SUPPLEMENTAL MATERIAL

Fig. 1 Comparison of repeat photographs taken in 1909 (P.S. Smith, top) and 2006 (M. T. Jorgenson, bottom) showing a small increase in tall alder shrub and a decrease in lichens in the Noatak Basin. Note a few colonizing alders in the foreground (left circle), an expanded alder patch (middle right), and only small changes in patch size in distance (upper right).

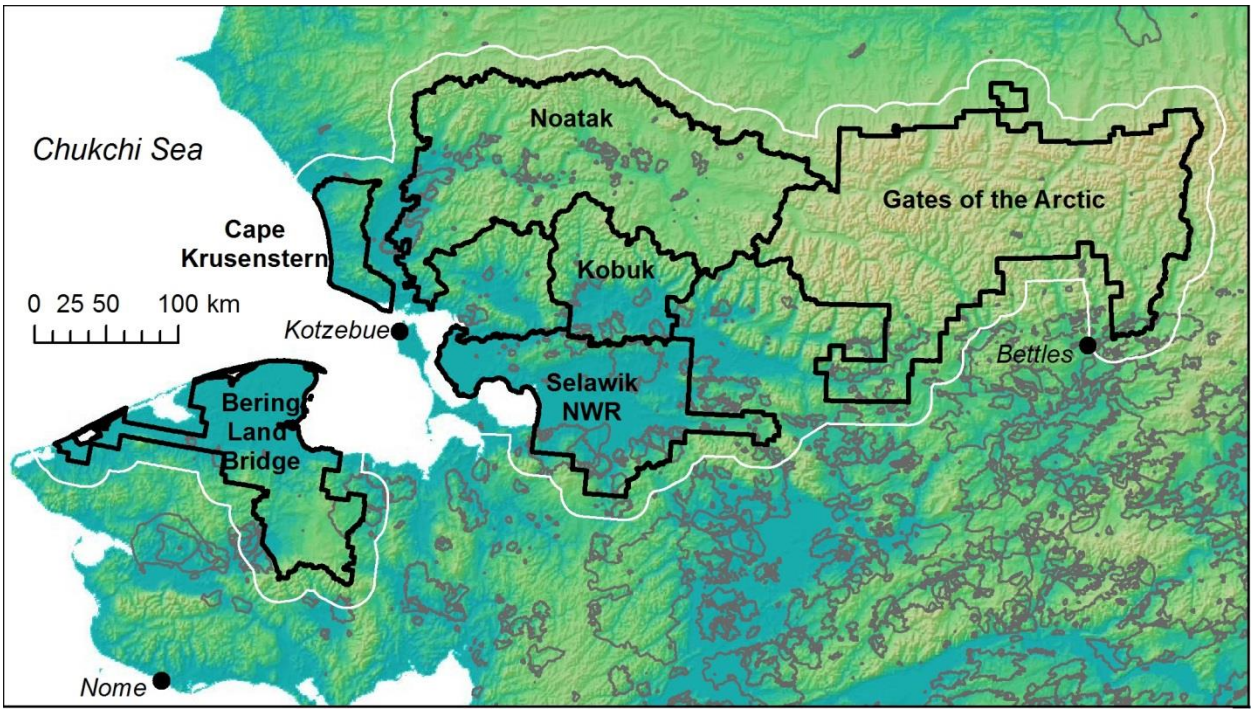

Fig. 2. Study area showing the Arctic network of national parklands and the Selawik National Wildlife Refuge (black), study area (white, including a 10-km buffer), and fires from 2050-2011 (gray), overlain on a shaded-relief map.

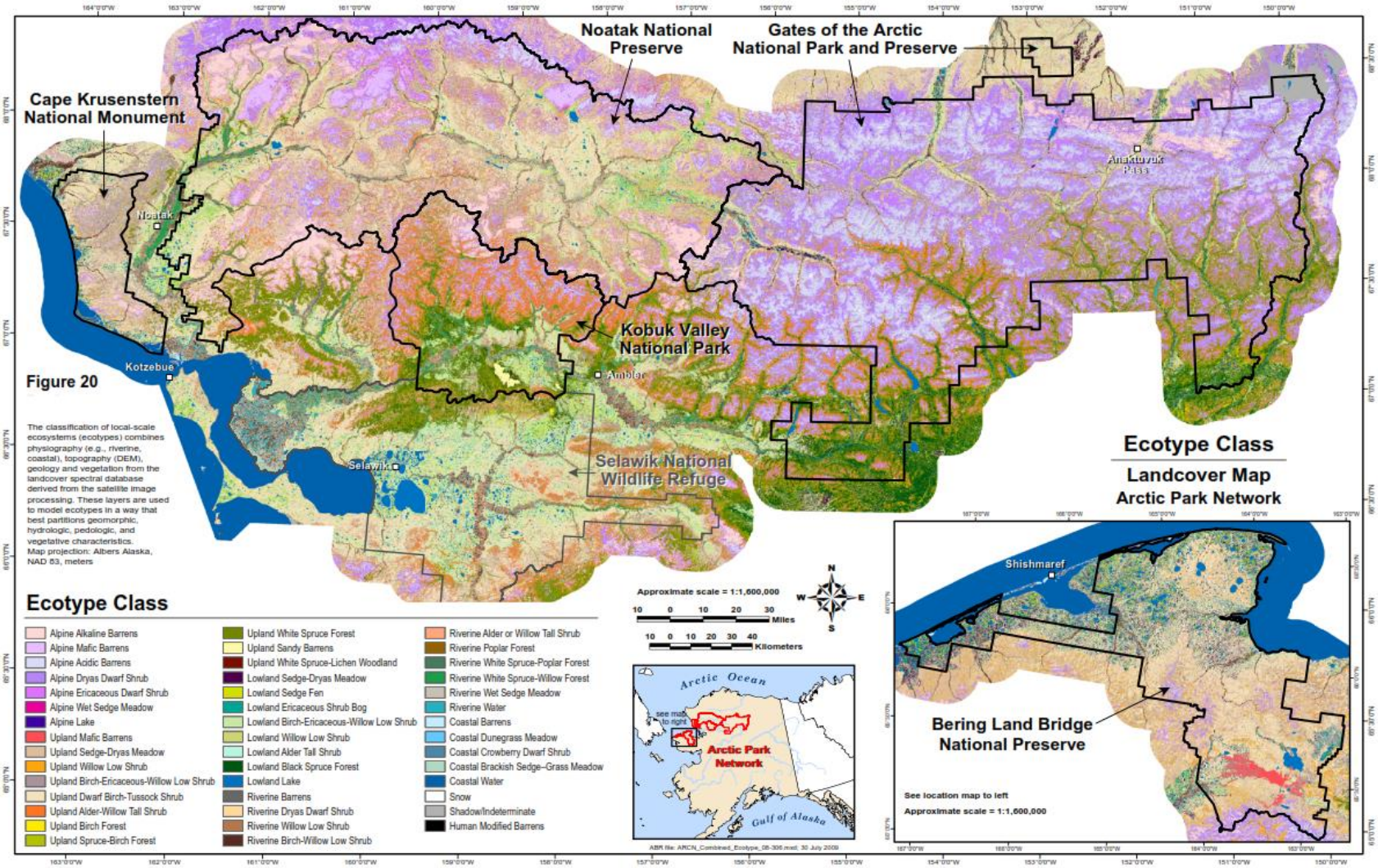

Fig. 3. Map of ecotype distribution within the Arctic network of national parks and the Selawik National Wildlife Refuge, northwest Alaska (from Jorgenson et al. 2009).

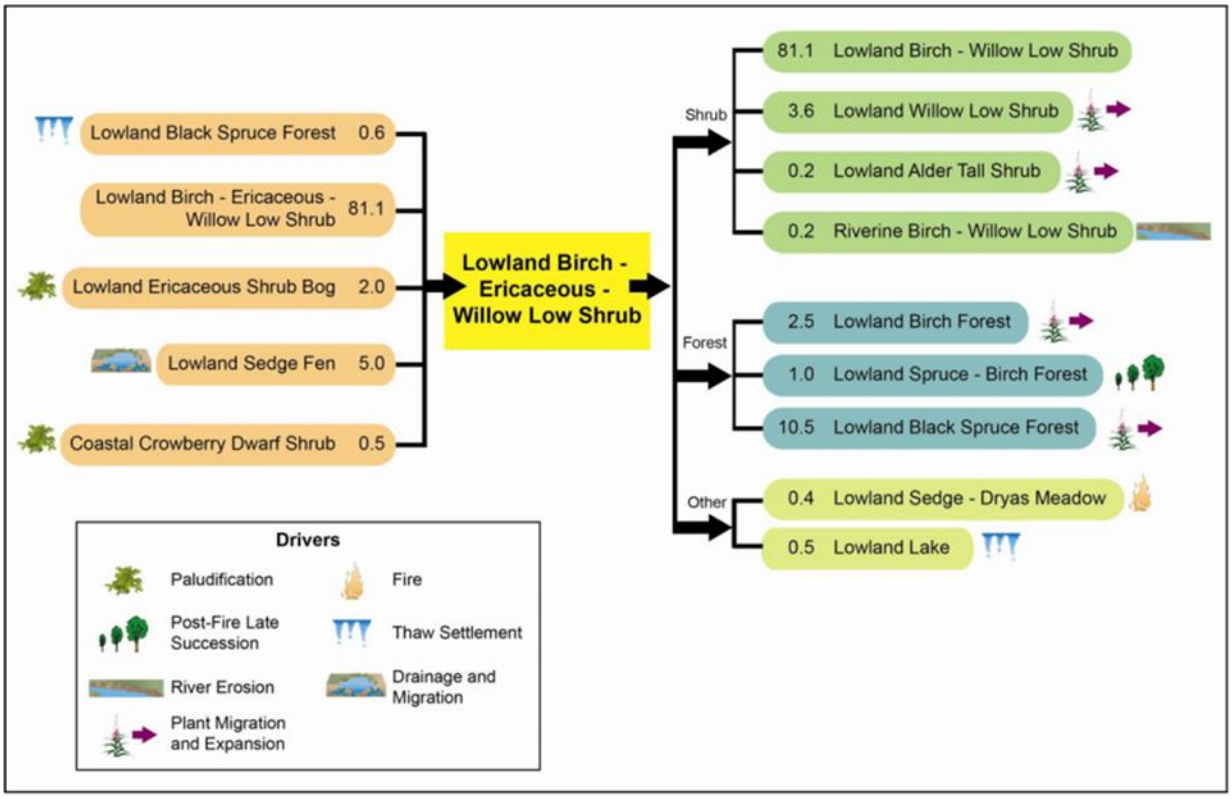

Fig. 4. Illustration of the transitions for Lowland birch-ericaeous-willow low shrub involving transitions from many ecotypes into one ecotype and subsequent transitions from the one ecotype into many other ecotypes (DeGange et al. 2013). The numbers are the transition probabilities derived from the compilation of historical change data and the symbols denote biophysical drivers associated with each transition.

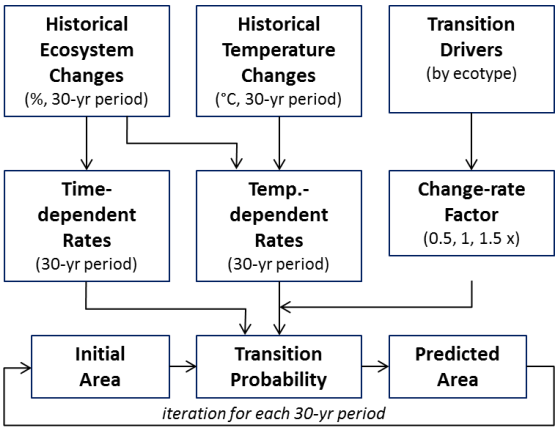

Fig. 5. Flow diagram of variables used in the time (left), temperature (middle), and rate-adjusted temperature (right) dependent models of ecotype change for each potential transition.

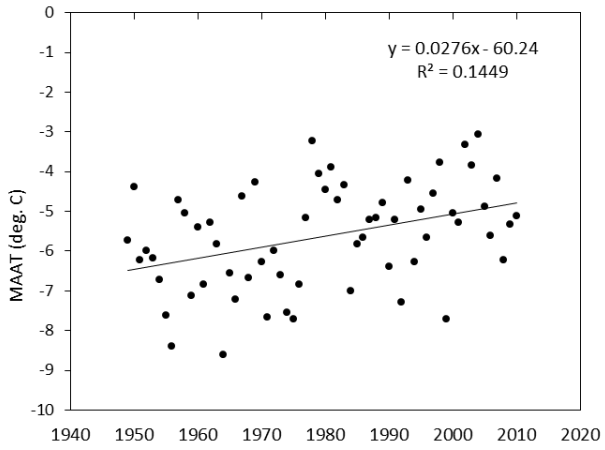

Fig. 6. Trends in mean annual air temperatures (MAAT) for Kotzebue from 1949 to 2010. Line represents linear regression trend of 0.83 °C/30 yrs.

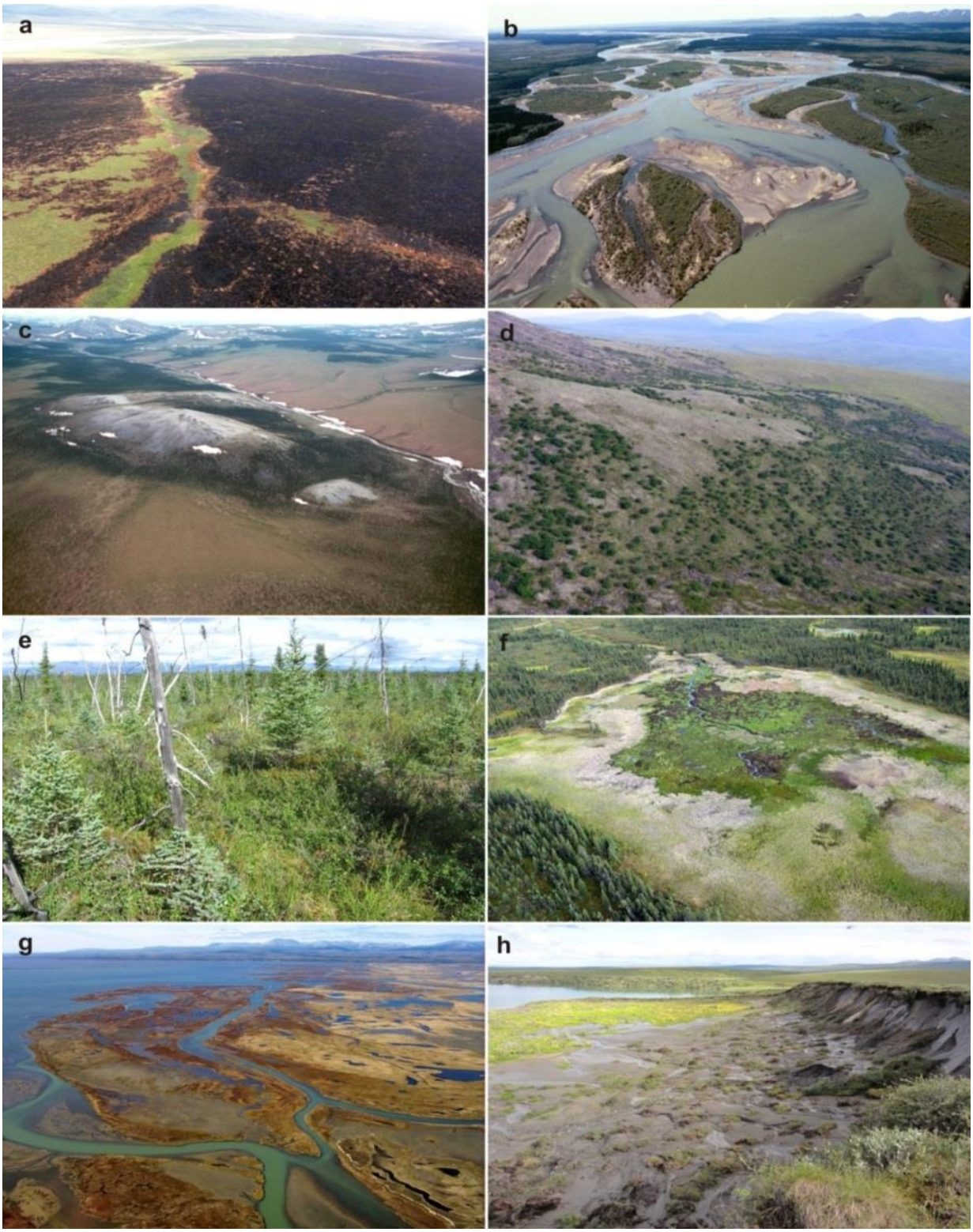

Fig. 7. Photographs illustrating important drivers of change within the ARCN study area, including fire (a), channel erosion and deposition (b), plant migration/expansion forest (c), alder expansion (d), post-fire early succession (e), drainage of thermokarst lake (f), coastal erosion and sedimentation (g), and thaw slump (h).

Table 1. Trends in mean annual air temperature (^{o}C/30 yrs) for 9 weather stations within or near the study area (nd = MAAT data not available). Values shown are derived from linear regressions for the periods denoted, which include approximate cold and warm phases of the Pacific Decadal Oscillation (PDO).

Location	Approx. 1949-2010	Cold PDO (~1949 -1975)	Warm PDO (~1976 -2010)	Full Record	Years of Data
Kotzebue	0.8	-1.0	0.1	0.5	1949-2010
Nome	0.7	-1.5	-0.4	0.3	1907-2010
Barrow	1.3	-1.4	2.3	0.4	1902-2010
Fairbanks	0.9	0.0	-0.5	0.7	1930-2010
Bettles	1.2	-0.3	0.0	1.2	1952-2010
Fort Yukon	nd	0.2	nd	0.5	1938-1989
Barter Isl.	-0.2	-2.4	-1.3	-0.2	1950-1988
Denali Park	0.7	-2.1	0.0	0.7	1953-2011
Tanana	0.9	-0.4	-0.1	0.9	1952-2011
Ave. (closest 5)	1.0	-0.8	0.3	0.5	

Table 2. Listing of state-transition model results for predicting future changes in the northwest Alaska.

Ecotype	Ecotype-Transition	Historical TransProb 30-yr Ave	References Used	Adjusted Historical TransProb 30-yr Ave	Total Area 2002	Total Area 2040	Total Area 2070	Total Area 2100	Partial Area 2040	Partial Area 2070	Partial Area 2100	TransProb-2040	TransProb-2070	Trans Prob-2100	AirTemp Change 30-yr Hist	Air-Temp Incr 2040	Air-Temp Change 2070	Air-Temp Change 2100	Change Rate Factor	Driver
Alpine Snowfields and Glaciers	Alpine Snowfields and Glaciers	95.5	5	96.0	250	220	168	107	220	168	107	88	76	64	1	2	4	6	1	None
Alpine Snowfields and Glaciers	Alpine Acidic Barrens	1.9	1	3.0					23	40	45	9.0	18.0	27.0	1	2	4	6	1.5	Glacier melting
Alpine Snowfields and Glaciers	Alpine Alkaline Barrens		0	1.0					8	13	15	3.0	6.0	9.0	1	2	4	6	1.5	Glacier melting
Alpine Mafic Barrens	Alpine Mafic Barrens	100.0	1	100.0	1112	1112	1112	1112	1112	1112	1112	100	100	100	1	2	4	6	1	None
Alpine Acidic Barrens	Alpine Acidic Barrens	99.0	2	98.9	9407	9427	9458	9486	9304	9219	9146	98.9	97.8	96.7	1	2	4	6	1	None
Alpine Acidic Barrens	Alpine Acidic Dryas Dwarf Shrub	0.4	1	0.3					28	56	85	0.3	0.6	0.9	1	2	4	6	0.5	Plant migration/expansion
Alpine Acidic Barrens	Upland Birch-Ericaceous-Willow Low Shr	0.2	1	0.1					9	19	28	0.1	0.2	0.3	1	2	4	6	0.5	Plant migration/expansion
Alpine Acidic Barrens	Upland Willow Low Shrub	1.3	1	0.7					66	132	198	0.7	1.4	2.1	1	2	4	6	0.5	Plant migration/expansion
Alpine Alkaline Barrens	Alpine Alkaline Barrens	99.8	2	99.8	4487	4489	4490	4487	4478	4471	4463	99.8	99.6	99.4	1	2	4	6	1	None
Alpine Alkaline Barrens	Alpine Alkaline Dryas Dwarf Shrub	0.5	1	0.2					9	18	27	0.2	0.4	0.6	1	2	4	6	0.5	Plant migration/expansion
Alpine Acidic Dryas Dwarf Shrub	Alpine Acidic Dryas Dwarf Shrub	98.8	2	99.2	16828	16688	16411	16003	16660	16354	15919	99	98	97	1	2	4	6	1	None
Alpine Acidic Dryas Dwarf Shrub	Alpine Acidic Barrens	0.5	1	0.2					67	134	197	0.4	0.8	1.2	1	2	4	6	1	Landslides/fans
Alpine Acidic Dryas Dwarf Shrub	Alpine Ericaceous Dwarf Shrub	1.0	1	0.3					50	100	148	0.3	0.6	0.9	1	2	4	6	0.5	Plant migration/expansion
Alpine Acidic Dryas Dwarf Shrub	Upland Alder-Willow Tall Shrub	1.0	1	0.3					50	100	148	0.3	0.6	0.9	1	2	4	6	0.5	Plant migration/expansion
Alpine Alkaline Dryas Dwarf Shrub	Alpine Alkaline Dryas Dwarf Shrub	100.0	1	99.7	1459	1462	1469	1478	1453	1451	1451	99.6	99.2	98.8	1	2	4	6	1	None
Alpine Alkaline Dryas Dwarf Shrub	Alpine Alkaline Barrens		0	0.1					3	6	9	0.2	0.4	0.6	1	2	4	6	1	Landslides/fans
Alpine Alkaline Dryas Dwarf Shrub	Upland Sedge-Dryas Meadow		0	0.1					1	3	4	0.1	0.2	0.3	1	2	4	6	0.5	Paludification
Alpine Alkaline Dryas Dwarf Shrub	Upland Willow Low Shrub		0	0.1					1	3	4	0.1	0.2	0.3	1	2	4	6	0.5	Plant migration/expansion
Alpine Ericaceous Dwarf Shrub	Alpine Ericaceous Dwarf Shrub	96.0	4	98.0	2362	2352	2333	2303	2298	2225	2144	97.3	94.6	91.9	1	2	4	6	1	None
Alpine Ericaceous Dwarf Shrub	Alpine Acidic Barrens	6.1	1	0.7					33	66	98	1.4	2.8	4.2	1	2	4	6	1	Landslides/fans
Alpine Ericaceous Dwarf Shrub	Upland Birch-Ericaceous-Willow Low Shrub		0	0.3					7	14	21	0.3	0.6	0.9	1	2	4	6	0.5	Dominance shift/infilling
Alpine Ericaceous Dwarf Shrub	Upland Alder-Willow Tall Shrub	5.1	1	0.5					12	24	35	0.5	1.0	1.5	1	2	4	6	0.5	Plant migration/expansion
Alpine Ericaceous Dwarf Shrub	Upland White Spruce Forest	5.1	1	0.5					12	24	35	0.5	1.0	1.5	1	2	4	6	0.5	Plant migration/expansion
Alpine Lake	Alpine Lake	100.0	1	100.0	40	40	40	40	40	40	40	100	100	100	1	2	4	6	1	None
Alpine Wet Sedge Meadow	Alpine Wet Sedge Meadow	100.0	2	99.8	973	969	961	949	969	961	949	99.6	99.2	98.8	1	2	4	6	1	None
Alpine Wet Sedge Meadow	Alpine Ericaceous Dwarf Shrub		0	0.2					3.9	7.7	11.5	0.4	0.8	1.2	1	2	4	6	1	Soil drainage
Upland Barrens-Burned	Upland Barrens-Burned		0	0.1	163	201	421	655	0	0	0	0.1	0.1	0.1	1	2	4	6	1	None
Upland Barrens-Burned	Upland Bluejoint-Herb Meadow		0	70.0					114	141	295	70.0	70.0	70.0	1	2	4	6	1	Post-fire early succession
Upland Barrens-Burned	Upland Dwarf Birch-Tussock Shrub		0	29.9					49	60	126	29.9	29.9	29.9	1	2	4	6	1	Post-fire early succession
Upland Barrens-Thermokarst	Upland Barrens-Thermokarst		0	10.0	163	481	976	1467	16	48	98	10	10	10	1	2	4	6	1	None
Upland Barrens-Thermokarst	Upland Willow Low Shrub		0	90.0					147	433	879	90.0	90.0	90.0	1	2	4	6	1	Early succession
Upland Barrens-Landslides	Upland Barrens-Landslides		0	10.0	163	35	39	50	16	4	4	10.0	10.0	10.0	1	2	4	6	1	None
Upland Barrens-Landslides	Upland Willow Low Shrub		0	90.0					147	32	35	90.0	90.0	90.0	1	2	4	6	1	Early succession
Upland Sandy Barrens	Upland Sandy Barrens		0	96.0	72	70	67	64	70	67	64	96	96	96	1	2	4	6	1	None
Upland Sandy Barrens	Upland Birch-Ericaceous-Willow Low Shrub		0	2.0					1	3	4	2.0	4.0	6.0	1	2	4	6	0.5	Early succession
Upland Sandy Barrens	Upland Alder-Willow Tall Shrub		0	2.0					1	3	4	2.0	4.0	6.0	1	2	4	6	0.5	Early succession
Upland Mafic Barrens	Upland Mafic Barrens	100.0	1	100.0	224	224	224	224	224	224	224	100	100	100	1	2	4	6	1	None
Upland Bluejoint-Herb Meadow	Upland Bluejoint-Herb Meadow		0	5.0	163	143	181	349	8	6	5	5	4	3	1	2	4	6	1	None
Upland Bluejoint-Herb Meadow	Upland Birch-Ericaceous-Willow Low Shr	1.1	1	5.0					8	7	9	5.0	5.0	5.0	1	2	4	6	1	Post-fire early succession
Upland Bluejoint-Herb Meadow	Upland Alder-Willow Tall Shrub		0	39.0					64	56	71	39.0	39.0	39.0	1	2	4	6	1	Post-fire early succession
Upland Bluejoint-Herb Meadow	Upland Birch Forest	10.7	1	30.0					49	43	54	30.0	30.0	30.0	1	2	4	6	1	Post-fire early succession
Upland Bluejoint-Herb Meadow	Upland Spruce-Birch Forest	41.7	1	20.0					33	29	36	20.0	20.0	20.0	1	2	4	6	1	Post-fire early succession
Upland Bluejoint-Herb Meadow	Upland White Spruce Forest	1.1	1	1.0					2	3	5	1.0	2.0	3.0	1	2	4	6	0.5	Post-fire early succession
Upland Sedge-Dryas Meadow	Upland Sedge-Dryas Meadow	98.4	4.0	96.5	9545	8897	7690	6126	8896	7687	6121	93.2	86.4	79.6	1	2	4	6	1	None
Upland Sedge-Dryas Meadow	Lowland Sedge Fen	1.3	1	0.5					143	267	346	1.5	3.0	4.5	1	2	4	6	1.5	Thaw settlement
Upland Sedge-Dryas Meadow	Upland Birch-Ericaceous-Willow Low Shr	3.0	1	1.4					267	498	646	2.8	5.6	8.4	1	2	4	6	1	Acidification-leaching
Upland Sedge-Dryas Meadow	Upland Willow Low Shrub	0.3	1	0.2					19	36	46	0.2	0.4	0.6	1	2	4	6	0.5	Dominance shift/infilling
Upland Sedge-Dryas Meadow	Upland Alder-Willow Tall Shrub	1.0	1	0.5					48	89	115	0.5	1.0	1.5	1	2	4	6	0.5	Plant migration/expansion
Upland Sedge-Dryas Meadow	Upland White Spruce Forest	1.0	1	0.4					38	71	92	0.4	0.8	1.2	1	2	4	6	0.5	Plant migration/expansion
Upland Sedge-Dryas Meadow	Upland Barrens-Thermokarst		0	0.3					86	160	208	0.9	1.8	2.7	1	2	4	6	1.5	Thaw slump
Upland Sedge-Dryas Meadow	Upland Barrens-Landslides		0	0.1					19	36	46	0.2	0.4	0.6	1	2	4	6	1	Landslides/fans
Upland Sedge-Dryas Meadow	Lowland Lake		0	0.1					29	53	69	0.3	0.6	0.9	1	2	4	6	1.5	Thaw settlement
Upland Sagebrush Shrub	Upland Sagebrush Shrub		0	100.0	0	0	0	1	0	0	0	100	100	100	1	2	4	6	1	None

Supplemental Table 1 (cont.).

Ecotype	Ecotype-Transition	Historical TransProb 30-yr Ave	References Used	Adjusted Historical TransProb 30-yr Ave	Total Area 2002	Total Area 2040	Total Area 2070	Total Area 2100	Partial Area 2040	Partial Area 2070	Partial Area 2100	TransProb-2040	TransProb-2070	Trans Prob-2100	AirTemp Change 30-yr Hist	Air-Temp Incr 2040	Air-Temp Change 2070	Air-Temp Change 2100	Change Rate Factor	Driver
Upland Dwarf Birch-Tussock Shrub	Upland Dwarf Birch-Tussock Shrub	97.6	4	98.60	30712	29928	28369	26194	29880	28309	26069	97.29	94.59	91.89	1	2	4	6	1	None
Upland Dwarf Birch-Tussock Shrub	Lowland Sedge Fen	3.2	1	0.40					369	718	1021	1.2	2.4	3.6	1	2	4	6	1.5	Thaw settlement
Upland Dwarf Birch-Tussock Shrub	Upland Birch-Ericaceous-Willow Low Shr	0.2	1	0.18					55	108	153	0.2	0.4	0.5	1	2	4	6	0.5	Dominance shift/infilling
Upland Dwarf Birch-Tussock Shrub	Upland Alder-Willow Tall Shrub	0.1	1	0.10					31	60	85	0.1	0.2	0.3	1	2	4	6	0.5	Plant migration/expansion
Upland Dwarf Birch-Tussock Shrub	Upland White Spruce Forest	2.8	2	0.40					123	239	340	0.4	0.8	1.2	1	2	4	6	0.5	Drainage & migration
Upland Dwarf Birch-Tussock Shrub	Upland Barrens-Burned		0	0.10					61	120	170	0.2	0.4	0.6	1	2	4	6	1	Fire
Upland Dwarf Birch-Tussock Shrub	Upland Barrens-Thermokarst		0	0.10					92	180	255	0.3	0.6	0.9	1	2	4	6	1.5	Thaw slump
Upland Dwarf Birch-Tussock Shrub	Lowland Lake	0.2	2	0.10					92	180	255	0.3	0.6	0.9	1	2	4	6	1.5	Thaw settlement
Upland Dwarf Birch-Tussock Shrub	Coastal Water		0	0.01					6	12	17	0.0	0.0	0.1	1	2	4	6	1	Coastal erosion
Upland Dwarf Birch-Tussock Shrub	Human Modified Barrens		0	0.01					3	3	3	0.01	0.01	0.01	1	2	4	6	1	Human development
Upland Birch-Ericaceous-Willow Low Shru	Upland Birch-Ericaceous-Willow Low Shr	83.1	6	93.5	16020	15277	13857	11927	14882	13107	10905	92.9	85.8	78.7	1	2	4	6	1	None
Upland Birch-Ericaceous-Willow Low Shru	Upland Alder-Willow Tall Shrub	19.4	3	3.5					561	1069	1455	3.5	7.0	10.5	1	2	4	6	0.5	Plant migration/expansion
Upland Birch-Ericaceous-Willow Low Shru	Upland Aspen Forest	5.9	1	0.1					16	31	42	0.1	0.2	0.3	1	2	4	6	0.5	Plant migration/expansion
Upland Birch-Ericaceous-Willow Low Shru	Upland Birch Forest	0.5	1	0.2					32	61	83	0.2	0.4	0.6	1	2	4	6	0.5	Post-fire late succession
Upland Birch-Ericaceous-Willow Low Shru	Upland Spruce-Birch Forest	0.6	2	0.2					32	61	83	0.2	0.4	0.6	1	2	4	6	0.5	Post-fire late succession
Upland Birch-Ericaceous-Willow Low Shru	Upland White Spruce Forest	6.8	5	1.4					224	428	582	1.4	2.8	4.2	1	2	4	6	0.5	Plant migration/expansion
Upland Birch-Ericaceous-Willow Low Shru	Upland White Spruce-Lichen Forest	1.6	1	0.8					128	244	333	0.8	1.6	2.4	1	2	4	6	0.5	Plant migration/expansion
Upland Birch-Ericaceous-Willow Low Shru	Upland Barrens-Thermokarst		0	0.2					96	183	249	0.6	1.2	1.8	1	2	4	6	1.5	Thaw slump
Upland Birch-Ericaceous-Willow Low Shru	Lowland Lake		0	0.1					48	92	125	0.3	0.6	0.9	1	2	4	6	1.5	Thaw settlement
Upland Willow Low Shrub	Upland Willow Low Shrub	90.0	5	97.3	4186	4436	4796	5512	4056	4161	4350	96.9	93.8	90.7	1	2	4	6	1	None
Upland Willow Low Shrub	Upland Alder-Willow Tall Shrub	37.0	1	1.0					42	89	144	1.0	2.0	3.0	1	2	4	6	0.5	Plant migration/expansion
Upland Willow Low Shrub	Upland White Spruce Forest	4.4	3	1.5					63	133	216	1.5	3.0	4.5	1	2	4	6	0.5	Plant migration/expansion
Upland Willow Low Shrub	Upland Barrens-Thermokarst		0	0.1					13	27	43	0.3	0.6	0.9	1	2	4	6	1.5	Thaw slump
Upland Willow Low Shrub	Lowland Lake		0	0.1					13	27	43	0.3	0.6	0.9	1	2	4	6	1.5	Thaw settlement
Upland Alder-Willow Tall Shrub	Upland Alder-Willow Tall Shrub	99.4	4	97.0	7571	8077	8920	9908	7268	7430	7850	96	92	88	1	2	4	6	1	None
Upland Alder-Willow Tall Shrub	Upland Birch Forest		0	0.4					30	65	107	0.4	0.8	1.2	1	2	4	6	0.5	Plant migration/expansion
Upland Alder-Willow Tall Shrub	Upland Aspen Forest		0	0.1					8	16	27	0.1	0.2	0.3	1	2	4	6	0.5	Plant migration/expansion
Upland Alder-Willow Tall Shrub	Upland White Spruce Forest	2.5	1	2.0					151	323	535	2.0	4.0	6.0	1	2	4	6	0.5	Plant migration/expansion
Upland Alder-Willow Tall Shrub	Upland Barrens-Thermokarst		0	0.4					91	194	321	1.2	2.4	3.6	1	2	4	6	1.5	Thaw slump
Upland Alder-Willow Tall Shrub	Lowland Lake		0	0.1					23	48	80	0.3	0.6	0.9	1	2	4	6	1.5	Thaw settlement
Upland Aspen Forest	Upland Aspen Forest	100.0	2	89.9	16	38	77	122	15	30	54	89.8	79.6	69.4	1	2	4	6	1	None
Upland Aspen Forest	Upland White Spruce-Lichen Forest		0	10.0					2	8	23	10.0	20.0	30.0	1	2	4	6	0.5	Post-fire late succession
Upland Aspen Forest	Upland Sagebrush Shrub		0	0.1					0	0	0	0.2	0.4	0.6	1	2	4	6	1	Drying/moisture Stress
Upland Birch Forest	Upland Birch Forest	47.6	2	36.5	763	517	448	497	388	242	191	50.9	46.8	42.7	1	2	4	6	1	None
Upland Birch Forest	Upland Bluejoint-Herb Meadow		0	1.0					15	21	27	2.0	4.0	6.0	1	2	4	6	1	Fire
Upland Birch Forest	Upland Spruce-Birch Forest	67.8	3	61.0					343	232	202	45.0	45.0	45.0	1	2	4	6	1	Post-fire late succession
Upland Birch Forest	Upland White Spruce Forest	1.5	1	1.0					8	10	13	1.0	2.0	3.0	1	2	4	6	0.5	Post-fire late succession
Upland Birch Forest	Upland Spruce-Birch-Herb Forest		0	0.2					2	2	3	0.2	0.4	0.6	1	2	4	6	0.5	Plant migration/expansion
Upland Birch Forest	Upland Barrens-Thermokarst		0	0.2					5	6	8	0.6	1.2	1.8	1	2	4	6	1.5	Thaw slump
Upland Birch Forest	Lowland Lake		0	0.1					2	3	4	0.3	0.6	0.9	1	2	4	6	1.5	Thaw settlement
Upland Spruce-Birch Forest	Upland Spruce-Birch Forest	96.7	4	93.0	1084	1406	1499	1454	986	1153	1094	91	82	73	1	2	4	6	1	None
Upland Spruce-Birch Forest	Upland Barrens-Burned		0	1.0					22	56	90	2.0	4.0	6.0	1	2	4	6	1	Fire
Upland Spruce-Birch Forest	Upland Bluejoint-Herb Meadow		1	0.5					5	14	22	0.5	1.0	1.5	1	2	4	6	0.5	Post-fire early succession
Upland Spruce-Birch Forest	Upland Birch-Ericaceous-Willow Low Shr	5.4	1	1.0					11	28	45	1.0	2.0	3.0	1	2	4	6	0.5	Post-fire early succession
Upland Spruce-Birch Forest	Upland Birch Forest	3.6	1	0.5					5	14	22	0.5	1.0	1.5	1	2	4	6	0.5	Post-fire late succession
Upland Spruce-Birch Forest	Upland White Spruce Forest		0	3.5					38	98	157	3.5	7.0	10.5	1	2	4	6	0.5	Post-fire late succession
Upland Spruce-Birch Forest	Upland Barrens-Thermokarst		0	0.4					13	34	54	1.2	2.4	3.6	1	2	4	6	1.5	Thaw slump
Upland Spruce-Birch Forest	Lowland Lake		0	0.1					3	8	13	0.3	0.6	0.9	1	2	4	6	1.5	Thaw settlement
Upland Spruce-Birch-Herb Forest	Upland Spruce-Birch-Herb Forest		0	100.0	0	2	4	6	0	2	4	100	100	100	1	2	4	6	1	None
Upland White Spruce Forest	Upland White Spruce Forest	99.2	5	99	11665	12052	12817	13881	11376	11455	11866	97.52	95.05	92.58	1	2	4	6	1	None
Upland White Spruce Forest	Upland Barrens-Burned		0	0.50					117	241	385	1.0	2.0	3.0	1	2	4	6	1	Fire
Upland White Spruce Forest	Upland Barrens-Thermokarst		0	0.20					70	145	231	0.6	1.2	1.8	1	2	4	6	1.5	Thaw slump
Upland White Spruce Forest	Upland Birch-Ericaceous-Willow Low Shr	3.4	1	0.30					35	72	115	0.3	0.6	0.9	1	2	4	6	0.5	Post-fire late succession
Upland White Spruce Forest	Upland Birch Forest		1	0.10					12	24	38	0.1	0.2	0.3	1	2	4	6	0.5	Post-fire late succession
Upland White Spruce Forest	Upland Spruce-Birch Forest	0.3	1	0.10					12	24	38	0.1	0.2	0.3	1	2	4	6	0.5	Post-fire late succession
Upland White Spruce Forest	Upland White Spruce-Herb Forest		0	0.10					12	24	38	0.1	0.2	0.3	1	2	4	6	0.5	Plant migration/expansion
Upland White Spruce Forest	Human Modified Barrens		0	0.01					1	1	1	0.01	0.01	0.01	1	2	4	6	1	Human development
Upland White Spruce Forest	Lowland Lake		0	0.09					31	65	104	0.3	0.5	0.8	1	2	4	6	1.5	Thaw settlement
Upland White Spruce-Herb Forest	Upland White Spruce-Herb Forest		0	100.0	0	12	36	74	0	12	36	100	100	100	1	2	4	6	1	None
Upland White Spruce-Lichen Forest	Upland White Spruce-Lichen Forest	100.0	1	99.7	169	297	546	892	168	294	536	99.4	98.8	98.2	1	2	4	6	1	None
Upland White Spruce-Lichen Forest	Upland Barrens-Burned		0	0.3					1	4	10	0.6	1.2	1.8	1	2	4	6	1	Fire

Supplemental Table 1 (cont.).

Ecotype	Ecotype-Transition	Historical TransProb 30-yr Ave	References Used	Adjusted Historical TransProb 30-yr Ave	Total Area 2002	Total Area 2040	Total Area 2070	Total Area 2100	Partial Area 2040	Partial Area 2070	Partial Area 2100	TransProb-2040	TransProb-2070	Trans Prob-2100	AirTemp Change 30-yr Hist	Air-Temp Incr 2040	Air-Temp Change 2070	Air-Temp Change 2100	Change Rate Factor	Driver
Lowland Black Spruce Forest	Lowland Black Spruce Forest	98.4	4	97.8	2937	3705	4925	5998	2787	3327	4171	94.9	89.8	84.7	1	2	4	6	1	None
Lowland Black Spruce Forest	Lowland Barrens-Burned		0	0.3					18	44	89	0.6	1.2	1.8	1	2	4	6	1	Fire
Lowland Black Spruce Forest	Lowland Ericaceous Shrub Bog	2.2	1	1.1					97	245	488	3.3	6.6	9.9	1	2	4	6	1.5	Thaw settlement
Lowland Black Spruce Forest	Lowland Birch-Ericaceous-Willow Low Sh	4.0	1	0.6					18	44	89	0.6	1.2	1.8	1	2	4	6	0.5	Post-fire early succession
Lowland Black Spruce Forest	Lowland Lake		0	0.2					18	44	89	0.6	1.2	1.8	1	2	4	6	1.5	Thaw settlement
Lowland Spruce-Birch Forest	Lowland Spruce-Birch Forest	72	2	72.0	81	162	270	325	51	42	-30	63	26	-11	1	2	4	6	1	None
Lowland Spruce-Birch Forest	Lowland Black Spruce Forest	46.6	1	20.0					16	65	162	20.0	40.0	60.0	1	2	4	6	0.5	Post-fire late succession
Lowland Spruce-Birch Forest	Lowland Sedge Fen	9.3	1	1.0					2	10	24	3.0	6.0	9.0	1	2	4	6	1.5	Thaw settlement
Lowland Spruce-Birch Forest	Lowland Barrens-Burned		0	7.0					11	45	114	14.0	28.0	42.0	1	2	4	6	1	Fire
Lowland Birch Forest	Lowland Birch Forest	81.5	2	89.0	81	258	497	607	69	180	273	85	70	55	1	2	4	6	1	None
Lowland Birch Forest	Lowland Spruce-Birch Forest	10.9	1	5.0					4	26	75	5.0	10.0	15.0	1	2	4	6	0.5	Post-fire late succession
Lowland Birch Forest	Lowland Black Spruce Forest	8.7	1	4.0					3	21	60	4.0	8.0	12.0	1	2	4	6	0.5	Post-fire late succession
Lowland Birch Forest	Lowland Sedge Fen	17.4	1	1.5					4	23	67	4.5	9.0	13.5	1	2	4	6	1.5	Thaw settlement
Lowland Birch Forest	Lowland Ericaceous Shrub Bog	0.7	1	0.3					1	5	13	0.9	1.8	2.7	1	2	4	6	1.5	Thaw slump
Lowland Birch Forest	Lowland Lake		0	0.2					0	3	9	0.6	1.2	1.8	1	2	4	6	1.5	Thaw settlement
Lowland Alder Tall Shrub	Lowland Alder Tall Shrub	63.6	1	90.0	1775	1595	1272	885	1580	1244	852	89	78	67	1	2	4	6	1	None
Lowland Alder Tall Shrub	Lowland Birch Forest		0	0.5					9	16	19	0.5	1.0	1.5	1	2	4	6	0.5	Plant migration/expansion
Lowland Alder Tall Shrub	Lowland Black Spruce Forest		0	8.0					142	255	305	8.0	16.0	24.0	1	2	4	6	0.5	Plant migration/expansion
Lowland Alder Tall Shrub	Upland White Spruce Forest	36.4	1	1.0					18	32	38	1.0	2.0	3.0	1	2	4	6	0.5	Plant migration/expansion
Lowland Alder Tall Shrub	Lowland Lake		0	0.5					27	48	57	1.5	3.0	4.5	1	2	4	6	1.5	Thaw settlement
Lowland Willow Low Shrub	Lowland Willow Low Shrub	97.7	4	99.0	1218	1694	2271	3009	1194	1627	2135	98	96	94	1	2	4	6	1	None
Lowland Willow Low Shrub	Lowland Sedge Fen	4.0	1	0.3					11	30	61	0.9	1.8	2.7	1	2	4	6	1.5	Thaw settlement
Lowland Willow Low Shrub	Lowland Alder Tall Shrub		0	0.1					1	3	7	0.1	0.2	0.3	1	2	4	6	0.5	Plant migration/expansion
Lowland Willow Low Shrub	Lowland Birch Forest	2.6	1	0.2					2	7	14	0.2	0.4	0.6	1	2	4	6	0.5	Plant migration/expansion
Lowland Willow Low Shrub	Lowland Black Spruce Forest	2.6	1	0.2					2	7	14	0.2	0.4	0.6	1	2	4	6	0.5	Plant migration/expansion
Lowland Willow Low Shrub	Lowland Lake		0	0.2					7	20	41	0.6	1.2	1.8	1	2	4	6	1.5	Thaw settlement
Lowland Birch-Ericaceous-Willow Low Shr	Lowland Birch-Ericaceous-Willow Low Sh	75.5	5	81	7086	5858	3985	2509	5633	3456	1534	80	59	39	1	2	4	6	1	None
Lowland Birch-Ericaceous-Willow Low Shr	Lowland Sedge-Dryas Meadow	0.5	1	0.4					57	94	96	0.8	1.6	2.4	1	2	4	6	1	Fire
Lowland Birch-Ericaceous-Willow Low Shr	Lowland Willow Low Shrub	5.2	1	3.6					255	422	430	3.6	7.2	10.8	1	2	4	6	0.5	Plant migration/expansion
Lowland Birch-Ericaceous-Willow Low Shr	Lowland Alder Tall Shrub		0	0.2					14	23	24	0.2	0.4	0.6	1	2	4	6	0.5	Plant migration/expansion
Lowland Birch-Ericaceous-Willow Low Shr	Lowland Birch Forest	3.3	2	2.5					177	293	299	2.5	5.0	7.5	1	2	4	6	0.5	Plant migration/expansion
Lowland Birch-Ericaceous-Willow Low Shr	Lowland Spruce-Birch Forest	0.9	3	1.0					71	117	120	1.0	2.0	3.0	1	2	4	6	0.5	Post-fire late succession
Lowland Birch-Ericaceous-Willow Low Shr	Lowland Black Spruce Forest	13.3	5	10.5					744	1230	1255	10.5	21.0	31.5	1	2	4	6	0.5	Post-fire late succession
Lowland Birch-Ericaceous-Willow Low Shr	Lowland Lake		0	0.5					106	176	179	1.5	3.0	4.5	1	2	4	6	1.5	Thaw settlement
Lowland Birch-Ericaceous-Willow Low Shr	Riverine Birch-Willow Low Shrub	0.4	1	0.2					28	47	48	0.4	0.8	1.2	1	2	4	6	1	River erosion
Lowland Ericaceous Shrub Bog	Lowland Ericaceous Shrub Bog	95.3	2	95	1394	1370	1381	1522	1273	1132	1021	91	83	74	1	2	4	6	1	None
Lowland Ericaceous Shrub Bog	Lowland Sedge Fen	44.1	1	2.0					84	164	249	6.0	12.0	18.0	1	2	4	6	1.5	Thaw settlement
Lowland Ericaceous Shrub Bog	Lowland Birch-Ericaceous-Willow Low Shrub		0	2.0					28	55	83	2.0	4.0	6.0	1	2	4	6	0.5	Paludification
Lowland Ericaceous Shrub Bog	Lowland Black Spruce Forest		0	0.7					10	19	29	0.7	1.4	2.1	1	2	4	6	0.5	Plant migration/expansion
Lowland Sedge-Dryas Meadow	Lowland Sedge-Dryas Meadow	93.9	3	97.00	1871	1874	1900	1982	1714	1559	1421	91.599	83.198	74.8	1	2	4	6	1	None
Lowland Sedge-Dryas Meadow	Lowland Sedge Fen	5.2	3	2.40					135	270	410	7.2	14.4	21.6	1	2	4	6	1.5	Thaw settlement
Lowland Sedge-Dryas Meadow	Lowland Willow Low Shrub	0.2	1	0.30					11	22	34	0.6	1.2	1.8	1	2	4	6	1	Soil drainage
Lowland Sedge-Dryas Meadow	Riverine Barrens	0.2	1	0.16					6	12	18	0.3	0.6	1.0	1	2	4	6	1	River erosion
Lowland Sedge-Dryas Meadow	Coastal Barrens	0.5	1	0.04					1	3	5	0.1	0.2	0.2	1	2	4	6	1	Coastal erosion
Lowland Sedge-Dryas Meadow	Coastal Water	0.5	1.0	0.10					4	7	11	0.2	0.4	0.6	1	2	4	6	1	Coastal erosion
Lowland Sedge Fen	Lowland Sedge Fen	86	5	85.90	1782	2134	2671	3073	1386	1187	892	77.8	55.6	33.4	1	2	4	6	1	None
Lowland Sedge Fen	Lowland Sedge-Dryas Meadow	4.1	3	2.90					103	248	465	5.8	11.6	17.4	1	2	4	6	1	Soil drainage
Lowland Sedge Fen	Lowland Birch-Ericaceous-Willow Low Sh	7.1	2	5.00					178	427	801	10.0	20.0	30.0	1	2	4	6	1	Soil drainage
Lowland Sedge Fen	Lowland Willow Low Shrub	5.0	2	4.00					71	171	320	4.0	8.0	12.0	1	2	4	6	0.5	Drainage & migration
Lowland Sedge Fen	Lowland Spruce-Birch Forest	5.0	1	2.00					36	85	160	2.0	4.0	6.0	1	2	4	6	0.5	Drainage & migration
Lowland Sedge Fen	Coastal Barrens	0.3	2	0.10					4	9	16	0.2	0.4	0.6	1	2	4	6	1	Coastal erosion
Lowland Sedge Fen	Coastal Water		0	0.10					4	9	16	0.2	0.4	0.6	1	2	4	6	1	Coastal erosion
Lowland Barrens-Burned	Lowland Barrens-Burned		0.0	0.1	163	29	90	202	0	0	0	0.1	0.1	0.1	1	2	4	6	1	None
Lowland Barrens-Burned	Lowland Willow Low Shrub		0	99.9					163	29	90	99.9	99.9	99.9	1	2	4	6	1	Post-fire early succession
Lowland Lake	Lowland Lake	86.2	3	87.1	2212	2041	1758	1471	1641	988	397	74.2	48.4	22.6	1	2	4	6	1	None
Lowland Lake	Lacustrine Barrens		0	1.0					44	82	105	2.0	4.0	6.0	1	2	4	6	1	Lake drainage
Lowland Lake	Lacustrine Bluejoint Meadow	12.6	1	7.0					310	572	738	14.0	28.0	42.0	1	2	4	6	1	Lake drainage
Lowland Lake	Lacustrine Wet Sedge Meadow	6.4	2	4.0					177	327	422	8.0	16.0	24.0	1	2	4	6	1	Lake drainage
Lowland Lake	Lacustrine Willow Shrub	2.5	2	0.9					40	73	95	1.8	3.6	5.4	1	2	4	6	1	Lake drainage
Lacustrine Wet Sedge Meadow	Lacustrine Wet Sedge Meadow	76.1	2	86.8	489	577	715	951	360	274	151	73.7	47.4	21.1	1	2	4	6	1	None
Lacustrine Wet Sedge Meadow	Lacustrine Bluejoint Meadow		0	1.0					10	23	43	2.0	4.0	6.0	1	2	4	6	1	Soil drainage
Lacustrine Wet Sedge Meadow	Lowland Lake	100.0	0	0.1					1	2	4	0.2	0.4	0.6	1	2	4	6	1	Lake erosion
Lacustrine Wet Sedge Meadow	Lacustrine Willow Shrub	40.9	1	12.0					117	277	515	24.0	48.0	72.0	1	2	4	6	1	Soil drainage
Lacustrine Wet Sedge Meadow	Lowland Sedge Fen	6.8	0	0.1					0	1	2	0.1	0.2	0.3	1	2	4	6	0.5	Paludification
Lacustrine Barrens	Lacustrine Barrens		0	0.1	33	44	82	106	0	0	0	0.1	0.1	0.1	1	2	4	6	1	None
Lacustrine Barrens	Lacustrine Wet Sedge Meadow		0	50.0					16	22	41	50.0	50.0	50.0	1	2	4	6	1	Early succession
Lacustrine Barrens	Lacustrine Bluejoint Meadow		0	49.9					16	22	41	49.9	49.9	49.9	1	2	4	6	1	Early succession

Supplemental Table 1 (cont.).

Ecotype	Ecotype-Transition	Historical TransProb 30-yr Ave	References Used	Adjusted Historical TransProb 30-yr Ave	Total Area 2002	Total Area 2040	Total Area 2070	Total Area 2100	Partial Area 2040	Partial Area 2070	Partial Area 2100	TransProb-2040	TransProb-2070	Trans Prob-2100	AirTemp Change 30-yr Hist	Air-Temp Incr 2040	Air-Temp Change 2070	Air-Temp Change 2100	Change Rate Factor	Driver
Lacustrine Bluejoint Meadow	Lacustrine Bluejoint Meadow		0	45.0	36	352	775	1171	16	158	349	45	45	45	1	2	4	6	1	None
Lacustrine Bluejoint Meadow	Lacustrine Willow Shrub	54.5	1	55.0					20	193	426	55.0	55.0	55.0	1	2	4	6	1	Early succession
Lacustrine Willow Shrub	Lacustrine Willow Shrub	81.8	1	85	163	315	765	1457	138	221	421	85	70	55	1	2	4	6	1	None
Lacustrine Willow Shrub	Lacustrine Wet Sedge Meadow	18.2	1	14.700					24	93	337	14.7	29.4	44.1	1	2	4	6	0.5	Paludification
Lacustrine Willow Shrub	Lowland Alder Tall Shrub		0	0.100					0	1	2	0.1	0.2	0.3	1	2	4	6	0.5	Plant migration/expansion
Lacustrine Willow Shrub	Lowland Birch Forest		0	0.100					0	1	2	0.1	0.2	0.3	1	2	4	6	0.5	Plant migration/expansion
Lacustrine Willow Shrub	Lowland Black Spruce Forest		0	0.100					0	1	2	0.1	0.2	0.3	1	2	4	6	0.5	Plant migration/expansion
Riverine Water	Riverine Water	65.9	4	65.9	842	909	1204	1403	478	351	246	56.8	38.6	20.4	1	2	4	6	1	None
Riverine Water	Riverine Barrens	34.6	3	25.0					210	227	301	25.0	25.0	25.0	1	2	4	6	1	River deposition
Riverine Water	Riverine Wet Sedge Meadow	4.0	2	2.1					35	76	152	4.2	8.4	12.6	1	2	4	6	1	River deposition
Riverine Water	Riverine Willow Low Shrub	9.0	3	7					118	255	506	14.0	28.0	42.0	1	2	4	6	1	River deposition
Riverine Barrens	Riverine Barrens	79.0	5	81	904	903	725	613	651	397	116	72	44	16	1	2	4	6	1	None
Riverine Barrens	Riverine Water	4.7	3	9.0					163	325	392	18.0	36.0	54.0	1	2	4	6	1	River erosion
Riverine Barrens	Riverine Dryas Dwarf Shrub	1.9	1	0.5					5	9	11	0.5	1.0	1.5	1	2	4	6	0.5	Early succession
Riverine Barrens	Riverine Willow Low Shrub	28.3	5	8.0					72	144	174	8.0	16.0	24.0	1	2	4	6	0.5	Early succession
Riverine Barrens	Riverine Wet Sedge Meadow	1.9	1	0.5					5	9	11	0.5	1.0	1.5	1	2	4	6	0.5	Early succession
Riverine Barrens	Riverine Alder-Willow Tall Shrub		0	1.0					9	18	22	1.0	2.0	3.0	1	2	4	6	0.5	Early succession
Riverine Wet Sedge Meadow	Riverine Wet Sedge Meadow	96.1	4	95.9	1256	1245	1228	1240	1205	1143	1077	96	92	88	1	2	4	6	1	None
Riverine Wet Sedge Meadow	Riverine Birch-Willow Low Shrub	4.3	1	3.0					38	75	111	3.0	6.0	9.0	1	2	4	6	0.5	Paludification
Riverine Wet Sedge Meadow	Riverine Willow Low Shrub		0	1.1					14	27	41	1.1	2.2	3.3	1	2	4	6	0.5	Paludification
Riverine Dryas Dwarf Shrub	Riverine Dryas Dwarf Shrub	87.5	3	87.8	208	173	118	63	169	109	52	81.3	62.6	43.9	1	2	4	6	1	None
Riverine Dryas Dwarf Shrub	Riverine Water	3.7	1	5.0					21	35	35	10.0	20.0	30.0	1	2	4	6	1	River erosion
Riverine Dryas Dwarf Shrub	Riverine Barrens	4.0	1	1.5					6	10	11	3.0	6.0	9.0	1	2	4	6	1	River erosion
Riverine Dryas Dwarf Shrub	Riverine Willow Low Shrub	14.9	2	5.0					10	17	18	5.0	10.0	15.0	1	2	4	6	0.5	Plant migration/expansion
Riverine Dryas Dwarf Shrub	Riverine Alder-Willow Tall Shrub			0.7					1	2	2	0.7	1.4	2.1	1	2	4	6	0.5	Plant migration/expansion
Riverine Willow Low Shrub	Riverine Willow Low Shrub	91.0	4	83.9	310	449	676	925	235	233	187	75.9	51.8	27.7	1	2	4	6	1	None
Riverine Willow Low Shrub	Riverine Water	3.0	3	5.0					31	90	203	10.0	20.0	30.0	1	2	4	6	1	River erosion
Riverine Willow Low Shrub	Riverine Barrens	5.5	3	3.0					19	54	122	6.0	12.0	18.0	1	2	4	6	1	River erosion
Riverine Willow Low Shrub	Riverine Alder-Willow Tall Shrub	8.2	1	4.0					12	36	81	4.0	8.0	12.0	1	2	4	6	0.5	Plant migration/expansion
Riverine Willow Low Shrub	Riverine Birch-Willow Low Shrub		0	0.1					0	1	2	0.1	0.2	0.3	1	2	4	6	0.5	Paludification
Riverine Willow Low Shrub	Riverine Poplar Forest	5.7	1	4.0					12	36	81	4.0	8.0	12.0	1	2	4	6	0.5	Plant migration/expansion
Riverine Birch-Willow Low Shrub	Riverine Birch-Willow Low Shrub	100.0	1	99.5	1400	1459	1567	1704	1393	1444	1543	99.5	99	98.5	1	2	4	6	1	None
Riverine Birch-Willow Low Shrub	Riverine Alder-Willow Tall Shrub		0	0.5					7	15	24	0.5	1.0	1.5	1	2	4	6	0.5	Plant migration/expansion
Riverine Alder-Willow Tall Shrub	Riverine Alder-Willow Tall Shrub	100.0	1	93.0	1347	1242	1065	874	1212	994	745	90	80	70	1	2	4	6	1	None
Riverine Alder-Willow Tall Shrub	Riverine Poplar Forest		0	4.0					54	99	128	4.0	8.0	12.0	1	2	4	6	0.5	Late succession
Riverine Alder-Willow Tall Shrub	Riverine Water		0	3.0					81	149	192	6.0	12.0	18.0	1	2	4	6	1	River erosion
Riverine Poplar Forest	Riverine Poplar Forest	92.2	1	86.0	174	204	254	303	138	118	94	79	58	37	1	2	4	6	1	None
Riverine Poplar Forest	Riverine Barrens	7.8	1	3.0					10	24	46	6.0	12.0	18.0	1	2	4	6	1	River erosion
Riverine Poplar Forest	Riverine White Spruce-Poplar Forest		0	7.0					12	29	53	7.0	14.0	21.0	1	2	4	6	0.5	Late succession
Riverine Poplar Forest	Riverine Water	100.0	1	4.0					14	33	61	8.0	16.0	24.0	1	2	4	6	1	River erosion
Riverine White Spruce-Poplar Forest	Riverine White Spruce-Poplar Forest	100.0	1	88.0	117	109	101	103	97	72	49	83	66	49	1	2	4	6	1	None
Riverine White Spruce-Poplar Forest	Riverine White Spruce-Willow Forest		0	7.0					8	15	21	7.0	14.0	21.0	1	2	4	6	0.5	Late succession
Riverine White Spruce-Poplar Forest	Riverine Water		0	5.0					12	22	30	10.0	20.0	30.0	1	2	4	6	1	River erosion
Riverine White Spruce-Willow Forest	Riverine White Spruce-Willow Forest	100.0	3	95.0	1104	1002	817	593	994	802	572	90	80	70	1	2	4	6	1	None
Riverine White Spruce-Willow Forest	Riverine Water		0	5.0					110	200	245	10.0	20.0	30.0	1	2	4	6	1	River erosion
Coastal Water	Coastal Water	97.9	1	99.9	11903	11917	11946	11993	11879	11869	11874	99.8	99.6	99.4	1	2	4	6	1	None
Coastal Water	Coastal Barrens	2.1	1	0.1					24	48	72	0.2	0.4	0.6	1	2	4	6	1	Coastal deposition
Coastal Barrens	Coastal Barrens	93.7	2.0	95.8	158	190	246	314	146	162	192	92.7	85.4	78.1	1	2	4	6	1	None
Coastal Barrens	Coastal Water	12.5	1	3.1					10	24	46	6.2	12.4	18.6	1	2	4	6	1	Coastal erosion
Coastal Barrens	Coastal Brackish Sedge–Grass Meadow		0	0.1					0	0	1	0.1	0.2	0.3	1	2	4	6	0.5	Early succession
Coastal Barrens	Coastal Dunegrass Meadow		0	1.0					2	4	7	1.0	2.0	3.0	1	2	4	6	0.5	Early succession
Coastal Brackish Sedge–Grass Meadow	Coastal Brackish Sedge–Grass Meadow	93.9	1	93.9	240	211	161	103	211	160	102	87.9	75.8	63.7	1	2	4	6	1	None
Coastal Brackish Sedge–Grass Meadow	Coastal Barrens		0	3.0					14	25	29	6.0	12.0	18.0	1	2	4	6	1	Coastal deposition
Coastal Brackish Sedge–Grass Meadow	Coastal Crowberry Dwarf Shrub		0	0.1					0	0	0	0.1	0.2	0.3	1	2	4	6	0.5	Paludification
Coastal Brackish Sedge–Grass Meadow	Coastal Water	6.1	1	3					14	25	29	6.0	12.0	18.0	1	2	4	6	1	Coastal erosion
Coastal Dunegrass Meadow	Coastal Dunegrass Meadow	100.0	1	95.0	19	20	21	26	18	18	18	95	90	85	1	2	4	6	1	None
Coastal Dunegrass Meadow	Coastal Crowberry Dwarf Shrub		0	5.0					1	2	3	5.0	10.0	15.0	1	2	4	6	0.5	Late succession
Coastal Crowberry Dwarf Shrub	Coastal Crowberry Dwarf Shrub	100.0	1	99.0	80	80	81	82	79	79	79	99	98	97	1	2	4	6	1	None
Coastal Crowberry Dwarf Shrub	Lowland Birch-Ericaceous-Willow Low Shrub		0	0.5					1	2	2	0.5	1.0	1.5	1	2	4	6	0.5	Paludification
Coastal Crowberry Dwarf Shrub	Upland Alder-Willow Tall Shrub		0	0.5					0	1	1	0.5	1.0	1.5	1	2	4	6	0.5	Plant migration/expansion
Human Modified Barrens	Human Modified Barrens		0	100.0	2	7	11	15	2	7	11	100	100	100	1	2	4	6	1	None
Shadow/Indeterminate	Shadow/Indeterminate		0	100.0	1888	1888	1888	1888	1888	1888	1888	100	100	100	1	2	4	6	1	None