



Battle of the Bads!

A Report on the Most Harmful
Nonindigenous Aquatic Species
Within the Contiguous States
West of the 100th Meridian

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With help from Justin Procopio and Wesley Daniel of the USGS

Methodology

Determining the most harmful Non-indigenous Aquatic Species and each species' "Harm Score"

To determine the Most Harmful Nonindigenous Aquatic Species (NAS) within states West of the 100th Meridian with significant Bureau of Land Management (BLM) acreage, Wildlife Forever asked 12 professional biologists to rank their Top 20 most harmful NAS out of a list of 104 NAS provided by the U.S. Geological Survey.

The western "BLM States" analyzed are 11 contiguous states that have large-scale BLM land holdings: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. The State of Alaska was also analyzed.

Each identified species was assigned points based upon the biologists' ranking responses. If a biologist ranked a species as the most harmful, that species was awarded 20 points, if ranked second most harmful, it was awarded 19 points, and so on.

After tallying the points from all the ranking surveys, a list of the 25 most harmful NAS was created for what Wildlife Forever calls the "Battle of the Bads." To determine the final ranking order, we asked the biologists to re-rank the NAS list, but this time choosing from the 25 species selected by the first round of surveys.

The final "Battle of the Bads" NAS list of the Top 25 most harmful species, was then assigned a "Harm Score" (HS) per species based on their rank within the Top 25. The most harmful NAS has an HS of 25, the second most harmful an HS of 24, and so on. On the next page is the final Battle of the Bads list as a result of the second round of NAS ranking responses.



Rusty Crayfish

25 Most Harmful NAS

Rank	Species	Harm Score
1	Quagga / Zebra Mussels	25
2	Eurasian Milfoil	24
3	Rusty Crayfish	23
4	New Zealand Mudsnail	22
5	Silver Carp	21
6	Northern Pike	20
7	Hydrilla	19
8	Bighead Carp	18
9	Curly-leaf Pondweed	17
10	Asian Clam	16
11	Nutria	15
12	Flowering Rush	14
13	Purple Loosestrife	13
14	Brazilian Elodea	12
15	Whirling Disease	11
16	Common Carp	10
17	Parrot Feather	9
18	Northern Snakehead	8
19	Waterhyacinth	7
20	Black Carp	6
21	Armored Sailfin Catfish	5
22	Western Mosquitofish	4
23	Ludwigia	3
24	Ringed Crayfish	2
25	Red Swamp Crayfish	1

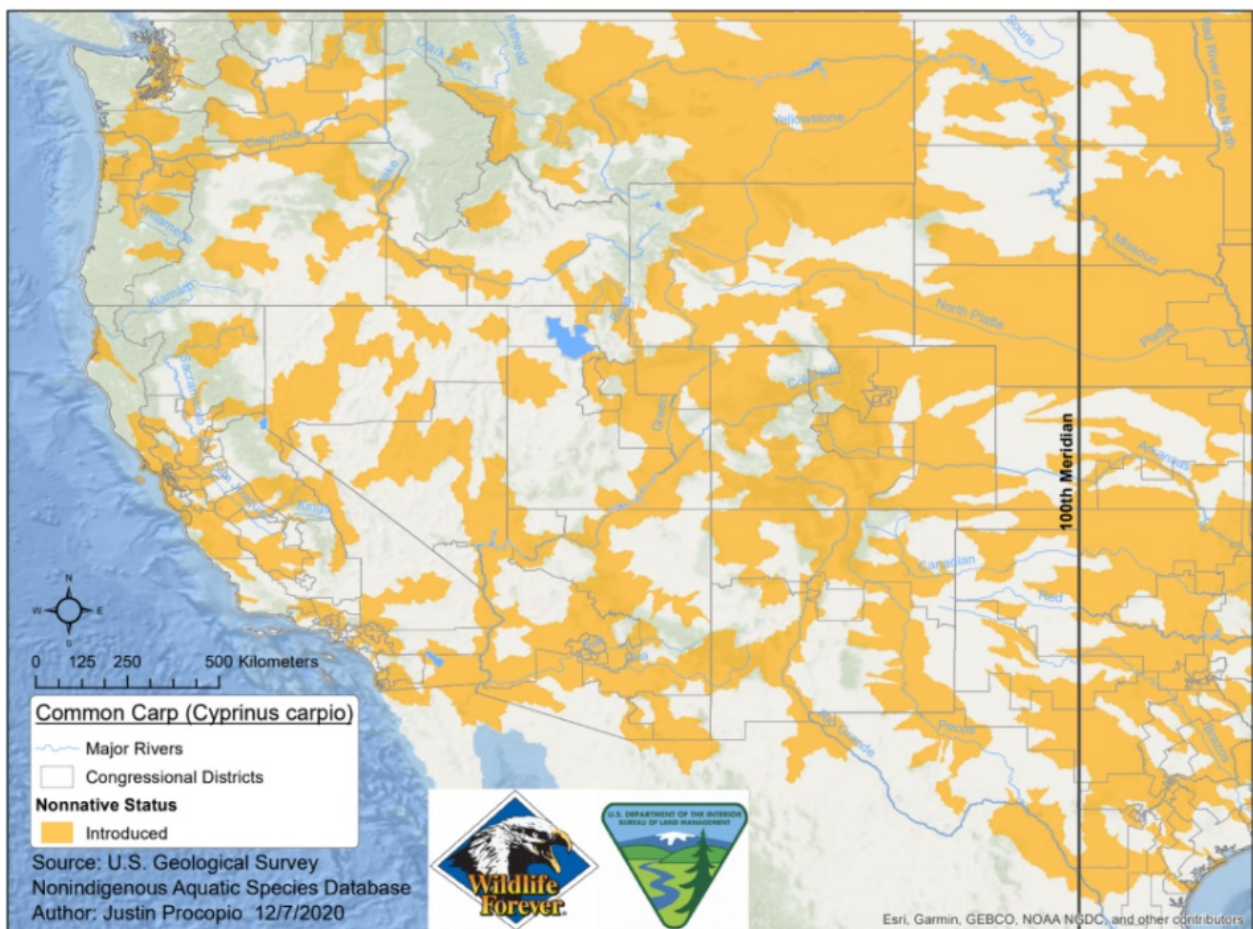
Determining the Prevalence of each species

From maps obtained through the U.S. Geological Survey, Wildlife Forever was able to determine the locations of each NAS. The maps were generated from the Nonindigenous Aquatic Species Database and authored by Justin Procopio under the supervision of Wesley Daniel of the USGS.

The maps contain the geographical area of each NAS overlaid onto a map of the U.S. Congressional Districts within states West of the 100th Meridian.

Urban congressional districts, like Nevada's District 1, home to Las Vegas, were not included in this analysis. In total, 56 predominantly rural congressional districts were analyzed.

For each district and each species, it was loosely estimated whether the species was prevalent to a 'major' or 'minor' extent within a given Congressional District. A species' full Harm Score was assigned in cases of 'major' prevalence and half a species' Harm Score in cases of 'minor' prevalent.



An example of the maps used.

Yellow represents areas where the Common Carp has been introduced

Determining each Congressional District's "Infestation Score"

A district's "Infestation Score" is the sum of all the species prevalent in the district, weighted by each species' "Harm Score."

Again, during each district's calculation, if a species was judged to be a major infestation, its full HS was assigned. If it was estimated to be a minor infestation, only half of its HS was assigned, rounded up to the nearest whole number.

For example, Nevada's District 3 has an Infestation Score of 74.

The NAS present in the district are:

- Quagga/Zebra Mussels (HS = 25)
- Eurasian Milfoil* (HS = $24/2 = 12$)
- Asian Clam* (HS = $16/2 = 8$)
- Bullfrog (HS = 11)
- Common Carp (HS = 10)
- Armored Sailfin Catfish* (HS = $5/2 = 3$)
- Western Mosquitofish (HS = 4)
- Red Swamp Crayfish (HS = 1)

* indicates a minor infestation

Nevada District 3's Infestation Score = $25 + 12 + 8 + 11 + 10 + 3 + 4 + 1 = 74$

A high Infestation Score means NAS are a major problem in that district. A low Infestation Score shows a relatively minor infestation status in the district.

The report authors recognize that the above scoring formula is inexact, however, it is hoped that the report provides a jumping off point for dialogue on NAS prevalence on BLM lands in the West.

Graphing each state's Congressional Districts by Infestation Score

To illustrate which districts in each state have the worst NAS problems, a bar graph was made for each state. The graphs visualize the Infestation Score of each state's Congressional Districts. See page 7.

Ranking all of the analyzed Congressional Districts

To determine which Congressional Districts are facing the worst NAS problems, we ranked them by Infestation Score. See page 11.

Ranking the NAS by Total Infestation Score

To determine which NAS are most prevalent and problematic, we calculated each species' Total Infestation Score.

The Total Infestation Score is the sum of each species' Harm Score multiplied by its prevalence.

For example, the Rusty Crayfish, which has an HS of 23, is prevalent in 5 districts, and somewhat prevalent in one district. Its Total Infestation Score = $23 \times 5 + 12 \times 1 = 127$

Alternatively, the New Zealand Mudsail, which has an HS of 22, is prevalent in 35 districts and somewhat prevalent in one district. Its Total Infestation Score = $22 \times 35 + 11 \times 1 = 781$

Even though the biologists consider the Rusty Crayfish more harmful than the NZ Mudsail, it is much less prevalent than the NZ Mudsail, giving it a lower Total Infestation Score.

While the Total Infestation Score is not rigorously scientific, it does indicate which NAS natural resource agencies may want to focus on.

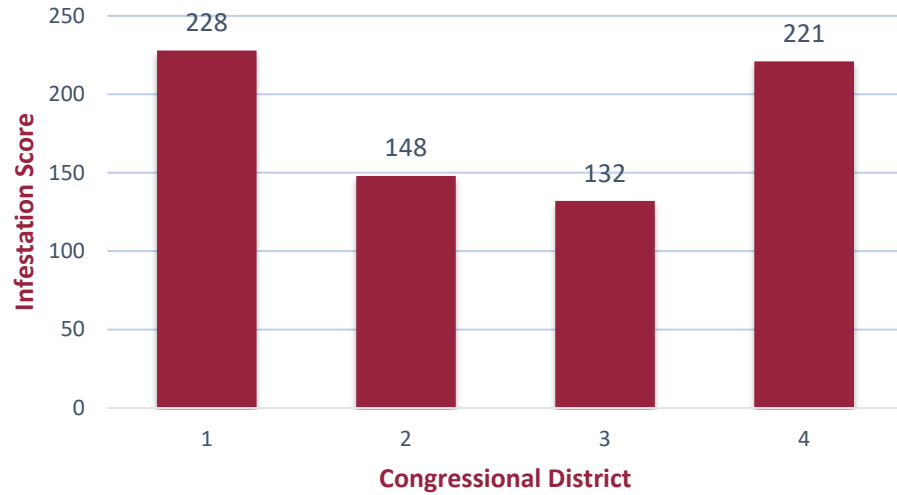
One drawback of the Total Infestation Score, is that the districts vary greatly with size. For example, both Montana and Wyoming only have one congressional district, despite their very large geographic area. Whereas California has many more districts, some of which are quite small. Thus, our Battle of the Bads rankings skew a bit towards species that are problems to a greater or lesser extent in states with more districts.



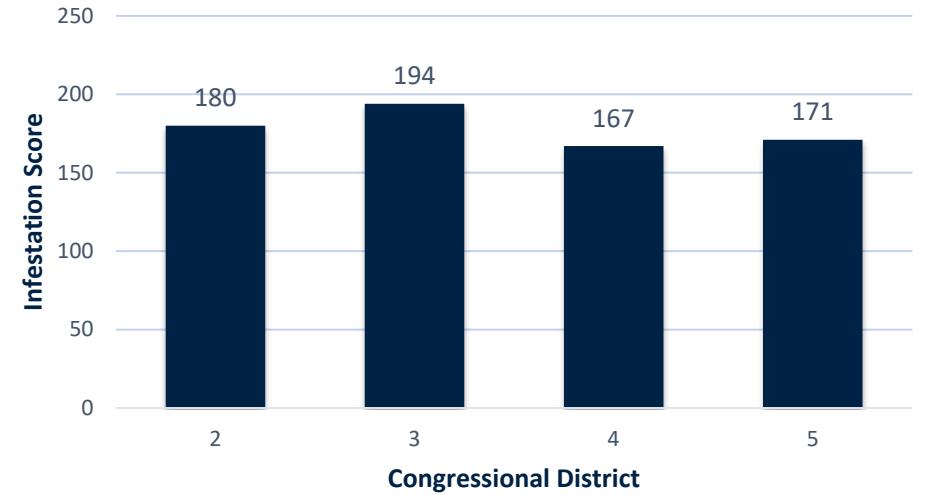
Asian Clam

Infestation Scores for each state's districts

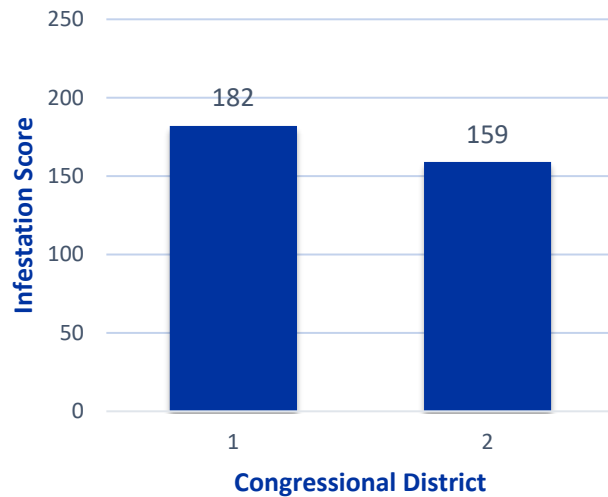
Arizona's Infestation Scores



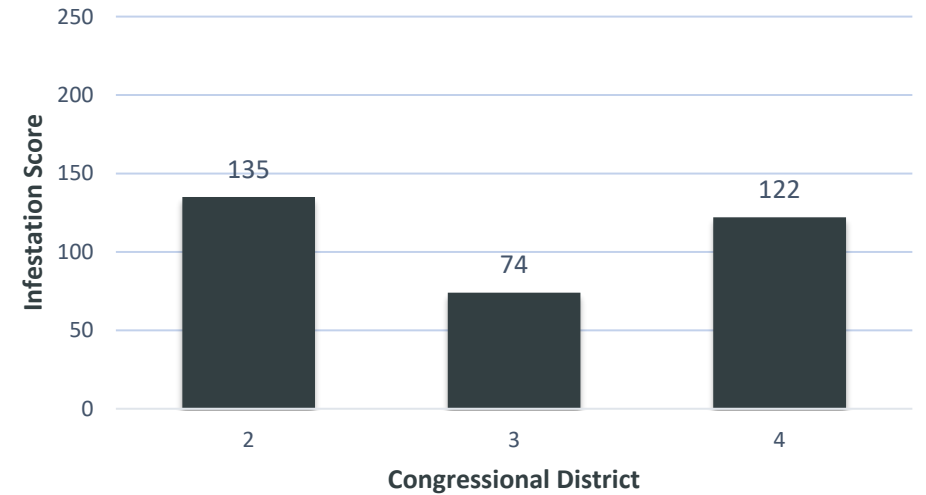
Colorado's Infestation Scores



Idaho's Infestation Scores



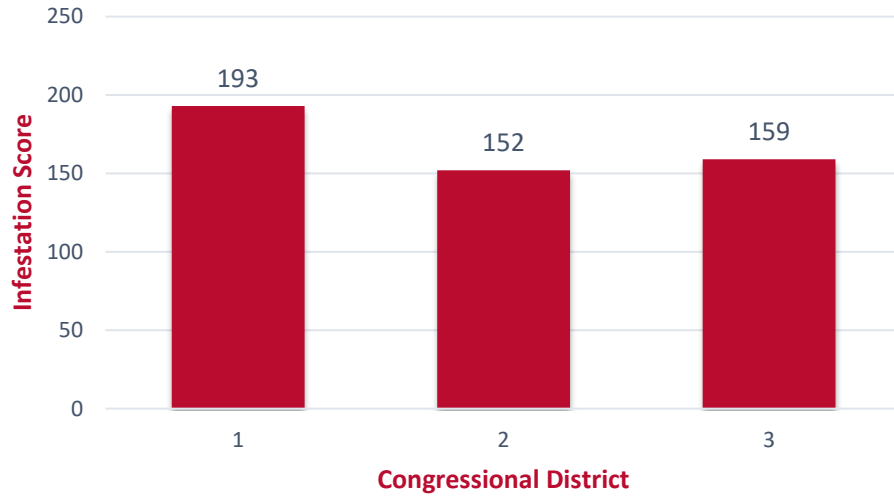
Nevada's Infestation Scores



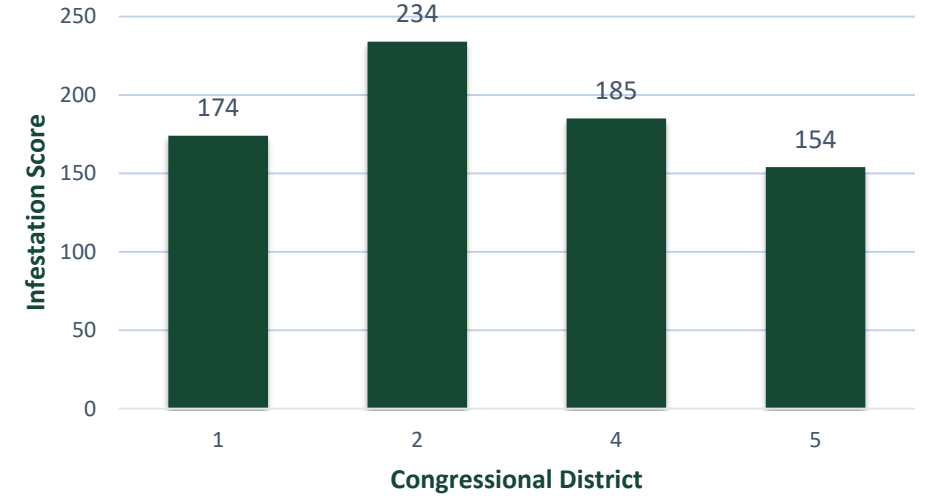
Note: Urban and suburban Congressional Districts are not included in this analysis.

Infestation Scores for each state's districts

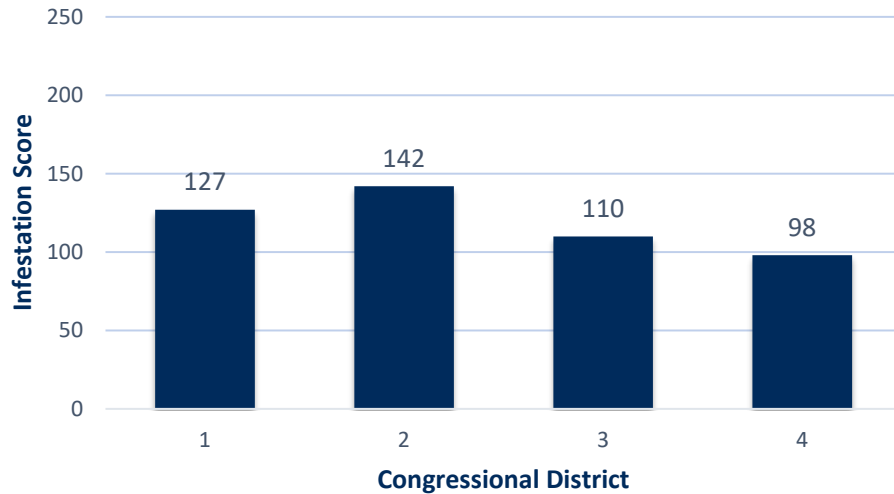
New Mexico's Infestation Scores



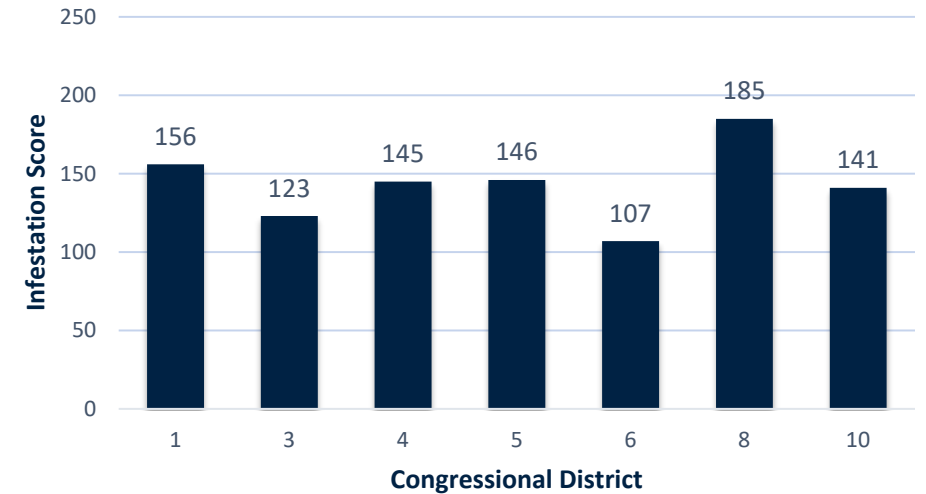
Oregon's Infestation Scores



Utah's Infestation Scores



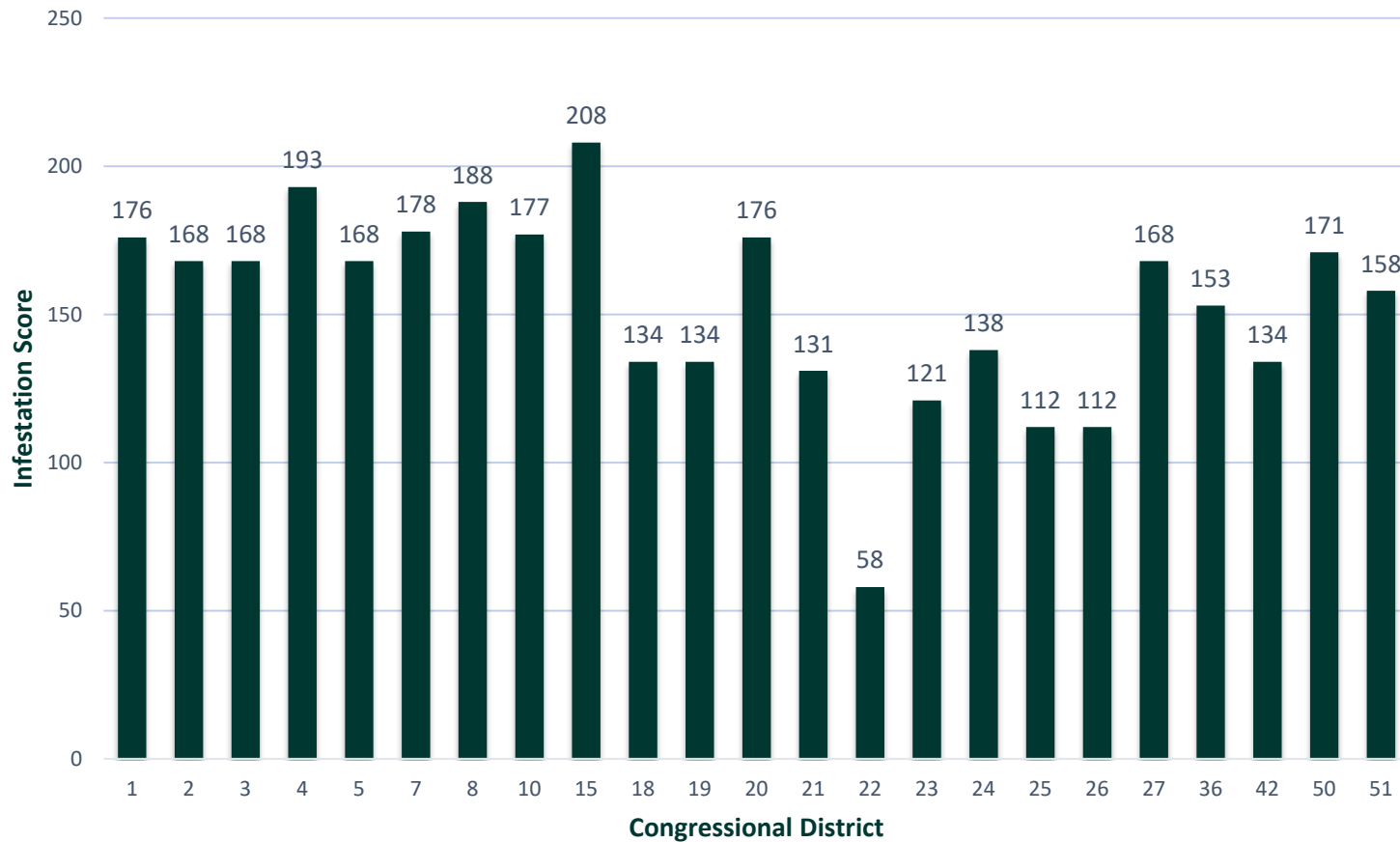
Washington's Infestation Scores



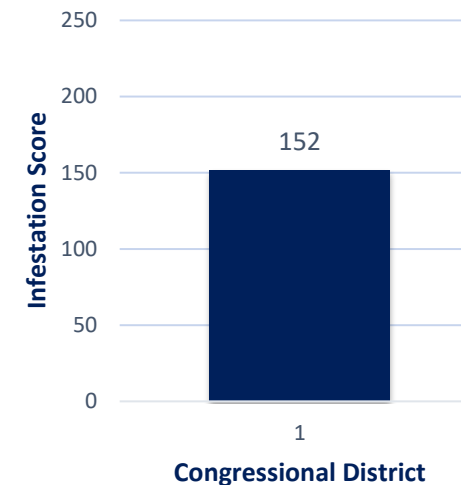
Note: Urban and suburban Congressional Districts are not included in this analysis.

Infestation Scores for each state's districts

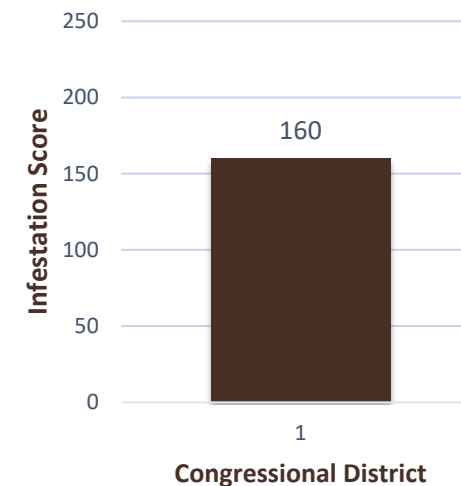
California's Infestation Scores



Montana

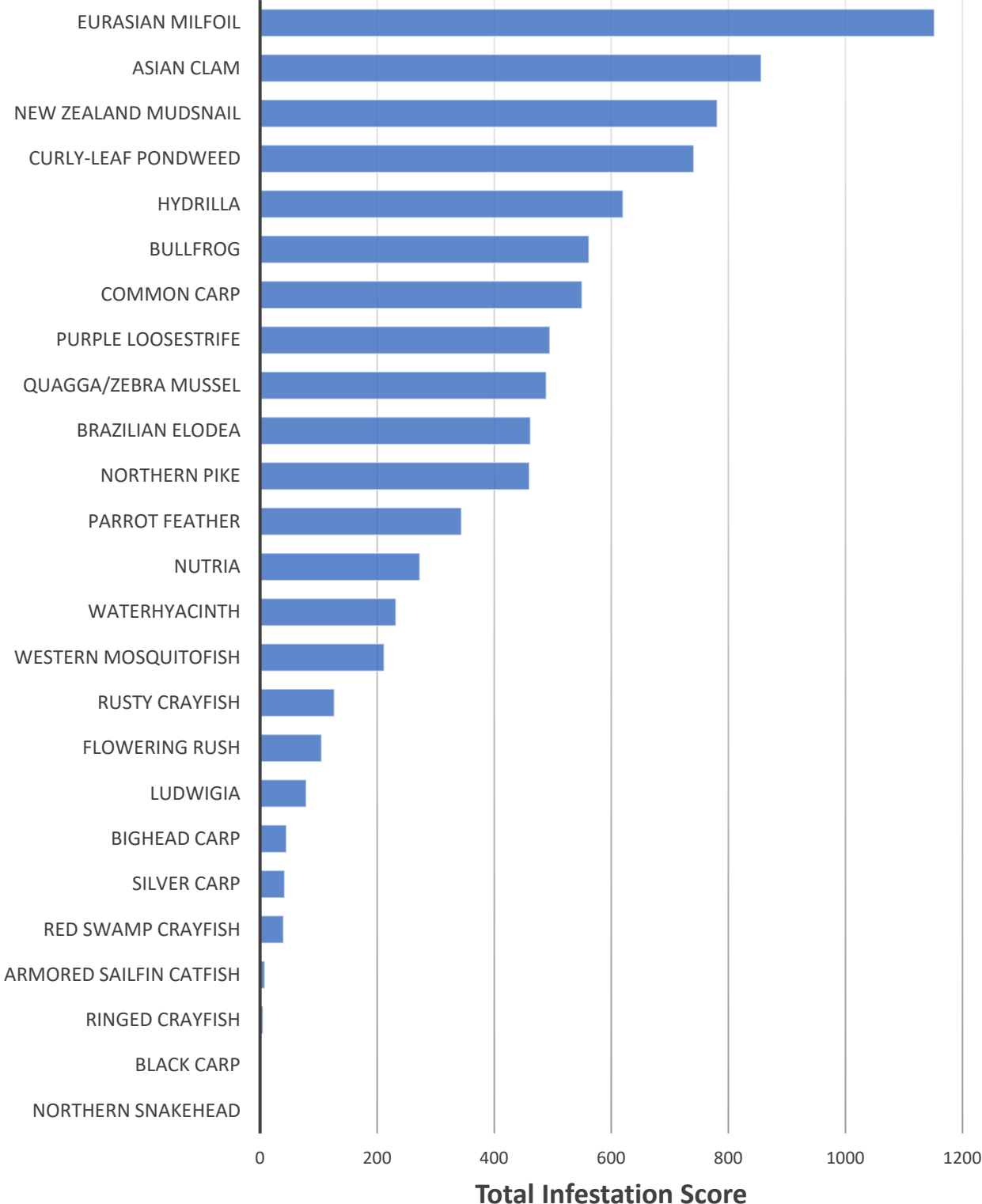


Wyoming



Note: Urban and suburban Congressional Districts are not included in this analysis.

Most Prevalent and Harmful NAS in BLM states



Ranking all Districts West of the 100th Meridian by Infestation Score

Congressional Districts by Infestation Score		
Rank	Congressional District	Infestation Score
1	Oregon 2	234
2	Arizona 1	228
3	Arizona 4	221
4	California 15	208
5	Colorado 3	194
6	California 4	193
7	New Mexico 1	193
8	California 8	188
9	Oregon 4	185
10	Washington 8	185
11	Idaho 1	182
12	Colorado 2	180
13	California 7	178
14	California 10	177
15	California 1	176
16	California 20	176
17	Oregon 1	174
18	California 50	171
19	Colorado 5	171
20	California 2	168
21	California 3	168
22	California 5	168
23	California 27	168
24	Colorado 4	167
25	Wyoming 1	160
26	Idaho 2	159
27	New Mexico 3	159
28	California 51	158

Congressional Districts by Infestation Score		
Rank	Congressional District	Infestation Score
29	Washington 1	156
30	Oregon 5	154
31	California 36	153
32	Montana 1	152
33	New Mexico 2	152
34	Arizona 2	148
35	Washington 5	146
36	Washington 4	145
37	Utah 2	142
38	Washington 10	141
39	California 24	138
40	Nevada 2	135
41	California 18	134
42	California 19	134
43	California 42	134
44	Arizona 3	132
45	California 21	131
46	Utah 1	127
47	Washington 3	123
48	Nevada 4	122
49	California 23	121
50	California 25	112
51	California 26	112
52	Utah 3	110
53	Washington 6	107
54	Utah 4	98
55	Nevada 3	74
56	California 22	58