WRITTEN FINDINGS OF THE
WASHINGTON STATE NOXIOUS WEED CONTROL BOARD
DRAFT July, 2013

Scientific name: All non-native *Typha* species and hybrids including: *Typha angustifolia* L., *Typha ×
glauca* Godr. pro sp. (*Typha angustifolia* x *T. latifolia*), *Typha domingensis* Pers.
and related hybrids

Synonyms: *Typha angustifolia*: *Typha angustifolia* L. var. *calumetensis* Peattie, *Typha
angustifolia* L. var. *elongata* (Dudley) Wiegand

Common name: cattail, cattail hybrids, narrow-leaf cattail, southern cattail, small reed mace, reed
mace, flags, bulrushes, cat o'nine tails, Cossack asparagus, baco

Family: Typhaceae

Legal Status: Proposed Class B noxious weed (as a group); Noxious Weed Committee is
considering a Class C listing instead.

Description and Variation:
Species-specific molecular markers have been developed to identify *Typha* species, their hybrids, or
backcrossed progeny and are the best way to identify cattail species though tests may be cost
prohibitive (Snow et al. 2010, Selboe and Snow 2004, Kuehn and White 1999). Measuring specific
morphological traits may allow identification of *T. latifolia*, *T. angustifolia* and *T. x glauca* with
approximately 90% accuracy. A discriminate analysis by Kuehn and White (1999) found measuring spike
length, spike interval, leaf width, and stigma width at its widest point (measured with a compound
microscope) provided this percentage of accurate identification (Kuehn and White 1999). Whereas
Smith (2000) states that except for the presence of mucilage glands on the leaf blades, unique to *Typha
domingensis* and its hybrids, the microscopic flower and bracteole structures are generally essential for
accurate identification of *Typha* species and hybrids. This is partly due to changes in the inflorescences
during development and partly because of phenotypic plasticity, especially of leaf blade widths. It is
often necessary to use forceps to pull a few pistillate flowers out of the spike and observe them with a
dissecting microscope at 20 power to 30 power.

Unless otherwise noted in the plant description, information is from Smith (2000) Flora of North America
Typha treatment. Refer to Smith's key in the FNA treatment for identification and additional species and
hybrid information.

Overall Habit:
Typha species and hybrids are perennials that grow in fresh to slightly brackish wetlands, often
emergent in water up to 1.5 meters deep.

Images: Left image, *Typha domingensis* (left) and *Typha latifolia* (right) growing in Hutchinson Lake in Adams County WA, image by Jenifer Parsons DOE; Right image, *Typha angustifolia* growing in North Lake in King County WA, image by Jenifer Parsons DOE.

Roots:
Plants have unbranched rhizomes, growing up to 70 cm long by 5-40 mm wide. Rhizomes are starchy, firm and scaly. Roots from the rhizomes are fibrous and shallow (DiTomaso and Healy 2003).

Stems and Leaves:
Typha stems are erect and pithy, growing from the rhizomes (Hitchcock et al. 1969). Stems are unbranched and either vegetative or flowering. Growing up to 4 meters tall, stems are elliptic in cross section. Leaves are alternately arranged, 2-ranked, sheathing, linear and rather spongy (Hitchcock et al. 1969). Leaf blades twist into a loose helix. Leaves have mucilage-secreting glands that are numerous in adaxial surface of leaf sheath and sometimes proximally (near the base) on the leaf blade. The glands are colorless to brown and roughly rectangular.

Typha angustifolia:
Stems of *Typha angustifolia* are 1.5-3 meters tall and not glaucous. Leaves are dark green, long, linear and strongly plano-convex, flat on one side and convex on the other (Grace and Harrison 1986) and up to 1 cm wide (DiTomaso and Healy 2003). Leaf sheath sides are membranous, margin broadly clear, and summit of sheath with membranous auricles (earlike lobes) which often disintegrate late in season. Leaves have mucilage glands that darken from clear to brown to black, as the plants ages (Lutz no date). The mucilage glands at sheath-blade transition are absent from the blade and usually from the center of the sheath near the summit. Leaves of *T. angustifolia* are longer than its inflorescences (Grace and Harrison 1986).

Image: *Typha angustifolia* with leaves longer than the inflorescences, image Jenifer Parsons, WA Dept. of Ecology.

Images: Left, *Typha angustifolia* top (summit) of leaf sheath, Image © 2005, Ben Legler; other three images show mucilage gland development of the adaxial surface (side toward the stem) of the leaf sheath on *T. angustifolia.* Glands occur on the leaf sheath but they are absent from the central part of the sheath and from the leaf blade. During mid to late development, they become visible to the unaided eye on the sides and lower central part of the sheath. Images Richard Lutz, http://iowaplants.com

Typha domingensis:
Stems of *Typha domingensis* grow 1.5-4 meters tall and are not glaucous. Like *T. angustifolia*, leaves of *T. domingensis* are long, linear and strongly plano-convex, flat on one side and convex on the other (DiTomaso and Healy 2003). Leaf sheaths have membranous sides, with broadly clear margins, and the summit is tapered to the leaf blade or has persistent, membranous auricles. Mucilage glands at sheath-blade transition are orange-brown and numerous on entire sheath and the lower 1-10 cm of the leaf blade. Widest leaf blades are 6-18 mm wide when fresh and the distal blade is about the same height as the inflorescence.

Typha x *glauca*:
Stems of *Typha x glauca* are 1-3 meters tall. The leaf sheaths are either auriculate at the base of the leaf blade or tapering. Its long, linear leaves are moderately plano-convex, 5-19 mm wide and can moderately overtop the inflorescence (Grace and Harrison 1986).

Flowers:
Typha inflorescences are cylindrical spikes of small monoecious flowers, with male (staminate) flowers occurring above the female (pistillate) flowers, all directly on the main axis and intermixed with slender hairs. Depending on the species or hybrid, the staminate flower spike may or may not be contiguous with the pistillate flower spike (Grace and Harrison 1986). Flowering time may shift depending on climate conditions and location. Male flower anthers are longer than the filaments (Hitchcock et al. 1969) and dehisce longitudinally. Female flowers' pistils have colorless, filiform hairs or apically enlarged and brown hairs that are exceeded by the stigmas. The carpodia are spongy and obovoid, bearing rudimentary styles. Male flowers are present early in the season and later absent, while female flowers may remain on the plant into the winter.

Images, Left image: example of three mature *Typha* pistillate spikes: left *T. latifolia* (broadleaf), center *T. angustifolia* (narrowleaf), right *T.* x *glauca* (hybrid), image MN Board of Water & Soil Resources;
Center image: *T. angustifolia* inflorescence showing a gap between the male and female flower spikes, image credit, Ben Legler, 2005; Right, *T.* x *glauca* inflorescences, image credit Robert W. Freckmann, University of Wisconsin-Stevens Point.

Typha angustifolia

Typha angustifolia typically blooms June through July (Hitchcock et al. 1969). The inflorescence consists of a narrow spike with an interval of naked axis 1-8 (-12) cm between the staminate and pistillate portions (Kuehn and White 1999). Staminate (male) flowers are 4-6 mm in size, anthers are 1.5-2 mm. Staminate flowers have brown, linear, almost bifid bracteoles and their pollen grains are in monads (Grace and Harrison 1986). The pistillate spike is 6-20 cm long and 5-6 mm across in flower expanding to 13 to 22 mm across in fruit. Pistillate flowers are on stalks +/- .05 mm long, are 2 mm in flower, and 5-7 mm when in fruit. Stigmas are linear and not fleshy (Grace and Harrison1986). Pistil hairs attach to the pistil base and their tips are medium brown and distinctly enlarged when viewed at 10-20 X magnification. Pistillate bracteole tips darker than (or as dark as) stigmas, very dark to medium brown, rounded (to acute), in mature spikes about equaling pistil hairs. Pistillate spikes are medium to dark brown.

Typha domingensis

Inflorescence blooms spring through summer. The staminate spike is separated from the pistillate spike by (0-)1-8 cm of naked axis. Pistillate spike is yellow to bright cinnamon-brown with whitish stigmas when flowering, maturing to orange to medium brown. Staminate flowers are 5 mm in size, with anthers 2-2.5 mm. Staminate scales are straw-colored to mostly bright orange-brown, variable in same spike, linear to cuneate, often laciniate distally and pollen in single grains (monads). Pistillate spike is 6-35 cm long by 5-6 mm wide in flower expanding to 15-25 mm wide in fruit. Pistillate flowers are on stalks 0.6 to 0.9 mm long, are 2 mm in flower and 8-9 mm in fruit. Pistil hair tips straw-colored to orange-brown in mass. Pistillate bracteole blades straw-colored to mostly bright orange-brown, much paler than to

nearly same color as linear stigmas, and acute (usually many acuminate) (DiTomaso and Healy 2003, Smith 2000).

Typha x *glauca*
Typha x *glauca* is typically intermediate between the characteristics of *T. latifolia* and *T. angustifolia* (Kuehn and White 1999). The gap between the pistillate spike and the staminate spike can range from 0-33 mm (Grace and Harrison 1986). Mature pistillate spikes are dark brown and the pistillate bracteoles pale and the stigmas are linear. The pollen is sometimes abortive with monads, diads, triads, and tetrads (Grace and Harrison 1986). *Typha* x *glauca* is highly sterile and produces very few or no seeds or viable pollen grains.

Fruits and Seeds:
Pistillate spikes usually persist into winter, when dry fruiting flowers often fall in masses. Fruits are small follicles, football-shaped, splitting longitudinally in water to release the seed. Seed counts per spike have been estimated ranging from 20,000 to 700,000 (Prunster 1941, Marsh 1962, Yeo 1964 in Grace and Harrison 1986). *Typha domingensis* is noted to not mature fruits on the cold coast of northern California. *Typha* x *glauca* may not produce any viable seeds.

Hybrid information
Hybrid descriptions included here are taken directly from Smith (2000) Flora of North America *Typha* treatment.

Typha x *glauca*: *T. latifolia* × *T. angustifolia* (=*T. ×glauca* Godr., pro sp.), Besides this parentage, Simon (2000) also notes that fertile or sterile intermediates between *T. ×glauca* and *T. angustifolia* occasionally occur, however. In spite of its sterility, *T. × glauca* is remarkably successful ecologically. It often spreads by means of rhizomes to form often very large clones and out-competes the parental species, especially in eutrophic, disturbed habitats with unstable water levels (S. W. Harris and W. H. Marshall 1963; S. G. Smith 1987).

Typha domingensis × *T. latifolia* (= *T. × provincialis* A. Camus, *T. bethulona* Costa) is known only from very few collections in Arkansas, California, Florida, Missouri, Nebraska, and North Carolina. All of these are highly sterile putative F_1s except for one putative F_2, in which the characteristics of the parental species are recombined, from southern California.

Typha angustifolia × *T. domingensis* is known from scattered specimens in Arkansas, California, Kansas, Kentucky, Missouri, and Nebraska. It is not known from the southeast coast, perhaps because of differences between the species in flowering dates. Most plants are highly fertile, and some may be F2 or later generation hybrids

Putative *T. angustifolia* × *T. domingensis* × *T. latifolia* trihybrids are locally common in California and rare in south-central United States. Introgression between the interfertile *T. angustifolia* and *T. domingensis* is presumably probably locally common in the south-central U.S. and north-central California, while introgression between *T. latifolia* and the other two species is probably very uncommon because of hybrid sterility. Published research presumably demonstrating introgression (e.g., N.C. Fassett and B. M. Calhoun 1952) is faulty (S. G. Smith 1967, 1987). The tetraploid *T. orientalis* of the Pacific Basin may be of hybrid origin (B. G. Briggs and L. A. S. Johnson 1968; S. G. Smith 1967, 1987).

Typha minima

Image, Typha minima, image by Andrea Moro, University of Trieste, Progetto Dryades, http://luirig.altervista.org

Typha minima Funck ex Hoppe, commonly called miniature cattail or dwarf cattail, is a non-native cattail species native to parts of Asia and Europe USDA ARS (2013). *Typha minima* looks like a miniature version of these other, larger, cattail species. It is described by Flora of China Editorial Committee (2010) as having: slender stems growing 16-65 cm tall; leaves usually basal and sheath-like and shorter than the scape; male part of flower spike 3-8 cm, with one deciduous bract at its base; female part of spike distinctly separate from the male, 1.6-4.5cm with bract at base. Its smaller size, narrow leaves and rounded female portion of the spike make this *Typha* species distinctly different from these other non-native *Typha* species. Currently there are not any herbarium records or known escaped populations of *T. minima* in the Pacific Northwest. *Typha minima* is sold as an ornamental pond plant and may also be used in floral arrangements. It is listed on New Hampshire's prohibited aquatic species list USDA ARS (2013).

Look-alikes:

Typha latifolia L., broad-leaved cattail or common cattail, Washington's only native *Typha* species, is distributed widely throughout Washington State and throughout North America and would not be included in this listing. *Typha latifolia* has erect stems growing 1.5-3 meters tall.

Leaves:

The erect shoots of *Typha latifolia* are more fanlike when young than in other North American species because the proximal leaves (dying by mid season) spread more widely. Leaves can appear glaucous when fresh. Leaf blades up to 120 cm long by 1-2.5 cm wide with the distal portion of the blade flat (DiTomaso and Healy 2003). Leaves are sheathing at the base, sheath sides are papery or membranous, margins narrowly clear and the summit tapered into blade to distinctly shouldered (truncate), or rarely with firm paper auricles. The mucilage glands at the sheath-blade transition are usually colorless and obscure. Mucilage glands are absent from the leaf blade and the center of the sheath. The widest leaf

blades on shoot are 10-23 (-29) mm wide when fresh, distal blades about equaling inflorescence or occasionally slightly overtopping it (Smith 2000, Grace and Harrison 1986).

Inflorescence:

The staminate spike of *Typha latifolia* is continuous with the pistillate spike or rarely in some clones separated by a small gap up to 4 (-8) cm of naked axis. The staminate scales are colorless to straw-colored, filiform and simple. Staminate flowers are 5-12 mm and consist of 2-7 deciduous stamens and small, colorless hairlike bracts (bracteoles) (DiTomaso and Healy 2003). Anthers are 1-3 mm and shed

Image: *Typha domingensis* inflorescence above, *Typha latifolia* inflorescence below. Image credit: Tony Valois, Wildflowers of the Santa Monica Mountains National Recreation Area.

pollen in tetrads (clusters of 4 grains). Pollen grains of some *T. latifolia* plants separate slightly and may be shed partly as mixtures of triads, dyads, and monads, perhaps due to introgression (S. G. Smith unpublished in Smith 2000).

The pistillate spikes are pale green in flower and dry to a brownish, then later blackish brown or reddish brown color. Pistillate spike is 5-25 cm long by 5-8 mm wide in flower expanding to 24-36 mm across in fruit. Pistillate flowers are 2-3 mm in flower and 10-15 mm in fruit. Pistil hair tips are colorless and appear whitish in mass, not enlarged, with persistent stigmas forming a solid layer on the spike surface. Pistillate flowers are without bracteoles and the stigmas are flattened, lanceolate to ovate-lanceolate (Grace and Harrison 1986). Carpodia are exceeded by, and hidden among pistil hairs, straw-colored, with a rounded apex. *Typha latifolia* flowers late spring to summer in northern regions and spring to early summer in southern regions. In fruit, the pistillate spikes are often mottled with whitish patches of pistil-hair tips.

Grace and Harrison (1986) note the following characteristics as the best traits to distinguish *Typha latifolia* in the field: its broad, flat leaves that rarely overtop the inflorescence, the usually contiguous (or only slightly separated) staminate and pistillate spikes, and the robust dark brown pistillate spike at maturity. *Typha latifolia* hybridizes with the other North American cattail species, *T. angustifolia* and *T. domingensis* where their distributions overlap. Hybrid swarms of all 3 species have been identified in central California (Gucker 2008).

Images: Left, comparison image of *Typha angustifolia* (left) and *T. latifolia* (right) female spike color; center, width of a *T. angustifolia* leaf; right, T. *latifolia* leaf width. Images Richard Lutz, http://iowaplants.com

Habitat:
Typha species and hybrids grow in wet or saturated soils and aquatic sediments in marshes, wet meadows, lakeshores, pond margins, seacoast estuaries, ditches, bogs and fens (Grace and Harrison 1986). They can invade managed and recreation aquatic systems including canals, ditches, reservoirs, cultivated fields, farm ponds and swimming and boating areas (Grace and Harrison 1986, Smith 2000).

Geographic Distribution:
T. *domingensis*:
In Flora of North America, Smith (2000) notes it grows 0-2,000 meters elevation and occurs in the following places:

- United States (Alabama, Arizona, Arkansas, California, Colorado, Delaware, Florida, Georgia, Illinois, Kansas, Kentucky, Louisiana, Maryland, Mississippi, Missouri, Nebraska, Nevada, New Mexico, North Carolina, Oklahoma, South Carolina, Texas, Utah, Virginia, Wyoming),
- Mexico
- West Indies
- Central America
- South America
- Eurasia
- Africa
- Pacific Islands (New Zealand)
- Australia

Smith (2000) additionally notes that *Typha domingensis* probably should be treated as a highly variable pantropic and warm temperate species, occurring to 40º E north and south latitude worldwide.

Typha angustifolia:
Because of many misidentified specimens, range expansion in recent years, and undercollecting, the distribution on the margins of the main range of *Typha angustifolia* is somewhat uncertain (Smith 2000). In recent decades it has expanded its range in many regions and become more abundant, especially in roadside ditches and other highly-disturbed habitats. USDA ARS (2013) lists the following localities as part of *T. angustifolia*'s native range:
- Northern Africa (Algeria, Morocco),
- Temperate parts of Asia (Afghanistan, Lebanon, Syria, Turkey, Armenia, Azerbaijan, Georgia, Russian Federation, Kazakhstan, Uzbekistan, Mongolia, China),
- Europe (Denmark, Finland, Ireland, Norway, Sweden, United Kingdom, Austria, Belgium, Czech Republic, Slovakia, Germany, Hungary, Netherlands, Poland, Switzerland, Belarus, Estonia Latvia, Lithuania, Moldova, Ukraine, Bulgaria, Former Yugoslavia, Romania, France, Portugal, and Spain),
- Canada (New Brunswick, Nova Scotia, Ontario, Prince Edward Island, Quebec, Manitoba, Saskatchewan),
- United States (Connecticut, Indiana, Maine Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, Illinois, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, Wisconsin, Colorado, Wyoming, Delaware, Kentucky, Maryland North Carolina, South Carolina and Virginia).

Whether *Typha angustifolia* is native to eastern North America, or not to North America at all, is still unclear. Shih and Finkelstein (2008) studied herbarium records that suggest *T. angustifolia* may have been present in North America prior to European settlement, but it was not widespread. Recent research using microsatellite data and chloroplast DNA sequences do suggest though that *T. angustifolia* is an introduced species from Europe due to the high level of genetic similarity between North American and European populations that is indicative of relatively recent intercontinental dispersal (Ciotir et al. 2013).

Typha x *glauca* was described in Europe during the late 1800's but was not well recognized in North America until the 1950's (Kantrud 1992). The appearance of *T. x glauca* in the record soon after the arrival of *T. angustifolia* points to the fact that hybrids were not always widespread. Kantrud (1992) noted that *T. x glauca* went from being present in central North Dakota wetlands to becoming the most abundant hydrophyte in the state in the span of twenty years. Similarly, *T. domingensis* is a species

native to southern latitudes of North America, but has been spreading northward. *T. domingensis* can hybridize with *T. angustifolia* and *T. latifolia*. All of these *Typhas* have demonstrated invasive tendencies by their recent colonization of areas outside of their historic occurrences.
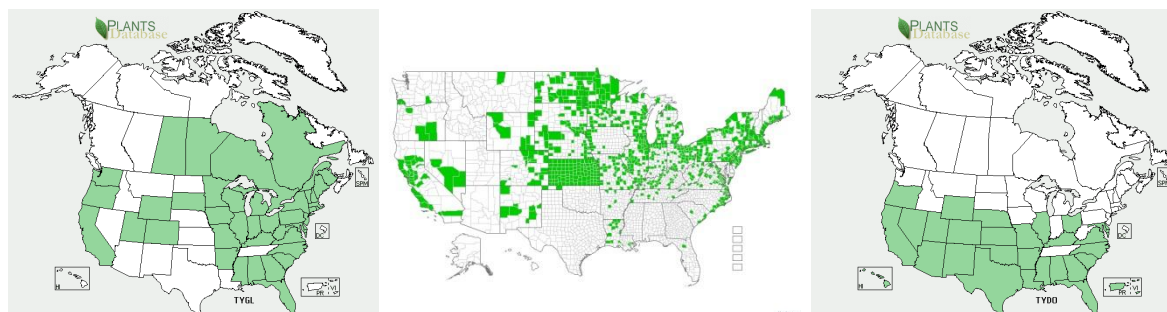

Image: Left, map of United States with documented Typha x glauca, image: USDA Plants 2013; Map of counties in the United States with the documented *T. angustifolia*, image EDDMaps 2013; Right, map of United States with documented *T. domingensis*, though not shown on this map, it has been documented in Washington State, image USDA Plants 2013.

Listings:
Typha x *glauca* is listed in Wisconsin as a restricted wetland species (under Chapter NR 40) and on Pennsylvania's Department of Conservation and Natural Resources Invasive Plant list of wetland plants. *Typha angustifolia* is listed on the Washington State Noxious Weed Control Board's monitor list, Wisconsin's restricted wetland species (under Chapter NR 40), and Pennsylvania's Department of Conservation and Natural Resources Invasive Plant list of wetland plants. Though not on an official state weed list, *T. angustifolia* and *T.* x *glauca* are listed as invasive plants to agricultural and ecological locations in North Dakota.

History and Distribution in Washington:
Typha domingensis and a hybrid *T. latifolia* x *T. domingensis* were first documented in Washington state in 2001 (Parsons and Smith 2004). These plants were found on the shores of lakes in the channeled scablands of central Washington where there is an abundance of *Typha* habitat that likely contain additional populations (Parsons and Smith 2004).

The earliest herbarium record of *Typha angustifolia* in Washington is from along Chinook River in Pacific County in 1957 (WTU 208019), with the next earliest collection from along the east margin of Grays Bay in Wahkiakum County in 1981 (WTU 284678) and the next from Benton County in 1984 (WS 290874). Herbarium records first document *T.* x *glauca* in Washington in 1997 in King County at Lake Sawyer (WTU 335393). The next earliest records of are of collections in Snohomish County at the Snohomish River Delta in 2002 (WTU 350444) and in Pierce County by the shore of Johnson Marsh in 2002 (WTU 355110). Known population locations compiled by David Heimer of the Washington State Department of Fish and Wildlife and Jenifer Parsons of the Washington State Department of Ecology are listed in Table 1.

Table 1. Non-native *Typha* species and hybrid population in Washington State (Heimer and Parsons 2013).

Species	County	Location
Typha angustifolia	Benton	Eastlake Pond
	Franklin	Mesa Lake
	Grant	Blythe Lake, Lower Crab Creek, Red Rock Lake
	Grays Harbor	Route 109 & Paulson Road, Hoquiam; Failor Lake
	King	Duwamish River, Lucerne Lake, North Lake, Otter

		(Spring) Lake, Pipe Lake, Lake Sammamish, Walsh Lake, Wilderness Lake
	Pacific	Chinook River
	Pierce	Bonney Lake, Clear Lake, Commencement Bay, Lake Kapowsin, Tanwax Lake
	Skagit	Sixteen Lake, South Skagit Bay
	Snohomish	Ebey's Slough, Quilceda Creek
	Spokane	Amber Lake, Badger Lake
	Thurston	Capitol Lake, Long Lake
	Wahkiakum	Grays Bay on Columbia River
	Whatcom	Stormwater ponds in North Bellingham
	Whitman	WSU Campus
Typha domingensis	Adams	Herman Lake, Hutchinson Lake
	Grant	Burke Lake
Typha x glauca	Grant	Unnamed pond (16N-23E-35)
	King	Sawyer Lake
	San Juan	Orcas Island private pond
	Skagit	Sixteen Lake
	Spokane	Liberty Lake
	Whatcom	Lake Terrell
T. latifolia x T. domingensis	Adams	Hutchinson Lake
	Grant	Burke Lake

Additional populations documented by herbarium records from the University of Washington Burke Herbarium that are not included in the table are as follows:
Typha angustifolia:
- SE of junction of Rainshadow Road and False Bay Drive, San Juan Island, San Juan County, WA (WTU 389137)
- Wawawai Road, Wawawai Canyon, Whitman County, WA (WTU 364530)
- Clear Lake, Pierce County, WA (WTU 370403) Jenifer Parsons s.n.

Typha x *glauca*:
- Duwamish River south of Seattle, King County, WA (WTU 368383)
- Grays Bay, near Pigeon, Wahkiakum County, WA (WTU 355110)
- Johnson Marsh, Fort Lewis, Pierce County, WA (WTU 379643)
- Snohomish River delta, Marysville, Snohomish County, WA (WTU 350444)

Biology:
Growth and Development:
Typha species tend to form extensive, almost pure stands in marshy areas (Hitchcock et al. 1969). *Typha angustifolia* and *T.* x *glauca* are noted to commonly form dense stands of live and dead biomass in coastal marshes of the Great Lakes (Vaccaro et al. 2009). Young plants produce multiple rhizomes and typically flower in their second year (Yeo, 1964 in Selboe and Snow 2004). In established stands, spring growth is high with deep water shoots tending to sprout before shoots in more shallow waters. *Typha* species generally produce leaves in the spring, flower in early to mid summer and have the greatest peak of rhizome growth in the fall that will constitute the first cohort of the follow spring (Grace and Harrison 1986). A study in Wisconsin found that total non-structural carbohydrates were at a maximum in old

rhizomes in early winter and that they gradually declined to a minimum in late June when flowering, which would be the time the plant is most susceptible to injury (Beule 1979).

Once *Typha* plants have senesced, they typically remain upright for 6-18 months before fragmenting, falling over and forming a litter layer (Davis and van der Valk 1978 in Vaccaro et al. 2009). Litter accumulation and biomass can vary depending on the setting (Vaccaro et al 2009).

Inflorescences are wind pollinated. All *Typha* and hybrids are protogynous, with the stigmas receptive several days prior to pollen release. Stigmas may still be receptive as pollen starts to release from its spike, so while outcrossing is favored, self-pollination may happen (Smith 1967 in Grace and Harrison 1986). Their small single-seeded fruits are dispersed and germinate on bare wet soils or under very shallow water (Smith 2000).

Non-native *Typha* species and hybrids may be found growing in the same habitats as native *Typha latifolia*. In stands where *Typha latifolia* and *T. angustifolia* grew mixed, *T. latifolia* density was reduced by 32 percent while *T. angustifolia* density was reduced by 59.4 percent compared to single species stands (Grace and Wetzel 1998). In a 32-year study, *Typha latifolia* actively restricted *T. angustifolia* from shallower locations (Grace and Wetzel 1998), while it has been shown that *T. domingensis* and *T. angustifolia* have a greater tolerance to deep water than *T. latifolia*, which died out from depths greater than 95 cm (Grace 1989). *Typha angustifolia* and *T. domingensis* can also tolerate a higher degree of salinity than *T. latifolia* (DiTomaso and Healy 2003).

Image: *Typha angustifolia* growing at 2.8 meters water depth in Clear Lake, Washington, image Jenifer Parsons, DOE.

Reproduction:
Typha species and hybrids can spread by rhizomatous growth and by seed (except for in most cases by *T.* x *glauca*). Plants are wind-pollinated (Grace and Harrison 1986 in Selboe and Snow 2004) and seeds are dispersed by wind, water, soil movement, human activities and by clinging with mud to the feet and fur of people and animals (DiTomaso and Healy 2003). Seeds primarily germinate in the spring on bare wet soils or under very shallow water. If conditions are favorable, seeds are capable of immediate germination, but if not, seeds may retain viability for long periods (Grace and Harrison 1986, van der Valk and Davis 1976 in Grace and Harrison 1986).

Establishment of new populations occurs often by seeds and then commonly spreads locally through vegetative growth of rhizomes (DiTomaso and Healy 2003). Plants can also spread by rhizome fragments that are moved to another location by tillage, water, and substrate movement and grow into new plants (DiTomaso and Healy 2003).

Hybrid seedlings are likely wherever two species form mixed stands and bare wet soil is available for seed germination and seedling establishment (Smith 2000). Hybrid populations are only found in regions where *T. latifolia* and *T. angustifolia* exist sympatrically (Shih and Finkelstein 2008). *Typha latifolia* and *T.*

angustifolia are now sympatric across a broad area in North America, and their hybrid, *T*. x *glauca* is commonly identified in areas where the parental species co-exist (reviewed in Galatowitsch et al. 1999; see also Kirk et al. 2011a; Travis et al. 2010 in Ciotir et al. 2013).

Control:
Typha species tend to invade and form monotypic stands in preferred habitats when hydrology, salinity or fertility change. Maintaining water flows into wetlands, lowering nutrient inputs and returning salinity to pre-disturbance levels will help maintain desirable plant communities (Stevens and Hoag 2006).

Mechanical Methods:
Mowing, burning, tilling and flooding have been used in combinations to control *Typha* species and hybrids.
Apfelbaum (1985) reviewed cattail control methods and found that control by all mechanical means was more a function of the relationship between water depth and height of the cut cattails than the methodology of cutting them. As long as flooding covered the entire cut cattail stem, reliable control of cattails could be achieved within several growing seasons (Apfelbaum 1985).

Mowing or clipping *Typha* species can be effective at controlling plants. In the Skagit Delta, Hood (2013) conducted an experiment on *T. angustifolia*, mowing it four times over the course of four years in a tidal marsh. The results were positive with native sedge (*Carex lyngyei*) and spikerush (*Elocharis palustris*) returning by year five. In trials by Sale and Wetzel (1983), they found that three below-water cutting during the growing season were enough to kill nearly all underwater structures. Similar cuts to plants above water reduced the total biomass, but much of the underwater structures remained healthy and able to regenerate. If a small amount of living or dead leaf material is left extending above the water, it is enough to supply adequate amounts of oxygen to the rhizomes and roots to prevent them from being killed.

If plants are cut above water, there will be considerable regrowth of plant material. In one experiment, stems were cut leaving 7 cm (3 inches) above the water surface, and no apparent kill resulted from the treatment (Nelson and Deitz 1966 in Beule 1979). Whereas in the same experiment, stems that were cut with at least 7 cm (3 inches) of water remaining over cut stems, more than 90% of the *Typha* reproduction was killed. The maintenance of water over the cut stubble is noted to be important in a number of studies if cutting is to be used as a control measure (Linde et al., 1976 in Sale and Wetzel 1983). Timing of the cutting treatment is also important. Cutting stems in May allowed for the best recovery of *Typha,* while cuttings that took place after May, resulted in better control with cutting in August (with cut plants being covered in water) resulted in 80% control in one experiment (Beule 1979).

Fire may be used as part of a *Typha* management plan. Fire will reduce aboveground plant debris, opening up stands for nesting waterfowl. *Typha* marshes are difficult to burn 2 years in a row though because accumulated plant debris is needed for fuel. The thick bases of *Typha* species are often the last part of the plant to dry out and are difficult to burn (Snyder 1993). Spring burning alone was not effective at controlling *Typha* in a Kansas wetland but did provide helpful site preparation before other management treatments were used (Kostecke et al. 2004). Ball (1990) compared mowing and burning treatments over ice in early spring, which were then flooded. Both treatments significantly reduced shoot density with mowing being significantly superior to burning at suppressing regrowth in shallow water, while in deeper water there was no significant difference between them. Kostecke et al. (2004) found discing or high-intensity grazing following prescribed burning effective in *Typha* control in a wetland

up to one year after treatment but also reduced non-*Typha* species diversity and shoot density. In this study, discing seemed to provide longer *Typha* suppression than the high intensity grazing, but ongoing management will still be needed. Also, if fire is prescribed during a drawdown followed by reflooding, it could eliminate standing cattail stems and reduce the need for cutting (Apfelbaum 1985).

Typha control by injuring developing rhizomes and shoots was investigated (Weller 1975). Crushing plants and reflooding showed that cattails injured after June had poor recoveries. Weller (1975) found that the success of crushing depended on the load used, number of times an area was crushed, and standing water depths after treatment. Spring and early summer treatments generally created favorable seedbeds for *Typha* that required a fall crushing to control seedlings. Crushing in this treatment involved pulling a 55-gallon water-filled drum behind a tractor. Deeper water areas showed highest control (up to 100 percent) while regrowth occurred in shallow areas.

Shading
Shading with black polyethylene tarps was experimented with to cover *Typha* species. Covering destroyed actively-growing plant tops wherever they were completely covered for a minimum of 60 days (Beule 1979). Wherever the tarps were ripped or disturbed, living stems were still present (Beule 1979). Using a sturdier tarp and being able to weight down tarps and keep them in place regardless of water depth, may work on small patches of *Typha*. Being able to apply this method on a large scale though would be limited.

Cultural Methods:
Manipulating water levels, if possible, is another technique that may be incorporated into a *Typha* management plan. Using water drawdowns to reduce *Typha* species and allow the establishment of annual species preferred by most waterfowl is a management option (Kadlec and Wentz 1974 in Grace and Harrison 1986). Increasing the water level may prevent *Typha* establishment. *Typha angustifolia* establishment was prevented when water levels were maintained at 1.2 m (47 in) or deeper (Steenis et al. 1958 in Apfelbaum 1985).

Biological Control:
During mechanical control trials in Wisconsin Buele (1979) noted deer eating the tops of succulent *Typha* seedlings less than 46 cm (18 inches) tall and the basal portions of resprouts less than 1 meter (3 feet) tall. Muskrats also continually fed on *Typha* during the trials and used plants for house building (Beule 1979).

Chemical methods:
The Pacific Northwest Weed Management Handbook provides the following recommendation for *Typha* species control using herbicide:
- Apply 2,4-D ester to plants before cattail heads appear in spring at a rate of 6 lb ae per 100 gal of spray solution for spot treatments with adding crop oil, diesel oil, or surfactant to increase wetting. Make sure to avoid drift to sensitive crops. Follow-up treatment will be needed.

- Apply glyphosate, a non-selective herbicide, to mature cattail plants after heads are formed and before frost at 3 lb ae/A. Glyphosate is a non-selective herbicide that will control grasses as well as other vegetation it comes in contact with.

- Apply imazapyr (Habitat) after cattail heads appear in the boot or after head emerges and before killing frost at 0.5 to 1 lb ae/A. Make sure not to apply in the root zone of desirable trees. Treated water cannot be used for irrigation for 120 days.

Select wick, broom or hand-spray applications in mid to late summer, followed by cutting and removing dead stems approximately a week later. Retreatment may be necessary due to *Typha* species' massive root system (Heimer and Parsons 2013).

Please refer to the PNW Weed Management Handbook, available online at http://weeds.ippc.orst.edu/pnw/weeds for further and specific herbicide instructions, as herbicide recommendations may have changed since the time of this writing.

Please note: Use of pesticides in water is regulated in Washington. All applicators must have an aquatic endorsement on their pesticide applicators' license, which is issued by the Washington State Department of Agriculture. In addition, coverage under a permit issued by the Department of Ecology is required. See http://www.ecy.wa.gov/programs/wq/pesticides/index.html for details.

Economic Importance:

Detrimental:
Invasive *Typha* species represent a threat to Washington through displacing native plants, through changing the genetic profile of native *Typha* stands, and through altering how organisms use marsh habitat. Non-native *Typha* species and hybrids can also be a serious problem in irrigated agricultural and managed aquatic systems.

Invasive *Typha* are capable of displacing native plants because of their tolerance to deeper water and to more saline conditions. Higher tolerance to depth and salinity means that the potential range that invasive *Typha* are capable occupying is much greater than the current distribution of *T. latifolia*. When competing with *T. angustifolia*, *T. latifolia* was restricted to shallower zones and could grow no deeper than about 37 cm (Grace and Wetzel 1998), while *T. angustifolia* could grow to depths greater than 100 cm (Grace and Wetzel 1982; Inoue and Tsuchiya 2009). Similarly, *T. domingensis* had a maximum depth of 150 cm (Grace 1987) and is invasive in brackish wetlands even in its native range (Smith 2000). The growth of invasive *Typha* into deeper habitats and their creation of very dense, monotypic stands can reduce, or eliminate emergent and submerged native plants through shading and resource competition. In a study by Selbo and Snow (2004), *T. angustifolia* was fifteen times more abundant that *T. latifolia*.

Allelopathy, through root exudates, may be a mechanism that confers a competitive advantage to *T. angustifolia* (Jarchow and Cook 2009). Roots exudates of *T. angustifolia* had an effect in greenhouse tests on river bulrush, *Bolboschoenus fluviatilis*, reducing longest leaf length, ramet number and biomass when activated carbon was not present (Jarchow and Cook 2009). Gallardo et al. (1998) found that aqueous extracts of *T. domingensis* were found to inhibit the growth of common water fern, *Salvinia minima*, with the root extracts being the most inhibitory.

In addition, in litter experiments *T. x glauca* was shown to outperform native plants in the uptake of nitrogen (Larkin et al. 2012). The net effect of this nutrient competeiveness over multiple seasonal studies could be to move nitrogen away from native species into living and dead *T. x glauca* biomass (Larkin et al. 2012). Vaccaro et al. (2009) also found a reduction in non-*Typha* species density and seedling survival with an increase in *Typha* litter. While clonal species studied were not affected by the

Typha litter, annual or non-clonal herbaceous plants with less below ground storage did not survive in cattail litter additions and could be vulnerable to accumulation of litter, causing a reduction in plant diversity.

The potential hybridization by invasive *Typha* threatens the genetic integrity of native *T. latifolia* marshes. Both *T. angustifolia* and *T. domingensis* have the ability to hybridize with *T. latifolia*. Since 1888, *T. x glauca* has been recognized as an interspecific hybrid in Europe (Smith 1987 as cited in Galatowitsch et al. 1999). *Typha x glauca* is more competitive than either parent (McDonald 1955; Grace and Wetzel 1981, 1982 a & b; Smith 1987; Waters and Shay 1990, 1992 as cited in Galatowitsch et al. 1999) which can lead to a replacement of *T. latifolia*. Backcrosses by the F$_1$ generation (Snow et al. 2010) can further alter the genetic diversity of native *Typha latifolia* populations making identification and conservation of these populations difficult. A similar situation occurred when the invasive *Spartina alterniflora* hybridized with the native *Spartina foliosa* in San Francisco Bay (Daehler and Strong 1997) making identification and control difficult. *Typha domingensis* will hybridize with *T. latifolia* (sometimes called *T. x provincialis*), with progeny that are usually sterile, though F2 plants are known from California. *Typha angustifolia* and *T. domingensis* hybridize to form fertile offspring. Trihybrids of *T. latifolia* x *T. angustifolia* x *T. domingensis* are common in parts of California (Smith 2000). The hybrids *T.* x *glauca* and *T. latifolia* x *T. domingensis* are both present in Washington.

Once established, invasive *Typha* change higher trophic level dynamics in the marsh. For example, microalgal densities were found to be even lower on *T. angustifolia* than on *Phragmites* in a freshwater wetland, possibly due to allelopathic leachates (Kulesza et al. 2008). In a study on amphibians, Maerz et al. (2010) found that treatments containing plant detritus with high C:N (i.e. *Typha angustifolia*) resulted in poor metamorph production and performance. In addition, ducks tend to avoid wetlands with monotypic vegetation like hybrid cattail. This is likely due to reduced abundance of shallow aquatic plants and their associated invertebrates, which female ducks and their young feed on (Kantrud 1992). Similarly, Hood (2013) found that ducks utilized sites where *T. angustifolia* had been removed and replaced by *Carex lyngbyei*, but not the *T. angustifolia*-dominated control site.

Non-native *Typha* species and hybrids can present a serious problem in irrigated agricultural lands and managed aquatic systems (National Academy of Sciences-National Research Council 1976 in Grace and Harrison 1986). While being especially troublesome in rice fields (Muenscher 1955 in Grace and Harrison 1986), *Typha* species can invade irrigation canals, farm ponds, and drainage ditches, impeding water flow and increasing siltation (Grace and Harrison 1986). Also, *Typha* stands, primarily of *T.* x *glauca*, that were near sunflower fields in North Dakota provided roosting sites for birds that damaged crops before harvest (Ralston 2004). Swimming, boating, fishing and other recreational activities can also be impacted by the invasion of *Typha*. Reservoirs in Canada and the western United States have also been impacted by *Typha's* rapid invasion of sandbars and influence on siltation rates (Fletcher and Elmendork 1955 and Hallock 1973 in Grace and Harrison 1986).

While people use *Typha* species as a food source, intoxication of livestock has been suspected in a few cases with signs primarily related to digestive tract problems, but one case involved stiffness, tremors, and sweating in horses (Hansen 1930 in Burrows and Tyrl 2013). Cattle and sheep did not experimentally show any signs of intoxication to the leaves (Morton 1975 in Burrows and Tyrl 2013) and overall there is unlikely significant risk to livestock (Burrows and Tyrl 2013).

Typha species also have a high growth rate that allows it to establish and produce a high quantity of biomass in a short period of time. *Typha* productivity and growth rates have been quantified in Indiana

(Apfelbaum et al. 1983, Wilcox, Apfelbaum, and Heibert 1984). Apfelbaum (1985) reports that based on dry weight, cattails contributed 700 kilograms (1543 pounds) of biomass per hectare (approx. 600 lbs/acre) where it grew in monocultures. Estimates made from aerial photographs showed growth increased from 2 to 37.5 hectares (5-93acres) from 1938 to 1982. This study also confirmed declines in sedge-grass and prairie meadow vegetation as cattail increased (Apfelbaum 1985). At Horicon Marsh in Wisconsin, *Typha* monocultures increased from 30 to 80 percent cover from 1947 to 1971 and associated vegetation declined (Linde 1963, Bedford, Zimmerman, and Zimmerman 1974, Wisconsin DNR 1971 in Apfelbaum 1985).

Beneficial:
Native *Typha* species have many beneficial uses, and the most common *Typha* species in Washington is the native species *Typha latifolia*. Due to their limited distribution and seemingly recent introduction based on herbarium records, it is unknown if the non-native *Typha* species or hybrids have any beneficial uses here in Washington State.

There is extensive information on the use of *Typha* species as a food source and for its use in dwellings, mats, baskets and handicraft objects in different parts of the world (Smith 2000, Grace and Harrison 1986). Historically, *Typha* species were used by Native Americans for food products and medicines, though that is not as common now (Smith 1987 in Gallardo et al. 1999).

Typha species can also provide food and shelter for wildlife. Stands of *Typha* can be used for wildlife habitat and food sources (i.e. for muskrats) when it is interspersed with open water (Beule 1979) *Typha* species also stabilize shorelines, protecting them from erosion due to waves.

Gallardo et al. (1999) notes how *Typha* species are being studies for their ability to remove various kinds of pollutants from wastewater, including phosphorus (DeBusk et al. 1995), nitrogen (Zhu and Silora, 1995) and heavy metals (Karathanasis and Mithcell 1995; DeBusk et al. 1996).

Typha latifolia and *T. minima* inflorescences have been used in decorative arrangements and as pond ornamentals, but it is unknown if any non-native species or hybrids have been used in this manner.

Rationale for Listing:
Nonnative, invasive *Typha* species are capable of displacing native plants, changing the genetic profile of native *Typha* stands, altering marsh habitat, and invading managed aquatic systems. These *Typhas* have been documented for invasiveness in many parts of the country and currently have a limited distribution in Washington, although recorded occurrences are increasing. Control of known populations while they are still small and more manageable will help prevent these nonnative, invasive species from dominating valuable wetland habitat. A Class C listing will increase awareness of the invasiveness of these nonnative *Typha* species and their hybrids and will give county weed control boards the option of mandatory, local control.

References:
Apfelbaum, S. I. Cattail (*Typha* spp.) Management. Natural Areas Journal, 1985.

Ball J.P. Influence of subsequent flooding depth on cattail control by burning and mowing. Journal of Aquatic Plant Management 28:32–36. 1990.

Beule, J. D. Control and management of cattails in southeastern Wisconsin wetlands Technical Bulletin No. 112. Madison, WI: Department of Natural Resources. 40 p. 1979.

Burrows, G. E. and R. J. Tyrl. Toxic Plants of North America, Second Edition. John Wiley & Sons, Inc. pp. 1268-1269. 2013.

Ciotir, C., H. Kirk, J. R. Row, and J. R. Freeland. Intercontinental dispersal of *Typha angustifolia* and *T. latifolia* between Europe and North America has implications for *Typha* invasions. Biological Invasions 15: 1377-1390. 2013.

Daehler, C.C. and D.R. Strong. Hybridization between introduced smooth cordgass (*Spartina alterniflora*; Poaceae) and native California cordgrass (*S. foliosa*) in San Francisco Bay, California, USA. American Journal of Botany 84:607-611. 1997.

DiTomaso, J. M. and E. A. Healy. Aquatic and Riparian Weeds of the West. University of California Agriculture and Natural Resources Publication 3421. Pp 378-386. 2003.

Flora of China Editorial Committee. Flora of China (Acoraceae through Cyperaceae). 23: 1–515. In C. Y. Wu, P. H. Raven & D. Y. Hong (eds.) Fl. China. Science Press & Missouri Botanical Garden Press, Beijing & St. Louis. 2010.

Galatowitsch, S.M., N.O. Anderson and P.D Ascher. Invasiveness in wetland plants in temperate North America. Wetlands 19:733-755. 1999.

Gallardo, M., Martin, B., Martin, D. Why cattails spread in Florida waters. Aquatics. 1999.

Grace, J. B. Effects of Water Depth on *Typha latifolia* and *Typha domingensis*. American Journal of Botany, 76 (5): 762-768. 1989.

Grace, J.B. and R.G. Wetzel. Niche differentiation between two rhizomatous plant species: *Typha latifolia* and *Typha angustifolia*. Canadian Journal of Botany 60:46-57. 1982.

Grace, J.B. and R.G. Wetzel. Long-term dynamics of *Typha* populations. Aquatic Botany 61: 137-146. 1998.

Gucker, C. L. *Typha latifolia*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). 2008. Available: http://www.fs.fed.us/database/feis/ 2013, May 30.

Heimer, D. and J. Parsons. A Request to List All Non-Native *Typhas (Typha angustifolia* L*, Typha x glauca*, *Typha domingensis* Pers. and related hybrids) as B-Class Noxious Weeds for 2014. 2013.

Hitchcock, C. L., A. Cronquist, M. Ownbey, and J. W. Thompson. Vascular Plants of the Pacific Northwest. Volume 1. University of Washington Press. 1969.

Hood, W.G. Applying and testing a predictive vegetation model to management of the invalsive cattail, *Typha angustifolia* l., in an oligohaline tidal marsh reveals priority effects caused by non-stationarity. Wetlands Ecology and Management. 2013.

Jarchow, M.E. and B.J. Cook. Allelopathy as a mechanism for the invasion of *Typha angustifolia*. Plant Ecology 204:113-124. 2009.

Kantrud, H.A. History of cattails on the prairies: Wildlife impacts. In Proceedings Cattail Management Symposium, Fargo, North Dakota February 12, 1992. George A. Linz, Symposium and Proceedings Editor. 1992.

Kostecke, R. M., L. M. Smith, and H. M. Hands. Vegetation response to cattail management at Cheyenne Bottoms, Kansas. Journal of Aquatic Plant Management. 42:39-45. 2004.

Kuehn, M. M., and B. N. White. Morphological analysis of genetically identified cattails *Typha latifolia*, *Typha angustifolia*, and *Typha* x *glauca*. Canadian Journal of Botany 77: 906-912. 1999.

Kulesza, A.M., J.R. Holomuzki, and D.M. Klarer. Benthic community structure in stands of *Typha angustifolia* and herbicide-treated and untreated *Phagmites australis*. Wetlands 28:40-56. 2008.

Lutz, R. W. http://iowaplants.com/index.html accessed May 30, 2013. Not dated.

Maerz J.C., J.S. Cohen and B. Blossey. Does detritus quality predict the effect of native and non-native plants on the performance of larval amphibians? Freshwater Biology 55:1694-1704. 2010.

Parsons, J. K. and S. G. Smith. Noteworthy Collections. Madroño, Vol. 51 (4) pp. 389-390. 2004.

Ralston, S. T., G. M. Linz, and W. J. Bleier. Quantification of cattail (*Typha* spp.) in the prairie pothole region of North Dakota in relation to blackbird damage to sunflower. *USDA National Wildlife Research Center - Staff Publications.* Paper 351. 2004.

Sale, P. J. M., and R. G. Wetzel. Growth and Metabolism of *Typha* species in relation to cutting treatments. Aquatic Botany 15: 321-334. 1983.

Selbo, S.M. and A.A. Snow. The potential for hybridization between *Typha angustifolia* and *Typha latifolia* in a constructed wetland. Aquatic Botany 78:361-369. 2004.

Shih, J.G. and S.A. Finkelstein. Range dynamics and invasive tendencies in *Typha latifolia* and *Typha angustifolia* in Eastern North America derived from herbarium and pollen records. Wetlands 28:1-16. 2008.

Smith, S.G. Typhaceae Jussieu (as Typhae) Cat-tail Family. Pp 278-285. In Flora of North America North of Mexico Vol. 22: Magnoliophyta: Alismatidae, Arecidae, Commelinidae (in part) and Zingiberidae. Oxford University Press, New York. 2000.

Snow, A.A., S.E Travis, R. Wildova, T. Fer, P.M. Sweeney, J.E. Marburger, S. Windels, B. Kubatova, D.E. Goldberg and E. Mutegi. Species-specific SSR alleles for studies of hybrid cattails (*Typha latifolia* x *T. angustifolia*; Typhaceae) in North America. American Journal of Botany 97:2061-2067. 2010.

Snyder, S. A. *Typha angustifolia*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). 1993. http://www.fs.fed.us/database/feis/ accessed May 30, 2013.

Stevens, M. and C. Hoag. Narrowleaf cattail, *Typha angustifolia* L. USDA, NRCS, National Plant Data Center & Idaho Plant Materials Center. USDA NRCS. 2006.

USDA, ARS, National Genetic Resources Program. *Germplasm Resources Information Network - (GRIN)* [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. 2013. URL: http://www.ars-grin.gov/cgi-bin/npgs/html/queries.pl?language=en (30 May 2013)

Vaccaro, L. E., B. L. Bedford, and C. A. Johnston. Litter accumulation promotes dominance of invasive species of cattails (*Typha* spp.) in Lake Ontario Wetlands. Wetlands 29 (3): 1036-1048. 2009.

Weller, M. W. Studies of cattail in relation to management for marsh wildlife. Iowa State J. Res. 49 (4): 383-412. 1975.