Koonamore -- KVR -- Ecology, ancient and modern

KVR stands for the Koonamore Vegetation Reserve. Its official name is "The T.G.B. Osborn Vegetation Reserve, Koonamore", but KVR is easier.

This long-term vegetation monitoring project is now over 90 years old, making it one of the longest-running monitoring series of its type in the world.

Here are some details:

THE T.G.B. OSBORN VEGETATION RESERVE, KOONAMORE

A Brief History

The TGB Osborn Vegetation Reserve at Koonamore * in arid South Australia has its roots in the historical traditions of ecological research in the School of Earth and Environmental Sciences; of land usage in South Australia; and of early 20th century ecology.

In the mid 1920's Professor TGB Osborn and his colleagues extended their interests in ecology and field physiology of vegetation to the arid zone of South Australia. In 1892 Dixon had warned the Royal Society of South Australia of serious degradation of the soils and vegetation resulting from pastoralism and other alien influences in the region. Equally important to the origin of KVR was the new theory of vegetation succession derived from North American work early in the century. Osborn was particularly concerned with the question as to whether overgrazing by domestic and feral herbivores would result in return of the original vegetation via recognisable 'seral' stages, or whether the changes were "artificial, mere destructions and as such outside the ecologist's proper field". Although the concepts of 'succession' and the scope of ecology have developed and changed much since that time, nevertheless it was interest in "succession to climax" that gave the initial impetus to KVR and many other long-term vegetation studies from that time.

In 1925 a badly overgrazed area of 400 ha on Koonamore Station was fenced to exclude permanently sheep and (hopefully) rabbits. The aims were stated by Osborn as:

i) To study the regeneration of natural vegetation, particularly of saltbush and trees in an overgrazed area, when all grazing influences, including those of rabbits, are removed.

ii) To study the effect of grazing of known intensity on the process of regeneration.

iii) To study the ecology of the area and particularly the autecology of the species that are most valuable economically.

The theory of vegetation succession gave rise to the permanent charted quadrat as a technique for observing vegetation change. An extensive series of permanent quadrats was set up on KVR and supplemented by a series of fixed photopoints, in order to pursue the first aim. Although some of these were allowed to lapse within five years, many others were sampled more or less regularly, some almost annually up to the present. Several early publications reviewing the progress of vegetation change resulted (See Bibliography). Nothing was done towards the second aim but autecological and population dynamics studies are still being carried out, based on

KVR and its records. The Bibliography contains a complete listing of research publications arising from work done on the Reserve.

Much of the continuity of the earlier records is due to the efforts of Miss Constance Eardley, who while a lecturer in the Department of Botany, organised annual visits of students and staff to take records and maintain KVR. However, after 1950 the rate of sampling had begun to decline and in the mid 1960's ceased altogether for a period of several years. In the 1970's Dr Russell Sinclair reactivated the recording programme and also began a sustained effort at rabbit control. Although the Reserve was originally fenced with rabbit-proof netting, the rabbits were never eradicated and the population has fluctuated greatly with the seasons. Beginning in 1975, numbers have been kept very low by careful annual inspection and control. Since that time there has been marked seedling establishment of several tree and shrub species which showed little previous regeneration. The Reserve records now contain a history of the vegetation over 50 years without sheep grazing followed by over 30 years without significant grazing by either sheep or rabbits. Kangaroos and emus have never been excluded from the Reserve, as they can jump the fence, and their numbers vary with the seasons.

The monitoring work at KVR and the curation of its records is continuing under the direction of Dr Sinclair. The Reserve is also used for post-graduate study and complements the arid-zone research interests of Environmental Biology at the Middleback Field Station near Whyalla.

Site Description

The Reserve is located in the centre of Koonamore Station, a sheep-grazing lease 400 km north-east of Adelaide, South Australia (Lat. $32^0$07'S, Long. $139^0$20'E) in predominantly chenopod shrubland with mean annual rainfall of about 200mm. The area consists of a complex of low sand dunes alternating with sand plain and harder loam soils with travertine limestone on the intervening flats. The tree cover is a low open woodland formation. The sand dunes carry *Acacia aneura* (mulga), *A. burkittii* and *Eremophila* spp., the sand plain a dense stand of *Casuarina pauper* (blackoak, belah), and the harder loam soils a mixed community of *Myoporum platycarpum* (false sandalwood) and *Alectryon oleifolius* (bullock bush, rosewood).

Understorey shrubs, which also form low chenopod shrubland communities in some areas, include *Atriplex vesicaria* (bladder saltbush), *A. stipitata* and *Maireana sedifolia* (bluebush). Numerous other chenopodiaceous shrubs also occur, and grass and ephemeral herb cover varies with the seasons. Several species of *Senna*, *Eremophila* and other shrubs also occur.

The Photographs

The photopoint collection now contains over 8000 photos, from approximately 80 photopoints.

The Quadrats

Five large quadats (four 100x100m, one 60x80m) and 7 smaller ones(10x10m and smaller) are regularly remapped. Several others were begun, but readings terminated after a few years. Quadrats were originally mapped annually or more frequently. After various gaps in the records, each quadrat is currently re-read about once every 3 years.

Other Records

The reserve is checked annually for rabbit activity. All burrows found are recorded, fumigated and filled in.
A transect across the reserve and beyond is walked annually to record kangaroo droppings, as an indication of kangaroo activity on the reserve and outside it.
Plant permanent transects across fences are re-read intermittently to record shrub density outside and in.
Several other monitoring projects are also in hand.
Almost no survey or recording of other animal activity is currently undertaken.

Acknowledgements, enquiries and contact details.

Work on the Reserve has been carried out by numerous staff of the Department of Ecology and Environmental Science, School of Biological Sciences, University of Adelaide, together with a host of undergraduate and postgraduate students, volunteers and others. Significant managers were Prof. T.G.B. Osborn, the founder (1925-1930), Prof. J.G. Wood (1931 -1936), Miss Constance M. Eardley (1937-1974), and Dr. Russell Sinclair (1974-present).
Dr. Russ Sinclair is the current manager, to whom enquiries should be addressed. Access to more detailed records, information about the project etc. may be obtained through him, at:

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Why are volunteers needed?

At the end of November each year a work-camp is held at KVR, to remap quadrats, check the reserve for rabbit activity, retake photopoint photos and do general monitoring and maintenance work. The work would not have continued so long if it hadn't been for teams of students each year. At one time these camps were part of the Botany course, but now we rely totally on enthusiastic volunteers. We always seem to find enough, and many people have come back several times, they enjoyed it so much.

We gain increasingly valuable data to add to the records; volunteers have a week of camaraderie among the heat, dust, flies, inspiring sunsets & magnificent cooking (David Ladd is the chef. If you haven't heard of his reputation, ask around; he's famous). You also have the satisfaction of contributing to a worthwhile project of a kind that is rare in the world, despite the increasing interest in long-term records to detect such things as response to climate change.

The deal is that we provide transport and food, you provide the labour, and we all have a good time.

CHRONOLOGICAL BIBLIOGRAPHY OF WORK RELATING TO THE T.G.B. OSBORN VEGETATION RESERVE, KOONAMORE

Papers, Conference presentations

Osborn, T.G.B. and Wood, J.G. (1923). On some halophytic and non-halophytic plant communities in arid South Australia. *Transactions and Proceedings of the Royal Society of South Australia* 47: 388-399

Osborn, T.G.B. (1925). The fodder plants of arid Australia. *The Pastoral Review*, Nov.16, 1925.

Osborn, T.G.B. (1925). On the ecology of the vegetation of arid Australia. No.1. Introduction and general description of the Koonamore Reserve for the study of the saltbush flora. *Trans. Roy. Soc. S. Aust.* 49: 290-297.

Osborn, T.G.B. (1926). The factors influencing the regeneration of vegetation in the arid parts of Australia, with special reference to the pastoral industry. *Rept. Aust. Assn. Adv. Science* 18: 823-824.

Osborn, T.G.B. (1926). Methods of work in semi-arid and arid Australia. In “Aims and Methods in the Study of Vegetation”. (eds AG Tansley and TF Chipp) British Empire Vegetation Committee and Crown Agents for the Colonies, Ch 13; 269-273.

Osborn, T.G.B. (1927-28). The Koonamore Vegetation Reserve. *CSIR* Journal 1: 365-368.

Osborn, T.G.B. (1931). Report to University of Adelaide Council on the Koonamore Vegetation Reserve. University of Adelaide Archives Series 150. Reports to Council, for 1931.

Osborn, T.G.B., Wood, J.G. and Paltridge, T.B. (1931). On the autecology of Stipa nitida, a study of a fodder grass in arid Australia. *Proc. Linn. Soc*. NSW. 56: 299-324.

Osborn, T.G.B., Wood, J.G. and Paltridge, T.B. (1932). On the growth and reaction to grazing of the perennial saltbush, *Atriplex vesicarium*. An ecological study of the biotic factor. *Proc. Linn. Soc*. NSW 57: 377-402.

Osborn, T.G.B., Wood, J.G. and Paltridge, T.B. (1935). On the climate and vegetation of the Koonamore Vegetation Reserve to 1931. *Proc. Linn. Soc.* NSW. 60: 392-427.

Wood, J.G. (1936). Regeneration of the vegetation on the Koonamore Vegetation Reserve, 1926 to 1936. *Trans. Roy. Soc.* S. Aust. 60: 96-111.

Hall, E.A.A., Specht, R.L. and Eardley, C.M. (1964). Regeneration of the vegetation on Koonamore Vegetation Reserve, 1926 - 1962. *Aust. J. Bot.* 12: 205-264.

Carrodus, B.B. and Specht, RL. (1965). Factors affecting the relative distribution of *Atriplex vesicaria* and *Kochia sedifolia* (Chenopodiaceae) in the arid zone of South Australia. *Aust. J. Bot.* 13: 419-433.

Carrodus, B.B., Specht, R.L. and Jackman, M.L. (1965). The vegetation of Koonamore Station, South Australia. *Trans. Roy. Soc*. S. Aust. 89: 41-57.

Sinclair, R. and Thomas, D.A. (1970). Optical properties of leaves of some species in arid South Australia. *Aust. J. Bot.* 18: 261-273.

Greenslade, P.J. M. and Greenslade, Penelope (1973). Ants of a site in arid southern Australia. Proceedings of the VII Congress of the IUSSI, London. pp 145-149.

Greenslade, P.J. M. and Greenslade, Penelope ( ). Soil surface insects of the Australian arid zone. In Arid Australia, eds H.G. Cogger and E.E. Cameron, Australian Museum, Sydney. pp 153-176.

Rogers, R.W. (1974). Lichens from the T.G.B. Osborn Vegetation Reserve at Koonamore in arid South Australia. *Trans. Roy. Soc. S. Aust*. 98: 113-124.

Greenslade, P.J.M. (1975). The role of soil fauna in arid shrubland in South Australia. In Progress in Zoology; Proceedings of the 5th International Colloquium on Soil Zoology, Prague 1973. Academia, Publishing house of the Czechoslovak Academy of Sciences. pp113-119.

Crisp, M.D. and Lange, R.T. (1976). Age structure, distribution and survival under grazing of the arid-zone shrub *Acacia burkittii. Oikos*: 27: 86-92.

Noble, I.R. (1977). Long-term biomass dynamics in an arid chenopod shrub community at Koonamore, South Australia. *Aust. J. Bot*. 25: 639-653.

Crisp, M.D. (1978). Demography and survival under grazing of three semi-desert shrubs. *Oikos* 30: 520-528.

Fatchen, T.J. (1978). Change in grazed Atriplex vesicaria and Kochia astrotricha (Chenopodiaceae) populations, 1929-1974. *Transactions of the Royal Society of South Australia* 102: 39-42.

Greenslade, Penelope. (1978). Collembola. In The physical and biological features of Kunoth Paddock in central Australia. Low, W.A. (Ed.) CSIRO Division of Land Resources Management. Technical Paper No. 4: 137pp.

Noble, I.R. and Crisp, M.D. (1980). Germination and growth models of short-lived grass and forb populations based on long term photo-point data at Koonamore, South Australia. *Israel J. Bot.* 28: 195-210.

Greenslade, Penelope. (1981). Survival of Collembola in arid environments: observations in South Australia and the Sudan. *Journal of Arid Environments*. 4, 219-228.

Silander, J.A. (l983). Demographic variation in the Australian desert cassia under grazing pressure. Oecologia 60: 227-233.

Sinclair, R. (1984). The T.G.B. Osborn Reserve; Koonamore. Aust. Rangel. Soc., Range Management Newsletter 84/4.

Andrew, M.H. and Lange, R.T. (1986). The spatial distributions of sympatric populations of kangaroos and sheep: Examples of dissociation between these species. *Aust. Wildl. Res.* 13: ~67-373.

Green, G.M. (1986). Use of SIR-A and Landsat MSS data in mapping shrub and inter-shrub vegetation at Koonamore, South Australia. *Photogram. Eng. & Remote Sensing* 52: 659~70.

Noble, I.R. (1986). The Dynamics of Range Ecosystems. In “Rangelands, a Resource under Siege.” Proc. 2nd Internat. Rangelands Congress. Aust. Acad. Science, Canberra, pp3-5.

Sinclair, R. (1986). The T.G.B. Osborn Vegetation Reserve at Koonamore: Long-term observations of changes in arid vegetation. In: “Rangelands, a Resource under Siege.” Proc. 2nd Internat. Rangelands Congress. Aust. Acad. Science, Canberra, pp67-8.

Greenslade, Penelope (1992). Conserving invertebrate diversity in agricultural, forestry and natural ecosystems in Australia. *Agriculture, Ecosystems and Environment* 40: 297-312.

Walker, C.N. and Sinclair, R. (1992). Soil salinity is correlated with a decline in 13C discrimination in leaves of *Atriplex* species. *Australian Journal of Ecology* 17: 83-88.

Sinclair, R., Emmerson, L.M., and Ladd, D. R. (1995). The T.G.B. Osborn Vegetation Reserve, Koonamore, South Australia. 70 years of vegetation monitoring. Poster displayed at the Ecological Society of America, Annual Meeting, Utah, USA.

Emmerson, L. M. and Facelli, J. M. (1996). Bluebush mound heights - an indicator of grazing regime? in Conference Papers, The Australian Rangeland Society 9th Biennial Conference, eds L.P. Hunt and R. Sinclair. Australian Rangeland Society, Port Augusta, South Australia, pp227-228.

Emmerson, L.M., Facelli, J. M. and Chesson, P.L. (1996). The effect of grazing on local populations of Erodiophyllum elderi. in Conference Papers, The Australian Rangeland Society 9th Biennial Conference, eds L.P. Hunt and R. Sinclair. Australian Rangeland Society, Port Augusta, South Australia, pp229-230.

Sinclair, R. (1996) Mulga regeneration at Koonamore. in Conference Papers, The Australian Rangeland Society 9th Biennial Conference, eds L.P. Hunt and R. Sinclair. Australian Rangeland Society, Port Augusta, South Australia, pp255-256.

Cox, J.A. and Conran, J.G. (1996) The effect of water stress on the life cycles of *Erodium crinitum* Carolin and *Erodium cicutarium* (L.) L'Hérit. Ex Aiton (Geraniaceae). *Australian Journal of Ecology* 21, 235 - 240.

Sinclair, R. (1999) Koonamore: The T.G.B. Osborn Vegetation Reserve. Biology Society of South Australia, Issue 3, March 1999. pp 4-6.

Sinclair, R. (2002) Dead Wood in the Arid Zone; Some data from the TGB Osborn Vegetation Reserve, Koonamore. In "Shifting Camp", Conference Proceedings, Australian Rangelands Society 12th Biennial Conference, eds Sarah Nicolson & David Wilcox, Kalgoorlie Sept. 2002. pp 123 - 128.

Hastwell, G.T. and Facelli, J.M. (2003) Differing effects of shade-induced facilitation on growth and survival during the establishment of a chenopod shrub. *Journal of Ecology* 91: 941-950.

Sinclair, R. (2004) Persistence of dead trees and fallen timber in the arid zone: 76 years of data from the T.G.B. Osborn Vegetation Reserve, Koonamore, South Australia. *Rangeland Journal* 26(1): 111-22.

Sinclair, R. (2005) Long-term changes in vegetation, gradual and episodic, on the TGB Osborn Vegetation Reserve, Koonamore, South Australia, (1926-2002). *Australian Journal of Botany*, 53: 283-296.

McArthur, L., Boland, J. and Tiver, F. (2006) A model to detect grazing sensitivity of *Myoporum platycarpum* in the arid rangelands of South Australia. Natural Resource Modelling 19:587-607.

Emmerson L.M, Facelli J.M, Chesson P. and Possingham H. (2010) Secondary seed dispersal of *Erodiophyllum elderi*, a patchily distributed short-lived perennial in the arid lands of Australia. *Austral Ecology* 35(8): 906-918.

Emmerson L.M., Facelli J.M., Chesson P., Possingham H. and Day, J.R. (2012) Changes in seed dispersal processes and the potential for between-patch connectivity for an arid land daisy. *Ecology* 93(3): 544-553.

Lawley, V., Parrot, L., Lewis, M., Sinclair, R. and Ostendorf, B. (2013) Self-organization and complex dynamics of regenerating vegetation in an arid ecosystem: 82 years of recovery after grazing. *Journal of Arid Environments* 88: 156-164.

Bowman A.S. and Facelli, J.M. (2013) Fallen logs as sources of patchiness in chenopod shrublands of South Australia. *Journal of Arid Environments* 97: 66-72.

Boland, J. and Sinclair, R. (2014) Developing age-size relationships for long lived tree species. *Journal of Biological Systems* 22: 309-326.

Bowman,A.S., Facelli, J.M., and Sinclair, R. (2015) Long-term influence of fallen logs on patch formation and their effects under contrasting grazing regimes. *Austral Ecology* 40: 238-244.

Theses, University of Adelaide

Sinclair, R (1967). Some aspects of the energy balance of arid zone plants. Ph.D. Thesis, Univ. of Adelaide.

Rogers, R.W. (1970). Ecology of soil-surface lichens in arid south-eastern Australia. Ph.D. Thesis, Univ. of Adelaide.

Crisp, M.D. (1975). Long term change in arid zone vegetation at Koonamore, South Australia. Ph.D. Thesis, Univ. of Adelaide.

Coleman, D.F. (1982). The Carbon balance of *Atriplex vesicaria*. Ph.D. Thesis, Univ. of Adelaide.

Cox, J.A. (1982). Drought tolerance and reproductive strategy of two arid zone annuals, *Erodium cicutarium* and *Erodium crinitum* (Geraniaceae). Hon. Thesis, Botany Dept., Univ. of Adelaide.

West, L. J. (1997) Age structure and population studies on two subspecies of *Senna artemesioides* (Desert Cassia, Punty Bush) on Koonamore Station, South Australia. Honours thesis, Botany Dept., Univ. of Adelaide.

Emmerson, L. M. (1999) Persistence mechanisms of *Erodiophyllum elderi*, an arid land daisy with a patchy distribution. Ph. D. Thesis, Univ. of Adelaide.

Hastwell, G.T. (2001) Facilitation and Fertile Islands: linking canopy effects with plant interactions. Ph.D. Thesis, Univ. of Adelaide.

Bowman, A. (2015) Fallen logs: creating patchiness in chenopod shrublands of South Australia. Ph.D. Thesis, Univ.of Adelaide.

Some scenes from Koonamore Vegetation Reserve

Bindy-I cottage, by the Reserve

Quadrat reading

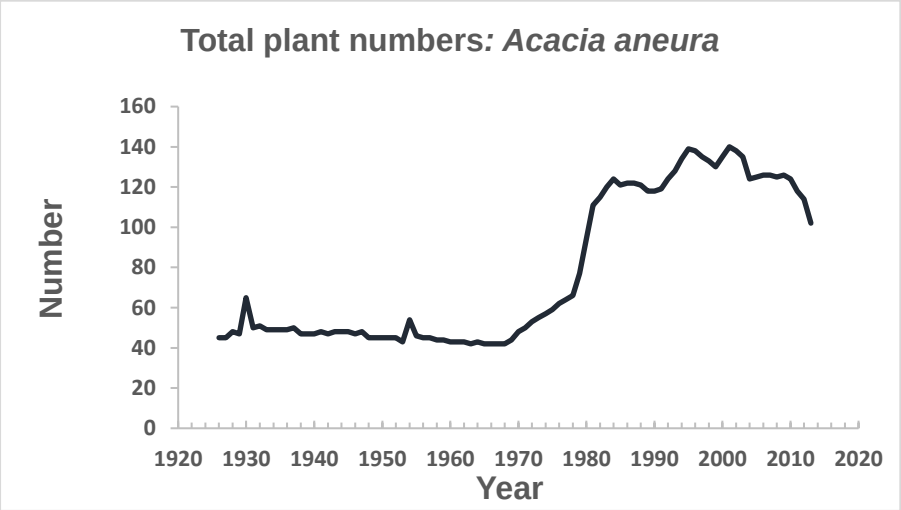
Measuring shrubs

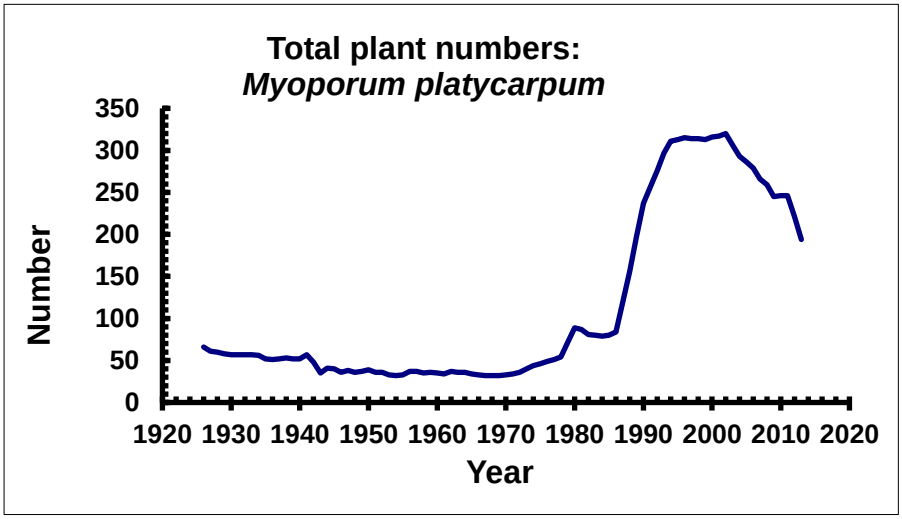
Mending the fence

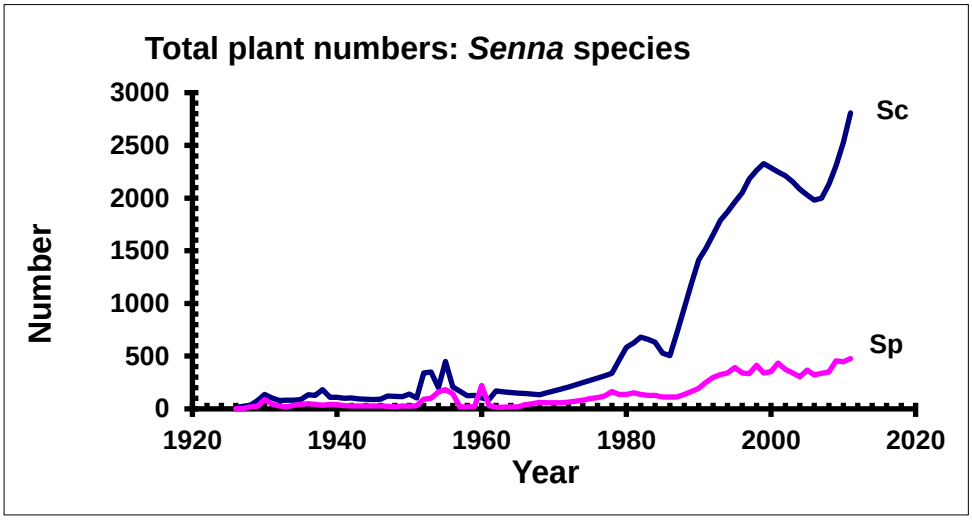
The new Dunny

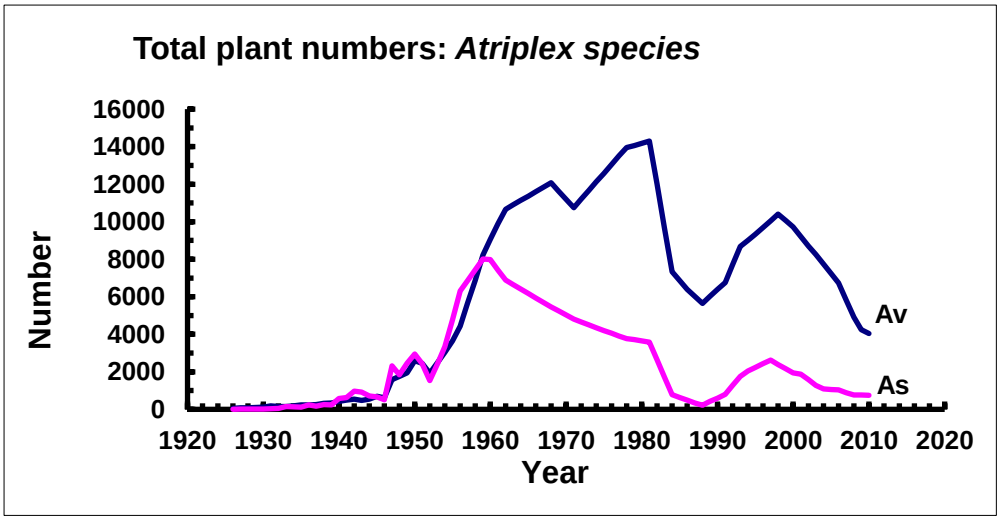
A local Resident

Some sample data








Total plant numbers: *Atriplex species*
Number
16000
14000
12000
10000
8000
6000
4000
2000
0
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
Year
Av
As