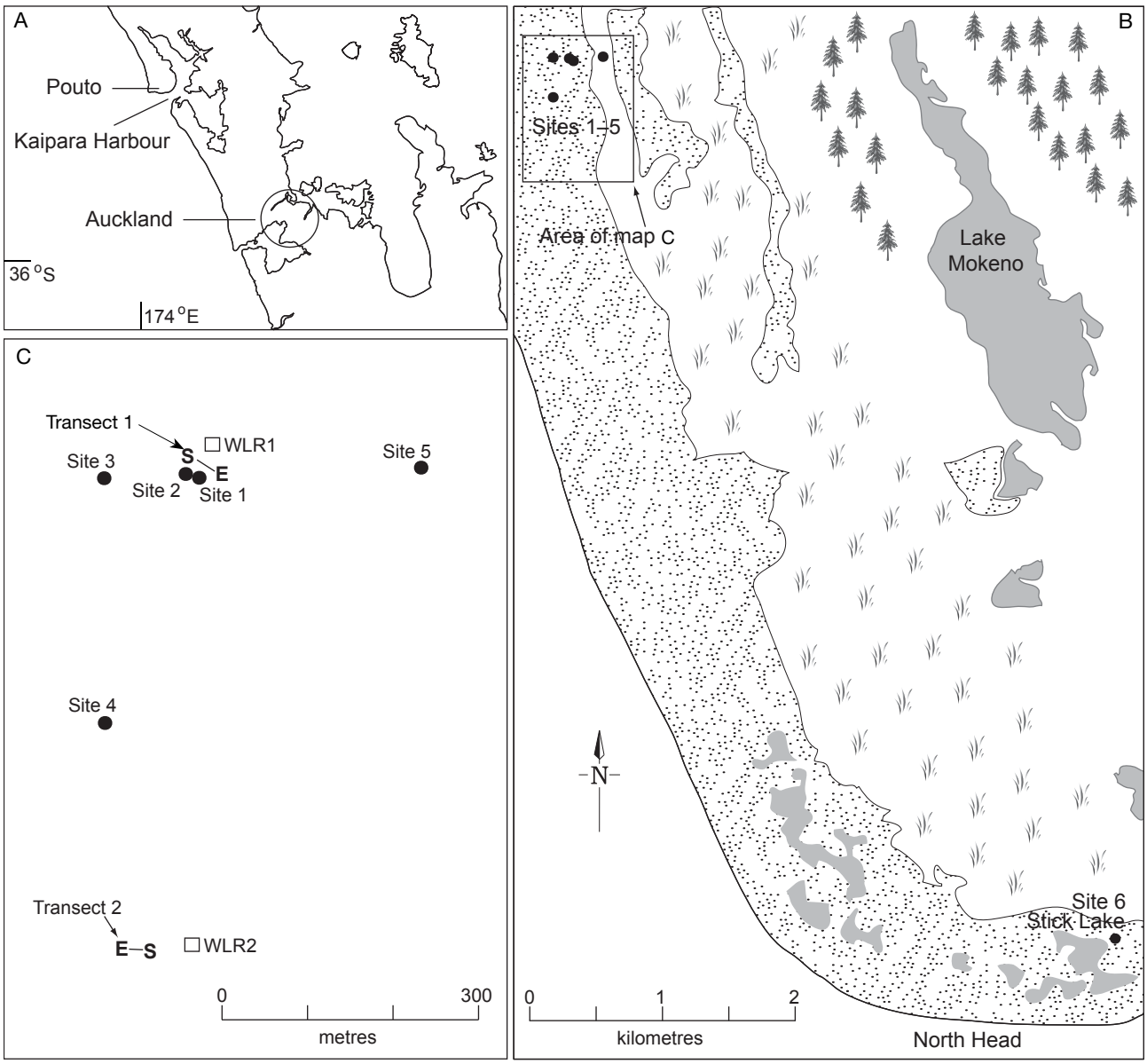

Figure 2. A—Map showing Pouto Peninsula study area. B—General location of sites. C—Map showing the 'Causeway' sites (1–5) in greater detail. Vegetation plots were established at each of these sites. Transects 1 and 2 are also shown, along with the locations of their associated water level recorders. Note, S = start of transect, E = end of transect.

Hawkins Lagoon and Whitiau Scientific Reserve (see section 4.3) have some of the best remaining examples of dune ephemeral wetlands in the Wanganui Conservancy. Hawkins Lagoon contains a complex of vegetation types. The following description is from Ogle (2002) with vegetation classification based on Atkinson 1985 (see hyperlink in the reference section) (alien species are denoted by an asterisk):

- Foredunes were dominated by spinifex – *marram (*Ammophila arenaria*) – (pingao) grassland.
- Hind dunes were dominated by (dead *tree lupin (*Lupinus arboreus*))/*marram – *tall fescue (*Schedonorus phoenix*) – *cocksfoot (*Dactylis glomerata*) grassland. Other pasture grasses were present, along with occasional shrubs including tauhinu, *boxthorn (*Lycium ferocissimum*), *gorse (*Ulex europaeus*) and *evening primrose (*Oenothera stricta*).

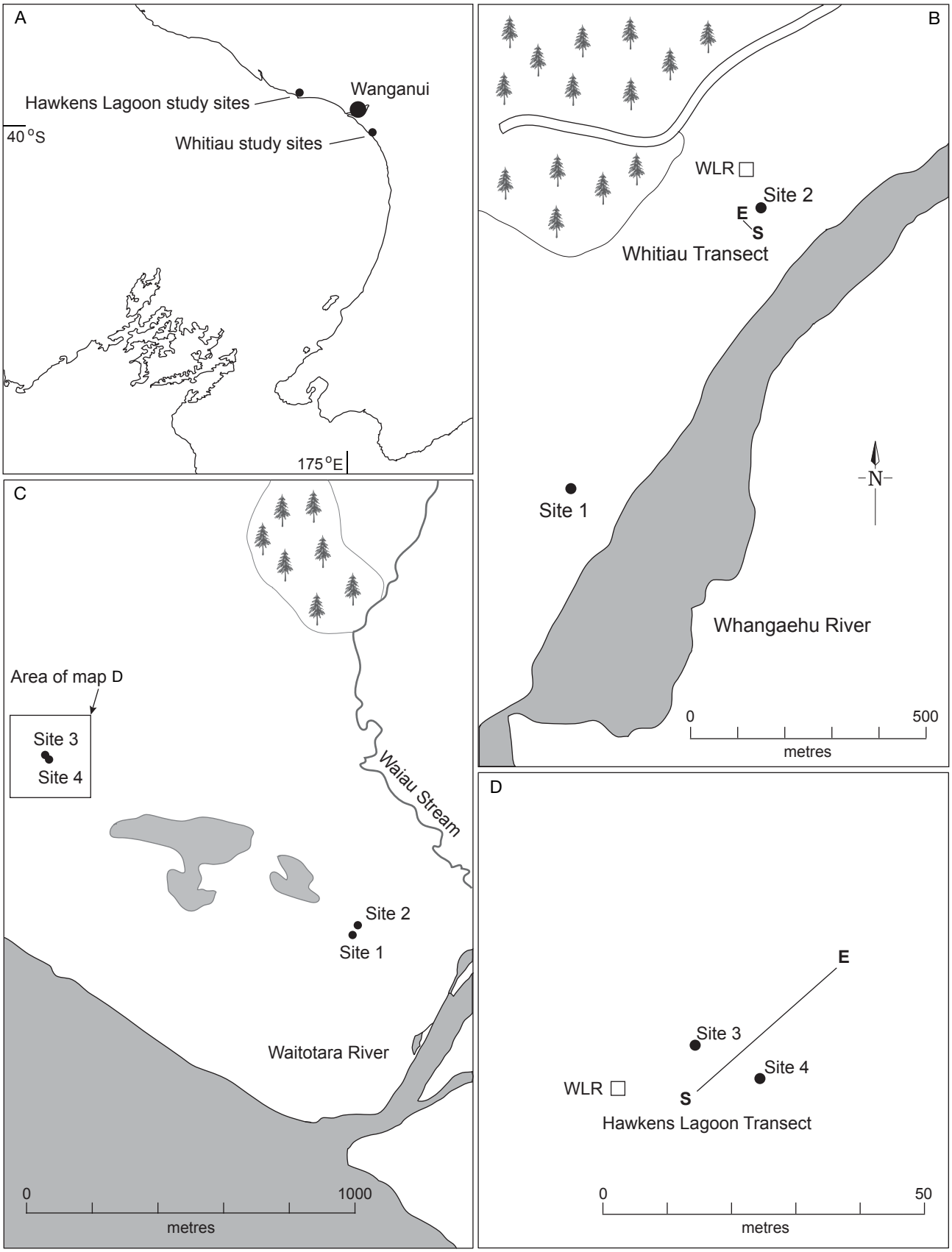

Figure 3. A—Map showing Hawkens Lagoon and Whitiau study sites. B—Whitiau; C—Hawkens Lagoon. D— Sites 3 & 4 and Transect at Hawkens Lagoon in more detail. Note, S = start of transect, E = end of transect.

- Dune flats, where the dune ephemeral wetlands occurred, had several vegetation types, including:
  - (Club sedge)/*ripgut brome (*Bromus diandrus*) grassland with occasional toetoe (*Cortaderia toetoe*), *pampas, sand willowherb (*Epilobium billardiereanum*), sand carex and three-square (*Schoenoplectus pungens*).
  - *Gunnera dentata* – *Myriophyllum votschii* – *Schoenus nitens* herbfield with *creeping bent (*Agrostis stolonifera*), *Triglochin striatum*, *Potentilla anserinoides*, *hawkbit (*Leontodon taraxacoides*), *Lilaeopsis novae-zelandiae, Isolepis cernua*, and *Eleocharis neozelandica*.
  - Water milfoil (*Myriophyllum propinquum*) – *Lilaeopsis* herbfield on pond margins.
  - Other shrub- and alien grass-dominated communities.

In August 2002, a population of the critically endangered *Sebaea ovata* was discovered on the dune flats at Hawkins Lagoon (Ogle 2002). Other threatened species present in this area include half-star (*Selliera rotundifolia*) and *Eleocharis neozelandica* (both classified as chronically threatened 'Gradual Decline').

4.3 WHITIAU SCIENTIFIC RESERVE

Whitiau Scientific Reserve is located south of Wanganui near the mouth of the Whangaehu River (Fig. 3). It is mostly (80%) fenced; however, domestic livestock and other animals (including rabbits and possums) are perceived to be a problem in the area because of their grazing and trampling impacts. Off-road vehicles also have access to the reserve, and cause damage to the dune system. Surrounding land is mostly used for forestry and stock grazing.

The reserve contains a complex of vegetation types, described as follows by Ogle (1997) (alien species are denoted by an asterisk):

- Foredunes were dominated by spinifex – *marram – (pingao) grassland with occasional sand daphne (*Pimelea arenaria*), sand convolvulus (*Calystegia soldanella*) and sand coprosma (*Coprosma acerosa*).
- Hind dunes are dominated by *tree lupin/*marram shrub-grassland with occasional *pampas, sand coprosma and tauhinu.
- The dune ephemeral wetlands occur on the dune flats. Several vegetation types have been described in the dune flats:
  - Oioi (club sedge)/*ripgut brome rushland with occasional cabbage tree (*Cordyline australis*), toetoe, *pampas, *boxthorn and patches of sand iris (*Libertia peregrinans*) and sand willowherb.
  - Halfstar (*Selliera rotundifolia*) – *Gunnera dentata* – *Schoenus nitens* herbfield with *Yorkshire fog (*Holcus lanatus*), *hawkbit and *Sebaea ovata*.
  - Oioi – sea rush (*Juncus kraussii* subsp. *australiensis*) or three-square rushland with mat-forming halophytes (e.g. *Samolus repens*, *Selliera radicans* and *Sarcocornia quinquenervia*).
  - Other shrub- and alien grass-dominated communities.

In 1989, *Sebaea ovata* was discovered at this site. At this time, it had not been reported in New Zealand for 17 years (Ogle 1991). Other threatened species that occur in the ephemeral wetlands at Whitiau include the chronically threatened *Isolepis basilaris, Mazus novaezelandiae* var. *impolitus* (both Serious Decline), *Selliera rotundifolia* and *Libertia peregrinans* (both Gradual Decline).

Ogle (1991) reported large areas of shallow standing water overlying much of the low, flat surfaces within the dunes for the six months between July and December, with the area surface-dry for the remaining six months. However, the prevalence of wetland plants at this site indicated that the water table remained high year-round.

Champion et al. (2003) studied the dynamics and ecology of *Sebaea ovata* at this location and Johnson & Rogers (2003) included the vegetation of the surrounding area in their report. Floristic records from both reports and Ogle (1997) are compared with plants recorded during this study in section 6.2.

5. Methods

5.1 DETERMINING SOIL FERTILITY AND PLANT TISSUE NUTRIENTS

5.1.1 Field sampling

Paired samples of vegetation (species composition/cover) and soil were collected during April and May 2002 from 12 sites in the three study areas: six amongst the sandplains on the Pouto Peninsula and six along the Wanganui Coast at Hawkens Lagoon and the Whitiau Scientific Reserve (see Figs 2 & 3). The sites had varying levels of weed invasion.

Vegetation composition and cover were described within two to four randomly placed quadrats (25 cm × 25 cm) at each site. Soil cores were taken from beneath a range of native and weed species using a volumetric soil corer (7 cm diameter × 10 cm deep) following the method described in Clarkson et al. (2003). Soil cores were sent to the Environmental Chemistry Laboratory (Landcare Research, Palmerston North) for analysis of total carbon (C), nitrogen (N) and phosphorus (P), acid-soluble P, % water and pH (methods in Blakemore et al. 1987).

In November 2002, belt transects (1 × 1 m quadrats laid end to end from start to finish of transect) for monitoring weed invasion were set up at, or adjacent to, 4 of the 12 study sites (Figs 2 & 3). Their locations and lengths are given in Table 1.

The fertility of the soils at each transect was determined from two to four soil samples taken at each transect site and analysed as described above. A further soil sample was taken at each site in December 2005 to determine whether there had been any change in soil fertility since 2002.

TABLE 1. LOCATIONS OF BELT TRANSECTS ESTABLISHED AT POUTO, HAWKENS LAGOON AND WHITIAU.

TRANSECT		NZMG COORDINATES		DISTANCE
		E	N	(m)
Pouto 1	Start	2602563	6540562	40
	Finish	2602526	6540579	
Pouto 2	Start	2602481	6539996	30
	Finish	2602458	6539996	
Hawkens	Start	2653240	6150399	30
	Finish	2653262	6150419	
Whitiau	Start	2689599	6128503	50
	Finish	2689563	6128539	

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