

Supporting information

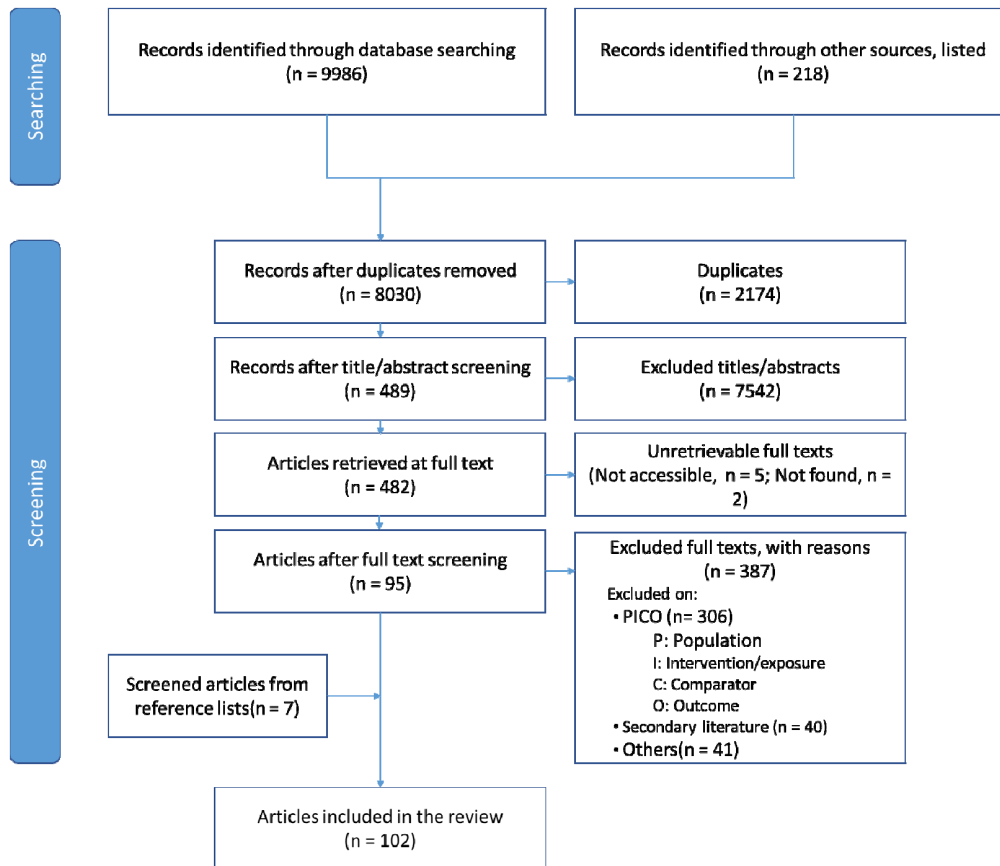


Fig. S1 Sequence of information in the different phases of a systematic review using the PRISMA protocol (Preferred Reporting Items for Systematic Reviews and Meta-Analyses).

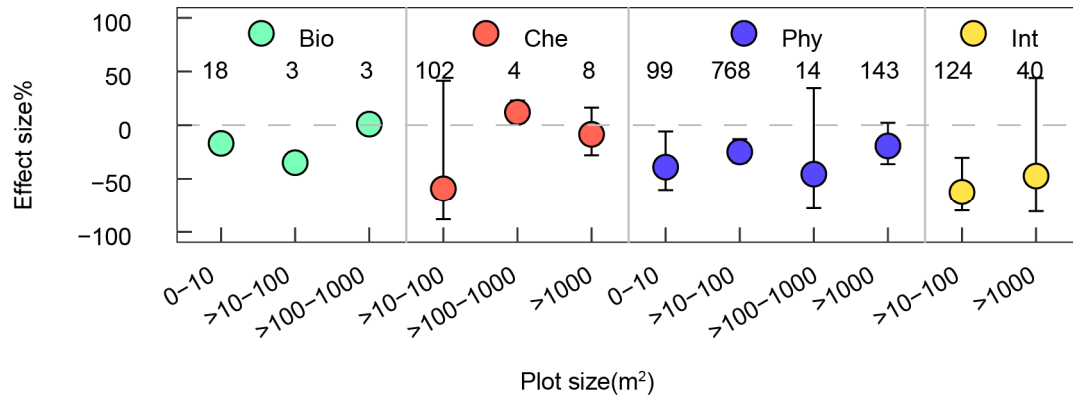


Fig. S2 Effects of control plot size on the performance of *Spartina* in different management interventions. Shown are mean effect sizes and 95% confidence intervals. Effect sizes are considered significant if their 95% CIs do not overlap zero. Number of comparisons are given on each bar. Bio: Biological control; Che: Chemical control; Phy: physical control; Int: Integrated control.

We just defined the areal extent of tropical, subtropical and temperate based on 0-23.5°, >23.5-40°, >40° because we would like to see if different management interventions can be applied in different region. This classification is not specific as previous category (Peel et al., 2007). Our results showed no significant difference between climate region so we did not further analyze annual mean temperature and precipitation as a potential factor influencing effects of management interventions.

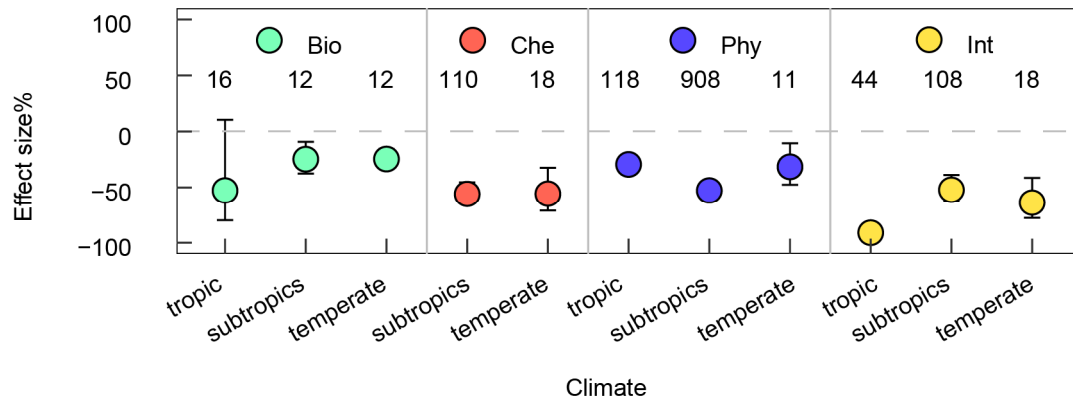


Fig. S3 Effects of climate on the performance of *Spartina* in different management interventions. Other details follow Fig. S2.

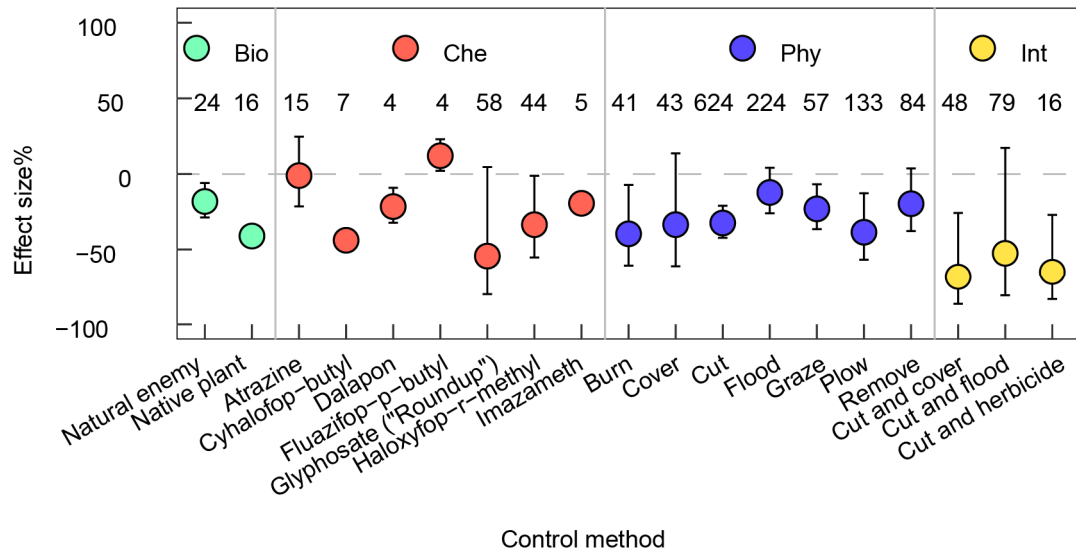
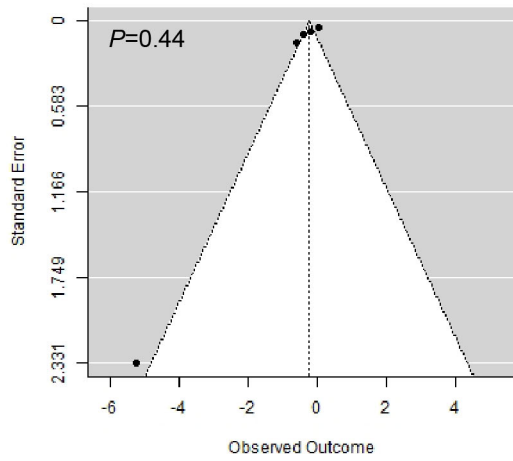
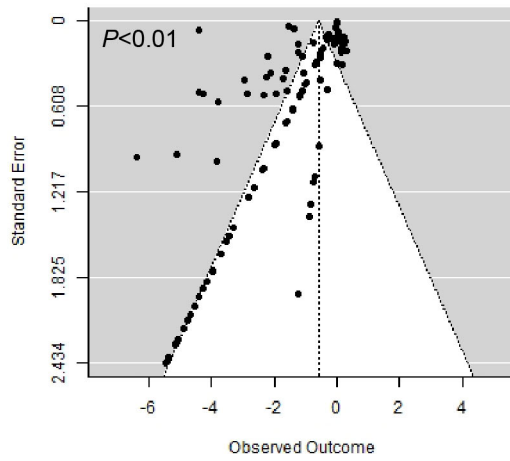


Fig. S4 Effects of specific control methods on the performance of *Spartina* in different management interventions (See Fig. S3 for explanations of color details), Other details follow Fig. S2.

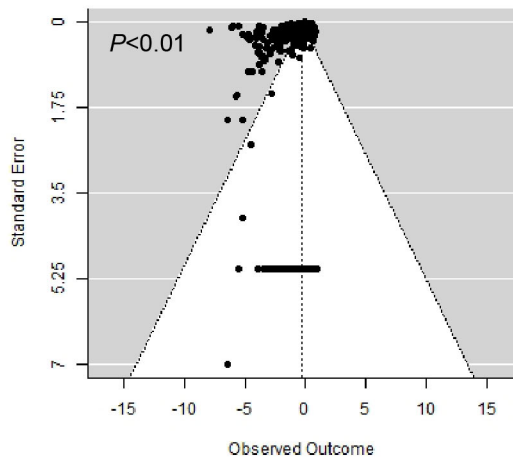
Biological : Spartina abundance



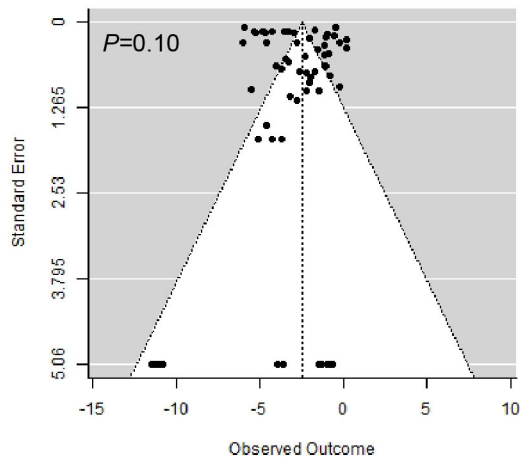
Chemical : Spartina abundance



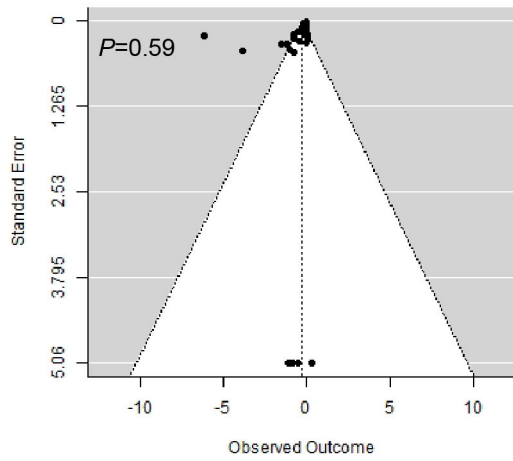
Physical : Spartina abundance



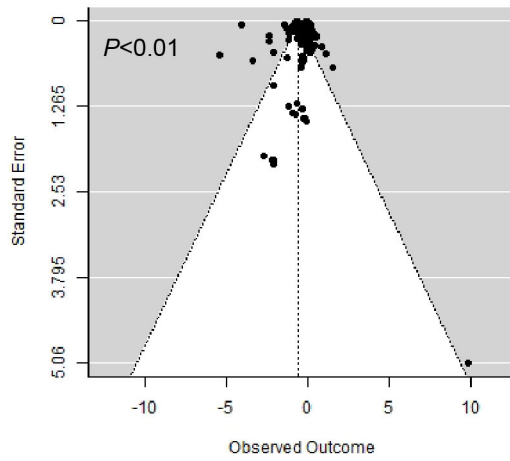
Integrated : Spartina abundance



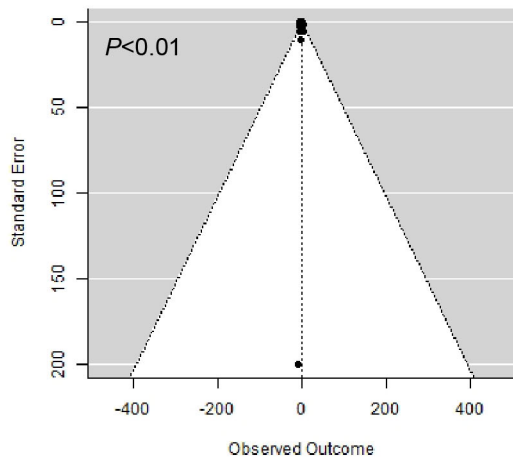
Biological : Spartina growth



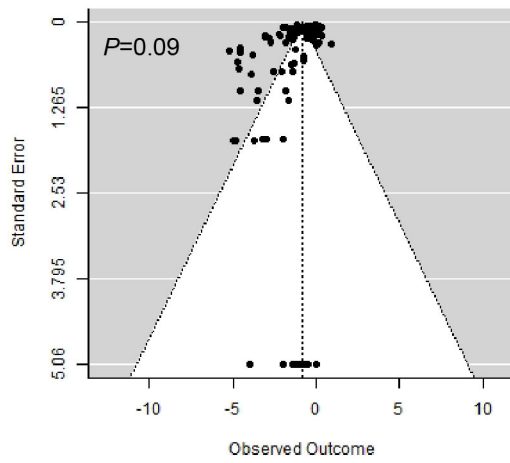
Chemical : Spartina growth



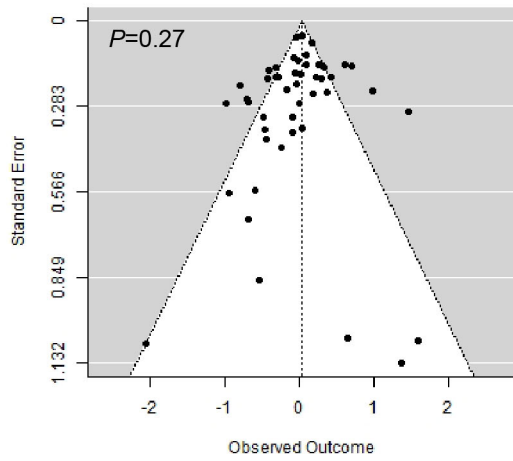
Physical : Spartina growth



Integrated : Spartina growth



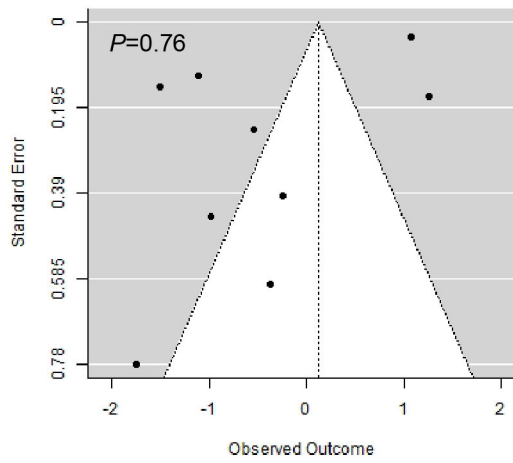
Chemical : Invertebrate abundance



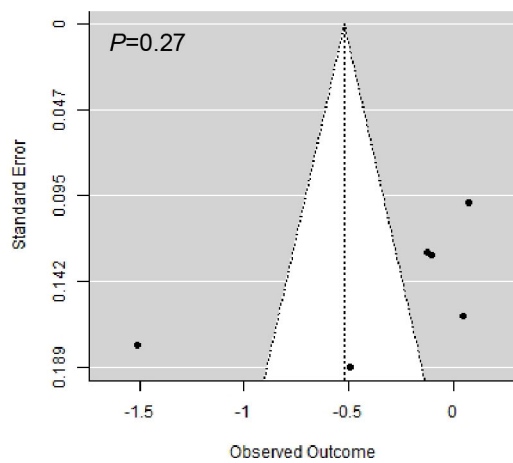
Physical : Invertebrate abundance



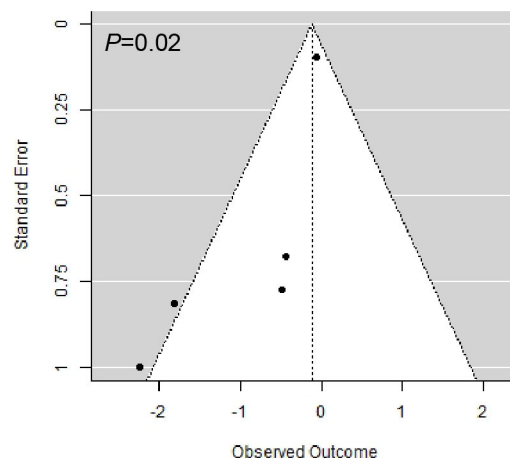
Integrated : Invertebrate abundance



Chemical : Invertebrate diversity



Integrated : Invertebrate diversity



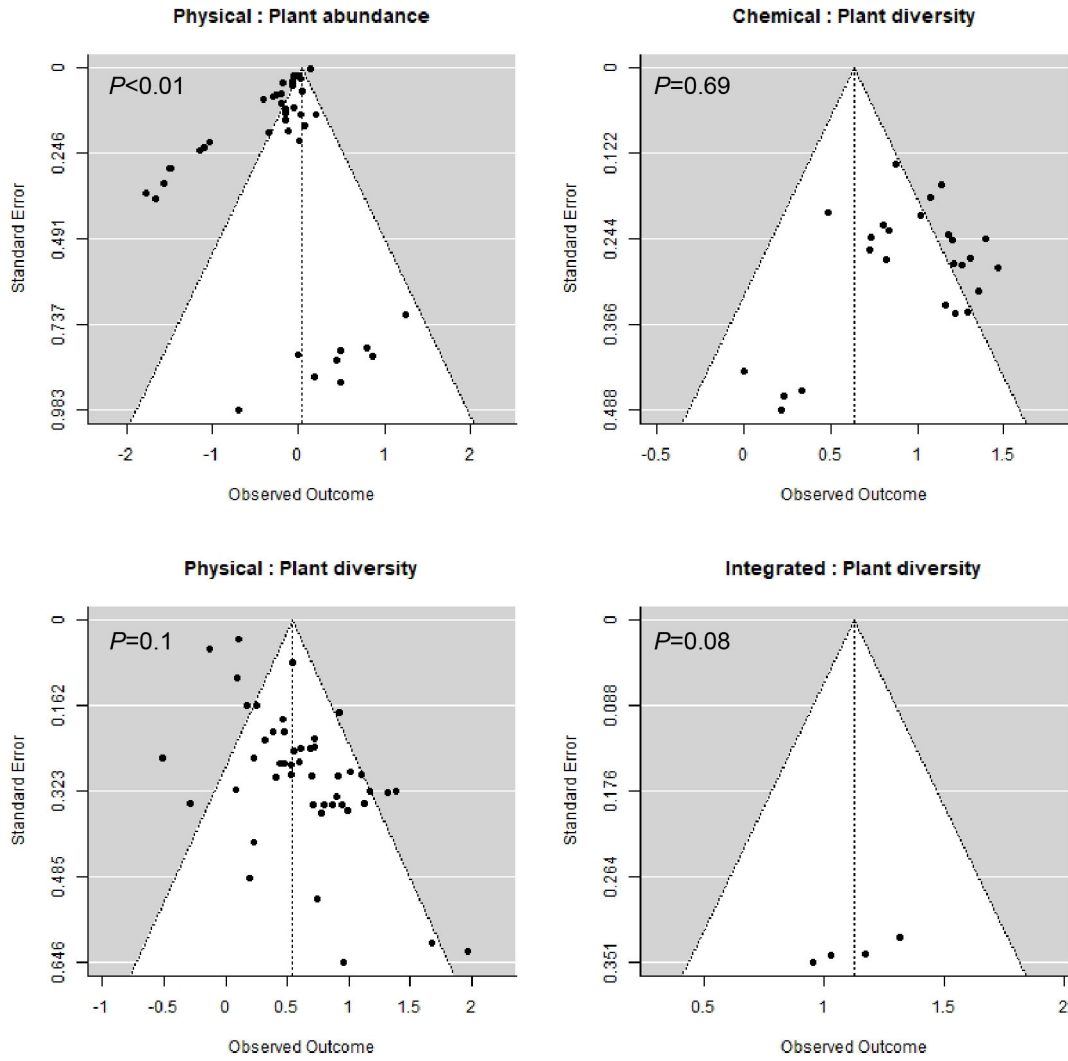


Fig. S5 Funnel plots for effect size metrics with detected asymmetry. In those cases, correcting bias did not alter whether a mean effect size was significant or not. $P < 0.05$ suggests asymmetry in the respective funnel plots.

Classification of interventions and outcomes

For ease of interpretation, management interventions were classified into four categories detailed below (based on those used for the systematic review (Martin et al., 2020) but more restrictive and specific).

All interventions

1. Biological control of *Spartina*
 - 1.1 *Bruguiera gymnorrhiza*
 - 1.2 *Kandelia candel*
 - 1.3 *Littoraria irrorate*
 - 1.4 *Phragmites communis*
 - 1.5 *Prokelisia marginata*
 - 1.6 *Rhizophora stylosa*
 - 1.7 *Sonneratia caseolaris*
2. Chemical control of *Spartina*
 - 2.1 Acetic acid (vinegar)
 - 2.2 Atrazine
 - 2.3 Cyhalofop-butyl
 - 2.4 Dalapon
 - 2.5 Fluazifop-p-butyl
 - 2.6 Gluphosinate ammonium
 - 2.7 Glyphosate ("Roundup")
 - 2.8 Haloxyfop-r-methyl
 - 2.9 Imazameth
 - 2.10 Imazapyr
 - 2.11 Monosodium methanearsonate
 - 2.12 Monosulfuron
 - 2.13 Penoxsulam
 - 2.14 Quinclorac
 - 2.15 Quizalofop-ethyl

3. Physical control of *Spartina*
 - 3.1 Burning
 - 3.2 Covering (e.g., shading)
 - 3.3 Cutting/chopping
 - 3.4 Digging/plowing
 - 3.5 Flooding/waterlogging
 - 3.6 Grazing
 - 3.7 Uprooting/removing
4. Integrated control of *Spartina*

One study reported *Spartina alterniflora* may be susceptible to *Claviceps purpurea* (Fisher et al., 2005), we didn't include it into our systematic review due to no relevant comparison according to our criteria.

All outcomes

1. Soil
 - 1.1 Soil oxidation/reduction potential
 - 1.2 Electrical conductivity
 - 1.3 Soil pH
 - 1.4 Soil salinity
 - 1.5 Soil organic carbon (SOC)
 - 1.6 Soil organic matter (SOM)
 - 1.7 Soil micronutrients and secondary nutrients (e.g., calcium [Ca] and magnesium [Mg])
 - 1.8 Nitrogen (N, including ammonium [NH₄⁺] and nitrate [NO₃⁻] in soils)
 - 1.9 Phosphorus (P) in soils
 - 1.10 Potassium (K) in soils
 - 1.11 Soil respiration
 - 1.12 Soil temperature
 - 1.13 Soil texture (i.e. sand, silt, and clay content)
 - 1.14 Soil enzymes

- 1.15 Soil microbial biomass
- 1.16 Nematodes (not including pests)

2. *Spartina*

2.1 *Spartina* abundance

- 2.1.1 *Spartina* density
- 2.1.2 *Spartina* survivorship
- 2.1.3 *Spartina* occurrence (weeds and invasive species) (e.g., presence/absence)

2.2 *Spartina* growth

2.2.1 Biomass

- 2.2.1.1 Aboveground biomass
- 2.2.1.2 Belowground biomass
- 2.2.1.3 Total biomass

2.2.2 *Spartina* size and growth rate

- 2.2.2.1 Ground diameter
- 2.2.2.2. Growth rate
- 2.2.2.3. Height
- 2.2.2.4. Leaf area
- 2.2.2.5. Leaf length

2.2.3 *Spartina* reproduction

- 2.2.3.1 Tilling number
- 2.2.3.2 Heading ratio
- 2.2.3.3 Seed production
- 2.2.3.4 Seed quality

2.3 *Spartina* condition

- 2.3.1 Carotenoid
- 2.3.2 Catalase activity
- 2.3.3 Chlorophyll
- 2.3.4 Peroxidase activity
- 2.3.5 Soluble protein

2.3.6 Soluble sugar

2.3.7 Superoxide dismutase activity

3. Biodiversity

3.1 Invertebrate abundance

3.2 Invertebrate diversity

3.3 Plant abundance

3.4 Plant diversity

References

- Fisher, A. J., DiTomaso, J. M., & Gordon, T. R. (2005). Intraspecific groups of *Claviceps purpurea* associated with grass species in Willapa Bay, Washington, and the prospects for biological control of invasive *Spartina alterniflora*. *Biological Control*, 34, 170-179
- Martin, P. A., Shackelford, G. E., Bullock, J. M., Gallardo, B., Aldridge, D. C., & Sutherland, W. J. (2020). Management of UK priority invasive alien plants: a systematic review protocol. *Environmental Evidence*, 9
- Peel, M. C., Finlayson, B. L., & McMahon, T. A. (2007). Updated world map of the Koppen-Geiger climate classification. *Hydrology and Earth System Sciences*, 11, 1633-1644