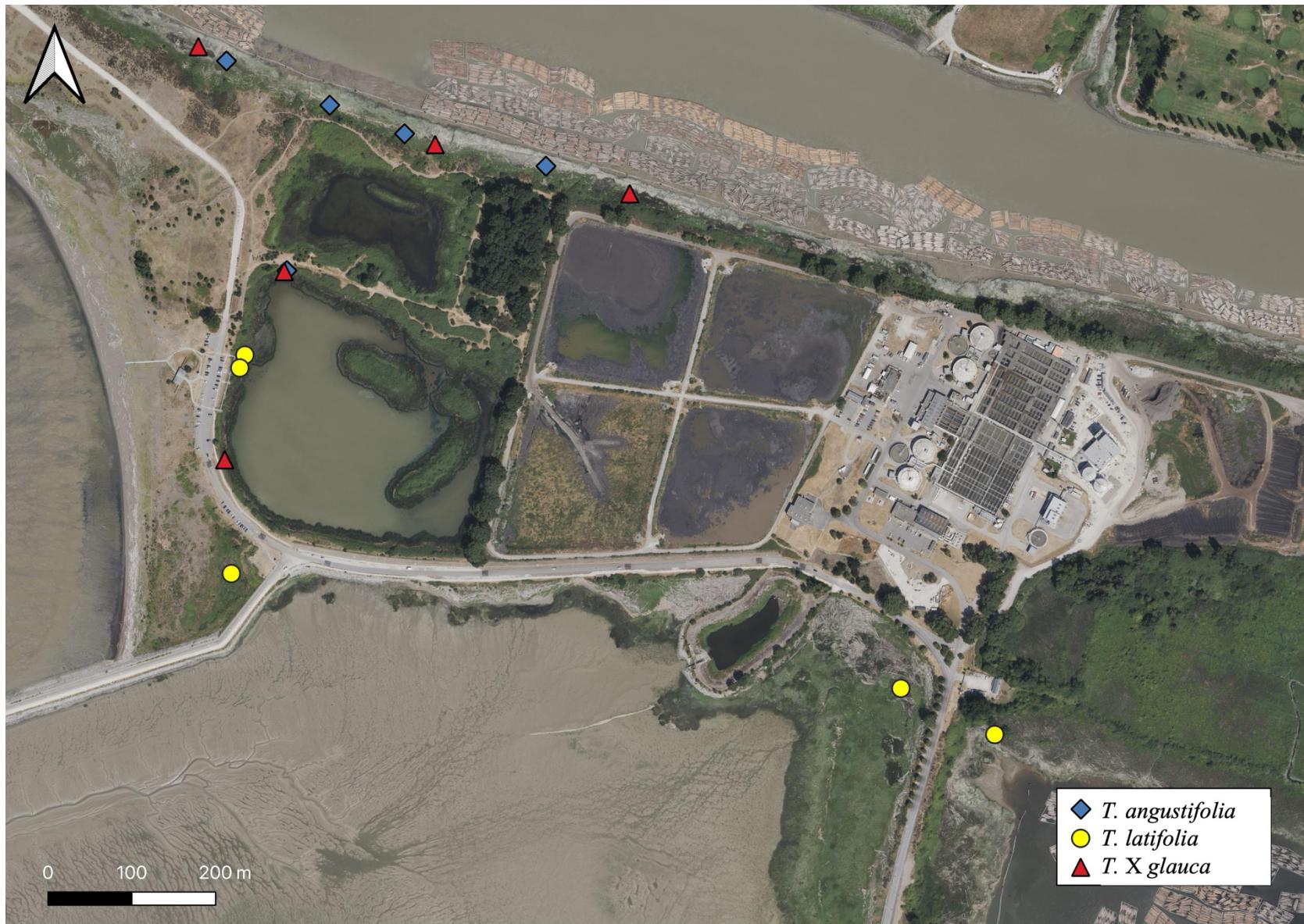


Supplementary Materials for “Decrypting the invasion of non-native cattails (*Typha* spp.) in the Fraser River Estuary, British Columbia using morphological and microsatellite analyses” in: *Estuaries and Coasts*

Gracy Buckholtz, Daniel Stewart\*, Diana M. Percy, Tara G. Martin, Quentin C. B. Cronk

\*Corresponding Author: [daniel.stewart@asarum.org](mailto:daniel.stewart@asarum.org)

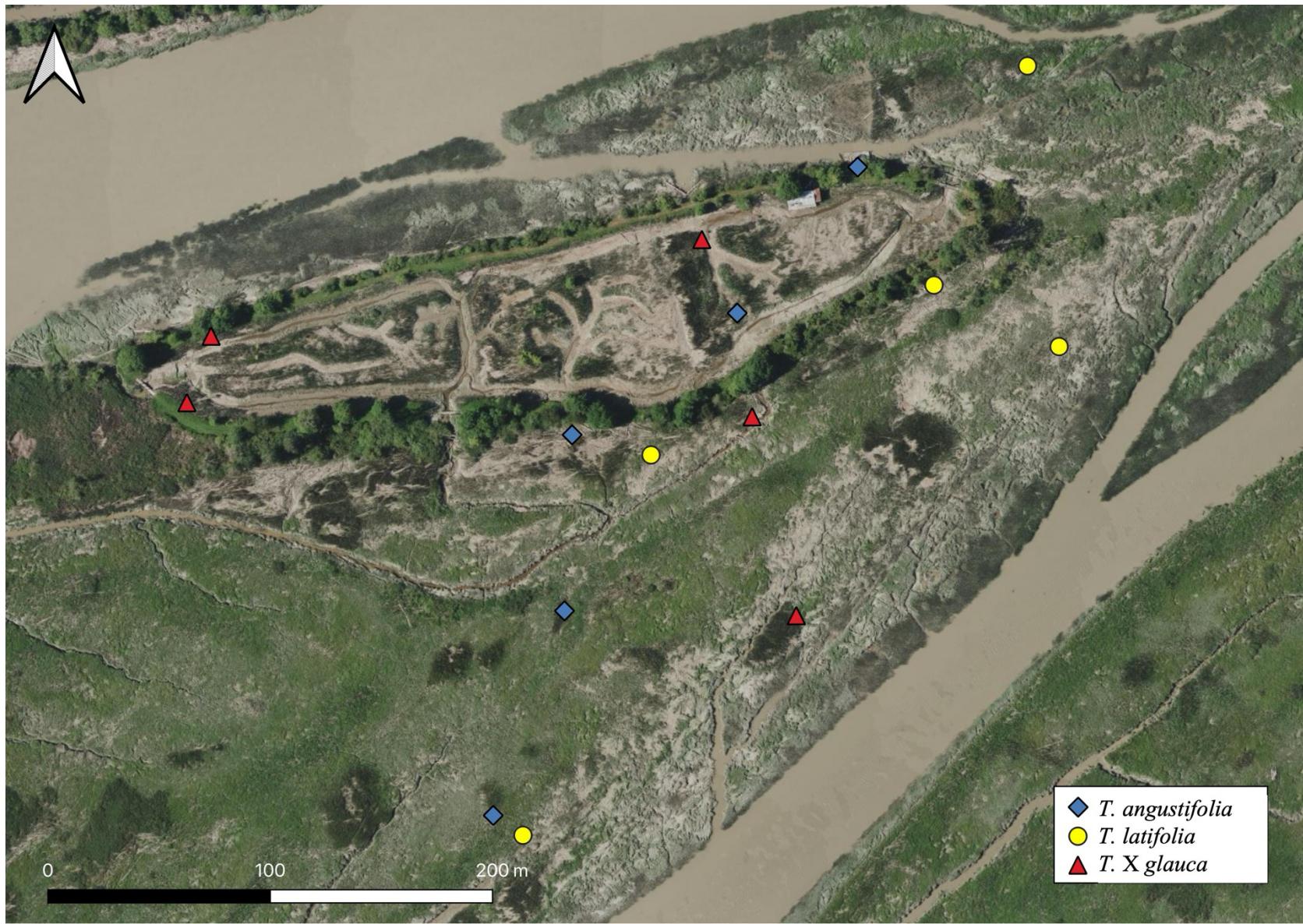
Materials are arranged in the order they appear in the manuscript.



**Fig. S1** Map of *Typha* ramets sampled at Iona Island, Fraser River Estuary in July 2020. Ramets were field identified into one of three taxa



**Fig. S2** Map of *Typha* ramets sampled at Sturgeon Bank, Fraser River Estuary, in July 2020. Ramets were field identified into one of three taxa

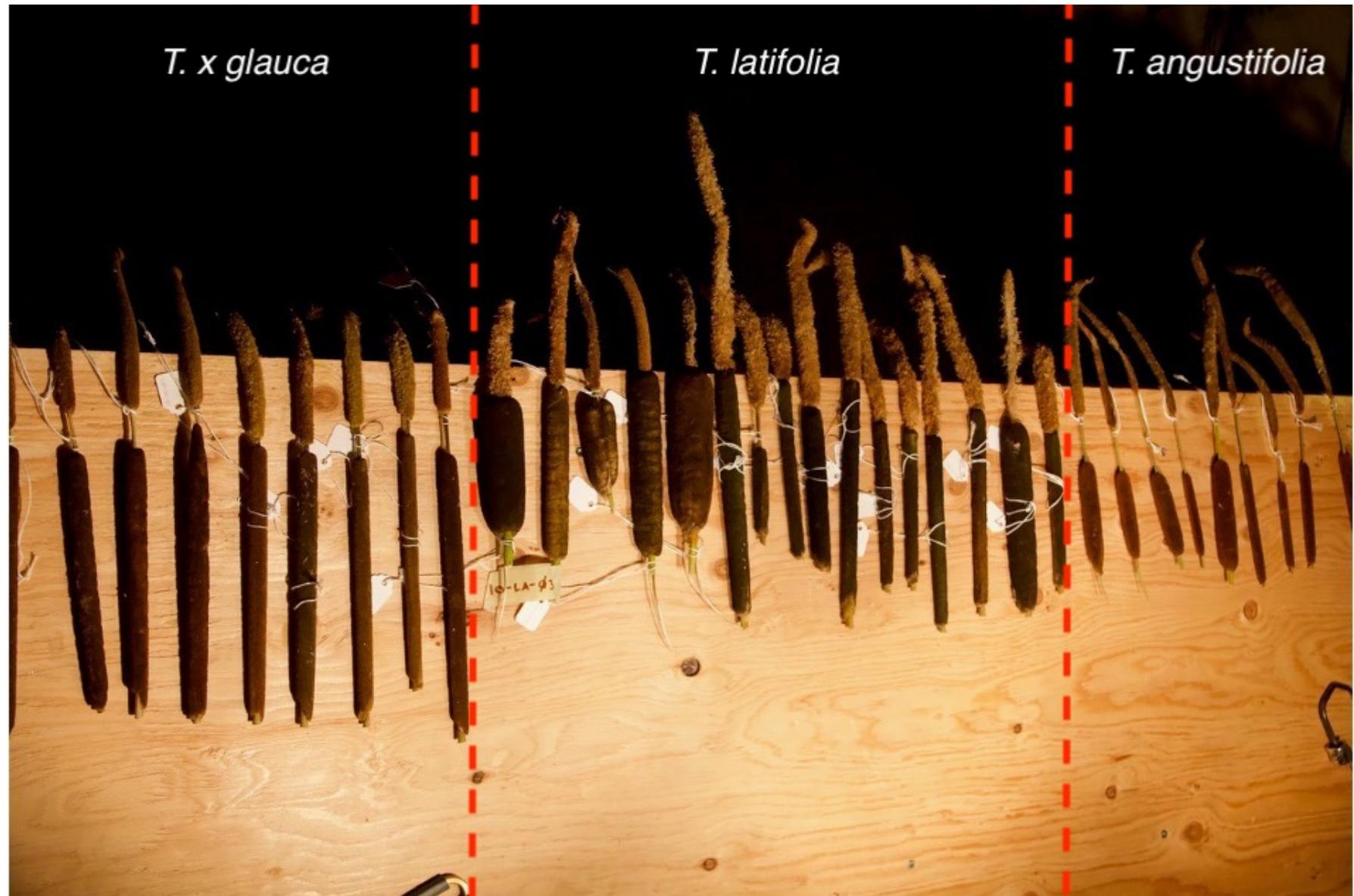


**Fig. S3** Map of *Typha* ramets sampled at Frenchies Island, Fraser River Estuary in July 2020. Ramets were field identified into one of three taxa

**Table S1** Location, date, and measurements of *Typha* collections included in this study. All measurements are in centimetres

ID	LOCATION	TIDAL MARSH?	UTM	COLLECTION DATE	ESTIMATED SPECIES	MAX LEAF WIDTH	SPIKE GAP	PISTILLATE LENGTH	PISTILLATE WIDTH	STAMINATE LENGTH	RAMET HEIGHT
AF1	Frenchies Island	Y	10 U 491693 5438725	2020-07-05	TYPHANG	0.7	3.5	10.9	0.6	16.8	188
AF2	Frenchies Island	Y	10 U 491768 5438779	2020-07-05	TYPHANG	0.7	3.2	10.8	0.6	13.9	155
AF3	Frenchies Island	Y	10 U 491690 5438646	2020-07-05	TYPHANG	0.6	6.5	11.8	0.5	16.9	195
AF4	Frenchies Island	Y	10 U 491658 5438554	2020-07-05	TYPHANG	0.6	4.2	10.2	0.5	16.0	191
AF5	Frenchies Island	Y	10 U 491822 5438844	2020-07-05	TYPHANG	0.9	4.0	18.3	0.5	22.9	246
GF1	Frenchies Island	Y	10 U 491531 5438769	2020-07-05	TYPHGLA	1.3	1.5	19.0	1.3	22.8	230
GF2	Frenchies Island	Y	10 U 491752 5438812	2020-07-05	TYPHGLA	1.2	2.5	16.2	1.2	21.3	224
GF3	Frenchies Island	Y	10 U 491774 5438733	2020-07-05	TYPHGLA	1.1	2.5	15.9	1.0	19.6	216
GF4	Frenchies Island	Y	10 U 491794 5438643	2020-07-05	TYPHGLA	1.2	0.8	17.3	1.0	21.3	220
GF5	Frenchies Island	Y	10 U 491520 5438739	2020-07-05	TYPHGLA	1.3	2.0	14.9	0.8	20.4	208
LF1	Frenchies Island	Y	10 U 491729 5438715	2020-07-05	TYPHLAT	1.5	0.0	13.3	1.2	16.5	184
LF2	Frenchies Island	Y	10 U 491898 5438890	2020-07-05	TYPHLAT	1.6	0.3	12.5	1.1	15.9	197
LF3	Frenchies Island	Y	10 U 491912 5438764	2020-07-05	TYPHLAT	1.8	0.0	16.2	1.3	16.1	208
LF4	Frenchies Island	Y	10 U 491671 5438545	2020-07-05	TYPHLAT	1.5	0.0	19.0	1.4	14.7	196
LF5	Frenchies Island	Y	10 U 491856 5438791	2020-07-05	TYPHLAT	1.6	0.2	15.6	1.1	16.9	204
AI1	Iona Island	N	10 U 484554 5451946	2020-07-21	TYPHANG	0.6	4.3	10.3	1.8	12.0	192
AI2	Iona Island	Y	10 U 484606 5452142	2020-07-21	TYPHANG	0.7	4.0	6.8	1.3	10.5	163
AI3	Iona Island	Y	10 U 484695 5452108	2020-07-21	TYPHANG	0.9	4.1	10.0	2.4	14.0	184
AI4	Iona Island	Y	10 U 484864 5452069	2020-07-21	TYPHANG	0.7	7.2	7.8	1.6	13.8	155
AI5	Iona Island	Y	10 U 484483 5452195	2020-07-21	TYPHANG	0.5	5.6	18.0	0.8	10.7	168
GI1	Iona Island	N	10 U 484480 5451721	2020-07-21	TYPHGLA	1.2	1.1	18.2	1.7	21.1	225
GI2	Iona Island	N	10 U 484551 5451945	2020-07-21	TYPHGLA	1.7	1.0	31.3	2.2	24.5	332
GI3	Iona Island	Y	10 U 484732 5452095	2020-07-21	TYPHGLA	1.0	2.8	12.0	1.7	17.4	212
GI4	Iona Island	Y	10 U 484964 5452036	2020-07-21	TYPHGLA	1.3	2.3	16.3	1.7	21.2	227
GI5	Iona Island	Y	10 U 484449 5452212	2020-07-21	TYPHGLA	1.2	3.4	17.5	1.5	22.0	195
LI1	Iona Island	Y	10 U 484487 5451585	2020-07-21	TYPHLAT	1.9	0.0	10.0	2.8	7.0	197

LI2	Iona Island	N	10 U 484504 5451845	2020-07-21	TYPHLAT	1.3	0.3	16.9	2.3	9.7	141
LI3	Iona Island	Y	10 U 485286 5451447	2020-07-21	TYPHLAT	1.5	0.0	12.5	1.7	12.6	173
LI4	Iona Island	Y	10 U 485397 5451391	2020-07-21	TYPHLAT	1.7	0.0	13.4	2.3	13.3	192
LI5	Iona Island	N	10 U 484498 5451830	2020-07-21	TYPHLAT	1.5	0.0	11.9	3.3	10.9	166
AS1	Sturgeon Bank	Y	10 U 485788 5446971	2020-07-15	TYPHANG	0.9	5.5	13.5	1.3	20.3	156
AS2	Sturgeon Bank	Y	10 U 485517 5446918	2020-07-15	TYPHANG	0.5	5.0	10.6	1.3	14.8	181
AS3	Sturgeon Bank	Y	10 U 485237 5446835	2020-07-15	TYPHANG	0.6	4.4	9.6	0.8	12.0	190
AS4	Sturgeon Bank	Y	10 U 485211 5446773	2020-07-15	TYPHANG	0.6	4.3	8.5	0.7	13.6	177
AS5	Sturgeon Bank	Y	10 U 485195 5446746	2020-07-15	TYPHANG	0.7	6.0	12.0	0.8	16.7	202
GS1	Sturgeon Bank	Y	10 U 485792 5446960	2020-07-15	TYPHGLA	1.4	0.5	17.9	1.1	21.4	200
GS2	Sturgeon Bank	Y	10 U 485297 5446853	2020-07-15	TYPHGLA	1.2	0.6	17.0	1.4	25.0	236
GS3	Sturgeon Bank	Y	10 U 485258 5446824	2020-07-15	TYPHGLA	1.3	2.3	17.8	1.1	26.8	247
GS4	Sturgeon Bank	Y	10 U 485214 5446789	2020-07-15	TYPHGLA	1.3	1.0	17.4	0.9	20.7	210
GS5	Sturgeon Bank	Y	10 U 485233 5446803	2020-07-15	TYPHGLA	1.4	2.8	19.7	1.4	30.8	228
LS1	Sturgeon Bank	Y	10 U 485823 5446962	2020-07-15	TYPHLAT	1.7	0.0	19.2	1.3	14.9	192
LS2	Sturgeon Bank	Y	10 U 485521 5446907	2020-07-15	TYPHLAT	1.5	0.1	12.8	1.3	14.5	209
LS3	Sturgeon Bank	Y	10 U 485367 5446807	2020-07-15	TYPHLAT	1.6	0.0	13.7	1.1	11.7	188
LS4	Sturgeon Bank	Y	10 U 485291 5446861	2020-07-15	TYPHLAT	2.0	0.0	13.9	0.9	14.3	244
LS5	Sturgeon Bank	Y	10 U 485219 5446769	2020-07-15	TYPHLAT	2.2	0.0	19.2	1.7	19.7	240
LS6	Sturgeon Bank	Y	10 U 485196 5446734	2020-07-15	TYPHLAT	1.3	3.2	7.0	1.1	11.5	227

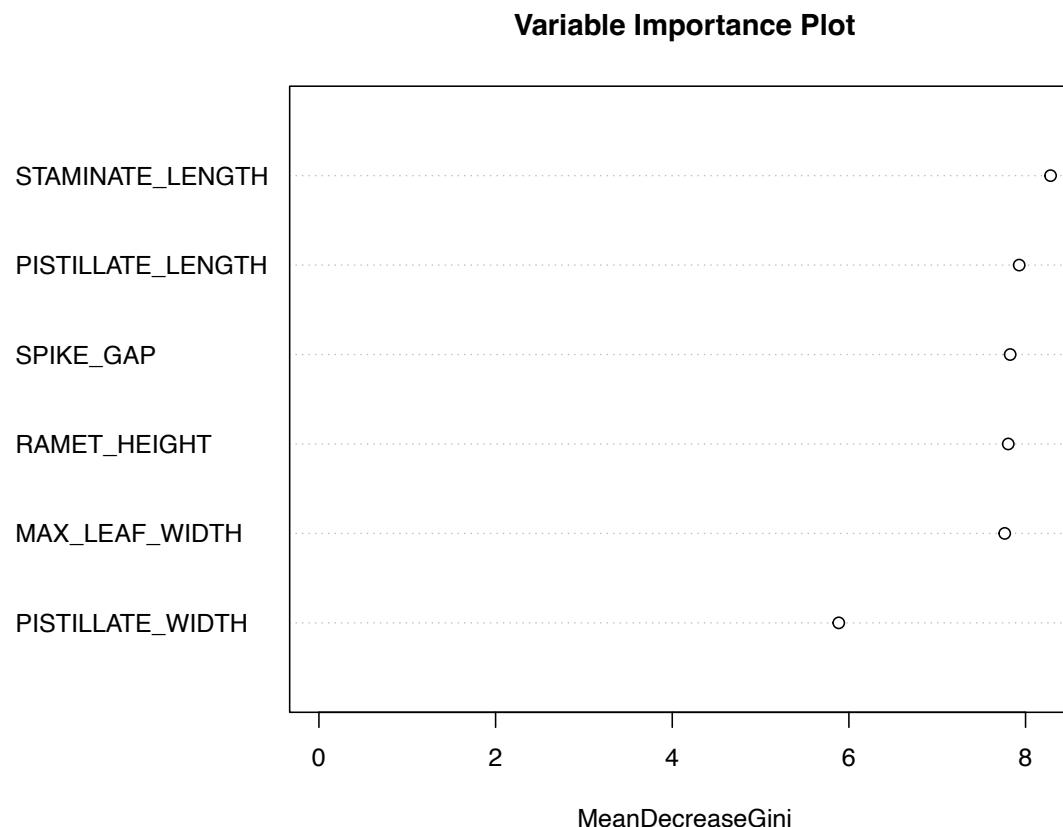


**Photo S1** Image of collected *Typha* flowers, grouped by field-identified taxa.

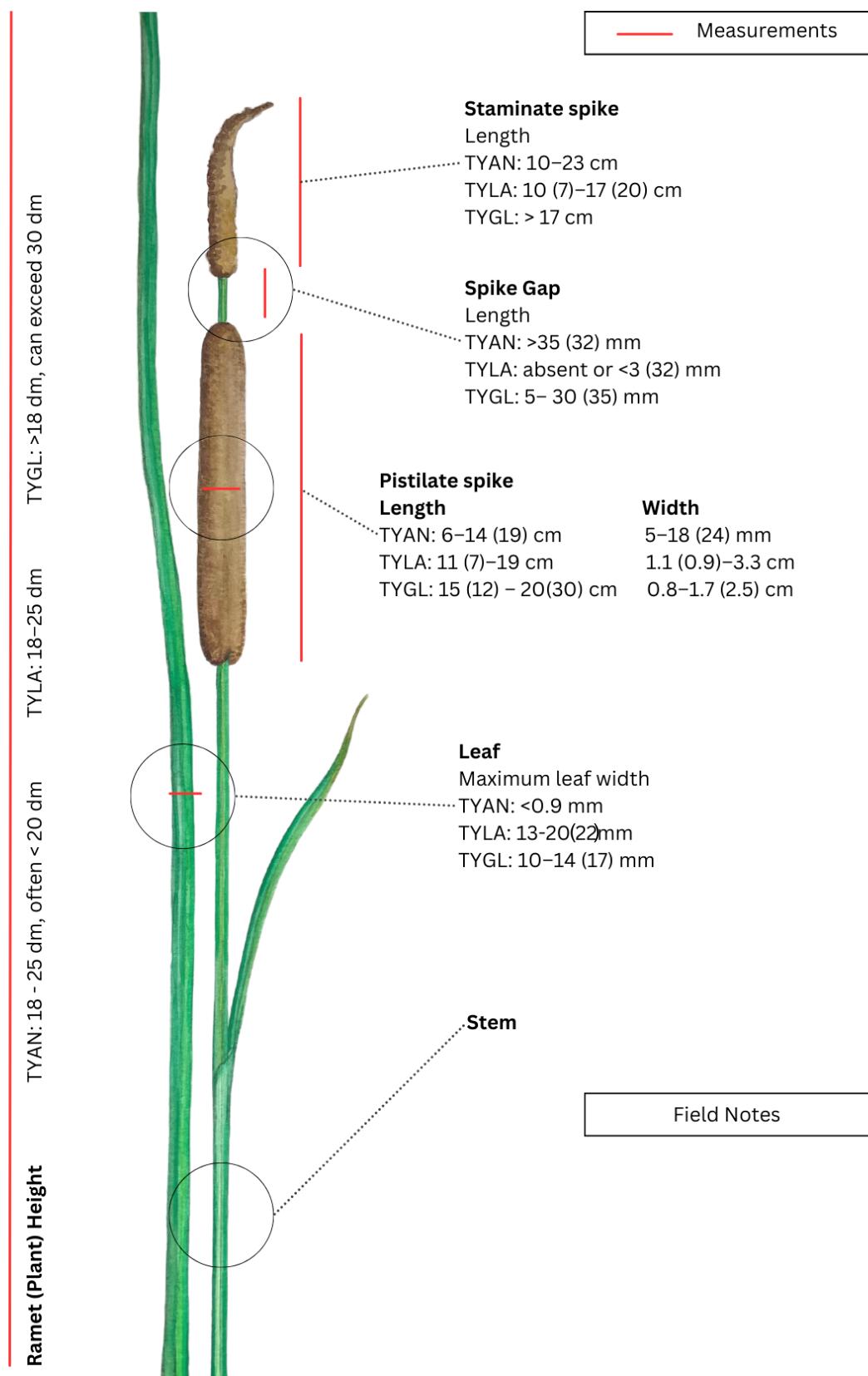
**Table S2** F1, F2, and backcross *Typha x glauca* identifications. LLD is the log-likelihood difference between the best and second-best genotype

Sample	Best Estimate	LLD
AI2	Backcross Parent 1	0.545259893
GF1	F1 Hybrids	3.055677283
GF2	F1 Hybrids	0.710848565
GF3	F2 Hybrids	0.320969751
GF4	F1 Hybrids	3.055677283
GF5	F1 Hybrids	3.055677283
GI1	F1 Hybrids	3.055677283
GI2	Backcross Parent 2	0.467402325
GI3	F1 Hybrids	3.055677283
GI4	Backcross Parent 1	0.772173983
GI5	F1 Hybrids	3.055677283
GS1	F1 Hybrids	3.046641285
GS2	F1 Hybrids	3.046641285
GS3	F1 Hybrids	3.046641285
GS4	F1 Hybrids	3.046641285
GS5	F1 Hybrids	3.046641285

**Fig. S4** Variable importance plot displaying the effect of each morphological trait on random forest predictions. Traits with a high mean decrease Gini score contribute more to reducing the impurity of nodes in the decision trees, leading to more homogeneous groups. Higher scores indicate that a trait is more important for distinguishing between taxa in the model



## Field Key to Identification of *Typha* in the Fraser River Estuary



Typha Illustration by Liljana Mead Martin

**Fig. S5** Field guide to *Typha* taxa (TYLA = *Typha latifolia*, TYAN = *Typha angustifolia*, TYGL = *Typha × glauca*) of the Fraser River Estuary based on the results of this study. The key should be used as a preliminary tool for early detection, not a proxy or substitute for genetic investigations, and will be most effective when applied (1) to specimens within the same time period as our measurements (July), (2) in similar tidal estuarine environments (so as to minimize genotypic and phenotypic variability), and (3) to representative ramets within a clonal patch, as morphological anomalies frequently occur within *Typha* populations that confound identification