

Annual variations in the size of a population of *Cardamine impatiens* L.

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ABSTRACT

A population of *Cardamine impatiens* Narrow-leaved Bittercress was monitored by annual counts of the number of plants during the decade 1988–1998 at Fryent Country Park, Middlesex (v.c. 21). There were large annual variations in the number of individuals, both in total and at each colony. Variations appeared to be due to the cyclic nature of populations at each colony, to unexplained variations possibly related to the weather, and to ground disturbance. The species increased in response to occasional ground disturbance. The reappearance of plants where it had not been observed for several years, suggested the role of a buried seed bank. The average spread, in a south-easterly direction, was 17 m a year over the decade.

KEYWORDS: Narrow-leaved Bittercress, Brassicaceae, monitoring, Middlesex, hedgerows.

INTRODUCTION

Cardamine impatiens, Narrow-leaved Bittercress is a scarce plant in Britain with scattered populations nationally (Stewart *et al.* 1994). It is a plant of varied habitats including shady woodland, rocks and screes, shady banks of streams and rivers and of damp roadsides. It occurs on both calcareous and neutral soils. In London and in Middlesex (v.c. 21) it was considered extinct (Kent 1975; Burton 1983) until a population was rediscovered in 1985 at Fryent Country Park, (TQ/198.881), in the former parishes of Kingsbury and Wembley. Prior to that the most recent record had been 'near Harrow' in 1901. Wembley was part of the Harrow parish until 1894. Monitoring of *C. impatiens* commenced in 1988 with the aim of providing information on how best to conserve the species locally.

METHOD

The investigation was undertaken at Fryent Country Park, approximately 15 km north-west of central London and in the London Borough of Brent. The Country Park covers an area of approximately 100 hectares of lowland countryside surrounded by suburbia and bisected by the A4140 road. The landscape is of hay meadows cut annually, with hedgerows, woodlands, ponds, and areas of scrub, rough grassland, amenity grassland and horse grazing. The park is on London Clay, with a pH of about 6.5, though Barn Hill, to the south, is capped with gravel and more acid soils. The altitude varies between 45–83 m O.D. The flora of the park was described by Williams (1996) and the landscape by Williams & Northcroft (1992).

Counts were made by the author to estimate the number of individual plants. Each more-or-less continuous group of plants was mapped as a "colony". Obviously there were limitations to this approach, since some of the colonies merged during the investigation. Counts were made towards the end of May (to early June) in each of the years 1988 to 1998.

RESULTS

The number of individuals at each colony are given in Table 1. The species was found in the northern, central part of the Country Park. Records were from both the Kingsbury and the Wembley parish areas, and from the park on both sides of the A4140 road. There was considerable

variation in the population size from year to year (Table 1 and Fig. 1). The highest count was in 1997 (9977) and the lowest in 1995 (504), though the 1994 count (1076) would probably have been lower if it had not been for two new colonies, on disturbed ground, totalling 900 plants.

There was an increase in the number of colonies during the investigation, mainly within the original range. However the linear spread, in a south-easterly direction was approximately 170 m, or an average of 17 m a year. At the end of the investigation the range of the species covered about 25 ha, or about a quarter, of the park.

Cardamine impatiens was predominately associated with hedgerow edge habitats. In almost all other cases it could be found within 10 m of a hedgerow, for example, on ditch and streamsides, in nearby scrub and on ground that had been disturbed near to hedgerows. *C. impatiens* preferred the herbaceous hedgerow edge, but was occasionally found under the hedgerow canopy in the centre of the hedgerows. The flora and history of the hedgerows has been described by Williams & Cunningham (1985), and in Williams *et al.* (1987).

A few plants were found in the adjacent hay meadows, probably as a result of ground disturbance or poaching of the ground. It was however, unable to survive in hay meadows beyond the first year. A colony established on an adjacent railway cutting. It survived as a weed in the garden of one property backing onto a hedgerow. Several plants were found in the drying mud of seasonal ponds.

In addition to the annual variation in the total population there was considerable variation in the counts of each colony. The relative variation in the numbers at individual colonies did not necessarily reflect the overall changes. Three main factors appeared to be responsible for the year to year variations in the population at each colony. These factors were cyclic variation, the weather and ground disturbance. In addition, the total population may have increased as a result of the establishment of new colonies.

At each colony there appeared to be a cycle as the population increased and then decreased. The duration of these cycles was difficult to estimate due to the other factors involved, but two to four cycles per decade appeared to be the norm. To some extent the cyclic nature would be expected from a biennial species, but the cycles could also be a facet of the weather-related variation.

The weather was possibly a significant factor affecting the population, particularly when the populations at most colonies increased or decreased in synchrony. Thus 1994 and 1995 were years of low populations, while the highest number of plants was recorded in 1997. It is not known which weather factors were responsible for these effects and at which stage/s in the life cycle. In 1990 many of the plants were smaller than usual, possibly as a result of the dry conditions of that year. Nevertheless, many plants were flowering even though they were less than 20 cm tall. In 1995 many of the young rosettes were affected by a late frost.

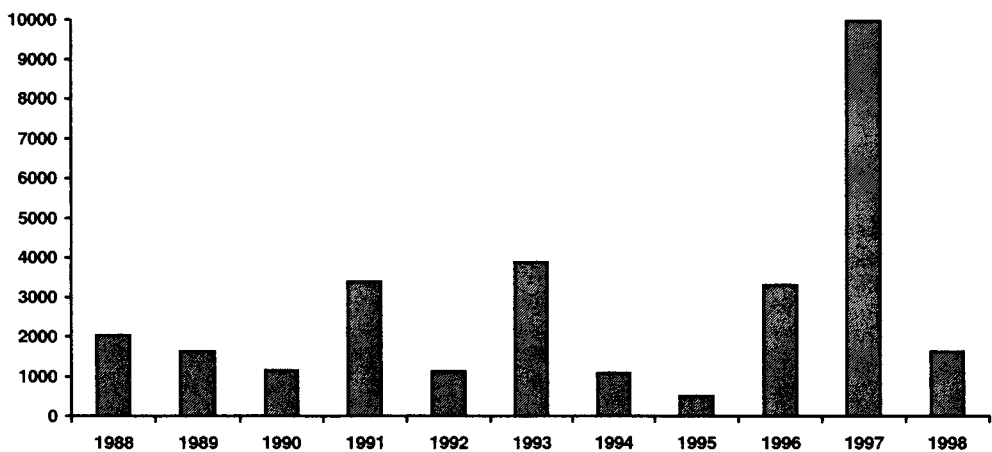


FIGURE 1. Changes in the population of *Cardamine impatiens* at Fryent Country Park, Middlesex, 1988–1998.

TABLE 1. COUNTS OF *CARDAMINE IMPATIENS* AT FRYENT COUNTRY PARK, MIDDLESEX, 1988-1998

Colony	Habitat	Year																
		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998						
A	Hedgerow/garden edge	44	40	30	100	82	160	60	10	150	-	-	-	-	-	-	-	
B	Hedgerow edge	55	150	360	220	330	39	20	170	450	5	28	-	-	-	-	-	
C	Hedgerow edge	150	28	60	250	15	272	-	-	230	231	370	-	-	-	-	-	
D	Hedgerow edge	627	19	319	700	205	50	25	30	281	755	165	-	-	-	-	-	
E	Disturbed ground - hedgerow	397	7	110	380	-	30	-	-	8	20	10	-	-	-	-	-	
F	Hedgerow edge	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
G	Hedgerow/scrub	610	490	120	620	181	540	11	-	21	4080	2	-	-	-	-	-	
H	Hedgerow/scrub	30	120	40	238	10	450	-	-	-	2500	-	-	-	-	-	-	
I	Hedgerow edge	6	410	7	300	20	52	-	-	-	-	70	-	-	-	-	-	
J	Hedgerow/streamside	10	160	13	40	-	45	-	90	13	-	10	-	-	-	-	-	
K	Rough grassland	100	75	83	35	49	20	-	-	173	130	190	-	-	-	-	-	
L	Scrub/rough grassland	-	120	10	100	15	300	-	-	-	15	-	-	-	-	-	-	
M	Hedgerow edge	-	-	-	73	3	2	-	-	-	50	48	-	-	-	-	-	
O	Hedgerow edge	-	-	-	200	-	46	-	35	160	70	8	-	-	-	-	-	
P	Hedgerow edge	-	-	-	70	180	170	26	50	317	130	91	-	-	-	-	-	
Z	Hedgerow edge	-	-	-	55	34	-	-	60	90	15	20	-	-	-	-	-	
N	Hedgerow edge - introduced to	-	-	-	5	-	5	-	-	-	-	-	-	-	-	-	-	
Q	Scrub/rough grassland	-	-	-	-	-	330	-	-	-	-	-	-	-	-	-	-	
R	Hedgerow edge	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	
S	Scrub/rough grassland	-	-	-	-	-	998	14	4	191	230	25	-	-	-	-	-	
T	Roadside/hedgerow	-	-	-	-	-	2	-	1	-	-	-	-	-	-	-	-	
U	Railway side	-	-	-	-	-	290	20	30	60	5	-	-	-	-	-	-	
V	Hedgerow edge/ditch	-	-	-	-	-	70	-	24	1028	1365	554	-	-	-	-	-	
W	Streamside/hedgerow	-	-	-	-	-	-	600	-	5	280	2	-	-	-	-	-	
X	Stream gabions/disturbed	-	-	-	-	-	-	300	-	-	-	-	-	-	-	-	-	
Y	Hedgerow edge	-	-	-	-	-	-	-	-	116	50	-	-	-	-	-	-	
Aa	Pond side	-	-	-	-	-	-	-	-	2	20	-	-	-	-	-	-	
Ab	Hedgerow bank	-	-	-	-	-	-	-	-	11	20	28	-	-	-	-	-	
Ac	Pondside	-	-	-	-	-	-	-	-	6	6	-	-	-	-	-	-	
	Totals	2030	1619	1152	3386	1124	3873	1076	504	3306	9977	1621	-	-	-	-	-	

Ground disturbance was responsible for some major fluctuations in populations. During the investigation ground disturbance was often a result of mechanical works on the park. The effect was also noted after work by conservation volunteers on hedgerow edges, ponds and streamsides. This suggested germination of seeds from a buried seed bank and/or from seeds released by adjacent plants. The evidence for a buried seed bank gains support from the observation that in some years no plants could be found at some colonies, and yet the colonies would revive in later years (Table 1).

DISCUSSION

It is accepted that counting errors could affect the results, though the results probably give a reasonable indication of the numbers of individual plants and of changes in abundance. Hutchings (1991) suggested a number of recording problems during counts of plant populations. Possible reasons for error include reductions in the number of seedlings surviving through the course of the growing season. Whilst the survey was undertaken in late May (to early June) each year, it is possible that in a 'late' season, more seedlings would have appeared subsequently. Hutchings (1991) emphasised that the growing plants do not necessarily reflect the size of the population of any dormant viable seeds in the soil. Indeed, it was obvious from the results that the seed bank played an important role in the reappearance of *C. impatiens* at sites where it had not been observed for one or more years.

The effect of ground disturbance on the maintenance of populations of *C. impatiens* was noted by Stewart *et al.* (1994) and by Briggs (1990). Where *C. impatiens* is present in southern ashwoods, seedlings appear in cleared sites within the year following felling. After three years, very few plants survive against the competing vegetation. The dormant seed buried in the soil, however, remains viable for many years. Corner (1988) described the habitat of a population of *C. impatiens* in Scotland where it occurred on scree in old woodland and noted that there was some ground disturbance at that site as a result of cattle and sheep grazing. Sinker *et al.* (1985) also noted that *C. impatiens* was intolerant of competition, but invasive in recently disturbed habitats. At Fryent Country Park, *C. impatiens* was recorded on recently re-dug garden soils adjacent to a hedgerow colony of the plant.

Whilst the species spreads mainly by the explosive release of seeds, it is possible that some of the new colonies, assuming that they are new, were established by seeds carried by other means.

In the London investigation, *C. impatiens* was largely associated with the hedgerow edge: a habitat additional to those listed by Rich (1991), but consistent with the shade preference of this species. The results suggest that locally, the species is best able to survive in light herbaceous vegetation, and on recently disturbed or exposed ground. It prefers moderate shade and limited competition from other plants.

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(Accepted March 1999)