Preslia, Praha, 66(1994):337-343, 1995

Technical note: Standing crop of *Reynoutria japonica* in the autumn of 1991 in the United Kingdom

Biomasa *Reynoutria japonica* na podzim 1991 ve Velké Británii

John H. Brock

School of Planning and Landscape Architecture, Arizona State University, Tempe, AZ 85287-2005, USA[1]

Brock J. H. (1995): Technical note: Standing crop of Reynoutria japonica in the autumn of 1991 in the United Kingdom. - Preslia, Praha, 66(1994):337-343.

Keywords: *Reynoutria japonica*, invasive weed, alien plant, riparian habitat, aerial biomass, root and rhizome biomass, United Kingdom

Standing crop of *Reynoutria japonica* (Japanese knotweed) was measured from randomly located plots on 2 sites in the United Kingdom in the autumn of 1991. One site was in southern Wales, and the other site was in central England. Aerial biomass averaged 9365 kg/ha and root + rhizome biomass, to a depth of 25 cm, averaged 14677 kg/ha.

Introduction

Reynoutria japonica Houtt. (Japanese knotweed) is also known by the scientific names of *Fallopia japonica* (Houtt.) Ronse Decraene, or *Polygonum cuspidatum* Sieb. & Zucc., and is in the buckwheat family (*Polygonaceae*) (Bailey 1989). This perennial is regarded as a weed on many sites disturbed by man and is particularily invasive to riparian habitats (Child et al. 1992). Although *F. japonica* is highly invasive it does not produce viable seeds in the United Kingdom as only female plants have been recorded (Bailey 1989). The primary mode of regeneration is vegetative from rhizomes and potentially from stem tissues (Brock et Wade 1992, Brock et al. 1994). The plant has become established through the whole of Great Britain especially along waterways and derelict lands since its introduction in around 1850 for horticultural purposes. The distribution of *R. japonica* in the United Kingdom was documented by Conolly (1977) and the spread of the plant is believed to be increasing. *R. japonica* is widely distributed in central and northern Europe (Tutin et al. 1964).

Few pieces of literature associated with the growth of *R. japonica* were found concerning its biomass production capabilities, and no literature was found that reported underground

[1] At time of research: International Centre of Landscape Ecology, Geography Department, Loughborough University of Technology, Loughborough, Leicestershire, LE11 3TU, United Kingdom

Table 1. - Simple statistics (mean, standard error SE, and coeffecient of variation CV) for *Reynoutria japonica* parameters of dry weight aerial biomass (g/m^2), root + rhizome biomass (g/m^2 per 0 to 10 and 10 to 25 cm soil depth), total root + rhizome biomass (0 to 25 cm soil depth), stem numbers, and plant height (m) for study sites at Loughborough and the River Tawe floodplain in the United Kingdom.

Study Site	Parameter	Mean	SE	CV
Loughborough	Aerial biomass	603	75.1	21.6
	Root + rhizome (0-10 cm)	430	117.1	68.8
	Root + rhizome (10-25 cm)	1166	814.9	120.8
	Root + rhizome (0-25 cm)	1596	976.7	105.8
	Stem numbers	10.7	0.9	9.8
	Plant height	2.7	0.2	12.6
River Tawe	Aerial Biomass	1269	208.5	28.4
	Root + rhizome (0-10 cm)	353	205.1	103.0
	Root + rhizome (10-25 cm)	986	527.1	92.5
	Root + rhizome (0-10 cm)	1339	484.7	62.6
	Stem numbers	18.0	4.1	22.7
	Plant height	3.4	0.1	4.7

root or rhizome biomass. Since the primary regeneration strategy of *R. japonica* is through vegetative means, information about its aerial and below soil biomass becomes important when determining regeneration potential. Knowledge of standing crop of an invasive weed is also important when considering its ecological impacts, such as displacement of preferred vegetation through colonization of portions of a habitat. The objective of this paper is to report on observations of standing crop of *R. japonica* in the autumn for both top growth and roots plus rhizomes.

Methods and procedures

Two stands of *R. japonica* were sampled in the autumn of 1991 when the annual growth cycle of the plant was complete. One stand was sampled on 28 September, on the campus of Loughborough University of Technology (Ordance Survey (OS) grid reference SK 523183), in Leicestershire, England. This stand was growing as part of a grouping of shrubs, with a few trees as overstory, in a general horticultural landscape scheme. The second stand, a monoculture, was growing on the floodplain of the River Tawe (OS grid reference SN 172021) near the town of Pontardawe, Wales, and was sampled on 2 October. Logistics limited sample numbers at both sites. At Loughborough, the limit was the size of the colony, and at the River Tawe site, the limit was time. Three randomly located 1.0 m^2 quadrats were sampled at each site. The number of stems in each sample was counted, and overall stem height (m) recorded. The standing crop was harvested to a height of approximately 2 cm above the soil surface. Harvested material was placed in large polyethylene bags for transport from the field to the laboratory.

Total fresh weights of of the samples was determined in the laboratory the day following harvest. A sub-sample of *R. japonica* top growth from each sample was retained, weighed, and placed in a drying over at 75-80°C for 48 hours. Percentage water content was determined and total fresh weight data was converted to oven dry weight for presentation as g/m^2 and kg/ha of standing crop.

Root and rhizome (root + rhizome) standing crop was estimated for 3 sub-samples in each of the 1.0 m^2 quadrats at 2 depth increments. The first increment was 0-10 cm, with the second being 10-25 cm in depth. The 3 sub-samples consisted of a 15 by 15 cm soil/ /root/rhizome block. The samples were placed in polyethylene bags for transport to the laboratory and refrigeration storage until the soil and root + rhizome material was hand separated in the laboratory. Following separation of the roots + rhizomes, the soil volume of each sub-sample was determined to allow conversion of the data to a weight per m^2 by depth basis. The root + rhizome material was oven dried at 75-80°C, and converted to g/m^2 and kg/ha for data presentation.

Descriptive statistics were calculated using STATVIEW software (Abacus Company Berkeley, California USA). Because of the limited number of samples, tests for statistical significance were not considered as appropriate for this data set, however linear regression analysis with the combined data were performed.

Results

Aerial standing crop of *R. japonica* at the River Tawe site was 2 times greater than that estimated for the Loughborough site (Table 1). The samples on the River Tawe site also contained more stems/m^2 and greater average plant height. The data from the sample sites was quite variable and as a result, high coeffecients of variation (CV) were found for the root + rhizome biomass at both study sites and soil depths, with values near 100 % being calculated. Less variation was observed for aerial biomass, with plant height being the most consistant variable measured (Table 1).

Average aerial biomass of *R. japonica* was estimated from samples at the Loughborough site to be 6037 kg/ha with 12963 kg/ha estimated from samples on the River Tawe floodplain (Fig. 1). Below ground biomass at both sites was greater at the 10-25 cm depth, with the combined root + rhizome biomass estimates approaching 16000 kg/ha. Combined aerial and root + rhizome biomass for the 2 sites was approximately 24000 kg/ha.

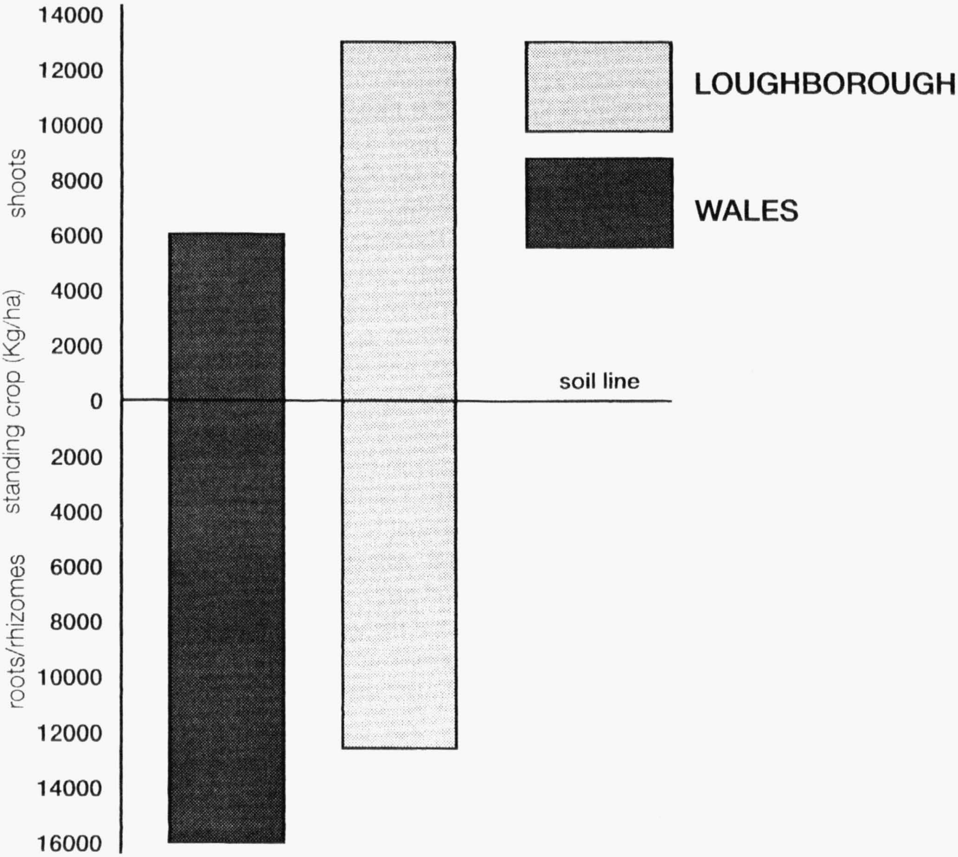

Fig. 1. - Standing crop (kg/ha) for stands of *Reynoutria japonica* in the autumn of 1991 near Loughborough and the River Tawe in the United Kingdom partitioned to shoot growth and root + rhizome mass to a 25 cm soil depth.

The relationships between aerial and root + rhizome standing crop to stem height and density of *R. japonica* was explored using linear regression. Root + rhizome biomass was poorly related to either stem height or numbers. The relationship between aerial standing crop and plant height provided an $r^2 = 0.729$ (Fig. 2a) while the number of stems per unit area provided an $r^2 = 0.957$ (Fig. 2b).

Discussion

The observed aerial biomass estimates of *R. japonica* in this study are within the range of the top growth quantity reported by Callahan et al. (1984) of approximately 8000 kg/ha.

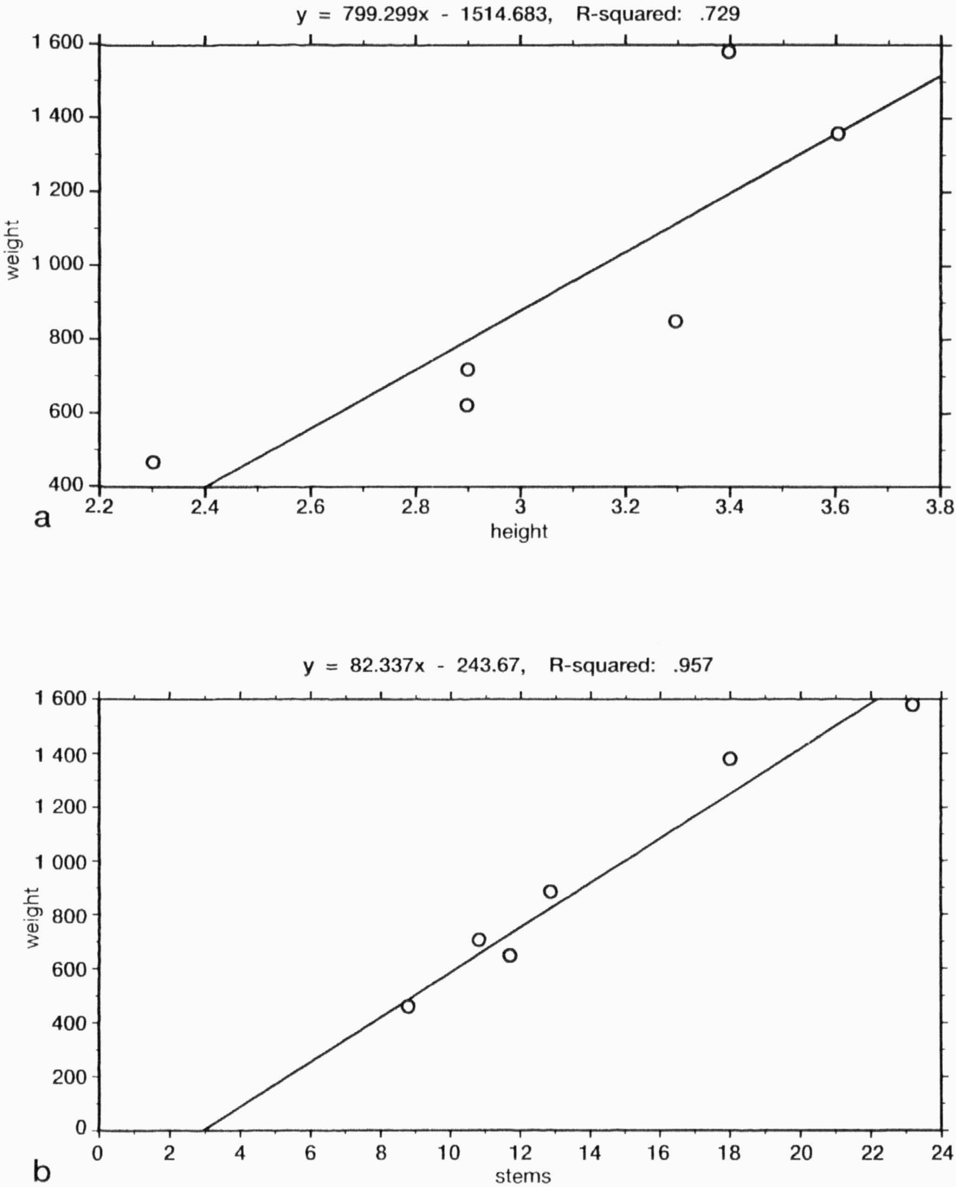

Fig. 2. - Linear regression of aerial standing crop of *Reynoutria japonica* (g/m²) as the dependent variable with (a) plant height (m) as the independent variable, and (b) the number of stems/m² as the independent variable.

Data from Beerling (1990) for top growth of *R. japonica*, was computed to average 12187 kg/ha. In other literature dealing with *R. japonica* biomass, Natouri et Totuska (1988) studied dry weight response to treatments with sulfur dioxide (SO_2) but did not report weight on an area basis. No literature that reported root and/or rhizome biomass was found.

The harvest technique to develop estimates of plant biomass can be laborious and time consuming. The good linear relationship of *R. japonica* weight with more easily acquired data types such as stem numbers and/or plant height provides an opportunity for larger numbers of samples for future data sets. A greater number of samples would increase precision in statistical testing of *R. japonica* standing crop between sites or treatments.

Brock et Wade (1992) reported a mean value of 70 % regeneration from rhizome segments of *R. japonica* that had a mean weight of 4.4 g. Brock et al. (1994) found that *R. japonica* stems under moist conditions also have the potential to produce new plants, and by conservative estimate could yield about 3 new shoots/m^2 based on the estimates of aerial biomass reported in this paper.

Conclusion

Estimates of *R. japonica* biomass are ecologically important. Knowledge of the aerial and root + rhizome biomass of this species is needed to fully appraise the invasive potential of established stands. The quantity of biomass production can justify management plans to control *R. japonica*, not only to slow its rate of spread, but also to provide a competitive advantage to native plants.

Souhrn

Na dvou místech ve Velké Británii (Loughborough ve střední Anglii a aluvium řeky Tawe v jižním Walesu) byla stanovena nadzemní a podzemní biomasa druhu *Reynoutria japonica*. Odběry byly provedeny koncem vegetačního období na podzim 1991. Průměrná hodnota z obou stanovišť dosahovala 9365 kg/ha nadzemní biomasy a 14667 kg/ha biomasy oddenků a kořenů. Vzhledem k tomu, že se tento invazní druh šíří prostřednictvím regenerujících úlomků lodyh a oddenků, je informace o produkci biomasy významná pro zhodnocení jeho invazního potenciálu.

References

Bailey J. P. (1989): Cytology and breeding behaviour of giant alien *Polygonum* species in Britain. - PhD Thesis, Leicester University.

Brock J. et Wade M. (1992): Regeneration of Japanese knotweed (*Fallopia japonica*) from rhizome and stems: Observations from greenhouse trials. - In: Proc. IXth Intern. Symp. on the Biology of Weeds, Dijon, France, 9:85-94.

Brock J. H., Child L. E., de Waal L. C. et Wade, P. M. (1994): The invasive nature of *Fallopia japonica* is enhanced by vegetative regeneration from stem tissues. - In: Pyšek P., Prach K., Rejmánek M. et Wade P. M. [red.], Plant invasions: general aspects and applications, SPB Academic Publ., The Hague [in press].

Beerling D. J. (1990): The ecology and control of Japanese knotweed (*Reynoutria japonica* Houtt.) and Himalayan balsam (*Impatiens glandulifera* Royle) on river banks in South Wales. - PhD Thesis, University of Wales, Cardiff.

Callahan T. V., Scott R., Lawson G. J. et Mainwaring A. M. (1984): An experimental assessment of natural and naturalised species of plants as renewable resources in Great Britain. - Bulletin, Energy Technology Support Unit (no. ETSU-B108613), 52 pp.

Child L. E., de Waal L. C., Wade P. M. et Palmer J. P. (1992): Control and management of *Reynoutria* species (knotweed). - Aspects Appl. Biol., 29:295-307.

Conolly A. P. (1977): The distribution and history in the British Isles of some alien species of *Polygonum* and *Reynoutria*. - Watsonia, London, 11:291-311.

Natouri T. et Totuska T. (1988): Response of dry weight growth under SO_2 stress in an SO_2 tolerant plant, *Polygonum cuspidatum*. - Ecol. Res., Tsukuba, 3:1-8.

Tutin T. G., Heywood V. H., Burges N. A., Valentine D. H., Walters S. M. et Webb D. A. [red.] (1964): Flora Europaea. Vol. 1. - Cambridge Univ. Press.

Received 8 August 1994
Accepted 8 September 1994

Arco Aguilar M. J. del, Perez de Paz P. L., Rodriguez Delgado O., Salas Pascual M. et Wildpret de la Torre W.

Atlas cartográfico de los pinares canarios.
II. Tenerife

Publicaciones de la Viceconsejería de Medio Ambiente, Consejería de Política Territorial del Gobierno de Canarias, Santa Cruz de Tenerife 1992, 230 str., 43 barev. map, 1 příl. (barev. mapa).

Tato publikace představuje druhý díl série vegetačních monografií o borových lesích Kanárských ostrovů. Podnětem k jejímu zpracování byla dohoda, uzavřená v r. 1989 mezi Generálním ředitelstvím pro životní prostředí při správě Kanárských ostrovů a oddělením vegetační biologie (botaniky) University v La Laguně na Tenerifě. Jejím předmětem bylo podrobné floristické, kartografické, ekologické a fytocenologické zpracování borů Kanárských ostrovů. Kolektiv specialistů (Arco Aguilar et al. 1990) publikoval již v r. 1990 první část zmíněné řady monografií, tehdy věnované borům dvou malých Kanárských ostrovů - La Gomery a El Hierra.

Bory pokrývaly před dobytím Kanárských ostrovů Španěly kolem 25 % rozlohy ostrovů. Jejich plocha byla postupně redukována, až v minulém století poklesla na pouhých 12 %. Od té doby se datuje znovuzalesňování jednotlivých ostrovů. V této části Makaronésie si lidé brzy začali uvědomovat význam lesů pro život člověka. Lesy zde výraznou měrou přispívají ke kondenzaci horizontálních srážek a doplňování zásob podzemní vody, jejíž úbytek se stává pro ostrovany životně důležitým problémem. Proto v současné době věnuje vláda značné finanční prostředky na zakládání pokusných ploch, na nichž je sledován vliv lesa a jeho jednotlivých složek na zadržování srážek a vodní režim krajiny.

Stejně důležité jsou lesy v hornatém území Tenerify pro ochranu prudkých svahů před erozí. To vše vedlo k velkým zalesňovacím akcím, jejichž výsledkem bylo zvětšení plochy borů na Tenerifě během posledních padesáti let na více než 15 000 ha. Většinu borů tvoří porosty endemické *Pinus canariensis*, menší část pokrývají plantáže introdukovaných druhů *Pinus radiata*, *P. halepensis* či *P. pinea*.

Historie borů před obsazením ostrova Španěly r. 1496 a proces znovuzalesňování Tenerify jsou podrobně rozebrány podle časových etap v první kapitole knihy.

K intenzívnějšímu zalesnění došlo v letech 1940-1987, odkdy bory tvoří téměř souvislý široký pás kolem vrcholových partií sopky El Teide. Tyto zalesňovací akce se setkaly s různou odezvou. Oprávněně bylo