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The Management of Giant Hogweed in an Irish River Catchment

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ABSTRACT

Giant hogweed (*Heracleum mantegazzianum* Sommier and Levier) is an alien plant that was introduced to Ireland as an ornamental in the late 19th Century. The banksides of rivers and streams are the preferred habitat for the plant and it is now a feature in many important angling catchments. The continued spread of this plant is a cause of concern because of its impact on human health and on the ecology of infested river corridors. As giant hogweed populations can only be perpetuated by seeds, most control strategies aim to limit recruitment to future generations and to deplete the seed bank reserve. Trials conducted in Ireland and in Europe have revealed the sensitivity of the plant to herbicidal treatment using glyphosate. Based on research conducted in Ireland a four-year treatment program, using glyphosate, was formulated. Prior to 1998 no coordinated attempt to eradicate giant hogweed from a catchment had been undertaken. To investigate the feasibility, and logistics, of managing this hazardous plant in a discrete river catchment, a control program on the Mulkear River catchment (670 km^2) was undertaken by the Office of Public Works. Field surveys indicated that an area of *circa* 35 km^2 within the catchment was overgrown with giant hogweed. Weed treatment commenced in March 1998 and continued through 1999 and 2000. With almost three of the four-year treatment schedule complete, the preliminary results are very encouraging. The benefits to the local community and the overall ecology of the river and riparian habitats are discussed.

Key words: Invasive plant, riparian habitat.

INTRODUCTION

Over the past decade a considerable amount of research has been focused on the biology, ecology and control of giant hogweed (Andersen 1994, Caffrey 1994, 1999a, Tiley and Philp 1994, Tiley et al. 1996, Pysek 1991, 1994, Lundstrom and Darby 1994, Wade et al. 1997). This reflects the problems for human health, amenity and recreational exploitation, and flood defence that the uncontrolled spread of this invasive plant has elicited (Drever and Hunter 1970, Lundstrom 1984, Wyse Jackson 1989, Briggs 1979, Williamson and Forbes 1982). Giant hogweed produces a sap that can induce phytophotodermatitis on contact with human skin (Hipkin 1991). This results in the formation of painful blisters and can permanently impair the skin's ability to filter ultraviolet A radiation, which is significant in sunlight. Dense populations of this large, leafy plant may alter the ecology of infested habitats by suppressing indigenous plant species and resulting in significantly reduced floral and faunal diversity.

In Ireland, up to the late 1960s, giant hogweed exhibited a relatively local distribution and presented few access or human health problems. Since that time, however, the plant has dramatically expanded its range and is currently recorded in many river catchments (Caffrey 1999b). The initial expansion followed the course of main rivers and tributary streams, reflecting the plant's dependence on flowing water for seed dispersal. Lateral expansion from river corridors is now a feature of the plant and is exacerbating the problems caused by this species.

The Mulkear River catchment, located in the south-west of Ireland (Figure 1), is one area that is seriously impacted by the spread of giant hogweed. While localized populations of hogweed have been reported in the Mulkear catchment since the 1930s (Praeger 1939), it is only since the 1980s that the plant has seriously impacted on the beneficial use of the watercourse. Continuous, dense stands of this tall and hazardous plant have established along the river corridor and, over many kilometres of channel, have precluded safe access to anglers or other water users.

The Mulkear is one of Ireland's most productive salmonid catchments, where fish stocks are dominated by Atlantic salmon (*Salmo salar* L.) and brown trout (*Salmo trutta* L.). The Mulkear is a highly regarded grilse fishery which also provides some spring salmon angling (O'Grady 1992). The annual rod catch for the Mulkear and Newport Rivers in the 1980s was between 2,000 and 3,000 fish (O'Reilly 1991).

The present paper describes the four-year giant hogweed control/eradication program for the Mulkear catchment and discusses the results to hand after almost three years of the study.

MATERIALS AND METHODS

Species Description

Giant hogweed is a member of the Umbelliferae and is easily recognized because of its considerable stature, with mature plants commonly achieving a height of 4 m. The plant is monocarpic and most individuals flower in their third or fourth year (Caffrey 1999a, b). Reproduction is entirely by seed and mature plants can produce very large numbers of viable seeds. Total counts conducted at a number of sites throughout Ireland revealed mean seed numbers per plant of between 13,000 and 69,000 (Caffrey 1999b). Seed-

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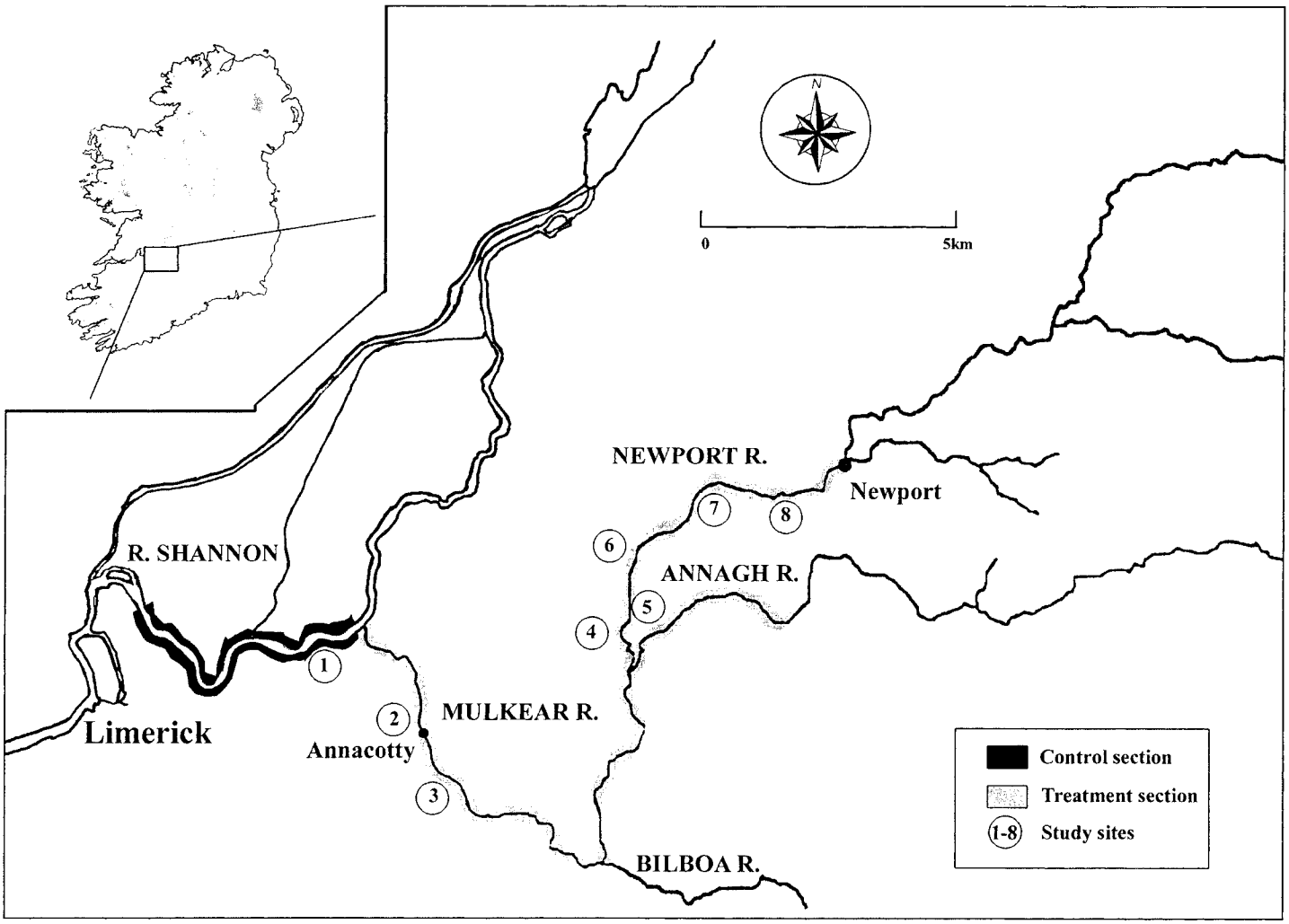

Figure 1. The distribution of giant hogweed in the Mulkear River catchment and on the lower River Shannon, showing control and treatment sections. Study sites: 1 = Control (R. Shannon), 2 = Annacotty, 3 = Heicht, 4 = Waterpark 1, 5 = Waterpark 2, 6 = d/s Bunkey Bridge, 7 = Bunkey Bridge, 8 = Newport.

lings germinate in January/February, with the seedling producing a single or small rosette of leaves (Tiley et al. 1996). The root is generally a deep tap-root although, where the substrate is hard or stony, it may produce numerous lateral branches. The above-ground vegetation dies back in early autumn each year. Following flowering and seed set the whole plant dies (Tiley et al. 1996).

Study Sites

The Mulkear catchment has a surface area of 670 km^2. The principal tributaries are the Newport, Annagh and Bilboa Rivers. The main channel discharges to the River Shannon circa 4 km north of Limerick (Figure 1). Within the Mulkear catchment infestation is most extensive from Newport town to the River Shannon, and on the lower reaches of the Annagh River. The plant also grows abundantly in riparian and adjacent habitats on the lower Shannon. During the present study a control site, which would remain untreated with glyphosate, was located downstream of the Shannon/Mulkear confluence. A further seven sites were selected along the Mulkear and Newport Rivers to best represent the levels of Giant hogweed infestation in the catchment. These sites would be treated as part of the four-year hogweed control program. The sites, in all cases, were located along or adjacent to the linear river bank habitat, which commonly represent the primary foci for further lateral expansion (Wade et al. 1997).

Funding to complete the four-year giant hogweed control program on the Mulkear catchment was awarded in February 1998. The study proper commenced immediately and will continue until the end of 2001. Because funding had not been granted earlier, it was not possible to compile comprehensive baseline data prior to the commencement of herbicidal treatment. Some hogweed density statistics had been collected, however, in May 1997 when the original project proposal was being formulated.

The entire length of the hogweed-infested channel was visually surveyed, while walking, on three occasions each year—March, May and late June. Detailed hogweed density data were collected at each of the study sites in the Mulkear catchment and on the lower Shannon. These visits coincided

with dates when the contractors were on site or immediately prior to spraying. In May and June density was determined by direct counts of individual plants (Brock and Farkas 1997) from randomly selected plots measuring 10 m by 5 m (50 m^2). The large plot size reflects the large stature of the vegetative and adult hogweed. Counts were recorded from five 50 m^2 plots on each sampling occasion. In March, when plants were small (≤10 cm high) and significantly more numerous, direct counts were made at each site from five 5 m by 2 m (10 m^2) plots. To permit direct comparison of the seasonal data sets the mean counts for March were extrapolated from numbers per 10 m^2 to numbers per 50 m^2. Plants were recorded as vegetative (seedlings and immature plants) and adult or flowering plants. It was not possible to use permanent plots because of the damage caused to young plants while counts were being conducted. In May 2000 the relative cover of associated herbaceous and woody plants at each study site was visually estimated using percentage ground cover (Braun-Blanquet 1964).

The protocol used to treat giant hogweed populations in the Mulkear catchment was developed by Caffrey (1999a, b), based on research conducted in Ireland. A certified contractor was commissioned by the Office of Public Works (O.P.W.) to undertake the control operation, under the supervision of the Central Fisheries Board (C.F.B.). The essential elements of the protocol are as follows:

- accurately map the distribution of giant hogweed in the catchment;
- commence treatment in March, using 5 l ha^{-1} glyphosate;
- treat again in May, July and September;
- in June/July locate and destroy flowering plants, remove umbels and burn;
- above program to run for four years (1998-2001).

RESULTS AND DISCUSSION

To date, no serious attempt has been made to control the spread or reduce the level of infestation of giant hogweed at a catchment, regional or national level (Wade et al. 1997). This largely reflects an ignorance regarding the health hazard posed by the plant, the impact its presence is having on local and national tourism, and the rate at which the plant is spreading. In the present study, a carefully planned and coordinated four-year giant hogweed control/eradication campaign was formulated for the Mulkear catchment, and implementation of this program commenced in February 1998. In 1997 the O.P.W. compiled maps which detailed the precise distribution of this hazardous plant in the catchment. Subsequent planimeter readings indicated that an area of 35 km^2, primarily along the linear bankside habitat, was infested with giant hogweed (Caffrey 1999a). The hogweed colonies commonly extended, uninterrupted, along the river corridor for up to 2 km and occasionally occupied up to 1 ha of adjacent habitat. Field surveys reported in Tiley et al. (1996) in Scotland indicated that Giant hogweed colonies were generally small (<50 plants), although large colonies (>2,000 plants, excluding seedlings) have been recorded (Ochsmann 1992, Tiley and Philp 1992). The large hogweed colonies extend downstream from the Mulkear/Shannon confluence, through a major university campus, and into Limerick city.

Response of Immature Plants to Treatment

All of the study sites examined contained mature, long established colonies of giant hogweed. For this reason seedlings which germinated in January or February were rapidly shaded-out and suppressed by older plants (1, 2 and 3 years old) which produced leafy vegetative stands early in the season from robust tap-roots. This accounts for the significant decrease in the density of vegetative plants (including seedlings and older immature plants) observed at the control site between March and May 1998 to 2000 (Figure 2a, b). This density-dependent response has been recorded among giant hogweed populations by many authors including Tiley et al. (1996) and Caffrey (1999a). Between May and late June the rate of mortality or suppression among established plants at the control site was markedly reduced (Figure 2b, c) and a final density of approximately 3 plants m^{-2} was achieved. This compares with density figures of between 6 to 10 m^{-2} for 1-year old specimens (Tiley et al. 1996) to 5 to 19 vegetative plants m^{-2} (Gibson et al. 1995) in Scottish colonies.

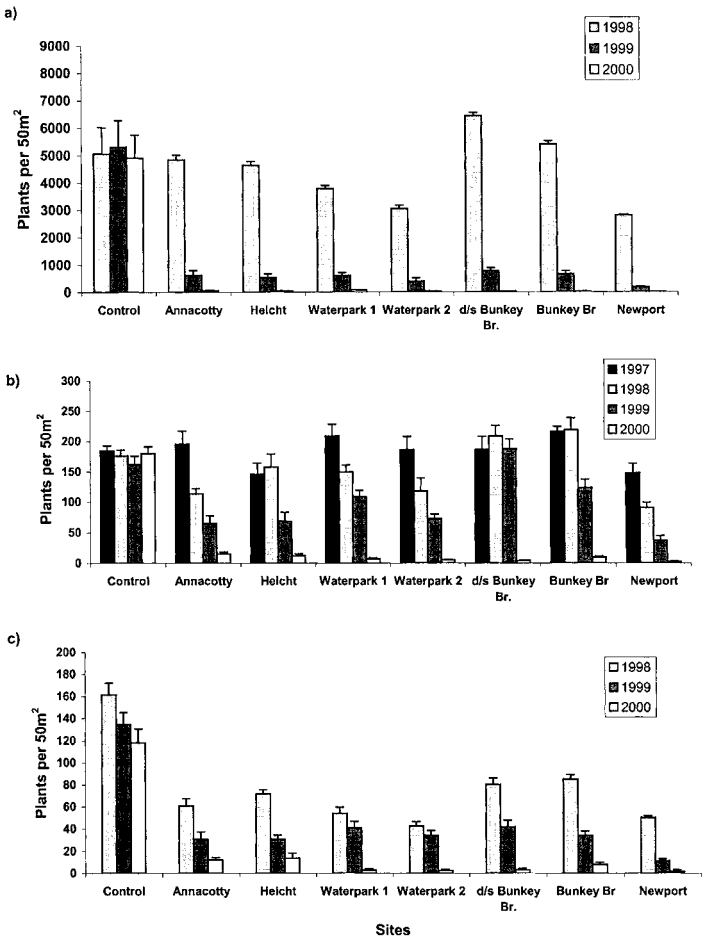

Figure 2. Mean density of immature giant hogweed plants (Number 50 per m^2) at control and treated sites on the lower Shannon and Mulkear catchment in: A—March 1998, 1999, 2000; B—May 1997, 1998, 1999, 2000; C—June 1998, 1999, 2000. Standard error bars are included.

It is noteworthy that there is no significant difference between the density figures recorded for May (1997 to 2000) at the control site on the River Shannon and those recorded pre-treatment (1997) at sites in the Mulkear catchment (Figure 2b). This suggests a relatively close similarity in population terms between the different sites, probably reflecting the climax nature of the populations in the catchment and in the River Shannon downstream. Likewise, there is no significant difference between the density figures obtained at the control site in March (1998 to 2000) and those recorded pre-treatment (1998) at sites in the Mulkear catchment (Figure 2a).

By March 1999, following one year of the four-year control program, a significant decrease in the density of immature plants was recorded (Figure 2a). Numbers decreased from 2,950-6,450 per 50 m^2 (circa 60-130 m^{-2}) in 1998 to 185-775 per 50 m^2 (circa 3 to 15 m^{-2}) in 1999. This compares with an actual increase in abundance recorded at the control site. A further decrease to <1 plant 50 m^{-2} was recorded at a number of treated sites by March 2000.

May is the only month for which data are available from 1997 to 2000, inclusive. At four of the treated sites, a moderate decrease in plant density was observed between 1997 and 1998 (Figure 2b). At the remaining three sites, however, numbers per 50 m^2 were greater following herbicide treatment. This resulted because of the proliferation of new seedling and suppressed immature plants once the older, canopy-forming hogweed plants had been killed by the March spray. Further treatments in May, July and September 1998 and in March 1999 resulted in a further moderate decrease in density at all sites. The most significant reduction, however, was recorded in May 2000 when 15 plants 50 m^{-2} was the highest figure observed (Figure 2b).

The data recorded for all treated sites in June (1998 to 2000) show a significant decrease compared with those available at the control site for this period (Figure 2c). By 2000 none of the sites supported even 1 plant m^{-2}.

The rate of decline among giant hogweed plants at treated sites between May/June 1998 and May/June 1999 was slower than anticipated. Close examination of the plants present in 1999 revealed that practically all were at least one year old (no seedlings were observed), suggesting that the seed reserve had been depleted or that conditions required to induce germination had not been fulfilled. Giant hogweed plants, even in March, can produce leaves measuring up to 0.5 m in width (Caffrey 1999a, Williamson and Forbes 1982) and are capable of providing adequate protection from spray droplets to the understory vegetation. Thus, while the density of vegetative plants present in March 1999 was relatively low, by comparison with values for March 1998, sufficient canopy cover was probably present to protect smaller individuals and to permit the expansion of the observed hogweed plants in May and June of that year.

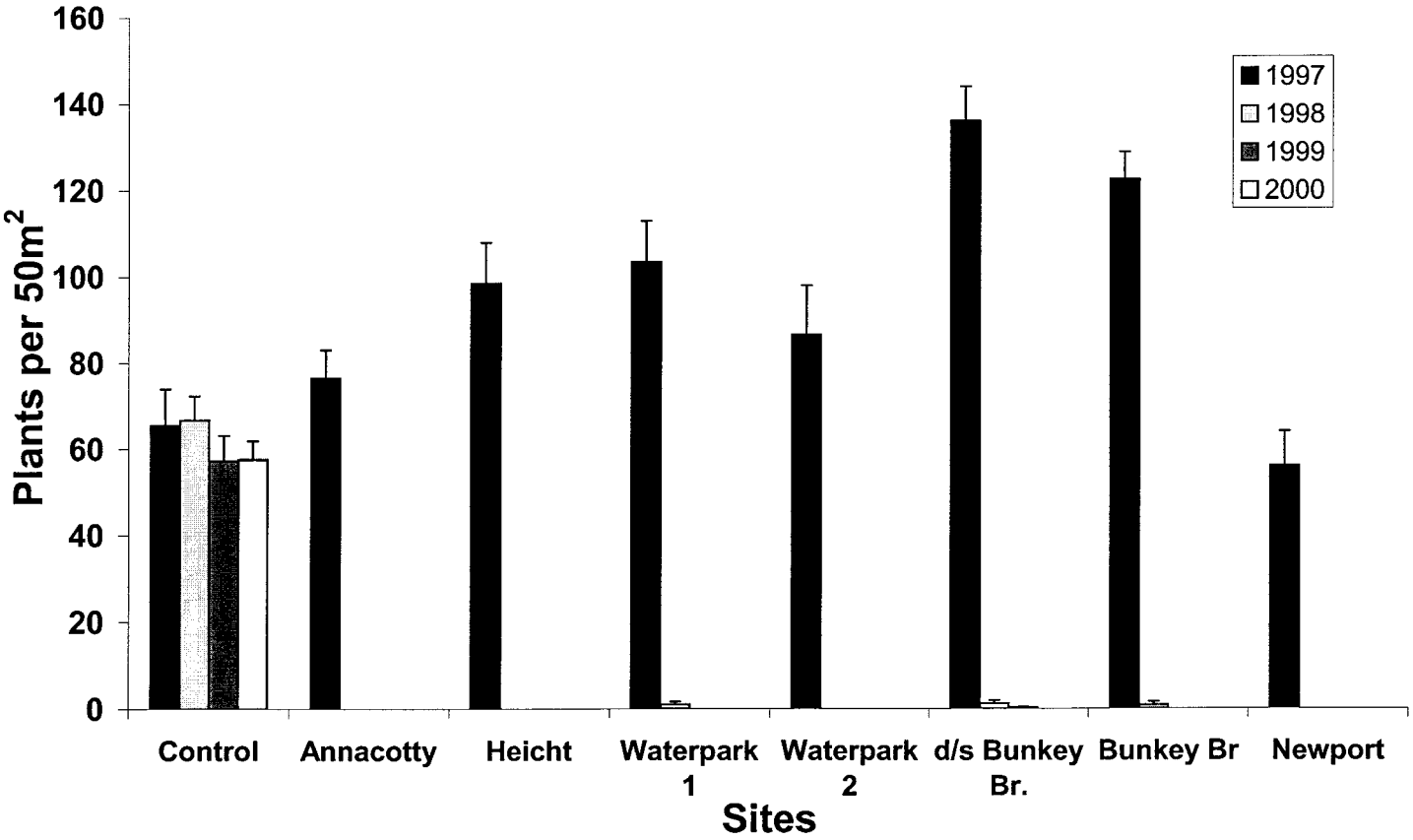

Figure 3. Mean density of mature flowering giant hogweed plants (Number 50 per m^2) at control and treated sites on the lower Shannon and Mulkear catchment in May 1997, 1998, 1999 and 2000. Standard error bars are included.

TABLE 1. RELATIVE COVER OF PRINCIPAL PLANT SPECIES RECORDED AT FIVE 50M² PLOTS FROM SITES ON THE RIVERS SHANNON AND MULKEAR IN MAY, 2000. COVER VALUES OF BRAUN-BLANQUET (1964): 1 = <5%, 2 = 6-25%, 3 = 25-50%, 4 = 51-75%, 5 = >75%.

	Control	Annacotty	Heicht	Waterpk 1	Waterpk 2	D/s Bunkey	Bunkey	Newport
Brassica napus L.	—	2	4	—	1	1	1	—
Anthriscus sylvestris (L.) Hoffm.	1	2	1	2	2	1	2	1
Circium vulgare (Savi) Ten.	—	2	—	1	—	—	1	—
Epilobium hirsutum L.	1	3	1	2	1	—	3	—
Gramineae	4	3	3	3	2	2	2	2
Galium aparine L.	1	1	2	1	1	1	2	1
Fallopia japonica	—	—	2	1	—	—	—	—
Hedera helix L.	—	—	2	—	1	1	2	2
Equisetum palustre L.	—	3	3	—	—	1	—	—
Petasites hybridus L.	—	1	—	3	5	5	4	—
Ranunculus repens L.	—	2	3	1	2	2	2	1
Urtica dioica L.	2	2	3	2	1	1	2	2
Salix spp.	—	2	—	3	—	2	—	1

Response of Adult Plants to Treatment

The number of adult plants present at the control site between 1997 and 2000 varied little (Figure 3). By comparison there was considerably more variation between adult plant numbers at the proposed treatment sites in May 1997. The numbers recorded ranged between 51 and 135 plants 50 m^{-2}. This range in density is broadly in agreement with figures produced by Gibson et al. (1995) and Tiley et al. (1996) for mature flowering plants in Scotland. From the commencement of the treatment program in March 1998, no flowering plants were recorded at four of the treated sites and only isolated, dwarf adult plants (<1.5 m tall) were present at the other three sites in May 1998. These plants were physically removed from the sites before seed set. A single dwarf flowering hogweed plant was recorded downstream of Bunkey Bridge in May 1999. This plant was deformed and exhibited signs of having been affected by a sublethal dose of glyphosate.

Between 1998 and 2000 no giant hogweed plants have seeded at any of the treated sites and practically no plants have successfully dispersed fruits throughout the Mulkear catchment. In view of the fact that giant hogweed populations can only be perpetuated by seeds (Tiley et al. 1996), and as the plant's life span is three to four years (Stewart and Grace 1984, Caffrey 1999a), it is clear that already, three years into a four-year campaign, significant steps towards controlling and ultimately eradicating the plant from this catchment have been made. Information of seed viability in the soil is fragmentary, although field observations in Scotland suggest that most if not all shed seeds germinate in the following year, if conditions are suitable (Tiley et al. 1996) This being the case, the potential to eradicate the plant from the catchment would be further enhanced.

Improved Bio-diversity Following Treatment

An examination of the associated plant community present at the untreated control site in May 2000 revealed a relatively small number of species, generally growing with low cover abundance (Table 1). These plants grew beneath the dense leafy canopy created by the tall mature and flowering giant hogweed plants. Among these, members of the Graminae were most prolific. At each of the treated sites species abundance and diversity increased significantly. Most of the species recorded are known to grow in association with giant hogweed (Neiland 1986, Caffrey 1994, Gibson et al. 1995, Tiley et al. 1996) but are only afforded the opportunity to proliferate when the shade factor produced by this plant's expansive leaves has been reduced or eliminated. At four of the seven treated sites one plant Butterbur (*Petasites hybridus* L.) has dominated the niche left by the hogweed. This is a fast-growing perennial whose leaves can reach a width of 0.5 m. It can, like hogweed, form dense monospecific stands along the banksides of rivers and along road verges. The shade created within these stands can further suppress the emergence of hogweed plants.

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