Demography of clonal Ostrich Fern (*Matteuccia struthiopteris*). III. Year three of a long-term study

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Introduction

In this contribution, I summarize results from the third year of a long-term study on the spatio-temporal dynamics of a clonal ostrich fern (*Matteuccia struthiopteris*) population in Oxbow Woods, Delta, Manitoba. The study was initiated in 1993 (year 1).

In many plant species, recruitment through the production of vegetative offshoots (clonal growth) is an important method of establishment and spread (Silvertown and Lovett Doust 1993). A number of clonal plant populations have been studied from a demographic standpoint (Jackson *et al.* 1985). Clonal ramets, like individual plants (genets), have individual demographic profiles (birth, death, size, reproductive capacity). Ramets differ in that they often remain attached to one another (via rhizomes or lateral roots), and may therefore remain physiologically interconnected. Intraspecific competition in clonal species may be extremely important in regulating clonal population density (Kenkel 1993). It has been found that clonal growth often leads to large, dense stands of a single genotype dominating a population, even though a large number of genets may have initially been present (Langer et al. 1964). This appears to be the case in the clonal bracken fern (*Pteridium aquilinum*), which forms large genetically uniform stands in burned areas in Finland (Oinonen 1967).

The biology of the ostrich fern is well known (Prange and von Aderkas 1985), but age-specific mortality rates and the longevity of clonal ramets have not been investigated. While a number of studies have demonstrated that the size and proximity of neighbours can affect growth rates of individuals in a population (Kenkel 1991), few studies have integrated spatial interactions with demographic processes. The objective of this long-term study is to relate individual ramet productivity (ramet size), reproduction (production of fertile fronds), and longevity to the size and proximity of ramet 'neighbours' in the stand. The first and second year results of this study are reported in Kenkel (1994, 1995).

Matteuccia struthiopteris (L.) Todaro

This fern species is a member of the Polypodiaceae. It is commonly known as the 'ostrich fern', or more generally as 'fiddle heads' after the edible young frond shoots. A large clonal species, ostrich fern occurs throughout much of northern North America and Eurasia. It often forms extensive, monodominant stands in moist deciduous forests, although it also occurs in the southern boreal forest. The species prefers rich alluvial sites, and it particularly common on river plain fluvial deposits. It is a good indicator of soil moisture conditions, preferring moist by well-drained soils (Mueller-Dombois 1964). In Manitoba, vegetative fronds have a stipe up to 40 cm in length and a blade to ca. 1 m in length. Individual ramets are erect rootstocks with a projecting crown of one or (usually) more fronds. Rootstocks are connected by a stout, persistent runner. Some ramets, usually the largest, produce separate and morphologically distinctive fertile fronds. These are thought to have a nutrient depletion effect on the vegetative fronds (Prange and von Aderkas 1985). In Manitoba, vegetative fronds complete their elongation in the last few weeks of May, and usually begin dying back by mid-August. Low moisture and high light reduce frond height and dry mass, and the species is considered to be 'shade-adapted' (Prange and von Aderkas 1985). Fertile fronds are persistent but not common. In New Brunswick, Prange and von Aderkas (1985) found that under shaded conditions only 1% of ramets produced fertile fronds, but that "in conditions of direct sunlight, a much higher percentage of plants (*sic*) develop fertile fronds".

Study Area

The ostrich fern population studied occurs in a gallery forest (known locally as Oxbow Woods) along a former oxbow of the Assiniboine River. The site is on the University of Manitoba Field Station (Delta Marsh) property (50°11'N, 98°23'W, ca. 3 km south of Lake Manitoba). The study plot was located within an extensive monodominant stand of ostrich fern located near the Inkster Farm site. This gallery forest is dominated by mature bur oak (*Quercus macrocarpa*) and green ash (*Fraxinus pennsylvanica*). Younger individuals of Manitoba maple (*Acer negundo*) occur at low abundance. Soils in the Oxbow Woods are rich clay-loams, with ca. 20% organic matter content and a near-neutral pH. The understory is locally variable and quite patchy. Few other species were found within the study plot, but in adjacent areas (where ostrich fern is not present) the conspicuous understory species include *Aralia nudicaulis*, *Carex assiniboinensis*, *Rhus radicans*, *Osmorhiza longistylis*, *Actaea rubra* and *Rudbeckia laciniata*. Löve (1959) characterizes most of these species as having an 'eastern' floristic affinity.

The climate of the area is humid sub-continental, with short warm summers and long cold winters. Mean annual temperature is ca. 1.5°C. July is the warmest month (mean of ca. 19°C), and January the coldest (ca. -20°C). Mean annual precipitation is ca. 50 cm, of which ca. 75% falls as rain.

Materials and Methods

A 5 x 5 m study plot was located in a dense, monodominant population of ostrich fern. Other understory species were present at very low abundance and cover, and abiotic conditions (soils, degree of shading) within the plot were uniform. All ramet rootstocks within the study plot were numbered with a small red 'flag' and mapped. Mapping was accomplished by measuring the distance (± 1 cm) to each of the four corner posts of the study plot. The law of cosines was then used to obtain the spatial coordinates of each rootstock. For each rootstock, the sizes (three classes: 'full', 'half' and 'small') and number of vegetative fronds were recorded. For fertile rootstocks, the number of new (current year) and older (previous years) fertile fronds were recorded. Mapping and recording of rootstocks was performed from August 3-7 of 1993, August 9-10 of 1994, and August 1-3 of 1995.

Results

Vegetative Fronds: 1994 vs. 1995

As in the 1993-1994 interval (Kenkel 1994), rootstock turnover from 1994-1995 was quite low. Of the 234 rootstocks present in 1994, only 10 had died by 1995. Twenty new rootstocks were mapped in 1995, and in addition four rootstocks present in 1993 but recorded as 'dead' in 1994 were mapped. Thus a total of 248 rootstocks were mapped in 1995, up from 235 in 1993. The total number of vegetative fronds has declined over time, from 1002 in 1993 (mean of 4.26 per rootstock), to 902 in 1994 (mean = 3.86) and 886 in 1995 (mean = 3.57). These values are lower than the 6.75 fronds per rootstock reported in New Brunswick populations (Prange and von Aderkas 1985). Most of the rootstocks that died between 1994 and 1995 were classed as 'small' (i.e. fronds much smaller than average, generally < 20 cm in height) in the 1994 survey, and most had a single vegetative frond. Correlations between the number of sterile fronds produced by rootstocks from 1993-1994 and 1994-1995 are similar ($r = 0.696$ and $r = 0.718$, respectively). The correlation over a two-year lag period (1993-1995) is lower but remains statistically significant ($r = 0.567$, $p < 0.01$). Note that these calculations are based on the number of vegetative fronds produced by both sterile and fertile rootstocks.

Fertile Fronds: 1994 vs. 1995

Population fecundity was much lower in 1995 than in the previous two years. Only 3 fertile rootstocks were produced (ca. 1.2% fertility), compared with 26 in 1994 (11.1% fertility) and 21 in 1993 (8.9% fertility). The 1995 value is close to the 1% fertility reported for shaded populations in New Brunswick (Prange and von Aderkas 1985). Only 4 fertile fronds were produced in 1995, down from 42 in 1994 and 31 in 1993. Of the three fertile rootstocks in 1995, two were also fertile in both 1993 and 1994 while the third had not previously been recorded as being fertile. The dramatic decline in stand fecundity observed in 1995 remains to be explained. A number of aborted fertile fronds were noted at the time of the 1995 survey, and many of the vegetative fronds were beginning to die back by early August (i.e. about 2-3 weeks earlier than in previous years). The early summer of 1995 was particularly hot and dry, which may have caused many of the fertile fronds to abort. Alternatively, a pest or pathogen may have attacked the emergent fertile fronds.

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