Propagule pressure of invasive common reed (*Phragmites australis*) in Suisun Marsh: seedset, germination success, and seedling susceptibility to herbicide

Virginia Matzek, Michael Weatherford, & Gabe Rodkey
Santa Clara University
Phragmites australis, “common reed”

Native to Eurasia, now invasive worldwide

Impedes navigation and recreational access by increasing, crowds out native fish and waterbirds, decreases food availability for wildlife.
Phragmites spreads fast when untreated
Marsh-wide, treatment is not halting the spread of Phragmites
Remote imaging suggests that much of *Phragmites* increase at a site is due to spread from underground rhizomes.
Questions:

1) Does intensive control of *Phragmites* result in lower seed production?

2) Does intensive control of *Phragmites* result in more herbicide-resistant plants?
We used data from Suisun Resource Conservation District to characterize marsh parcels as:

- “high-intensity management” (10+ years of control)
- or “low-intensity management” (0-3 years of control)
We located parcels with at least 5 patches of *Phragmites* from which we could sample seed.

We did this at both “high-intensity” and “low-intensity” managed sites.
We collected the inflorescences (seedheads) of *Phragmites* when they were ripe in August 2022.
We measured patch size and the density of inflorescences.
Seeds are very tiny… so stripping, weighing, and counting the spikelets is quite tedious
Seeds per spikelet

Spikelets per inflorescence

Inflorescences per m²

m² of Phragmites in high- and low-intensity areas
Seeds per spikelet

Spikelets per inflorescence

Inflorescences per m²

= “propagule pressure,” seeds per m² of marsh, a measure of threat of invasion spread from seeds

m² of Phragmites in high- and low-intensity areas
Mean propagule pressure (seeds per m$^2$ of marsh)

- **GI**: High and Low
- **WFU**: High and Low
- **ISU**: High and Low
- **LJ**: High and Low
- **GD**: High and Low
- **FL**: High and Low
- **GVF**: High and Low
- **GH**: High and Low
- **TP**: High and Low
- **DK**: High and Low
- **IC**: High and Low
- **SP**: High and Low
- **AGECRU**: High and Low
- **GK**: High and Low
- **MZ**: High and Low

**Historical Herbicide**

- High: 4486 seeds per m$^2$ of marsh
- Low: 1214 seeds per m$^2$ of marsh
This is partly due to *Phragmites* making less seed and fewer inflorescences in patches where control has been long-term.

But our analysis shows the major driver of the trend is *patch size*. 
But how many of these seeds will actually germinate?
After a period of cold treatment to break seed dormancy, seeds were germinated in SCU growth chambers to test viability.
We couldn’t detect any statistical difference in germination rate as a result of treatment intensity.
We then took our germinable seeds and outplanted them in the greenhouse, grew them up as baby *Phragmites* plants…and killed them with herbicide.
Plants were visually assessed on a 0-5 damage scale

0 – no damage

1 – treated leaf has partial damage

2 - treated leaf completely dead

3 – some stem or leaf damage below treated leaf

4 – mostly dead below treated leaf

5 – completely dead
Good news—we found no statistical evidence of herbicide resistance in *Phragmites* from heavily treated areas.
Conclusions:

1) Propagule pressure of *Phragmites* is greatly diminished in heavily treated areas of the marsh, but this has more to do with decreasing patch size and inflorescence number, not seedset.

2) A long history of treatment did not have a detectable effect on germinability of *Phragmites* seeds.

3) There was no evidence of herbicide resistance developing in long-treated populations of *Phragmites*. 
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