Use of personal digital assistants for data collection in field biology classes

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THE PROBLEM

context



-investigation of the composition of a plant community on a shingle bar in Devon

-part of year 2 undergraduate field biology unit

current situation

-with 6 groups of students this exercise generates a very large amount of data

-collation and processing of data from written recording sheets is very time consuming

-occupies most of the evening lab session that should be focussed on **evaluation** of analysed data

-so how to capture and process data rapidly?

THE SOLUTION?

-collect data directly into Personal Digital Assistants (PDAs)
-in the field transfer data by Bluetooth to laptop
-extract data into a form utilisable by bespoke analysis software

July 2006

- done along with paper recording methods used in previous years

How is the data collected?

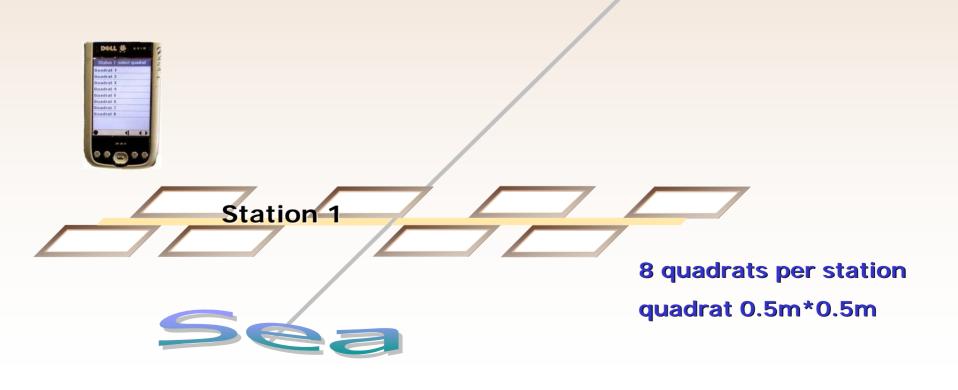
Belt transect

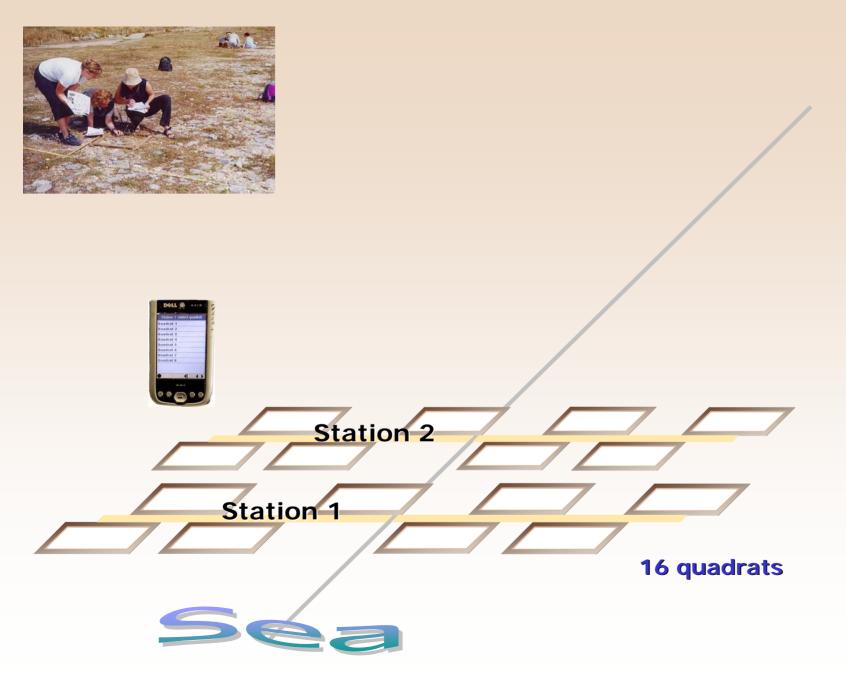


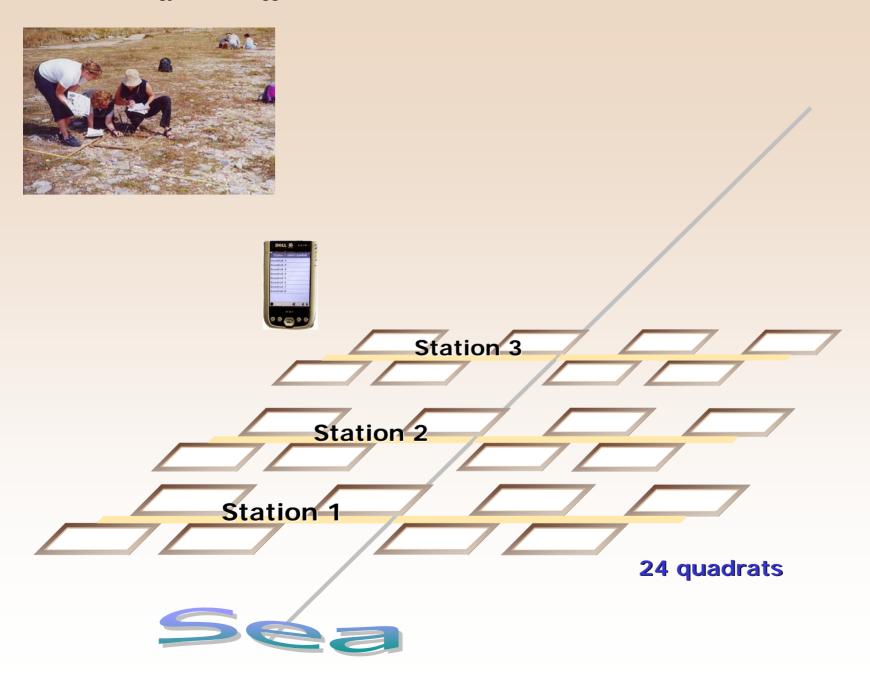
Stations 4 to 10 Stations 1 to 4 = 8 *10 quadrats/group – 6 groups =480 data points more than 60 species



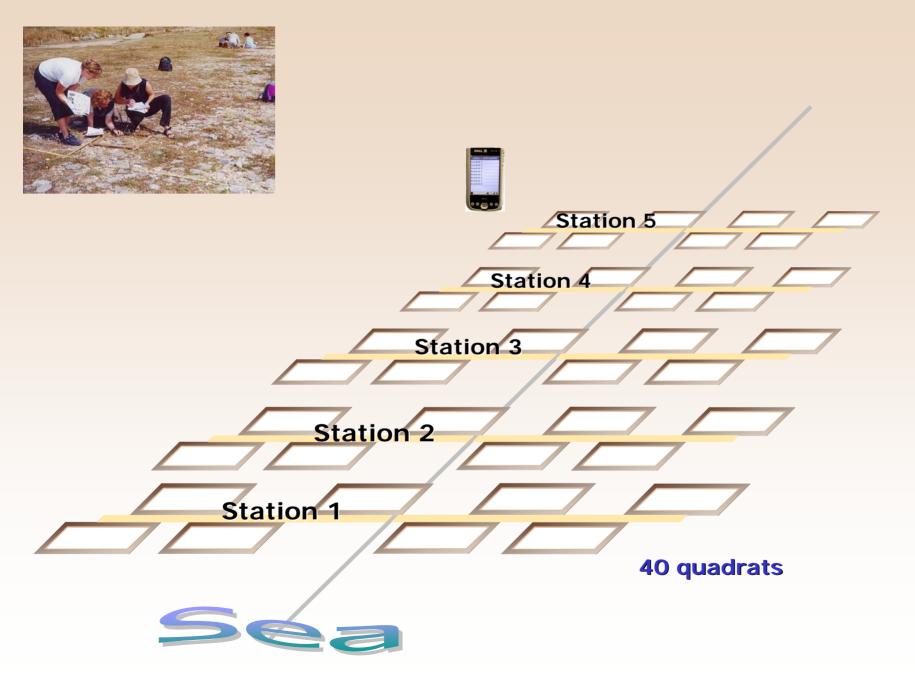
for each group

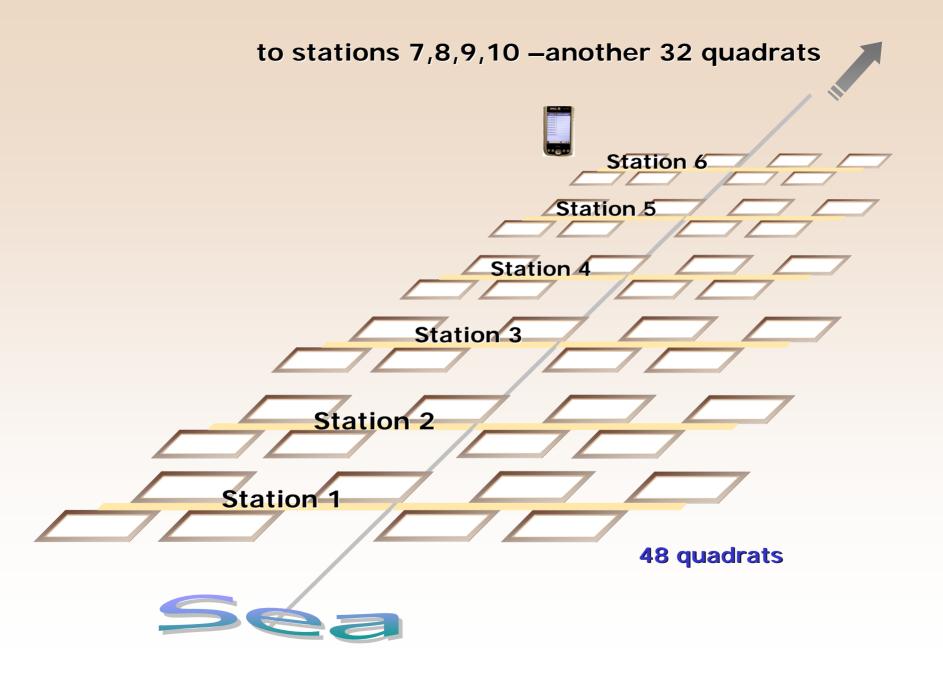












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paper recording



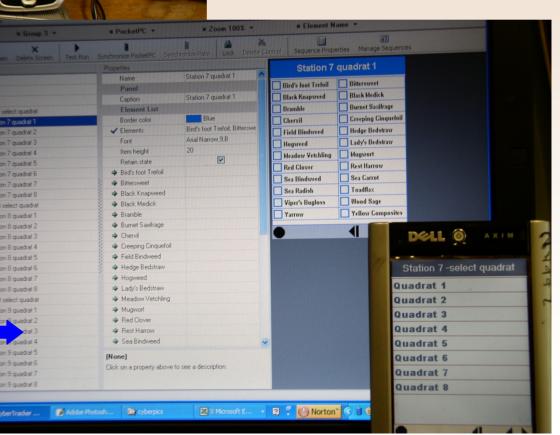
Toshiba Portege with Dell Axim x51 PDAs. Data transfer by Bluetooth.

Portege R200 only 1.3 kg and Axim battery life >6 hours of field work.

data collected in MSAccess database Cybertracker v3 forms

http://www.cybertracker.co.za/

- integrated GPS



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1	4 Sea Spurge	Euphorbia paralias	P									Ő	i.	i.	i i	i	
	5 Sea Mayweed	Tripleurospermium spp.	P									Ő	1	1	1	1	
	6 Yellow Composites	Hypochoeris/Leodon	H									Ő	1	1	1	1	
	7 Bird's foot Trefoil	Lotus corniculata	H									Ő	1	1	1	1	
	8 Rest Harrow	Ononis repens	Н	1	1	1	1		1	1	1	7	2	2	2	2	
	9 Ribwort Plantain	Plantago lanceolata	н		1	1	1	1	1	1	1	7	1	2	2	2	
	10 Curled Dock	Rumex crispus	Н									0	1	1	1	1	
	11 Buck's horn Plantain	Plantago coronopus	н	1		1						2	2	1	2	1	
	12 Ragwort	Senecio jacobaea	Н									0	1	1	1	1	
	13 Dandelion	Taraxacum officinale	н									0	1	1	1	1	
	14 Red Clover	Trifolium pratense	н			1				1		1	1	1	1	1	
	15 Orache	Atriplex hastata	MS									0	1	1	1	1	
	16 Thrift	Armeria maritima	MS	1	1	1	1	1	1	1	1	8	2	2	2	2	
	17 Sea Beet	Beta vulgaris	MS									0	1	1	1	1	
	18 Sea Bindweed	Calystegia soldanella	MS									0	1	1	1	1	
	19 Sea Carrot	Daucus carota	MS		1	1	1	1	1		1	6	1	2	2	2	
	20 Viper's Bugloss	Echium vulgare	MS									0	1	1	1	1	
	21 Red Fescue	Festuca rubra	MS				1		1	1		3	1	1	1	2	
	22 Sea Plantain	Plantago maritima	MS		1	1		1				2	1	2	1	1	
	23 Sea Radish	Raphanus maritimus	MS									0	1	1	1	1	
	24 Sea Campion	Silene maritima	MS	1	1	1		1		1	1	6	2	2	2	1	
	2 Rock Samphire	Crithmum maritimum	P									1					
	3 Sand Couch Grass	Elymus farctus	P					-	_	-			0	0	0	0	
	4 Sea Spurge	Euphorbia paralias	P							_			0	0	0	0	
	5 Sea Mayweed	Tripleurospermium spp.	P										0	0	0	0	
	6 Yellow Composites	Hypochoeris/Leodon	Н							-			0	0	0	0	
	7 Bird's foot Trefoil	Lotus corniculata	н		-						-		0	0	0	0	
	8 Rest Harrow	Ononis repens	H					-					1	1	1	1	
	9 Ribwort Plantain 10 Could Death	Plantago lanceolata	H					-					U	1	1	1	
	10 Curled Dock	Rumex crispus	H										U	0	0	0	
-	11 Buck's horn Plantain	Plantago coronopus	H					4	-				1	0	1	0	
	12 Ragwort 13 Dandelion	Senecio jacobaea Taraxacum officinale	H			7		-	-		, ,		0	0	0	0	
-	13 Dangelion 14 Red Clover	Trifolium pratense	H			· ·			-	-	· · ·		0	0	0	0	
	15 Orache	Atriplex hastata	MS					-	-		-		0	0	0	0	
	16 Thrift	Atripiex nastata Armeria maritima	MS										0	0	0		
	17 Sea Beet	Beta vulgaris	MS										0		1	0	
	18 Sea Bindweed	Calustegia soldanella	MS										0	0	0	0	
4	► ► K / station3group2	/ station3group3)		roun4	statio	n4group1	/ stat	tion4grou	in2 / c	tation40	iouna /	station4q	roun4 /	l∎ °	0		
	MA stationogroupz	V stationisgroups V	seacional	group /	(stado	rigioupi	V stat	asingiou	PE A 3	Gaconnyi	Cabo V	seconny	Jubi /				

Incidence of inaccuracies

	S	Statio	าร 234	4		S	Statio	ns 78	9
Group Number	1	2	3	4		1	2	3	4
Number of duplicate quadrats	0	1	1	0		0	0	0	0
Number of corrected quadrats	0	0	7	0		0	0	0	1
					- 1				
Number of observations on pda but not on form	2	0	1	5		9	7		1
Number of observations on form but not on PDA	3	0	0	9		1	3	1	3
Number of presences	147	188	170	159		100	94	113	118
errors as % of presences ^a	3.4	0	5.9	8.8		10.0	10.6	0.9	3.3
Total number of potential records	384	384	384	408		408	384	312	408
errors as % of total	1.3	0	0.3	3.4		2.4	2.6	0.3	1.0

a – both types of error/total presences*100

									ig sheet 2006														
December of est 2000								GROUP	NAMES				SHI	NGLE	RID	GE S	STA	TION	1 NU	MBE	ER		
Recording sheet 2006		0.2400	SHING		INGE	STATI		Quadrat N	lumber				1	2	3	4	5		6	7	8	Т	otal
Guadrat Number		T		3				Bare grou	nd (%)										_				
Bare ground (%)	Crambe mari tma	_		=				Sea Kale		Crambe man	itima	Р	1										
Se a Kale Rock Samp Lire	Crithmum maritmum	P	+	-	+	_		Rock Sam	phire	Crithmum m	aritimum	Р						7					
Sandcouch grass	Elymus farctus	P						Sand coud	h grass	Elymus farct	us	P											
Sea Spurge	Euphorbla parallas Glaucum flavum	P				2		Sea Spurg	le	Euphorbia pa	aralias	Р								í		-	
Yellow Horned Poppy Sea Mayweed	Tripleurospermium sp.	P	+	-	+	-			rned Poppy	Glaucum flav	um	Р									-		
Yarrow	Achillea millefolla	Н						Sea Mayw		Tripleurospe	rmium sp.	P									-		
Haberd-leaved oracite	Atiplex hastata Atiplex patula	Н		- 5			- H	Yarrow		Achillea mille		H									+		
Commo NO racke Mouse eared chickweed	Ceras tum sp.	H	\vdash	+	+	<u> </u>			a∨ed orache	Atriplex hast		H									-		
Hogweed	Heracleum spondylum	H					- H	Common (Atriplex patu		H						-+			+		
Yellow composites Birds foot Trefoll	Hypochoeris/Leodon Lotus corniculata	н			-	- 2											-			i	+		
Rest Harrow	On onl's repens	Н			+		-		ed chickweed	Cerastium s		H				4	+			<u> </u>	+	_	
Ribwort Plantain	Plantago lanceolata	Н						Hogweed		Heracleum s		H								<u> </u>			
Curled Dock	Rume×crispus Senecio (acobaea	Н		- 5		2	-	Yellow cor		Hypochoeris		н	1							<u> </u>			
Ragwort Dandelion	Taraxacum officinale	H		+	+			Birds foot		Lotus cornice		н				_							
Hop Tre foll	Tritollum campeste	н			-	2		Rest Harro		Ononis repe	75	н											
Red Clover	Trifollum pratense Armenia maritma	H		-				Ribwort PI	antain	Plantago lan	ceolata	н											
Tirfft Frosted Oraclie	Armena mantina Atiplexsabulosa	M S M S	\vdash	+	+			Curled Do	ck	Rumex crisp	us	н											
Sea Beet	Beta wilgaris	MS				2		Ragwort		Senecio jaco	baea	н				-	-				+		
Se a Bli dweed	Calystegla soldanella Daucus carota	MS	+	_	_			Dandelion	0	Taraxacum c		н	1			1	-				1	-	
Sea Carrot Vipers Bigloss	Echlum vulgare	M S M S	++	+			- H	Hop Trefo		-		1	1	1		+					+		
Red Fescie	Festuca rubra	MS			-			Red Clove	(C)	sheet 2005 - SI	HINGLE RIDGI	EVEGE	ETATIO	N : ente	er no. (ofqua	drats	record	led at	each s	station	forea	ach spe
Se a Plantalı	Plantago maxitma	MS		\square				Thrift	STATION	IUMBER -				T	1	2	3	4	5	6	7	8	9
Se a Riadis I Se a Ciampio I	Raphanus manitmus Silene maritma	M S M S	+	+	-	_	-	Frosted O	; Bare ground	d (%)							1						
Other grasses				-	-		- H		Sea Kale		Crambe mar.	itima		P						0	1		<u>(</u>
Kidney Vetch	An theris vuineraria	MC		\mp	-			Sea Beet	- Rock Samp	hire	Crithmum ma	aritimur	n	P		10			-				6
Mugwort Hairy Bitter cress	Artemisia vulgaris Cardamine hirsu ta	MC	++	+		-		Sea Bindv		i grass	Elvmus farctu	IS		P		19							
Black Kirapweed	Cen tauria ni gra	MC			-		L	Sea Carro	Sea Spurge	1	Euphorbia pa	aralias		P	2	18			-				
Chervil	Chaerophyllum 50.	MC						Vipers Bug			Glaucum flav			P	3	1			1				
Field bindweed Foxglove	Convulvulus arvensis Digitalis purpurea	MC	\vdash	_	+	_		Red Fescu		ed	Tripleurospe		SØ.	P	2	17	1		5	1			
Common Stork's bill	Eredum, cicutarium.	MC		+	+	-		$\gamma \gamma$	Yarrow		Achillea mille			н	-	3	28	32	21	12	5	5	1
Eyebright	Euphrasla nemorosa	MC			1	8	1	1	Halberd-lea		Atriplex hasta			н	-				-		_	1	
Hedge Bedstraw	Gallum mollugo Gallum verum	MC		_		2	1		Common O		Atriplex patur			H	-	-	-	-	1	-	-	<u> </u>	
Lady's bedstraw DovestootCratesbill	Geranium molle	MC				-	-			d chickweed	Cerastium sc			H	-	<u> </u>	<u> </u>	-		0	4.4	10	10
Herb Robert	G <mark>eranlu</mark> m robertanum	MC			1	- S	1	1	Hogweed		Heracleum s			H	-	10	7	1.1	1	3	14	19	19
Meadow Vetobling Toadflax	La tiyrus pratensis Linaria vulgaris	MC		_		2			Yellow com Birds foot T		Hvpochoeris		1	H	-	16	7	14	25 8	23	10 19	4	4
Burnet Saxifrage	Pimpinella saxiraga	MC				-	-		Rest Harrow		Lotus cornicu	6 C C C C C C C C C C C C C C C C C C C		H	-	23	6	24		4	8	16	4
Creeping Cinqueroli	Potentilla reptans	MC			1		1		Ribwort Pla		Ononis reper Plantago lan		:	H	-	16	28	30		3	0	6	0
Sorrel Bitters we et	Rumexacetsa Solanum dulcamara	MC			_			<u> </u>	Curled Doc		Rumex crisp			H	-	+ 10	20	100	20	1			
Lesser Trefoll	Trifolium dublum	MC			+				Buck's-horr		Plantago con			H	-	1	-	f	-	<u>12 A2</u>			2
White clover	Trifollum repens	MC				1			Dandelion	plantant	Taraxacum c			H	-	1	<u> </u>	\vdash	1	-	-	-	
Turte diveto i Holov Tore	Vicia cracca Vicia hirsuta	MC		_	_	2			Hop Trefoil		Trifolium can			Ĥ	1	1			7	1	1		Ĩ
Hairy Tare Common Vetch	Vicia ini sula Vicia sa tva	MC	<u>├</u> ─┼─	+	+	-	-		Red Clover		Trifolium prai			H		1	5	16	26	3	2	4	
Old Man's beard	Clema is <u>sp</u>	\$C							Thrift		Armeria mari			MS	-	20	26	27	23	8			8
Goosegrass	Gallum a parine Hedera helix	SC		_	_	2			Frosted Ora	ache	Atriplex sabu			MS					1		3		
lov Honeys tokle	Lonicera sp.	5																	4	3			1
Blacktion	Prunusspinosa	\$			•				12.00							4	4	3	1		4		
Bramble	Rubus fru tcosus	S	– (12				an	i time	<u>ο</u> ΤΟ Ε		at	e			23	30	29	24	24	21	27	10
Elder Woodsage	Sambucus nigra Teucreum scorodonia	S		20									U			1		7	4	6	1		1
Gorse	Ulexsp.	S				12									-	15	27	32	27	15	15	19	8
Nettle	Unica dolca	S	an	ICI.	C	21	C	221	the o	nan		n			_	5	2	1	<u> </u>		1		
P – plo ne er i ; MB – marit	tim e «peclalist»; H – hardy	gen					U								-	+	1	1	6	8	13	10	16
															-	21	22	24	21	0.0	3	-	0.0
			n	ar	NT	C	N	mm	unity	STri	CTUC	0		_	-	+	<u> </u>	12	18	30	31	28	32
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			Pit				9 1		<u> </u>	<u> </u>		•••		H	-		<u> </u>	-			-	-	0
			Pr						Hairy Bitter		Cardamine h	99110		MC	-								8

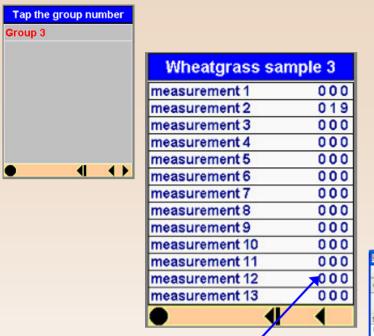
Outcome - technology increased student time for learning



another outcome - more beach time

Thanks to the HEFCE e-learning funding via e-LAG. Students and teaching staff of the Field Biology unit.

No handouts just a link http://193.61.20.125/cyber/bienvenue.html



individual lengths
 (mm) recorded in PDAs
 Cybertracker forms

 transfer to Excel, compute means and standard deviations, plot graph

PDA/Cybertracker training exercise

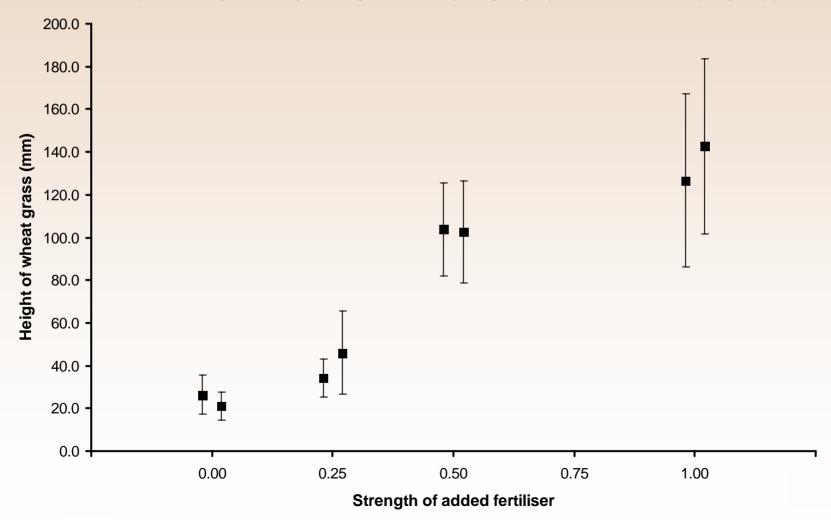


Wheatgrass grown to 4 different heights – plants sampled and length measured.

Sequences 🔻	Sequence 3	3 🕶	PocketPC •	= Zoom 100% 🔻	= Element Name 🔻
New Screen New Subscreen	× Delete Screen	Test Run	Synchronize PocketPC Synch	hronize Palm Lock Delete C	
Screen			Properties		Wheatgrass sample 3
🖃 🔲 Wheatgrass measureme	nt Group 3		Name	sample 3	wheatgrass sample 5
🖃 🔲 Group 3			Panel		measurement 1 000
🔲 sample 3			Caption	Wheatgrass sample 3	measurement 2 000
			Element List		measurement 3 000
			Elements	measurement 1; measurem	measurement 4 000
			🌩 measurement 1		measurement 5 000
			measurement 2		measurement 6 000
			🌳 measurement 3		measurement 7 000
			🌩 measurement 4		measurement 8 000
			🌳 measurement 5		measurement 9 000
			🍦 measurement 6		measurement 10 000
			🍦 measurement 7		measurement 11 000
			🍦 measurement 8		
			🚽 measurement 9		
			🍦 measurement 10		measurement 13 000
			🍦 measurement 11		
			🍦 measurement 12		
			🍦 measurement 13		
			Navigator		
			Show GPS		Form
			Show Next		
			Show Options	V	
			Show Save 1	V	otructuro
			Show Save 2		structure
			Take GPS Reading		
			🌳 Save 1 Target	🔲 Group 3 🛛 🗸	
			(None) Click on a property above to	see a description.	

With 8 groups this plot produced in < 10 minutes

Figure. The effect of application of different strengths of fertiliser on the mean height (+/-SD) of wheat grass 7 days after germination (two groups per treatment, n=13 per group)





Objective

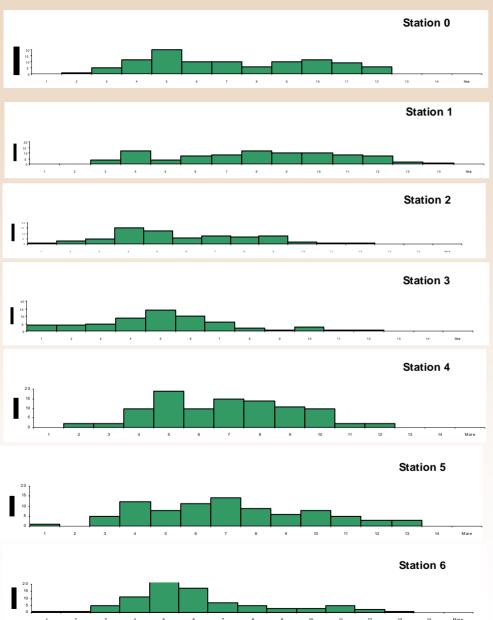
- to measure change in Gammarus length (mm) along a stream

- hypothesis possible link to water velocity
- use individual lengths recorded by 'wheatgrass' forms
- GPS to measure altitude



mm	no.	🔀 Microsoft Exce	el - gamr	narus																	PX
1		Eile Edit View					Contraction of the Contract of	A CONTRACT OF CONTRACT													_ 8 ×
2																					
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3	1	🙆 🖪 🖪												-							
4	1111	N15 -	1	=																	
5		A 1 Date	B 38924	C 38924	D 38924	E 38924	F 38924	G 38924	H 38924	1 38924	J 38924	K 38924	L 38924	M 38924	N 38924	0 38924	P 38924	Q 38924	R 38924	S 38924	T
U		2 Time	0.512523	0.513715			0.521424	0.56963		0.571863	0.63463	0.634641	0.636296	0.678819	0.678854		0.714907	0.714919	0.715139	0.745208	0.745
6	111	3 Sequence 1																			
7		4 Longitude					-3.656747	<u> </u>		-3.655545			-3.655655			-3.654405			-3.65297		
'		5 Latitude 6 Altitude					50.30413 109	2		50.30219 11.6			50.3008 74	-		50.30045 35.4			50.29988 37.6		
8	111111	7 Accuracy					3			1.8			1.8			2.7			1.1		
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40		10 Station 3 11 Station 4	2	2	ð	2	2		2		1	1	1	- 1	1	1					
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14	1	20 measurement 3 21 measurement 4		-		-		4		4	- 1	- 1	<u> </u>		10			4	4	2	
		22 measurement 5						9	9	9	3	3	3	17	17	17	6	6	6	5	
		23 measurement 6						5		5	3	3	3	9	9		8	8	8	7	
		24 measurement 7 25 measurement 8		<u>.</u>	<u>6</u>	<u> </u>		5		5	1	1	1	9	9		8	8	8	3	
		26 measurement 9	3	3	8 3	8 8	3 3	+ 5	5					6	6	-	5	5	5		
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		Ready																	ſ	ſ	

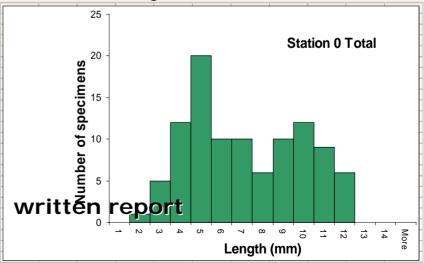
Gammarus lengths tallied; NOT recorded singly as for wheatgrass

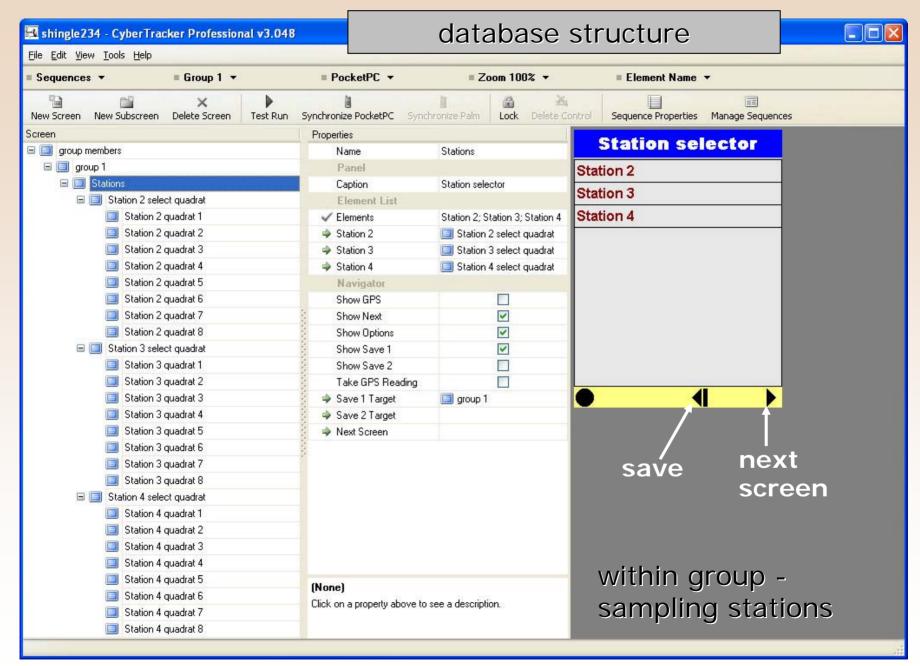


Length (mm)



Project outcomes





Sequences 🔻	= Group 1 💌	PocketPC +	= Zoom 100% 🔻	Element Name 🔻	
ew Screen New Subscr	reen Delete Screen Test Ru	In Synchronize PocketPC Sync	hronize Palm Lock Delete Co	ontrol Sequence Properties Manage Sequence	ces
een		Properties		Station 2 -select quadrat]
group members		Name	Station 2 select quadrat	Station 2 -select quadrat	
🖃 📃 group 1		Panel		Quadrat 1	
🖃 📃 Stations		Caption	Station 2 -select quadrat	Quadrat 2	
🖃 🔳 Station 2		Element List			-
	ion 2 quadrat 1	Elements	Quadrat 1; Quadrat 2; Quadral	Quadrat 3	
	ion 2 quadrat 2	🌳 Quadrat 1	Station 2 quadrat 1	Quadrat 4	
	ion 2 quadrat 3	🌩 Quadrat 2	Station 2 quadrat 2	Quadrat 5	-
	ion 2 quadrat 4	🌳 Quadrat 3	🔲 Station 2 quadrat 3		-
	ion 2 quadrat 5	🤿 Quadrat 4	Station 2 quadrat 4	Quadrat 6	
	ion 2 quadrat 6	🌳 Quadrat 5	🔲 Station 2 quadrat 5	Quadrat 7	
State Street	ion 2 quadrat 7	🍦 Quadrat 6	Station 2 quadrat 6		-
COLORADO DE LA COLORA	ion 2 quadrat 8	🍦 Quadrat 7	Station 2 quadrat 7	Quadrat 8	
🖃 🧾 Station 🤇		🌩 Quadrat 8	Station 2 quadrat 8		
	ion 3 quadrat 1	Navigator			
	ion 3 quadrat 2	Show GPS			1
	ion 3 quadrat 3	Show Next	\checkmark		
	ion 3 quadrat 4	Show Options	\checkmark		
	ion 3 quadrat 5	Show Save 1			
	ion 3 quadrat 6	Show Save 2			
🔲 Stat	ion 3 quadrat 7	Take GPS Reading			
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🖃 🧾 Station 4		🌩 Save 2 Target		within station-8	quadra
🔲 Stat	ion 4 quadrat 1	Ant Screen 🤿			
🔲 Stat	ion 4 quadrat 2				
	ion 4 quadrat 3				
🔲 Stat	ion 4 quadrat 4				
State State State	ion 4 quadrat 5	(None)			
🧾 Stat	ion 4 quadrat 6	Click on a property above to	see a description		
📃 Stat	ion 4 quadrat 7	click on a property above to	socia accomption.		
🔲 Stat	ion 4 quadrat 8				