (2011, 2012, and 2013). The results are summarized below, with statistically significant findings in **bold**. All findings are significant at the  $p < .05$  level.

- 1) What percentage of stores carries one or more species of invasive plants?
  - 2013 data: No significant differences between climate zones or store types.
  - Cross-year analysis: **The percentage of box stores selling invasive plants in 2013 is significantly higher than it was in 2011.**
- 2) 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?
  - 2013 data: No significant differences between climate zones or store types.
  - Cross-year analysis: No significant differences over the three years of data.
- 3) What's the average number of invasive plants carried by all stores?
  - 2013 data: No significant differences between climate zones or store types.
  - Cross-year analysis: **The average number of species sold in box stores in 2013 is significantly higher than it was in 2011.**
- 4) For each invasive species separately, what percentage of stores carries that species?
  - a) Capeweed
    - 2013 data: No significant differences between climate zones or store types.
    - Cross-year analysis: No significant differences over the three years of data.
  - b) Chinese Tallow:
    - 2013 data: **Compared to other climate zones, a significantly higher percentage of stores in the Central Valley were carrying Chinese Tallow Tree**
    - Cross-year analysis: No significant differences over the three years of data.
  - c) Crystalline Ice Plant:
    - 2013 data: No significant differences between climate zones or store types.
    - Cross-year analysis: No significant differences over the three years of data.
  - d) French Broom:
    - 2013 data: No significant differences between climate zones or store types.
    - Cross-year analysis: No significant differences over the three years of data.
  - e) Green Fountain Grass:
    - 2013 data: No significant differences between climate zones or store types.
    - Cross-year analysis: No significant differences over the three years of data.
  - f) Highway Ice Plant:
    - 2013 data: No significant differences between climate zones or store types.
    - Cross-year analysis: No significant differences over the three years of data.
  - g) Pampas Grass:
    - 2013 data: **Compared to other store types, a significantly higher percentage of Independent Retailers and a significantly lower percentage of Box Stores were carrying Pampas Grass.**

- Cross-year analysis: No significant differences over the three years of data.
- h) Periwinkle:
- 2013 data: No significant differences between climate zones or store types.
  - Cross-year analysis: **Compared to the 2011 Box Stores, a significantly higher proportion of the 2012 Box Stores were selling Periwinkle.**
- i) Russian Olive:
- 2013 data: No significant differences between climate zones or store types.
  - Cross-year analysis: No significant differences over the three years of data.
- j) Scotch Broom:
- 2013 data: **Compared to other climate zones, a significantly higher percentage of stores in the Desert were carrying Scotch Broom.**
  - Cross-year analysis: No significant differences over the three years of data.
- k) Spanish Broom:
- 2013 data: **Compared to other climate zones, a significantly higher percentage of stores in the Desert were carrying Spanish Broom.<sup>9</sup>**
  - Cross-year analysis: No significant differences over the three years of data.
- l) Brazilian Peppertree:
- 2013 data: No significant differences between climate zones or store types.
- m) Mexican Feather Grass:
- 2013 data:
    - **Compared to other climate zones, a significantly higher percentage of stores in the North & Central Coast climate zone were carrying Mexican Feather Grass.**
    - **Mexican Feather Grass is also significantly more likely to be found at Independent Retailers than Box Stores.**
- n) Victorian Box:
- 2013 data: No significant differences between climate zones or store types.
- o) Water Hyacinth:
- 2013 data: **Compared to other store types, a significantly lower percentage of Box Stores were carrying Water Hyacinth.**
- p) Yellow Water Iris:
- 2013 data: No significant differences between climate zones or store types.

---

<sup>9</sup> This finding was not included in the body of the report because Spanish Broom was found just once (at a store in the Desert climate zone). The LFA team agreed this statistically significant finding was therefore not a truly meaningful finding, and did not include it in the body of the report.