

Rivers

Riparian vegetation and river flow

A completed Water Research Commission (WRC) project explored the links between riparian vegetation and flow.

Background

Riparian vegetation communities occur along rivers in lateral zones parallel to the direction of river flow. These zones are sub-sections of a riparian area where groups of plants preferentially grow in association with one another as a result of shared habitat preferences and adaptations to the prevailing hydrogeomorphological conditions.

A WRC project sought to quantify the links between the components of the flow regime and the occurrence of riparian species in lateral zones alongside rivers. The need to understand and to quantify these links rose from the need to predict changes in riparian communities in response to changes in river flow.

Characteristics of lateral zones

Undisturbed headwaters are well suited to the study of zonation patterns as the riparian communities are characterised by steep lateral gradients. The riparian vegetation of the Fynbos has not been intensively studied until recently, and there is no formal classification of riparian vegetation communities for the Western Cape.

Despite the seemingly obvious lateral patterning within riparian areas and the contention that different communities may be distinguished floristically *in situ* there are discrepancies between the results from different studies. To date, most studies have assumed the pattern exists and accommodated this assumption within the sampling protocol, usually by delineating sample plots within community types *a priori*.

Three lateral zones were adopted and tested: marginal, lower and upper zones. There is also a fourth lateral zones, namely a transitional zone between the marginal and lower.

The key question was 'can characteristic species/taxa be used to identify lateral zones?' Three hypotheses were tested:

- Riparian plants are distributed in a repetitive and predictable manner.
- Groundcovers and canopy species contribute in different ways to the pattern.
- Characteristic taxa are restricted to specific lateral zones.

Some species were considered to be useful indicators for the lateral zones:

- *Prionium serratum* and *Isolepis prolifera* for the marginal;
- *Calopsis paniculata* and *Morella serrata* for the lower dynamic;
- *Erica caffra* for the body of the riparian area, being equally distributed across the lower dynamic and lower zones, and at low abundance in the marginal and upper zones;
- *Metrosideros angustifolia* trees and *Elegia capensis* for the lower; and
- *Diospyros glabra* and *Pteridium aquilinum* for the upper zone.

Links between lateral zones and flow

The flow regime is considered to be the master variable responsible for the occurrence of lateral zones as it directs, inter alia, river channel structure, water availability and the life histories of plants, which also interact and influence one another.

Several authors have proposed links between inundation of a river bank and the plant communities that occur there, mostly along Northern Hemisphere rivers with floorplains. Thus, the conceptual framework for this study was based on the understanding that water availability decreases laterally away from the river channel.

Similarly, depth to groundwater, the probability of being flooded and the duration of inundation when flooded also decrease. Using this, the researchers proposed there would be two main lateral zones, one flooded intra-annually and the other inter-annually.

The marginal and lower zones consisted of riparian species inundated intra-annually and every one to three years respectively, while the upper zone consisted of a mixture of riparian and terrestrial species and inundated at intervals greater than three years.

The study then tested whether the four lateral zones for Fynbos riparian vegetation occurred on other South African rivers.

Perennial rivers were selected in three regions with differing hydrographs viz summer peak flow in Mpumalanga; the aseasonal or early spring peak in the Southern Cape; and winter peak flow in the Western Cape. Not coincidentally, distinct vegetation communities occur in each region: Lowveld Riverine Forest and Northern Mistbelt Forest in Mpumalanga; Southern Afrotemperate Forest in the Southern Cape and Fynbos Riparian Vegetation in the Western Cape.

Results from the study

Most river ecologists have the general understanding that the riparian area is separated into a wet and dry bank, but it was not clear how many zones there were within these two basic groups or whether these were always present. The longitudinal dimension of how plants arrange themselves is a good avenue for further research.

There is no knowledge of similar studies at lower reaches, such as lower foothills or lowlands. Lower reaches tend to have floodplains, which makes modelling flow more complicated as it is necessary to account for vertical and lateral exchanges, and storage, of surface flows and groundwater in and outflows.

In South Africa, river health is assessed in two (marginal and non-marginal) or three (marginal, lower and upper) zones, depending on the level of assessment, using the VEGRAI (Vegetation Response Assessment Index). However, the lower dynamic appears to be an area of preferential recruitment and, as such, its inclusion in an updated VEGRAI is worth considering.

Inundation duration was shown to separate the wet bank into its two zones, the marginal and lower dynamic.

Inundation duration is not currently specified in environmental water requirements but is known and, as such, merits inclusion.

Overall, it was possible to link the occurrence of lateral zones to flood recurrence or inundation as follows:

- The wet bank and dry bank may be separated using the stage of the 1:2-year flood on a cross section;
- The marginal zone will be located where the cross-section is inundated for longer than one month per annum;
- The lower dynamic zone will be located where the cross-section is inundated for shorter than one month per annum;
- The lower zone is situated at a position on the cross section that is inundated for shorter than one week every second year.

It was shown from a species perspective, a combination of groundcovers and trees was best to distinguish the lateral zones. Trees did not produce a useful pattern alone, whereas the patterns produced by groundcovers on their own were similar to the patterns of the two combined.

Thus, data that combine trees and groundcovers are recommended for studies of this nature. It is particularly useful to consider the responses of trees and groundcovers separately in each lateral zone, since they respond at different temporal scales to prevailing conditions.

Conclusion

There is little understanding of the recruitment and succession of riparian vegetation populations in southern Africa. Although detailed studies have been done on the Northern Hemisphere rivers, their results are not directly applicable to southern African rivers.

Experimental studies on the reproductive biology of southern African riparian flora would greatly improve the ability to prescribe flow regimes that cater for their needs. This field offers great scope for interesting and relevant experimental research that would directly contribute to more effective management of rivers in the sub-continent.

Further reading:

To order the report, *Links between riparian vegetation and flow (Report No. 1981/1/13)* contact Publications at Tel: (012) 330-0340, Email: orders@wrc.org.za or Visit: www.wrc.org.za to download a free copy.