DUGONGS AND GREEN TURTLES: GRAZERS IN THE TROPICAL SEAGRASS ECOSYSTEM

(APPENDICES)

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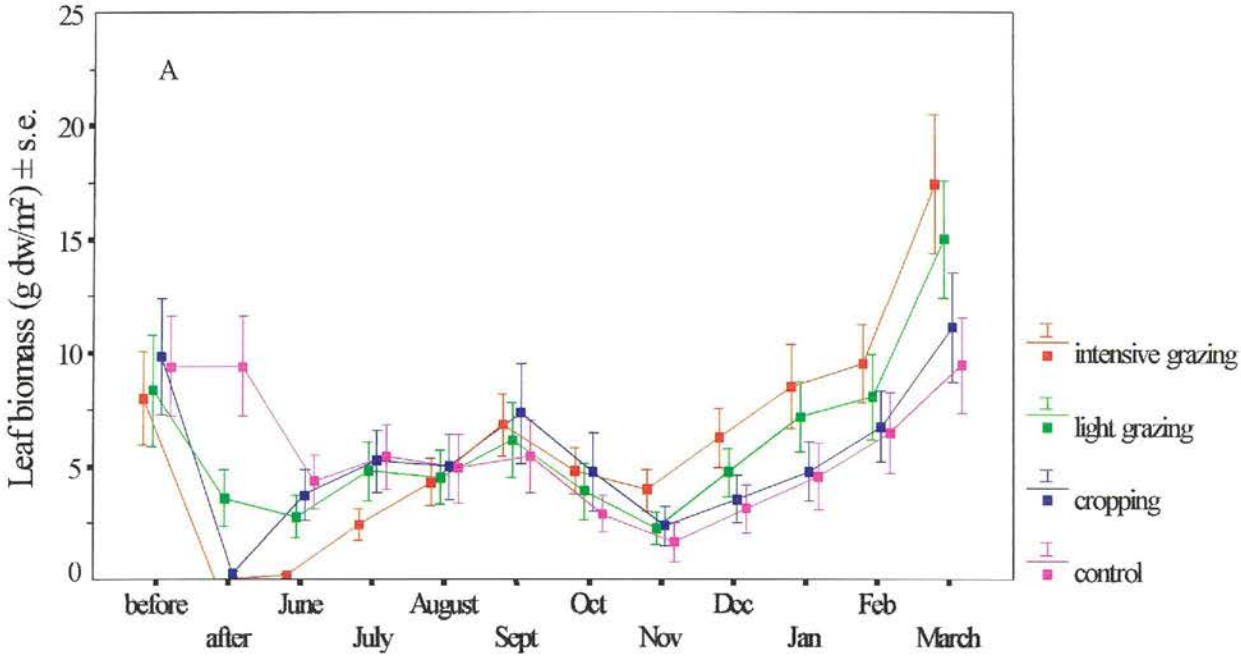
Appendix 1. A comparison of potential methods to investigate grazing by dugongs and cropping by green turtles on seagrasses.

	Advantage(s)	Disadvantage(s)
1) Simulated feeding *vs* actual		
simulated	time scale known exactly	not authentic
	repeatable	
natural	authentic	time scale unknown
		difficult to follow through time
2) Exclusion experiment *vs* 'open' experiment		
enclosure	prevents natural grazing	very expensive (to construct and maintain)
		limited replication possible
		confounding factors (e.g. fouling and shading)
		unacceptable in Marine Parks at levels of replication required
open	cheap	natural grazing may occur
	easy to replicate (more statistical power)	
3) Intertidal *vs* subtidal		
intertidal	easily accessible	time limited by duration of low tides
subtidal	environmental variables more uniform	poor visibility (i.e. turbid waters)
		difficult to access
		presence of sharks and crocodiles

Appendix 2. Other related plots of the response of the leaf biomass from the grazing experiments.

H. ovalis



Zostera/Cymodocea

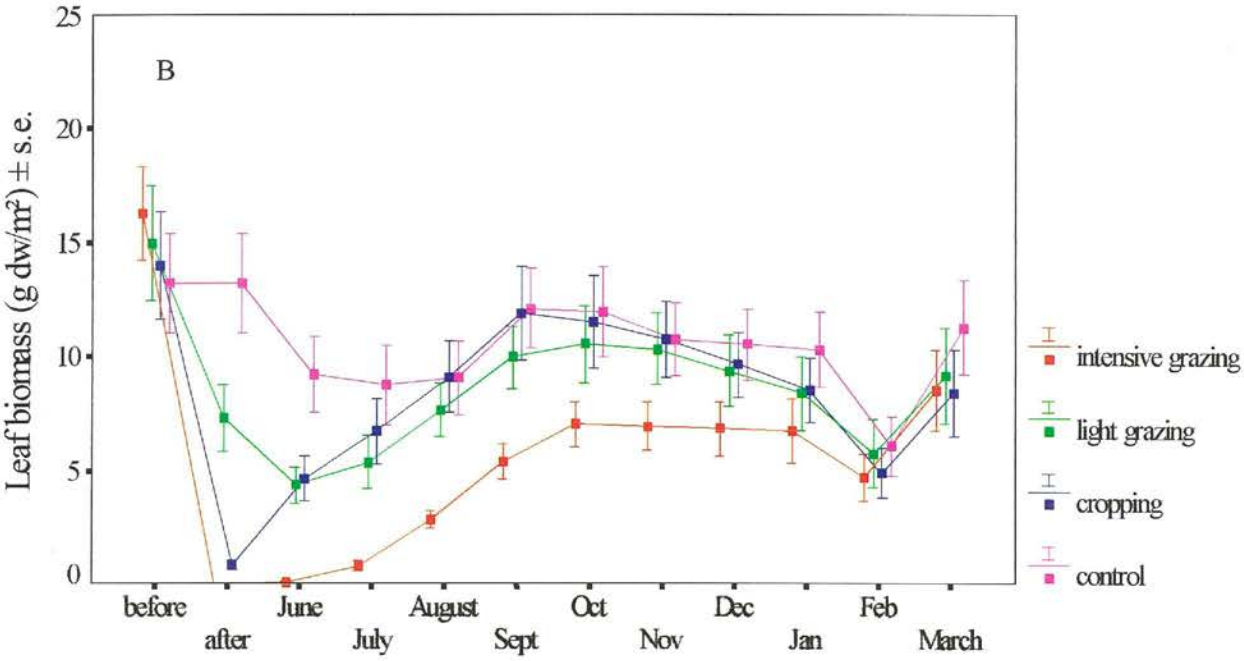


Figure 1a & b. The individual response of the leaf biomass (g dw/m^2) of (**a**) *Halophila ovalis* and (**b**) *Zostera/Cymodocea* to the different treatment levels (simulated intensive and light dugong grazing, turtle cropping and control) over time at Ellie Point; showing the means (n=4) with standard errors. Both the before and after simulation measurements were carried out on the same day in May 1993.

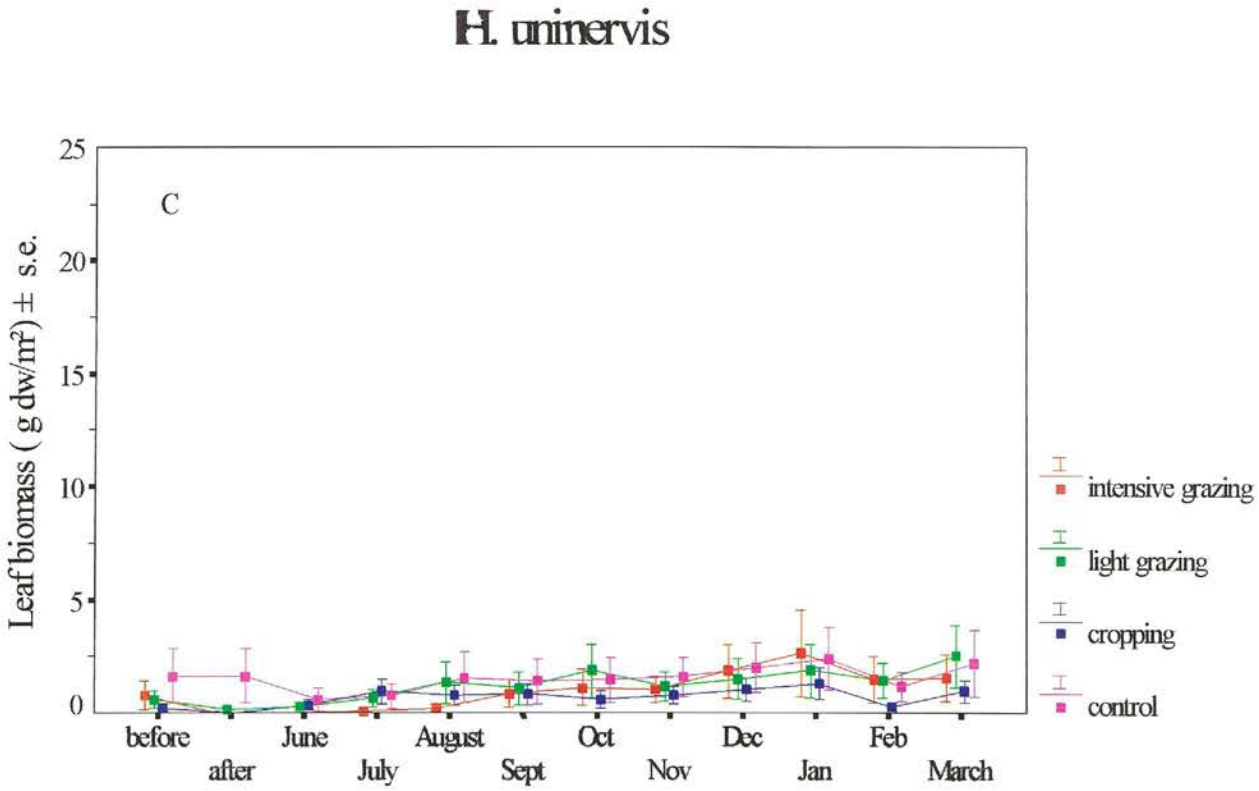


Figure 1c. The individual response of the leaf biomass (g dw/m^2) of *Halodule uninervis* to the different treatment levels (simulated intensive and light dugong grazing, turtle cropping and control) over time at Ellie Point; showing the means (n=4) with standard errors. Both the before and after simulation measurements were carried out on the same day in May 1993.

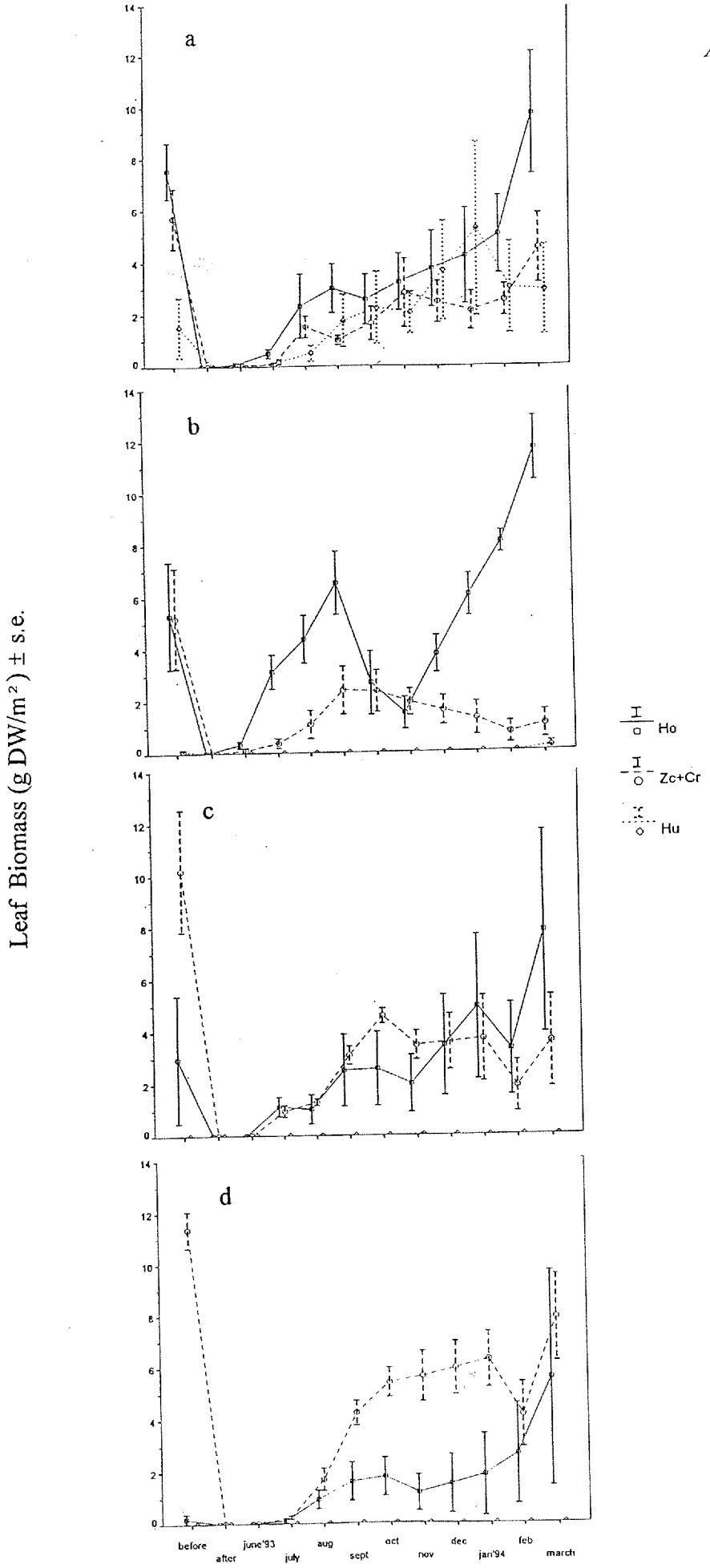
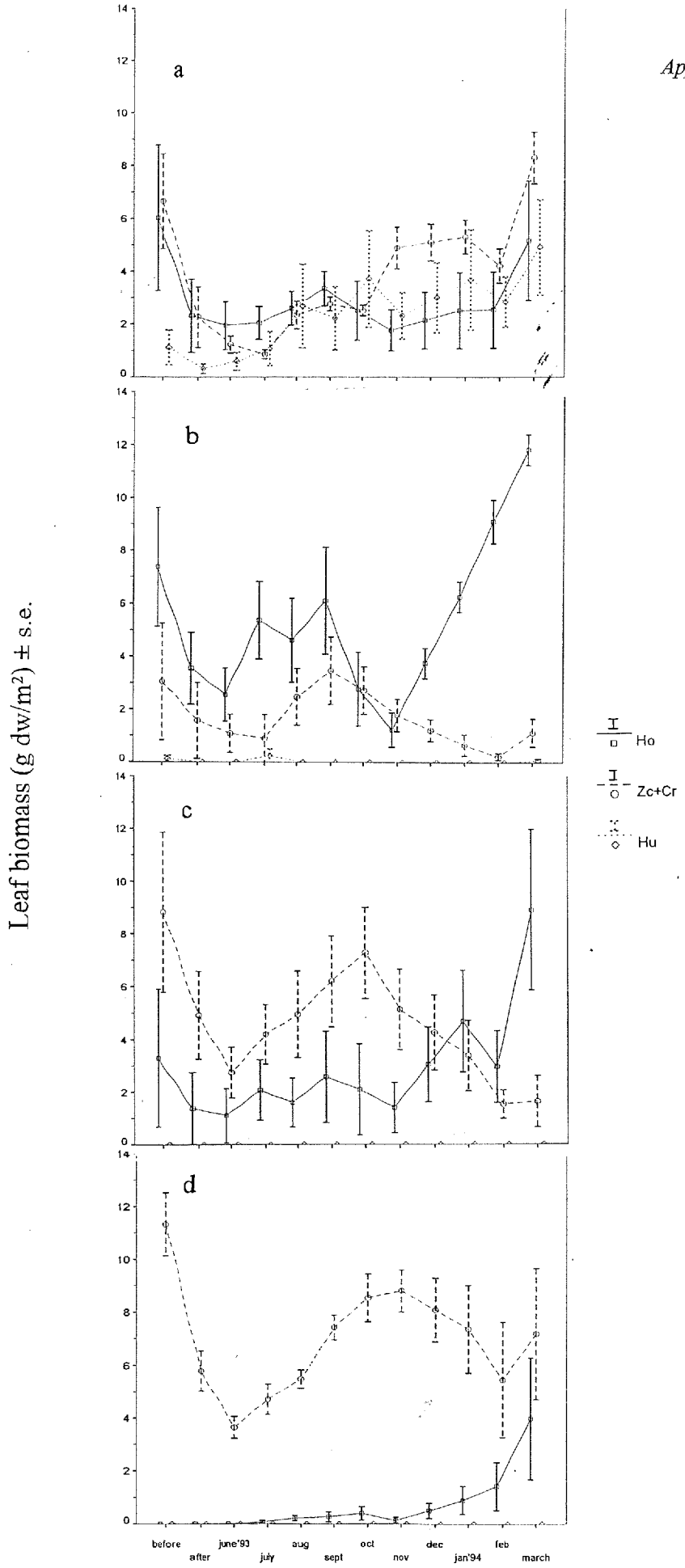


Figure 2. Plots of the response of the leaf biomass (g dw/m²) of the three seagrass species (Ho = *H. ovalis*, Zc+Cr = *Zostera/Cymodocea*, and Hu = *H. uninervis*) to simulated intensive dugong grazing over time at the four sites (**a** to **d**) at Ellie Point; showing the means (n=4) with standard errors. Sites were 25 to 35 m apart. Both the before and after simulation measurements were carried out on the same day in May 1993. Note: Measurement of the response at the site level is technically possible only if site is considered a fixed factor, however in the original assumption it was random. Therefore, these figures are approximations only.



'igure 3. Plots of the response of the leaf biomass (g dw/m²) of the three seagrass species (Ho = *H. ovalis*, Zc+Cr = *Zostera/Cymodocea*, and Hu = *H. uninervis*) to simulated light dugong grazing over time at the four sites (**a** to **d**) at Ellie Point; showing the means (n=4) with standard errors. Sites were 25 to 35 m apart. Both the before and after simulation measurements were carried out on the same day in May 1993. Note: Measurement of the response at the site level is technically possible only if site is considered a fixed factor, however in the original assumption it was random. Therefore, these figures are approximations only.

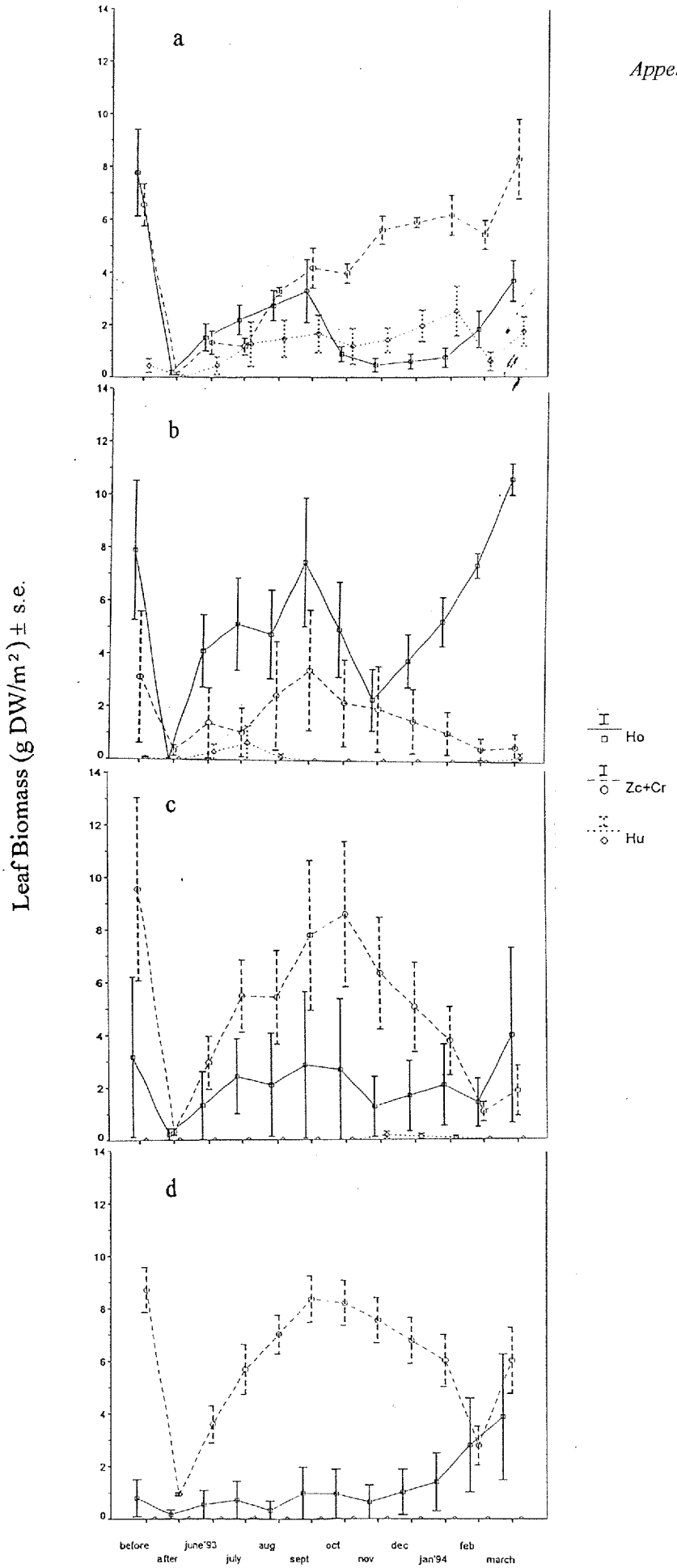


Figure 4. Plots of the response of the leaf biomass (g dw/m²) of the three seagrass species (Ho = *H. ovalis*, Zc+Cr = *Zostera/Cymodocea*, and Hu = *H. uninervis*) to simulated turtle cropping over time at the four sites (**a** to **d**) at Ellie Point; showing the means (n=4) with standard errors. Sites were 25 to 35 m apart. Both before and after simulation measurements were carried out on the same day in May 1993. Note: Measurement of the response at the site level is technically possible only if site is considered a fixed factor, however in the original assumption it was random. Therefore, these figures are approximations only.

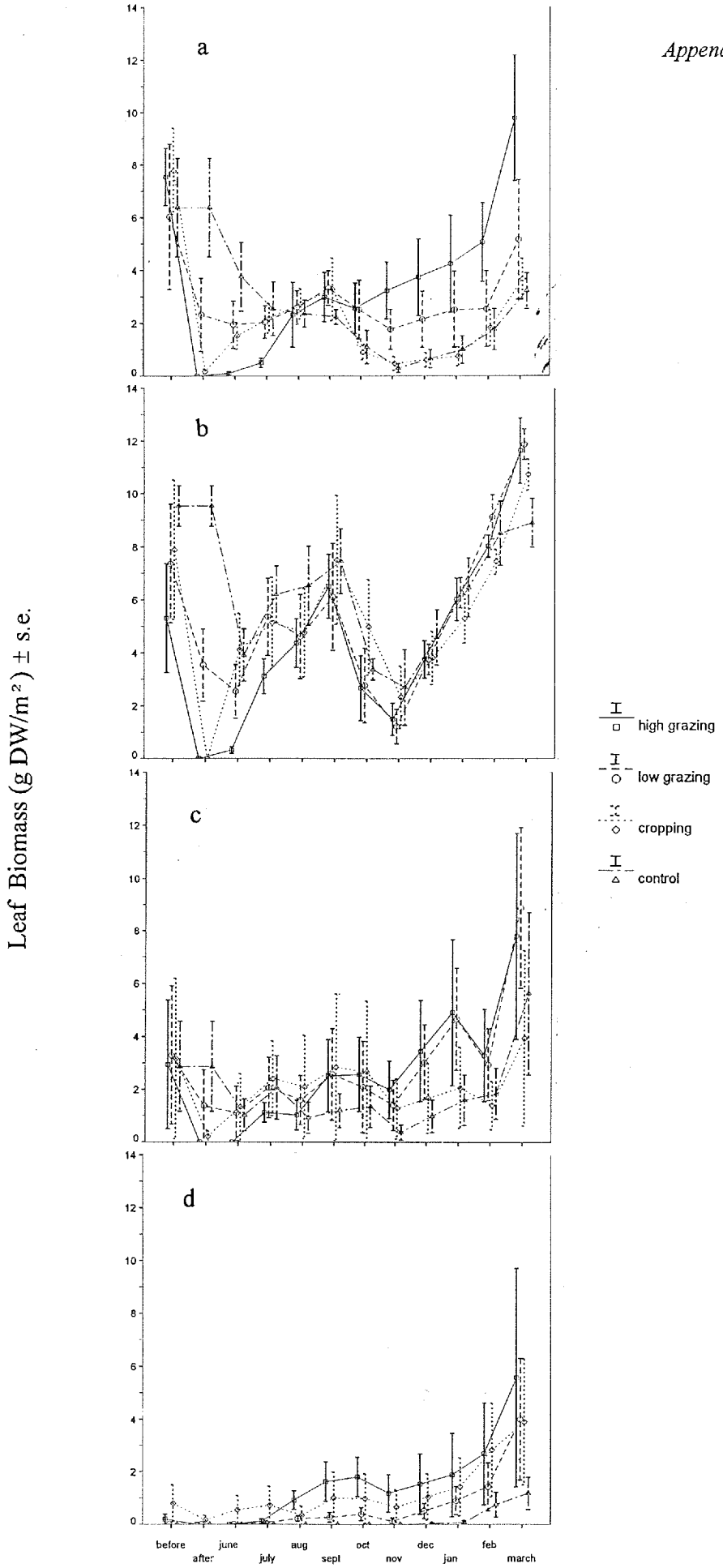


Figure 5. Plots of the response of the leaf biomass (g dw/m²) of *H. ovalis* to different treatment levels (simulated intensive and light dugong grazing, turtle cropping and control) over time at the four sites (**a** to **d**) at Ellie Point; showing the means (n=4) with standard errors. Sites were 25 to 35 m apart. Both before and after simulation measurements were carried out on the same day in May 1993. Note: Measurement of the response at the site level is technically possible only if site is considered a fixed factor, however in the original assumption it was random. Therefore, these figures are approximations only.

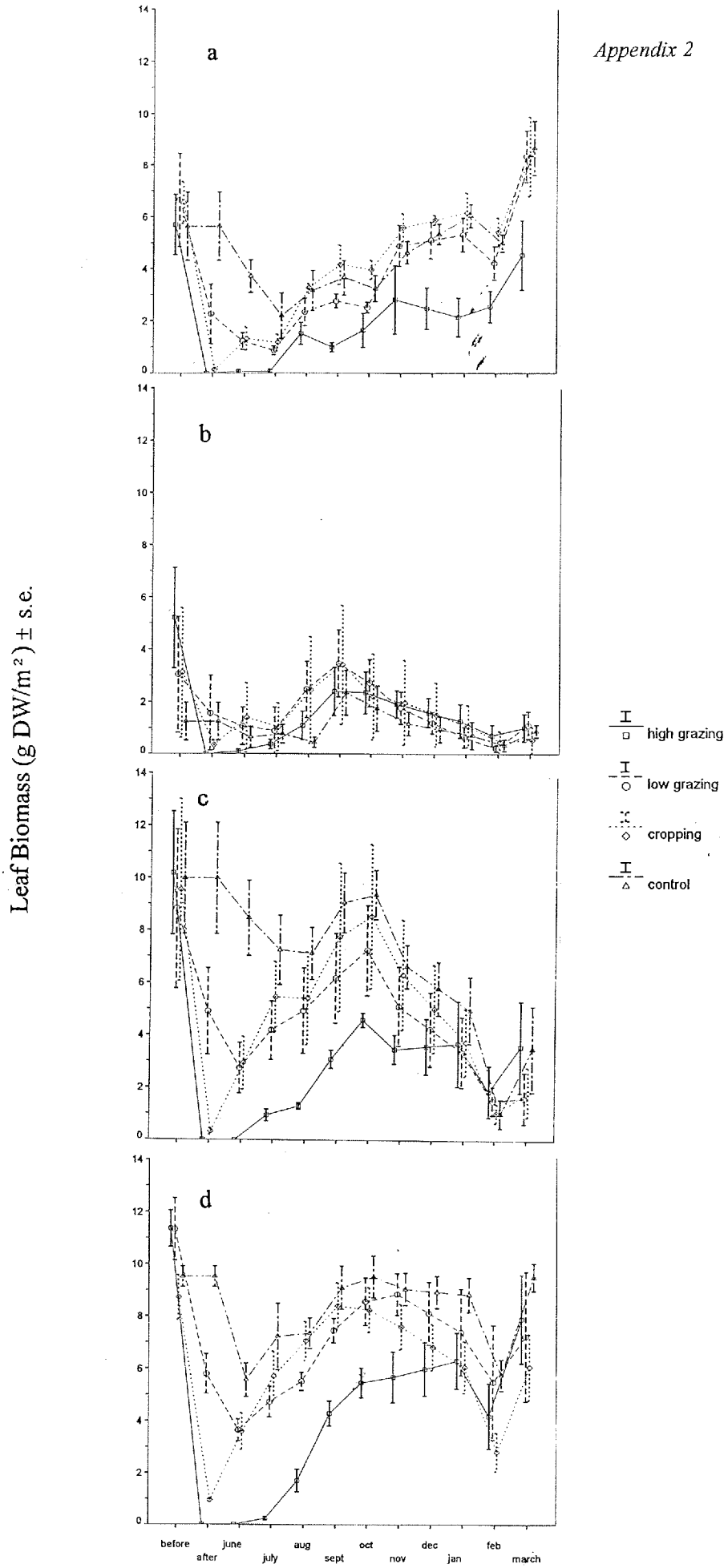


Figure 6. Plots of the response of the leaf biomass (g dw/m²) of *Zostera/Cymodocea* to different treatment levels (simulated high and low intensity dugong grazing, turtle cropping and control) over time arranged at the four sites (**a** to **d**) at Ellie Point; showing the means (n=4) with standard errors. Sites were 25 to 35 m apart. Both before and after simulation measurements were carried out on the same day in May 1993. Note: Measurement of the response at the site level is technically possible only if site is considered a fixed factor, however in the original assumption it was random. Therefore, these figures are approximations only.

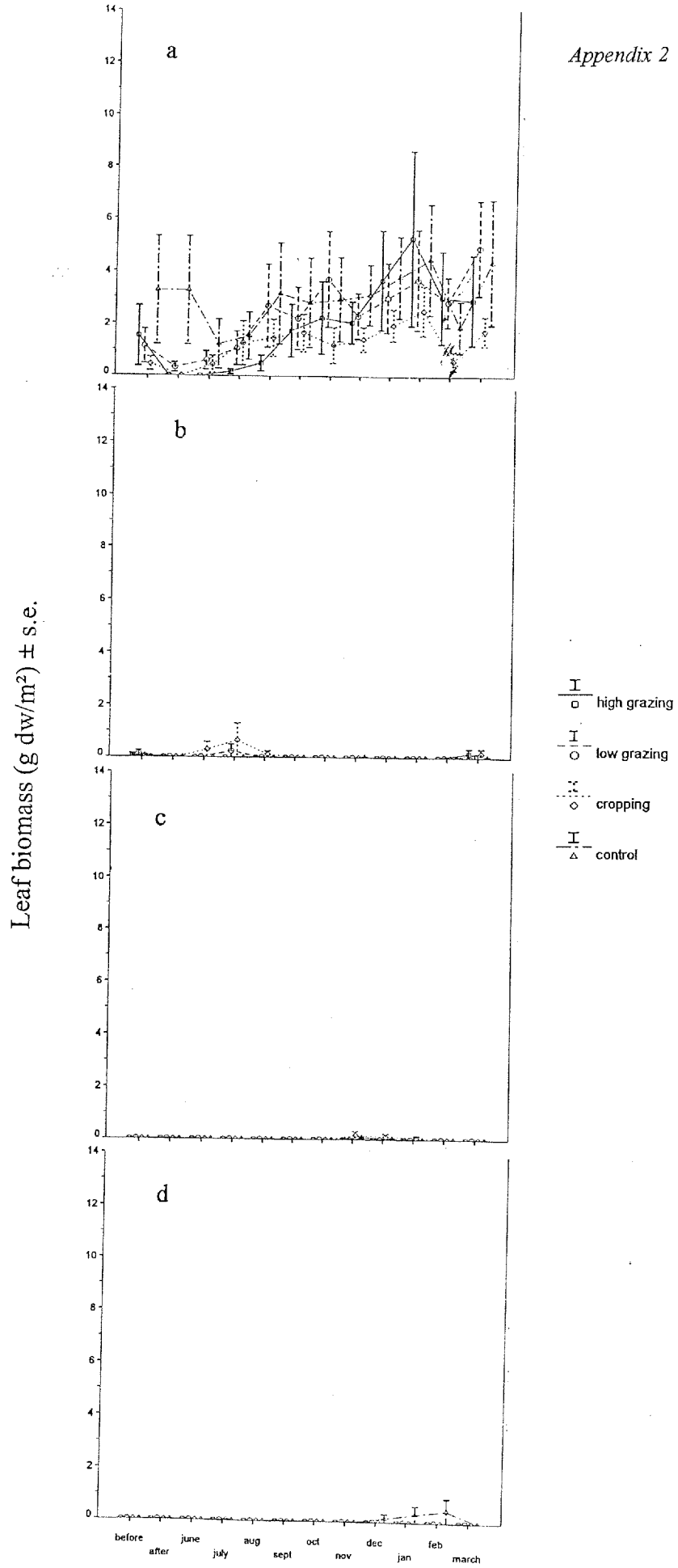


Figure 7. Plots of the response of the leaf biomass (g dw/m^2) of *H. uninervis* to different treatment levels (simulated high and low intensity dugong grazing, turtle cropping and control) over time at the four sites (**a** to **d**) at Ellie Point; showing the means (n=4) with standard errors. Sites were 25 to 35 m apart. Both before and after simulation measurements were carried out on the same day in May 1993. Note: Measurement of the response at the site level is technically possible only if site is considered a fixed factor, however in the original assumption it was random. Therefore, these figures are approximations only.

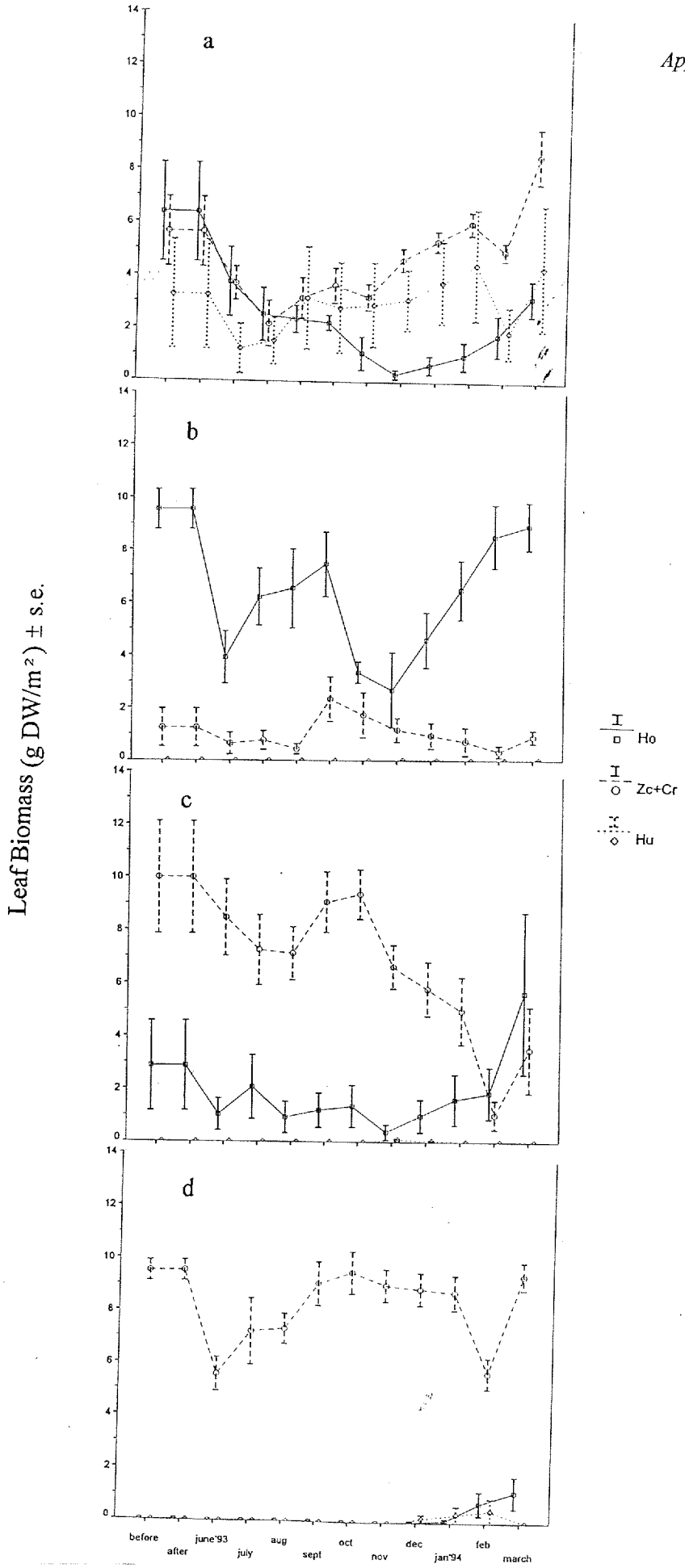
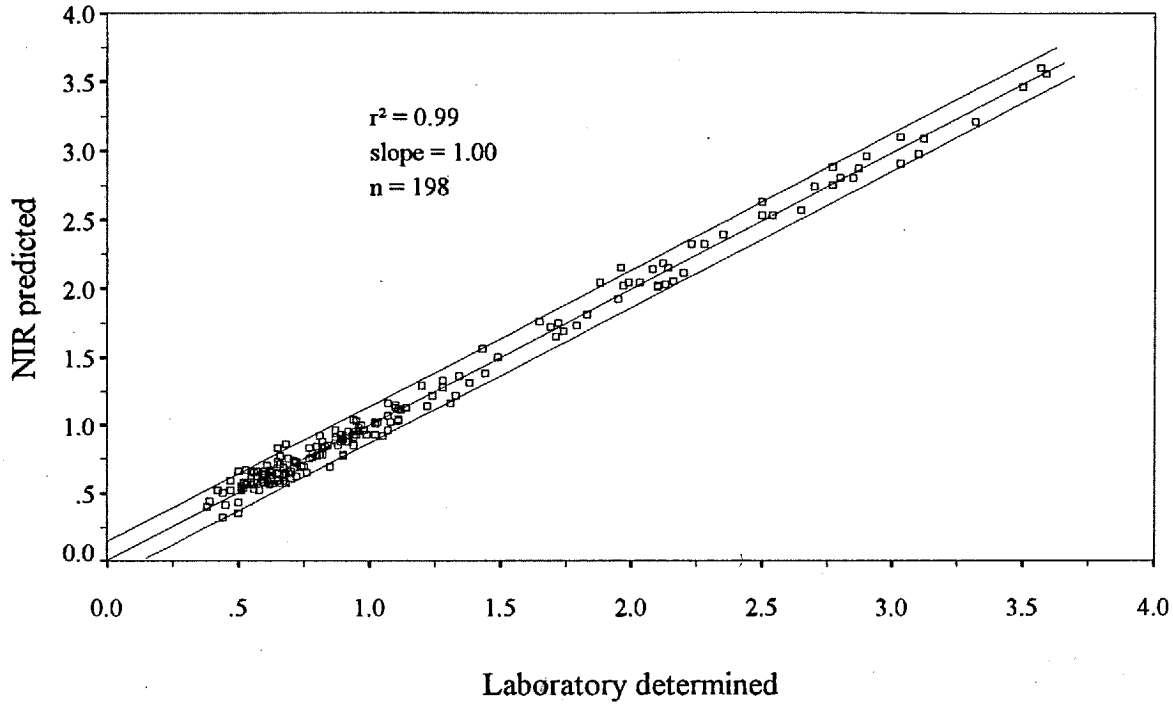


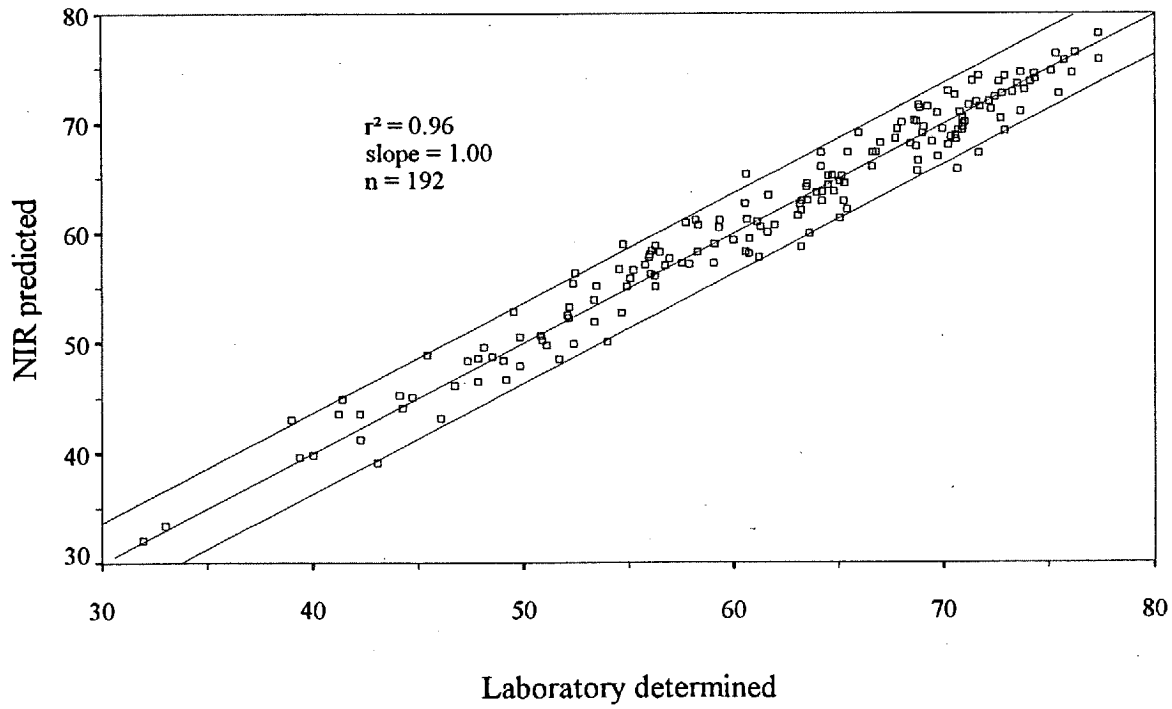
Figure 8. Plots of the change in leaf biomass (g dw/m^2) of the three seagrass species (Ho = *H. ovalis*, Zc+Cr = *Zostera/Cymodocea*, and Hu = *H. uninervis*) from the undisturbed plots over time at the four sites (**a** to **d**) at Ellie Point; showing the means (n=4) with standard errors. Sites were 25 to 35 m apart. Both before and after simulation measurements were carried out on the same day in May 1993. Note: Measurement of the response at the site level is technically possible only if site is considered a fixed factor, however in the original assumption it was random. Therefore, these figures are approximations only.

Appendix 3. Relationship between NIR predicted values for the different nutritional components and laboratory values (% dry matter) of the samples in the calibration set (leaves, roots/rhizomes and detritus). Shown are the r^2 and slope values, and the number of samples.

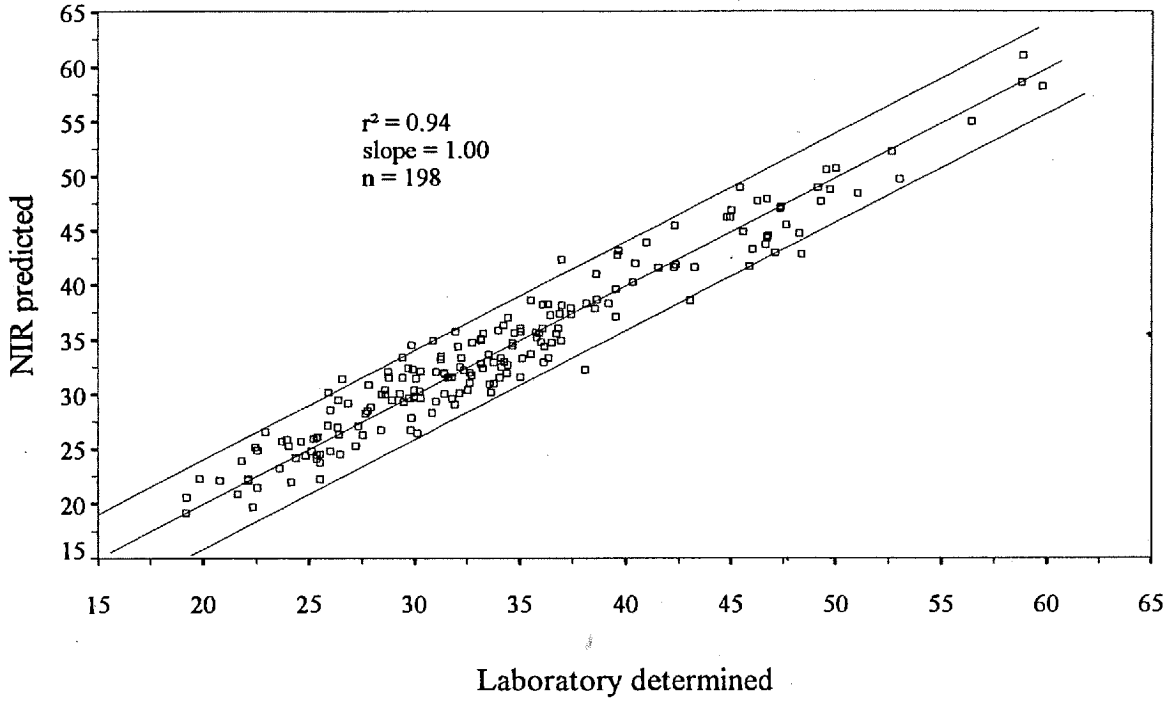
Nitrogen



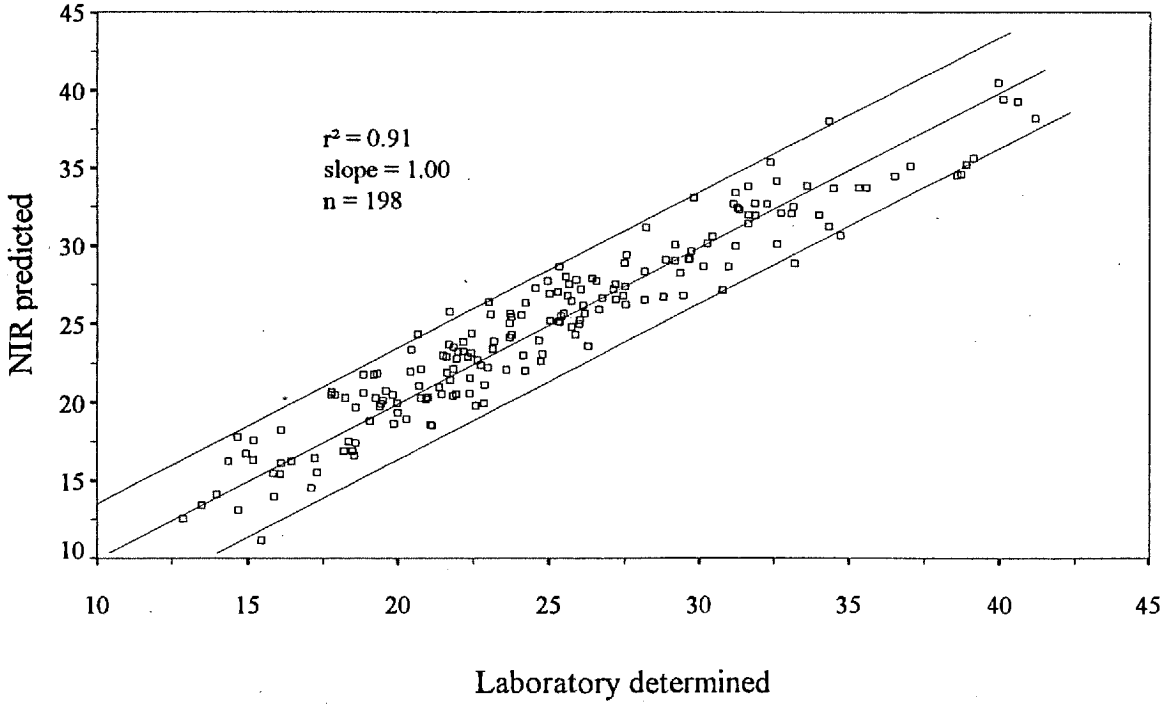
Organic Matter



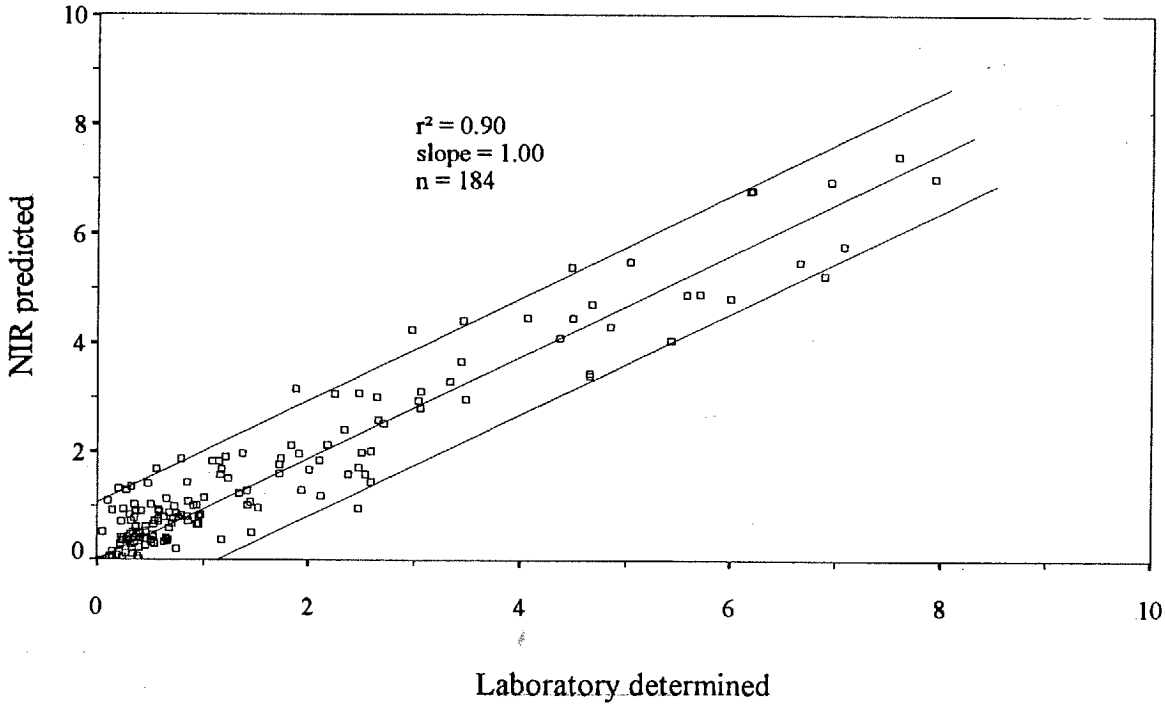
Neutral Detergent Fibre



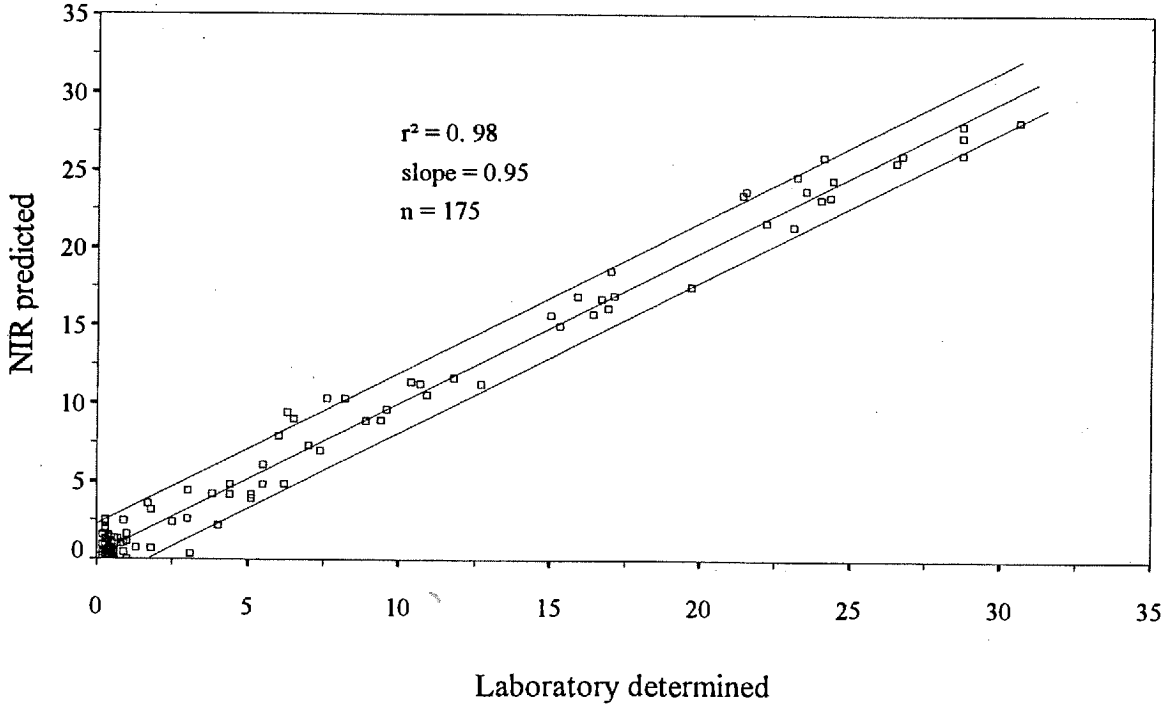
Acid Detergent Fibre



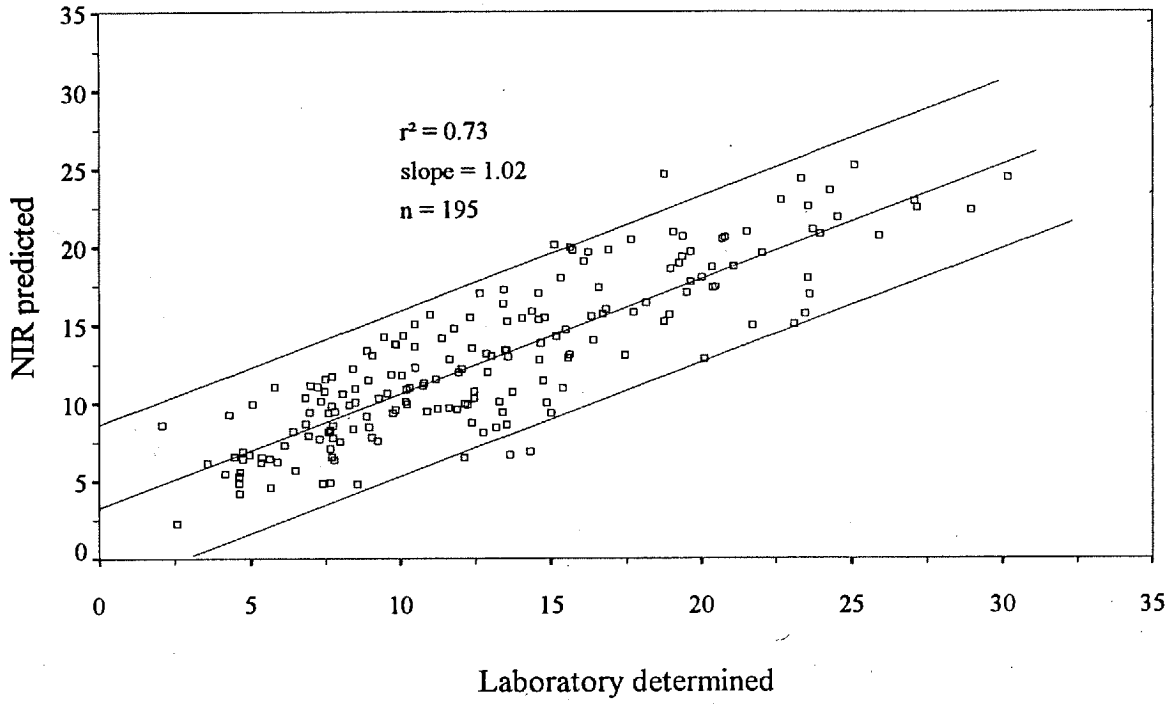
Water Soluble Carbohydrates



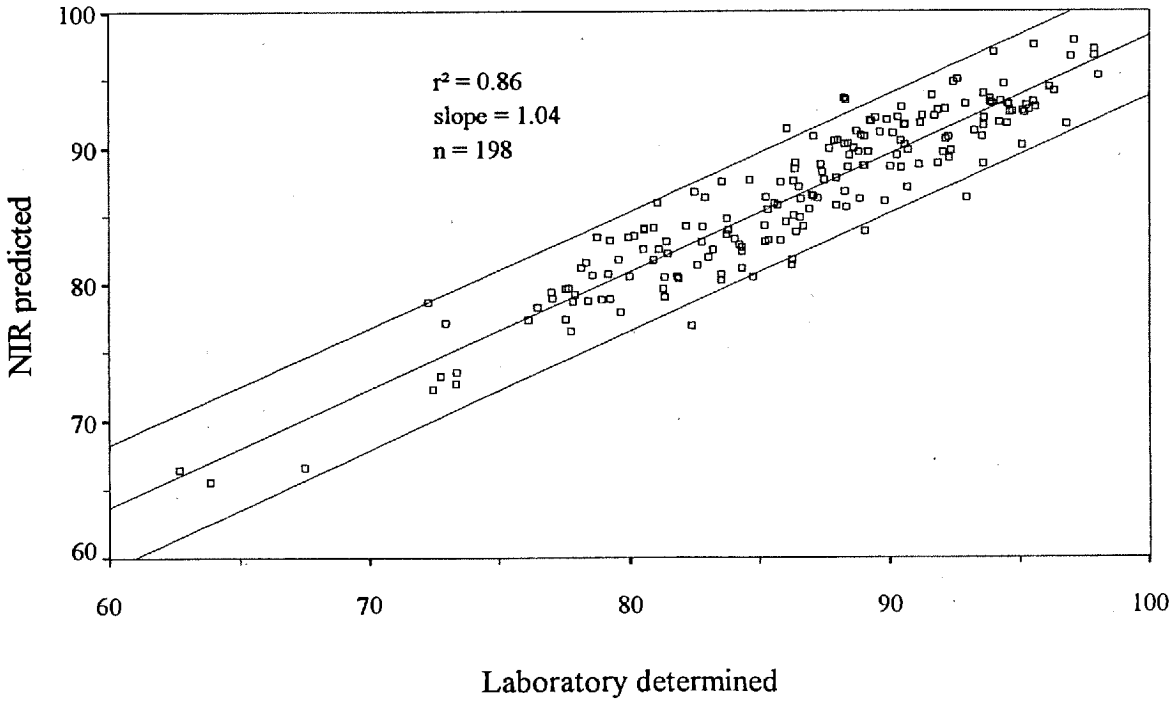
Total Starch



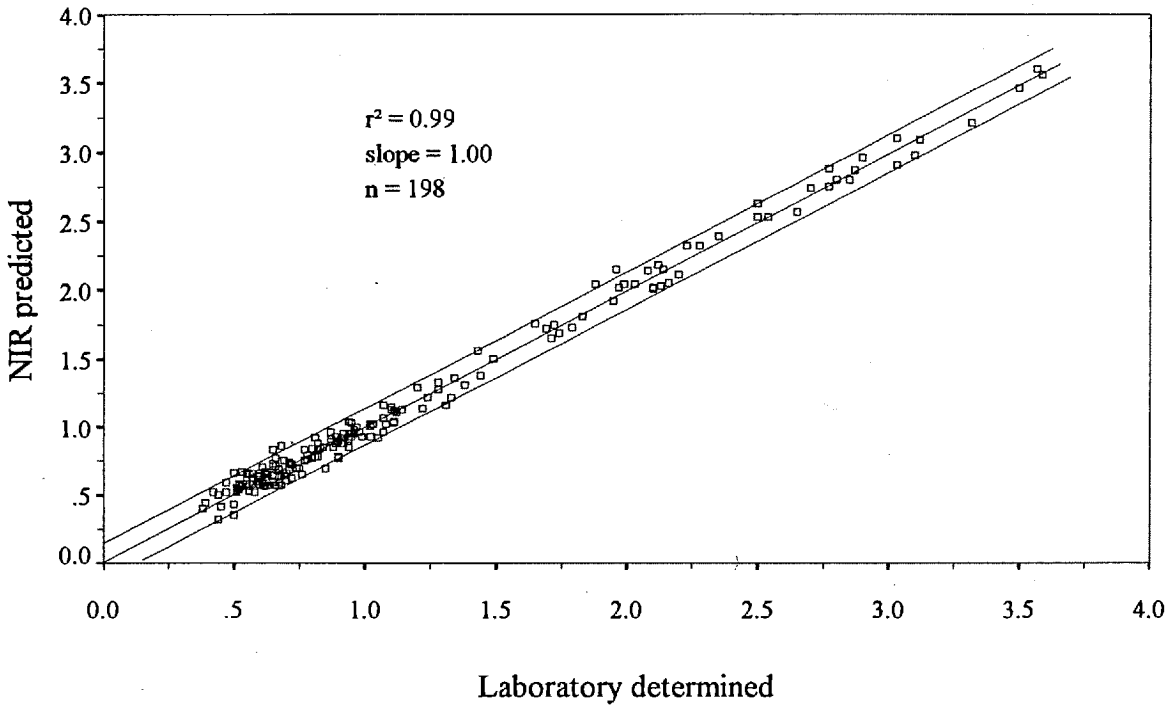
Lignin



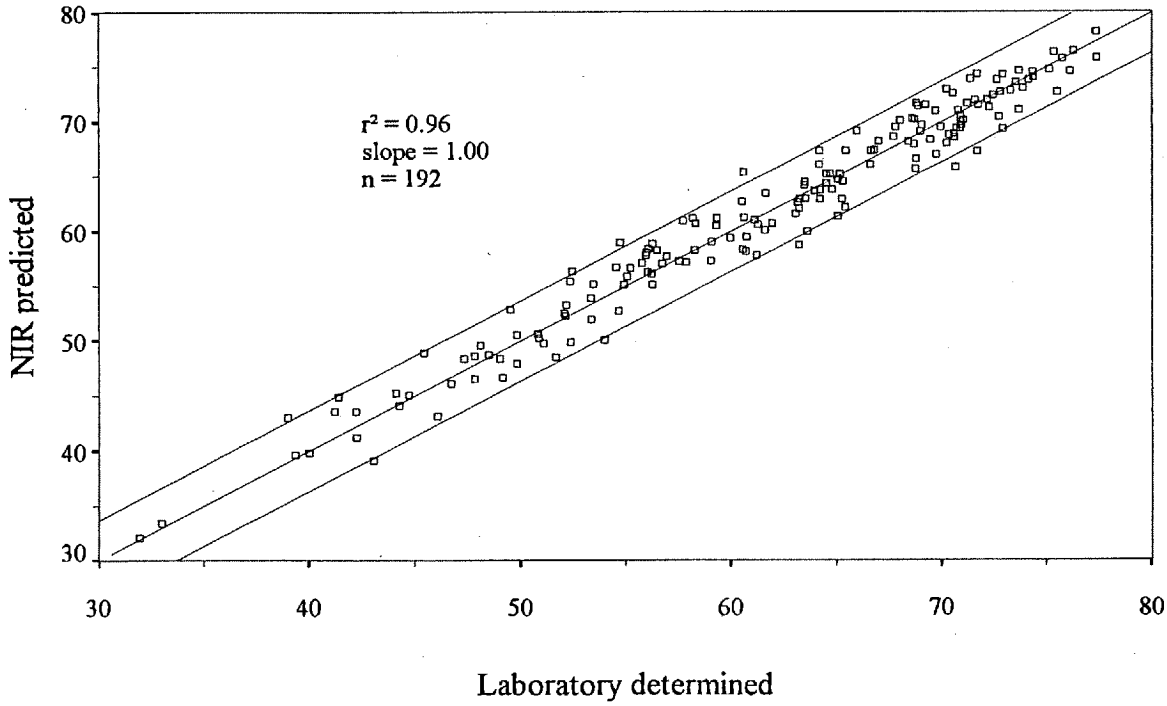
In Vitro Dry Matter Digestibility



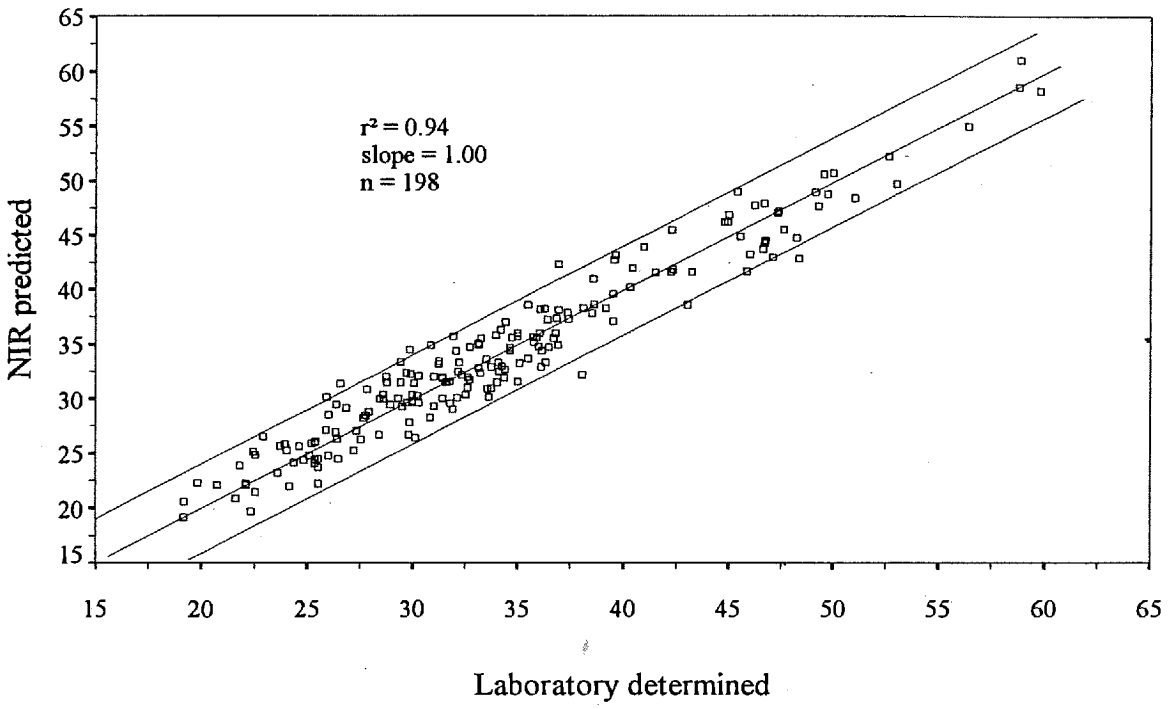
Nitrogen



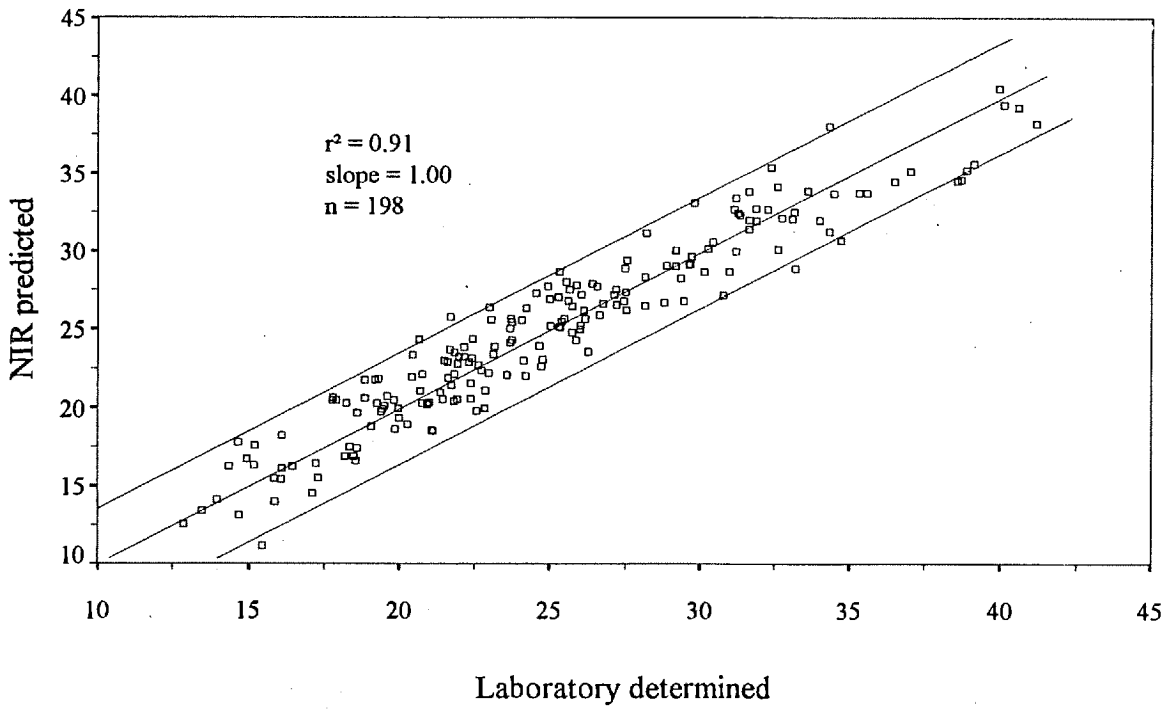
Organic Matter



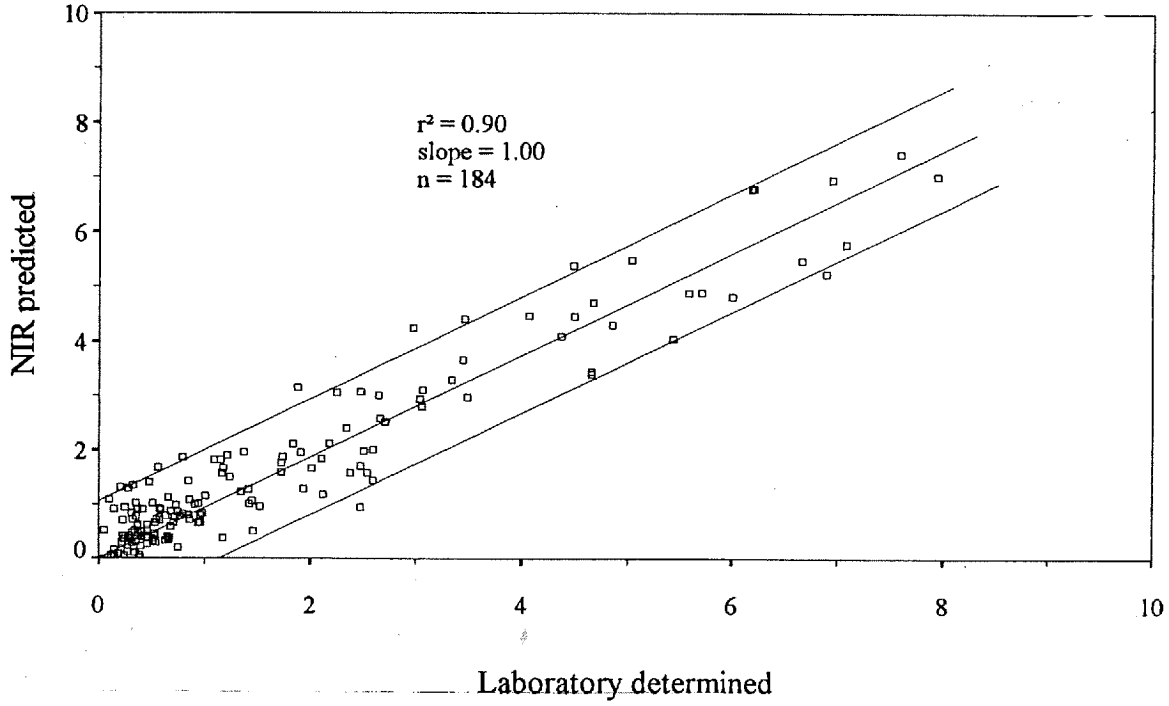
Neutral Detergent Fibre



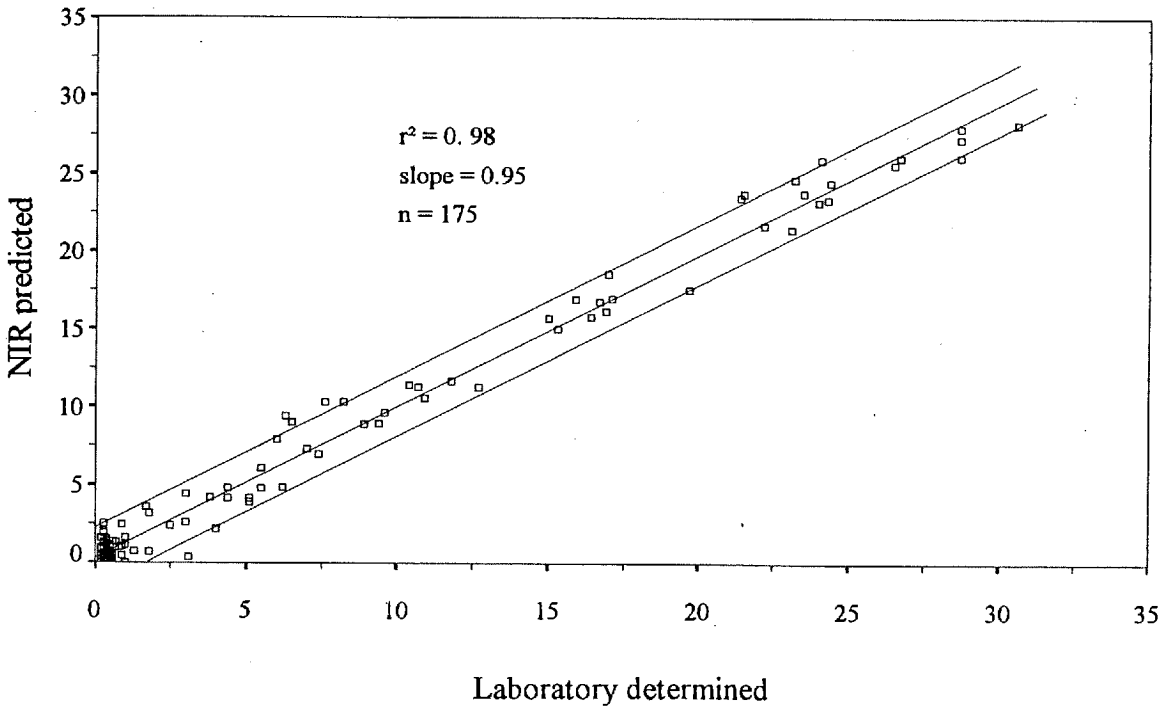
Acid Detergent Fibre



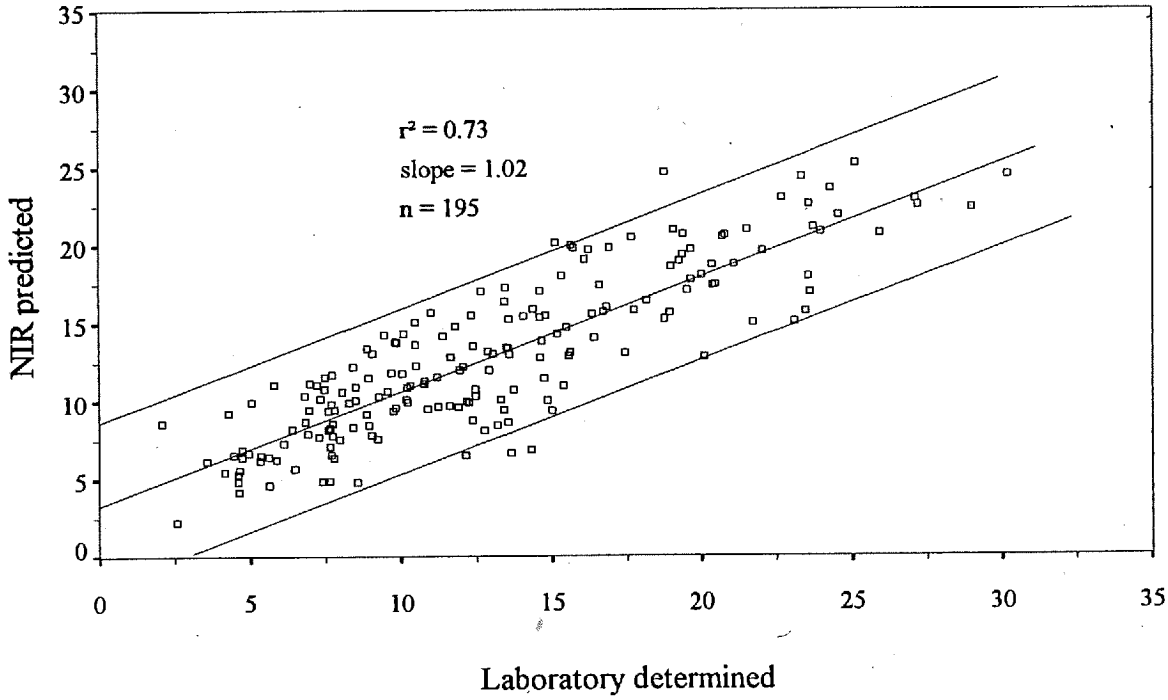
Water Soluble Carbohydrates



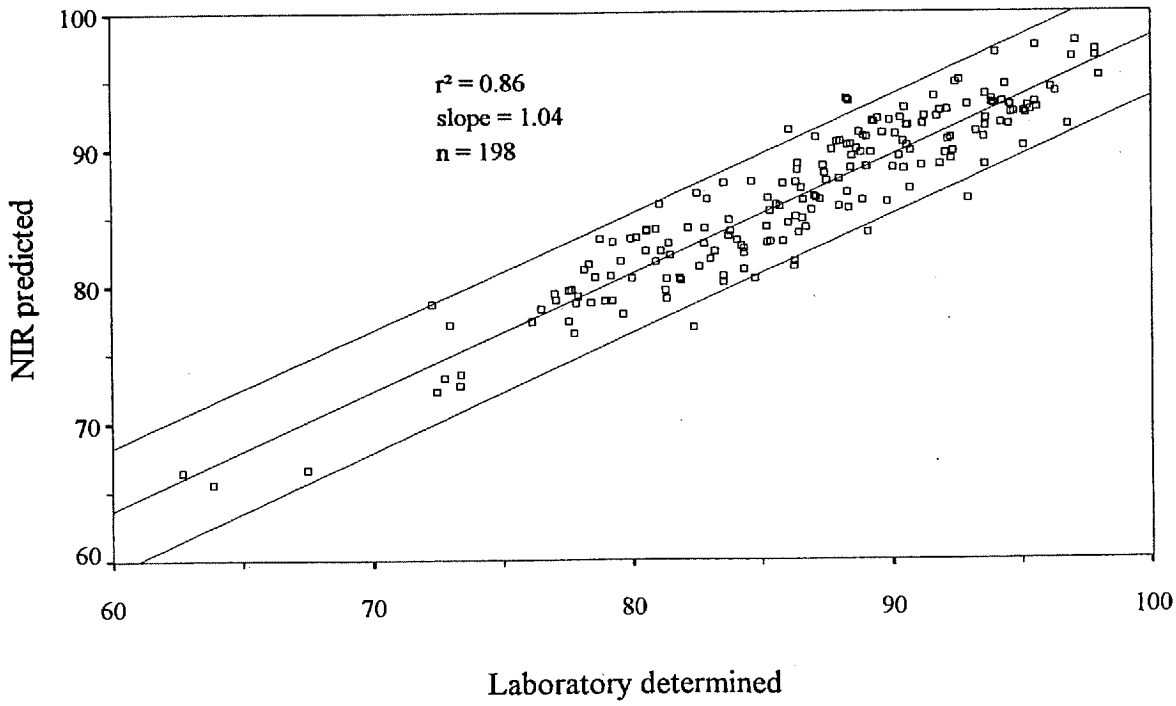
Total Starch



Lignin



In Vitro Dry Matter Digestibility



Appendix 4. Formulae for the calculation of water soluble carbohydrate and starch used in this study.

1) Water soluble carbohydrate (WSC)

$$\text{WSC \% dry matter} = \frac{\mu g}{ml} \times \frac{1}{1000} \times DF \times 24 \times \frac{100}{W}$$

Where: $\frac{\mu g}{ml}$ = equivalent micrograms fructose per millilitre of extract from calibration equations

$\frac{1}{1000}$ = Conversion from micrograms to milligrams

DF = Dilution Factor (number times the extract was diluted)

24 = Total number of ml extracted

$\frac{100}{W}$ = Expresses 'WSC' as a percentage of dry weight

(W = dry weight of sample in mg)

2) Starch

$$\text{Starch \% dry matter} = \Delta E \times F \times \frac{EV}{AA} \times \frac{1}{1000} \times \frac{100}{W} \times \frac{1}{1000} \times \frac{162}{180}$$

Where: ΔE = Absorbance(reaction) read against the reagent blank

$$F = \frac{100\ (\mu g \text{ of glucose})}{\text{absorbance for } 100\ \mu g \text{ of glucose}}$$

(conversion from absorbance to µg)

EV = Extract Volume = 0.2 ml EtOH + 2.0 ml DMSO + 3.0 ml α-amylase

+ 4.1 ml amyloglucosidase + volume of water in pellet[1]

AA = Amount in Assay = normally 100 µl (or 0.1 ml)

$\frac{1}{1000}$ = Conversion from micrograms to milligrams (glucose)

$\frac{100}{W}$ = Expresses 'Starch' as a percentage of sample dry weight in mg (W)

$\frac{1}{1000}$ = Conversion from grams of sample to milligrams

$\frac{162}{180}$ = Adjustment from free glucose to anhydro glucose (as occurs in starch)

[1] Volume of water in pellet = (wet weight of tube + pellet) - (initial dry weight of tube and pellet).

Appendix 5. A prediction equation for nitrogen calculated by NIRS 3 (ISI 1992) showing the regression constant (B(0)), and the corresponding coefficient values for each of the 259 terms including the data point and wavelength.

nitrogen

	Coefficient	Data Point	Wavelength
B(0) =	2.49		
B(1) =	-0.23	5	408.0
B(2) =	-0.55	9	416.0
B(3) =	-0.54	13	424.0
B(4) =	-0.14	17	432.0
B(5) =	-0.14	21	440.0
B(6) =	-0.09	25	448.0
B(7) =	0.10	29	456.0
B(8) =	0.05	33	464.0
B(9) =	-0.17	37	472.0
B(10) =	0.18	41	480.0
B(11) =	0.65	45	488.0
B(12) =	0.65	49	496.0
B(13) =	0.92	53	504.0
B(14) =	-0.24	57	512.0
B(15) =	-0.93	61	520.0
B(16) =	-0.26	65	528.0
B(17) =	-0.07	69	536.0
B(18) =	0.34	73	544.0
B(19) =	1.36	77	552.0
B(20) =	0.54	81	560.0
B(21) =	-0.29	85	568.0
B(22) =	-0.53	89	576.0
B(23) =	-0.45	93	584.0
B(24) =	-0.09	97	592.0
B(25) =	-0.48	101	600.0
B(26) =	-0.55	105	608.0
B(27) =	-0.83	109	616.0
B(28) =	-0.83	113	624.0
B(29) =	-0.91	117	632.0
B(30) =	-0.37	121	640.0
B(31) =	0.36	125	648.0
B(32) =	0.24	129	656.0
B(33) =	0.39	133	664.0
B(34) =	1.30	137	672.0
B(35) =	-0.38	141	680.0
B(36) =	-0.75	145	688.0
B(37) =	0.11	149	696.0
B(38) =	-0.55	153	704.0
B(39) =	-0.56	157	712.0
B(40) =	0.55	161	720.0
B(41) =	0.54	165	728.0
B(42) =	1.36	169	736.0
B(43) =	0.06	173	744.0
B(44) =	-0.57	177	752.0
B(45) =	-0.52	181	760.0
B(46) =	-0.67	185	768.0
B(47) =	-0.21	189	776.0
B(48) =	-0.91	193	784.0
B(49) =	-0.38	197	792.0
B(50) =	-1.09	201	800.0
B(51) =	-0.58	205	808.0
B(52) =	0.49	209	816.0

nitrogen

	Coefficient	Data Point	Wavelength
B(53) =	0.88	213	824.0
B(54) =	1.25	217	832.0
B(55) =	2.24	221	840.0
B(56) =	1.82	225	848.0
B(57) =	1.67	229	856.0
B(58) =	1.07	233	864.0
B(59) =	0.02	237	872.0
B(60) =	0.60	241	880.0
B(61) =	-0.25	245	888.0
B(62) =	-0.14	249	896.0
B(63) =	-0.32	253	904.0
B(64) =	-0.39	257	912.0
B(65) =	-0.58	261	920.0
B(66) =	-0.75	265	928.0
B(67) =	-0.85	269	936.0
B(68) =	-1.84	273	944.0
B(69) =	-1.18	277	952.0
B(70) =	-1.21	281	960.0
B(71) =	-1.93	285	968.0
B(72) =	-1.17	289	976.0
B(73) =	-0.66	293	984.0
B(74) =	-0.70	297	992.0
B(75) =	-0.70	301	1000.0
B(76) =	0.20	305	1008.0
B(77) =	0.36	309	1016.0
B(78) =	0.44	313	1024.0
B(79) =	1.93	317	1032.0
B(80) =	2.51	321	1040.0
B(81) =	1.78	325	1048.0
B(82) =	2.58	329	1056.0
B(83) =	2.78	333	1064.0
B(84) =	2.39	337	1072.0
B(85) =	2.49	341	1080.0
B(86) =	2.96	345	1088.0
B(87) =	-0.07	355	1108.0
B(88) =	0.11	359	1116.0
B(89) =	-0.29	363	1124.0
B(90) =	0.64	367	1132.0
B(91) =	-1.10	371	1140.0
B(92) =	-0.56	375	1148.0
B(93) =	-0.70	379	1156.0
B(94) =	0.18	383	1164.0
B(95) =	-0.33	387	1172.0
B(96) =	-0.86	391	1180.0
B(97) =	0.59	395	1188.0
B(98) =	1.54	399	1196.0
B(99) =	0.81	403	1204.0
B(100) =	1.95	407	1212.0
B(101) =	1.30	411	1220.0
B(102) =	0.15	415	1228.0
B(103) =	-0.68	419	1236.0
B(104) =	-0.79	423	1244.0
B(105) =	-0.74	427	1252.0
B(106) =	-1.95	431	1260.0

nitrogen

	Coefficient	Data Point	Wavelength
B(107) =	-3.79	435	1268.0
B(108) =	-1.58	439	1276.0
B(109) =	-0.66	443	1284.0
B(110) =	-1.17	447	1292.0
B(111) =	-1.62	451	1300.0
B(112) =	-1.40	455	1308.0
B(113) =	-0.58	459	1316.0
B(114) =	0.74	463	1324.0
B(115) =	2.05	467	1332.0
B(116) =	1.40	471	1340.0
B(117) =	-0.16	475	1348.0
B(118) =	-0.65	479	1356.0
B(119) =	-0.10	483	1364.0
B(120) =	-1.89	487	1372.0
B(121) =	-0.45	491	1380.0
B(122) =	1.19	495	1388.0
B(123) =	1.49	499	1396.0
B(124) =	1.62	503	1404.0
B(125) =	0.72	507	1412.0
B(126) =	0.04	511	1420.0
B(127) =	0.56	515	1428.0
B(128) =	0.86	519	1436.0
B(129) =	1.95	523	1444.0
B(130) =	0.36	527	1452.0
B(131) =	-0.57	531	1460.0
B(132) =	-1.61	535	1468.0
B(133) =	-3.42	539	1476.0
B(134) =	-6.85	543	1484.0
B(135) =	-6.01	547	1492.0
B(136) =	-3.83	551	1500.0
B(137) =	-2.06	555	1508.0
B(138) =	-1.78	559	1516.0
B(139) =	0.08	563	1524.0
B(140) =	1.53	567	1532.0
B(141) =	3.47	571	1540.0
B(142) =	5.10	575	1548.0
B(143) =	4.14	579	1556.0
B(144) =	3.55	583	1564.0
B(145) =	3.69	587	1572.0
B(146) =	4.09	591	1580.0
B(147) =	6.53	595	1588.0
B(148) =	5.10	599	1596.0
B(149) =	4.30	603	1604.0
B(150) =	2.88	607	1612.0
B(151) =	2.67	611	1620.0
B(152) =	1.04	615	1628.0
B(153) =	1.53	619	1636.0
B(154) =	1.31	623	1644.0
B(155) =	-0.03	627	1652.0
B(156) =	-1.46	631	1660.0
B(157) =	-7.72	635	1668.0

nitrogen	Coefficient	Data Point	Wavelength
B(158) =	-6.74	639	1676.0
B(159) =	-3.60	643	1684.0
B(160) =	-5.02	647	1692.0
B(161) =	-2.92	651	1700.0
B(162) =	1.83	655	1708.0
B(163) =	2.09	659	1716.0
B(164) =	1.35	663	1724.0
B(165) =	1.02	667	1732.0
B(166) =	0.33	671	1740.0
B(167) =	3.49	675	1748.0
B(168) =	5.70	679	1756.0
B(169) =	3.38	683	1764.0
B(170) =	-0.44	687	1772.0
B(171) =	-3.49	691	1780.0
B(172) =	-2.14	695	1788.0
B(173) =	-2.38	699	1796.0
B(174) =	-3.86	703	1804.0
B(175) =	-8.24	707	1812.0
B(176) =	-7.55	711	1820.0
B(177) =	-3.00	715	1828.0
B(178) =	2.76	719	1836.0
B(179) =	3.54	723	1844.0
B(180) =	2.58	727	1852.0
B(181) =	0.99	731	1860.0
B(182) =	0.15	735	1868.0
B(183) =	0.72	739	1876.0
B(184) =	0.34	743	1884.0
B(185) =	-0.27	747	1892.0
B(186) =	-0.21	751	1900.0
B(187) =	-1.23	755	1908.0
B(188) =	-0.06	759	1916.0
B(189) =	-0.13	763	1924.0
B(190) =	-0.22	767	1932.0
B(191) =	0.61	771	1940.0
B(192) =	0.03	775	1948.0
B(193) =	0.09	779	1956.0
B(194) =	0.72	783	1964.0
B(195) =	1.20	787	1972.0
B(196) =	2.64	791	1980.0
B(197) =	3.09	795	1988.0
B(198) =	0.03	799	1996.0
B(199) =	-1.01	803	2004.0
B(200) =	-0.31	807	2012.0
B(201) =	-0.36	811	2020.0
B(202) =	-0.08	815	2028.0
B(203) =	-0.12	819	2036.0
B(204) =	0.31	823	2044.0
B(205) =	0.43	827	2052.0
B(206) =	0.30	831	2060.0
B(207) =	1.32	835	2068.0
B(208) =	0.29	839	2076.0
B(209) =	0.23	843	2084.0
B(210) =	-1.46	847	2092.0

nitrogen

	Coefficient	Data Point	Wavelength
B(211) =	-1.48	851	2100.0
B(212) =	-1.93	855	2108.0
B(213) =	-1.14	859	2116.0
B(214) =	-1.35	863	2124.0
B(215) =	-2.77	867	2132.0
B(216) =	-2.64	871	2140.0
B(217) =	-1.03	875	2148.0
B(218) =	-0.87	879	2156.0
B(219) =	-3.26	883	2164.0
B(220) =	-2.88	887	2172.0
B(221) =	-1.49	891	2180.0
B(222) =	-1.10	895	2188.0
B(223) =	-0.45	899	2196.0
B(224) =	-0.03	903	2204.0
B(225) =	-0.68	907	2212.0
B(226) =	1.16	911	2220.0
B(227) =	3.20	915	2228.0
B(228) =	2.42	919	2236.0
B(229) =	0.67	923	2244.0
B(230) =	-0.42	927	2252.0
B(231) =	-0.19	931	2260.0
B(232) =	0.46	935	2268.0
B(233) =	-0.27	939	2276.0
B(234) =	0.70	943	2284.0
B(235) =	2.21	947	2292.0
B(236) =	1.76	951	2300.0
B(237) =	1.59	955	2308.0
B(238) =	1.20	959	2316.0
B(239) =	1.04	963	2324.0
B(240) =	1.23	967	2332.0
B(241) =	1.12	971	2340.0
B(242) =	0.93	975	2348.0
B(243) =	2.28	979	2356.0
B(244) =	0.96	983	2364.0
B(245) =	0.33	987	2372.0
B(246) =	0.41	991	2380.0
B(247) =	1.24	995	2388.0
B(248) =	1.55	999	2396.0
B(249) =	0.96	1003	2404.0
B(250) =	0.77	1007	2412.0
B(251) =	1.37	1011	2420.0
B(252) =	1.17	1015	2428.0
B(253) =	0.41	1019	2436.0
B(254) =	0.60	1023	2444.0
B(255) =	1.03	1027	2452.0
B(256) =	0.65	1031	2460.0
B(257) =	0.06	1035	2468.0
B(258) =	0.59	1039	2476.0
B(259) =	1.35	1043	2484.0

Appendix 6.

Appendix 6. Summary table of related information on the samples of *Halophila spinulosa* collected off Pipon Island to examine the effects of depth on nutritional composition.

Depth collected (m) (based on Port Datum)	n	Date of collection	Secchi depth (m)	Substrate type	Seagrass cover (%)	Comments
10	3	7/12/94	no data	no data	no data	–
16.5	2	29/11/94	7	mud, sand, shell	60	with *H. decipiens*
18	2	29/11/94	13	mud, sand	85	with possible dugong feeding trails
20	3	7/12/94	13.5	mud, sand, shell	60 - 70	–
20.5	2	29/11/94	12	mud, sand	85	with *H. ovalis* and with dugong feeding trails
27	3	29/11/94	11.5	sand, mud, shell	60 - 70	mixed with some *H. ovalis*, and *H. capricorni*

Appendix 7. Output tables of the ANOVAs on the effects of nutrient enhancement on the different the nutritional components of the leaf and root/rhizome fractions, and the whole plants of *Halophila minor* and *Halodule uninervis*.

Table 1. Results of the multi-factorial analysis of variance which examined the response of the nitrogen concentration for separate and combined plant parts (whole plant) of *H. minor* and *H. uninervis* to additional nutrients (nitrogen and phosphorus each at three different levels: no additional nutrients, 1 times more than the ambient concentration, and 2 times more than the ambient concentration) conducted at Shelley Beach. A sequential sums of squares regression was used because of uneven replication between species. All factors were tested against the within+residuals. Significant *p* values are highlighted in bold.

Source	df	MS	F	*p*
1) Leaves				
within+residual	28	0.03		
Block	2	0.09	2.50	0.100
Species	1	2.42	70.59	**0.000**
Nitrogen	2	0.68	19.80	**0.000**
Phosphorus	2	0.06	1.79	0.186
Species*Nitrogen	2	0.05	1.58	0.224
Species*Phosphorus	2	0.00	0.11	0.897
Nitrogen*Phosphorus	4	0.02	0.46	0.765
Species*Nitrogen*Phosphorus	4	0.03	0.92	0.466
2) Roots/Rhizomes				
within+residual	28	0.01		
Block	2	0.05	3.15	0.058
Species	1	0.29	19.34	**0.000**
Nitrogen	2	0.06	3.71	**0.037**
Phosphorus	2	0.01	0.41	0.670

Species*Nitrogen	2	0.02	1.28	0.293
Species*Phosphorus	2	0.00	0.24	0.790
Nitrogen*Phosphorus	4	0.00	0.28	0.888
Species*Nitrogen*Phosphorus	4	0.00	0.20	0.938
3) Whole Plant				
within+residual	76	0.77		
Block	2	0.13	0.16	0.848
Species	1	2.19	2.85	0.095
Nitrogen	2	0.56	0.73	0.485
Phosphorus	2	0.05	0.07	0.934
Species*Nitrogen	2	0.07	0.09	0.915
Species*Phosphorus	2	0.00	0.01	0.995
Nitrogen*Phosphorus	4	0.02	0.02	0.999
Species*Nitrogen*Phosphorus	4	0.01	0.02	0.999

Table 2. Results of the multi-factorial analysis of variance which examined the response of the levels of organic matter for separate and combined plant parts (whole plant) of *H. minor* and *H. uninervis* to additional nutrients (nitrogen and phosphorus each at three different levels: no additional nutrients, 1 times more than the ambient concentration, and 2 times more than the ambient concentration) conducted at Shelley Beach. A sequential sums of squares regression was used because of uneven replication between species. All factors were tested against the within+residuals. Significant *p* values are highlighted in bold.

Source	df	MS	F	*p*
1) Leaves				
within+residual	28	12.68		
Block	2	34.17	2.69	0.085
Species	1	2173.97	171.44	**0.000**
Nitrogen	2	5.48	0.43	0.653
Phosphorus	2	4.27	0.34	0.717
Species*Nitrogen	2	6.53	0.52	0.603
Species*Phosphorus	2	4.78	0.38	0.689
Nitrogen*Phosphorus	4	12.40	0.98	0.435
Species*Nitrogen*Phosphorus	4	2.26	0.18	0.948
2) Roots/Rhizomes				
within+residual	28	12.55		
Block	2	287.62	22.92	**0.000**
Species	1	9339.73	744.23	**0.000**
Nitrogen	2	6.89	0.55	0.584
Phosphorus	2	4.78	0.38	0.687

Species*Nitrogen	2	44.94	3.58	**0.041**
Species*Phosphorus	2	4.22	0.34	0.717
Nitrogen*Phosphorus	4	9.88	0.79	0.543
Species*Nitrogen*Phosphorus	4	19.57	1.56	0.213
3) Whole Plant				
within+residual	76	31.50		
Block	2	255.15	8.10	**0.001**
Species	1	10262.88	325.78	**0.000**
Nitrogen	2	2.10	0.07	0.936
Phosphorus	2	6.49	0.21	0.814
Species*Nitrogen	2	8.84	0.28	0.756
Species*Phosphorus	2	5.87	0.19	0.830
Nitrogen*Phosphorus	4	12.11	0.38	0.819
Species*Nitrogen*Phosphorus	4	6.62	0.21	0.932

Table 3. Results of the multi-factorial analysis of variance which examined the response of the concentration of neutral detergent fibre for separate and combined plant parts (whole plant) of *H. minor* and *H. uninervis* to additional nutrients (nitrogen and phosphorus each at three different levels: no additional nutrients, 1 times more than the ambient concentration, and 2 times more than the ambient concentration) conducted at Shelley Beach. A sequential sums of squares regression was used because of uneven replication between species. All factors were tested against the within+residuals. Significant *p* values are highlighted in bold.

Source	df	MS	F	*p*
1) Leaves				
within+residual	28	6.24		
Block	2	76.58	12.27	**0.000**
Species	1	2860.05	458.42	**0.000**
Nitrogen	2	41.43	6.64	**0.004**
Phosphorus	2	1.22	0.19	0.824
Species*Nitrogen	2	0.21	0.03	0.967
Species*Phosphorus	2	10.16	1.63	0.214
Nitrogen*Phosphorus	4	4.50	0.72	0.585
Species*Nitrogen*Phosphorus	4	3.35	0.54	0.710
2) Roots/Rhizomes				
within+residual	28	3.47		
Block	2	33.62	9.68	**0.001**
Species	1	541.77	156.06	**0.000**
Nitrogen	2	3.33	0.96	0.395
Phosphorus	2	5.44	1.57	0.226

Species*Nitrogen	2	0.08	0.02	0.977
Species*Phosphorus	2	1.77	0.51	0.606
Nitrogen*Phosphorus	4	2.60	0.75	0.566
Species*Nitrogen*Phosphorus	4	2.88	0.83	0.518
3) Whole Plant				
within+residual	76	63.77		
Block	2	104.37	1.64	0.201
Species	1	2945.70	46.19	**0.000**
Nitrogen	2	31.51	0.49	0.612
Phosphorus	2	5.83	0.09	0.913
Species*Nitrogen	2	0.02	0.00	1.000
Species*Phosphorus	2	8.86	0.14	0.871
Nitrogen*Phosphorus	4	3.29	0.05	0.995
Species*Nitrogen*Phosphorus	4	3.46	0.05	0.994

Table 4. Results of the multi-factorial analysis of variance which examined the response of the concentration of acid detergent fibre for separate and combined plant parts (whole plant) of *H. minor* and *H. uninervis* to additional nutrients (nitrogen and phosphorus each at three different levels: no additional nutrients, 1 times more than the ambient concentration, and 2 times more than the ambient concentration) conducted at Shelley Beach. A sequential sums of squares regression was used because of uneven replication between species. All factors were tested against the within+residuals. Significant *p* values are highlighted in bold.

Source	df	MS	F	*p*
1) Leaves				
within+residual	28	4.20		
Block	2	36.98	8.79	**0.001**
Species	1	1167.78	277.75	**0.000**
Nitrogen	2	3.16	0.75	0.481
Phosphorus	2	1.15	0.27	0.762
Species*Nitrogen	2	1.59	0.38	0.689
Species*Phosphorus	2	1.61	0.38	0.686
Nitrogen*Phosphorus	4	3.61	0.86	0.501
Species*Nitrogen*Phosphorus	4	1.13	0.27	0.895
2) Roots/Rhizomes				
within+residual	28	4.06		
Block	2	7.09	1.75	0.193
Species	1	22.77	5.61	**0.025**
Nitrogen	2	3.41	0.84	0.443
Phosphorus	2	2.96	0.73	0.491

Species*Nitrogen	2	3.61	0.89	0.422
Species*Phosphorus	2	3.26	0.80	0.458
Nitrogen*Phosphorus	4	1.62	0.40	0.808
Species*Nitrogen*Phosphorus	4	3.06	0.75	0.564
3) Whole Plant				
within+residual	76	25.25		
Block	2	34.80	1.38	0.258
Species	1	758.34	30.03	**0.000**
Nitrogen	2	6.54	0.26	0.773
Phosphorus	2	3.84	0.15	0.859
Species*Nitrogen	2	3.74	0.15	0.863
Species*Phosphorus	2	3.05	0.12	0.886
Nitrogen*Phosphorus	4	3.27	0.13	0.971
Species*Nitrogen*Phosphorus	4	3.21	0.13	0.972

Table 5. Results of the multi-factorial analysis of variance which examined the response of the concentration of hemicellulose for separate and combined plant parts (whole plant) of *H. minor* and *H. uninervis* to additional nutrients (nitrogen and phosphorus each at three different levels: no additional nutrients, 1 times more than the ambient concentration, and 2 times more than the ambient concentration) conducted at Shelley Beach. A sequential sums of squares regression was used because of uneven replication between species. All factors were tested against the within+residuals. Significant *p* values are highlighted in bold.

Source	df	MS	F	*p*
1) Leaves				
within+residual	28	0.84		
Block	2	7.24	8.58	**0.001**
Species	1	372.75	441.73	**0.000**
Nitrogen	2	23.08	27.35	**0.000**
Phosphorus	2	0.68	0.81	0.455
Species*Nitrogen	2	1.52	1.80	0.183
Species*Phosphorus	2	3.72	4.41	**0.022**
Nitrogen*Phosphorus	4	1.71	2.03	0.117
Species*Nitrogen*Phosphorus	4	1.57	1.86	0.145
2) Roots/Rhizomes				
within+residual	28	1.32		
Block	2	11.99	9.11	**0.001**
Species	1	342.40	260.21	**0.000**
Nitrogen	2	0.15	0.12	0.891
Phosphorus	2	2.47	1.88	0.172

Species*Nitrogen	2	2.71	2.06	0.146
Species*Phosphorus	2	0.99	0.75	0.480
Nitrogen*Phosphorus	4	0.43	0.33	0.855
Species*Nitrogen*Phosphorus	4	0.49	0.37	0.828
3) Whole Plant				
within+residual	76	12.18		
Block	2	18.83	1.55	0.220
Species	1	714.83	58.68	**0.000**
Nitrogen	2	10.33	0.85	0.432
Phosphorus	2	2.87	0.24	0.791
Species*Nitrogen	2	3.75	0.31	0.736
Species*Phosphorus	2	3.59	0.29	0.746
Nitrogen*Phosphorus	4	1.39	0.11	0.977
Species*Nitrogen*Phosphorus	4	0.19	0.02	1.000

Table 6. Results of the multi-factorial analysis of variance which examined the response of the concentration of lignin for separate and combined plant parts (whole plant) of *H. minor* and *H. uninervis* to additional nutrients (nitrogen and phosphorus each at three different levels: no additional nutrients, 1 times more than the ambient concentration, and 2 times more than the ambient concentration) conducted at Shelley Beach. A sequential sums of squares regression was used because of uneven replication between species. All factors were tested against the within+residuals. Significant *p* values are highlighted in bold.

Source	df	MS	F	*p*
1) Leaves				
within+residual	28	3.38		
Block	2	15.28	4.51	**0.020**
Species	1	354.83	104.83	**0.000**
Nitrogen	2	14.23	4.20	**0.025**
Phosphorus	2	0.45	0.13	0.876
Species*Nitrogen	2	4.39	1.30	0.289
Species*Phosphorus	2	0.92	0.27	0.764
Nitrogen*Phosphorus	4	1.63	0.48	0.750
Species*Nitrogen*Phosphorus	4	1.98	0.58	0.676
2) Roots/Rhizomes				
within+residual	28	1.90		
Block	2	5.09	2.68	0.086
Species	1	111.72	58.82	**0.000**
Nitrogen	2	2.05	1.08	0.353
Phosphorus	2	0.79	0.42	0.664

Species*Nitrogen	2	6.36	3.35	**0.050**
Species*Phosphorus	2	0.51	0.27	0.768
Nitrogen*Phosphorus	4	1.29	0.68	0.612
Species*Nitrogen*Phosphorus	4	1.48	0.78	0.549
3) Whole Plant				
within+residual	76	9.97		
Block	2	18.96	1.90	0.156
Species	1	432.38	43.37	**0.000**
Nitrogen	2	13.15	1.32	0.273
Phosphorus	2	1.20	0.12	0.887
Species*Nitrogen	2	10.58	1.06	0.351
Species*Phosphorus	2	0.75	0.08	0.928
Nitrogen*Phosphorus	4	1.92	0.19	0.941
Species*Nitrogen*Phosphorus	4	2.59	0.26	0.903

Table 7. Results of the multi-factorial analysis of variance which examined the response of the concentration of water soluble carbohydrate for separate and combined plant parts (whole plant) of *H. minor* and *H. uninervis* to additional nutrients (nitrogen and phosphorus each at three different levels: no additional nutrients, 1 times more than the ambient concentration, and 2 times more than the ambient concentration) conducted at Shelley Beach. A sequential sums of squares regression was used because of uneven replication between species. All factors were tested against the within+residuals. Significant *p* values are highlighted in bold.

Source	df	MS	F	*p*
1) Leaves				
within+residual	28	0.66		
Block	2	1.47	2.22	0.127
Species	1	4.52	6.82	**0.014**
Nitrogen	2	0.04	0.06	0.940
Phosphorus	2	0.80	1.22	0.312
Species*Nitrogen	2	0.70	1.06	0.361
Species*Phosphorus	2	0.02	0.03	0.969
Nitrogen*Phosphorus	4	0.73	1.10	0.376
Species*Nitrogen*Phosphorus	4	0.42	0.63	0.645
2) Roots/Rhizomes				
within+residual	28	1.64		
Block	2	5.75	3.51	**0.044**
Species	1	0.45	0.28	0.604
Nitrogen	2	0.45	0.28	0.760
Phosphorus	2	4.31	2.64	0.089

Species*Nitrogen	2	0.53	0.32	0.726
Species*Phosphorus	2	1.76	1.08	0.354
Nitrogen*Phosphorus	4	1.82	1.11	0.371
Species*Nitrogen*Phosphorus	4	0.68	0.41	0.797
3) Whole Plant				
within+residual	76	1.32		
Block	2	6.51	4.91	**0.010**
Species	1	1.06	0.80	0.374
Nitrogen	2	0.36	0.27	0.764
Phosphorus	2	4.40	3.32	**0.041**
Species*Nitrogen	2	0.75	0.57	0.571
Species*Phosphorus	2	0.76	0.57	0.568
Nitrogen*Phosphorus	4	2.31	1.75	0.148
Species*Nitrogen*Phosphorus	4	0.36	0.27	0.894

Table 8. Results of the multi-factorial analysis of variance which examined the response of the concentration of starch for separate and combined plant parts (whole plant) of *H. minor* and *H. uninervis* to additional nutrients (nitrogen and phosphorus each at three different levels: no additional nutrients, 1 times more than the ambient concentration, and 2 times more than the ambient concentration) conducted at Shelley Beach. A sequential sums of squares regression was used because of uneven replication between species. All factors were tested against the within+residuals. Significant *p* values are highlighted in bold.

Source	df	MS	F	*p*
1) Leaves				
within+residual	28	0.20		
Block	2	0.16	0.81	0.457
Species	1	0.49	2.50	0.125
Nitrogen	2	0.17	0.87	0.431
Phosphorus	2	0.38	1.93	0.164
Species*Nitrogen	2	0.77	3.91	**0.032**
Species*Phosphorus	2	0.30	1.51	0.239
Nitrogen*Phosphorus	4	0.16	0.83	0.520
Species*Nitrogen*Phosphorus	4	0.22	1.11	0.371
2) Roots/Rhizomes				
within+residual	28	2.43		
Block	2	117.87	48.58	**0.000**
Species	1	5106.13	2104.44	**0.000**
Nitrogen	2	2.86	1.18	0.322
Phosphorus	2	3.18	1.31	0.285

Species*Nitrogen	2	6.43	2.65	0.088
Species*Phosphorus	2	3.88	1.60	0.220
Nitrogen*Phosphorus	4	4.27	1.76	0.165
Species*Nitrogen*Phosphorus	4	1.01	0.42	0.796
3) Whole Plant				
within+residual	76	92.47		
Block	2	61.81	0.67	0.516
Species	1	2503.31	27.07	**0.000**
Nitrogen	2	2.20	0.02	0.976
Phosphorus	2	0.86	0.01	0.991
Species*Nitrogen	2	1.72	0.02	0.982
Species*Phosphorus	2	1.19	0.01	0.987
Nitrogen*Phosphorus	4	2.44	0.03	0.999
Species*Nitrogen*Phosphorus	4	0.90	0.01	1.000

Table 9. Results of the multi-factorial analysis of variance which examined the response of the digestibility (*in vitro*) of dry matter for separate and combined plant parts (whole plant) of *H. minor* and *H. uninervis* to additional nutrients (nitrogen and phosphorus each at three different levels: no additional nutrients, 1 times more than the ambient concentration, and 2 times more than the ambient concentration) conducted at Shelley Beach. A sequential sums of squares regression was used because of uneven replication between species. All factors were tested against the within+residuals. Significant *p* values are highlighted in bold.

Source	df	MS	F	*p*
1) Leaves				
within+residual	28	2.15		
Block	2	1.75	0.81	0.454
Species	1	12.64	5.88	**0.022**
Nitrogen	2	0.05	0.02	0.977
Phosphorus	2	1.51	0.70	0.503
Species*Nitrogen	2	4.65	2.16	0.134
Species*Phosphorus	2	0.45	0.21	0.813
Nitrogen*Phosphorus	4	0.43	0.20	0.936
Species*Nitrogen*Phosphorus	4	0.39	0.18	0.947
2) Roots/Rhizomes				
within+residual	28	2.59		
Block	2	22.57	8.72	**0.001**
Species	1	1638.42	632.73	**0.000**
Nitrogen	2	10.40	4.02	**0.029**
Phosphorus	2	2.12	0.82	0.451

Species*Nitrogen	2	11.35	4.38	**0.022**
Species*Phosphorus	2	1.04	0.40	0.672
Nitrogen*Phosphorus	4	3.37	1.30	0.293
Species*Nitrogen*Phosphorus	4	1.50	0.58	0.680
3) Whole Plant				
within+residual	76	26.54		
Block	2	17.03	0.64	0.529
Species	1	681.64	25.69	**0.000**
Nitrogen	2	4.51	0.17	0.844
Phosphorus	2	2.39	0.09	0.914
Species*Nitrogen	2	15.22	0.57	0.566
Species*Phosphorus	2	1.00	0.04	0.963
Nitrogen*Phosphorus	4	2.98	0.11	0.978
Species*Nitrogen*Phosphorus	4	1.28	0.05	0.996

Appendix 8. Tables of the mean and range (minimum and maximum) of the values of the nutritional components of the different species examined in this study; and the plots of the mean concentrations (% dry matter) of each nutritional component of the different seagrass species (*Halophila ovalis*, Ho; *Zostera capricorni*, Zc; *Halodule uninervis*, Hu; *Halophila spinulosa*, Hs; *Halophila minor,* Hm; *Cymodocea serrulata*, Cs; *Cymodocea rotundata*, Cr; and *Syringodium isoetifolium*, Si) and plant parts collected in this study. Please note of the different scales in the y-axes.

Table 1. Summary of the means (% dm, including standard error, % of mean), range of values and number of samples (*n*) of each nutritional component of the different plant parts of 10 tropical seagrass species examined in this study. Included is the nutritional composition of the seeds of *Zostera capricorni*.

			Nitrogen		Organic Matter		Neutral Detergent Fibre		Acid Detergent Fibre		Hemicellulose	
Species	Plant part	*n*	mean	range	mean	range	mean	range	mean	range	mean	range
Halophila ovalis	Leaf	81	1.73 (0.06)	0.72 - 3.06	56.73 (0.45)	42.17 - 64.20	32.26 (0.43)	18.16 - 42.94	21.89 (0.34)	7.72-30.09	10.38 (0.25)	3.87 -16.11
	Root/ Rhizome	77	0.62 (0.02)	0.12 - 1.28	49.0 (0.64)	39.66 - 63.87	26.48 (0.38)	19.16 - 34.34	21.41 (0.32)	14.50 - 28.66	5.07 (0.20)	1.69 - 10.78
	Whole Plant	158	1.19 (0.06)	0.12 - 3.06	52.96 (0.49)	39.66 - 64.20	29.44 (0.37)	18.16 - 42.94	21.66 (0.23)	7.72 - 30.09	7.79 (0.26)	1.69 - 16.11
Zostera capricorni	Leaf	61	1.91 (0.05)	1.03 - 2.85	63.91 (0.51)	54.55 - 73.84	43.23 (0.67)	35.16 - 61.01	28.02 (0.48)	19.33 - 40.48	15.21 (0.31)	9.68 - 21.55
	Root/ Rhizome	67	0.66 (0.03)	0.26 - 1.66	56.21 (0.84)	38.29 - 72.10	34.26 (0.65)	22.21 - 46.19	26.17 (0.62)	17.60 - 38.02	8.09 (0.28)	3.42 - 14.13
	Whole Plant	128	1.26 (0.06)	0.26 - 2.85	59.88 (0.61)	38.29 - 73.84	38.54 (0.61)	22.21 - 61.01	27.05 (0.41)	17.60 - 40.48	11.49 (0.38)	3.42 - 21.55
	Seeds	3	1.51 (0.03)	1.45 - 1.55	66.71 (0.24)	66.24 - 67.00	57.30 (10.27)	36.77 - 67.89	32.60 (0.58)	31.49 - 33.45	24.70 (9.71)	5.28 - 34.44
Halodule uninervis	Leaf	283	2.89 (0.03)	1.56 - 3.76	68.58 (0.20)	58.90 - 79.28	48.21 (0.22)	35.51 - 62.15	32.59 (0.17)	21.07 - 42.52	15.62 (12)	9.19 - 21.22
	Root/ Rhizome	279	0.84 (0.01)	0.53 - 1.58	65.33 (0.46)	47.17 - 81.82	28.27 (0.25)	17.37 - 40.42	19.99 (0.23)	9.43 - 29.30	8.28 (0.13)	0.70 - 15.28
	Whole Plant	562	1.87 (0.05)	0.53 - 3.76	66.97 (0.26)	47.17 - 81.82	38.31 (0.45)	17.37 - 62.15	26.33 (0.30)	9.43 - 42.52	11.98 (0.18)	0.70 - 21.22
H. spinulosa	Leaf	75	1.10 (0.02)	0.83 - 1.83	64.77 (0.60)	47.19 - 72.02	35.07 (0.43)	26.03 - 46.78	26.95 (0.32)	18.87 - 35.27	8.14 (0.22)	4.81 - 13.15
	Root/ Rhizome	74	0.63 (0.01)	0.46 - 0.84	67.95 (0.56)	55.23 - 77.20	36.43 - 0.31	26.35 - 40.80	26.68 (0.25)	23.00 - 31.36	8.81 (0.14)	3.35 - 11.99

	Whole Plant	149	0.87 (0.02)	0.46 - 1.83	66.35 (0.43)	47.19 - 77.20	35.75 (0.27)	26.03 - 46.78	27.31 (0.21)	18.87 - 35.27	8.47 (0.13)	3.35 - 13.35
H. minor	Leaf	27	1.95 (0.07)	1.33 - 2.66	50.86 (0.81)	41.07 - 58.07	31.86 (0.61)	22.31 - 35.72	20.72 (0.48)	14.40 - 26.61	11.15 (0.25)	7.91 - 13.65
	Root/ Rhizome	27	0.56 (0.03)	0.29 - 0.88	44.20 (0.89)	32.04 - 54.54	24.32 (0.50)	16.90 - 29.61	19.75 (0.80)	12.66 - 31.38	5.04 (0.37)	0.46 - 7.83
	Whole Plant	54	1.25 (0.10)	0.29 - 2.66	47.53 (0.75)	32.04 - 58.07	28.09 (0.65)	16.90 - 35.72	20.23 (0.47)	12.66 - 31.38	8.09 (0.47)	0.46 - 13.65
Cymodocea serrulata	Leaf	4	1.67 (0.19)	1.26 - 1.99	71.23 (2.33)	66.48 - 75.80	46.23 (2.38)	40.79 - 50.70	29.15 (0.46)	27.91 - 30.13	17.08 (2.10)	11.67 - 20.57
	Root/ Rhizome	4	0.75 (0.07)	0.56 - 0.89	73.40 (1.75)	69.95 - 78.00	39.47 (2.63)	32.48 - 43.88	30.22 (2.05)	25.46 - 33.85	9.25 (0.75)	7.02 - 10.23
	Whole Plant	8	1.21 (0.20)	0.56 -1.99	72.31 (1.41)	66.48 - 78.00	42.85 (2.08)	32.48 - 50.70	29.69 (0.99)	25.46 - 33.85	13.16 (1.81)	7.02 - 20.57
C. rotundata	Leaf	12	2.60 (0.09)	2.07 - 3.16	67.43 (1.29)	58.30 - 73.08	50.71 (0.69)	48.24 - 55.53	32.91 (0.66)	28.52 - 36.57	17.80 (0.57)	14.15 - 21.49
	Root/ Rhizome	13	0.91 (0.03)	0.70 - 1.10	60.73 (1.75)	52.75 - 75.67	42.24 (1.43)	26.57 - 46.91	32.51 (1.26)	19.25 - 35.90	9.73 (0.46)	7.32 - 12.68
	Whole Plant	25	1.72 (0.18)	0.70 - 3.16	63.94 (1.28)	52.75 - 75.67	46.31 (1.18)	26.57 - 55.53	32.71 (0.71)	19.25 - 36.57	13.60 (0.90)	7.23 - 21.49
Syringodium isoetifolium	Leaf	12	1.36 (0.11)	0.83 - 2.02	61.41 (1.54)	55.21 - 69.68	36.99 (1.11)	30.40 - 42.64	26.65 (0.95)	21.76 - 30.38	10.35 (0.56)	7.87 - 14.34
	Root/ Rhizome	12	0.78 (0.04)	0.59 - 0.96	75.51 (4.34)	49.79 - 89.34	34.25 (1.16)	28.44 - 39.94	26.27 (1.34)	19.99 - 35.97	7.98 (1.33)	0.75 - 13.66
	Whole Plant	24	1.07 (0.08)	0.59 - 2.02	68.46 (2.69)	49.79 - 89.34	35.62 (0.83)	28.44 - 42.64	26.46 (0.81)	19.99 - 35.97	9.16 (0.75)	0.75 - 14.34
H. trichostata	Whole Plant	7	1.03 (0.05)	0.77 - 1.18	65.88 (1.11)	60.92 - 70.25	33.13 (0.62)	30.83 - 35.77	24.72 (0.87)	22.72 - 29.25	8.42 (0.41)	6.52 - 9.93
H. decipiens	Whole Plant	4	0.75 (0.03)	0.67 - 0.81	51.46 (0.85)	48.96 - 52.72	27.49 (1.25)	24.10 - 29.60	20.39 (1.01)	17.52 - 22.11	7.10 (0.41)	6.51 - 8.26

			Lignin		Water Soluble Carbohydrate		Starch		*In vitro* Dry Matter Digestibility	
Species	Part part	*n*	mean	range	mean	range	mean	range	mean	range
Halophila ovalis	Leaf	81	10.78 (0.40)	1.17 - 20.63	0.08 (0.01)	0.00 - 0.40	0.93 (0.08)	0.00 - 2.80	93.04 (0.36)	85.93 - 99.99
	Root/ Rhizome	77	8.97 (0.34)	2.34 - 16.00	0.20 (0.01)	0.00 - 0.55	0.98 (0.16)	0.00 - 7.80	92.26 (0.34)	82.25 - 99.99
	Whole Plant	158	9.90 (0.27)	1.17 - 20.63	0.14 (0.01)	0.00 - 0.55	0.96 (0.09)	0.00 - 7.80	92.66 (0.25)	82.25 - 99.99
Zostera capricorni	Leaf	61	15.35 (0.42)	8.55 - 25.21	0.08 (0.01)	0.00 - 0.43	1.06 (0.07)	0.00 - 2.30	90.19 (0.34)	82.48 - 96.07
	Root/ Rhizome	67	15.07 (0.55)	6.83 - 24.64	0.13 (0.01)	0.00 - 0.49	7.08 (0.52)	0.00 - 15.50	82.29 (0.75)	63.18 - 92.66
	Whole Plant	128	15.20 (0.35)	6.83 - 25.21	0.11 (0.01)	0.00 - 0.49	4.22 (0.38)	0.00 - 15.50	86.06 (0.55)	63.18 - 96.07
	Seeds	3	22.26 (0.48)	21.49 - 23.15	0.42 (0.01)	0.42 - 0.43	1.03 (0.04)	1.00 - 1.10	85.04 (0.25)	84.56 - 85.41
Halodule uninervis	Leaf	283	18.94 (0.15)	11.43 - 29.43	0.10 (0.01)	0.00 - 0.74	1.15 (0.05)	0.00 - 5.00	90.05 (0.12)	84.24 - 94.88
	Root/ Rhizome	279	8.43 (0.16)	1.58 - 16.60	0.18 (0.01)	0.00 - 0.75	13.68 (0.53)	0.10 - 30.70	83.65 (0.18)	74.80 - 91.64
	Whole Plant	562	13.72 (0.25)	1.58 - 29.43	0.14 (0.01)	0.00 - 0.75	7.37 (0.37)	0.00 - 30.70	86.87 (0.17)	74.80 - 94.88
H. spinulosa	Leaf	75	11.21 (0.39)	4.54 - 23.89	0.08 (0.01)	0.00 - 0.34	1.41 (0.16)	0.00 - 7.00	89.04 (0.39)	78.34 - 97.35
	Root/ Rhizome	74	8.77 (0.21)	4.42 - 12.70	0.18 (0.01)	0.02 - 0.40	0.57 (0.05)	0.00 - 1.70	96.02 (0.30)	90.12 - 99.99
	Whole Plant	149	10.00 (0.24)	4.42 - 23.89	0.13 (0.01)	0.00 - 0.40	1.00 (0.09)	0.00 - 7.00	92.51 (.038)	78.34 - 99.99

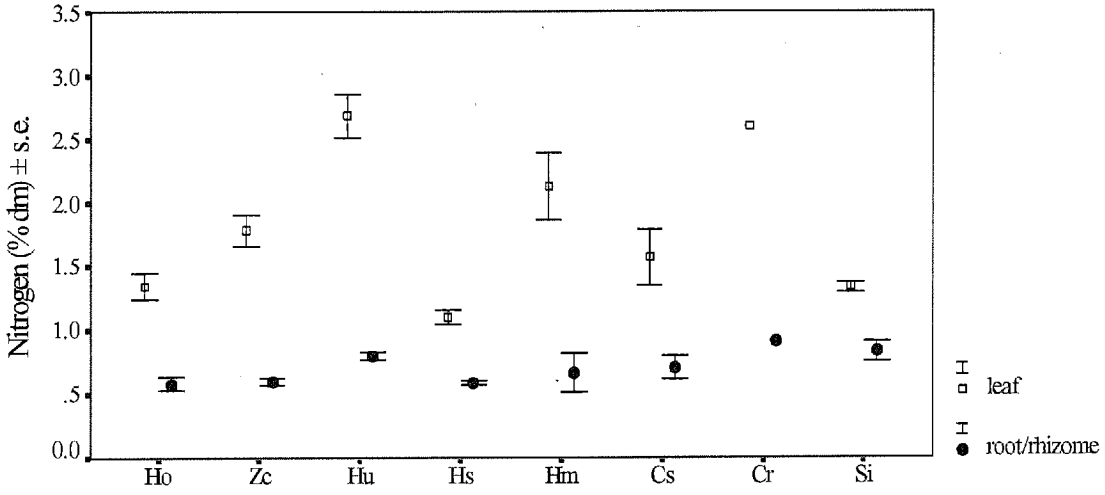
H. minor	Leaf	27	11.52 (0.50)	4.92 - 17.05	0.10 (0.01)	0.01 - 0.19	0.81 (0.08)	0.00 - 1.80	90.12 (0.38)	86.24 - 93.96
	Root/ Rhizome	27	8.75 (0.61)	4.21 - 18.03	0.24 (0.03)	0.03 - 0.65	1.78 (0.25)	0.20 - 5.70	91.26 (0.44)	85.48 - 95.08
	Whole Plant	54	10.14 (0.43)	4.21 - 18.03	0.17 (0.02)	0.01 - 0.65	1.30 (0.14)	0.00 - 5.70	90.69 (0.30)	85.48 - 95.08
Cymodocea serrulata	Leaf	4	15.28 (0.76)	13.01 - 16.13	0.11 (0.01)	0.07 - 0.13	0.19 (0.13)	0.00 - 0.60	89.72 (2.00)	85.68 - 93.46
	Root/ Rhizome	4	15.79 (1.87)	11.91 - 19.79	0.55 (0.08)	0.37 - 0.70	1.40 (0.34)	0.70 - 2.30	80.98 (2.77)	77.14 - 89.21
	Whole Plant	8	15.53 (0.94)	11.91 - 19.79	0.33 (0.09)	0.07 - 0.70	0.80 (0.28)	0.00 - 2.30	85.36 (2.29)	77.14 - 93.46
C. rotundata	Leaf	12	19.03 (0.75)	14.13 - 24.63	0.05 (0.01)	0.01 - 0.11	0.75 (0.18)	0.10 - 2.20	87.00 (0.96)	79.22 - 89.58
	Root/ Rhizome	13	19.85 (0.95)	10.11 - 22.92	0.18 (0.06)	0.00 - 0.76	2.31 (1.16)	0.10 - 15.00	72.95 (1.53)	65.60 - 83.47
	Whole Plant	25	19.46 (0.60)	10.11 - 24.63	0.12 (0.03)	0.00 - 0.76	1.56 (0.62)	0.10 - 15.00	79.69 (1.69)	65.60 - 89.58
Syringodium isoetifolium	Leaf	12	10.22 (0.97)	4.97 - 16.00	1.93 (0.50)	0.00 - 4.49	1.62 (0.32)	0.50 - 3.20	96.90 (0.67)	93.83 - 99.91
	Root/ Rhizome	12	11.09 (1.36)	5.30 - 19.94	6.41 (1.50)	0.30 - 10.93	3.87 (0.89)	0.00 - 7.10	84.65 (0.54)	81.75 - 87.75
	Whole Plant	24	10.65 (0.82)	4.97 - 19.94	4.17 (0.90)	0.00 - 10.93	2.74 (0.52)	0.00 - 7.10	90.77 (1.35)	81.75 - 99.91
H. trichostata	Whole Plant	7	8.09 (0.48)	6.19 - 9.79	0.12 (0.01)	0.05 (0.18)	5.60 (0.90)	0.80 - 8.10	93.52 (0.78)	90.77 - 97.13
H. decipiens	Whole Plant	4	4.84 (0.96)	2.27 - 6.89	0.08 (0.01)	0.04 - 0.11	2.62 (0.43)	1.50 - 3.60	92.45 (0.76)	90.23 - 93.57

Table 2. Comparison of the nutritional composition of two varieties (narrow- and wide-leaf) of *Zostera capricorni* and *Halodule uninervis* harvested from along the coastal waters of Queensland during the course of this study.

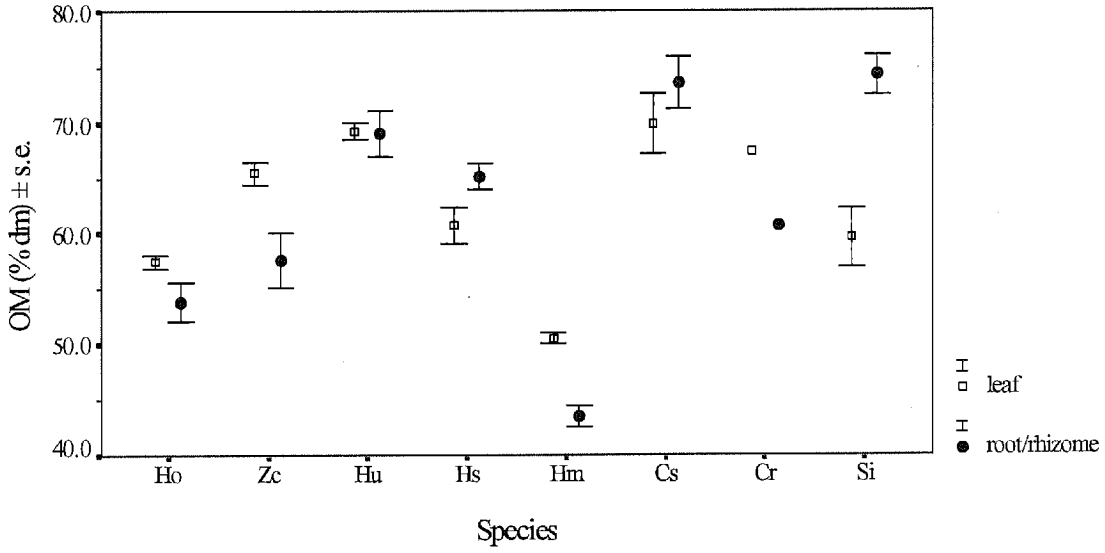
				Nitrogen		Organic Matter		Neutral Detergent Fibre		Acid Detergent Fibre		Hemicellulose	
Species	Variety	Plant Part	n	mean	range	mean	range	mean	range	mean	range	mean	range
Zostera capricorni	narrow	leaf	8	1.89 (0.11)	1.52-2.44	67.93 (1.35)	63.44-73.84	40.52 (1.24)	36.20-45.60	27.57 (0.57)	25.88-30.53	12.95 (0.89)	9.68-16.11
		root/ rhizome	6	0.61 (0.03)	0.48-0.66	61.87 (2.99)	50.06-72.10	27.96 (1.14)	24.16-30.86	20.01 (0.49)	18.22-21.77	7.94 (1.08)	3.66-10.67
		whole plant	14	1.34 (0.18)	0.48-2.44	65.33 (1.65)	50.06-73.84	35.13 (1.91)	24.16-45.60	24.33 (1.10)	18.22-30.53	10.80 (0.95)	3.66-16.11
	wide	leaf	53	1.92 (0.05)	1.03-2.85	63.30 (0.51)	54.55-71.05	43.64 (0.74)	35.16-61.01	28.08 (0.55)	19.33-40.48	15.56 (0.31)	10.46-21.55
		root/ rhizome	61	0.66 (0.03)	0.26-1.66	55.66 (0.85)	38.29-68.74	34.88 (0.65)	38.29-68.74	26.77 (0.63)	17.60-38.02	8.11 (0.29)	3.42-14.13
		whole plant	114	1.25 (0.07)	0.26-2.85	59.21 (0.62)	38.29-71.05	38.95 (0.64)	22.21-61.01	27.38 (0.43)	17.60-40.48	11.57 (0.41)	3.42-21.55
Halodule uninervis	narrow	leaf	273	2.93 (0.02)	1.99-3.76	68.52 (0.21)	58.90-79.28	48.33 (0.22)	35.51-62.15	32.66 (0.18)	21.07-45.52	15.67 (0.12)	9.19-21.22
		root/ rhizome	269	0.85 (0.01)	0.53-1.58	65.04 (0.47)	47.17-81.82	28.13 (0.25)	17.37-40.42	19.89 (0.24)	9.43-29.30	8.24 (0.13)	0.70-15.28
		whole plant	542	1.90 (0.05)	0.53-3.76	66.79 (0.27)	47.17-81.82	38.31 (0.47)	17.37-62.15	26.32 (0.31)	9.43-42.52	11.98 (0.18)	0.70-21.22
	wide	leaf	10	1.68 (0.03)	1.56-1.82	70.27 (0.56)	68.31-73.00	44.99 (0.44)	42.70-46.56	30.62 (0.27)	28.92-31.97	14.36 (0.36)	12.90-16.00
		root/ rhizome	10	0.63 (0.02)	0.57-0.70	73.20 (1.15)	68.58-81.35	32.05 (0.42)	29.30-34.50	22.65 (0.40)	20.22-24.31	9.40 (0.47)	7.76-12.10
		whole plant	20	1.16 (0.12)	0.57-1.82	71.73 (0.71)	68.31-81.35	38.52 (1.51)	29.30-46.56	26.64 (0.94)	20.22-31.97	11.88 (0.64)	7.76-16.00

				Lignin		Water Soluble Carbohydrate		Starch		*In Vitro* Dry matter Digestibility	
Species	Variety	Plant Part	n	mean	range	mean	range	mean	range	mean	range
Zostera capricorni	narrow	leaf	8	16.12 (0.80)	12.40 - 19.96	0.20 (0.05)	0.10 - 0.43	0.97 (0.18)	0.20 - 1.60	91.36 (1.01)	87.28 - 94.64
		root/ rhizome	6	9.70 (0.73)	7.72 - 12.20	0.32 (0.05)	0.21 - 0.49	7.58 (1.74)	3.40 - 13.10	90.51 (1.04)	85.65 - 92.66
		whole plant	14	13.37 (1.03)	7.72 - 19.96	0.25 (0.04)	0.10 - 0.49	3.80 (1.15)	0.20 - 13.10	90.99 (0.71)	85.65 - 94.64
	wide	leaf	53	15.24 (0.47)	8.55 - 25.21	0.07 (0.01)	0.00 - 0.37	1.08 (0.08)	0.00 - 2.30	90.02 (0.36)	82.48 - 96.07
		root/ rhizome	61	15.59 (0.55)	6.83 - 24.64	0.11 (0.01)	0.00 - 0.31	7.04 (0.55)	0.00 - 15.50	81.48 (0.74)	63.18 - 91.88
		whole plant	114	15.43 (0.36)	6.83 - 25.21	0.09 (0.01)	0.00 - 0.37	4.27 (0.41)	0.00 - 15.50	84.45 (0.58)	63.18 - 96.07
Halodule uninervis	narrow	leaf	273	19.09 (0.15)	11.43 - 29.43	0.10 (0.01)	0.00 - 0.74	1.18 (0.05)	0.00 - 5.00	90.11 (0.12)	84.24 - 94.88
		root/ rhizome	269	8.31 (0.16)	1.58 - 16.60	0.18 (0.01)	0.00 - 0.75	13.56 (0.54)	0.10 - 30.70	83.78 (0.18)	74.80 - 91.64
		whole plant	542	13.74 (0.26)	1.58 - 29.43	0.14 (0.01)	0.00 - 0.75	7.32 (0.38)	0.00 - 30.70	86.97 (0.17)	74.80 - 94.88
	wide	leaf	10	14.86 (0.37)	13.05 - 16.96	0.13 (0.01)	0.09 - 0.22	0.38 (0.09)	0.10 - 0.90	88.39 (0.69)	85.07 - 91.15
		root/ rhizome	10	11.59 (0.61)	6.76 - 13.11	0.19 (0.02)	0.11 - 0.31	17.09 (0.68)	15.00 - 22.80	80.07 (0.52)	77.90 - 83.54
		whole plant	20	13.22 (0.51)	6.76- 16.96	0.16 (0.01)	0.09 - 0.31	8.74 (1.95)	0.10 - 22.80	84.23 (1.04)	77.90 - 91.15

1. Nitrogen

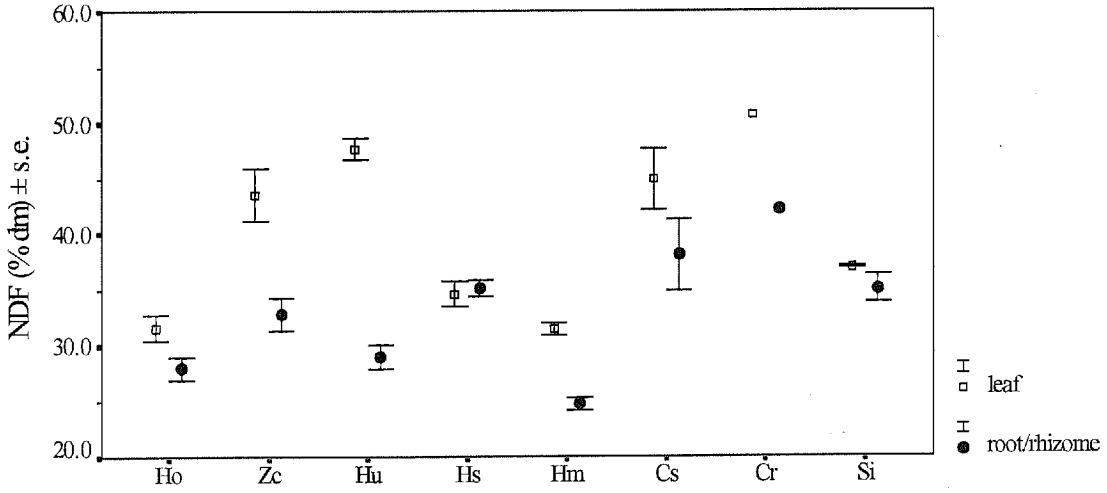


2. Organic Matter

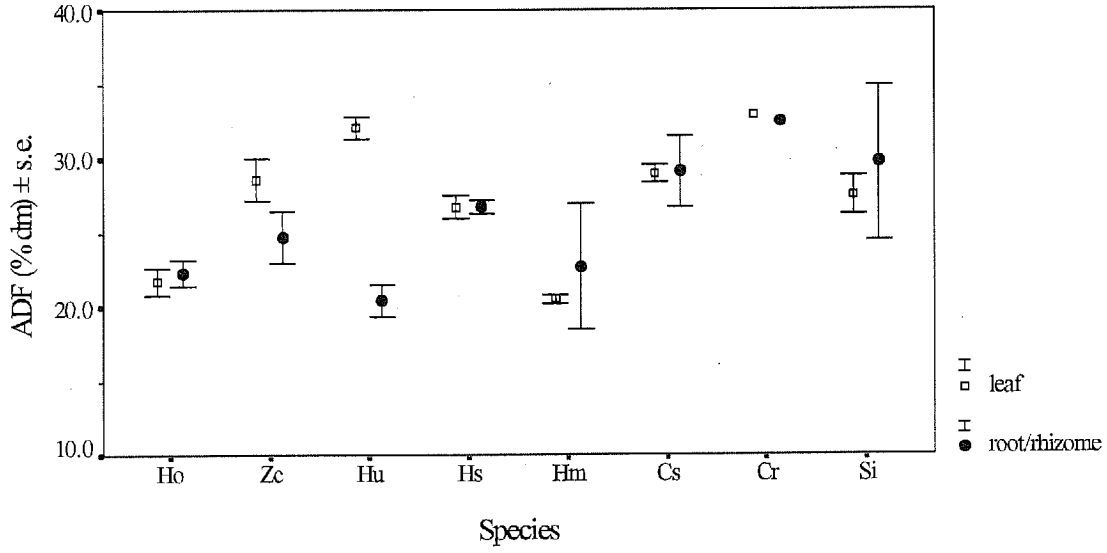


Figures 1 and 2.

3. Neutral Detergent Fibre

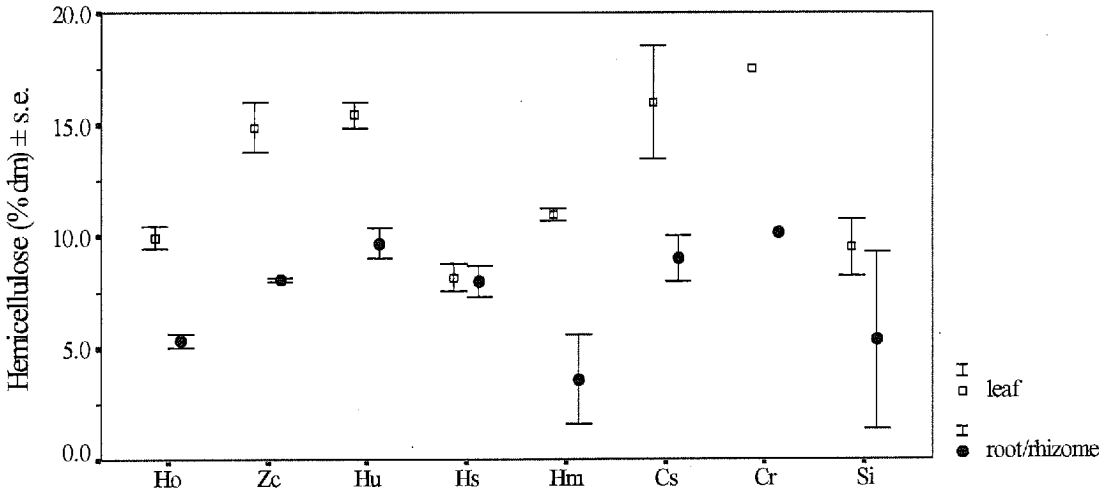


4. Acid Detergent Fibre

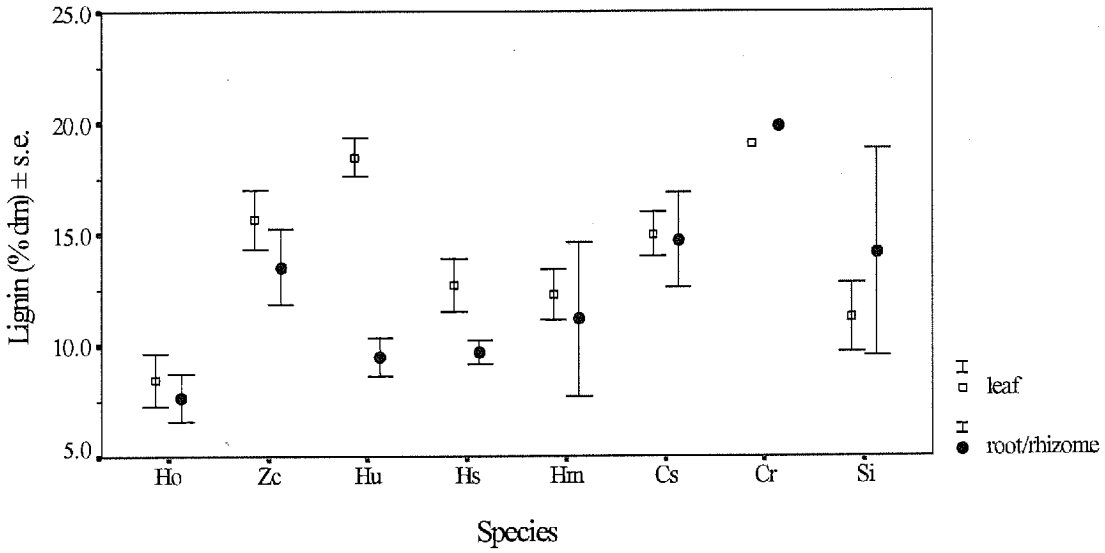


Figures 3 and 4.

5. Hemicellulose

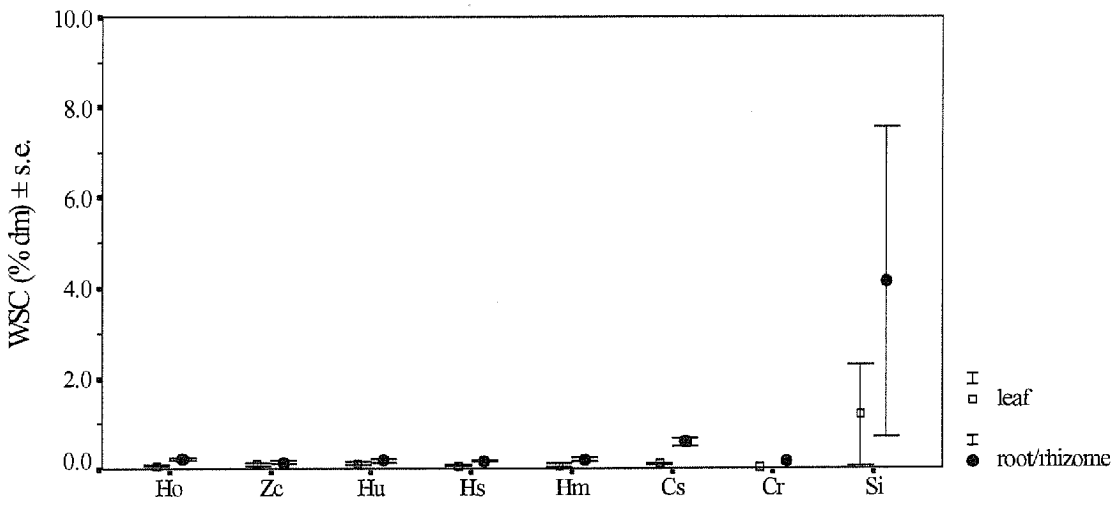


6. Lignin

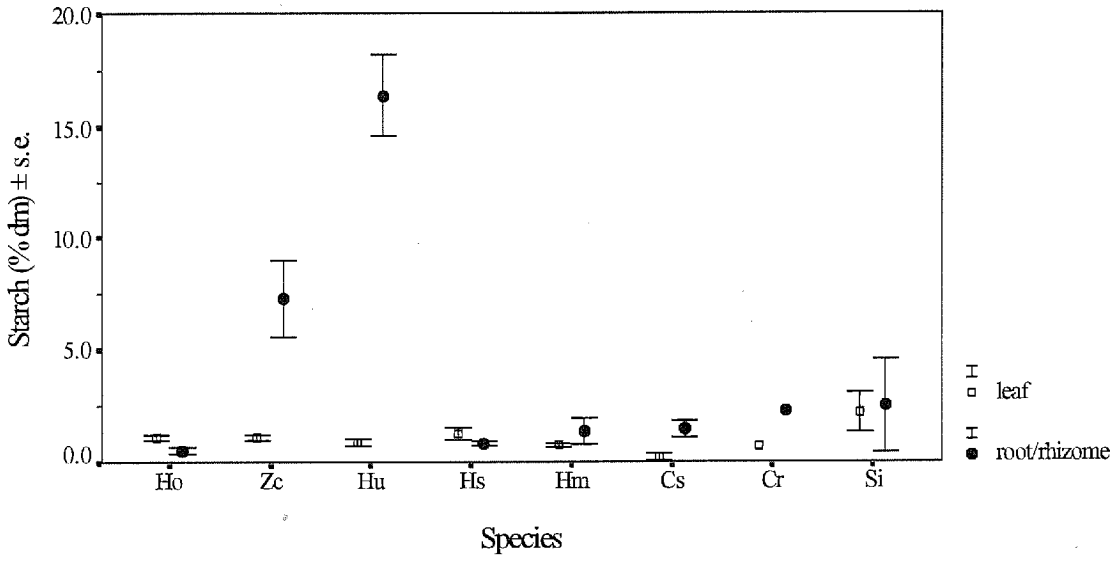


Figures 5 and 6.

7. Water Soluble Carbohydrate



8. Starch



Figures 7 and 8.

9. In Vitro Dry Matter Digestibility

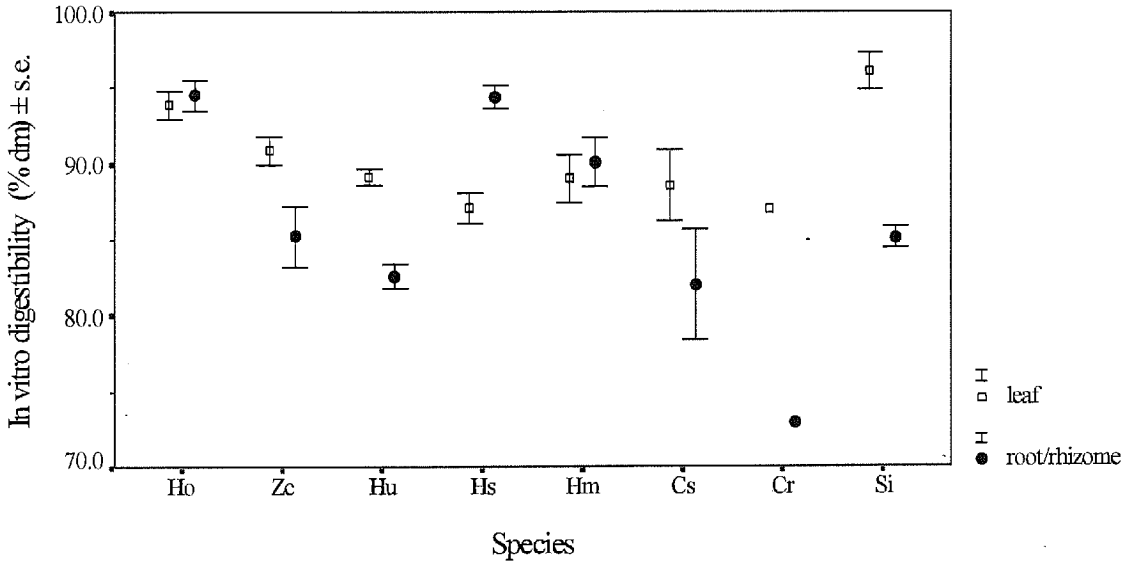


Figure 9.

Appendix 9.

Table 1. Results of the univariate *F* tests (with 7, 547 df) on the leaf fraction of the different seagrass species collected in this study (as oppose to the results of the multivariate tests presented in Table 7.2). Variables (nutritional components) are ordered by size of *F* ratio. The values for the water soluble carbohydrate and starch were log transformed.

Variable	Hypothesis SS	Error SS	Hypothesis MS	Error MS	*F*	*p*
Neutral Detergent Fibre	26170.4584	2846.63469	3738.63691	5.20409	718.40423	**0.000**
Acid Detergent Fibre	10205.9272	1556.69287	1457.98960	2.84587	512.31706	**0.000**
Organic Matter	15002.0056	2928.31345	2143.14365	5.35341	400.33268	**0.000**
Nitrogen	257.22369	55.01262	36.74624	0.10057	365.37424	**0.000**
Lignin	7414.82907	2256.39926	1059.26130	4.12504	256.78786	**0.000**
In Vitro Dry Matter Digestibility	1389.91422	1457.64563	198.55917	2.66480	74.51185	**0.000**
Water Soluble Carbohydrate	19.58264	39.294000	2.79752	0.07184	38.94343	**0.000**
Starch	5.23550	18.61372	0.74793	0.03403	21.97934	**0.000**

Table 2. Results of the univariate *F* tests (with 7, 545 df) for root/rhizome fraction of the different species collected in this study (as oppose to the results of the multivariate tests presented in Table 7.2). Variables (nutritional components) are ordered by size of *F* ratio. The values for the water soluble carbohydrate and starch were log transformed.

Variable	Hypothesis SS	Error SS	Hypothesis MS	Error MS	*F*	*p*
Starch	173.25481	22.56650	24.75069	0.04141	597.74990	**0.000**
In Vitro Dry Matter Digestibility	15881.2621	3062.62428	2268.75173	5.61949	403.72882	**0.000**
Neutral Detergent Fibre	9438.73008	2641.24177	1348.39001	4.84632	278.22995	**0.000**
Acid Detergent Fibre	6647.99158	2410.99186	949.71308	4.42384	214.68079	**0.000**
Organic Matter	32086.8829	11700.3871	4583.84041	21.46860	213.51371	**0.000**
Lignin	4018.40835	2188.27675	574.05834	4.01519	142.97177	**0.000**
Water Soluble Carbohydrate	29.62374	16.93318	4.23196	0.03107	136.20716	**0.000**
Nitrogen	6.55236	3.79182	0.93605	0.00696	134.53914	**0.000**

Appendix 10. Output tables of the ANOVAs which examined the response of the different nutritional components of seagrass from the long-term and short-term grazing experiments.

Table 1. Results of the multi-factor analysis of variance which examined the mean response of the amounts of nitrogen (% dry matter) for separated (leaf and roots/rhizomes fractions) and combined (whole plant) plant parts to the different treatment levels (simulated high and low grazing and cropping, and undisturbed) from the different seagrass species (*H. ovalis* and *Z. capricorni* + *C. rotundata*) harvested from the long-term experiments conducted at Ellie Point. Random factors are italicised, otherwise they are fixed. Significant *p* values are highlighted in bold.

Factor	Error Term	SS	df	MS	F	p
Leaves						
Site	Residual	5.76	3	1.92	29.39	**0.000**
Treatment (=Trt)	*Site**Trt	0.84	3	0.28	4.26	**0.039**
Species	Species**Site*	0.03	1	0.03	0.08	0.794
*Site**Trt	Residual	0.59	9	0.07	1.00	0.447
Species**Site*	Residual	1.24	3	0.41	6.32	**0.001**
Species*Trt	*Site**Species*Trt	0.88	3	0.29	4.74	**0.030**
*Site**Species*Trt	Residual	0.56	9	0.06	0.95	0.487
Site*Sp*Trt*Replication		4.25	65	0.07		
Roots/Rhizomes						
Site	Residual	0.96	3	0.32	19.80	**0.000**
Treatment (=Trt)	*Site**Trt	0.10	3	0.03	2.70	0.108
Species	Species**Site*	0.05	1	0.05	0.60	0.494
*Site**Trt	Residual	0.11	9	0.01	0.75	0.658
Species**Site*	Residual	0.27	3	0.09	5.50	**0.002**
Species*Trt	*Site**Species*Trt	0.02	3	0.01	1.21	0.360
*Site**Species*Trt	Residual	0.05	9	0.01	0.37	0.944
Site*Sp*Trt*Replication		1.07	66	0.02		

Factor	Error Term	SS	df	MS	F	p
Whole Plant						
Site	Residual	5.25	3	1.75	2.68	**0.049**
Treatment (=Trt)	*Site**Trt	0.75	3	0.25	5.23	**0.023**
Species	Species**Site*	0.00	1	0.00	0.00	0.991
*Site**Trt	Residual	0.43	9	0.05	0.07	1.000
Species**Site*	Residual	1.01	3	0.34	0.52	0.672
Species*Trt	*Site**Species*Trt	0.48	3	0.16	3.08	0.083
*Site**Species*Trt	Residual	0.47	9	0.05	0.08	1.000
Site*Sp*Trt*Replication		106.27	163	0.65		

Table 2. Results of the multi-factor analysis of variance which examined the mean response of the amounts of organic matter (% dry matter) for separated (leaf and roots/rhizomes fractions) and combined (whole plant) plant parts to the different treatment levels (simulated high and low grazing and cropping, and undisturbed) from the different seagrass species (*H. ovalis* and *Z. capricorni* + *C. rotundata*) harvested from the long-term experiments conducted at Ellie Point. Random factors are italicised, otherwise they are fixed. Significant *p* values are highlighted in bold.

Factor	Error Term	SS	df	MS	F	p
Leaves						
Site	Site*Sp*Trt*Replication	295.65	3	98.55	11.08	**0.000**
Treatment (=Trt)	*Site**Trt	78.18	3	26.06	1.61	0.256
Species	Species**Site*	851.72	1	851.72	36.24	**0.009**
*Site**Trt	Site*Sp*Trt*Replication	146.07	9	16.23	1.83	0.080
Species**Site*	Site*Sp*Trt*Replication	70.50	3	23.50	2.64	0.057
Species*Trt	*Site**Species*Trt	20.97	3	6.99	1.00	0.435
*Site**Species*Trt	Site*Sp*Trt*Replication	62.67	9	6.96	0.78	0.633
Site*Sp*Trt*Replication		577.94	65	8.89		
Roots/Rhizomes						
Site	Site*Sp*Trt*Replication	304.51	3	101.50	3.64	**0.017**
Treatment (=Trt)	*Site**Trt	262.43	3	87.48	4.42	**0.036**
Species	Species**Site*	1262.55	1	1262.55	13.00	**0.037**
*Site**Trt	Site*Sp*Trt*Replication	178.18	9	19.80	0.71	0.698
Species**Site*	Site*Sp*Trt*Replication	291.28	3	97.09	3.48	**0.021**
Species*Trt	*Site**Species*Trt	17.16	3	5.72	0.29	0.835
*Site**Species*Trt	Site*Sp*Trt*Replication	180.33	9	20.04	0.72	0.690
Site*Sp*Trt*Replication		1840.71	66	27.89		

Factor	Error Term	SS	df	MS	F	p
Whole Plant						
Site	Site*Sp*Trt*Replication	540.86	3	180.29	4.58	**0.004**
Treatment (=Trt)	*Site*Trt	299.26	3	99.75	3.67	0.056
Species	Species**Site*	2078.16	1	2078.16	23.00	**0.017**
*Site*Trt	Site*Sp*Trt*Replication	244.64	9	27.18	0.69	0.717
Species**Site*	Site*Sp*Trt*Replication	271.07	3	90.36	2.30	0.080
Species*Trt	*Site*Species*Trt	6.13	3	2.04	0.23	0.875
*Site*Species*Trt	Site*Sp*Trt*Replication	81.06	9	9.01	0.23	0.990
Site*Sp*Trt*Replication		6416.12	163	39.36		

Table 3. Results of the multi-factor analysis of variance which examined the mean response of the amounts of neutral detergent fibre (% dry matter) for separated (leaf and roots/rhizomes fractions) and combined (whole plant) plant parts to the different treatment levels (simulated high and low grazing and cropping, and undisturbed) from the different seagrass species (*H. ovalis* and *Z. capricorni* + *C. rotundata*) harvested from the long-term experiments conducted at Ellie Point. Random factors are italicised, otherwise they are fixed. Significant *p* values are highlighted in bold.

Factor	Error Term	SS	df	MS	F	p
Leaves						
Site	Site*Sp*Trt*Replication	505.52	3	168.51	12.17	**0.000**
Treatment (=Trt)	*Site**Trt	69.82	3	23.27	3.00	0.087
Species	Species**Site*	2324.55	1	2324.55	50.20	**0.006**
*Site**Trt	Site*Sp*Trt*Replication	69.71	9	7.75	0.56	0.825
Species**Site*	Site*Sp*Trt*Replication	138.92	3	46.31	3.34	**0.024**
Species*Trt	*Site**Species*Trt	24.93	3	8.31	0.57	0.651
*Site**Species*Trt	Site*Sp*Trt*Replication	132.30	9	14.70	1.06	0.403
Site*Sp*Trt*Replication		899.94	65	13.85		
Roots/Rhizomes						
Site	Site*Sp*Trt*Replication	306.45	3	102.15	6.56	**0.001**
Treatment (=Trt)	*Site**Trt	17.99	3	6.00	0.44	0.728
Species	Species**Site*	2098.58	1	2098.58	19.84	**0.021**
*Site**Trt	Site*Sp*Trt*Replication	121.64	9	13.52	0.87	0.558
Species**Site*	Site*Sp*Trt*Replication	317.29	3	105.76	6.79	**0.000**
Species*Trt	*Site**Species*Trt	23.16	3	7.72	0.43	0.734
*Site**Species*Trt	Site*Sp*Trt*Replication	159.91	9	17.77	1.14	0.348
Site*Sp*Trt*Replication		1028.22	66	15.58		

Factor	Error Term	SS	df	MS	F	p
Whole Plant						
Site	Site*Sp*Trt*Replication	712.71	3	237.57	8.51	**0.000**
Treatment (=Trt)	*Site*Trt	64.42	3	21.47	2.08	0.173
Species	Species**Site*	4401.51	1	4401.51	32.63	**0.011**
*Site*Trt	Site*Sp*Trt*Replication	92.97	9	10.33	0.37	0.948
Species**Site*	Site*Sp*Trt*Replication	404.73	3	134.91	4.83	**0.003**
Species*Trt	*Site*Species*Trt	26.86	3	8.95	0.40	0.757
*Site*Species*Trt	Site*Sp*Trt*Replication	202.06	9	22.45	0.80	0.613
Site*Sp*Trt*Replication		4548.76	163	27.91		

Table 4. Results of the multi-factor analysis of variance which examined the mean response of the amounts of acid detergent fibre (% dry matter) for separated (leaf and roots/rhizomes fractions) and combined (whole plant) plant parts to the different treatment levels (simulated high and low grazing and cropping, and undisturbed) from the different seagrass species (*H. ovalis* and *Z. capricorni* + *C. rotundata*) harvested from the long-term experiments conducted at Ellie Point. Random factors are italicised, otherwise they are fixed. Significant *p* values are highlighted in bold.

Factor	Error Term	SS	df	MS	F	p
Leaves						
Site	Site*Sp*Trt*Replication	152.35	3	50.78	5.91	**0.001**
Treatment (=Trt)	*Site**Trt	19.07	3	6.36	1.32	0.326
Species	Species**Site*	848.98	1	848.98	37.92	**0.009**
*Site**Trt	Site*Sp*Trt*Replication	43.21	9	4.80	0.56	0.825
Species**Site*	Site*Sp*Trt*Replication	67.17	3	22.39	2.61	0.059
Species*Trt	*Site**Species*Trt	12.43	3	4.14	0.56	0.656
*Site**Species*Trt	Site*Sp*Trt*Replication	66.82	9	7.42	0.86	0.561
Site*Sp*Trt*Replication		558.16	65	8.59		
Roots/Rhizomes						
Site	Site*Sp*Trt*Replication	363.72	3	121.24	11.52	**0.000**
Treatment (=Trt)	*Site**Trt	10.51	3	3.50	0.69	0.580
Species	Species**Site*	708.63	1	708.63	23.92	**0.016**
*Site**Trt	Site*Sp*Trt*Replication	45.54	9	5.06	0.48	0.883
Species**Site*	Site*Sp*Trt*Replication	88.88	3	29.91	2.81	**0.046**
Species*Trt	*Site**Species*Trt	10.04	3	3.35	0.27	0.849
*Site**Species*Trt	Site*Sp*Trt*Replication	113.46	9	12.61	1.20	0.312
Site*Sp*Trt*Replication		694.78	66	10.53		

Factor	Error Term	SS	df	MS	F	p
Whole Plant						
Site	Site*Sp*Trt*Replication	492.47	3	164.16	18.45	**0.000**
Treatment (=Trt)	*Site*Trt	8.18	3	2.73	0.46	0.714
Species	Species**Site*	1556.87	1	1556.87	31.21	**0.011**
*Site*Trt	Site*Sp*Trt*Replication	52.90	9	5.88	0.66	0.744
Species**Site*	Site*Sp*Trt*Replication	149.66	3	49.89	5.61	**0.001**
Species*Trt	*Site*Species*Trt	3.84	3	1.29	0.09	0.964
*Site*Species*Trt	Site*Sp*Trt*Replication	128.85	9	14.32	1.61	0.116
Site*Sp*Trt*Replication		1450.32	163	8.90		

Table 5. Results of the multi-factor analysis of variance which examined the mean response of the amounts of hemicellulose (% dm) for separated (leaf and roots/rhizomes fractions) and combined (whole plant) plant parts to the different treatment levels (simulated high and low grazing and cropping, and undisturbed) from the different seagrass species (*H. ovalis* and *Z. capricorni* + *C. rotundata*) harvested from the long-term experiments conducted at Ellie Point. Random factors are italicised, otherwise they are fixed. Significant *p* values are highlighted in bold.

Factor	Error Term	SS	df	MS	F	p
Leaves						
Site	Site*Sp*Trt*Replication	112.64	3	37.55	8.85	**0.000**
Treatment (=Trt)	*Site*Trt	25.41	3	8.47	0.86	0.498
Species	Species**Site*	363.91	1	363.91	76.78	**0.003**
*Site*Trt	Site*Sp*Trt*Replication	89.01	9	9.89	2.33	**0.024**
Species**Site*	Site*Sp*Trt*Replication	14.22	3	4.74	1.12	0.349
Species*Trt	*Site*Species*Trt	13.21	3	4.40	0.58	0.644
*Site*Species*Trt	Site*Sp*Trt*Replication	68.63	9	7.63	1.80	0.086
Site*Sp*Trt*Replication		275.88	65	4.24		
Roots/Rhizomes						
Site	Site*Sp*Trt*Replication	32.09	3	10.70	2.02	0.120
Treatment (=Trt)	*Site*Trt	8.09	3	2.70	0.43	0.738
Species	Species**Site*	247.77	1	247.77	25.99	**0.015**
*Site*Trt	Site*Sp*Trt*Replication	56.79	9	6.31	1.19	0.316
Species**Site*	Site*Sp*Trt*Replication	28.60	3	9.53	1.80	0.156
Species*Trt	*Site*Species*Trt	4.73	3	1.58	0.89	0.484
*Site*Species*Trt	Site*Sp*Trt*Replication	16.01	9	1.78	0.34	0.960
Site*Sp*Trt*Replication		349.92	66	5.30		

Factor	Error Term	SS	df	MS	F	p
Whole Plant						
Site	Site*Sp*Trt*Replication	79.97	3	26.66	1.47	0.225
Treatment (=Trt)	*Site*Trt	22.03	3	7.34	0.69	0.580
Species	Species**Site*	597.75	1	597.75	65.10	**0.004**
*Site*Trt	Site*Sp*Trt*Replication	95.56	9	10.62	0.59	0.808
Species**Site*	Site*Sp*Trt*Replication	27.55	3	9.18	0.51	0.679
Species*Trt	*Site*Species*Trt	8.18	3	2.73	0.45	0.726
*Site*Species*Trt	Site*Sp*Trt*Replication	55.05	9	6.12	0.34	0.961
Site*Sp*Trt*Replication		2956.98	163	18.14		

Table 6. Results of the multi-factor analysis of variance which examined the mean response of the amounts of lignin (% dm) for separated (leaf and roots/rhizomes fractions) and combined (whole plant) plant parts to the different treatment levels (simulated high and low grazing and cropping, and undisturbed) from the different seagrass species (*H. ovalis* and *Z. capricorni* + *C. rotundata*) harvested from the long-term experiments conducted at Ellie Point. Random factors are italicised, otherwise they are fixed. Significant *p* values are highlighted in bold.

Factor	Error Term	SS	df	MS	F	p
Leaves						
Site	Site*Sp*Trt*Replication	149.97	3	49.99	6.28	**0.001**
Treatment (=Trt)	*Site**Trt	16.02	3	5.34	0.55	0.660
Species	Species**Site*	325.21	1	325.21	160.06	**0.001**
*Site**Trt	Site*Sp*Trt*Replication	87.24	9	9.69	1.22	0.300
Species**Site*	Site*Sp*Trt*Replication	6.10	3	2.03	0.26	0.857
Species*Trt	*Site**Species*Trt	19.76	3	6.59	0.60	0.629
*Site**Species*Trt	Site*Sp*Trt*Replication	98.36	9	10.93	1.37	0.216
Site*Sp*Trt*Replication		517.53	65	7.96		
Roots/Rhizomes						
Site	Site*Sp*Trt*Replication	221.73	3	73.91	9.89	**0.000**
Treatment (=Trt)	*Site**Trt	3.54	3	1.18	0.17	0.915
Species	Species**Site*	960.10	1	960.10	40.10	**0.008**
*Site**Trt	Site*Sp*Trt*Replication	62.77	9	6.97	0.93	0.502
Species**Site*	Site*Sp*Trt*Replication	71.83	3	23.94	3.20	**0.029**
Species*Trt	*Site**Species*Trt	6.49	3	2.16	0.39	0.766
*Site**Species*Trt	Site*Sp*Trt*Replication	50.51	9	5.61	0.75	0.661
Site*Sp*Trt*Replication		493.08	66	7.47		

Factor	Error Term	SS	df	MS	F	p
Whole Plant						
Site	Site*Sp*Trt*Replication	332.18	3	110.73	13.06	**0.000**
Treatment (=Trt)	*Site*Trt	7.14	3	2.38	0.21	0.886
Species	Species**Site*	1204.47	1	1204.47	59.66	**0.005**
*Site*Trt	Site*Sp*Trt*Replication	101.42	9	11.27	1.33	0.226
Species**Site*	Site*Sp*Trt*Replication	60.57	3	20.19	2.38	0.072
Species*Trt	*Site*Species*Trt	6.45	3	2.15	0.19	0.899
*Site*Species*Trt	Site*Sp*Trt*Replication	100.35	9	11.15	1.31	0.233
Site*Sp*Trt*Replication		1382.19	163	8.48		

Table 7. Results of the multi-factor analysis of variance which examined the mean response of the concentrations of water-soluble carbohydrates (% dm) for separated (leaf and roots/rhizomes fractions) and combined (whole plant) plant parts to the different treatment levels (simulated high and low grazing and cropping, and undisturbed) from the different seagrass species (*H. ovalis* and *Z. capricorni* + *C. rotundata*) harvested from the long-term experiments conducted at Ellie Point. Random factors are italicised, otherwise they are fixed. Significant *p* values are highlighted in bold.

Factor	Error Term	SS	df	MS	F	p
Leaves						
Site	Site*Sp*Trt*Replication	149.98	3	49.33	2.88	**0.043**
Treatment (=Trt)	*Site**Trt	81.20	3	27.07	0.43	0.735
Species	Species**Site*	0.02	1	0.02	0.00	0.991
*Site**Trt	Site*Sp*Trt*Replication	563.26	9	62.58	3.65	**0.001**
Species**Site*	Site*Sp*Trt*Replication	384.11	3	128.04	7.47	**0.000**
Species*Trt	*Site**Species*Trt	143.16	3	47.72	1.84	0.210
*Site**Species*Trt	Site*Sp*Trt*Replication	233.65	9	25.96	1.52	0.161
Site*Sp*Trt*Replication		1113.77	65	17.13		
Roots/Rhizomes						
Site	Site*Sp*Trt*Replication	255.82	3	85.27	1.85	0.147
Treatment (=Trt)	*Site**Trt	366.14	3	122.05	2.46	0.129
Species	Species**Site*	528.30	1	528.30	2.70	0.199
*Site**Trt	Site*Sp*Trt*Replication	445.90	9	49.54	1.07	0.395
Species**Site*	Site*Sp*Trt*Replication	586.68	3	195.56	4.23	**0.008**
Species*Trt	*Site**Species*Trt	359.94	3	119.98	4.44	**0.036**
*Site**Species*Trt	Site*Sp*Trt*Replication	243.36	9	27.04	0.59	0.805
Site*Sp*Trt*Replication		3049.53	66	46.21		

Factor	Error Term	SS	df	MS	F	p
Whole Plant						
Site	Site*Sp*Trt*Replication	283.61	3	94.54	2.10	0.102
Treatment (=Trt)	*Site**Trt	167.13	3	55.71	1.15	0.382
Species	Species**Site*	256.55	1	256.55	0.94	0.404
*Site**Trt	Site*Sp*Trt*Replication	437.44	9	48.60	1.08	0.379
Species**Site*	Site*Sp*Trt*Replication	821.25	3	273.75	6.09	**0.001**
Species*Trt	*Site**Species*Trt	446.52	3	148.84	16.32	**0.001**
*Site**Species*Trt	Site*Sp*Trt*Replication	82.07	9	9.12	0.20	0.994
Site*Sp*Trt*Replication		7327.80	163	44.96		

Table 8. Results of the multi-factor analysis of variance which examined the mean response of the concentrations of total starch (% dry matter) for separated (leaf and roots/rhizomes fractions) and combined (whole plant) plant parts to the different treatment levels (simulated high and low grazing and cropping, and undisturbed) from the different seagrass species (*H. ovalis* and *Z. capricorni* + *C. rotundata*) harvested from the long-term experiments conducted at Ellie Point. Random factors are italicised, otherwise they are fixed. Significant *p* values are highlighted in bold.

Factor	Error Term	SS	df	MS	F	p
Leaves						
Site	Site*Sp*Trt*Replication	12.12	3	4.04	3.31	**0.026**
Treatment (=Trt)	*Site**Trt	7.22	3	2.41	0.81	0.518
Species	Species**Site*	6.25	1	6.25	1.32	0.334
*Site**Trt	Site*Sp*Trt*Replication	26.64	9	2.96	2.42	**0.019**
Species**Site*	Site*Sp*Trt*Replication	14.21	3	4.74	3.88	**0.013**
Species*Trt	*Site**Species*Trt	4.63	3	1.54	0.51	0.684
*Site**Species*Trt	Site*Sp*Trt*Replication	27.12	9	3.01	2.47	**0.017**
Site*Sp*Trt*Replication		79.42	65	1.22		
Roots/Rhizomes						
Site	Site*Sp*Trt*Replication	90.95	3	30.32	3.59	**0.018**
Treatment (=Trt)	*Site**Trt	55.44	3	18.49	2.85	0.098
Species	Species**Site*	317.32	1	317.32	5.88	0.094
*Site**Trt	Site*Sp*Trt*Replication	58.40	9	6.49	0.77	0.646
Species**Site*	Site*Sp*Trt*Replication	161.84	3	53.95	6.39	**0.001**
Species*Trt	*Site**Species*Trt	21.49	3	7.16	0.52	0.681
*Site**Species*Trt	Site*Sp*Trt*Replication	124.70	9	13.86	1.64	0.122
Site*Sp*Trt*Replication		557.59	66	8.45		

Factor	Error Term	SS	df	MS	F	p
Whole Plant						
Site	Site*Sp*Trt*Replication	42.57	3	14.19	1.51	0.214
Treatment (=Trt)	*Site*Trt	36.60	3	12.20	3.62	0.058
Species	Species**Site*	206.91	1	206.91	5.13	0.109
*Site*Trt	Site*Sp*Trt*Replication	30.30	9	3.37	0.36	0.953
Species**Site*	Site*Sp*Trt*Replication	121.08	3	40.36	4.29	**0.006**
Species*Trt	*Site*Species*Trt	20.70	3	6.90	1.66	0.241
*Site*Species*Trt	Site*Sp*Trt*Replication	37.34	9	4.15	0.44	0.911
Site*Sp*Trt*Replication		1533.44	163	9.41		

Table 9. Results of the multi-factor analysis of variance which examined the mean response of the concentrations of *in vitro* digestibility (% dry matter) for separated (leaf and roots/rhizomes fractions) and combined (whole plant) plant parts to the different treatment levels (simulated high and low grazing and cropping, and undisturbed) from the different seagrass species (*H. ovalis* and *Z. capricorni* + *C. rotundata*) harvested from the long-term experiments conducted at Ellie Point. Random factors are italicised, otherwise they are fixed. Significant *p* values are highlighted in bold.

Factor	Error Term	SS	df	MS	F	p
Leaves						
Site	Site*Sp*Trt*Replication	219.04	3	73.01	11.02	**0.000**
Treatment (=Trt)	*Site**Trt	45.87	3	15.29	0.79	0.530
Species	Species**Site*	300.21	1	300.21	10.06	**0.050**
*Site**Trt	Site*Sp*Trt*Replication	174.43	9	19.38	2.93	**0.006**
Species**Site*	Site*Sp*Trt*Replication	89.55	3	29.85	4.51	**0.006**
Species*Trt	*Site**Species*Trt	48.78	3	16.26	0.83	0.510
*Site**Species*Trt	Site*Sp*Trt*Replication	176.03	9	19.56	2.95	**0.005**
Site*Sp*Trt*Replication		430.57	65	6.62		
Roots/Rhizomes						
Site	Site*Sp*Trt*Replication	525.62	3	175.21	10.32	**0.000**
Treatment (=Trt)	*Site**Trt	48.23	3	16.08	0.97	0.447
Species	Species**Site*	2651.12	1	2651.12	41.65	**0.008**
*Site**Trt	Site*Sp*Trt*Replication	148.61	9	16.51	0.97	0.471
Species**Site*	Site*Sp*Trt*Replication	190.97	3	63.66	3.75	**0.015**
Species*Trt	*Site**Species*Trt	8.71	3	2.90	0.63	0.615
*Site**Species*Trt	Site*Sp*Trt*Replication	41.67	9	4.63	0.27	0.980
Site*Sp*Trt*Replication		1120.56	66	16.98		

Factor	Error Term	SS	df	MS	F	p
Whole Plant						
Site	Site*Sp*Trt*Replication	540.90	3	180.30	5.36	**0.002**
Treatment (=Trt)	*Site*Trt	40.76	3	13.59	0.63	0.614
Species	Species**Site*	2387.85	1	2387.85	219.40	**0.001**
*Site*Trt	Site*Sp*Trt*Replication	194.41	9	21.60	0.64	0.760
Species**Site*	Site*Sp*Trt*Replication	32.65	3	10.88	0.32	0.808
Species*Trt	*Site*Species*Trt	51.67	3	17.22	1.20	0.363
*Site*Species*Trt	Site*Sp*Trt*Replication	128.84	9	14.32	0.43	0.920
Site*Sp*Trt*Replication		5486.36	163	33.66		

Table 10. Results of the multi-factor analysis of variance which examined the mean response of the amounts of nitrogen (% dry matter) for separated (leaf and roots/rhizomes fractions) and combined (whole plant) plant parts to the different treatment levels (simulated high and low grazing and cropping, and undisturbed) of *H.uninervis* harvested from the long-term experiments conducted at Cardwell. Random factors are italicised, otherwise they are fixed. Significant *p* values are highlighted in bold.

Factor	Error Term	SS	df	MS	F	p
Leaves						
Site	Residual	0.34	3	0.11	6.08	**0.001**
Treatment (=Trt)	*Site**Trt	0.18	3	0.06	4.41	**0.036**
*Site**Trt	Residual	0.12	9	0.01	0.73	0.677
Site*Trt*Replication		0.89	48	0.02		
Roots/Rhizomes						
Site	Residual	0.29	3	0.10	10.49	**0.000**
Treatment (=Trt)	*Site**Trt	0.09	3	0.03	16.20	**0.001**
*Site**Trt	Residual	0.02	9	0.00	0.20	0.992
Site*Trt*Replication		0.44	48	0.01		
Whole Plant						
Site	Residual	0.55	3	0.18	0.11	0.956
Treatment (=Trt)	*Site**Trt	0.26	3	0.09	8.40	**0.006**
*Site**Trt	Residual	0.09	9	0.01	0.01	1.000
Site*Trt*Replication		191.56	112	1.71		

Table 11. Results of the multi-factor analysis of variance which examined the mean response of the amounts of organic matter (% dry matter) for separated (leaf and roots/rhizomes fractions) and combined (whole plant) plant parts to the different treatment levels (simulated high and low grazing and cropping, and undisturbed) of *H.uninervis* harvested from the long-term experiments conducted at Cardwell. Random factors are italicised, otherwise they are fixed. Significant *p* values are highlighted in bold.

Factor	Error Term	SS	df	MS	F	p
Leaves						
Site	Residual	76.74	3	25.58	4.88	**0.005**
Treatment (=Trt)	*Site**Trt	1.80	3	0.60	0.08	0.971
*Site**Trt	Residual	69.86	9	7.76	1.48	0.182
Site*Trt*Replication		251.58	48	5.24		
Roots/Rhizomes						
Site	Residual	15.25	3	5.08	1.03	0.386
Treatment (=Trt)	*Site**Trt	31.60	3	10.53	2.99	0.089
*Site**Trt	Residual	31.75	9	3.53	0.72	0.690
Site*Trt*Replication		235.98	48	4.92		
Whole Plant						
Site	Residual	28.83	3	9.61	0.38	0.768
Treatment (=Trt)	*Site**Trt	16.95	3	5.65	0.74	0.553
*Site**Trt	Residual	68.50	9	7.61	0.30	0.973
Site*Trt*Replication		2836.43	112	25.33		

Table 12. Results of the multi-factor analysis of variance which examined the mean response of the amounts of neutral detergent fibre (% dry matter) for separated (leaf and roots/rhizomes fractions) and combined (whole plant) plant parts to the different treatment levels (simulated high and low grazing and cropping, and undisturbed) of *H.uninervis* harvested from the long-term experiments conducted at Cardwell. Random factors are italicised, otherwise they are fixed. Significant *p* values are highlighted in bold.

Factor	Error Term	SS	df	MS	F	p
Leaves						
Site	Residual	55.89	3	18.63	2.98	**0.040**
Treatment (=Trt)	*Site**Trt	30.11	3	10.04	1.91	0.199
*Site**Trt	Residual	47.38	9	5.26	0.84	0.581
Site*Trt*Replication		299.76	48	6.24		
Roots/Rhizomes						
Site	Residual	14.74	3	4.91	0.69	0.565
Treatment (=Trt)	*Site**Trt	83.91	3	27.97	9.24	**0.004**
*Site**Trt	Residual	27.23	9	3.03	0.42	0.916
Site*Trt*Replication		343.36	48	7.15		
Whole Plant						
Site	Residual	60.46	3	20.15	0.16	0.923
Treatment (=Trt)	*Site**Trt	91.75	3	30.58	6.24	**0.014**
*Site**Trt	Residual	44.12	9	4.90	0.04	1.000
Site*Trt*Replication		14146.88	112	126.31		

Table 13. Results of the multi-factor analysis of variance which examined the mean response of the amounts of acid detergent fibre (% dry matter) for separated (leaf and roots/rhizomes fractions) and combined (whole plant) plant parts to the different treatment levels (simulated high and low grazing and cropping, and undisturbed) of *H.uninervis* harvested from the long-term experiments conducted at Cardwell. Random factors are italicised, otherwise they are fixed. Significant *p* values are highlighted in bold.

Factor	Error Term	SS	df	MS	F	p
Leaves						
Site	Residual	18.83	3	6.28	1.59	0.205
Treatment (=Trt)	*Site**Trt	17.40	3	5.80	4.40	**0.036**
*Site**Trt	Residual	11.87	9	1.32	0.33	0.959
Site*Trt*Replication		189.99	48	3.96		
Roots/Rhizomes						
Site	Residual	23.27	3	7.76	1.08	0.365
Treatment (=Trt)	*Site**Trt	140.05	3	46.68	14.34	**0.001**
*Site**Trt	Residual	29.29	9	3.25	0.45	0.897
Site*Trt*Replication		343.57	48	7.16		
Whole Plant						
Site	Residual	39.41	3	13.14	0.23	0.874
Treatment (=Trt)	*Site**Trt	122.90	3	40.97	13.63	**0.001**
*Site**Trt	Residual	27.05	9	3.01	0.05	1.000
Site*Trt*Replication		6363.97	112	56.82		

Table 14. Results of the multi-factor analysis of variance which examined the mean response of the amounts of hemicellulose (% dm) for separated (leaf and roots/rhizomes fractions) and combined (whole plant) plant parts to the different treatment levels (simulated high and low grazing and cropping, and undisturbed) of *H.uninervis* harvested from the long-term experiments conducted at Cardwell. Random factors are italicised, otherwise they are fixed. Significant *p* values are highlighted in bold.

Factor	Error Term	SS	df	MS	F	p
Leaves						
Site	Residual	12.33	3	4.11	2.46	0.074
Treatment (=Trt)	*Site**Trt	12.96	3	4.32	1.58	0.260
*Site**Trt	Residual	24.54	9	2.73	1.63	0.134
Site*Trt*Replication		80.31	48	1.67		
Roots/Rhizomes						
Site	Residual	22.25	3	7.42	5.98	**0.002**
Treatment (=Trt)	*Site**Trt	9.58	3	3.19	4.87	**0.028**
*Site**Trt	Residual	5.90	9	0.66	0.53	0.846
Site*Trt*Replication		59.53	48	1.24		
Whole Plant						
Site	Residual	21.03	3	7.01	0.44	0.723
Treatment (=Trt)	*Site**Trt	11.23	3	3.74	2.03	0.181
*Site**Trt	Residual	16.63	9	1.85	0.12	0.999
Site*Trt*Replication		1771.32	112	15.82		

Table 15. Results of the multi-factor analysis of variance which examined the mean response of the amounts of lignin (% dry matter) for separated (leaf and roots/rhizomes fractions) and combined (whole plant) plant parts to the different treatment levels (simulated high and low grazing and cropping, and undisturbed) of *H.uninervis* harvested from the long-term experiments conducted at Cardwell. Random factors are italicised, otherwise they are fixed. Significant *p* values are highlighted in bold.

Factor	Error Term	SS	df	MS	F	p
Leaves						
Site	Residual	32.06	3	2.54	0.89	0.540
Treatment (=Trt)	*Site**Trt	15.30	3	5.10	2.00	0.184
*Site**Trt	Residual	22.90	9	2.54	0.89	0.540
Site*Trt*Replication		137.00	48	2.85		
Roots/Rhizomes						
Site	Residual	30.13	3	10.04	2.33	0.086
Treatment (=Trt)	*Site**Trt	101.46	3	33.82	27.78	**0.000**
*Site**Trt	Residual	10.96	9	1.22	0.28	0.977
Site*Trt*Replication		207.19	48	4.32		
Whole Plant						
Site	Residual	53.73	3	17.91	0.34	0.800
Treatment (=Trt)	*Site**Trt	89.22	3	29.74	13.74	**0.001**
*Site**Trt	Residual	19.47	9	2.16	0.04	1.000
Site*Trt*Replication		5986.37	112	53.45		

Table 16. Results of the multi-factor analysis of variance which examined the mean response of the concentrations of water soluble carbohydrates (% dm) for separated (leaf and roots/rhizomes fractions) and combined (whole plant) plant parts to the different treatment levels (simulated high and low grazing and cropping, and undisturbed) of *H.uninervis* harvested from the long-term experiments conducted at Cardwell. Random factors are italicised, otherwise they are fixed. Significant *p* values are highlighted in bold.

Factor	Error Term	SS	df	MS	F	p
Leaves						
Site	Residual	0.56	3	0.19	1.70	0.180
Treatment (=Trt)	*Site**Trt	0.64	3	0.21	1.41	0.303
*Site**Trt	Residual	1.36	9	0.15	1.37	0.228
Site*Trt*Replication		5.30	48	0.11		
Roots/Rhizomes						
Site	Residual	0.07	3	0.02	0.09	0.963
Treatment (=Trt)	*Site**Trt	2.72	3	0.91	2.82	0.099
*Site**Trt	Residual	2.89	9	0.32	1.23	0.299
Site*Trt*Replication		12.51	48	0.26		
Whole Plant						
Site	Residual	0.18	3	0.06	0.19	0.903
Treatment (=Trt)	*Site**Trt	2.33	3	0.78	2.21	0.156
*Site**Trt	Residual	3.16	9	0.35	1.12	0.353
Site*Trt*Replication		35.05	112	0.31		

Table 17. Results of the multi-factor analysis of variance which examined the mean response of the concentrations of starch (% dry matter) for separated (leaf and roots/rhizomes fractions) and combined (whole plant) plant parts to the different treatment levels (simulated high and low grazing and cropping, and undisturbed) of *H.uninervis* harvested from the long-term experiments conducted at Cardwell. Random factors are italicised, otherwise they are fixed. Significant *p* values are highlighted in bold.

Factor	Error Term	SS	df	MS	F	p
Leaves						
Site	Residual	1.88	3	0.63	1.78	0.164
Treatment (=Trt)	*Site**Trt	2.43	3	0.81	2.69	0.109
*Site**Trt	Residual	2.71	9	0.30	0.85	0.572
Site*Trt*Replication		16.95	48	0.35		
Roots/Rhizomes						
Site	Residual	33.73	3	11.24	2.33	0.086
Treatment (=Trt)	*Site**Trt	26.15	3	8.72	1.25	0.349
*Site**Trt	Residual	62.96	9	7.00	1.45	0.194
Site*Trt*Replication		231.40	48	4.82		
Whole Plant						
Site	Residual	19.34	3	6.45	0.44	0.727
Treatment (=Trt)	*Site**Trt	13.11	3	4.37	1.18	0.371
*Site**Trt	Residual	33.38	9	3.71	0.25	0.986
Site*Trt*Replication		1651.03	112	14.74		

Table 18. Results of the multi-factor analysis of variance which examined the mean response of the concentrations of *in vitro* digestibility (% dry matter) for separated (leaf and roots/rhizomes fractions) and combined (whole plant) plant parts to the different treatments (simulated high and low grazing and cropping, and undisturbed) of *H.uninervis* harvested from the long-term experiments conducted at Cardwell. Random factors are italicised, otherwise they are fixed. Significant *p* values are highlighted in bold.

Factor	Error Term	SS	df	MS	F	p
Leaves						
Site	Residual	1.40	3	0.47	1.00	0.402
Treatment (=Trt)	*Site**Trt	4.15	3	1.38	6.71	**0.011**
*Site**Trt	Residual	1.86	9	0.21	0.44	0.906
Site*Trt*Replication		22.49	48	0.47		
Roots/Rhizomes						
Site	Residual	5.83	3	1.94	0.96	0.421
Treatment (=Trt)	*Site**Trt	3.40	3	1.13	0.64	0.608
*Site**Trt	Residual	15.92	9	1.77	0.87	0.557
Site*Trt*Replication		97.44	48	2.03		
Whole Plant						
Site	Residual	6.14	3	2.05	0.13	0.941
Treatment (=Trt)	*Site**Trt	4.97	3	1.66	1.64	0.249
*Site**Trt	Residual	9.11	9	1.01	0.06	1.000
Site*Trt*Replication		1748.45	112	15.61		

Table 19. Results of the multi-factor analysis of variance which examined the mean response of the amounts of nitrogen (% dry matter) for separated (leaf and roots/rhizomes fractions) and combined (whole plant) plant parts of *Halodule uninervis* from the short-term grazing experiments at Cardwell involving three treatment-control pairs: simulated light dugong grazing (Trt I), turtle cropping harvested after one month (Trt III), and turtle cropping harvested after two months (Trt V), with their respective controls (Trts II, IV and VI). Random factors are italicised, otherwise they are fixed. Significant *p* values are hghlighted in bold.

Factor	Error term	SS	df	MS	F	p
Trts I & II						
A) Leaves						
Site	Residuals	0.20	3	0.07	3.08	**0.038**
Treatment (=Trt)	Trt**Site*	0.96	1	0.96	10.32	**0.049**
Trt**Site*	Residuals	0.28	3	0.09	4.23	**0.011**
Residuals (=Trt*Site*Rep)		0.88	40	0.02		
Trts I & II						
B) Roots/Rhizomes						
Site	Residuals	0.07	3	0.02	2.69	0.059
Treatment (=Trt)	Trt**Site*	0.05	1	0.05	3.56	0.155
Trt**Site*	Residuals	0.04	3	0.01	1.74	0.174
Residuals (=Trt*Site*Rep)		0.34	40	0.01		
Trts I & II						
C) Whole Plant						
Site	Residuals	0.05	3	0.02	0.02	0.997
Treatment (=Trt)	Trt**Site*	0.73	1	0.73	9.14	0.057
Trt**Site*	Residuals	0.24	3	0.08	0.07	0.974
Residuals (=Trt*Site*Rep)		94.39	88	1.07		

Factor	Error term	SS	df	MS	F	p
Trts III & IV A) Leaves *Site*	Residuals	0.32	3	0.11	4.03	**0.014**
Treatment (=Trt)	Trt**Site*	0.09	1	0.09	3.17	0.173
Trt**Site*	Residuals	0.08	3	0.03	1.04	0.385
Residuals (=Trt*Site*Rep)		1.07	40	0.03		
Trts III & IV B) Roots/Rhizomes *Site*	Residuals	0.58	3	0.19	12.21	**0.000**
Treatment (=Trt)	Trt**Site*	0.00	1	0.00	0.00	0.970
Trt**Site*	Residuals	0.00	3	0.00	0.08	0.971
Residuals (=Trt*Site*Rep)		0.63	40	0.02		
Trts III & IV C) Whole Plant *Site*	Residuals	0.71	3	0.24	0.19	0.905
Treatment (=Trt)	Trt**Site*	0.04	1	0.04	2.38	0.221
Trt**Site*	Residuals	0.06	3	0.02	0.01	0.998
Residuals (=Trt*Site*Rep)		111.18	88	1.26		

Factor	Error term	SS	df	MS	F	p
Trts V & VI A) Leaves *Site*	Residuals	1.05	3	0.35	11.99	**0.000**
Treatment (=Trt)	Trt**Site*	0.69	1	0.69	16.04	**0.028**
Trt**Site*	Residuals	0.13	3	0.04	1.49	0.233
Residuals (=Trt*Site*Rep)		1.16	40	0.03		
Trts V & VI B) Roots/Rhizomes *Site*	Residuals	0.61	3	0.20	11.07	**0.000**
Treatment (=Trt)	Trt**Site*	0.11	1	0.11	5.47	0.101
Trt**Site*	Residuals	0.06	3	0.02	1.11	0.355
Residuals (=Trt*Site*Rep)		0.74	40	0.02		
Trts V & VI C) Whole Plant *Site*	Residuals	1.44	3	0.48	0.46	0.712
Treatment (=Trt)	Trt**Site*	0.68	1	0.68	11.11	**0.045**
Trt**Site*	Residuals	0.18	3	0.06	0.06	0.981
Residuals (=Trt*Site*Rep)		91.98	88	1.05		

Table 20. Results of the multi-factor analysis of variance which examined the mean response of the amounts of organic matter (% dry matter) for separated (leaf and roots/rhizomes fractions) and combined (whole plant) plant parts of *Halodule uninervis* from the short-term grazing experiments at Cardwell involving three treatment-control pairs: simulated light dugong grazing (Trt I), turtle cropping harvested after one month (Trt III), and turtle cropping harvested after two months (Trt V), with their respective controls (Trts II, IV and VI). Random factors are italicised, otherwise they are fixed. Significant *p* values are highlighted in bold.

Factor	Error term	SS	df	MS	F	p
Trts I & II						
A) Leaves						
Site	Residuals	17.68	3	5.89	1.93	0.139
Treatment (=Trt)	Trt**Site*	6.69	1	6.69	1.90	0.262
Trt**Site*	Residuals	10.56	3	3.52	1.16	0.338
Residuals (=Trt*Site*Rep)		121.81	40	3.05		
Trts I & II						
B) Roots/Rhizomes						
Site	Residuals	281.13	3	93.71	12.43	**0.000**
Treatment (=Trt)	Trt**Site*	14.52	1	14.52	7.23	0.074
Trt**Site*	Residuals	6.02	3	2.01	0.27	0.849
Residuals (=Trt*Site*Rep)		301.60	40	7.54		
Trts I & II						
C) Whole Plant						
Site	Residuals	116.74	3	38.91	4.55	**0.005**
Treatment (=Trt)	Trt**Site*	0.75	1	0.75	0.34	0.603
Trt**Site*	Residuals	6.69	3	2.23	0.26	0.853
Residuals (=Trt*Site*Rep)		751.99	88	8.55		

Factor	Error term	SS	df	MS	F	p
Trts III & IV A) Leaves						
Site	Residuals	119.02	3	39.67	4.31	**0.010**
Treatment (=Trt)	Trt**Site*	50.76	1	50.76	8.09	0.065
Trt**Site*	Residuals	18.83	3	6.28	0.68	0.568
Residuals (=Trt*Site*Rep)		367.85	40	9.20		
Trts III & IV B) Roots/Rhizomes						
Site	Residuals	145.75	3	48.58	5.79	**0.002**
Treatment (=Trt)	Trt**Site*	72.77	1	72.77	4.44	0.126
Trt**Site*	Residuals	49.21	3	16.40	1.96	0.136
Residuals (=Trt*Site*Rep)		335.53	40	8.39		
Trts III & IV C) Whole Plant						
Site	Residuals	180.58	3	60.19	1.48	0.225
Treatment (=Trt)	Trt**Site*	122.54	1	122.54	5.84	0.095
Trt**Site*	Residuals	62.98	3	20.99	0.52	0.672
Residuals (=Trt*Site*Rep)		3572.28	88	40.59		

Factor	Error term	SS	df	MS	F	p
Trts V & VI A) Leaves						
Site	Residuals	105.51	3	35.17	4.52	**0.008**
Treatment (=Trt)	Trt**Site*	39.89	1	39.89	11.82	**0.041**
Trt**Site*	Residuals	10.13	3	3.38	0.43	0.730
Residuals (=Trt*Site*Rep)		311.19	40	7.78		
Trts V & VI B) Roots/Rhizomes						
Site	Residuals	681.03	3	227.01	12.44	**0.000**
Treatment (=Trt)	Trt**Site*	230.26	1	230.26	41.85	**0.007**
Trt**Site*	Residuals	16.51	3	5.50	0.35	0.824
Residuals (=Trt*Site*Rep)		730.22	40	18.26		
Trts V & VI C) Whole Plant						
Site	Residuals	644.63	3	214.88	7.44	**0.000**
Treatment (=Trt)	Trt**Site*	39.23	1	39.23	8.15	0.065
Trt**Site*	Residuals	14.45	3	4.82	0.17	0.919
Residuals (=Trt*Site*Rep)		2541.16	88	28.88		

Table 21. Results of the multi-factor analysis of variance which examined the mean response of the amounts of neutral detergent fibres (% dry matter) for separated (leaf and roots/rhizomes fractions) and combined (whole plant) plant parts of *Halodule uninervis* from the short-term grazing experiments at Cardwell involving three treatment-control pairs: simulated light dugong grazing (Trt I), turtle cropping harvested after one month (Trt III), and turtle cropping harvested after two months (Trt V), with their respective controls (Trts II, IV and VI). Random factors are italicised, otherwise they are fixed. Significant *p* values are highlighted in bold.

Factor	Error term	SS	df	MS	F	p
Trts I & II						
A) Leaves						
Site	Residuals	84.87	3	28.29	5.14	**0.004**
Treatment (=Trt)	Trt**Site*	0.87	1	0.87	0.20	0.688
Trt**Site*	Residuals	13.27	3	4.42	0.80	0.500
Residuals (=Trt*Site*Rep)		220.25	40	5.51		
Trts I & II						
B) Roots/Rhizomes						
Site	Residuals	127.56	3	42.52	6.46	**0.001**
Treatment (=Trt)	Trt**Site*	1.71	1	1.71	0.32	0.613
Trt**Site*	Residuals	16.22	3	5.41	0.82	0.490
Residuals (=Trt*Site*Rep)		263.42	40	6.59		
Trts I & II						
C) Whole Plant						
Site	Residuals	203.32	3	67.77	0.42	0.739
Treatment (=Trt)	Trt**Site*	2.50	1	2.50	0.28	0.632
Trt**Site*	Residuals	26.54	3	8.85	0.05	0.983
Residuals (=Trt*Site*Rep)		14212.01	88	161.50		

Factor	Error term	SS	df	MS	F	p
Trts III & IV A) Leaves						
Site	Residuals	30.66	3	10.22	1.71	0.180
Treatment (=Trt)	Trt**Site*	96.31	1	96.31	3.69	0.150
Trt**Site*	Residuals	78.20	3	26.07	4.37	**0.009**
Residuals (=Trt*Site*Rep)		238.83	40	5.97		
Trts III & IV B) Roots/Rhizomes						
Site	Residuals	50.75	3	16.92	2.20	0.103
Treatment (=Trt)	Trt**Site*	0.37	1	0.37	0.05	0.838
Trt**Site*	Residuals	22.09	3	7.36	0.96	0.422
Residuals (=Trt*Site*Rep)		307.67	40	7.69		
Trts III & IV C) Whole Plant						
Site	Residuals	40.82	3	13.61	0.13	0.939
Treatment (=Trt)	Trt**Site*	42.39	1	42.39	1.40	0.323
Trt**Site*	Residuals	91.10	3	30.37	0.30	0.826
Residuals (=Trt*Site*Rep)		8917.37	88	101.33		

Factor	Error term	SS	df	MS	F	p
Trts V & VI A) Leaves *Site*	Residuals	61.54	3	20.51	3.22	**0.033**
Treatment (=Trt)	Trt**Site*	10.02	1	10.02	2.18	0.237
Trt**Site*	Residuals	13.82	3	4.61	0.72	0.544
Residuals (=Trt*Site*Rep)		254.43	40	6.36		
Trts V & VI B) Roots/Rhizomes *Site*	Residuals	34.66	3	11.55	1.24	0.308
Treatment (=Trt)	Trt**Site*	40.21	1	40.21	7.59	0.070
Trt**Site*	Residuals	15.88	3	5.29	0.57	0.639
Residuals (=Trt*Site*Rep)		372.78	40	9.32		
Trts V & VI C) Whole Plant *Site*	Residuals	14.87	3	4.96	0.05	0.987
Treatment (=Trt)	Trt**Site*	45.18	1	45.18	5.19	0.107
Trt**Site*	Residuals	26.11	3	8.70	0.08	0.971
Residuals (=Trt*Site*Rep)		9690.93	88	110.12		

Table 22. Results of the multi-factor analysis of variance which examined the mean response of the amounts of acid detergent fibres (% dry matter) for separated (leaf and roots/rhizomes fractions) and combined (whole plant) plant parts of *Halodule uninervis* from the short-term grazing experiments at Cardwell involving three treatment-control pairs: simulated light dugong grazing (Trt I), turtle cropping harvested after one month (Trt III), and turtle cropping harvested after two months (Trt V), with their respective controls (Trts II, IV and VI). Random factors are italicised, otherwise they are fixed. Significant *p* values are highlighted in bold.

Factor	Error term	SS	df	MS	F	p
Trts I & II						
A) Leaves						
Site	Residuals	73.31	3	24.44	4.42	**0.009**
Treatment (=Trt)	Trt**Site*	0.00	1	0.00	0.00	0.992
Trt**Site*	Residuals	8.43	3	2.81	0.51	0.679
Residuals (=Trt*Site*Rep)		221.28	40	5.53		
Trts I & II						
B) Roots/Rhizomes						
Site	Residuals	88.53	3	29.51	8.44	**0.000**
Treatment (=Trt)	Trt**Site*	8.45	1	8.45	1.70	0.284
Trt**Site*	Residuals	14.93	3	4.98	1.42	0.250
Residuals (=Trt*Site*Rep)		139.93	40	3.50		
Trts I & II						
C) Whole Plant						
Site	Residuals	149.59	3	49.86	0.58	0.628
Treatment (=Trt)	Trt**Site*	4.17	1	4.17	0.72	0.458
Trt**Site*	Residuals	17.36	3	5.79	0.07	0.977
Residuals (=Trt*Site*Rep)		7539.92	88	85.68		

Factor	Error term	SS	df	MS	F	p
Trts III & IV A) Leaves						
Site	Residuals	9.31	3	3.10	0.79	0.508
Treatment (=Trt)	Trt**Site*	64.01	1	64.01	10.39	**0.048**
Trt**Site*	Residuals	18.47	3	6.16	1.56	0.213
Residuals (=Trt*Site*Rep)		157.45	40	3.94		
Trts III & IV B) Roots/Rhizomes						
Site	Residuals	170.54	3	56.85	10.90	**0.000**
Treatment (=Trt)	Trt**Site*	1.66	1	1.66	0.78	0.441
Trt**Site*	Residuals	6.37	3	2.12	0.41	0.749
Residuals (=Trt*Site*Rep)		208.59	40	5.21		
Trts III & IV C) Whole Plant						
Site	Residuals	95.92	3	31.97	1.27	0.291
Treatment (=Trt)	Trt**Site*	22.52	1	22.52	3.06	0.179
Trt**Site*	Residuals	22.09	3	7.36	0.29	0.831
Residuals (=Trt*Site*Rep)		2222.22	88	25.25		

Factor	Error term	SS	df	MS	F	p
Trts V & VI A) Leaves						
Site	Residuals	111.61	3	37.20	13.84	**0.000**
Treatment (=Trt)	Trt**Site*	0.40	1	0.40	0.06	0.820
Trt**Site*	Residuals	19.59	3	6.53	2.43	0.079
Residuals (=Trt*Site*Rep)		107.56	40	2.69		
Trts V & VI B) Roots/Rhizomes						
Site	Residuals	50.27	3	16.76	2.59	0.066
Treatment (=Trt)	Trt**Site*	74.03	1	74.01	38.02	**0.009**
Trt**Site*	Residuals	5.84	3	1.95	0.30	0.824
Residuals (=Trt*Site*Rep)		258.61	40	6.47		
Trts V & VI C) Whole Plant						
Site	Residuals	45.13	3	15.04	0.31	0.821
Treatment (=Trt)	Trt**Site*	42.68	1	42.68	5.52	0.100
Trt**Site*	Residuals	23.19	3	7.73	0.16	0.925
Residuals (=Trt*Site*Rep)		4334.58	88	49.26		

Table 23. Results of the multi-factor analysis of variance which examined the mean response of the amounts of hemicellulose (% dm) for separated (leaf and roots/rhizomes fractions) and combined (whole plant) plant parts of *Halodule uninervis* from the short-term grazing experiments at Cardwell involving three treatment-control pairs: simulated light dugong grazing (Trt I), turtle cropping harvested after one month (Trt III), and turtle cropping harvested after two months (Trt V), with their respective controls (Trts II, IV and VI). Random factors are italicised, otherwise they are fixed. Significant *p* values are highlighted in bold.

Factor	Error term	SS	df	MS	F	p
Trts I & II						
A) Leaves						
Site	Residuals	8.73	3	2.91	4.21	**0.011**
Treatment (=Trt)	Trt**Site*	0.90	1	0.90	1.91	0.261
Trt**Site*	Residuals	1.42	3	0.47	0.68	0.567
Residuals (=Trt*Site*Rep)		27.64	40	0.69		
Trts I & II						
B) Roots/Rhizomes						
Site	Residuals	23.43	3	7.81	3.99	**0.014**
Treatment (=Trt)	Trt**Site*	2.56	1	2.56	10.77	**0.046**
Trt**Site*	Residuals	0.71	3	0.24	0.12	0.947
Residuals (=Trt*Site*Rep)		78.37	40	1.96		
Trts I & II						
C) Whole Plant						
Site	Residuals	27.60	3	9.20	0.69	0.560
Treatment (=Trt)	Trt**Site*	0.21	1	0.21	0.48	0.539
Trt**Site*	Residuals	1.33	3	0.44	0.03	0.992
Residuals (=Trt*Site*Rep)		1172.31	88	13.32		

Factor	Error term	SS	df	MS	F	p
Trts III & IV A) Leaves						
Site	Residuals	8.73	3	2.91	0.68	0.568
Treatment (=Trt)	Trt**Site*	3.29	1	3.29	0.41	0.567
Trt**Site*	Residuals	23.94	3	7.98	1.87	0.150
Residuals (=Trt*Site*Rep)		170.60	40	4.26		
Trts III & IV B) Roots/Rhizomes						
Site	Residuals	41.62	3	13.87	5.44	**0.003**
Treatment (=Trt)	Trt**Site*	0.47	1	0.47	0.26	0.647
Trt**Site*	Residuals	5.44	3	1.81	0.71	0.551
Residuals (=Trt*Site*Rep)		102.01	40	2.55		
Trts III & IV C) Whole Plant						
Site	Residuals	35.83	3	11.94	0.38	0.764
Treatment (=Trt)	Trt**Site*	3.11	1	3.11	0.39	0.577
Trt**Site*	Residuals	23.98	3	7.99	0.26	0.856
Residuals (=Trt*Site*Rep)		2730.81	88	31.03		

Factor	Error term	SS	df	MS	F	p
Trts V & VI A) Leaves						
Site	Residuals	76.13	3	25.38	8.57	**0.000**
Treatment (=Trt)	Trt**Site*	6.40	1	6.40	1.40	0.321
Trt**Site*	Residuals	13.68	3	4.56	1.54	0.219
Residuals (=Trt*Site*Rep)		118.48	40	2.96		
Trts V & VI B) Roots/Rhizomes						
Site	Residuals	5.76	3	1.92	0.73	0.541
Treatment (=Trt)	Trt**Site*	5.12	1	5.12	2.33	0.224
Trt**Site*	Residuals	6.59	3	2.20	0.83	0.483
Residuals (=Trt*Site*Rep)		105.36	40	2.63		
Trts V & VI C) Whole Plant						
Site	Residuals	41.58	3	4.70	0.30	0.823
Treatment (=Trt)	Trt**Site*	0.04	1	0.04	0.01	0.936
Trt**Site*	Residuals	14.11	3	4.70	0.30	0.823
Residuals (=Trt*Site*Rep)		1367.01	88	15.53		

Table 24. Results of the multi-factor analysis of variance which examined the mean response of the amounts of lignin (% dm) for separated (leaf and roots/rhizomes fractions) and combined (whole plant) plant parts of *Halodule uninervis* from the short-term grazing experiments at Cardwell involving three treatment-control pairs: simulated light dugong grazing (Trt I), turtle cropping harvested after one month (Trt III), and turtle cropping harvested after two months (Trt V), with their respective controls (Trts II, IV and VI). Random factors are italicised, other factors are fixed. Significant *p* values are highlighted in bold.

Factor	Error term	SS	df	MS	F	p
Trts I & II						
A) Leaves						
Site	Residuals	34.73	3	11.58	5.32	**0.004**
Treatment (=Trt)	Trt**Site*	1.02	1	1.02	0.52	0.523
Trt**Site*	Residuals	5.86	3	1.95	0.90	0.451
Residuals (=Trt*Site*Rep)		87.06	40	2.18		
Trts I & II						
B) Roots/Rhizomes						
Site	Residuals	6.66	3	2.22	2.51	0.072
Treatment (=Trt)	Trt**Site*	1.97	1	1.97	1.22	0.351
Trt**Site*	Residuals	4.87	3	1.62	1.84	0.156
Residuals (=Trt*Site*Rep)		35.32	40	0.88		
Trts I & II						
C) Whole Plant						
Site	Residuals	30.65	3	10.22	0.25	0.861
Treatment (=Trt)	Trt**Site*	2.91	1	2.91	0.91	0.410
Trt**Site*	Residuals	9.56	3	3.19	0.08	0.972
Residuals (=Trt*Site*Rep)		3599.97	88	40.91		

Factor	Error term	SS	df	MS	F	p
Trts III & IV A) Leaves						
Site	Residuals	10.55	3	3.52	1.01	0.397
Treatment (=Trt)	Trt**Site*	53.85	1	53.85	5.59	0.099
Trt**Site*	Residuals	28.91	3	9.64	2.77	0.054
Residuals (=Trt*Site*Rep)		138.93	40	3.47		
Trts III & IV B) Roots/Rhizomes						
Site	Residuals	54.34	3	18.11	4.42	**0.009**
Treatment (=Trt)	Trt**Site*	6.42	1	6.42	11.09	**0.045**
Trt**Site*	Residuals	1.74	3	0.58	0.14	0.935
Residuals (=Trt*Site*Rep)		163.83	40	4.10		
Trts III & IV C) Whole Plant						
Site	Residuals	26.32	3	8.77	0.31	0.818
Treatment (=Trt)	Trt**Site*	48.72	1	48.72	6.62	0.082
Trt**Site*	Residuals	22.06	3	7.35	0.26	0.854
Residuals (=Trt*Site*Rep)		2484.82	88	28.24		

Factor	Error term	SS	df	MS	F	p
Trts V & VI A) Leaves						
Site	Residuals	0.94	3	0.31	0.16	0.920
Treatment (=Trt)	Trt**Site*	7.23	1	7.23	1.15	0.361
Trt**Site*	Residuals	18.80	3	6.27	3.27	**0.031**
Residuals (=Trt*Site*Rep)		76.77	40	1.92		
Trts V & VI B) Roots/Rhizomes						
Site	Residuals	20.47	3	6.82	2.79	0.053
Treatment (=Trt)	Trt**Site*	0.67	1	0.67	0.83	0.429
Trt**Site*	Residuals	2.41	3	0.80	0.33	0.805
Residuals (=Trt*Site*Rep)		97.85	40	2.45		
Trts V & VI C) Whole Plant						
Site	Residuals	6.45	3	2.15	0.06	0.979
Treatment (=Trt)	Trt**Site*	6.15	1	6.15	1.10	0.370
Trt**Site*	Residuals	16.69	3	5.56	0.16	0.921
Residuals (=Trt*Site*Rep)		2996.62	88	34.05		

Table 25. Results of the multi-factor analysis of variance which examined the mean response of the concentrations of water-soluble carbohydrates (% dm) for separated (leaf and roots/rhizomes fractions) and combined (whole plant) plant parts of *Halodule uninervis* from the short-term grazing experiments at Cardwell involving three treatment-control pairs: simulated light dugong grazing (Trt I), turtle cropping harvested after one month (Trt III), and turtle cropping harvested after two months (Trt V), with their respective controls (Trts II, IV and VI). Random factors are italicised, otherwise they are fixed. Significant *p* values are highlighted in bold.

Factor	Error term	SS	df	MS	F	p
Trts I & II						
A) Leaves						
Site	Residuals	19.92	3	6.64	3.01	**0.041**
Treatment (=Trt)	Trt**Site*	0.36	1	0.36	0.28	0.636
Trt**Site*	Residuals	3.96	3	1.32	0.60	0.619
Residuals (=Trt*Site*Rep)		88.17	40	2.20		
Trts I & II						
B) Roots/Rhizomes						
Site	Residuals	45.78	3	15.26	4.11	**0.012**
Treatment (=Trt)	Trt**Site*	0.15	1	0.15	0.19	0.691
Trt**Site*	Residuals	2.28	3	0.76	0.20	0.893
Residuals (=Trt*Site*Rep)		148.38	40	3.71		
Trts I & II						
C) Whole Plant						
Site	Residuals	0.61	3	0.20	6.43	**0.001**
Treatment (=Trt)	Trt**Site*	0.21	1	0.21	0.48	0.539
Trt**Site*	Residuals	1.33	3	0.44	0.03	0.992
Residuals (=Trt*Site*Rep)		1172.31	88	13.32		

Factor	Error term	SS	df	MS	F	p
Trts III & IV A) Leaves						
Site	Residuals	8.73	3	2.91	0.68	0.568
Treatment (=Trt)	Trt**Site*	3.29	1	3.29	0.41	0.567
Trt**Site*	Residuals	23.94	3	7.98	1.87	0.150
Residuals (=Trt*Site*Rep)		170.60	40	4.26		
Trts III & IV B) Roots/Rhizomes						
Site	Residuals	41.62	3	13.87	5.44	**0.003**
Treatment (=Trt)	Trt**Site*	0.47	1	0.47	0.26	0.647
Trt**Site*	Residuals	5.44	3	1.81	0.71	0.551
Residuals (=Trt*Site*Rep)		102.01	40	2.55		
Trts III & IV C) Whole Plant						
Site	Residuals	35.83	3	11.94	0.38	0.764
Treatment (=Trt)	Trt**Site*	3.11	1	3.11	0.39	0.577
Trt**Site*	Residuals	23.98	3	7.99	0.26	0.856
Residuals (=Trt*Site*Rep)		2730.81	88	31.03		

Factor	Error term	SS	df	MS	F	p
Trts V & VI A) Leaves *Site*	Residuals	76.13	3	25.38	8.57	**0.000**
Treatment (=Trt)	Trt**Site*	6.40	1	6.40	1.40	0.321
Trt**Site*	Residuals	13.68	3	4.56	1.54	0.219
Residuals (=Trt*Site*Rep)		118.48	40	2.96		
Trts V & VI B) Roots/Rhizomes *Site*	Residuals	5.76	3	1.92	0.73	0.541
Treatment (=Trt)	Trt**Site*	5.12	1	5.12	2.33	0.224
Trt**Site*	Residuals	6.59	3	2.20	0.83	0.483
Residuals (=Trt*Site*Rep)		105.36	40	2.63		
Trts V & VI C) Whole Plant *Site*	Residuals	41.58	3	4.70	0.30	0.823
Treatment (=Trt)	Trt**Site*	0.04	1	0.04	0.01	0.936
Trt**Site*	Residuals	14.11	3	4.70	0.30	0.823
Residuals (=Trt*Site*Rep)		1367.01	88	15.53		

Table 26. Results of the multi-factor analysis of variance which examined the mean response of the concentrations of starch (% dry matter) for separated (leaf and roots/rhizomes fractions) and combined (whole plant) plant parts of *Halodule uninervis* from the short-term grazing experiments at Cardwell involving three treatment-control pairs: simulated light dugong grazing (Trt I), turtle cropping harvested after one month (Trt III), and turtle cropping harvested after two months (Trt V), with their respective controls (Trts II, IV and VI). Random factors are italicised, other factors are fixed. Significant *p* values are highlighted in bold.

Factor	Error term	SS	df	MS	F	p
Trts I & II						
A) Leaves						
Site	Residuals	2.17	3	0.72	2.30	0.092
Treatment (=Trt)	Trt**Site*	0.00	1	0.00	0.01	0.914
Trt**Site*	Residuals	0.80	3	0.27	0.85	0.477
Residuals (=Trt*Site*Rep)		12.58	40	0.31		
Trts I & II						
B) Roots/Rhizomes						
Site	Residuals	203.97	3	67.99	0.48	0.699
Treatment (=Trt)	Trt**Site*	76.84	1	76.84	6.79	0.080
Trt**Site*	Residuals	33.96	3	11.32	1.39	0.259
Residuals (=Trt*Site*Rep)		325.19	40	8.13		
Trts I & II						
C) Whole Plant						
Site	Residuals	203.97	3	67.99	0.48	0.699
Treatment (=Trt)	Trt**Site*	38.95	1	38.95	7.12	0.076
Trt**Site*	Residuals	16.40	3	5.47	0.04	0.990
Residuals (=Trt*Site*Rep)		12546.55	88	142.57		

Factor	Error term	SS	df	MS	F	p
Trts III & IV A) Leaves *Site*	Residuals	2.49	3	0.83	1.96	0.135
Treatment (=Trt)	Trt**Site*	3.34	1	3.34	11.82	**0.041**
Trt**Site*	Residuals	0.85	3	0.28	0.67	0.576
Residuals (=Trt*Site*Rep)		16.94	40	0.42		
Trts III & IV B) Roots/Rhizomes *Site*	Residuals	277.26	3	92.42	31.17	**0.000**
Treatment (=Trt)	Trt**Site*	122.08	1	122.08	25.64	**0.015**
Trt**Site*	Residuals	14.29	3	4.76	1.61	0.203
Residuals (=Trt*Site*Rep)		118.58	40	2.96		
Trts III & IV C) Whole Plant *Site*	Residuals	164.96	3	54.99	9.47	0.000
Treatment (=Trt)	Trt**Site*	82.92	1	82.92	22.66	**0.018**
Trt**Site*	Residuals	10.98	3	3.66	0.63	0.598
Residuals (=Trt*Site*Rep)		511.01	88	5.81		

Factor	Error term	SS	df	MS	F	p
Trts V & VI A) Leaves *Site*	Residuals	5.94	3	1.98	5.66	**0.003**
Treatment (=Trt)	Trt**Site*	0.12	1	0.12	0.12	0.754
Trt**Site*	Residuals	2.92	3	0.97	2.79	0.053
Residuals (=Trt*Site*Rep)		13.99	40	0.35		
Trts V & VI B) Roots/Rhizomes *Site*	Residuals	1186.95	3	395.65	25.06	**0.000**
Treatment (=Trt)	Trt**Site*	733.75	1	733.75	99.60	**0.002**
Trt**Site*	Residuals	22.10	3	7.37	0.47	0.707
Residuals (=Trt*Site*Rep)		631.43	40	15.79		
Trts V & VI C) Whole Plant *Site*	Residuals	643.85	3	214.62	5.53	**0.002**
Treatment (=Trt)	Trt**Site*	376.12	1	376.12	131.80	**0.001**
Trt**Site*	Residuals	8.56	3	2.85	0.07	0.974
Residuals (=Trt*Site*Rep)		3417.03	88	38.83		

Table 27. Results of the multi-factor analysis of variance which examined the mean response of the concentrations of *in vitro* digestibility (% dry matter) for separated (leaf and roots/rhizomes fractions) and combined (whole plant) plant parts of *Halodule uninervis* from the short-term grazing experiments at Cardwell involving three treatment-control pairs: simulated light dugong grazing (Trt I), turtle cropping harvested after one month (Trt III), and turtle cropping harvested after two months (Trt V), with their respective controls (Trts II, IV and VI). Random factors are italicised, other factors are fixed. Significant *p* values are highlighted in bold.

Factor	Error term	SS	df	MS	F	p
Trts I & II A) Leaves						
Site	Residuals	74.55	3	24.85	10.13	**0.000**
Treatment (=Trt)	Trt**Site*	0.19	1	0.19	0.05	0.845
Trt**Site*	Residuals	12.54	3	4.18	1.70	0.182
Residuals (=Trt*Site*Rep)		98.10	40	2.45		
Trts I & II B) Roots/Rhizomes						
Site	Residuals	61.56	3	20.52	4.23	**0.011**
Treatment (=Trt)	Trt**Site*	1.93	1	1.93	0.70	0.464
Trt**Site*	Residuals	8.27	3	2.76	0.57	0.639
Residuals (=Trt*Site*Rep)		193.90	40	4.85		
Trts I & II C) Whole Plant						
Site	Residuals	89.99	3	30.00	2.60	0.057
Treatment (=Trt)	Trt**Site*	0.46	1	0.46	0.07	0.807
Trt**Site*	Residuals	19.11	3	6.37	0.55	0.649
Residuals (=Trt*Site*Rep)		1016.76	88	11.55		

Factor	Error term	SS	df	MS	F	p
Trts III & IV A) Leaves *Site*	Residuals	6.06	3	2.02	1.58	0.208
Treatment (=Trt)	Trt**Site*	20.09	1	20.09	16.00	**0.028**
Trt**Site*	Residuals	3.77	3	1.26	0.98	0.410
Residuals (=Trt*Site*Rep)		51.03	40	1.28		
Trts III & IV B) Roots/Rhizomes *Site*	Residuals	2.66	3	0.89	0.24	0.871
Treatment (=Trt)	Trt**Site*	6.84	1	6.84	3.08	0.177
Trt**Site*	Residuals	6.65	3	2.22	0.59	0.625
Residuals (=Trt*Site*Rep)		150.24	40	3.76		
Trts III & IV C) Whole Plant *Site*	Residuals	2.82	3	0.94	0.07	0.975
Treatment (=Trt)	Trt**Site*	25.18	1	25.18	7.87	0.068
Trt**Site*	Residuals	9.60	3	3.20	0.25	0.863
Residuals (=Trt*Site*Rep)		1139.82	88	12.95		

Factor	Error term	SS	df	MS	F	p
Trts V & VI A) Leaves *Site*	Residuals	59.52	3	19.84	6.47	**0.001**
Treatment (=Trt)	Trt**Site*	4.42	1	4.42	1.41	0.321
Trt**Site*	Residuals	9.43	3	3.14	1.03	0.392
Residuals (=Trt*Site*Rep)		122.65	40	3.07		
Trts V & VI B) Roots/Rhizomes *Site*	Residuals	62.39	3	20.80	5.24	**0.004**
Treatment (=Trt)	Trt**Site*	14.77	1	14.77	2.93	0.186
Trt**Site*	Residuals	15.13	3	5.04	1.27	0.297
Residuals (=Trt*Site*Rep)		158.62	40	3.97		
Trts V & VI C) Whole Plant *Site*	Residuals	84.42	3	28.14	4.96	**0.003**
Treatment (=Trt)	Trt**Site*	17.68	1	17.68	2.69	0.200
Trt**Site*	Residuals	19.73	3	6.58	1.16	0.330
Residuals (=Trt*Site*Rep)		499.25	88	5.67		

Nitrogen

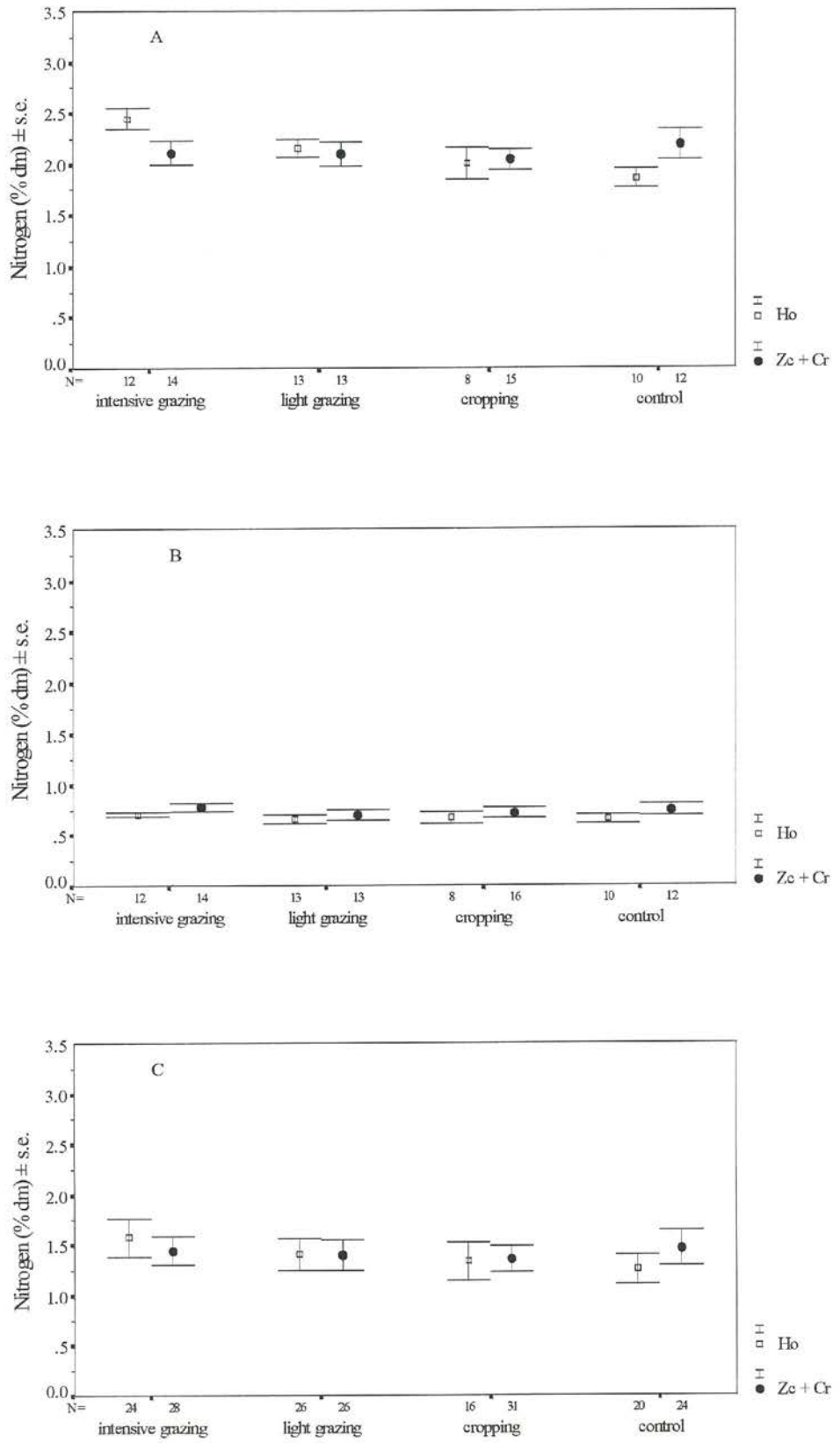


Figure 1. Plots of the mean response of nitrogen concentration (% dm, with standard errors) in the (**a**) leaves, (**b**) roots/rhizomes and (**c**) whole plants of *Halophila ovalis* (Ho) and *Zostera capricorni* + *Cymodocea rotundata* (Zc + Cr) to the different treatments (intensive grazing, light grazing, cropping and control) in the long-term grazing experiments conducted at Ellie Point.

Organic Matter

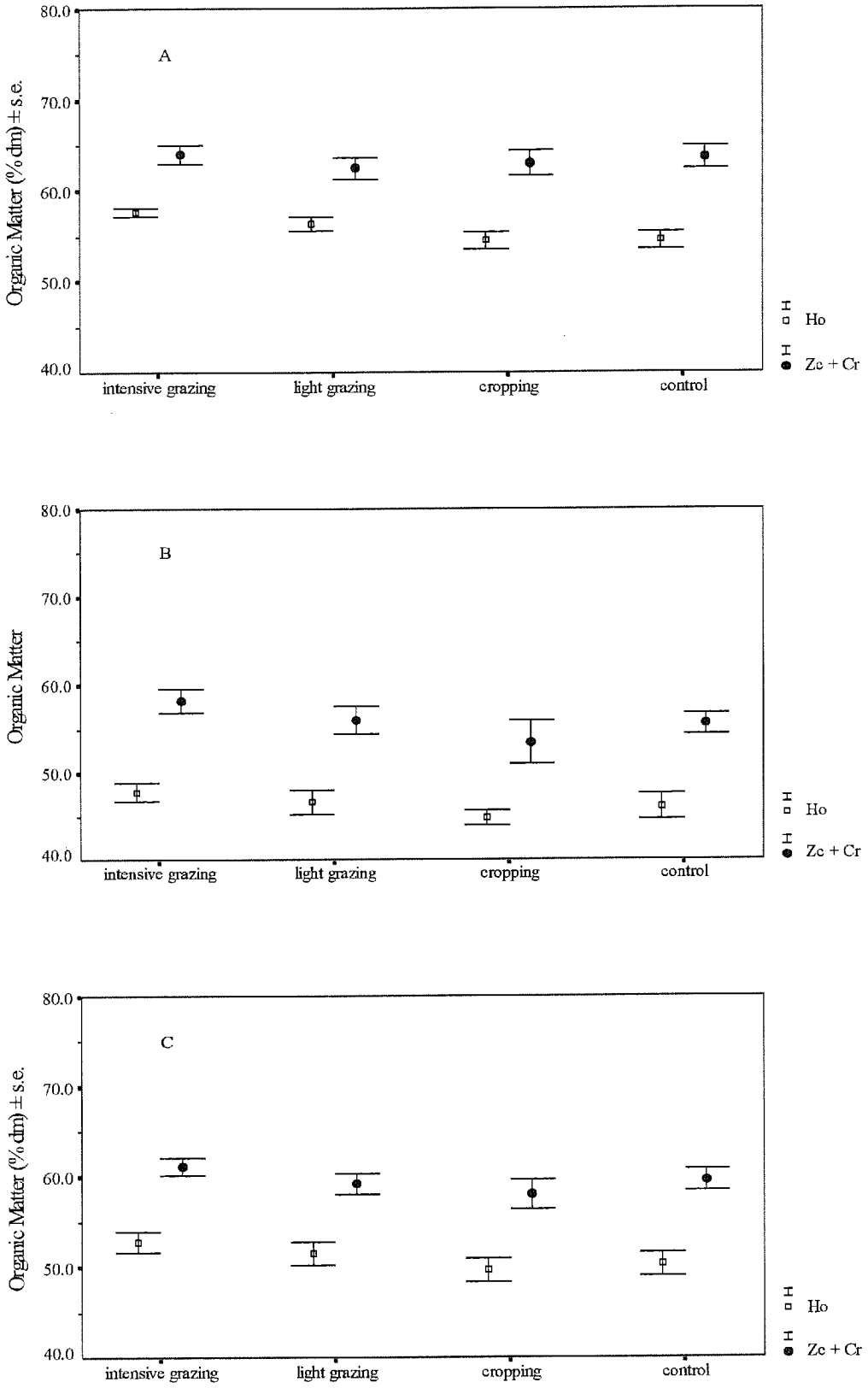


Figure 2. Plots of the mean response of organic matter concentration (% dm, with standard errors) in the (**a**) leaves, (**b**) roots/rhizomes and (**c**) whole plants of *Halophila ovalis* (Ho) and *Zostera capricorni* + *Cymodocea rotundata* (Zc + Cr) to the different treatments (intensive grazing, light grazing, cropping and control) in the long-term grazing experiments conducted at Ellie Point.

Neutral Detergent Fibre

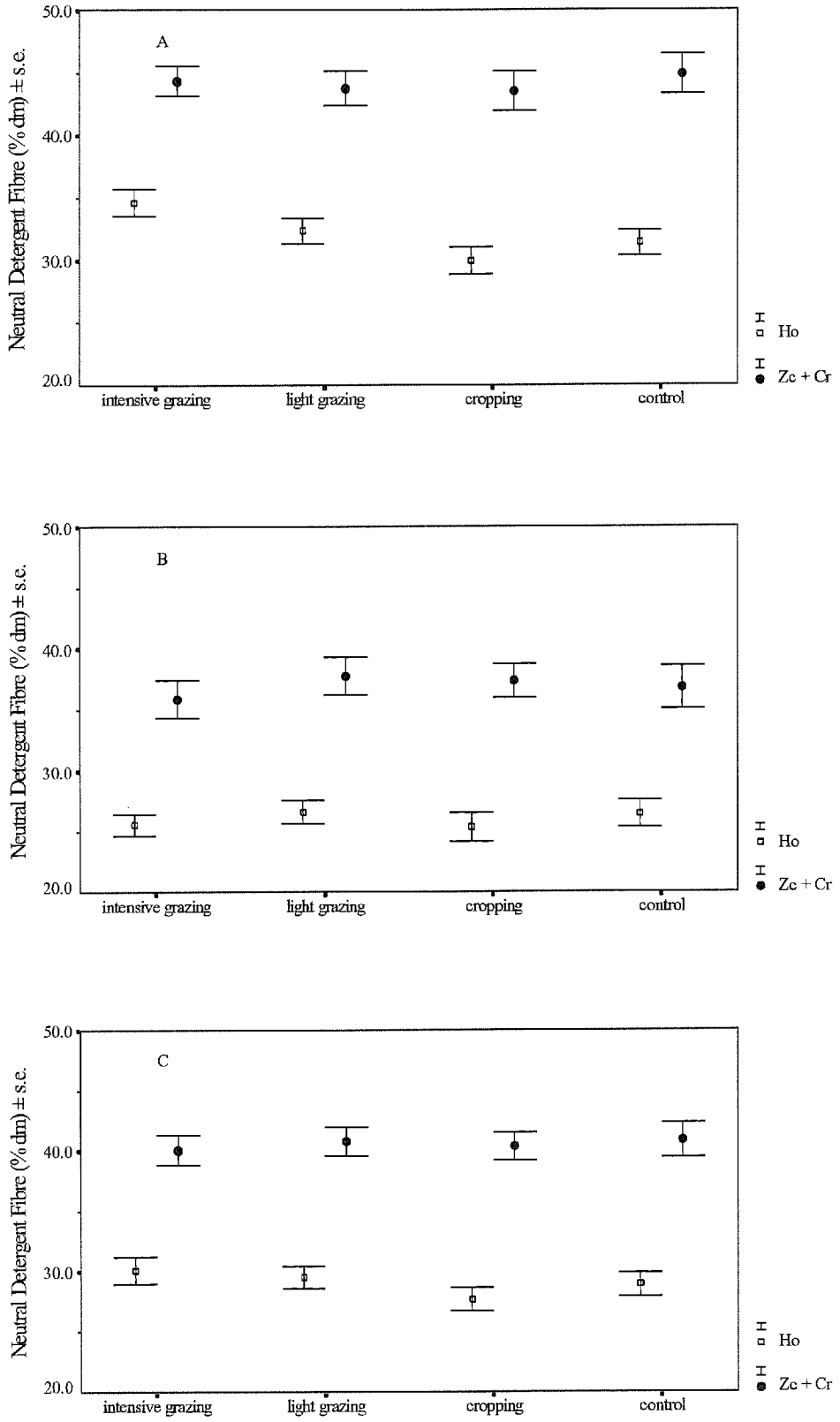


Figure 3. Plots of the mean response of the concentration of neutral detergent fibre (% dm, with standard errors) in the (**a**) leaves, (**b**) roots/rhizomes and (**c**) whole plants of *Halophila ovalis* (Ho) and *Zostera capricorni* + *Cymodocea rotundata* (Zc + Cr) to the different treatments (intensive grazing, light grazing, cropping and control) in the long-term grazing experiments conducted at Ellie Point.

Acid Detergent Fibre

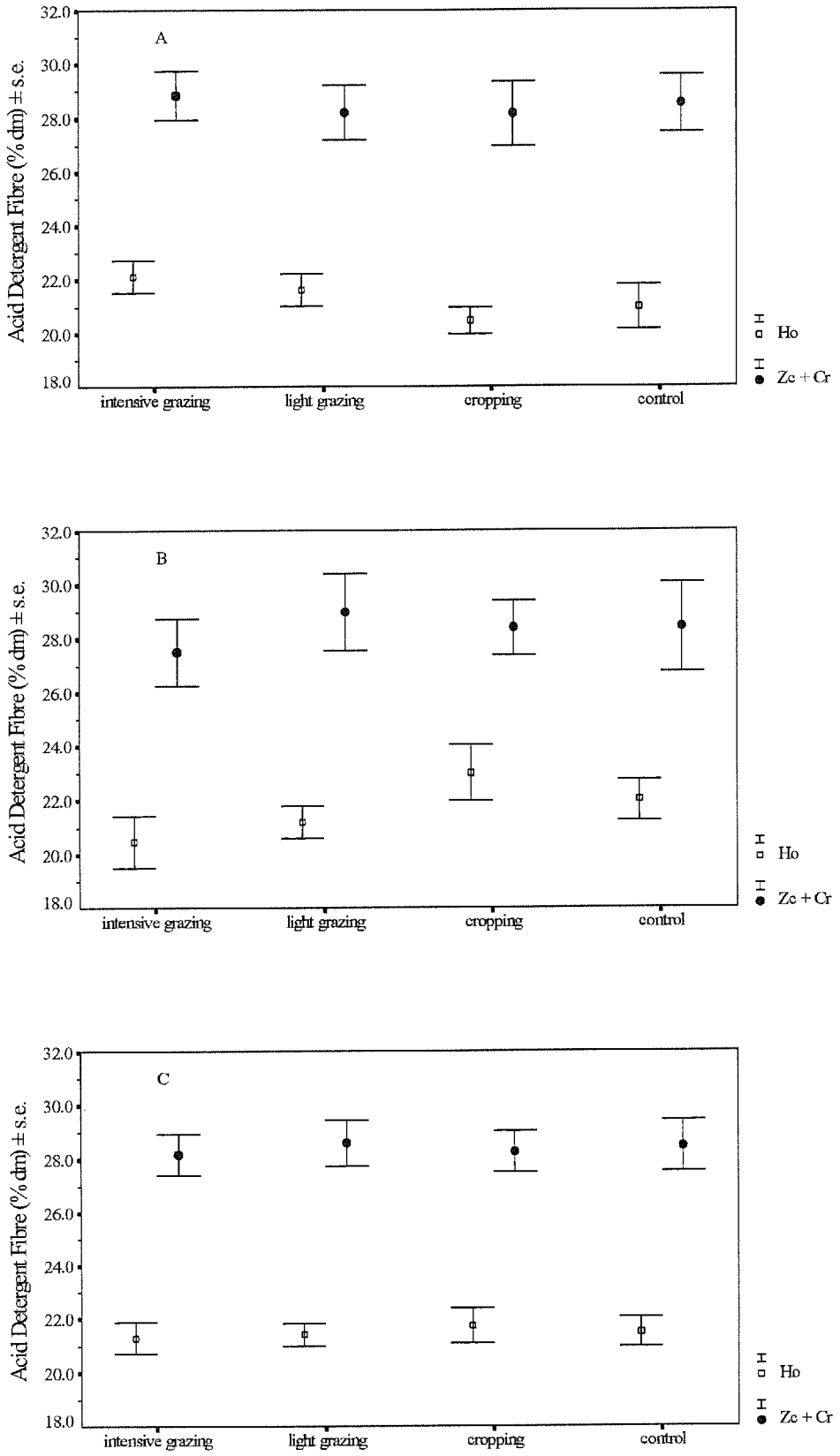


Figure 4. Plots of the mean response of the concentration of acid detergent fibre (% dm, with standard errors) in the (**a**) leaves, (**b**) roots/rhizomes and (**c**) whole plants of *Halophila ovalis* (Ho) and *Zostera capricorni* + *Cymodocea rotundata* (Zc + Cr) to the different treatments (intensive grazing, light grazing, cropping and control) in the long-term grazing experiments conducted at Ellie Point.

Hemicellulose

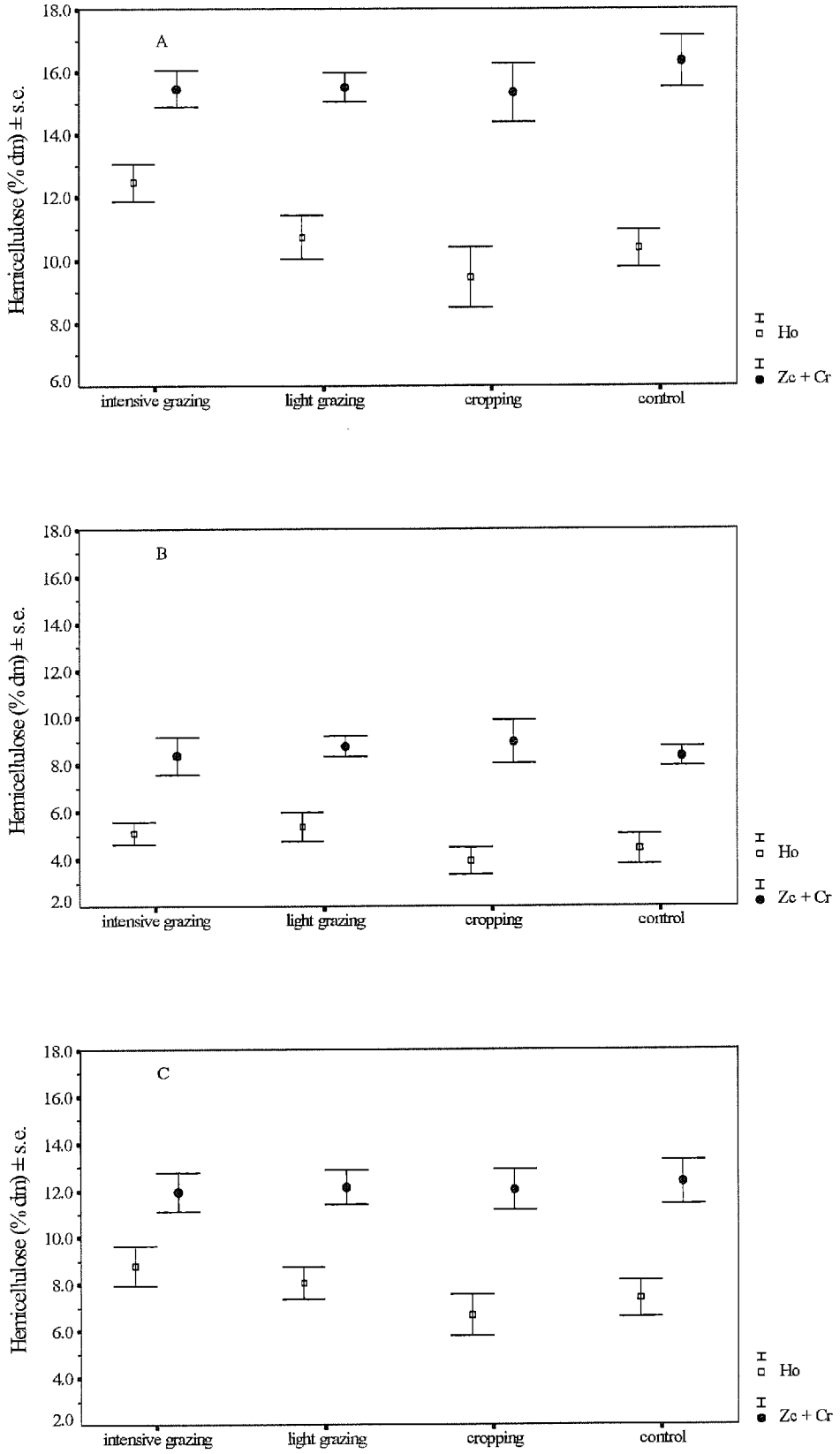


Figure 5. Plots of the mean response of the concentration of hemicellulose (% dm, with standard errors) in the (**a**) leaves, (**b**) roots/rhizomes and (**c**) whole plants of *Halophila ovalis* (Ho) and *Zostera capricorni* + *Cymodocea rotundata* (Zc + Cr) to the different treatments (intensive grazing, light grazing, cropping and control) in the long-term grazing experiments conducted at Ellie Point.

Lignin

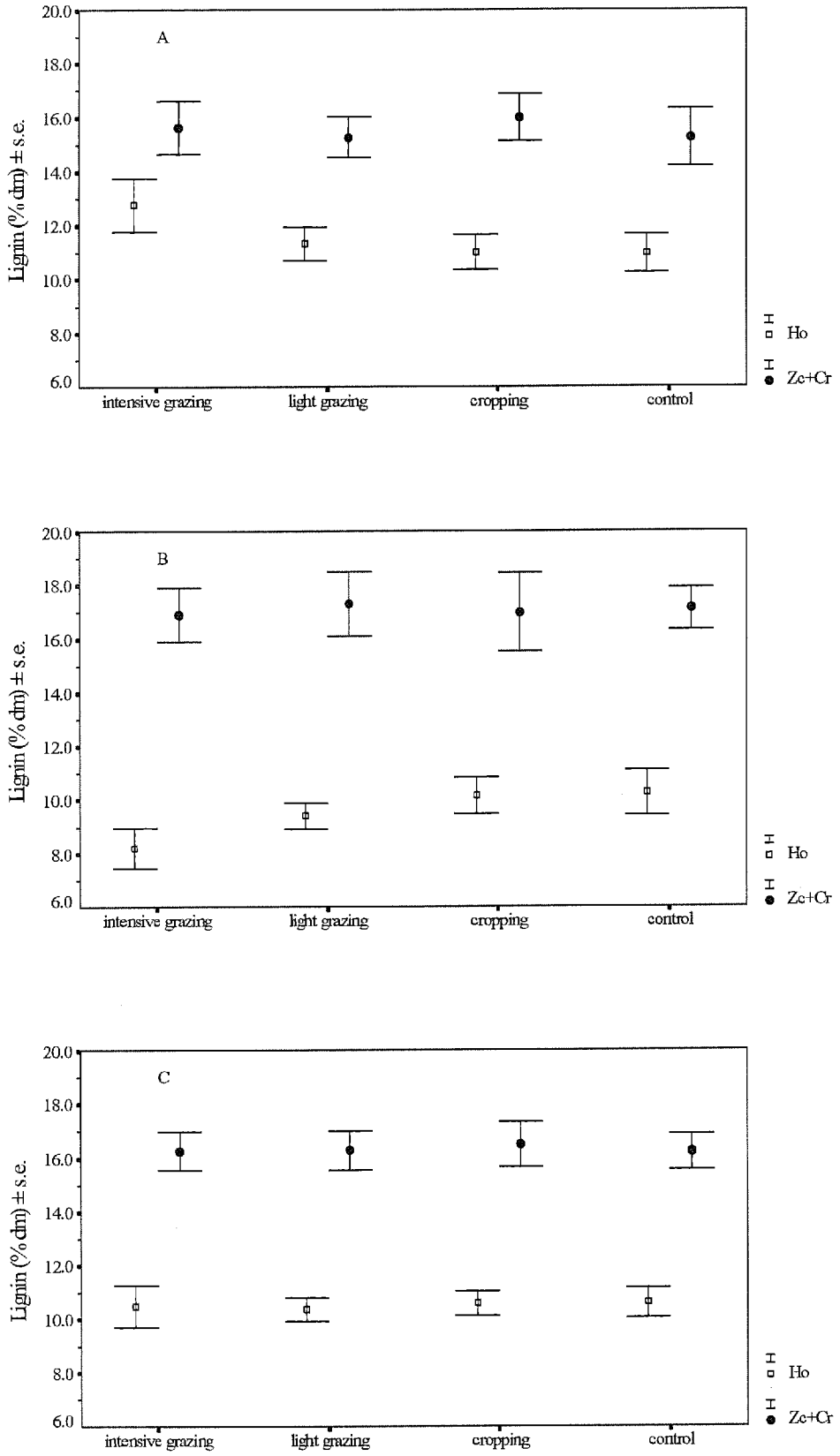


Figure 6. Plots of the mean response of the concentration of lignin (% dm, with standard errors) in the (**a**) leaves, (**b**) roots/rhizomes and (**c**) whole plants of *Halophila ovalis* (Ho) and *Zostera capricorni* + *Cymodocea rotundata* (Zc + Cr) to the different treatments (intensive grazing, light grazing, cropping and control) in the long-term grazing experiments conducted at Ellie Point.

Water Soluble Carbohydrate

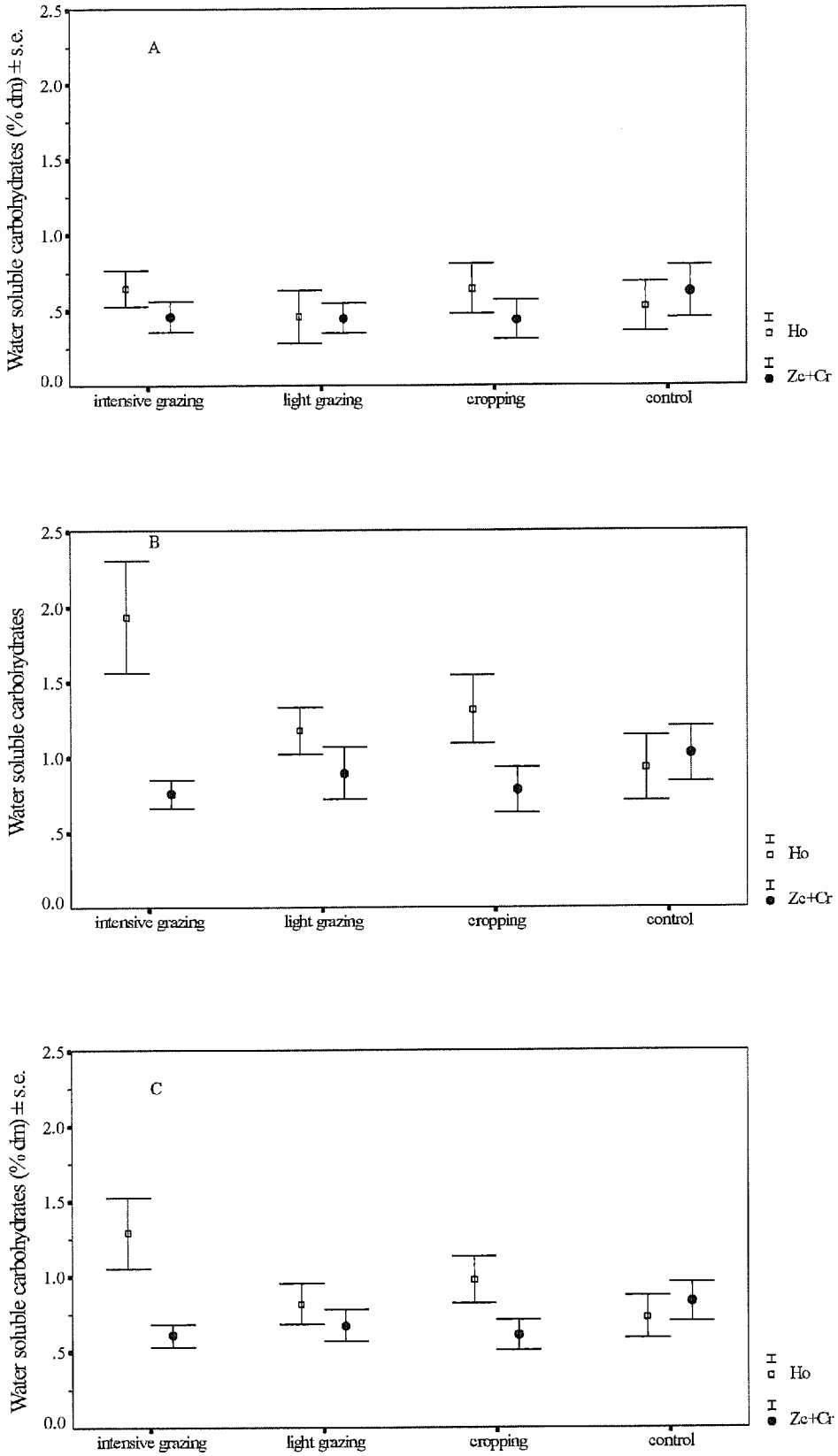


Figure 7. Plots of the mean response of the concentration of water soluble carbohydrate (% dm, with standard errors) in the (**a**) leaves, (**b**) roots/rhizomes and (**c**) whole plants of *Halophila ovalis* (Ho) and *Zostera capricorni* + *Cymodocea rotundata* (Zc + Cr) to the different treatments (intensive grazing, light grazing, cropping and control) in the long-term grazing experiments conducted at Ellie Point.

Starch

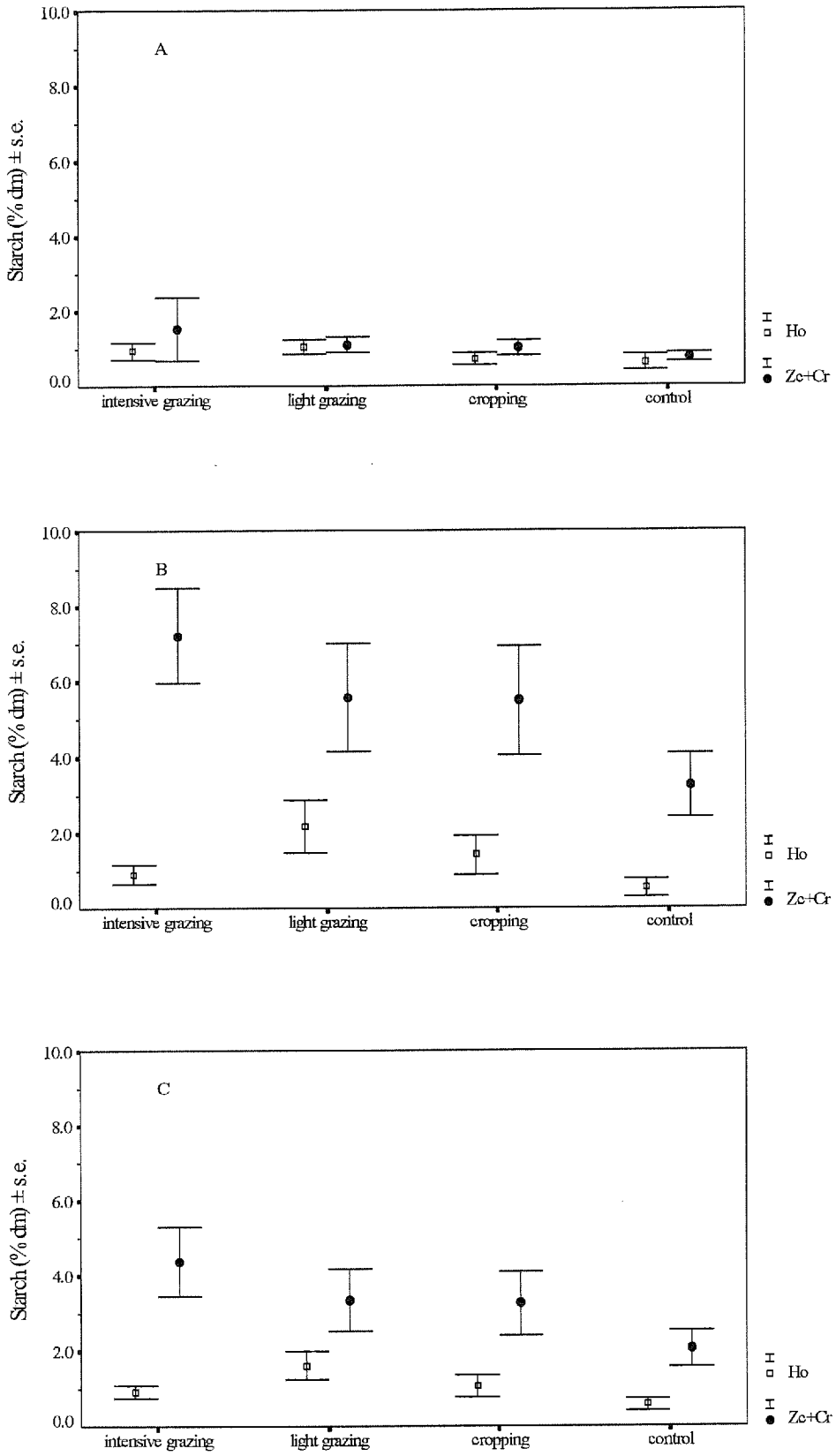


Figure 8. Plots of the mean response of the concentration of starch (% dm, with standard errors) in the (**a**) leaves, (**b**) roots/rhizomes and (**c**) whole plants of *Halophila ovalis* (Ho) and *Zostera capricorni* + *Cymodocea rotundata* (Zc + Cr) to the different treatments (intensive grazing, light grazing, cropping and control) in the long-term grazing experiments conducted at Ellie Point.

In Vitro Dry Matter Digestibility

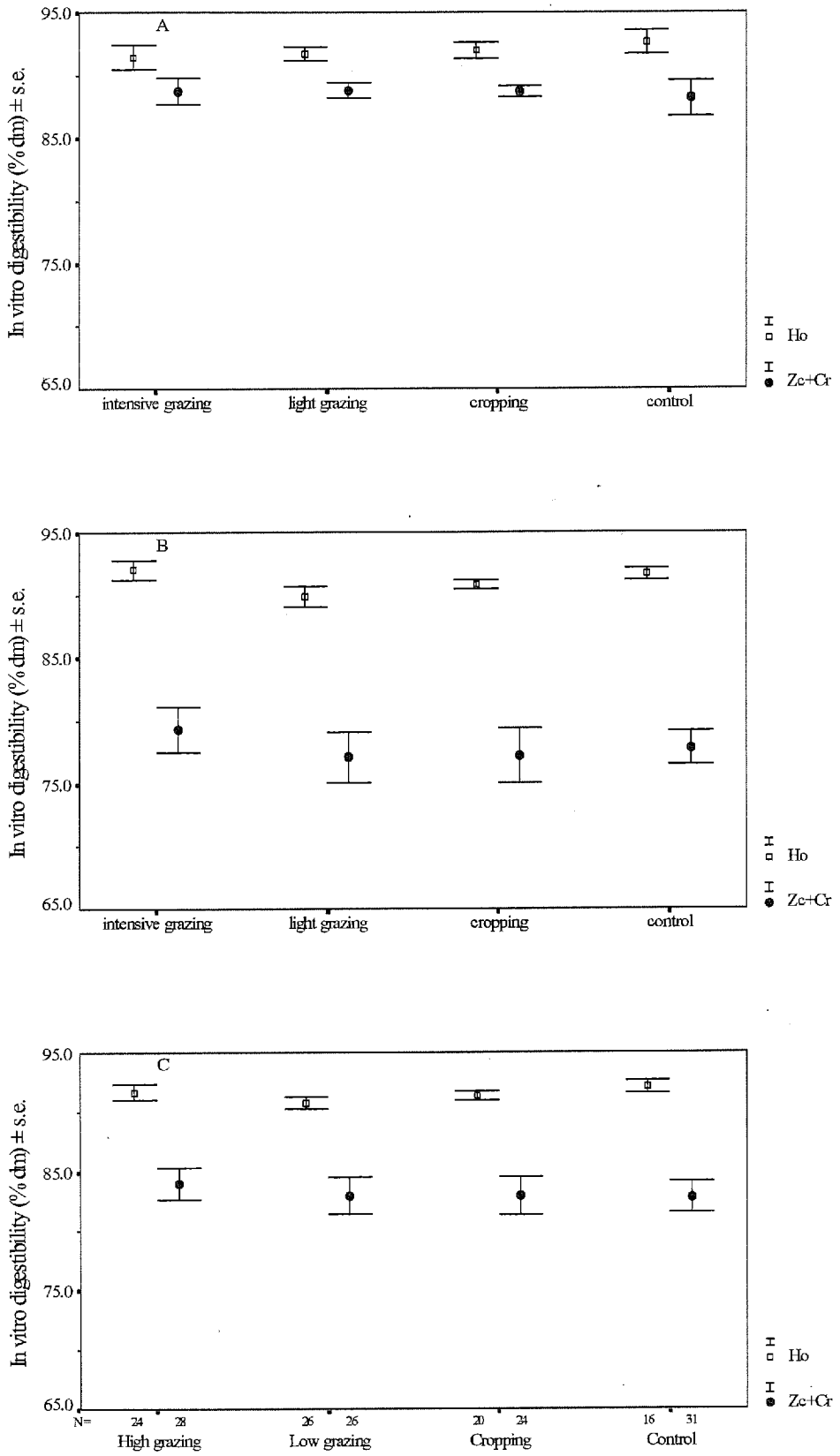
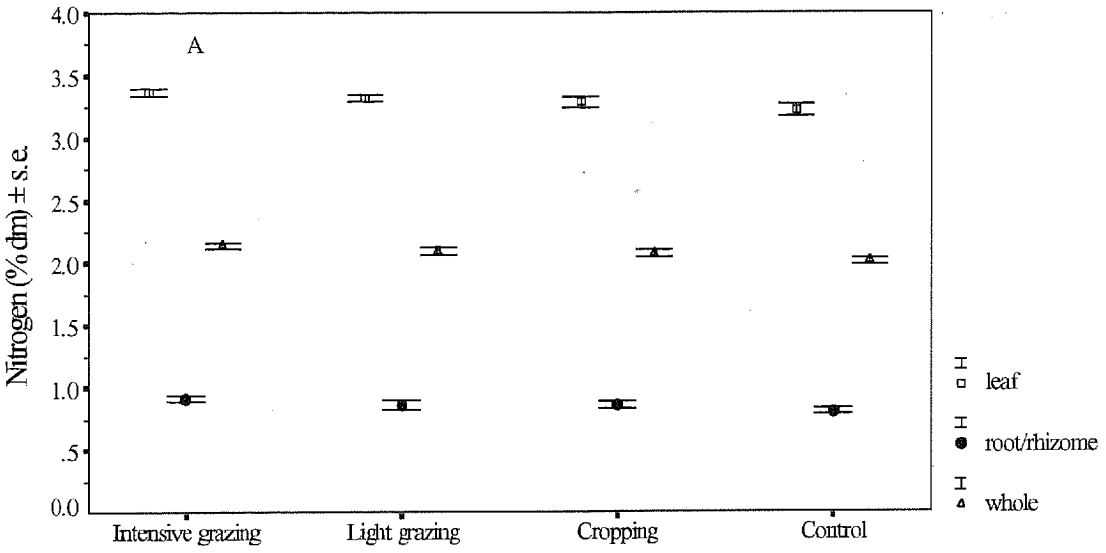


Figure 9. Plots of the mean response of the *in vitro* digestibility (% dm, with standard errors) of the (**a**) leaves, (**b**) roots/rhizomes and (**c**) whole plants of *Halophila ovalis* (Ho) and *Zostera capricorni* + *Cymodocea rotundata* (Zc + Cr) to the different treatments (intensive grazing, light grazing, cropping and control) in the long-term grazing experiments conducted at Ellie Point.

Nitrogen



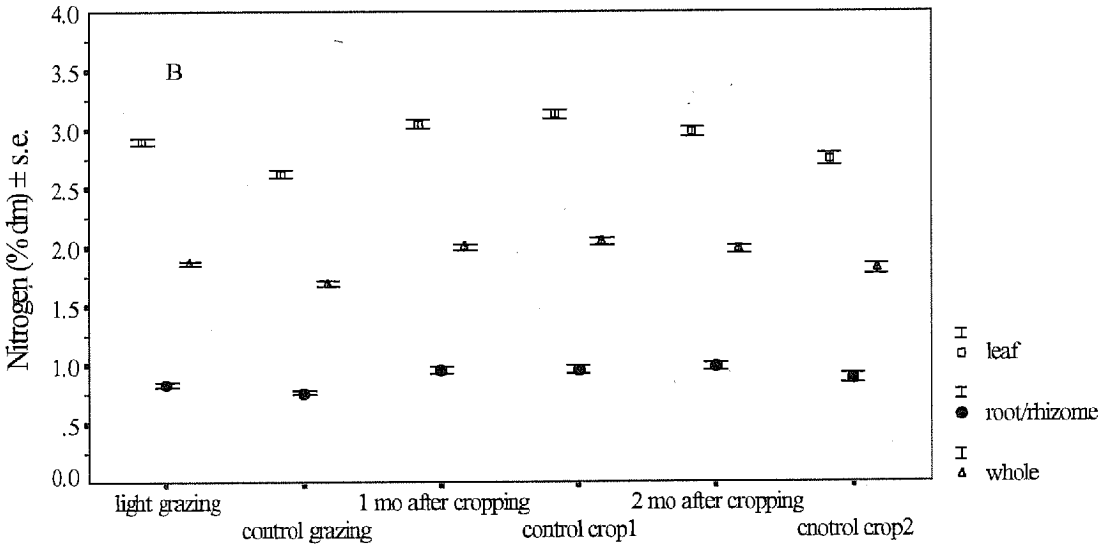


Figure 10. Plots of the mean response of nitrogen concentration (% dm, with standard errors) in the leaves (□) , roots/rhizomes (•) and whole plants (Δ) of *Halodule uninervis* to the different treatments of herbivory in the (**A**) long-term (intensive grazing, light grazing, cropping and control) and (**B**) short-term experiments (light grazing, 1 month after cropping, 2 months after cropping, and their respective controls) conducted at Cardwell.

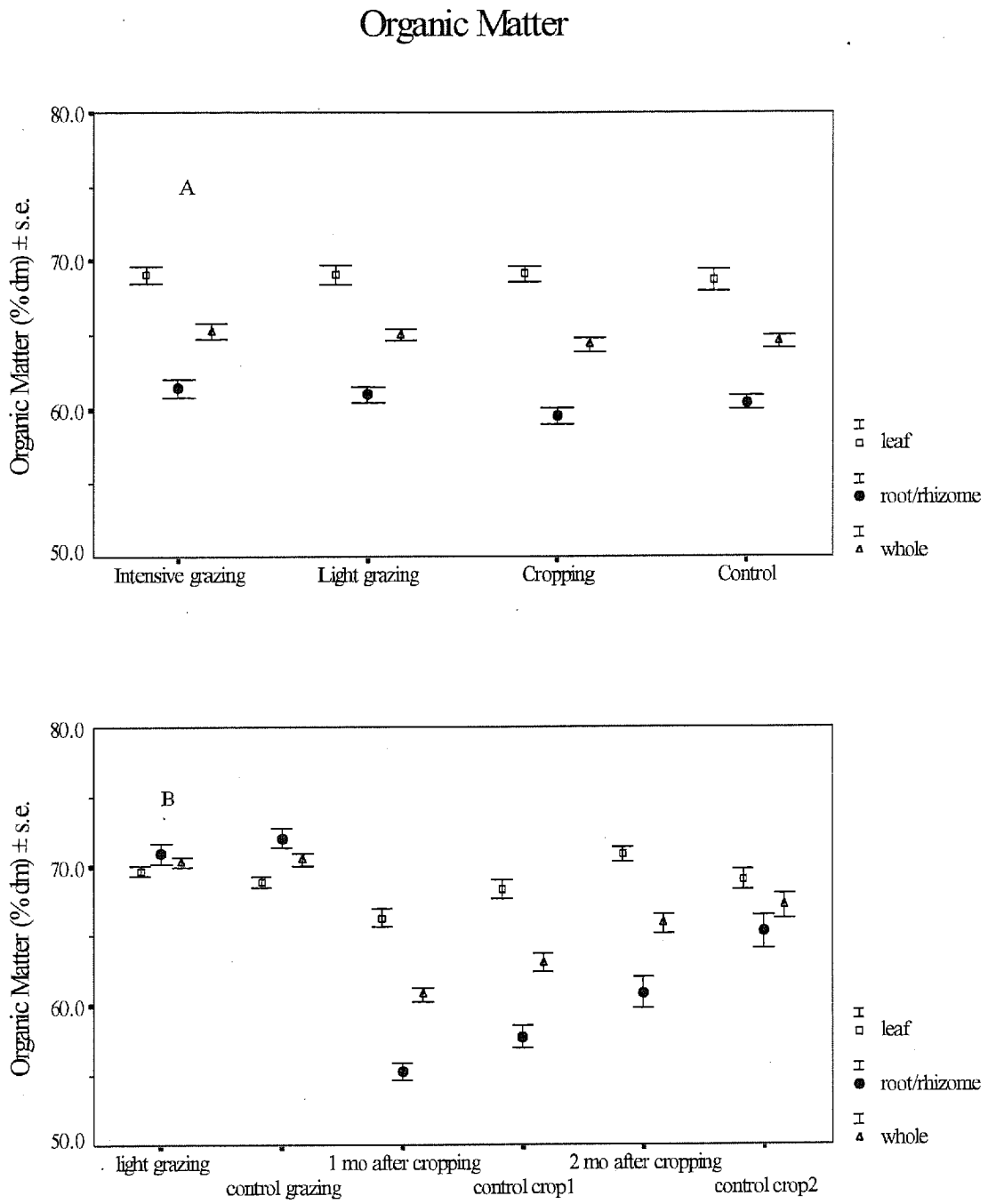
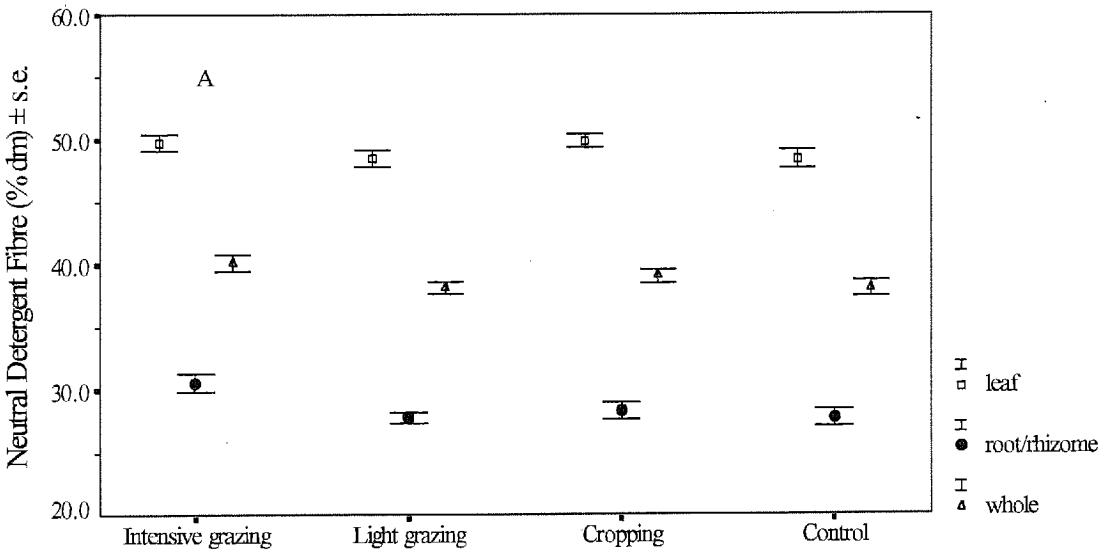


Figure 11. Plots of the mean response of organic matter concentration (% dm, with standard errors) in the leaves (□), roots/rhizomes (•) and whole plants (▵) of *Halodule uninervis* to the different treatments of herbivory in the (**A**) long-term (intensive grazing, light grazing, cropping and control) and (**B**) short-term experiments (light grazing, 1 month after cropping, 2 months after cropping, and their respective controls) conducted at Cardwell.

Neutral Detergent Fibre



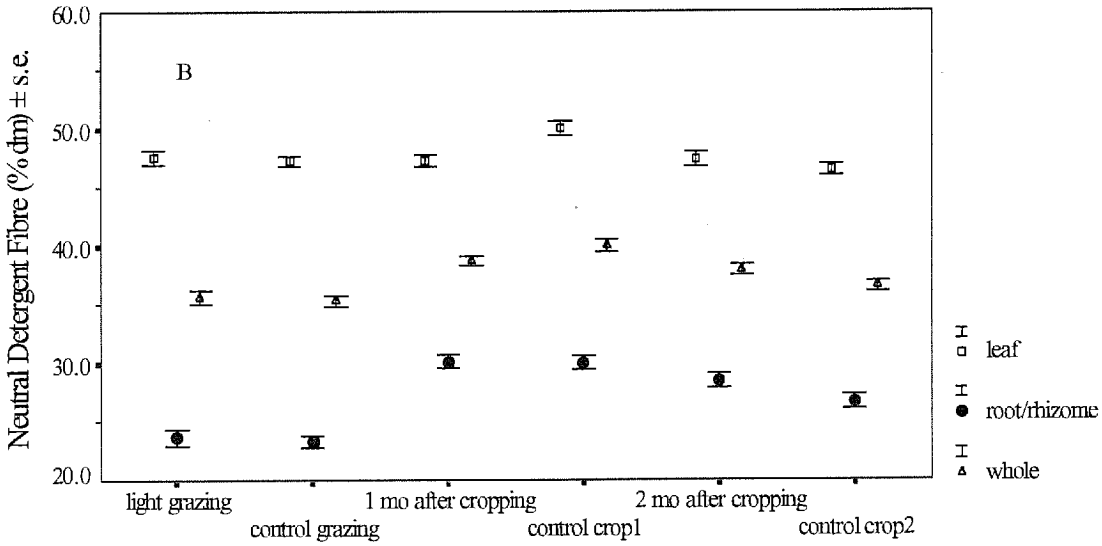
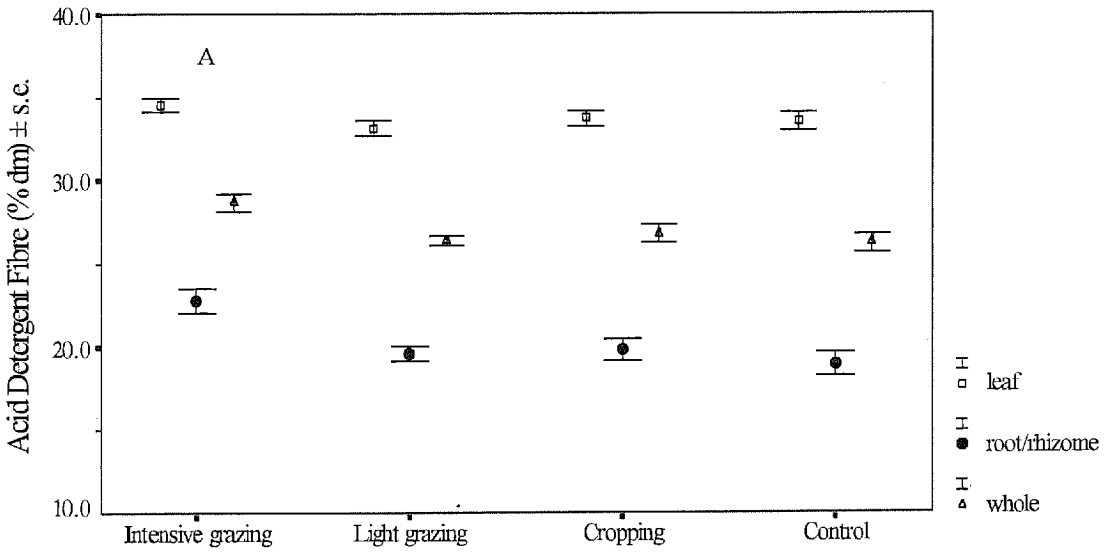


Figure 12. Plots of the mean response of the concentration of neutral detergent fibre (% dm, with standard errors) in the leaves (□) , roots/rhizomes (•) and whole plants (Δ) of *Halodule uninervis* to the different treatments of herbivory in the (**A**) long-term (intensive grazing, light grazing, cropping and control) and (**B**) short-term experiments (light grazing, 1 month after cropping, 2 months after cropping, and their respective controls) conducted at Cardwell.

Acid Detergent Fibre



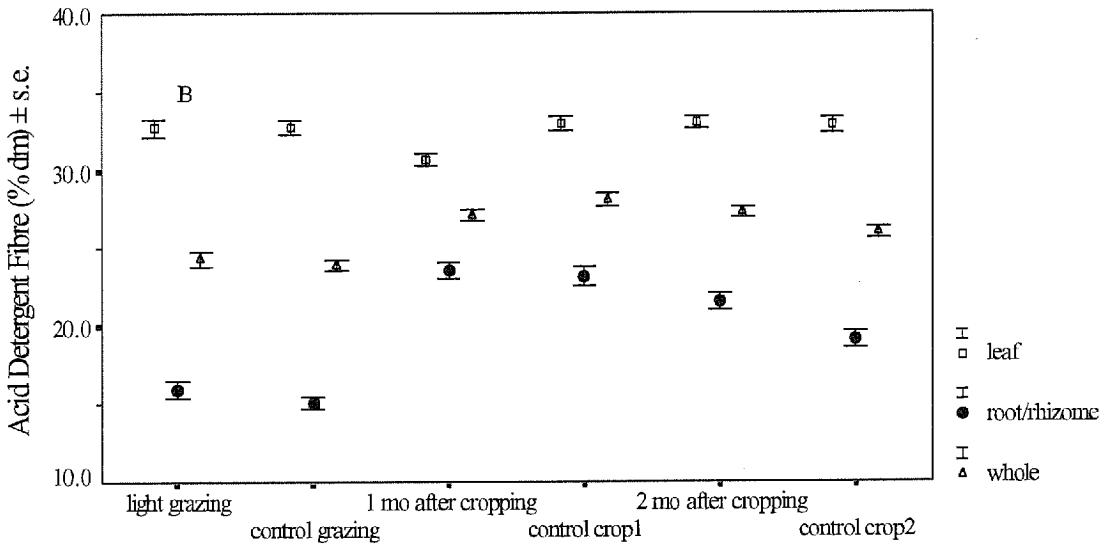
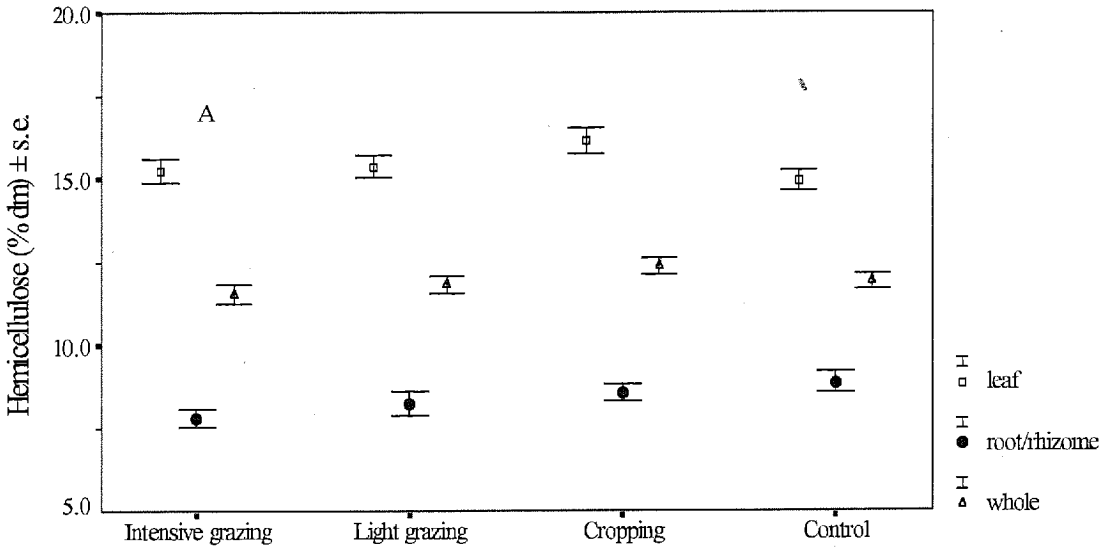


Figure 13. Plots of the mean response of the concentration of acid detergent fibre (% dm, with standard errors) in the leaves (□) , roots/rhizomes (•) and whole plants (Δ) of *Halodule uninervis* to the different treatments of herbivory in the (**A**) long-term (intensive grazing, light grazing, cropping and control) and (**B**) short-term experiments (light grazing, 1 month after cropping, 2 months after cropping, and their respective controls) conducted at Cardwell.

Hemicellulose



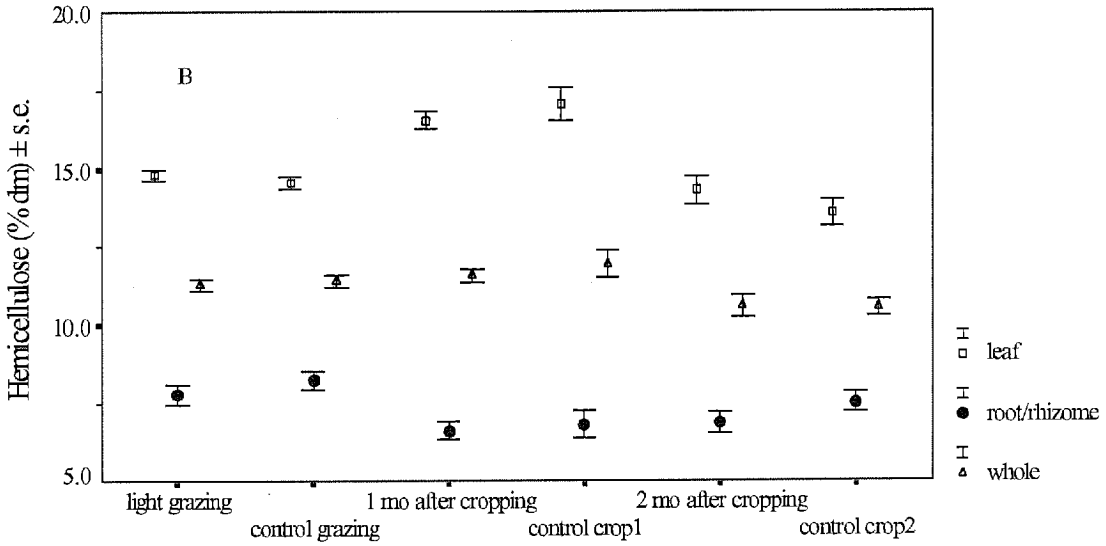
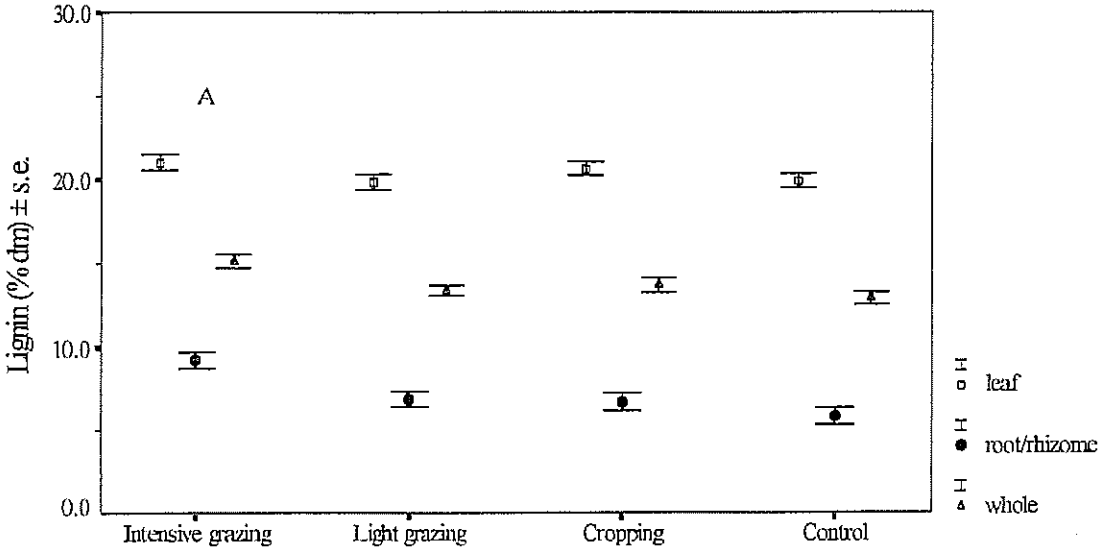


Figure 14. Plots of the mean response of the concentration of hemicellulose (% dm, with standard errors) in the leaves (□) , roots/rhizomes (•) and whole plants (Δ) of *Halodule uninervis* to the different treatments of herbivory in the (**A**) long-term (intensive grazing, light grazing, cropping and control) and (**B**) short-term experiments (light grazing, 1 month after cropping, 2 months after cropping, and their respective controls) conducted at Cardwell.

Lignin



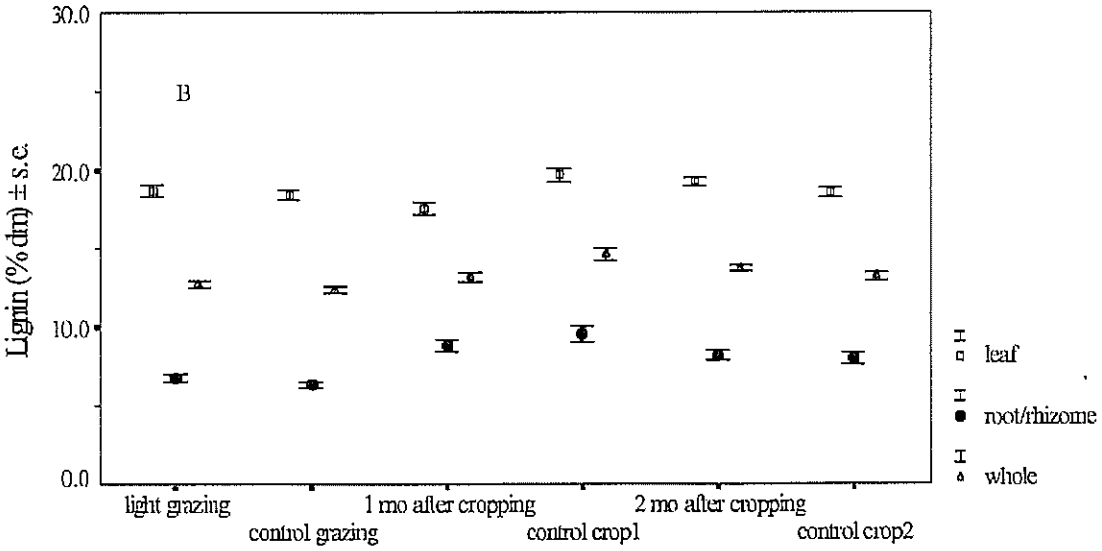


Figure 15. Plots of the mean response of the concentration of lignin (% dm, with standard errors) in the leaves (□), roots/rhizomes (•) and whole plants (▵) of *Halodule uninervis* to the different treatments of herbivory in the (**A**) long-term (intensive grazing, light grazing, cropping and control) and (**B**) short-term experiments (light grazing, 1 month after cropping, 2 months after cropping, and their respective controls) conducted at Cardwell.

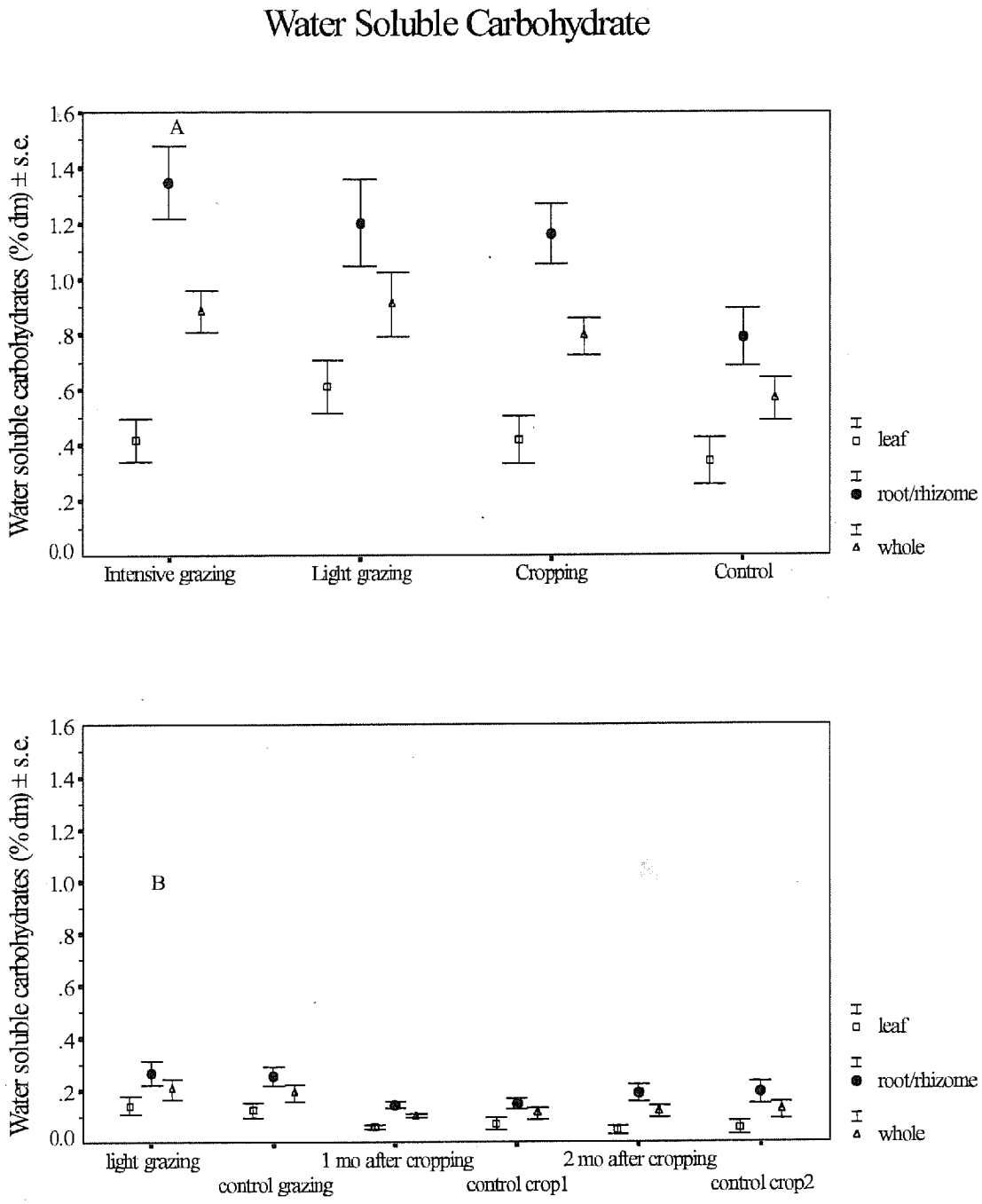
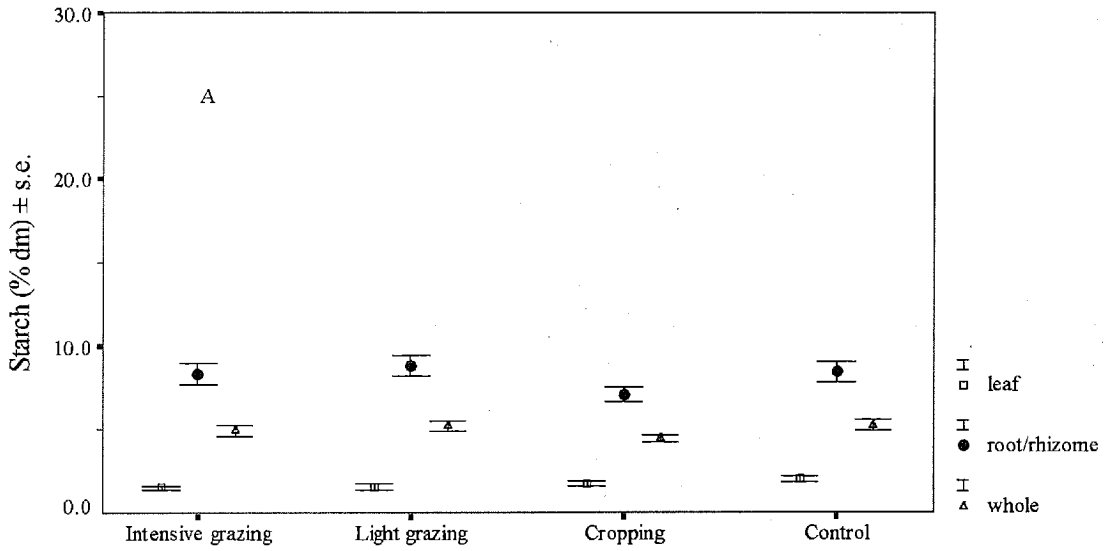


Figure 16. Plots of the mean response of the concentration of water soluble carbohydrate (% dm, with standard errors) in the leaves (□), roots/rhizomes (•) and whole plants (Δ) of *Halodule uninervis* to the different treatments of herbivory in the (**A**) long-term (intensive grazing, light grazing, cropping and control) and (**B**) short-term experiments (light grazing, 1 month after cropping, 2 months after cropping, and their respective controls) conducted at Cardwell.

Starch



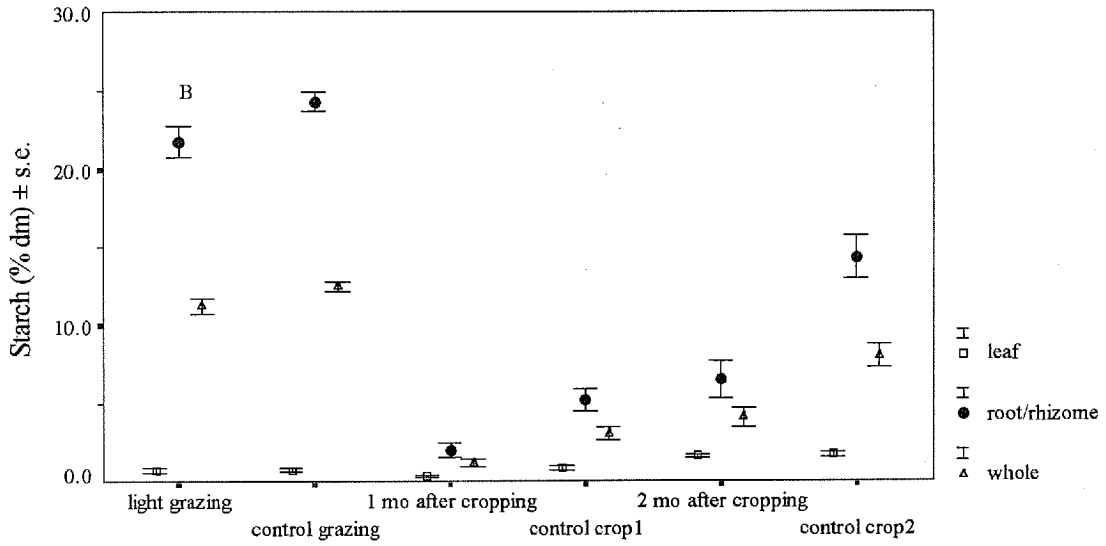


Figure 17. Plots of the mean response of the concentration of starch (% dm, with standard errors) in the leaves (□), roots/rhizomes (•) and whole plants (Δ) of *Halodule uninervis* to the different treatments of herbivory in the (**A**) long-term (intensive grazing, light grazing, cropping and control) and (**B**) short-term experiments (light grazing, 1 month after cropping, 2 months after cropping, and their respective controls) conducted at Cardwell.

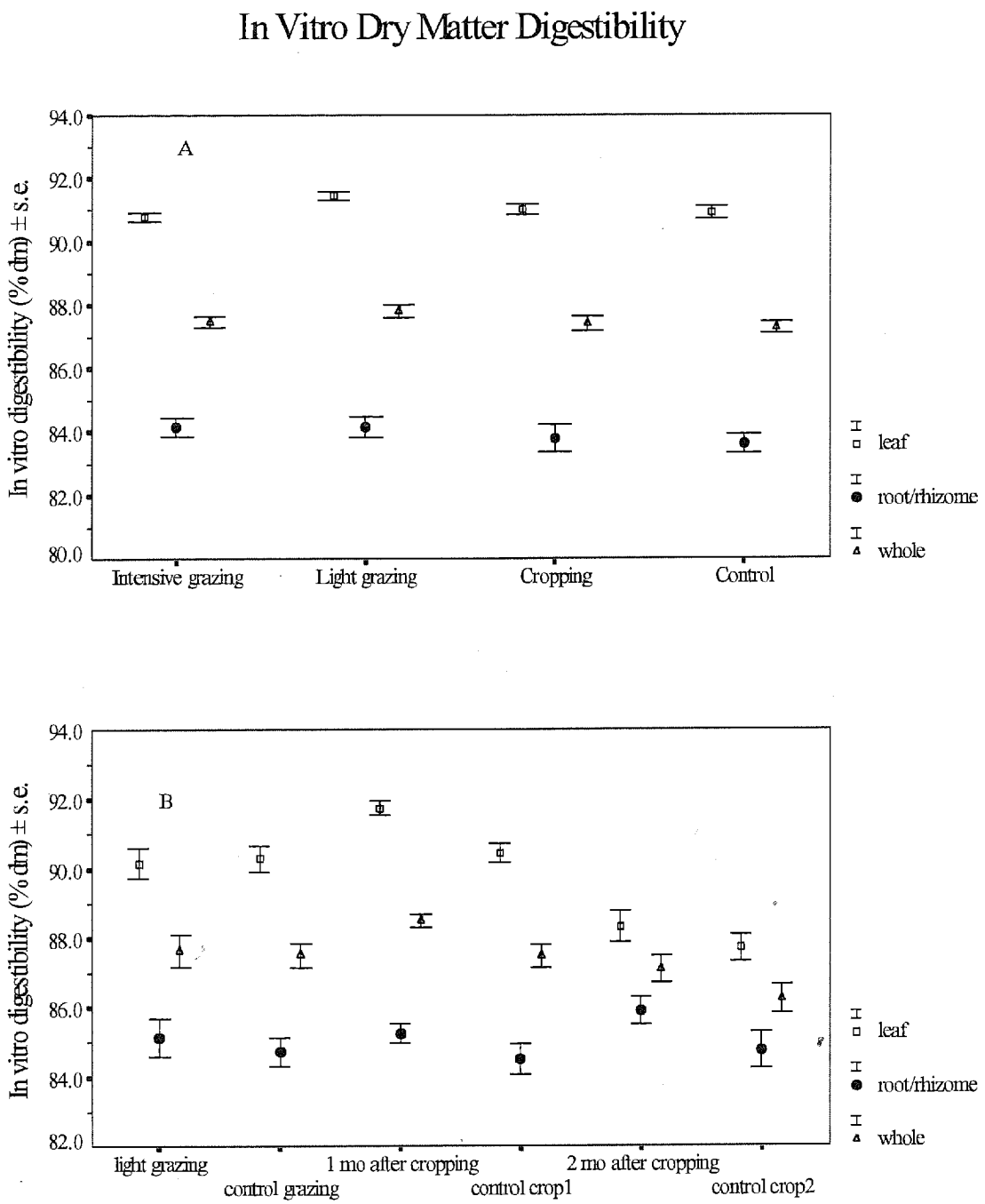


Figure 18. Plots of the mean response of the *in vitro* digestibility (% dm, with standard errors) of the leaves (□), roots/rhizomes (•) and whole plants (Δ) of *Halodule uninervis* to the different treatments of herbivory in the (**A**) long-term (intensive grazing, light grazing, cropping and control) and (**B**) short-term experiments (light grazing, 1 month after cropping, 2 months after cropping, and their respective controls) conducted at Cardwell.

Appendix 11. Plots of the mean concentrations (% dry matter) of the nutritional components significantly affected by enhanced nutrients in the sediments in each plant part of *Halophila minor* and *Halodule uninervis* conducted at Shelley Beach, Townsville. The concentrations of acid deteregnt fibre and water soluble carbohydrate were not signifcantly affected by the treatments.

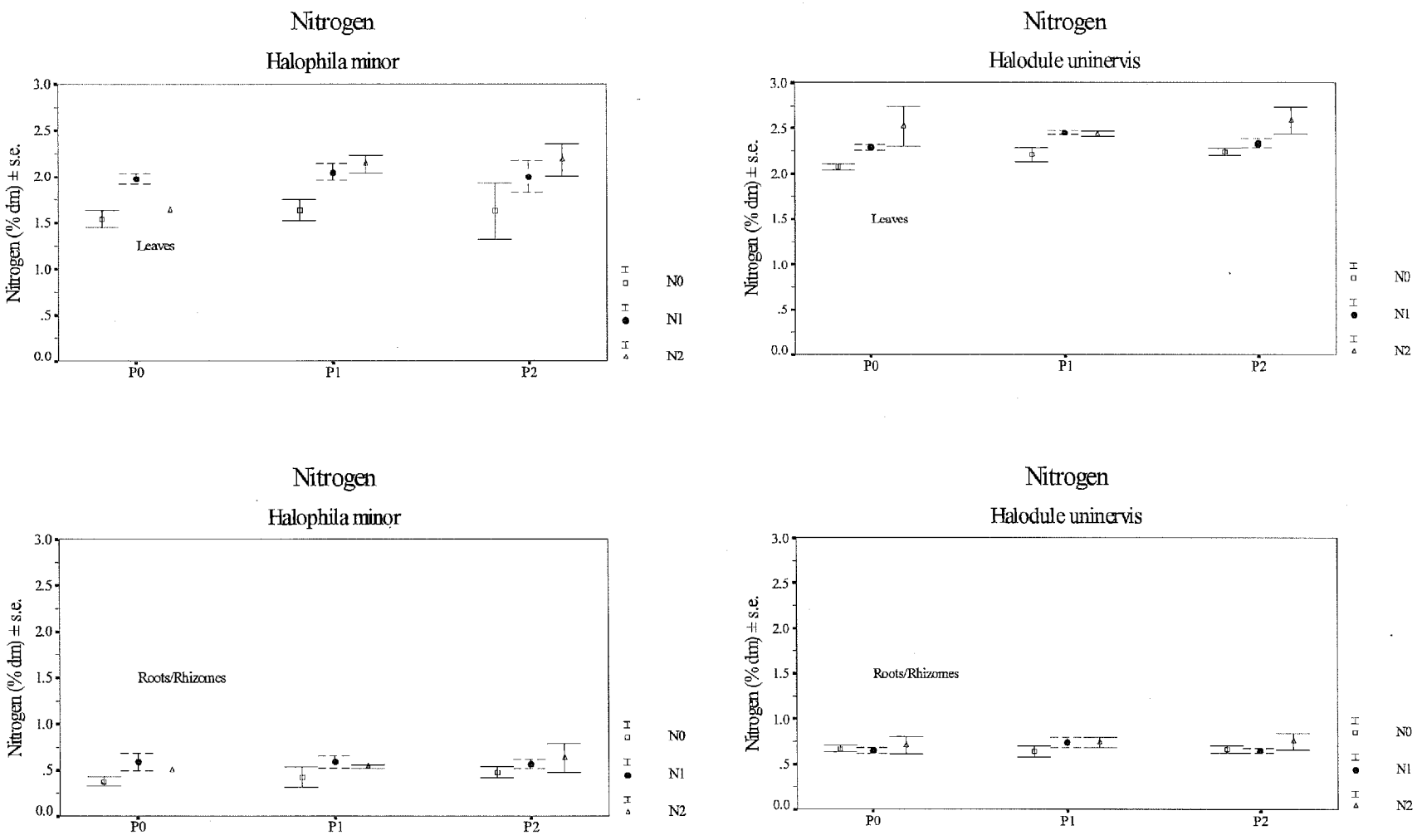

Nitrogen
Halophila minor
Nitrogen (% dm) ± s.e.
Leaves
P0
P1
P2
N0
N1
N2
Nitrogen
Halodule uninervis
Nitrogen (% dm) ± s.e.
Leaves
P0
P1
P2
N0
N1
N2
Nitrogen
Halophila minor
Nitrogen (% dm) ± s.e.
Roots/Rhizomes
P0
P1
P2
N0
N1
N2
Nitrogen
Halodule uninervis
Nitrogen (% dm) ± s.e.
Roots/Rhizomes
P0
P1
P2
N0
N1
N2

Figure 1

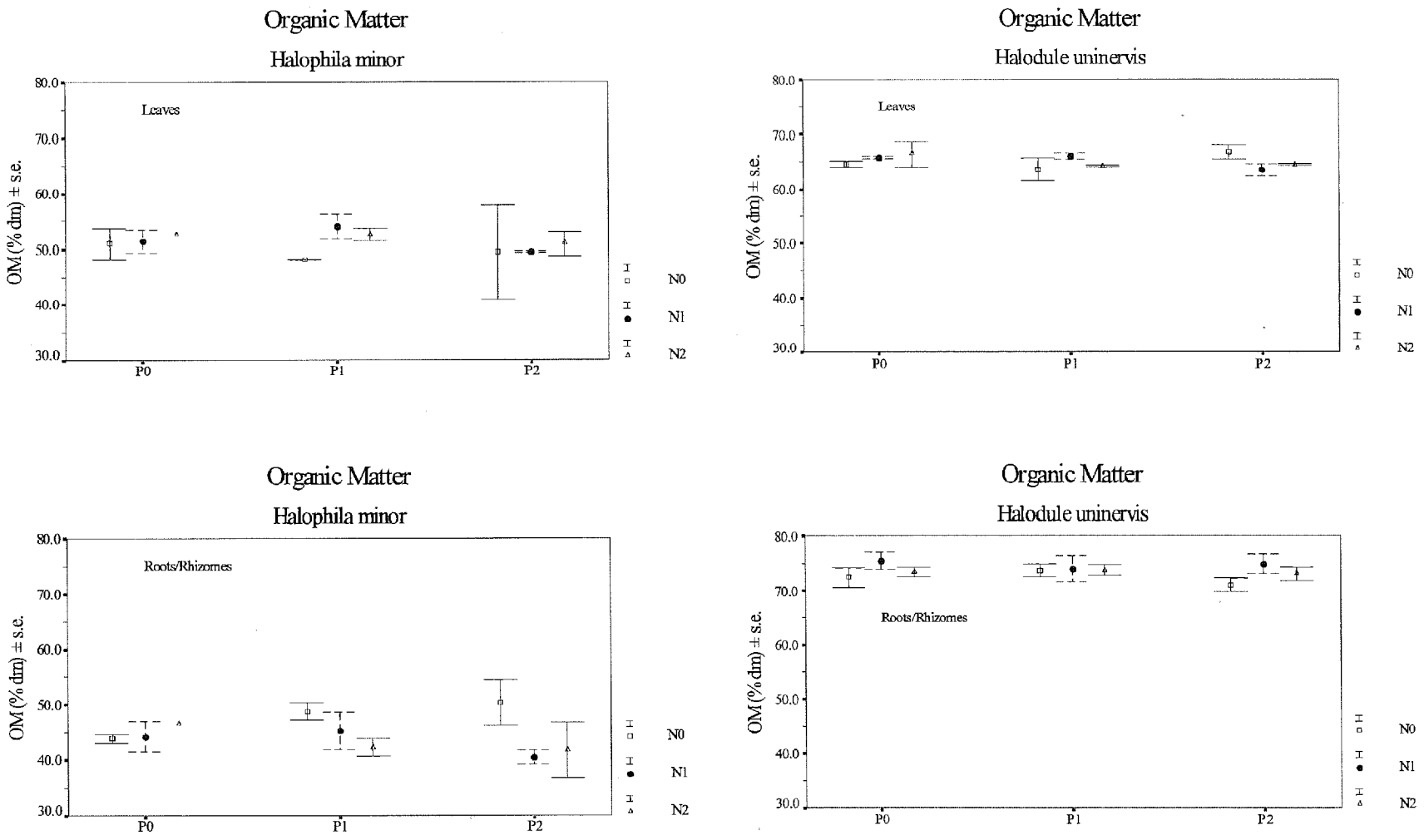
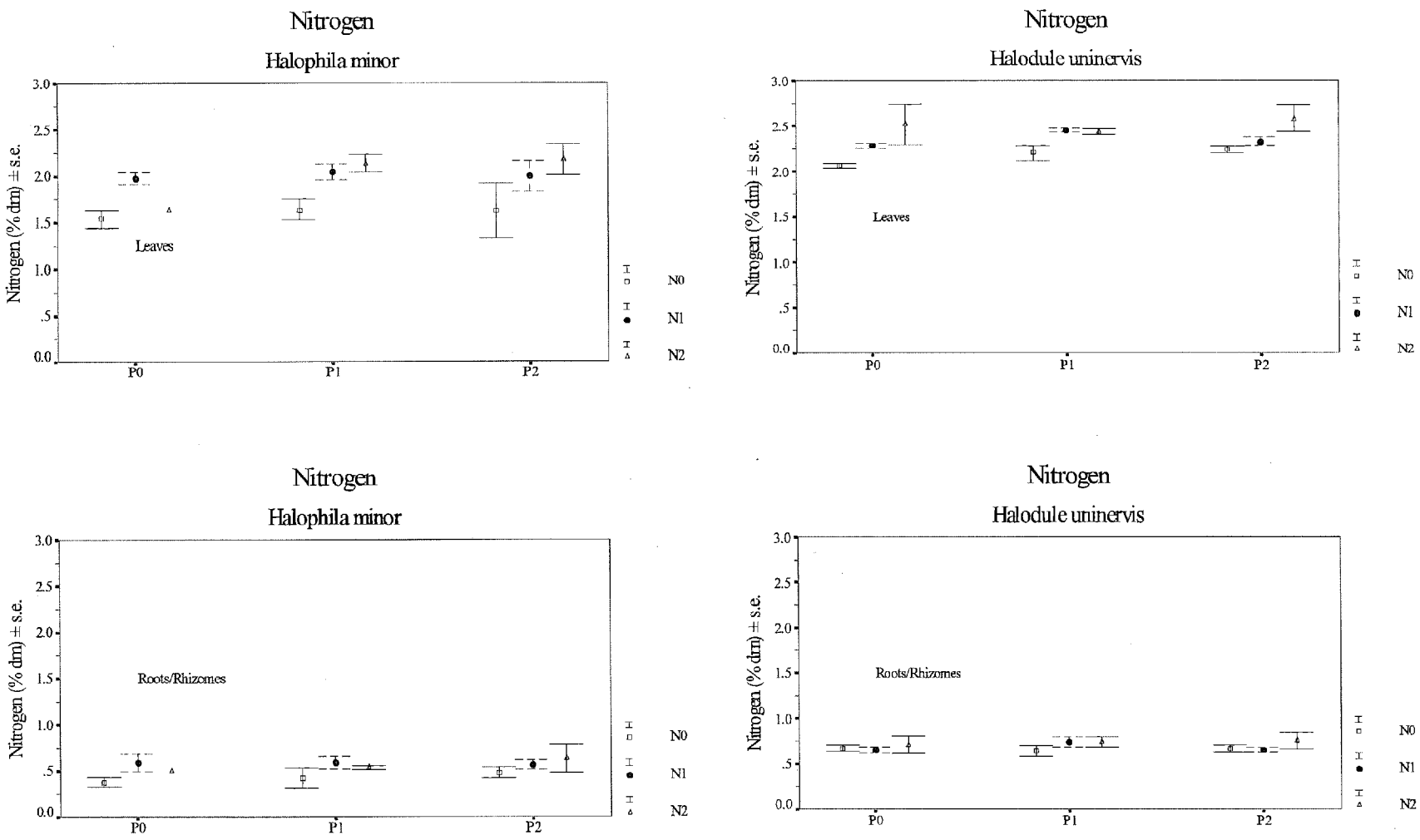
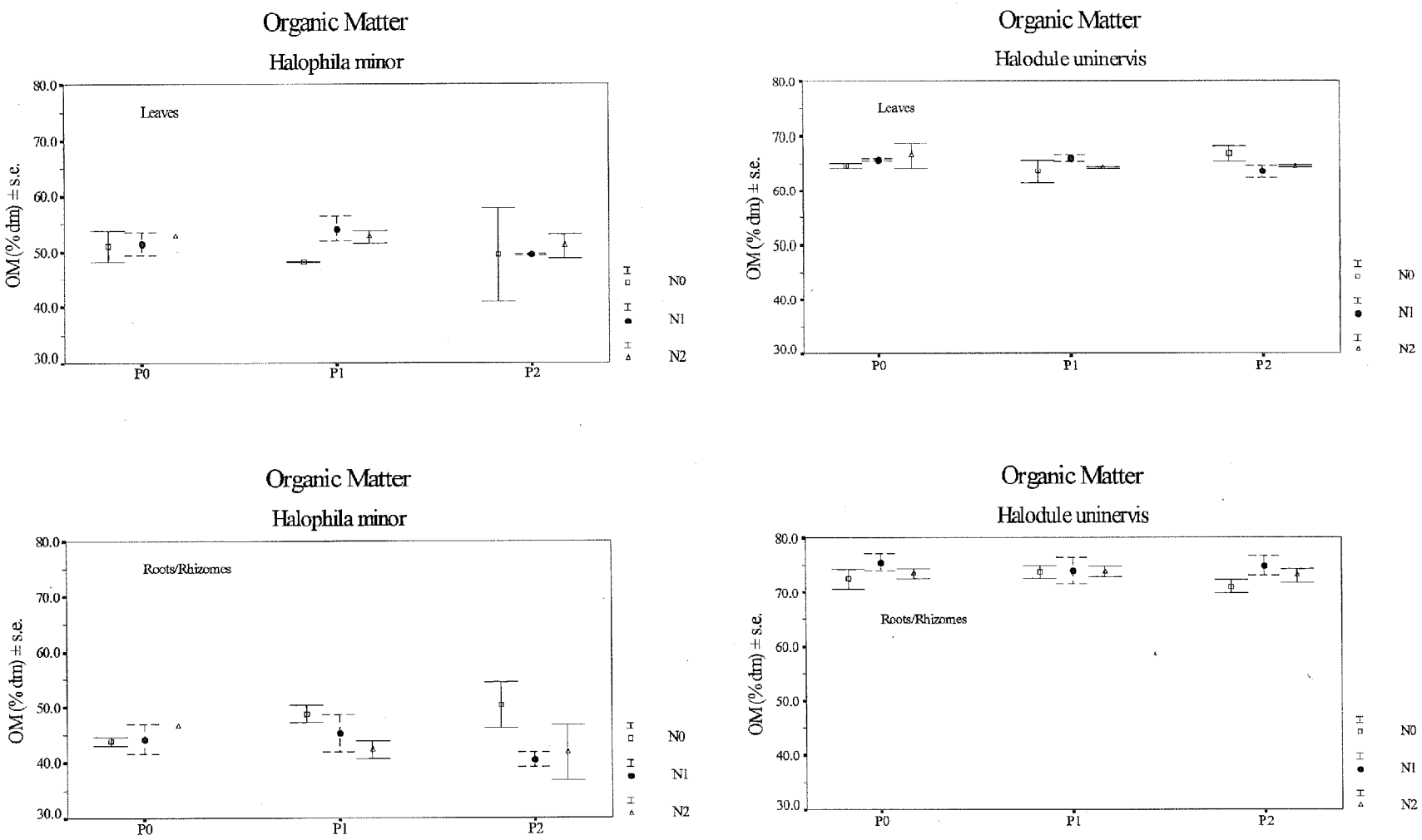

Organic Matter
Halophila minor
Leaves
OM (% dm) ± s.e.
80.0
70.0
60.0
50.0
40.0
30.0
P0
P1
P2
N0
N1
N2
Organic Matter
Halodule uninervis
Leaves
OM (% dm) ± s.e.
80.0
70.0
60.0
50.0
40.0
30.0
P0
P1
P2
N0
N1
N2
Organic Matter
Halophila minor
Roots/Rhizomes
OM (% dm) ± s.e.
80.0
70.0
60.0
50.0
40.0
30.0
P0
P1
P2
N0
N1
N2
Organic Matter
Halodule uninervis
Roots/Rhizomes
OM (% dm) ± s.e.
80.0
70.0
60.0
50.0
40.0
30.0
P0
P1
P2
N0
N1
N2

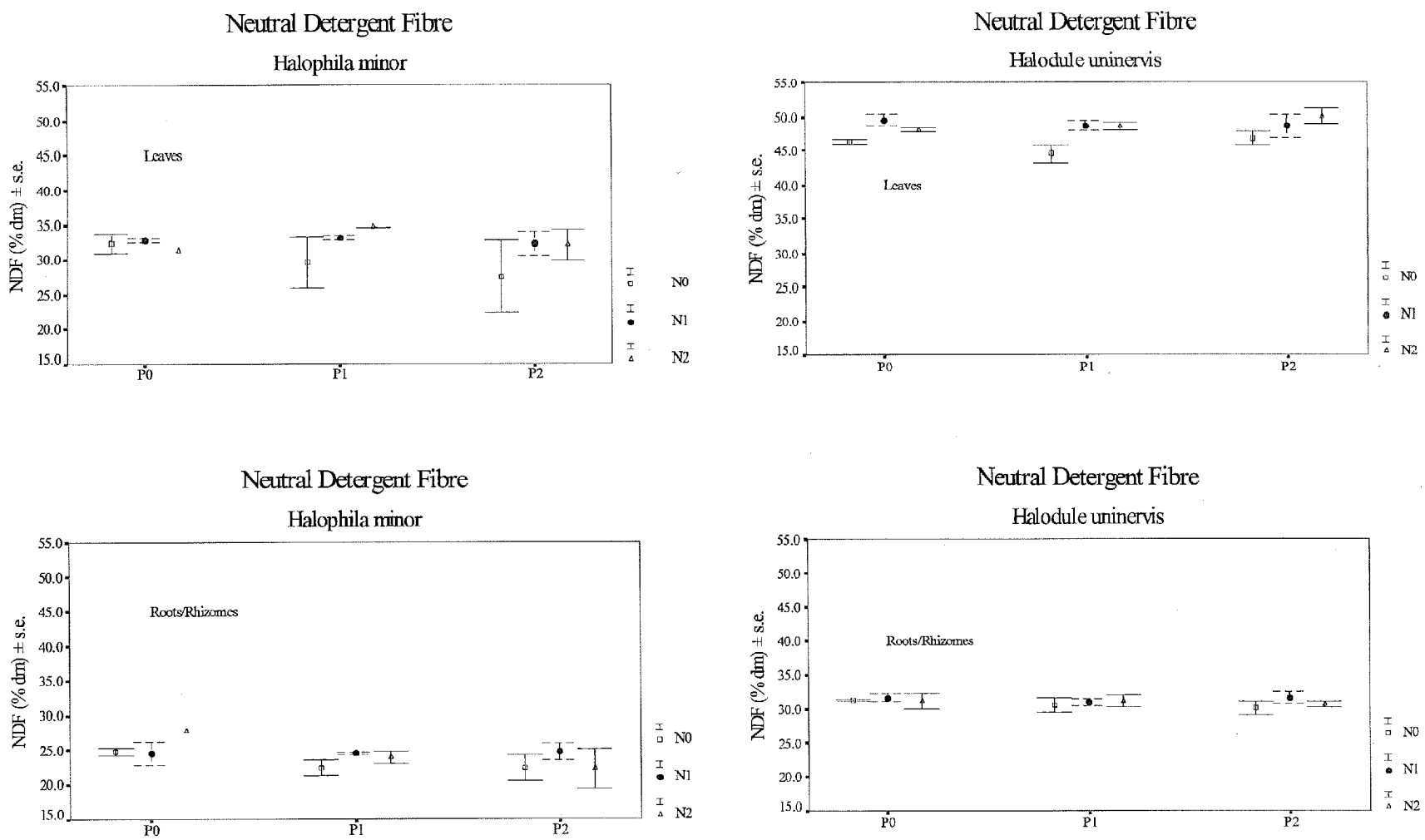
Figure 2.



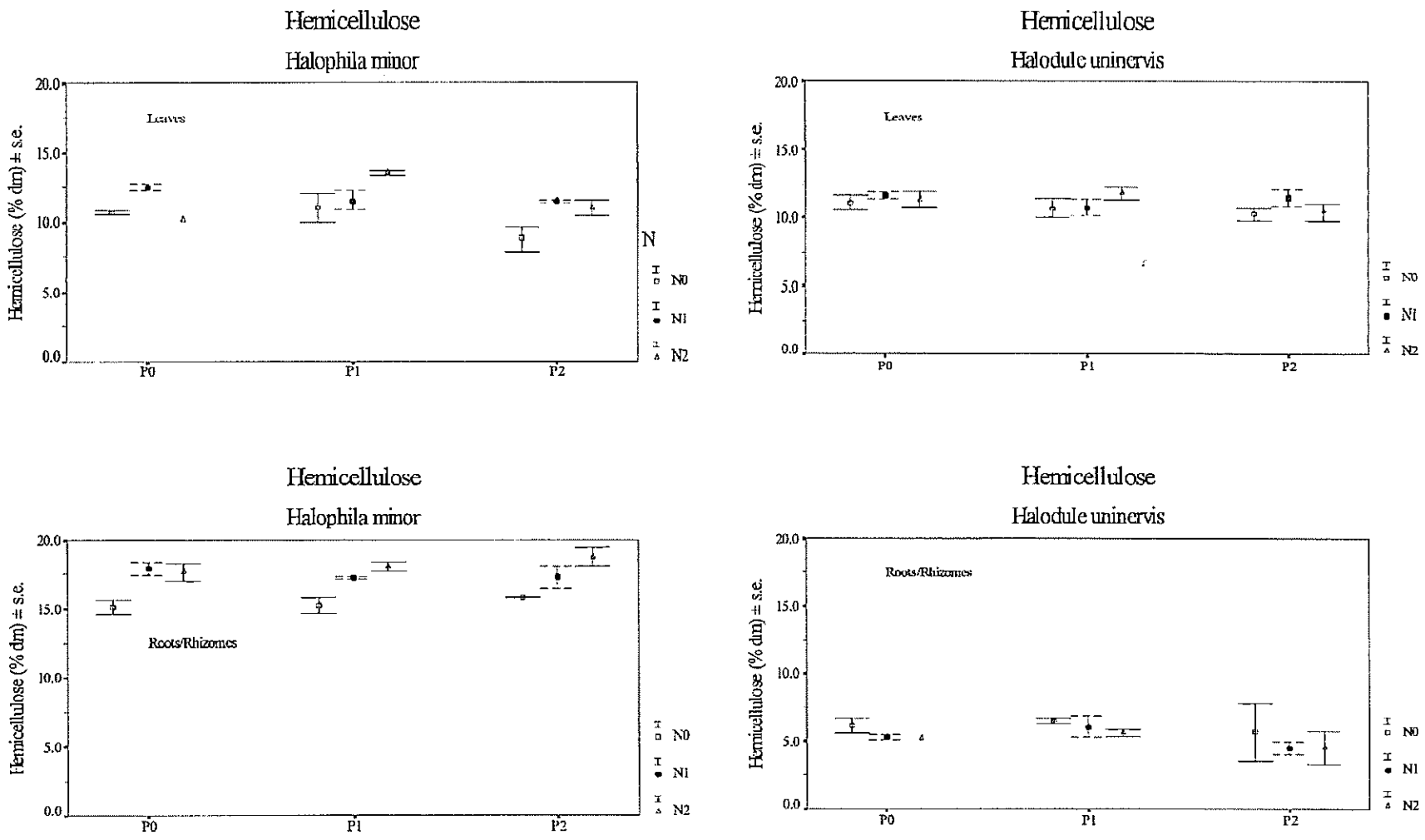
Appendix 11 Figure 1



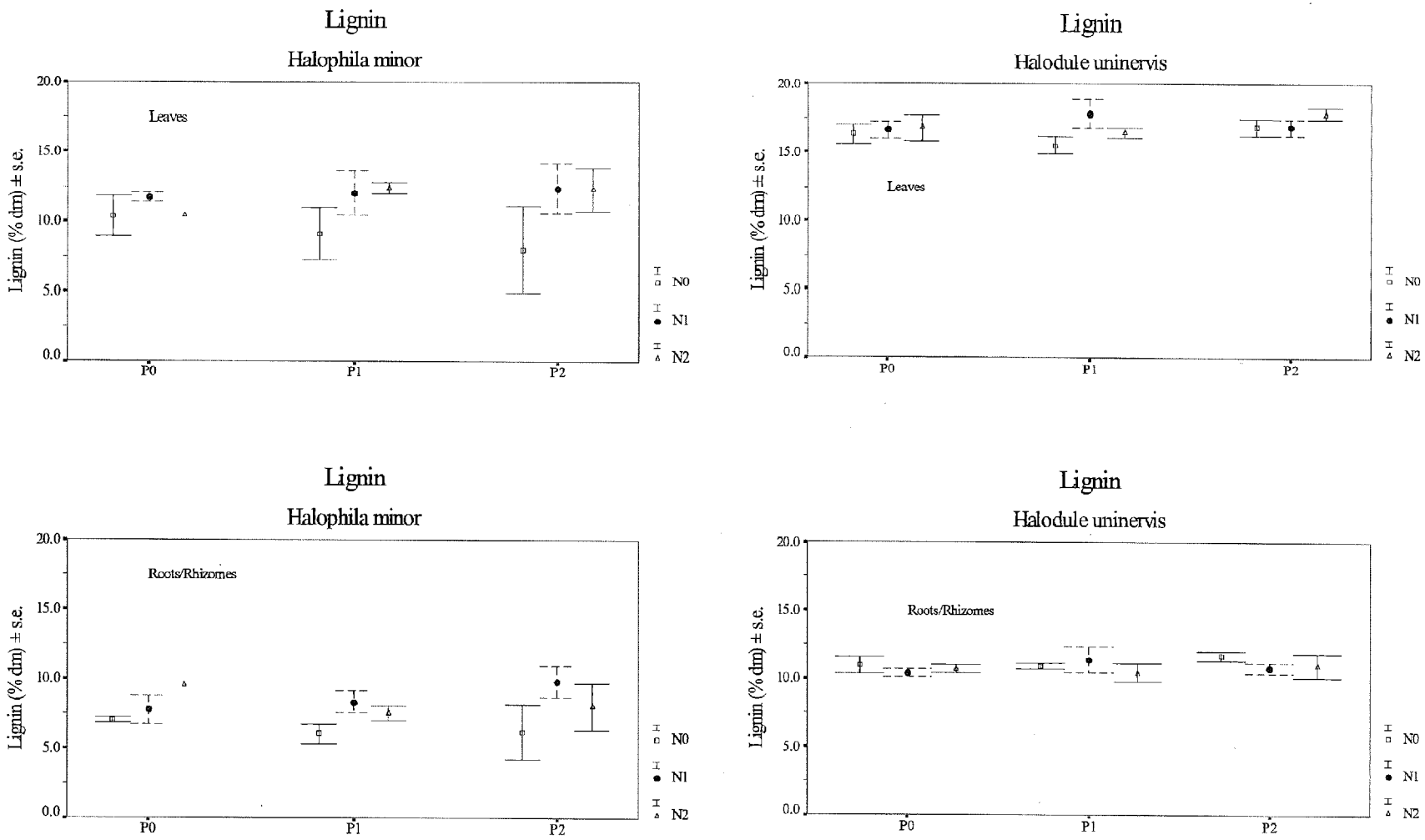
Appendix 11 Figure 2.



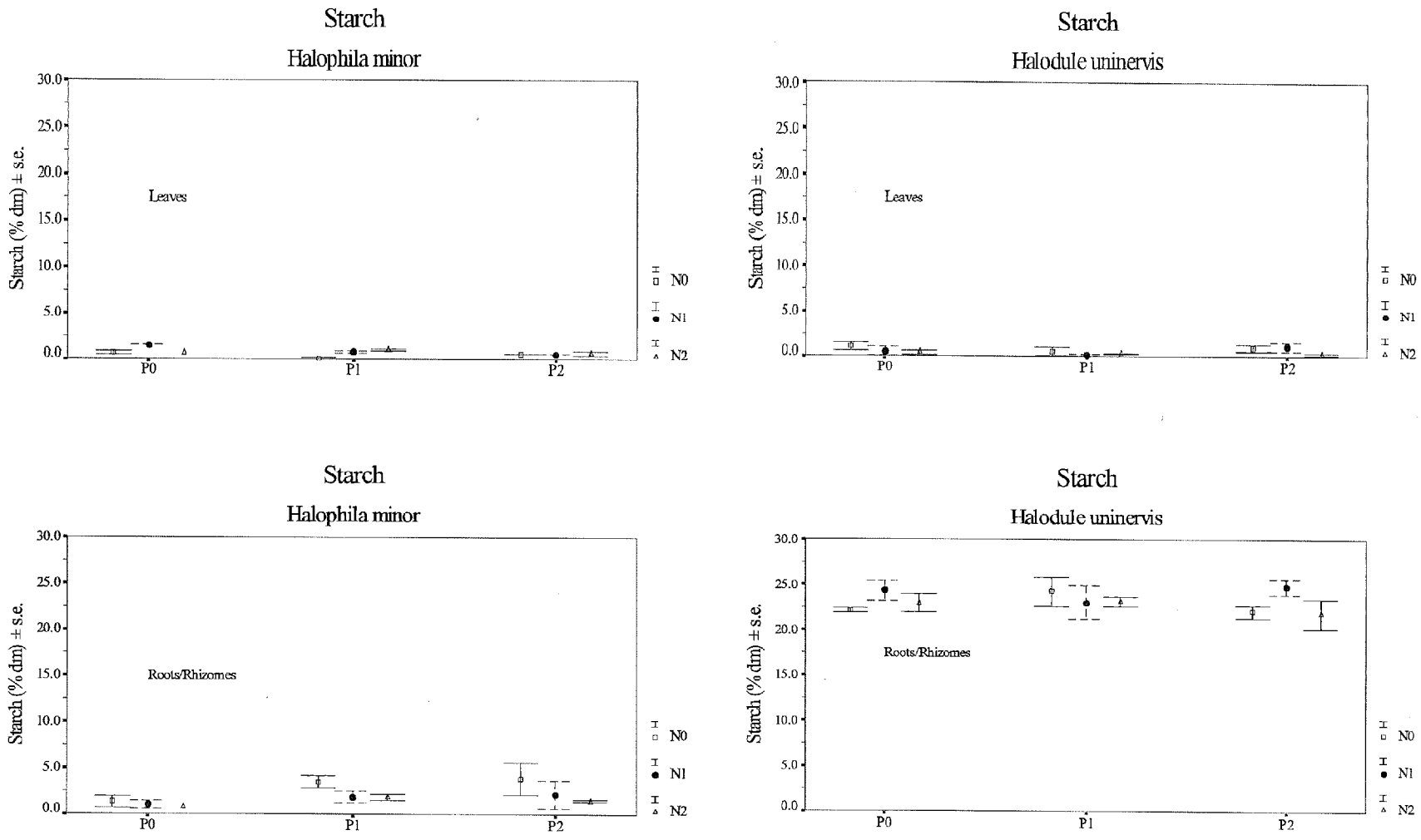
Appendix 11 Figure 3



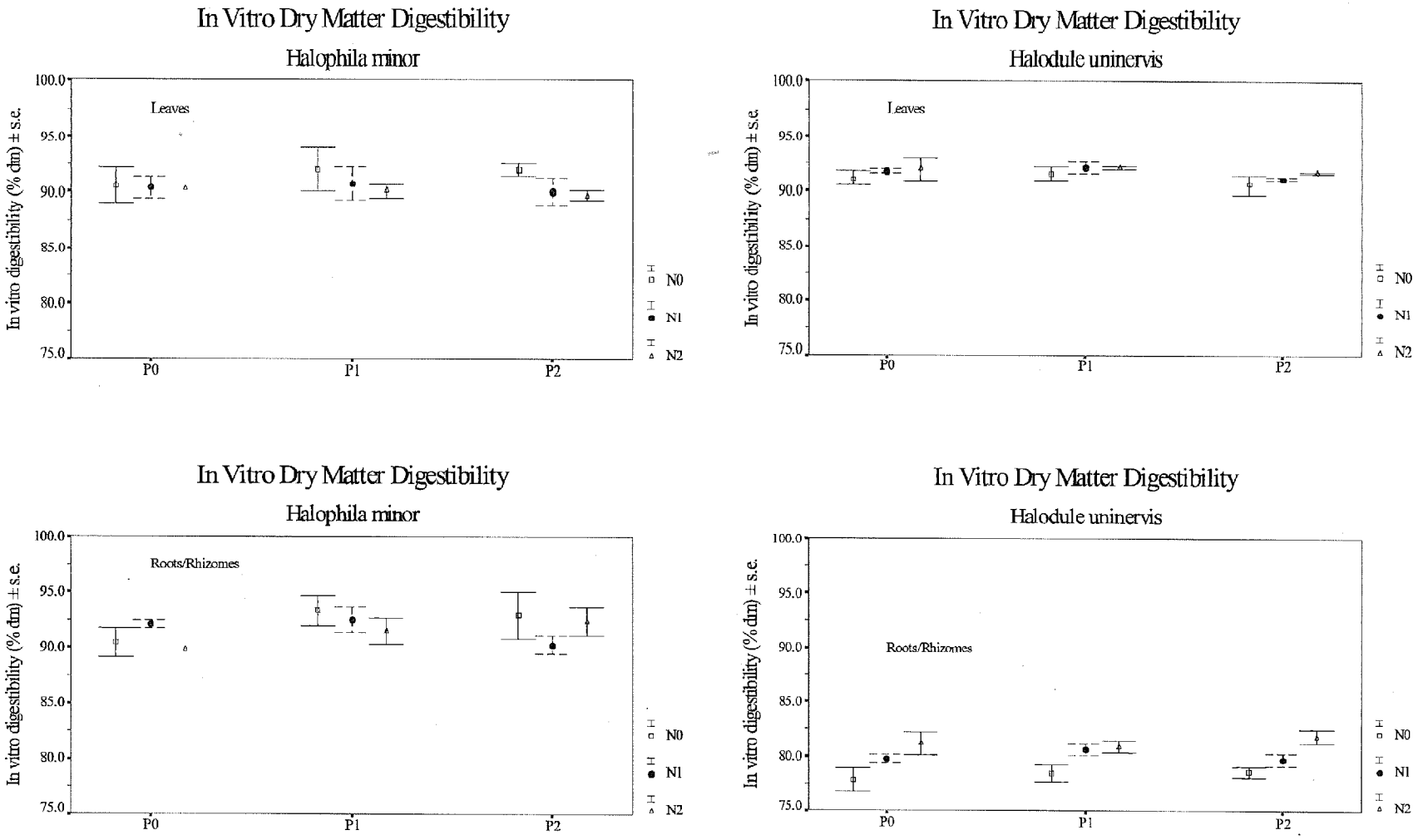
Appendix 11 Figure 4



Appendix 11 Figure 5.



Appendix 11 Figure 6.



Appendix 11 Figure 7.

Appendix 12. Summary of the elemental composition (% of dm) of the ash and neutral detergent fibre residue of some seagrass samples determined by X-ray fluorescence (analysed by the Advanced Analytical Centre, James Cook University, Townsville).

Sample Catalogue No.	Species	plant part	ash/NDF residue	% Ash or % Ash of NDF residue	% Na	% Cl	% Mg	% Si	% Ca	% K	% P
1	*Zostera capricorni*[1] (Ellie Point)	roots/ rhizomes	ash	45.45	15.90	28.44	8.12	21.19	6.91	4.43	0.93
			NDF residue	18.84	21.54	1.08	1.07	48.65	1.23	5.10	1.07
4	*Zostera capricorni*[1] (Ellie Point)	roots/ rhizomes	ash	38.39	20.05	32.97	11.07	11.92	7.05	3.53	1.07
			NDF residue	20.31	26.77	3.64	3.42	37.56	1.50	5.26	1.24
5	*Zostera capricorni*[1] (Ellie Point)	roots/ rhizomes	ash	39.24	19.82	39.74	10.59	8.29	7.42	3.18	1.03
			NDF residue	8.54	29.10	0.38	0.70	39.60	0.88	4.09	0.71
12	*Cymodocea serrulata* (Ellie Point)	roots/ rhizomes	ash	25.64	19.22	35.92	11.09	5.03	5.81	8.92	2.07
			NDF residue	3.34	36.63	1.47	0.93	31.36	1.01	4.04	1.14
20	*Zostera capricorni*[1] (Moreton Bay)	roots/ rhizomes	ash	54.57	14.82	32.39	7.45	25.24	4.31	6.80	0.60
			NDF residue	23.80	11.58	0.78	0.39	74.02	1.11	2.81	0.31

33	*Zostera capricorni*[1] (Moreton Bay)	detrital matter	ash	68.75	14.21	25.45	6.19	34.21	6.38	2.87	0.62
			NDF residue	35.17	5.54	4.29	1.07	79.51	1.78	1.51	0.46
42	*Halodule uninervis/ pinifolia*[2] (Cardwell)	leaves	ash	30.75	16.11	34.93	9.23	13.20	4.36	8.08	2.72
			NDF residue	2.40	31.37	1.12	0.44	38.22	0.85	3.17	3.49
8	*Halodule uninervis*[2] (Ellie Point)	roots/ rhizomes	ash	27.73	19.42	37.32	9.16	9.82	6.94	3.46	1.12
			NDF residue	4.10	27.30	1.02	1.02	33.27	0.86	3.58	0.98
94	*Halodule uninervis*[1] (Moreton Bay)	roots/ rhizomes	ash	27.63	20.12	39.85	11.38	7.21	6.02	5.83	0.72
			NDF residue	10.65	35.69	0.42	0.68	34.92	0.81	1.56	1.23

[1] wide-leaf variety
[2] narrow-leaf variety

Continuation of Appendix 12

Sample Catalogue No.	Species	plant part	ash/NDF residue	% S	% Fe	% Al	% O	% Cu	% Zn
1	*Zostera capricorni* (Ellie Point)	roots/ rhizomes	ash	4.20	3.47	4.85	0.00	0.25	0.05
			NDF residue	6.74	3.34	8.36	0.00	0.34	0.05
4	*Zostera capricorni* (Ellie Point)	roots/ rhizomes	ash	4.18	2.43	3.49	0.00	0.09	0.04
			NDF residue	6.79	3.23	9.13	0.00	0.00	0.00
5	*Zostera capricorni* (Ellie Point)	roots/ rhizomes	ash	4.03	2.58	2.95	0.00	0.00	0.00
			NDF residue	7.78	3.51	9.76	0.00	0.00	0.00
12	*Cymodocea serrulata* (Ellie Point)	roots/ rhizomes	ash	4.13	1.25	1.28	5.00	0.00	0.00
			NDF residue	11.03	2.38	7.57	0.00	0.13	0.31
20	*Zostera capricorni*[1] (Moreton Bay)	roots/ rhizomes	ash	3.46	2.02	2.42	0.00	0.10	0.03
			NDF residue	3.02	1.15	3.16	0.00	0.22	0.02

33	*Zostera capricorni*[1] (Moreton Bay)	detrital matter	ash	3.40	2.36	2.13	0.00	0.36	0.02
			NDF residue	2.11	0.49	1.98	0.00	0.10	0.02
42	*Halodule uninervis/ pinifolia*[2] (Cardwell)	leaves	ash	3.65	1.40	3.71	0.00	0.00	0.00
			NDF residue	13.83	1.25	5.51	0.00	0.08	0.06
8	*Halodule uninervis*[2] (Ellie Point)	roots/ rhizomes	ash	4.19	4.99	3.76	0.00	0.00	0.00
			NDF residue	13.88	4.48	11.87	0.00	0.10	0.09
94	*Halodule uninervis*[1] (Moreton Bay)	roots/ rhizomes	ash	6.67	0.84	1.13	0.00	0.03	0.04
			NDF residue	13.15	1.75	7.27	0.00	0.00	0.00

[1] wide-leaf variety
[2] narrow-leaf variety