Soils and hydrology at Mangarakau wetland
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Soils were described at 6 sites in the wetland and subsequently water level variation has been monitored at the same sites. The sites were chosen to represent different distinctive vegetation communities as outlined in Table 1 and to assess whether differences in vegetation reflected differences in hydrological regime. Four of the sites are in the central part of the wetland near the visitor centre (Mk1, 2, 3, 6) and two are at the north-eastern end (Mk4, 5). The latter two sites have had fires through them since the vegetation descriptions were completed. The locations of the sites are shown in Fig. 1.

Soil characteristics were described at each site (horizonation, depth, colour, texture, organic matter content and decomposition) following Milne et al. (1995) and Harris (1968). All the soils are classed as Organic soils (Hewitt 1992). Capacitance-type water level recorders were installed at each site to characterise the hydrological regime of the different communities. They record the height of the water table every 30 minutes and give a detailed understanding of the hydrological characteristics of the swamp. Raw data recorded by the capacitance probes were transformed to depth below the local ground surface to provide a continuous time series of water table depths for each site. Summary statistics (mean, median, mode, range, etc) and a frequency analysis were derived from this record.

Rainfall has also been measured on site since February 2005. The following annual totals (January to December) have been recorded:
- 2006 1806 mm
- 2007 1569 mm
- 2008 2266 mm

The Mangarakau wetland lies in a structurally controlled basin with steep hills to the north-west and south-east. It receives runoff from both sides though a series of small streams draining from these hills. The wetland extends in tongues up several of these valleys. The streams enter the margins of the wetland as surface flow and quickly lose surface expression within the wetland. However they provide significant input of water and nutrients to the wetland. The wetland incorporates several areas of open water (Lake Mangarakau, Big Pond and Little Pond) which previously were probably more extensive. A lake at the northern end of the wetland disappeared after early attempts to drain the wetland by deepening the channel which connects the northern end to Whanganui inlet. The wetland is drained by streams at both southern and northern ends. Armour and Kennedy (2005) show that the wetland has been forming for at least 6500 years and that a lake formed in the basin prior to the establishment of the wetland and has been progressively filled as the wetland developed.

The soils generally comprise moderately to highly decomposed peat that may be more than 5 m deep - at Mk1, 3, 4 we probed to 3 m and had not reached the base of the peat. However towards the edge of the swamp and where streams drain in to the swamp the peat tends to be shallower and less organic – peat depths at Mk2, 5, 6 were 2 m, 1.7 m, and 2.3 m respectively. These sites also had some layers of silty alluvium (representing flood deposits) within the peat. Typically the top c.1 m comprises fibrous, less decomposed peat that grades down to more decomposed peat. Wood fragments and logs were commonly encountered at depth when coring the peat suggesting there may have previously been more woody vegetation.

Selected physical and chemical analyses of the soils are given in Table 2. Bulk density was very low at all sites (c.0.1 t/m^3), typical of moderately decomposed peat. The pH was strongly acid and slightly higher at Mk1 and Mk6 than the other sites. Electrical conductivity was higher at Mk5 and Mk 6 than the other sites, both sites that had more evidence of mineral inputs from adjacent streams. Similarly total P was considerably higher at both these sites. Total C and N were very high at all sites, with surprisingly little difference between the sites. The C/N ratio was medium-high at all sites.

The hydrological regime of the 6 sites is summarised in Table 3. Mk1–4 all have average and median water table depths slightly above the surface of the wetland and differ from Mk5 and 6 which have average and median water table depths slightly below the ground surface. The extreme range of water table depth is quite high at all sites, varying from 0.7 m to 1.1 m. However, there is a clear difference in hydrological response between the two sites with more influence of mineral inputs in to the peat near the edge of the wetland (Mk5 and 6) and the remainder of the sites. These two sites have a wider range of water level response, respond more rapidly to rainfall and water levels fall more quickly after rain stops (Fig. 2). At these two sites the water table typically draws down to greater depth between rain events than at the other sites. Mk4 typically had the highest water table while Mk1–3 were intermediate between these two extremes. Mk2 tends to have the least variation in water table fluctuation. Fig. 2 also shows there can be seasonal differences in water table behaviour. In 2008 the first half of the year was characterised by some large storms with intervening dry periods. At all sites except Mk2 the water table fluctuated quite widely between storms. By contrast in the second half of the year storms were smaller but more frequent and the water table at al sites remained higher than it had typically been in the first half of the year. A similar pattern was also evident in 2006 and 2007.

An overview of the proportion of time the water table is at different depths at the 6 sites is shown in Fig. 3 and shows some clear differences between the sites. Mk2 has the least variable water table, mostly lying between -0.05 m and 0.2 m. Mk5 has the most variable water table depth, typically lying between -0.4 m and 0.15 m. The water table at Mk6 commonly draws down to 0.3 m but there is a strong mode in water table depth at about the surface. Mk 1 and 3 have fairly similar patterns of water table variation with the water table mostly lying between -0.01 and 0.2 m, while at Mk 4 the range is slightly higher (up to 0.3 m). This analysis also indicates the extreme high water tables (>0.5 m) occur for only a very small period of time after major storms.

These data show that the wetland is classed as a swamp, although it is dominated by peat substrate with limited input of mineral material where streams drain in to the edge of the wetland. The water table is on average above the ground surface at 4 of the 6 sites, and during storms is above the surface at all 6 sites.

References

Armour RM, Kennedy DM 2005. Comparative palynomorph signals of vegetation change preserved in an adjacent peat swamp and estuary in North-west Nelson, New Zealand. New Zealand Journal of Botany 43: 451–465.
Harris WF 1968. Peat classification by pedological methods, applied to peats of western Wellington, New Zealand. Bulletin 189, Department of Scientific and Industrial Research, Wellington.
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Milne JDG, Clayden B, Singleton PL, Wilson AD 1995. Soil Description Handbook. Mannaki Whenua Press, Lincoln.

Table 1 Characteristics of the 6 sites

Site	Location	Dominant vegetation (from Bev's descriptions)	Soil
Mk1	E2466680 N6062420	Bau art - Gle dic-Lep aus	peat >3m
Mk2	E2466486 N6062426	Typ ori – Bau art	2 m of peat over gritty silt loam which becomes sandier with depth
Mk3	E2466770 N6062570	Bau art – Typ ori	peat >3m
Mk4	E2467891	Lep aus – Bau art	peat >3m

	N6063503		
Mk5	E2467990	Gle dic – Pho ten – Cop	1.7 m of peat over a gritty silt
	N6063473	ten	loam
Mk6	E2466147	Pho ten – Cop ten – Bau	least organic of the soils,
	N6062414	art – Typ ori	dominated by loamy peat with layers of more peaty material

Note – sites 4 and 5 are in the area that has been burnt and may have changed significantly since these descriptions

Table 2 Selected physical and chemical characteristics of the surface peat (0-75 mm)

	Bulk density (t/m3)	pH	Electrical Conductivity (mS/cm)	Total C (%)	Total N (%)	C/N ratio	Total P (mg/kg)
Mk 1	0.07	5.17	0.48	31.6	1.80	18	693
Mk 3	0.10	4.64	0.35	26.6	1.46	18	649
Mk 4	0.08	4.72	0.33	33.6	1.96	17	812
Mk 5	0.13	4.58	0.64	32.5	2.02	16	1195
Mk 6	0.06	5.28	1.23	42.0	2.83	15	1926

Table 3 Summary statistics for water table depth

	Water table depth (m)					
Site	Mean±sd	Median	Mode	Max.	Min.	Range
M1	0.036±0.085	0.039	0.018	0.724	-0.194	0.918
M2	0.065±0.079	0.052	0.036	0.701	-0.095	0.796
M3	0.033±0.078	0.028	0.001	0.698	-0.141	0.839
M4	0.090±0.120	0.120	0.235	0.413	-0.232	0.645
M5	-0.139±0.160	-0.140	-0.184	0.223	-0.471	0.694
M6	-0.065±0.105	-0.046	-0.021	0.752	-0.370	1.122

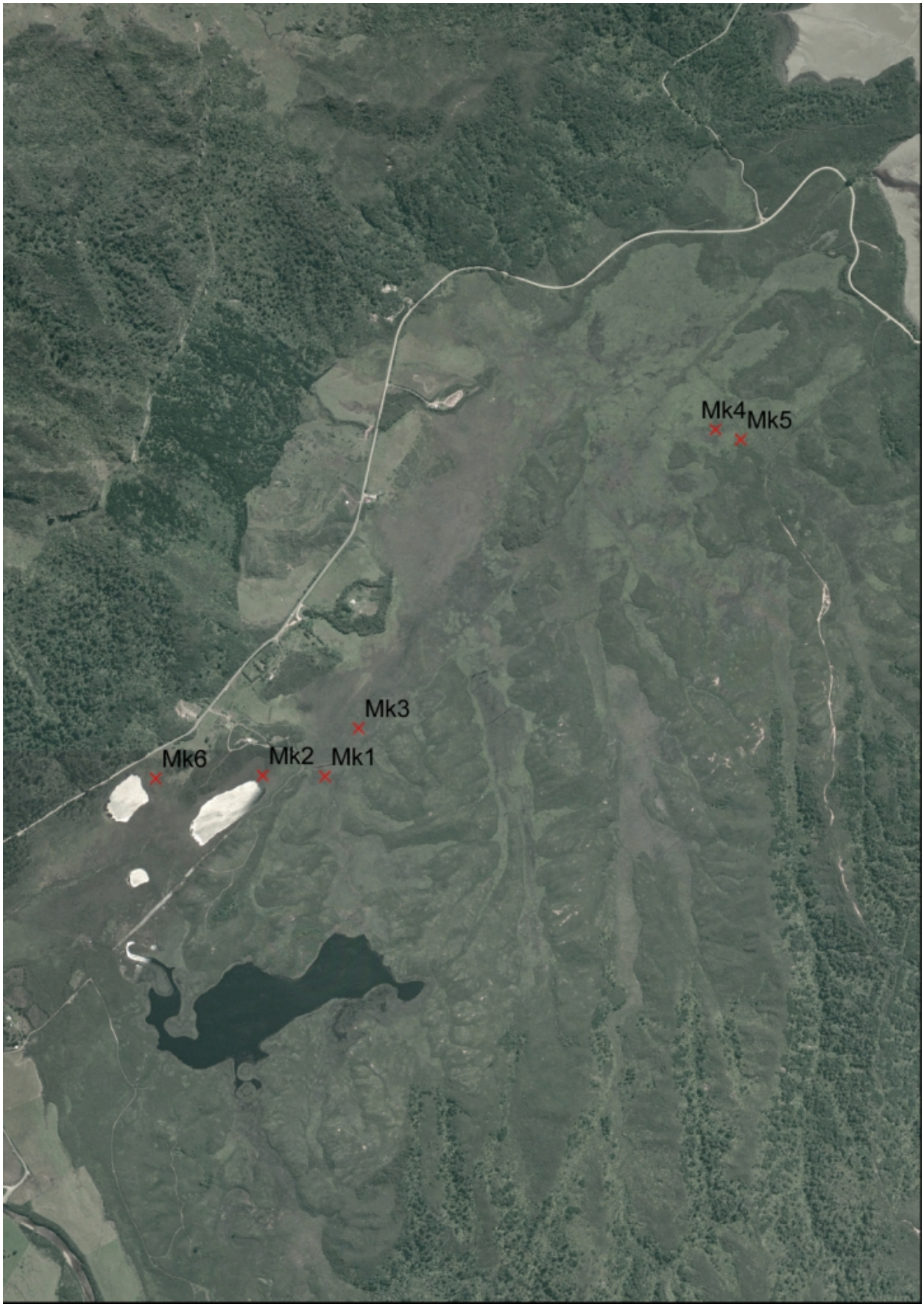

Fig. 1 Location of the 6 sites with water level records

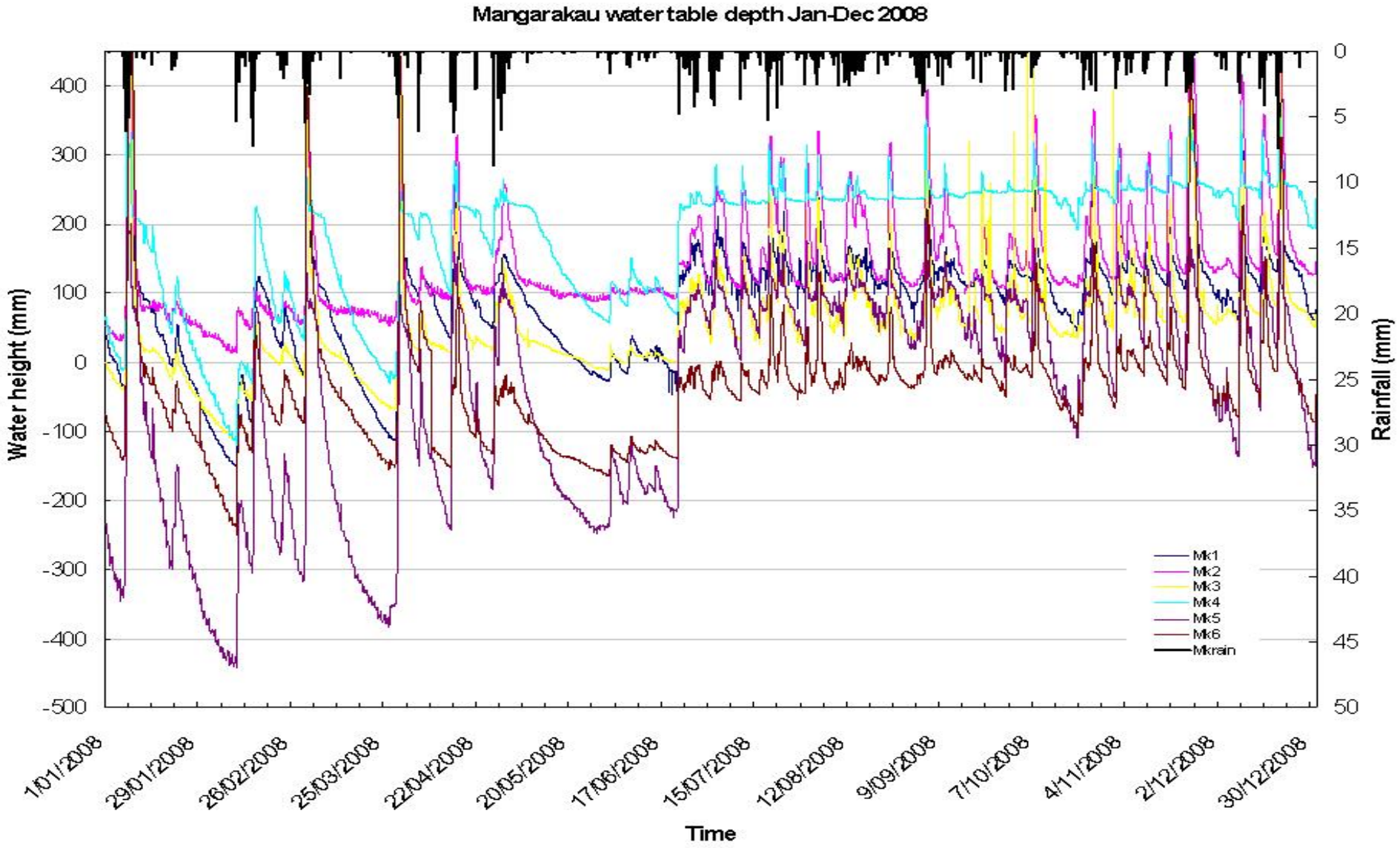

Fig. 2 Water level record for the 6 sites during 2008

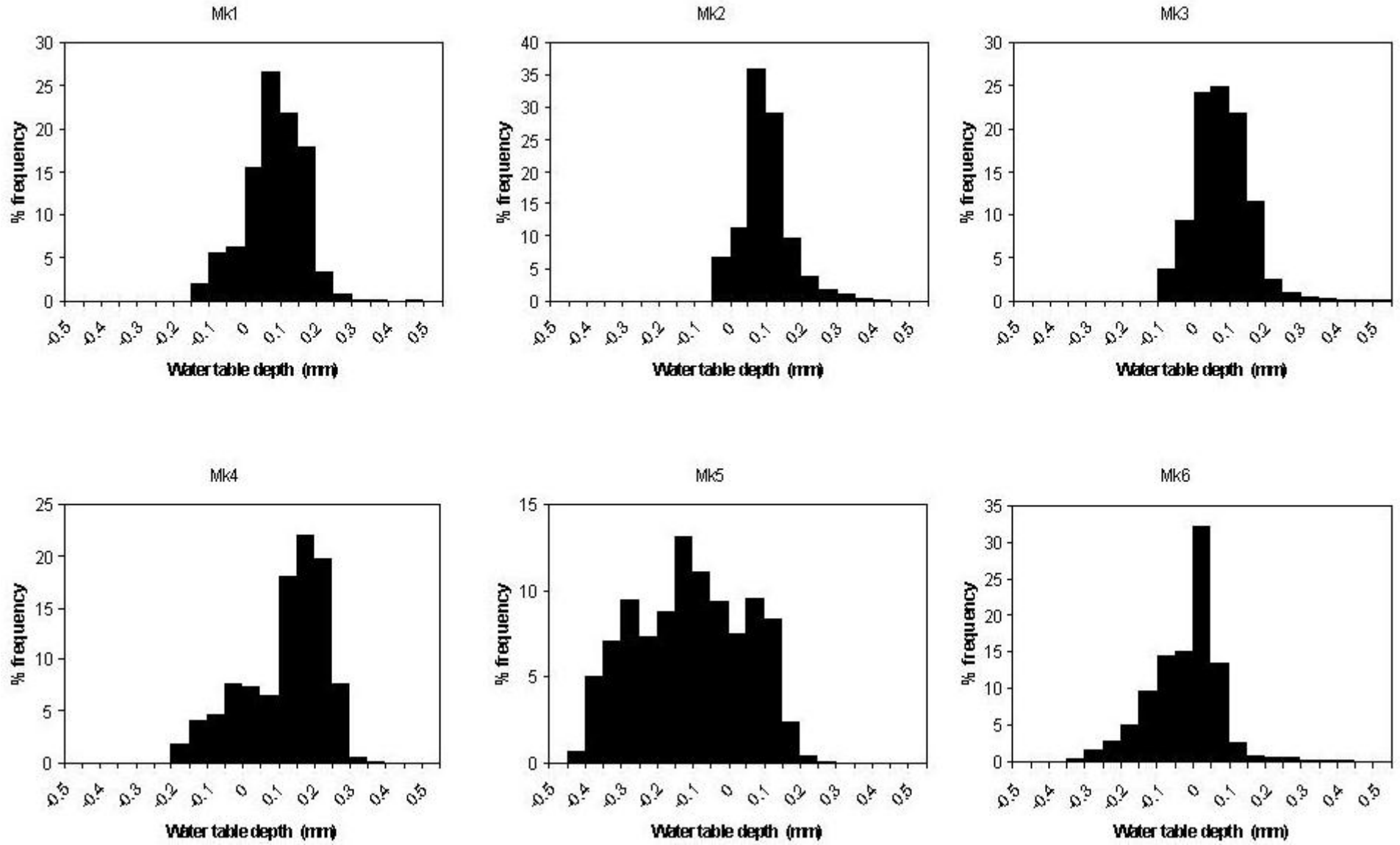

Fig. 3 Frequency distribution of water table depth at the 6 sites