Ecology of Lowland Rivers, their flood plains and wetlands

Introduction

• Distinction between the upland and lowland rivers develop gradually

Changes down a river system, as the erosive, often upland, system is replaced by the lowland flood plain (source: Brian Moss, 1998)
The river continuum concept

The idea of streams as factories for the orderly processing of allochthonous organic matter is explained by River Continuum concept.

Vannote et al. created this concept to summarize information about this idea.
Submerged plants and their growth

- Water differs greatly from air and yet the appearance of submerged plants is much like that of their land relatives

(a) *Potamogeton natans*

(b) *Littorella uniflora*

(c) *Myriophyllum spicatum*

(d) *Wilflia columbiana* and

(e) *Spirodela polyrhiza*
KEY 1: EMERGENT NARROW-LEAVED PLANTS

All characteristics are based on leaves
All heights are maximum

Emergent part of plant resembles a rush
Christmas tree
Cone top X1
Stiff X1
Cone tip X1

CRASSIS
Tall, will grow to touch
ovate to
narrow to

Sedges
Soft, puffy
rounded

Rushes
Slender, more

Grasses
Tall, will grow to
narrow to

Monocotyledons
Leaves oblong at
base
Rosette characteristic

Hippuris

Glycera

Phalaris

Pyramidites
narrow to

Carex

TRUE RUSHES
Slender, more

FALSE RUSHES
Slender, more

Acorus

Eleocharis

Schoenoplectus

Typha

Sparganium

Butomus

Leaves X1, X2
Spikelets X1
Spikelets X1

Flowers X1
Flowers X1
Flowers X1

Leaves X1
Leaves X1
Leaves X1

Stems X1
Stems X1
Stems X1
KEY 2: EMERGENT BROAD-LEAVED PLANTS

All characteristics are based on leaves

DIVERGING VEINS
From Nodes, like an oak leaf (Decurrent)

WHORLED
Group of three or more leaves coming off the stem at same level

EMERGENT PART OF PLANT
Resembles a Christmas tree
Horizontally 30 cm (1 ft) out of the water & form dense stands

SQUARED STEM
Mat-like rooted, stalked
Up to 90 cm (3 ft) high

MAIN STEM
Smooth, purplish, clustered purple flowers
Up to 120 cm (4 ft) high

SINGLE STEM
Smooth, pointed, or rounded
Slightly toothed edges
Small blue or pink flowers
Creeping stems
Up to 30 cm (1 ft) high

ROUND STEM
Shiny, pointed leaves with slightly toothed edges
Small blue or pink flowers
Creeping stems
Up to 30 cm (1 ft) high

SQUARE STEM
Mat-like rooted, stalked
Up to 90 cm (3 ft) high

SCROPHULARIA
Leaves with heart-shaped base
Dark green & shiny
Yellow flowers
Up to 60 cm (2 ft) high

LYTHRUM
Very toothed, nettle-like
Small stalk, white flowers
Up to 100 cm (3 ft) high

CATHA

POLYGONUM
Shiny leaves, spike of pink flowers

VERONICA
Hairy, non-flowering mud
Pink, white & blue flowers
Up to 60 cm (2 ft) high

MYOSOTIS
Long, thin leaves
Up to 120 cm (4 ft) high

RORIPPA

UMBELLIFERS
Up to three pairs of leaves
Wide at base of stem, narrow
Leaves at base of flowers
Up to 100 cm (3 ft) high

BERULA

UMBELLIFERS
Up to three pairs of leaves
Wide at base of stem, narrow
Leaves at base of flowers
Up to 100 cm (3 ft) high

APN

CENANTHE

PARALLEL VEINS
(continuously decurrent)

DOUBLE LEAF SHAPED
Up to 80 cm (2 ft) long

ALISA

SAGITTARIA

TRIFOLIATE

RESEMBLING A PASTURE CLOVER LEAF ON A LONG STEM
Opaque of pink or purple flowers
Up to 30 cm (1 ft) high

MENYANTHES

VENUS FIDELIS

CHELIDONIUM

ARRHENATHERUM

SAND WORT

ONE TO THREE PAIRS OF LEAVES
Narrow at base of stem, wide
Leaves at base of flowers
Up to 100 cm (3 ft) high

STREET LINEN

PERSICARIA
**FLOATING-LEAVED PLANTS**

- **KEY 8**
  - **FINE FILAMENTS**
    - Which grow to form large floating mats
      - Algae
  - **SAW-EDGED ROSETTE**
    - Like a pineapple top
      - *Stratiotes*
  - **ROUND**
    - Rooted
      - **SMALL LILY**
        - Up to 10cm (4 in) wide, wavy edges
        - Small bell-shaped yellow flowers
          - *Nymphoides*
      - **PARALLEL VEINS**
        - Oval and rounded dull green spike of flowers
          - *Potamogeton*
      - **DIVERGING VEINS**
        - Chlorophyllous and possess characteristic spike of pink flowers
          - *Polygonum*
    - **FREE-FLOATING**
      - Small flat, green, up to 1cm (1/2 in) wide
        - *Lemma*
      - Small fern, bluish green becoming red in autumn. Up to 3cm (1 in) wide
        - *Azolla*
      - Three to ten leaves issued. About 3cm (1 in) wide
        - *Hydrocharis*
  - **LARGE LILIES**
    - Leaves up to 30cm (12 in) wide
      - **OVAL**
        - Up to 12cm (5 in) long
      - **STAR-SHAPED**
        - Notched tips to leaves, clustered to form 'star'
          - *Callitriche*
      - **STRAP-SHAPED**
        - Boat-shaped tips
          - *Glyceria*
      - **BUTTERCUP**
        - Finely divided submerged leaves may also be present.
          - *White Water Ranunculus*
Methods of measuring the primary productivity of submerged plants

- Whole Community methods
- Enclosure methods
Submerged plants and the river ecosystem

- Plant-bed management in rivers
- Ecotoxicology – the testing of potentially hazardous chemicals
Floodplains, swamps, and marshes

• Floodplains:
  – are sometimes called inland deltas. Land between a river channel that is periodically flooded, and raised land on the edge of a river valley are defined as floodplains.
  – In Nepal there are over 3 dozens floodplains.
  – Some of the common and fertile floodplains are Koshi, Narayani and Karnali floodplains

• Swamps:
  – Swamps develop in stillwater areas around lake margins and in parts of floodplains, such as oxbows, where the water remains for long periods of time.
  – Swamp areas have freshwater and woody communities throughout, or variably during, the growing seasons

• Marshes:
  – Marshes exist where groundwater, surface springs, streams or runoff are common and frequently cause flooding, and are more or less permanently shallow
Productivity of swamps and floodplain marshes

- Swamps and marshes are among the most productive of the world’s ecosystems.
- They are dominated by *Taxodium* sp., *Cyperus papyrus*, *Phragmites australis*.
- Many estimates of swamp production are probably underestimates.
Productivity of swamps and floodplain marshes

- Floodplains often have large populations of birds and mammals; fish may be equally abundant.
Swamp soils and the fate of the high primary production

Dead organic matter

↓

Swamp floor

↓

Water movement impeded

↓

Little is washed downstream

↓

Much of the production must be oxidized or stored as peat
Wetlands of International Importance: Nepal,


Ghodaghodi Lake Area.
Situated in Kailali District; 2,563 ha; 28°41'N, 080°57'E.
A large and shallow oxbow lake with associated marshes and meadows surrounded by tropical deciduous forest on the lower slopes of Siwalik, the youngest mountain range of the Himalaya in Western Nepal.
There are around 13 associated lakes and ponds, and some streams separated by hillocks situated on the site's periphery. The forest and wetlands serve as the wildlife corridor between the lowland and the Siwalik.
Ghodaghodital

Ghodaghodital

The lake is an important religious place with a shrine dedicated to Ghodaghodi deity where indigenous Tharu people celebrate a traditional festival, Agan Panchami, in December and take a holy bath in the lake.

Due to dense population within the site (around 6,700 people of whom 50% are illegal immigrants from adjoining hilly areas), it is intensively used for traditional fishing and agriculture.

The factors putting pressure on the site’s ecology include highway traffic at the southern edge, construction of unplanned new temples, over grazing, poaching and hunting as well as illegal tree felling and smuggling of Sal (Shorea robusta) and Khair (Acacia catechu) timber, natural eutrophication accelerated by human religious and agricultural activities.

Nevertheless with the help of IUCN Nepal, the users' groups of local communities and NGOs are involved in the conservation process which has helped to reduce poaching, initiate fencing towards the highway to control grazing and encroachment, and develop a participatory community-centered management plan. Ramsar site no. 1314.
Jagadishpur Reservoir

- Located in Kapilvastu; 225 ha; 27°35'N 083°05'E.
- A reservoir constructed in the early 1970s over the Jakhira lake and agricultural lands for irrigation purposes.
- The water is fed from the Banganga lake in the Churia hills catchment.
- The reservoir is surrounded by cultivated land and a few smaller lakes serving as a buffer zone for bird movements.
- The site provides shelter for an assemblage of some rare, endangered species of conservation importance species, which include plants such as endangered Serpentine (*Rauvolfia serpentine*), rare Pondweed (*Potamogeton lucens*), threatened Lotus (*Nelumbo nucifera*), and endangered and the tallest flying bird species Indian Sarus Crane (*Grus antigone antigone*).
- The current use of the reservoir by local population includes fishing, grazing, fuel wood and fodder collection, domestic use and supply of water for irrigation in 6,200 ha of surrounding cultivated land. Ramsar site no. 1315.
Beeshazarital

- **Beeshazar and Associated Lakes.**
- Situated in Chitawan; 3,200 ha; 27°37'N, 084°26'E.
- National Park buffer zone.
- An extensive, typical oxbow lake system of the tropical Inner Terai area in Central Nepal, lying inside buffer zone of the Royal Chitwan National Park, a World Heritage site.
- Situated between the Mahabharat mountain range to the north and the Siwalik range to the south, this forested wetland provides excellent habitat as a water hole and corridor for endangered wildlife species, including the critically endangered White-rumped Vulture (*Gyps bengalensis*), endangered tiger (*Panthera tigris*), one-horned rhinoceros (*Rhinoceros unicornis*) and Gharial (*Gavialis gangeticus*), vulnerable Smooth-coated Otter (*Lutra perpiscillata*), Sloth Bear (*Melaurus ursinus*), Marsh Crocodile (*Crocodylus palustris*), Lesser Adjutant Stork (*Leptotilos javanicus*), Ferruginous duck (*Aythya nyroca*), and Band-tailed fish eagle (*Haileetus leucoryphus*).
Beeshazarital

• The surrounding forest area is populated by nearly 100,000 people who practice farming and fishing in the lake, which is managed through a fishing contract, awarded once a year.

• Thanks to heightened awareness of the site's importance the protection of its resources has been improved, e.g. invasive species posing threats to the wetlands are manually removed by local communities and authorities of the Royal Chitwan National Park.

• Due to the recent designation as the buffer zone, the Buffer Zone Management Committee has been constituted for its participatory management.

• There is a training centre for Armed Forest Guards/Ministry of Forest and Soil Conservation which was formerly known as the Rhino Patrol, and a visitor center established at Royal Chitwan National Park. Ramsar site no. 1313.
Koshi Tappu

Koshi Tappu.
• Situated in Kosi; 17,500 ha; 26°39’N 086°59’E.
• Nature Reserve.
• A section of the Sapta Kosi River and its floodplain of extensive mudflats, reedbeds, and freshwater marshes.
• An important staging area for waterbirds, the site supports several species of notable birds (including the Bengal Falcon, Oriental White Ibis, and White-tailed Eagle), and notable mammals, such as the panther.
• Located in a densely populated area, the site is subject to livestock grazing and attempts by local people to re-establish themselves in the reserve.
• Land use in surrounding areas includes subsistence fishing and rice cultivation. Ramsar site no. 380.