Climate Change on the Canadian Prairie: Frost Free Duration

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Introduction

- The Canadian Prairies have become warmer over the past 4-5 decades.
- The largest temperature increase has tended to occur during late winter-early spring whereas the change in fall temperatures has tended to be relatively small.
- Both maximum and minimum temperatures have increased for the late winter-early spring season, whereas only minimum temperatures have increased for the growing season.

Objective

- To look at meteorological records from weather stations across the Canadian prairies for evidence of increased frost free durations and earlier dates of last spring frosts (0°C).

Methods

- We gathered meteorological records from numerous weather stations across the agricultural portion of the Canadian prairies.
- We determined the last date for spring frost (0°C), the first date for fall frost, and the frost free duration yearly between 1946 and 1995 at each weather station.
- We analyzed the data to compare 1 O-year average dates (1946-l 955 and 1986-l 995) of last spring frost, first fall frosts, and frost free duration among ecodistricts and among several locations throughout the Canadian prairies.

Results

- Note: These results are preliminary. Analyses are ongoing.
- Averaged across the prairies, generally, the last date of spring frost has been occurring progressively earlier (Figure 1) and frost free duration has been increasing with time (Figure 2).
- The largest change in frost dates appears to be in the spring rather than fall (Table 1).
- When averaged across several locations on the prairies, first fall frosts occurred about 3 days later during 1986-l 995 compared to 1946-l 955, last spring frosts occurred about 10 days earlier, resulting in an increase in the frost free duration of about 12 to 13 days (Table 1).
- When comparing among ecodistricts, 1 O-year averages for 1946-l 955 and 1986-l 995 suggest that the largest increase in frost free duration and the largest increase in earliness of last spring frost tend to be in the Dark Brown and Black soil zones of Saskatchewan, and along the northern and western periphery of the prairie agricultural region such as northwest Saskatchewan and the foothills of Alberta (Figures 1 and 2).
- Comparing 1946-l 955 to 1986-1995, the change in frost free durations within ecodistricts range from no change, or even a decrease (such as in the Peace River region of northwestern Alberta and in northwestern and southeastern Manitoba), to an increase of more than 25 days (such as the foothill region west of Calgary and Edmonton, and south of North Battleford , SK) (Figure 2).
- Isolated locations have had large increases in frost free durations, such as Scott with a 39 day increase (Table 1).
- Provincially, the lowest average increase in frost free duration has occurred in Manitoba (5 to 10 days), whereas the average increase in Alberta is about 10 to 15 days, and in Saskatchewan is about 15 days.

Conclusions

- On average, the duration of the growing season (frost free days) on the Canadian prairies has increased by about 10 to 15 days from 1946-l 955 to 1986-l 995.
- Averaged across the prairies, the last date of spring frost (0°C) is about 10 days earlier whereas the first date of fall frost tends to be about 3 days later now than in the late 1940's-early 1950's.

Table 1: For selected locations throughout the agricultural portion of the Canadian prairies, 1 O-year average dates for last spring frost (0°C) and first fall frost, and frost free duration during 1946-1955 and 1986-l 995 and the difference (diff .) between the 1 O-year means.

Location	Soil Zone	Last Spring Frost (Julian day)			First Fall Frost (Julian day)			Frost Free Duration (day)		
		1946-55	1986-95	diff.	1946-55	1986-95	diff.	1946-55	1986-95	diff.
Manitoba										
Morden	Moist Black	141	133	-8	263	266	3	122	133	11
Saskatchewan										
Indian Head	Black	150	137	-13	255	259	4	105	122	17
Regina	Dark Brown	147	133	-14	257	258	1	110	125	15
Tugaske	Dark Brown	150	134	-16	253	258	5	103	124	21
Outlook	Brown	142	133	-9	259	257	-2	117	124	7
Scott	Dark Brown	166	139	-27	250	259	9	84	120	36
Melfort	Moist Black	157	144	-13	253	258	5	96	114	18
Alberta										
Medicine Hat	Brown	137	133	-4	263	266	3	126	133	7
Gleichen	Wet Black	142	143	1	259	254	-5	117	111	-6
Beaverlodge	Dark Grey	135	143	8	254	258	4	1 1 9	115	-4
	Average	147	137	10	257	259	3	110	122	12

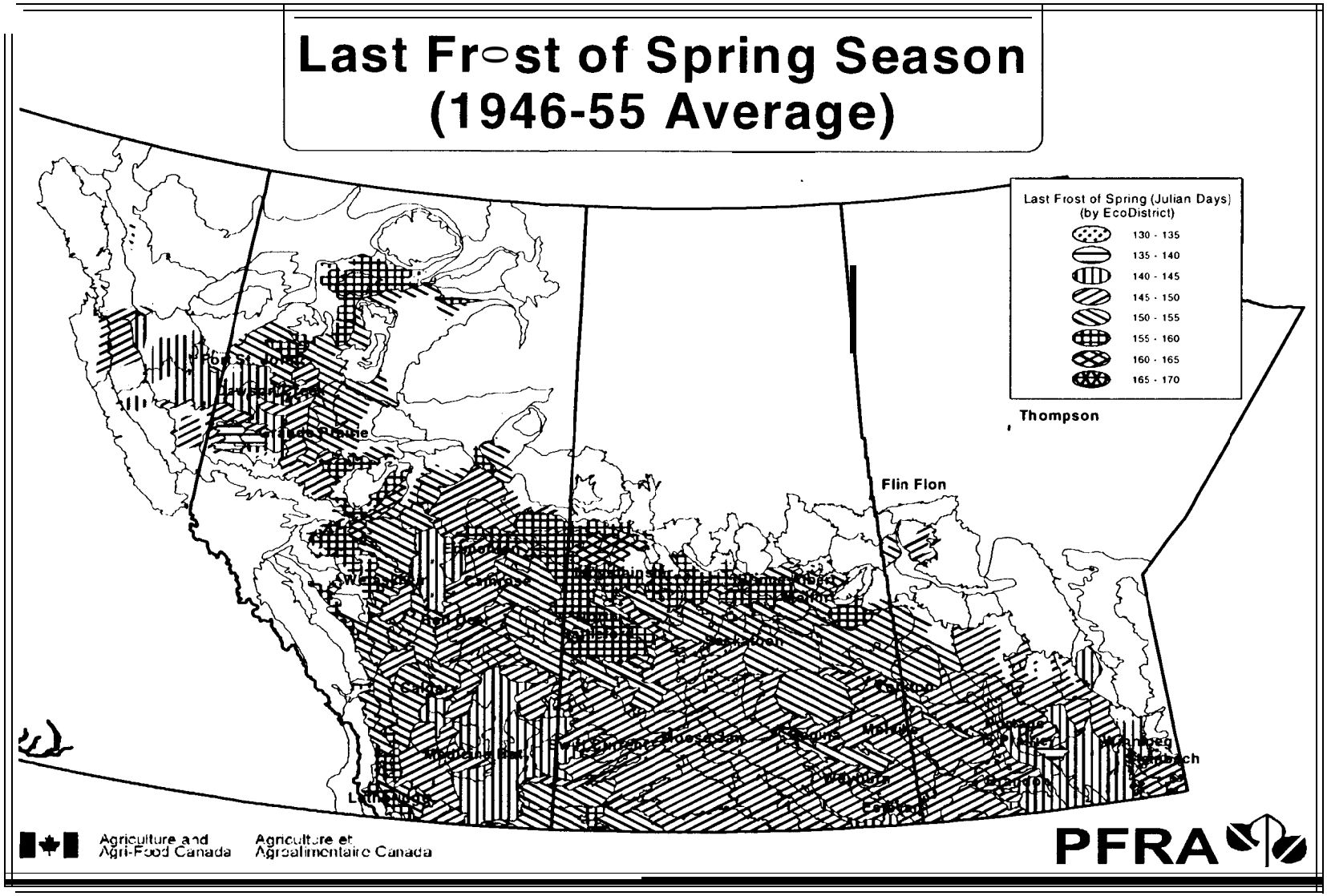

Figure 1a: Ten-year average date (1946-1955) of last spring frost by ecodistrict across the Canadian prairie.

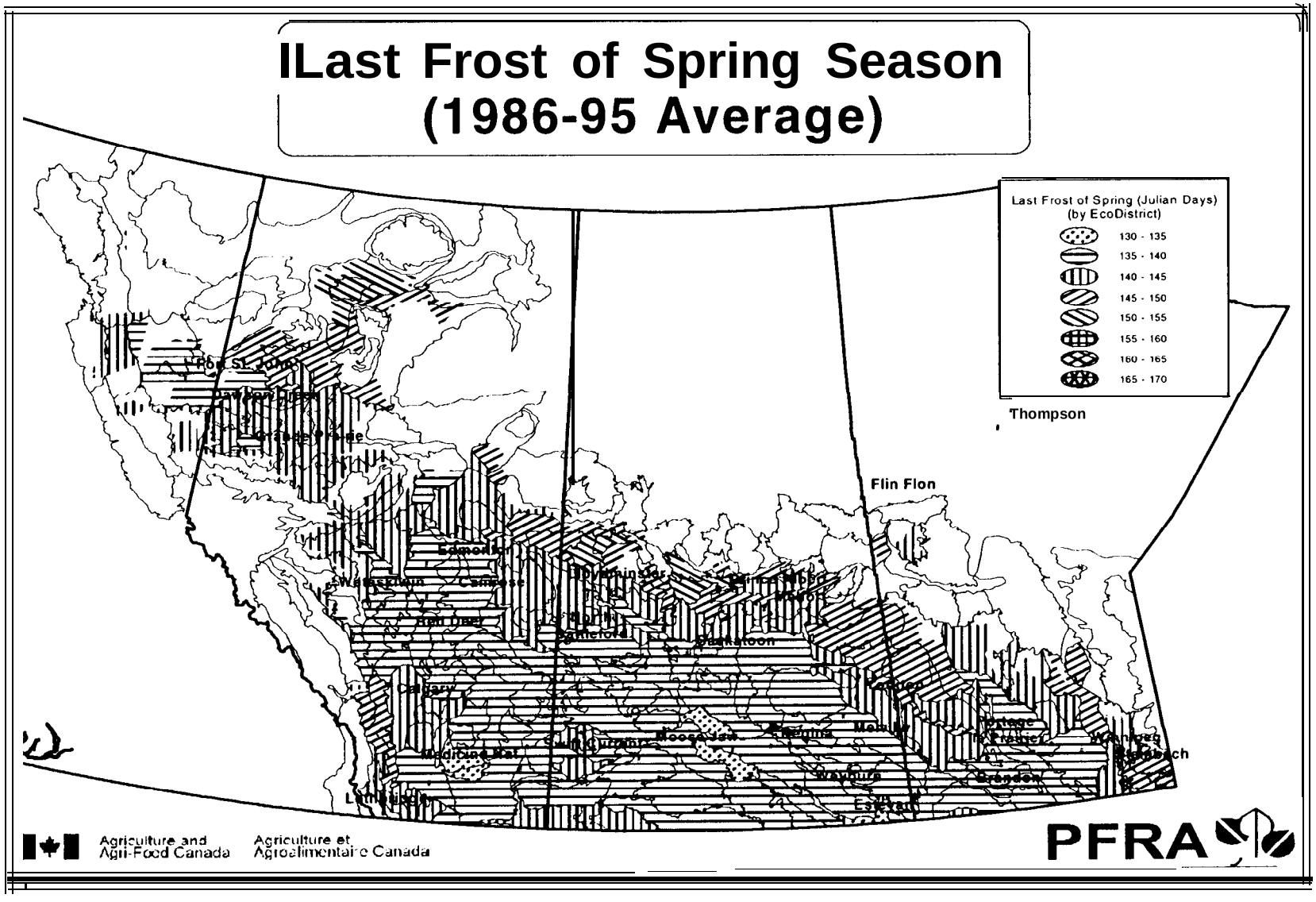

Figure 1 b: Ten-year average date (1986-l 995) of last spring frost by ecodistrict across the Canadian prairie.

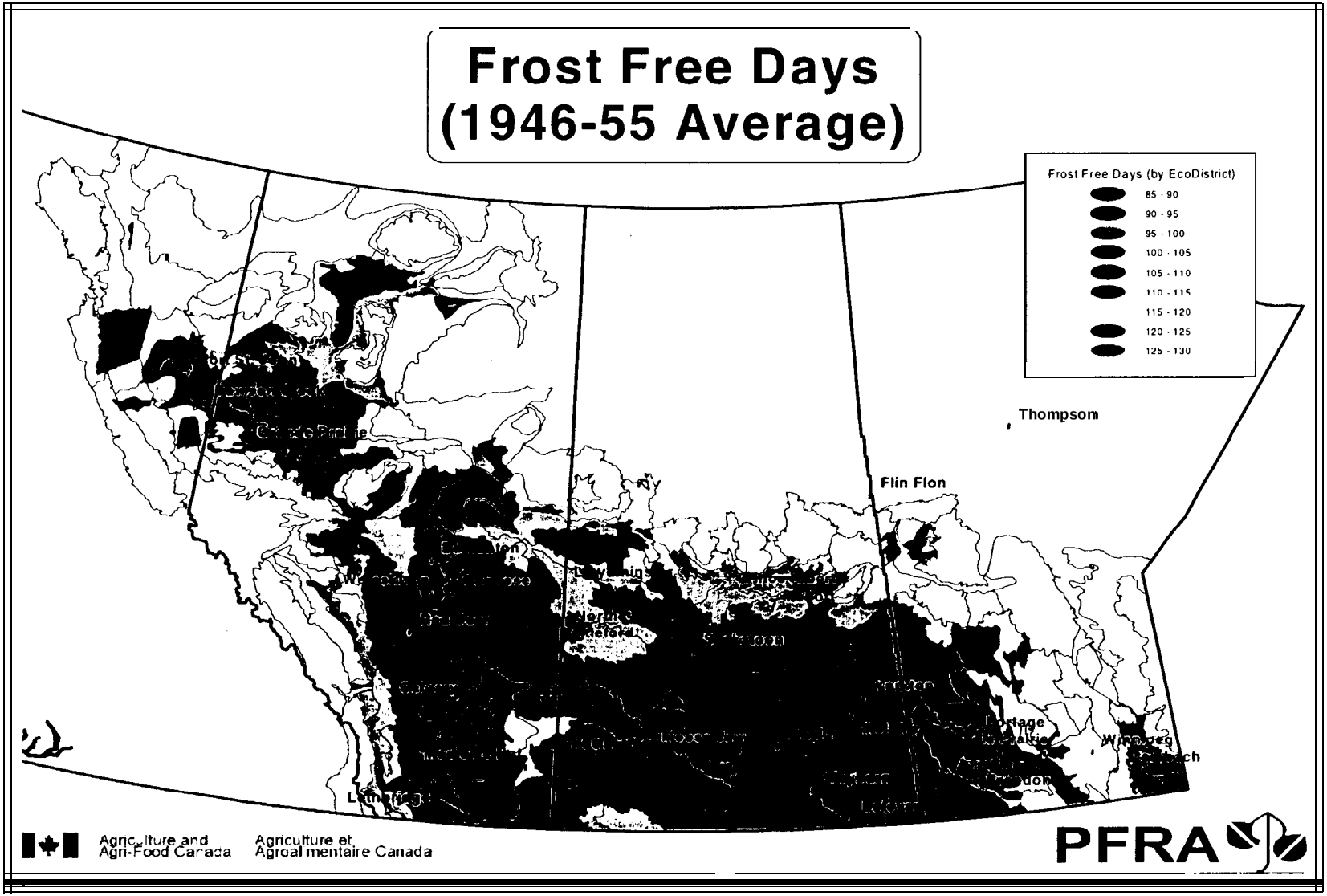

Figure 2a: Ten-year average (1946-l 955) frost free duration by ecodistrict across the Canadian prairie.

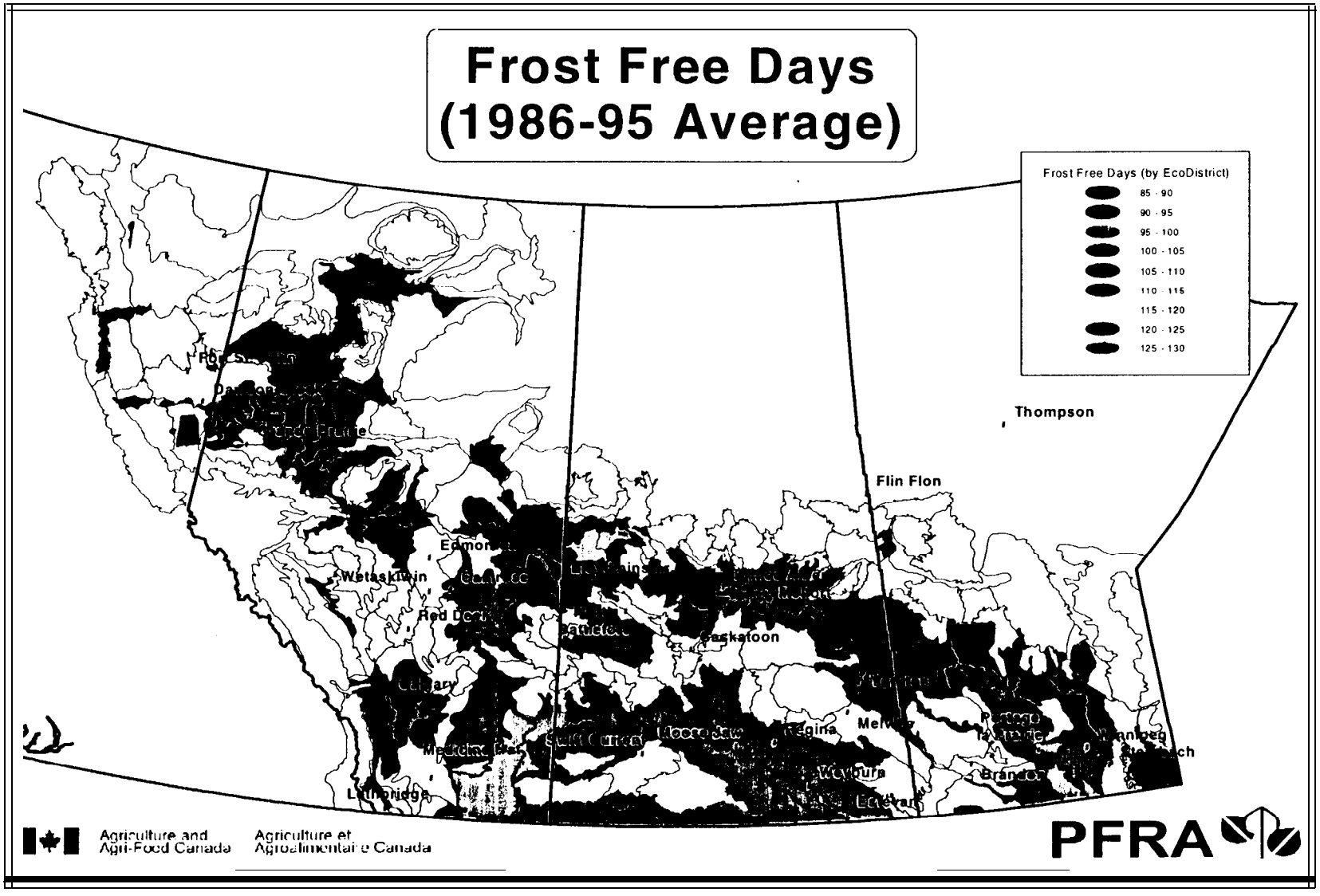

Figure 2b: Ten-year average (1986-l 995) frost free duration by ecodistrict across the Canadian prairie.