

## **Stinkwort Invades Cal State East Bay Concord's Galindo Field Station**

### **Project Goal:**

Report on extent of invasive non-native Stinkwort (*Dittrichia graveolens*)<sup>1</sup> at the Galindo Field Station at Cal State East Bay in Concord. Share botanical/ecological insights about the species and report on the possible implications for current grazing practices and the general health of the Station property ecosystem. Review options for control and suggest options for follow-up.

### **What is Stinkwort?**

Stinkwort is a fall-flowering, sticky aromatic annual plant in the aster/daisy family (Asteraceae), native to the Mediterranean area. It has become invasive in many parts of the world, arriving recently in California (around 1984). The USDA considers it “High Risk” and highly invasive.<sup>2</sup> The California Invasive Plant Council (Cal-IPC) has it on “Alert” status—posing a Moderate threat to California’s overall ecosystem.<sup>3</sup> Stinkwort is causing alarm as it rapidly spreads, threatening grazing lands, vineyards and valued existing ecosystems [see Figure 1].

Stinkwort thrives in our Mediterranean climate, and tolerates a wide variety of soils and range of soil moisture, from very dry conditions to the margins of wetlands. It needs near-full sun to thrive (i.e., a grassland/pasture environment). It invades aggressively in disturbed areas and over-grazed pastures and into bare patches along roadways and field edges. Because of its enormous seed production (15,000+ seeds/plant!), it can spread very rapidly. While naturally distributed by wind (to 200 meters) or water, its sticky seeds attach to bikes, cars, people and animals, and it can “jump” to fairly distant new areas.

The mature plant is up to a meter in height, with a “Christmas Tree” or mounding shape [Photo #1]. The leaves are short, narrow and linear (0.75” x 1-3mm), and hairy stems produce small yellow flowers (0.25” diameter) [#2]. The plant’s lime green foliage is intensely aromatic, with the smell described variously as camphor, Pine-Sol, butane, and “like Vicks VapoRub”. Its root ball is typically shallow, although a taproot becomes more noticeable in drier soils [#3]. Stinkwort seeds germinate readily (90%+) when moistened by winter rains. The seedlings and small rosettes are inconspicuous [#4; #5] until the plant bolts in mid-summer, with notable erect size by late July/early August. Flowering begins in September, with rapid seed production through October/November, as the plant dries and turns grey.

---

<sup>1</sup> Various species share the common name “stinkwort”. As used here: *Dittrichia graveolens*, which often appears in older literature as *Inula graveolens*.

<sup>2</sup>

[https://www.aphis.usda.gov/plant\\_health/plant\\_pest\\_info/weeds/downloads/wra/Dittrichia\\_graveolens\\_WRA.pdf](https://www.aphis.usda.gov/plant_health/plant_pest_info/weeds/downloads/wra/Dittrichia_graveolens_WRA.pdf)

<sup>3</sup> <https://www.cal-ipc.org/plants/profile/dittrichia-graveolens-profile/>

## **Where is Stinkwort currently found at the Galindo Field Station (and is it expanding)?**

Stinkwort at Galindo is easily seen along the immediate edges of the entry roadway (past the gate) [#6; #7], intruding in lower density into the grassy area on the east side of the roadway (in the direction of the creek bed). There are a few patches in the grassy area to the east of the creek (a prime spot for further invasion). There is a dense line of Stinkwort on the west side of the barbed wire fence in the grazed portion of the station [#8], where soils show more disturbance by ranch vehicles, but is by far most notable on the upper edges of the swale that forms the large “wetlands” depression running north/south in the approximate middle of the grazed portion of the Station [#9; #10]. Notable near-monoculture stands appear in this area [#11], and continue west beyond the boundary of the Field Station [#12]. As Stinkwort reaches its seed-bearing maturity in September/October (after the annual oats and other grasses have dried, browned and begun to lay down), the bright lime-green “Christmas tree/mounding shapes of moderate to dense stands of Stinkwort in these areas are very easy to spot on the landscape [#13]. Anecdotal reports from neighbors and others suggest that coverage and density of invasive Stinkwort has been noticeably expanding at the Station, but no formal comparative measurements have yet been made.

## **What’s So Bad About Stinkwort?**

**Stinkwort shares the negative characteristics of all invasive plants, but is worse than many.**

- It threatens existing ecosystem health by exploiting disturbances to form dense stands, creating sterile monocultures that crowd out natives or more desirable **plants** that better service the ecosystem (e.g., by providing food to native **insects**). While Stinkwort’s foliage and flowers may feed certain insects, a monoculture that depresses the diversity of native forbs will exclude plants upon which certain insects are uniquely dependent—reducing the diversity and productivity of the flora and larger ecosystem. Stinkwort’s ability to tolerate serpentine and saline soils provides it with broad target areas for infestation (including some areas where rare California native plants currently enjoy dominance and protection from most invaders).
- While **grazers** generally avoid Stinkwort naturally, if ingested, the barbed seeds embed in the intestine and can cause sickness and death, particularly in sheep. The meat and milk of cows becomes tainted. Increasing spread crowds out desirable grasses and edible forbs, and threatens the health of cattle unfortunate enough to ingest it.
- **Humans** may suffer itching and contact dermatitis from the plants’ oils if gloves are not worn.

## **Why do we see Stinkwort everywhere?**

- Invasives like Stinkwort thrive in disturbed and damaged (i.e., human-impacted) ecosystems, but also, Stinkwort is filling an empty ecological niche in our non-native Mediterranean grasslands (the same one it and its relatives do at home). A casual survey of other forbs in the Galindo grasslands showed (almost exclusively) other non-native Mediterranean forbs (most rated “invasive” by Cal-IPC), such as Yellow Starthistle (High); Broadleafed Pepperweed (High), Shortpod Mustard (Moderate) and Bristly Oxtongue (Limited). Much of the area might be considered almost wholly non-native. No tarweeds (see below) were observed (although INat shows them present in nearby areas).
- **What California natives once filled the empty ecological niche that Stinkwort is exploiting?**
  - Native California Tarweeds, which share many similarities (an aromatic plant with sticky stems and leaves that grows and flowers in the late summer, after grasses have died back). One expert suggests that (similarly distasteful) native tarweeds resisted grazers introduced by Europeans, increasing in density and coverage as drought and overgrazing damaged and eliminated both native forbs and grasses along with introduced grasses.

Tarweeds were targeted for elimination by ranchers for many decades in the 1900's, and were finally almost wholly eliminated when herbicides became available in the 1950's. That empty ecological niche remained in our grazing lands until Stinkwort arrived to begin to exploit it.<sup>4</sup>

### **Can Stinkwort be Stopped?**

Stinkwort has been an invasive pest in Australia for over 150 years, providing California with control insights. Management of invasive Stinkwort is particularly challenging<sup>5</sup>, as discussed below. About the only good news about Stinkwort biology is that its seeds have a short shelf-life, limiting the period where heavily infested areas must be aggressively revisited to only 2-3 years (with spot follow-up thereafter).

- **Grazing as a control?**
  - Cattle: As discussed, cattle (and sheep) will typically avoid it, browsing it only as a food of last resort. If they do, sickness, taint, and for sheep, even death, may result. Physical disturbance of soil by cattle and ranch vehicles promotes infestation (as well as spread of sticky seeds).
  - Goats? Australian reports suggest that goats share at least a moderate aversion, and could also be harmed by ingestion of seeds. It's not clear if ingestion of seed-free plants by (unhappy) goat grazing could be a successful option earlier in the season.
- **Mowing/weed whacking/slashing?**
  - Has been called "ineffective" (at least as CalTrans typically uses mowing as a control), and mowing early in the summer (e.g., for fire control) favours Stinkwort by removing shading competitors from above the ground-hugging rosettes. **Mowing in August, before flower production, may show some real effectiveness**, but note that Stinkwort resprouts readily from even ground-level cuts, and it will flower and set seed on new, if highly stunted, regrowth (as short as 2 cm.). Multiple passes over a season may be needed.
- **Herbicides?**
  - If general pre-emergents are used in grassland areas, they must be applied early (November/December).
  - Low dose herbicides can be more effective on early spring rosettes/young plants (which have less oil on leaves—which oil reduces effectiveness).
  - The use of highly effective systemic herbicides like glyphosates is currently being curtailed because of public concerns about cancer risk.<sup>6</sup> Despite its proven efficacy in the fight against invasive plants (the Nature Conservancy, Cal-IPC and others endorse and are defending its use)<sup>7,8</sup>, the UC System has banned its use, and legislative efforts to impose wider bans have followed recent high-profile litigation.<sup>9</sup>

---

<sup>4</sup> <http://www.ecoseeds.com/stinkwort.html>

<sup>5</sup> Good overview of current insights from research: <https://www.cal-ipc.org/wp-content/uploads/2017/12/3Brownsey.pdf>

<sup>6</sup> <https://www.timesheraldonline.com/2019/07/19/east-bay-park-district-joins-growing-list-of-public-agencies-banning-roundup/>

<sup>7</sup> <https://www.cal-ipc.org/wp-content/uploads/2017/11/Cal-IPC-glyphosate-policy.pdf>

<sup>8</sup> <https://slate.com/technology/2019/10/glyphosate-does-not-cause-cancer-saves-native-plants.html>

<sup>9</sup> <https://www.independentsciencenews.org/news/university-of-california-system-halts-use-of-glyphosate-herbicide/>

- A recent study demonstrated that **treatment of mature plants with the herbicide imazapyr (Habitat) was effective against both the plant and its seeds**.<sup>10</sup>
- Consider the possible need for permits/approvals (and possible opposition from some environmentalists): wetland areas in particular may shelter threatened species like red-legged frogs, pacific garter snakes and other amphibians.
- **Hand removal?**
  - It can be difficult to recognize Stinkwort sprouts and young rosettes, making early removal challenging, but it is important to dig/compost Stinkwort before it flowers.
  - Oils can cause contact dermatitis, and even the aroma can irritate sensitive individuals (and dogs!) who walk through dense patches. Wear gloves and long-sleeved shirts/long pants (avoid spreading by removing sticky hitchhikers if seeds are present).
  - Fairly shallow root system—can usually pull roots up from plant base. Tap root develops “late”, arguing for earlier hand digging (if present, must dig out taproot to prevent resprouting).
    - Those tasked with hand removal outside the grazing area should be made aware of the possible presence of desirable native Tarweeds, which also flower late within grasslands, have sticky leaves and stems, their own distinctive aroma (described as “minty-sage-y) and in some cases, small (but larger than Stinkwort) yellow flowers (more often, white) and less “hairy” stems. Shape is the best way to distinguish “spindly” Tarweeds, which form more of a bush shape than the typical conical/Christmas Tree shape of Stinkwort.<sup>11</sup>
  - Mowing, chopping or hand removal of Stinkwort after flowering begins is discouraged, since plants will retain the ability to deploy viable seeds. Such plants can still be removed, but should be carefully bagged and “sterilized” using a method described in the link at this footnote.<sup>12</sup>
- **Fire/Flaming (& steaming)?**
  - Aside from the obvious risks and challenges associated with using fire as a possible control mechanism, Stinkwort has been known to return to burned areas. The efficacy of steaming as a control has not yet been tested.
- **Land management controls**
  - Shade deters Stinkwort, as does competition generally. Australian cereal producers learned to exclude Stinkwort by increasing soil fertility (supporting competition). While stinkwort is a prolific seed producer and highly opportunistic, it is most successful in disturbed, sparsely vegetative or degraded/over-grazed areas: a healthy pasture, grassland or other well-vegetated space will resist infiltration. Overgrazing creates bare/open spots (and disturbance) that favors Stinkwort. Avoid early mowing.

---

<sup>10</sup> [https://www.cal-ipc.org/wp-content/uploads/2017/11/Cal\\_IPC\\_Symposium\\_2010\\_Meg\\_Marriott\\_Spread\\_and\\_control\\_of\\_Dittrichia\\_graveolens.pdf](https://www.cal-ipc.org/wp-content/uploads/2017/11/Cal_IPC_Symposium_2010_Meg_Marriott_Spread_and_control_of_Dittrichia_graveolens.pdf)

<sup>11</sup> <https://www.paloaltoonline.com/news/reports/1516670038.pdf> For a mostly unrelated but fascinating discussion of tarweeds, see <https://baynature.org/biodiversity/livermore-tarweed/>

<sup>12</sup><http://www.ecoseeds.com/stinkwort.html> (about mid-article)

**SUMMARY: AUGUST IS STINKWORT ELIMINATION MONTH!** [See Figure 2]. Mowing before flowering begins may prove effective (and will certainly prove helpful). The existing seed bank will make aggressive efforts necessary for 2-3 years (believed to be the life of older seeds in soil). While recontamination is likely, more limited infestations, caught early, could be targeted with well-timed spot herbicide treatment or hand pulling (if cost-effective). A nice summary document with additional information on herbicide use/efficacy is at

[https://wric.ucdavis.edu/information/natural%20areas/wr\\_D/Dittrichia.pdf](https://wric.ucdavis.edu/information/natural%20areas/wr_D/Dittrichia.pdf).

### **Further reading:**

- See links in footnotes throughout (bolded items of particular value/interest)
- Want more about the Stinkwort challenge? I recommend viewing the roundtable discussion with Senior Ecologist Claire Elliott with Grassroots Ecology at : <https://www.youtube.com/watch?v=p0hQUzoMNsA>
- There are no doubt many resources directed to the (much more significant) challenge of converting a non-native, degraded grassland to one more reflective of “native” California, but the many links at the home page of the passionate native grass advocate Craig Demann make for interesting and informative reading. See: <http://www.ecoseeds.com/contents.html>

### **Unanswered Questions and Possible Follow-Up:**

- Just how fast is Stinkwort spreading at Galindo? A careful survey would be of greatest help, but comparing photos taken this year to similar ones next year at the same time might help confirm more casual observations. Even without abatement, there may be natural limits to its ability to expand to become a monoculture, related to existing soil moisture or soil fertility.
  - A Citizen Science project (perhaps an Eagle Scout Project?) might be to install one or more semi-permanent pole-mounted cell phone photo brackets, ensuring a consistent camera viewpoint from which to compare similarly dated photos (or even to assemble a “time lapse”). This approach is being used to study habitat recovery following the 2013 Morgan Fire on Mount Diablo.<sup>13</sup>
- Would “Green” herbicidal treatments be as effective as glyphosates, or other commercial products? A side by side test of equally sized stands using different formulations might be interesting and helpful.
- A controlled experiment to determine the efficacy of mowing (by timing, cutting height, repeated passes) might help guide future management decisions.
- Would soil amendments (i.e., fertilizer) depress Stinkwort populations by encouraging more aggressive cover?
- Does casual hand-pulling (i.e., without attention to digging out any taproot) effectively prevent regrowth?
- From an ecological science perspective, just how “sterile” is non-native Stinkwort?
  - Studies to assess the ecosystem services it may be providing would be of interest. For example, inspecting plants for insect damage; observations regarding what may feed on its nectar (or pollen); a “count” of caterpillar or other feeding insects; etc., might help determine how noxious it is from an ecosystem services standpoint (esp. as compared to native Tarweeds).

<sup>13</sup> <https://www.kqed.org/science/16861/hikers-use-smartphones-to-capture-fire-recovery-on-mt-diablo>

## Figures & Photos

Figure 1: Rate of Spread

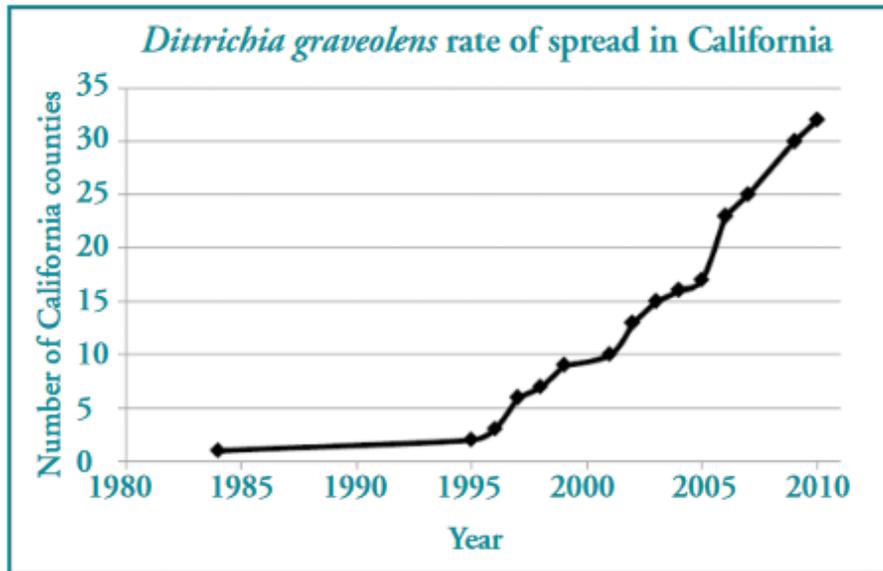


Photo #1: Mature Stinkwort Showing “Christmas Tree” Shape



**Photos #2: Close-up of stem, flowers and leaves**



**Photo #3: Root ball showing Taproot**



**Photos #4 & #5: Seedling and Rosettes**



*Dittrichia graveolens* rosettes on a roadside in Davis, CA.

**Photos #6 & #7: Stinkwort in Roadway near Gate**



**Photo #8: Stinkwort along Fence in Grazing area (note preference for bare/disturbed soil):**



**Photo #9: Stinkwort within central “Swale”/wetland area – view from South looking North**



**Photo #10 Stinkwort within central  
“Swale”/wetland area – North looking South**



**Photo #11: Stinkwort within central  
“Swale”/wetland area – Example of  
“monoculture area”**



**Photo #12: Stinkwort continuing to West of Field Station Property**



**Photo #13: Lime Green Stinkwort stands out on Galindo Property in Early October**



**Figure #2: August is Stinkweed Removal Month!**  
**(full sized, but not yet flowering)**

Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Germination	Germination										Germination	
Growth			Rosette			Moderated Growth		Exponential canopy growth				
Reproduction									Flowering			
										Seed Production		
Dispersal										Dispersal		

Figure 2. *Dittrichia graveolens* life cycle based on field experiments in Davis, California.