Oikos

O17072

Godbold, J. A., Solan, M. and Killham, K. 2009. Consumer and resource diversity effects on marine macroalgal decomposition. – Oikos 118: 77–86.

Appendix 1.

Table A1. Summary of invertebrate species and algal species combinations

Model A1 – A16. Summaries of statistical models

Table A1. Summary of invertebrate species and algal species combinations (mean ± SD in parentheses) used in the assembled macrofaunal communities (n = 5 replicates per treatment, total = 125). *Littorina littorea* are individuals mesocosm^{-1}. Species richness = invertebrate species richness. *F.spiralis* = *Fucus spiralis*, *U. intestinalis* = *Ulva intestinalis*, *H. diversicolor* = *Hediste diversicolor*; *H. ulvae* = *Hydrobia ulvae*; *L. littorea* = *Littorina littorea.*

	Biomass (mesocosm^{-1})				
Species richness	*H. diversicolor* (g)	*H. ulvae* (g)	*L. littorea* (ind.)	*F. sprialis* (g)	*U. intestinalis* (g)
0	–	–	–	–	–
0	–	–	–	10.104 (0.039)	–
0	–	–	–	–	10.028 (0.043)
0	–	–	–	5.092 (0.050)	5.089 (0.049)
1	0.999 (0.083)	–	–	10.646 (0.019)	–
1	–	1.005 (0.002)	–	10.121 (0.013)	–
1	–	–	3	10.096 (0.068)	–
1	0.996 (0.005)	–	–	–	10.043 (0.035)
1	–	1.002 (0.002)	–	–	10.015 (0.019)
1	–	–	3	–	10.009 (0.013)
1	1.002 (0.004)	–	–	5.052 (0.035)	5.041 (0.038)
1	–	1.001 (0.003)	–	5.083 (0.094)	5.074 (0.093)
1	–	–	3	5.070 (0.039)	5.069 (0.040)
2	0.499 (0.006)	0.500 (0.002)	–	10.068 (0.056)	–
2	0.501 (0.006)	–	2	10.053 (0.003)	–
2	–	0.502 (0.001)	–	10.125 (0.058)	–
2	0.504 (0.004)	0.503 (0.002)	–	–	9.999 (0.006)
2	0.499 (0.067)	–	2	–	9.994 (0.004)
2	–	0.501 (0.003)	2	–	10.003 (0.004)
2	0.497 (0.002)	0.502 (0.004)	–	5.068 (0.036)	5.065 (0.032)
2	0.503 (0.004)	–	2	5.107 (0.043)	5.120 (0.059)
2	–	0.503 (0.001)	2	5.094 (0.058)	5.107 (0.031)
3	0.336 (0.003)	0.331 (0.004)	1	10.065 (0.046)	–
3	0.333 (0.005)	0.331 (0.002)	1	–	10.001 (0.008)
3	0.327 (0.004)	0.332 (0.003)	1	5.117 (0.004)	5.121 (0.03)

Figure A1. Arrangement of mesocosms along the mid-tide line on the mudflats of the Ythan estuary, Aberdeenshire, Scotland. Mesocosms were randomly distributed in six rows of 21 mesocosms (approximately 70 cm apart) and buried to a depth of 10 cm in the mudflat (see inset) to align the sediment-water interface between the mesocosm and the mudflat.

Model summary

Summary of the statistical analyses for our 16 GLS models. For each model, we list the initial linear regression model and the minimal adequate linear regression model with GLS estimation, a comparison of the standardised residuals versus fitted values for the initial and minimal adequate models, a summary of the coefficient table and, where applicable, a graphical summary of the interactions within the minimal adequate model.

For brevity in this document, we use the following abbreviations:

Species richness and macrofaunal invertebrate identity:

Species	Species richness (SR)	Invertebrate identity (IID)
Control	0	0
Hediste diversicolor (HD)	1	1
Hydrobia ulvae (HU)	1	2
Littorina littorea (LL)	1	3
HDHU	2	4
HDLL	2	5
HULL	2	6
HDHULL	3	7

Algal identity (AID): *Fucus spiralis* (FS), *Ulva intestinalis* (UI), and the 50:50 mixture of *F. spiralis* and *U. intestinalis* (FSUI).

Remaining algal biomass (X_{rem}), where x = A for total algal biomass irrespective of algal identity, FS for *F. spiralis*, UI for *U. intestinalis* and FSUI for the 50:50 mixture of *F. spiralis* and *U. intestinalis* (FSUI).

Sediment C:N ratio ($C:N_y$), where y = S for the sediment C:N ratio irrespective of algal identity, FS for the sediment C:N ratio in the *F. spiralis* treatments, UI for the sediment C:N ratio in the *U. intestinalis* treatments and FSUI for the sediment C:N ratio in treatments containing the 50:50 mixture of *F. spiralis* and *U. intestinalis.*

Microbial activity (MA_z), where z = S for sediment microbial activity irrespective of algal identity, FS for the sediment microbial activity in the *F. spiralis* treatments, UI for the sediment microbial activity in the *U. intestinalis* treatments and FSUI for the sediment microbial activity in treatments containing the 50:50 mixture of *F. spiralis* and *U. intestinalis.*

Model A1

Form of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation (incorporating AID and SR as variance covariates) for the effects of SR on A_{rem}.

(a) A_{rem} ~ as.factor(SR) + as.factor(AID) + MA_s
+ as.factor(SR):as.factor(AID)
+ as.factor(SR): MA_s
+ as.factor(AID): MA_s
+ as.factor(SR):as.factor(AID): MA_s

(b) A_{rem} ~ as.factor(SR) + as.factor(AID) + MA_s
+ as.factor(AID): MA_s,
weights = varIdent(form = ~ 1|as.factor(AID)*as.factor(SR)), method = "ML"

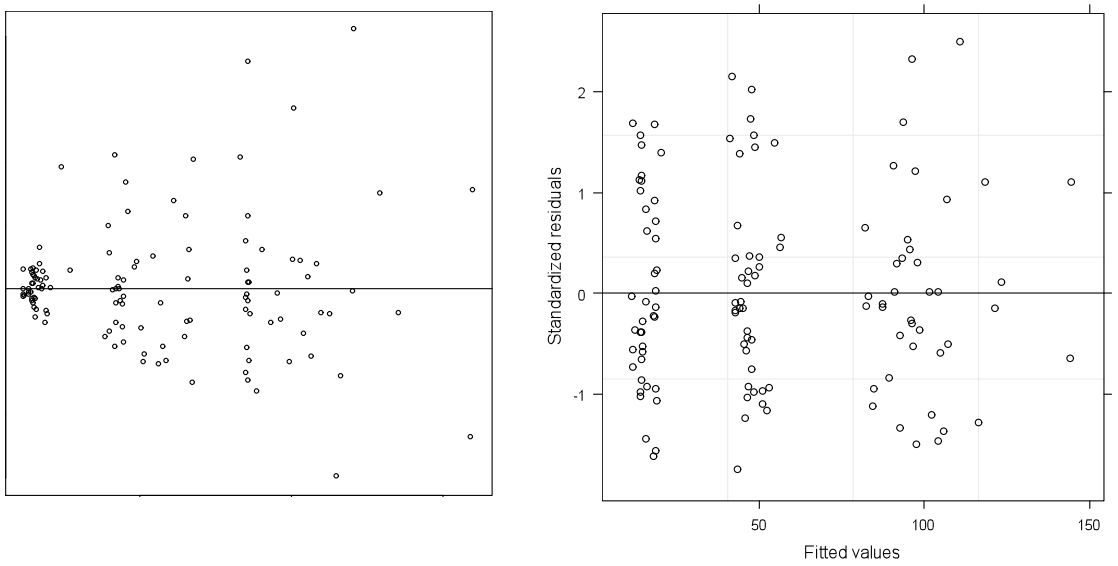


Figure A1.1. Standardized residuals vs fitted values of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation.

Coefficient Table A1

	Value	SE	t-value	p-value
(Intercept)	13.931	5.459	2.552	0.012
SR_1	2.767	2.376	1.165	0.247
SR_2	–1.456	1.988	–0.732	0.466
SR_3	–4.077	2.172	–1.877	0.063
UI	22.054	20.098	1.097	0.275
FSUI	21.255	10.886	1.952	0.053
MA_s	4.649	11.386	0.408	0.684
UI × MA_s	132.689	41.526	3.195	0.002
FSUI × MA_s	20.773	22.006	0.944	0.347

Model A2

Form of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation (incorporating SR as a variance covariate) for the effects of SR on FS_{rem}.

(a) FS_{rem} ~ as.factor(SR) + MA_{FS}
+ as.factor(SR): MA_{FS}

(b) FS_{rem} ~ as.factor(SR),
weights = varIdent(form = ~ 1|as.factor(SR)), method = "ML"

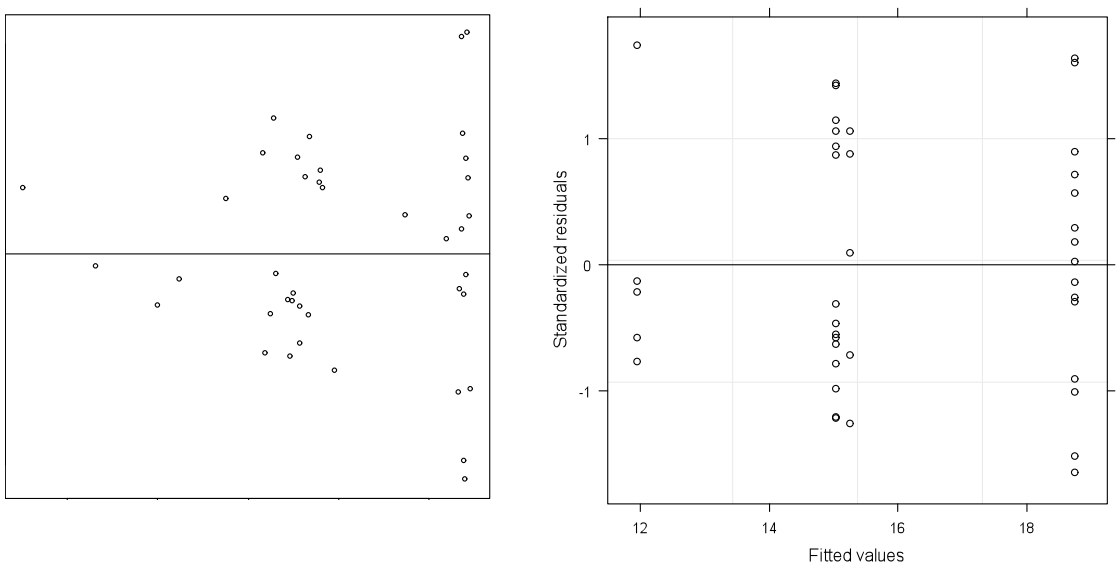


Figure A2.1. Standardized residuals vs fitted values of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation.

Coefficient Table A2

	Value	SE	t-value	p-value
(Intercept)	15.274	1.644	9.293	<0.0001
SR_1	3.496	2.518	1.388	0.174
SR_2	–0.229	2.037	–0.112	0.911
SR_3	–3.312	2.197	–1.507	0.142

Model A3

Form of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation (incorporating SR as a variance covariate) for the effects of SR on UI_{rem}.

(a) UI_{rem} ~ as.factor(SR) + MA_{UI}
+ as.factor(SR): MA_{UI}

(b) UI_{rem} ~ as.factor(SR) + MA_{UI},
weights = varIdent(form = ~ 1|as.factor(SR)), method = "ML")

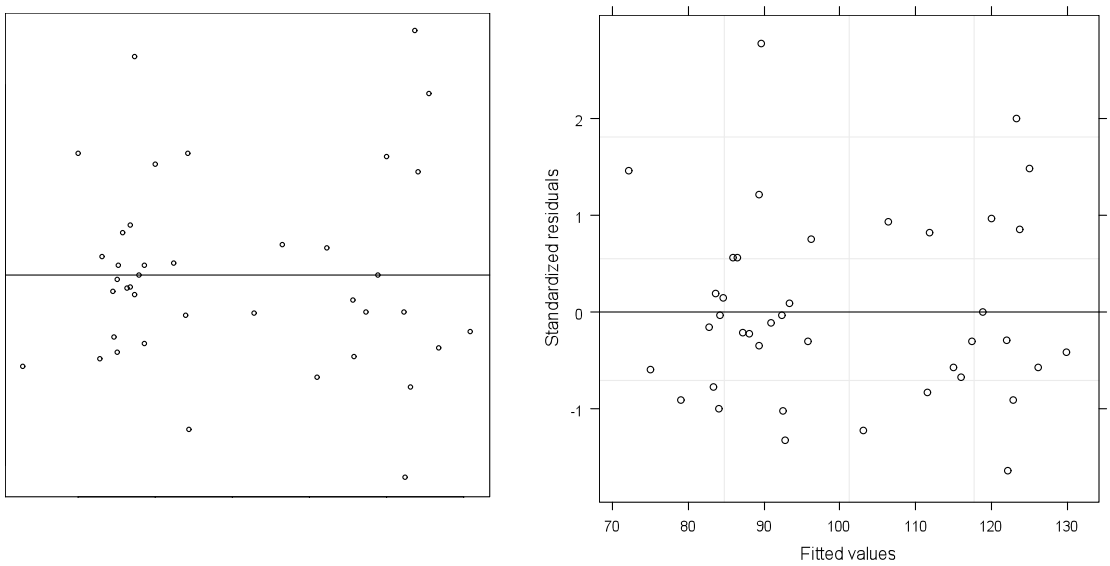


Figure A3.1. Standardized residuals vs fitted values of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation.

Coefficient Table A3

	Value	SE	t-value	p-value
(Intercept)	144.086	18.872	7.635	<0.0001
SR_1	14.994	11.861	1.264	0.215
SR_2	–23.015	8.174	–2.816	0.008
SR_3	–18.017	13.479	–1.337	0.190
MA_{UI}	–81.614	39.319	–2.076	0.045

Model A4

Form of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation (incorporating SR as a variance covariate) for the effects of SR on $FSUI_{rem}$.

(a) $FSUI_{rem}$ ~ as.factor(SR) + MA_{FSUI}
+ as.factor(SR): MA_{FSUI}

(b) $FSUI_{rem}$ ~ as.factor(SR),
weights = varIdent(form = ~ 1|as.factor(SR)), method = "ML"

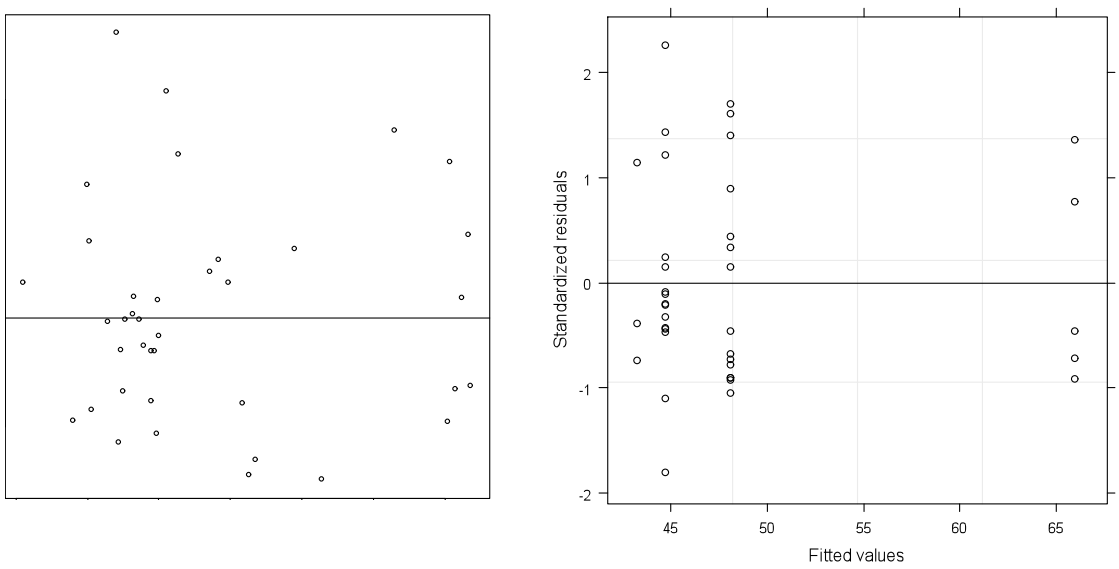


Figure A4.1. Standardized residuals vs fitted values of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation.

Coefficient Table A4

	Value	SE	t-value	p-value
(Intercept)	66.014	6.356	10.386	<0.0001
SR_1	–17.859	8.713	–2.050	0.048
SR_2	–21.221	7.057	–3.007	0.005
SR_3	–22.677	7.939	–2.856	0.007

Model A5

Form of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation (incorporating AID and SR as variance covariates) for the effects of SR on $C:N_s$.

(a) $C:N_s$ ~ as.factor(SR) + as.factor(AID) + A_{rem} + MA_s
+ as.factor(SR):as.factor(AID)
+ as.factor(SR): A_{rem}
+ as.factor(SR): MA_s
+ as.factor(AID): A_{rem}
+ as.factor(AID): MA_s
+ A_{rem}: MA_s
+ as.factor(SR):as.factor(AID): MA_s
+ as.factor(SR):as.factor(AID): A_{rem}
+ as.factor(SR): A_{rem}: MA_s
+ as.factor(AID): A_{rem}: MA_s
+ as.factor(SR):as.factor(AID): A_{rem}: MA_s

(b) $C:N_s$ ~ as.factor(SR) + as.factor(AID) + A_{rem}
+ as.factor(SR):as.factor(AID)
+ as.factor(SR): A_{rem}
+ as.factor(AID): A_{rem}
+ as.factor(SR):as.factor(AID): A_{rem},
weights = varIdent(form = ~ 1|as.factor(AID) * as.factor(SR)), method = "ML"

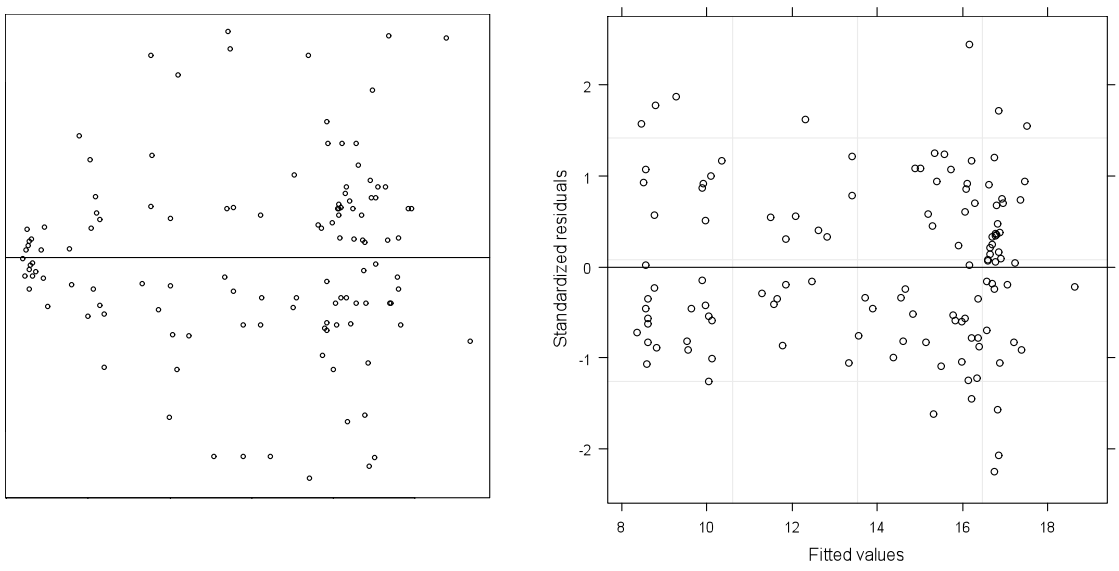


Figure A5.1. Standardized residuals vs fitted values of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation.

Coefficient Table A5

	Value	SE	t-value	p-value
(Intercept)	17.745	6.330	2.803	0.006
SR_1	–8.824	6.336	–1.393	0.167
SR_2	–0.349	6.421	–0.054	0.957
SR_3	0.691	6.615	0.104	0.917
UI	–9.028	9.194	–0.982	0.329
FSUI	2.060	7.043	0.293	0.771
A_{rem}	–0.266	0.405	–0.657	0.513
MA_s	10.770	9.259	1.163	0.248
$SR_1 \times UI$	8.294	9.491	0.874	0.384
$SR_2 \times UI$	4.034	9.536	0.423	0.673
$SR_3 \times UI$	–1.389	7.203	–0.193	0.848
$SR_1 \times FSUI$	2.543	7.759	0.328	0.744
$SR_2 \times FSUI$	–1.935	7.511	–0.258	0.797
$SR_3 \times FSUI$	0.251	0.405	0.620	0.537
$SR_1 \times A_{rem}$	0.207	0.411	0.504	0.616
$SR_2 \times A_{rem}$	0.166	0.434	0.383	0.703
$SR_3 \times A_{rem}$	0.337	0.410	0.822	0.413
$UI \times A_{rem}$	0.205	0.408	0.502	0.617
$FSUI \times A_{rem}$	–0.328	0.410	–0.800	0.426
$SR_1 \times UI \times A_{rem}$	–0.275	0.416	–0.661	0.510
$SR_2 \times UI \times A_{rem}$	–0.216	0.439	–0.492	0.624
$SR_3 \times UI \times A_{rem}$	–0.115	0.409	–0.282	0.779
$SR_1 \times FSUI \times A_{rem}$	–0.113	0.409	–0.278	0.782
$SR_2 \times FSUI \times A_{rem}$	–0.293	0.418	–0.700	0.486
$SR_3 \times FSUI \times A_{rem}$	–0.163	0.436	–0.375	0.709

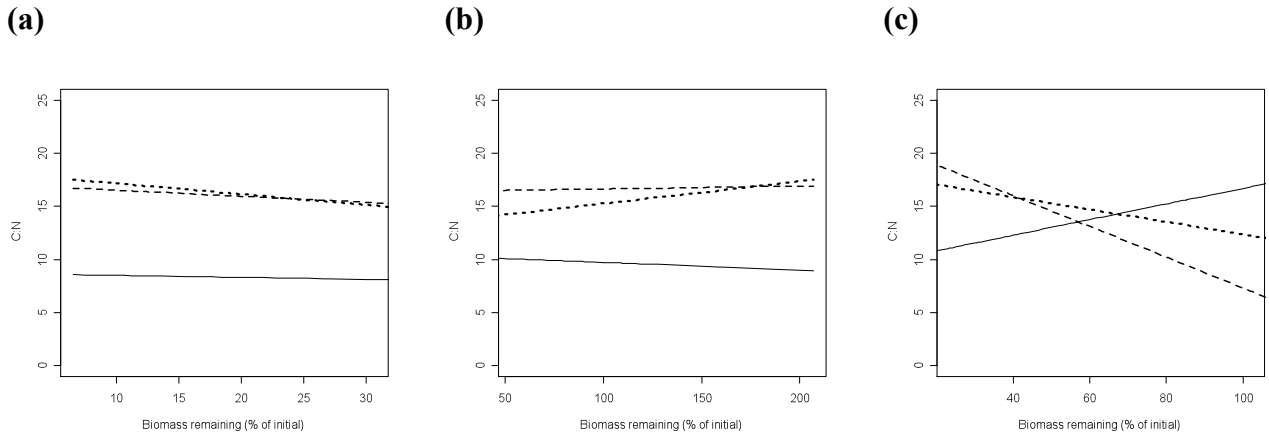


Figure A5.2. Interaction plots for SR × AID × A_{rem} for (a) FS, (b) UI and (c) FSUI. Solid line = SR_1, long dashed line = SR_2, short dashed line = SR_3.

Model A6

Form of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation (incorporating SR as a variance covariate) for the effects of SR on $C{:}N_{FS}$.

(a) $C{:}N_{FS}$ ~ as.factor(SR)+ FS_{rem} + MA_{FS}
+ as.factor(SR): FS_{rem}
+ as.factor(SR): MA_{FS}
+ FS_{rem}: MA_{FS}
+ as.factor(SR): FS_{rem}: MA_{FS}

(b) $C{:}N_{FS}$ ~ as.factor(SR)+ FS_{rem} + MA_{FS}
+ FS_{rem}: MA_{FS},
weights = varIdent(form = ~ 1|as.factor(SR)),method = "ML"

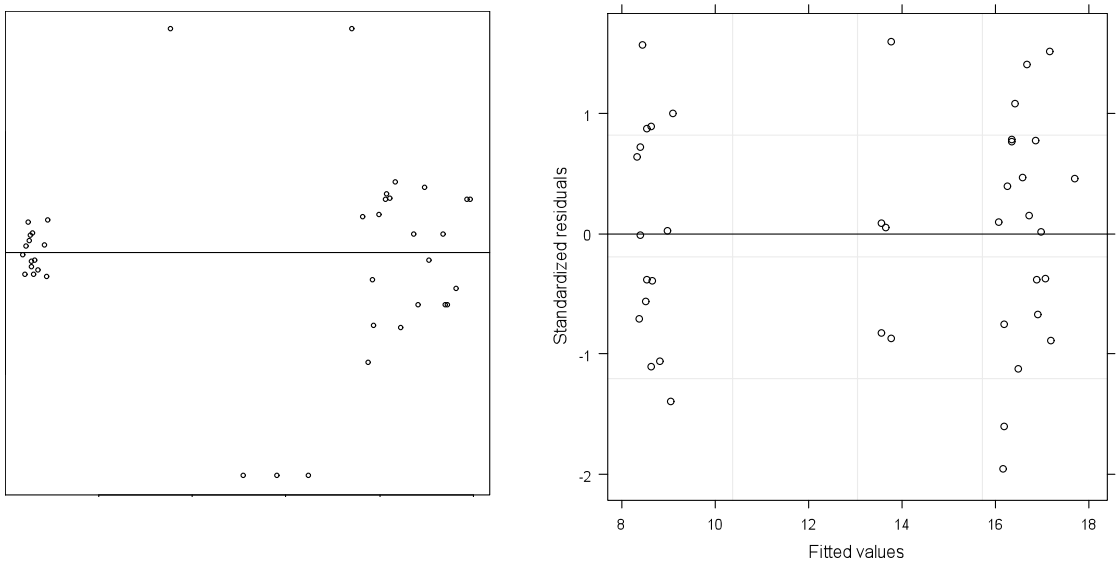


Figure A6.1. Standardized residuals vs fitted values of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation.

Coefficient Table A6

	Value	SE	t-value	p-value
(Intercept)	10.810	1.926	5.611	<0.0001
SR_1	–4.937	1.221	–4.044	<0.001
SR_2	2.867	1.2471	2.300	0.028
SR_3	3.474	1.268	2.740	0.010
FS_{rem}	0.082	0.060	1.365	0.181
MA_{FS}	7.030	3.234	2.1740	0.037
$FS_{rem} \times MA_{FS}$	–0.229	0.123	–1.850	0.073

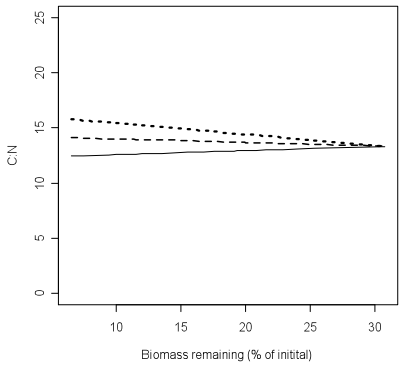


Figure A6.2. Interaction plots for $FS_{rem} \times MA_{FS}$. Solid line = 0.2 nmol g^{-1} h^{-1}, long dashed line = 0.5 nmol g^{-1} h^{-1}, short dashed line = 0.8 nmol g^{-1} h^{-1}.

Model A7

Form of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation (incorporating MA_{UI} and SR as variance covariates) for the effects of SR on $C{:}N_{UI}$.

(a) $C{:}N_{UI}$ ~ as.factor(SR)+ Erem + MA_{UI}
+ as.factor(SR):UI_{rem}
+ as.factor(SR): MA_{UI}
+ UI_{rem}: MA_{UI}
+ as.factor(SR): UI_{rem}: MA_{UI}

(b) $C{:}N_{UI}$ ~ as.factor(SR)+ MA_{UI}
+ as.factor(SR): MA_{UI},
weights = varComb(varExp(form = ~ MA_{UI}),
varIdent(form = ~ 1|as.factor(SR))), method = "ML"

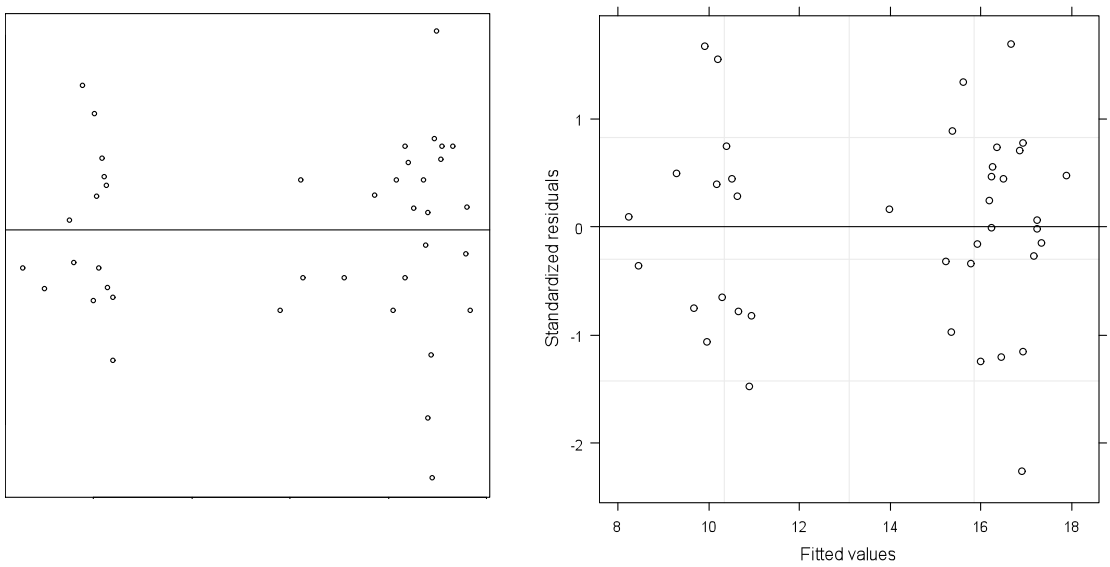


Figure A7.1. Standardized residuals vs fitted values of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation.

Coefficient Table A7

	Value	SE	t-value	p-value
(Intercept)	11.682	4.683	2.494	0.018
SR_1	1.827	4.798	0.381	0.706
SR_2	1.675	5.688	0.295	0.770
SR_3	–6.488	9.479	–0.685	0.499
MA_{UI}	8.984	8.408	1.069	0.293
$SR_1 \times MA_{UI}$	–15.689	8.540	–1.837	0.076
$SR_2 \times MA_{UI}$	–1.126	10.687	–0.105	0.917
$SR_3 \times MA_{UI}$	14.106	20.447	0.690	0.495

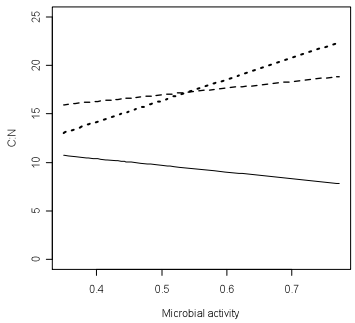


Figure A7.2. Interaction plots for $SR \times MA_{UI}$. Solid line = SR_1, long dashed line = SR_2, short dashed line = SR_3.

Model A8

Form of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation (incorporating SR as a variance covariate) for the effects of SR on $C{:}N_{FSUI}$.

(a) $C{:}N_{FSUI}$ ~ as.factor(SR)+ $FSUI_{rem}$ + MA_{FSUI}
+ as.factor(SR): $FSUI_{rem}$
+ as.factor(SR): MA_{FSUI}
+ $FSUI_{rem}$: MA_{FSUI}
+ as.factor(SR): $FSUI_{rem}$: MA_{FSUI}

(b) $C{:}N_{FSUI}$ ~as.factor(SR)+ $FSUI_{rem}$
+ as.factor(SR): $FSUI_{rem}$,
weights = varIdent(form = ~ 1|as.factor(SR)), method = "ML"

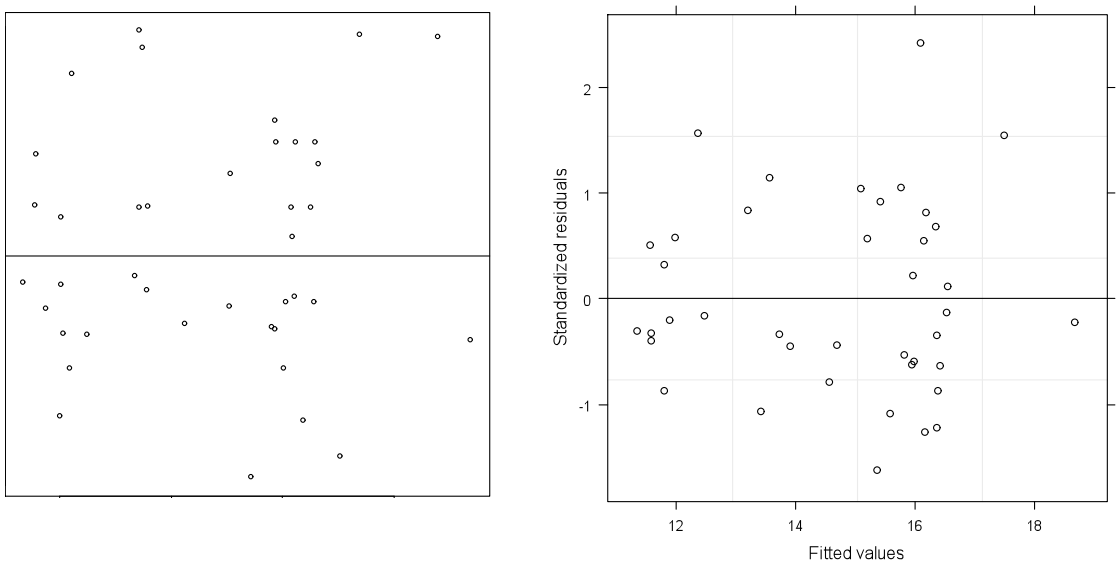


Figure A8.1. Standardized residuals vs fitted values of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation.

Coefficient Table A8

	Value	SE	t-value	p-value
(Intercept)	19.805	3.089	6.412	<0.0001
SR_1	–10.213	3.426	–2.981	0.006
SR_2	2.194	4.355	0.504	0.618
SR_3	–1.245	3.559	–0.350	0.729
$FSUI_{rem}$	–0.061	0.046	–1.334	0.192
$SR_1 \times FSUI_{rem}$	0.136	0.054	2.528	0.017
$SR_2 \times FSUI_{rem}$	–0.081	0.081	–1.003	0.323
$SR_3 \times FSUI_{rem}$	0.002	0.055	0.036	0.972

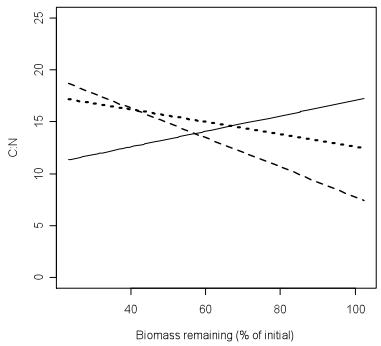


Figure A8.2. Interaction plots for mixture biomass remaining × species richness. Solid line = SR_1, long dashed line = SR_2, short dashed line = SR_3.

Model A9

Form of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation (incorporating AID as a variance covariate) for the effects of IID on A_{rem}.

(a) A_{rem} ~ as.factor(IID) + as.factor(AID) + MA_s
+ as.factor(IID):as.factor(AID)
+ as.factor(IID): MA_s
+ as.factor(AID): MA_s
+ as.factor(IID):as.factor(AID): MA_s

(b) A_{rem} ~ as.factor(IID) + as.factor(AID)
+ as.factor(IID):as.factor(AID),
weights = varIdent(form = ~ 1|as.factor(AID)), method = "ML"

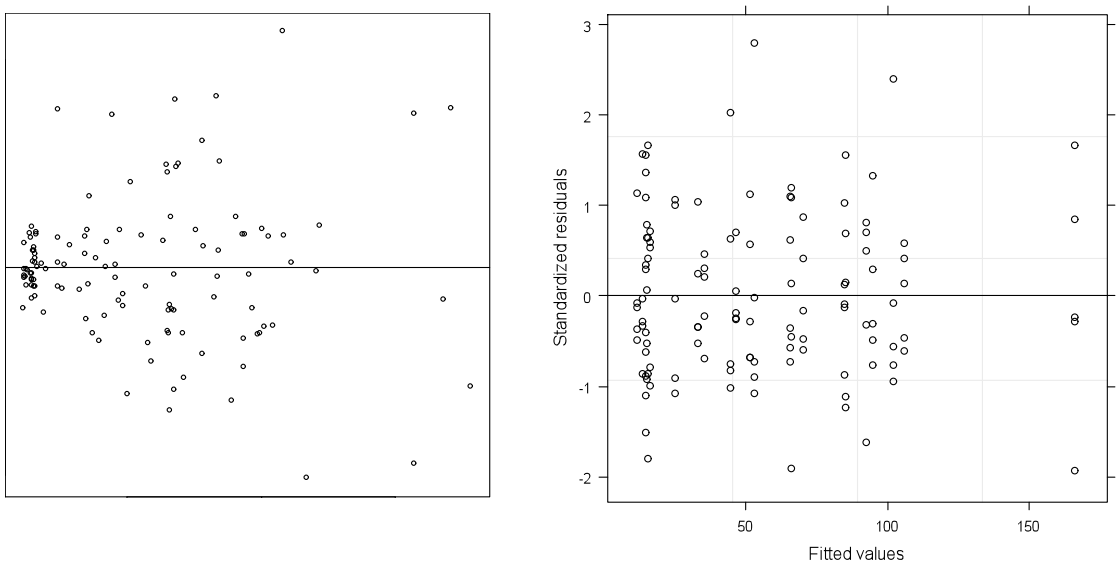


Figure A9.1. Standardized residuals vs fitted values of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation.

Coefficient Table A9

	Value	SE	t-value	p-value
(Intercept)	15.274	2.246	6.799	<0.0001
HD	0.396	3.177	0.125	0.901
HU	10.222	3.177	3.218	0.002
LL	–0.130	3.177	–0.041	0.967
HDHU	1.152	3.177	0.363	0.718
HDLL	–1.494	3.177	–0.470	0.639
HULL	–0.344	3.177	–0.108	0.914
HDHULL	–3.312	3.177	–1.043	0.300
UI	90.796	11.183	8.119	<0.0001
FSUI	50.740	8.211	6.179	<0.0001
HD × UI	–11.228	15.815	–0.710	0.480
HU × UI	50.228	15.815	3.176	0.002
LL × UI	–13.190	15.815	–0.834	0.406
HDHU × UI	–22.202	15.815	–1.404	0.164
HDLL × UI	–34.210	15.815	–2.163	0.033
HULL × UI	–3.426	15.815	–0.217	0.829
HDHULL × UI	–17.186	15.815	–1.087	0.280
HD × FSUI	–21.618	11.612	–1.862	0.066
HU × FSUI	–9.928	11.612	–0.855	0.395
LL × FSUI	–32.518	11.612	–2.800	0.006
HDHU × FSUI	–15.408	11.612	–1.327	0.188
HDLL × FSUI	–28.834	11.612	–2.483	0.015
HULL × FSUI	–18.736	11.612	–1.613	0.110
HDHULL × FSUI	–9.420	11.612	–0.811	0.419

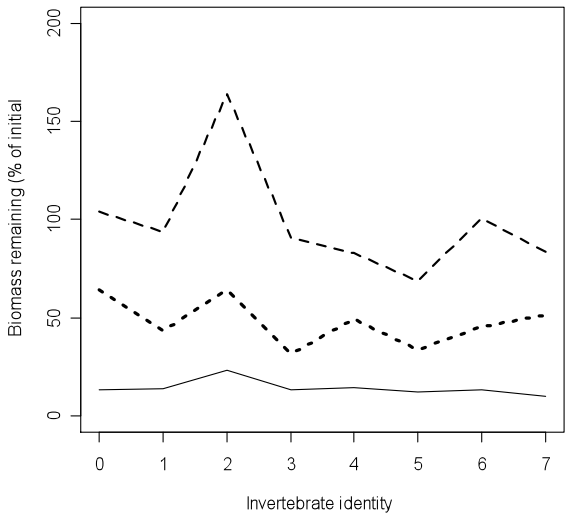


Figure A9.2. Interaction plots for IID × AID. Solid line = FS, long dashed line = UI, short dashed line = FSUI.

Model A10

Form of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation (incorporating MA_{FS} as a variance covariate) for the effects of IID on FS_{rem}.

(a) FS_{rem} ~ as.factor(IID) + MA_{FS}
+ as.factor(IID): MA_{FS}

(b) FS_{rem} ~ as.factor(IID)+ MA_{FS}
+ as.factor(IID): MA_{FS},
weights = varExp(form = ~ MA_{FS}), method = "ML"

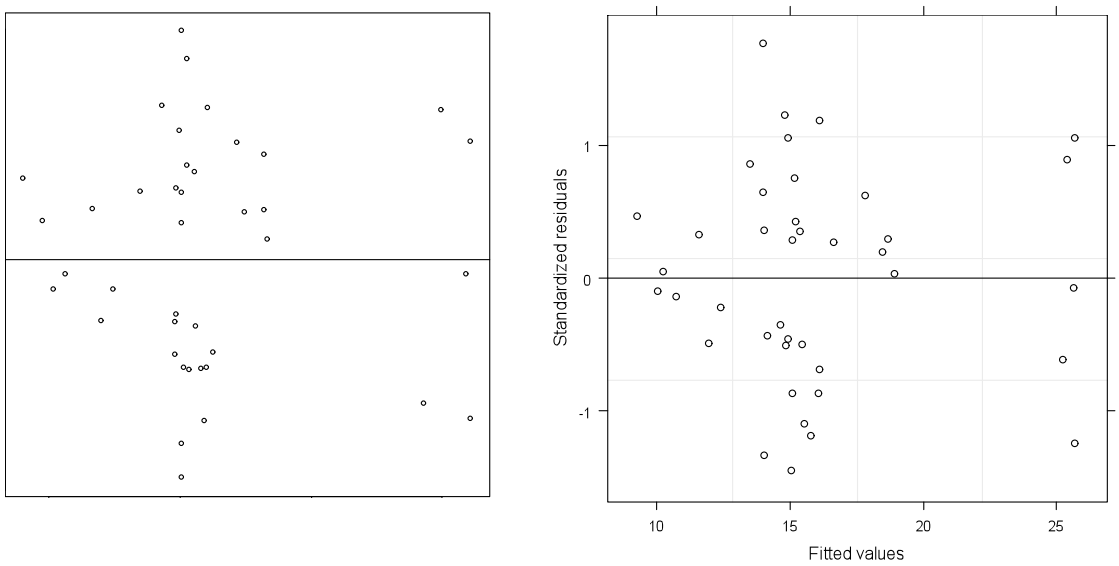


Figure A10.1. Standardized residuals vs fitted values of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation.

Coefficient Table A10

	Value	SE	t-value	p-value
(Intercept)	22.753	23.390	0.973	0.340
HD	–13.755	24.319	–0.566	0.577
HU	1.495	30.974	0.048	0.962
LL	–9.150	27.644	–0.331	0.744
HDHU	–20.301	28.400	–0.715	0.482
HDLL	–29.991	32.690	–0.917	0.368
HULL	11.741	28.547	0.411	0.685
HDHULL	40.636	65.431	0.621	0.540
MA_{FS}	–16.780	50.297	–0.334	0.742
HD × MA_{FS}	28.687	51.195	0.560	0.580
HU × MA_{FS}	19.765	66.369	0.298	0.768
LL × MA_{FS}	20.093	59.181	0.340	0.737
HDHU × MA_{FS}	47.660	60.365	0.790	0.438
HDLL × MA_{FS}	64.134	70.637	0.908	0.373
HULL × MA_{FS}	–25.775	60.454	–0.426	0.674
HDHULL × MA_{FS}	–95.431	141.916	–0.672	0.508

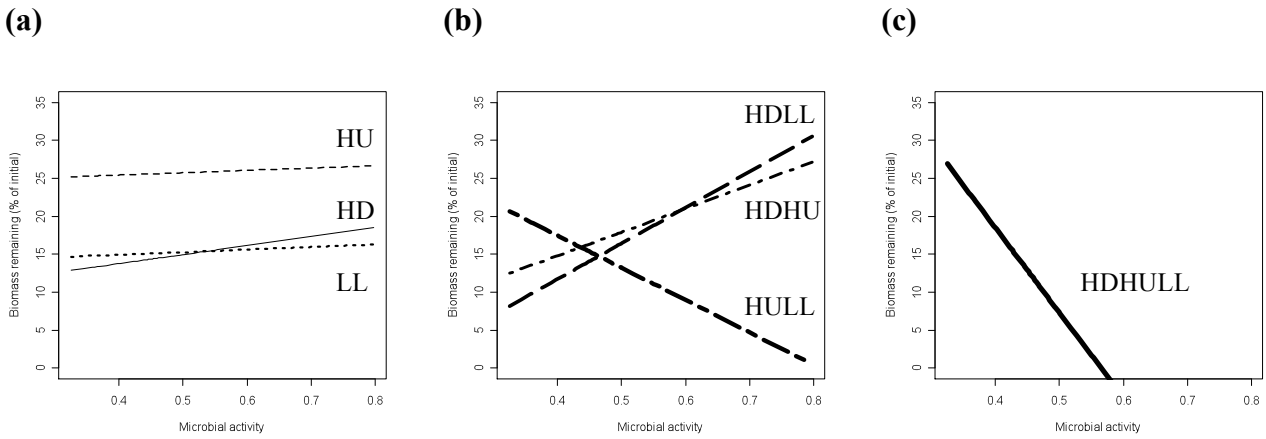


Figure A10.2. Interaction plots for IID × MA_{FS} for (a) SR_1, (b) SR_2 and (c) SR_3. Species mixtures are indicated in each panel.

Model A11

Form of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation (incorporating IID and MA_{UI} as variance covariates) for the effects of IID on UI_{rem}.

(a) UI_{rem} ~ as.factor(IID) + MA_{UI}
+ as.factor(IID): MA_{UI}

(b) UI_{rem} ~ as.factor(IID)+ MA_{UI}
+ as.factor(IID): MA_{UI},
weights = varComb(varIdent(form = ~ 1|as.factor(IID)),
varConstPower(form = ~ MA_{UI})), method = "ML"

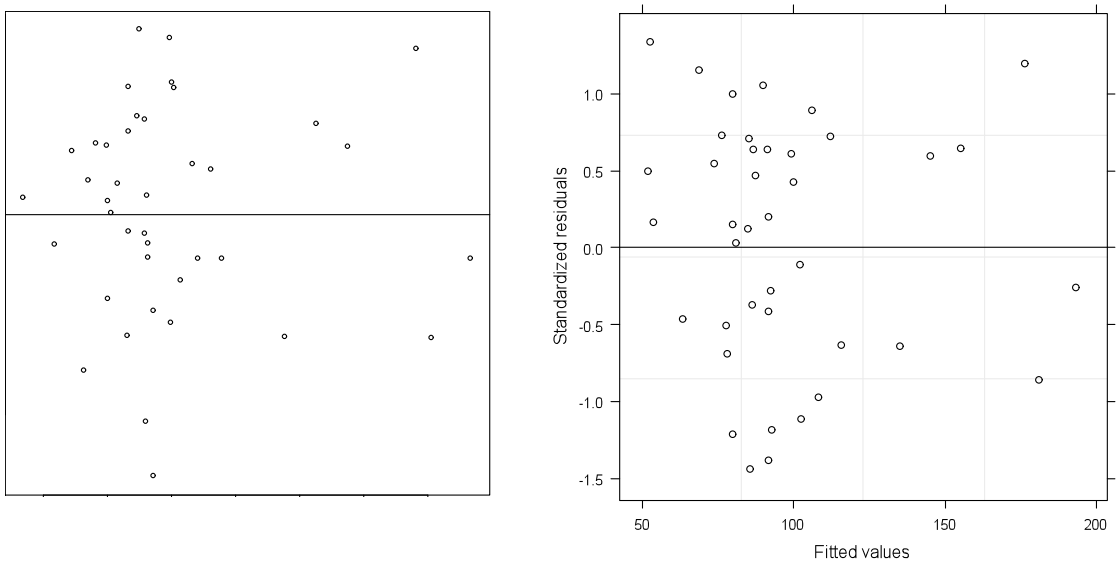


Figure A11.1. Standardized residuals vs fitted values of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation.

Coefficient Table A11

	Value	SE	t-value	p-value
(Intercept)	148.291	26.629	5.569	0.000
HD	8.353	28.828	0.290	0.775
HU	367.980	182.652	2.015	0.055
LL	–16.274	116.764	–0.139	0.890
HDHU	–108.368	49.107	–2.207	0.037
HDLL	–11.726	43.107	–0.272	0.788
HULL	407.183	64.716	6.292	0.000
HDHULL	–26.649	109.136	–0.244	0.809
MA_{UI}	–90.905	57.254	–1.588	0.125
HD × MA_{UI}	–44.128	61.256	–0.720	0.478
HU × MA_{UI}	–684.591	403.962	–1.695	0.103
LL × MA_{UI}	2.111	261.782	0.008	0.994
HDHU × MA_{UI}	190.944	108.025	1.768	0.090
HDLL × MA_{UI}	–70.562	99.790	–0.707	0.486
HULL × MA_{UI}	–950.877	146.927	–6.472	0.000
HDHULL × MA_{UI}	20.648	222.381	0.093	0.927

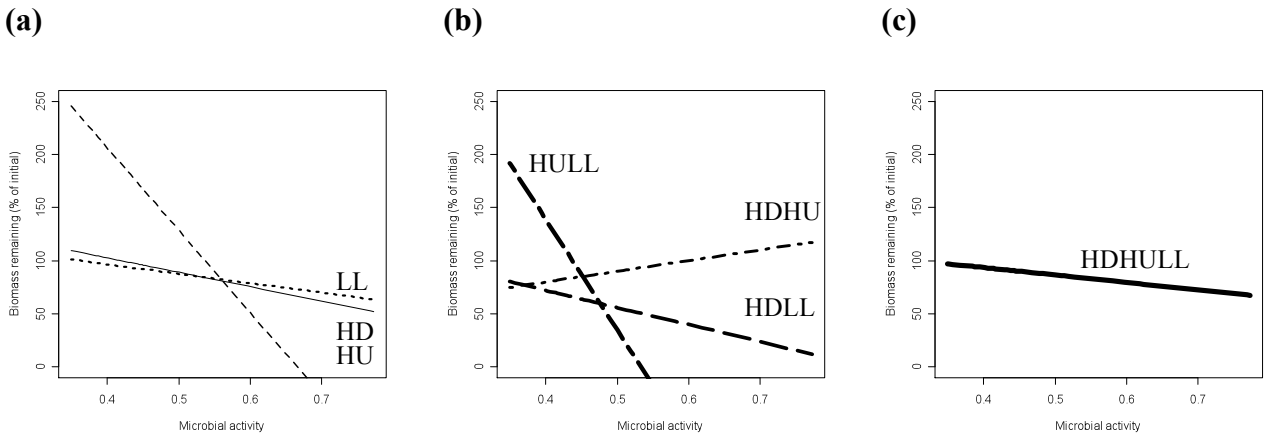


Figure A11.2. Interaction plots for IID × MA_{UI} for (a) SR_1, (b) SR_2 and (c) SR_3. Species mixtures are indicated in each panel.

Model A12

Form of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation (incorporating IID as a variance covariate) for the effects of IID on $FSUI_{rem}$.

(a) $FSUI_{rem}$ ~ as.factor(IID) + MA_{FSUI}
+ as.factor(IID):MA_{FSUI}

(b) $FSUI_{rem}$ ~ as.factor(IID),
weights = varIdent(form = ~ 1|as.factor(IID)), method = "ML"

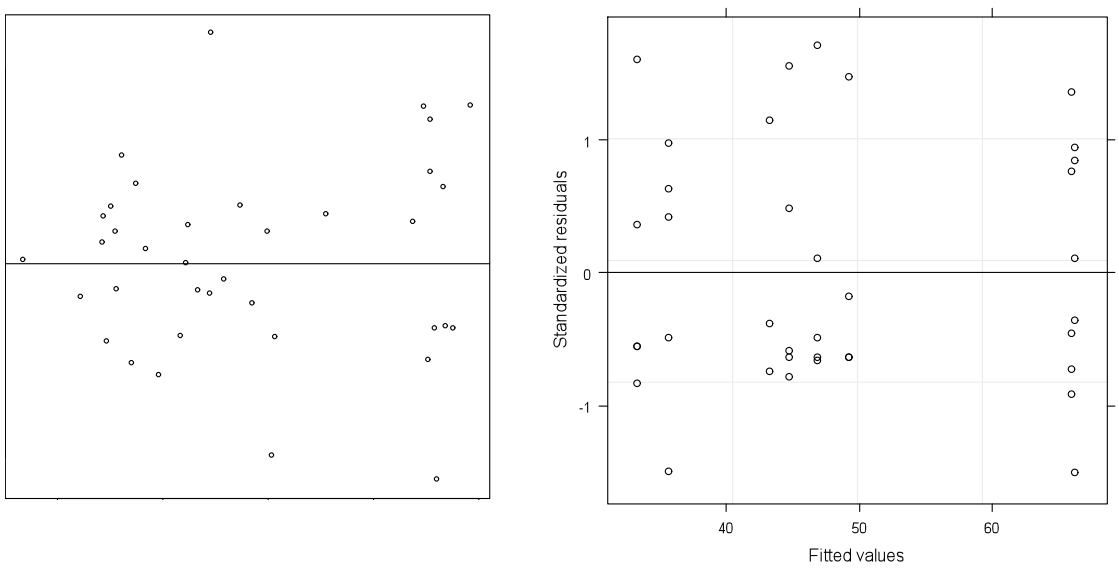


Figure A12.1. Standardized residuals vs fitted values of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation.

Coefficient Table A12

	Value	SE	t-value	p-value
(Intercept)	66.014	6.356	10.386	<0.0001
HD	–21.222	12.101	–1.754	0.090
HU	0.294	11.899	0.025	0.981
LL	–32.648	8.139	–4.011	<0.0001
HDHU	–16.749	9.899	–1.692	0.101
HDLL	–30.328	7.353	–4.124	<0.0001
HULL	–19.080	7.118	–2.680	0.012
HDHULL	–22.677	7.939	–2.856	0.008

Model A13

Form of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation (incorporating IID as a variance covariate) for the effects of IID on C:N_s.

(a) $C{:}N_s$ ~ as.factor(IID) + as.factor(AID) + A_{rem} + MA_s
+ as.factor(IID):as.factor(AID)
+ as.factor(IID): A_{rem}
+ as.factor(IID): MA_s
+ as.factor(AID): A_{rem}
+ as.factor(AID): MA_s
+ A_{rem}: MA_s
+ as.factor(IID):as.factor(AID): MA_s
+ as.factor(IID):as.factor(AID): A_{rem}
+ as.factor(IID): A_{rem}: MA_s
+ as.factor(AID): A_{rem}: MA_s
+ as.factor(IID):as.factor(AID): A_{rem}: MA_s

(b) $C{:}N_s$ ~ as.factor(IID) + as.factor(AID) + A_{rem} + MA_s
+ as.factor(IID):as.factor(AID)
+ as.factor(IID): A_{rem}
+ as.factor(IID): MA_s
+ as.factor(AID): A_{rem}
+ as.factor(AID): MA_s
+ A_{rem} + MA_s
+ as.factor(IID):as.factor(AID): MA_s
+ as.factor(IID):as.factor(AID): A_{rem}
+ as.factor(IID): A_{rem}: MA_s
+ as.factor(AID): A_{rem}: MA_s
+ as.factor(IID):as.factor(AID): A_{rem}: MA_s,
weights = varIdent(form = ~ 1|as.factor(IID)), method = "ML"

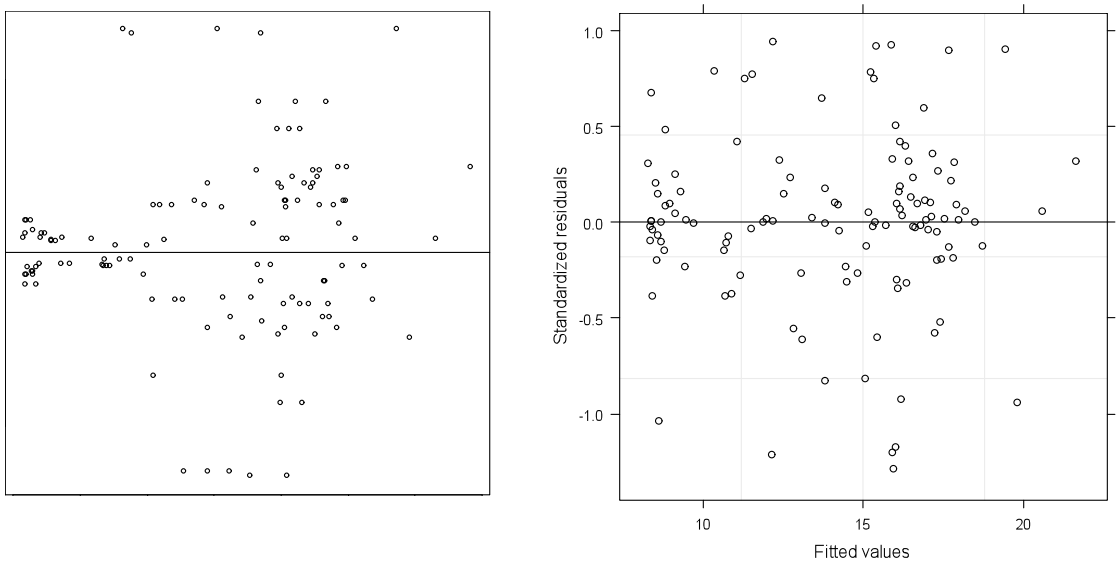


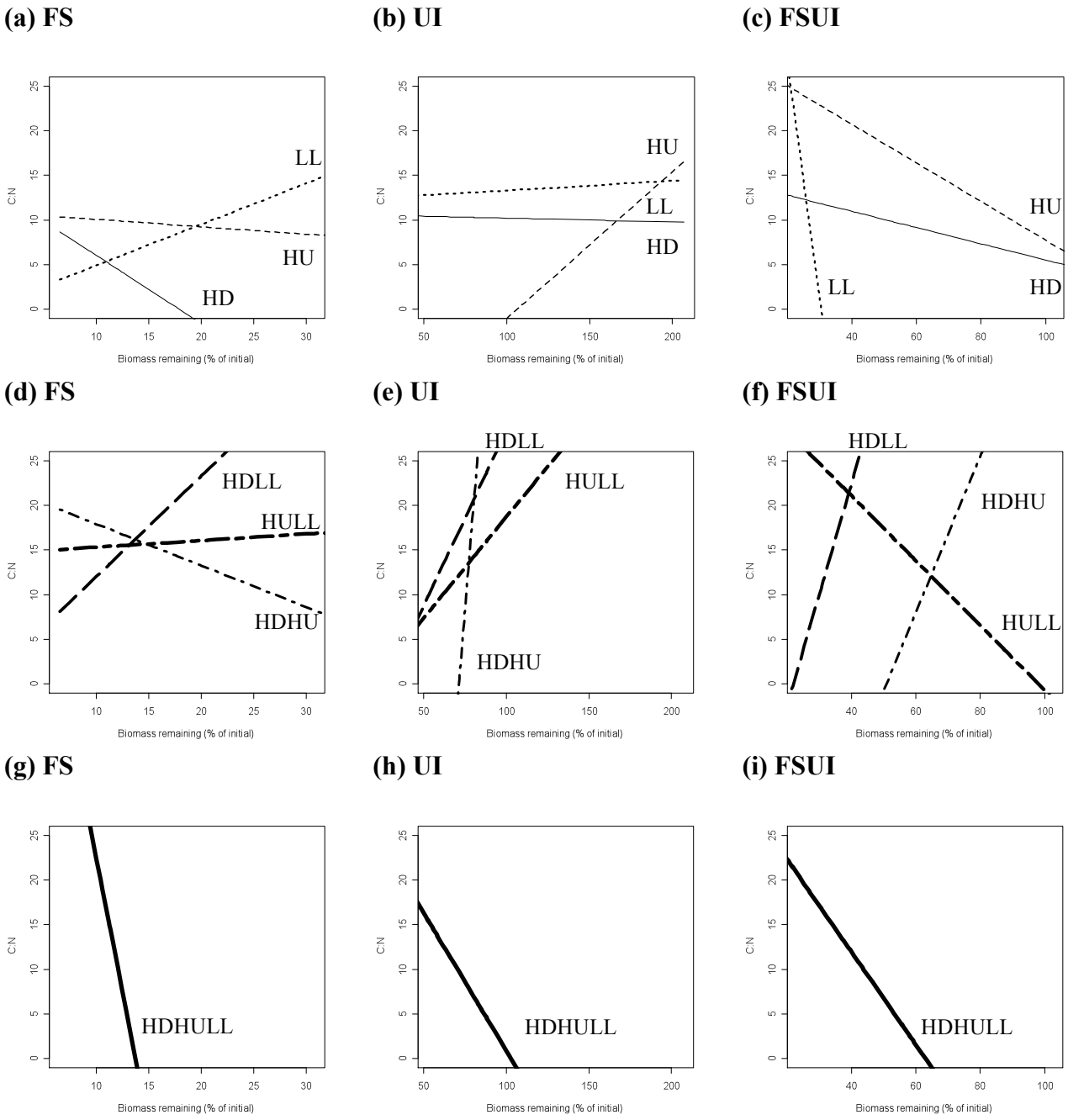
Figure A13.1. Standardized residuals vs fitted values of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation.

Coefficient Table A13

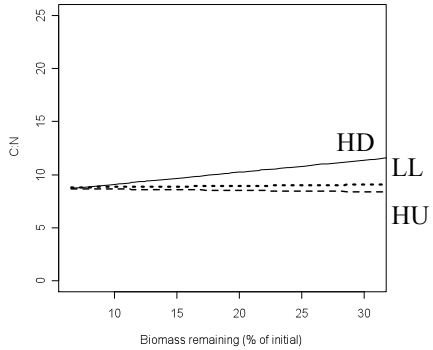
	Value	SE	t-value	p-value
(Intercept)	214.285	361.417	0.593	0.559
HD	–196.801	361.635	–0.544	0.591
HU	–201.973	364.396	–0.554	0.585
LL	–219.610	362.780	–0.605	0.551
HDHU	–187.216	362.241	–0.517	0.610
HDLL	–225.558	363.263	–0.621	0.541
HULL	–204.050	362.628	–0.563	0.579
HDHULL	–81.476	432.907	–0.188	0.852
UI	–113.189	381.769	–0.296	0.769
FSUI	–209.100	364.645	–0.573	0.572
A_{rem}	–13.235	22.002	–0.602	0.553
MA_s	–424.895	782.696	–0.543	0.592
HD × UI	109.045	382.123	0.285	0.778
HU × UI	74.391	386.938	0.192	0.849
LL × UI	129.942	383.307	0.339	0.738
HDHU × UI	–203.530	389.547	–0.522	0.606
HDLL × UI	93.086	384.768	0.242	0.811
HULL × UI	83.163	386.785	0.215	0.832
HDHULL × UI	28.057	454.006	0.062	0.951
HD × FSUI	208.458	364.971	0.571	0.573
HU × FSUI	237.207	370.171	0.641	0.528
LL × FSUI	385.626	366.145	1.053	0.303
HDHU × FSUI	93.435	370.693	0.252	0.803
HDLL × FSUI	148.004	368.029	0.402	0.691
HULL × FSUI	262.808	371.456	0.708	0.486
HDHULL × FSUI	122.223	437.104	0.280	0.782
HD × A_{rem}	11.889	22.050	0.539	0.595
HU × A_{rem}	13.106	22.061	0.594	0.558
LL × A_{rem}	13.995	22.082	0.634	0.532
HDHU × A_{rem}	12.395	22.045	0.562	0.579
HDLL × A_{rem}	15.207	22.222	0.684	0.500
HULL × A_{rem}	13.552	22.063	0.614	0.545
HDHULL × A_{rem}	2.629	30.545	0.086	0.932
HD × MA_s	405.867	783.242	0.518	0.609
HU × MA_s	417.808	788.330	0.530	0.601
LL × MA_s	453.019	785.306	0.577	0.569
HDHU × MA_s	402.369	784.361	0.513	0.613
HDLL × MA_s	484.813	787.399	0.616	0.544
HULL × MA_s	446.586	785.648	0.568	0.575
HDHULL × MA_s	173.870	941.377	0.185	0.855
UI × A_{rem}	12.509	22.030	0.568	0.575
FSUI × A_{rem}	13.453	22.014	0.611	0.547
UI × MA_s	225.165	824.154	0.273	0.787
FSUI × MA_s	454.313	788.752	0.576	0.570
A_{rem} × MA_s	28.022	47.583	0.589	0.561
HD × UI × MA_s	–219.661	824.933	–0.266	0.792
HU × UI × MA_s	–172.905	831.789	–0.208	0.837
LL × UI × MA_s	–249.246	827.125	–0.301	0.766
HDHU × UI × MA_s	445.265	840.532	0.530	0.601
HDLL × UI × MA_s	–182.173	831.850	–0.219	0.829
HULL × UI × MA_s	–167.494	836.121	–0.200	0.843
HDHULL × UI × MA_s	–54.009	986.347	–0.055	0.957
HD × FSUI × MA_s	–446.471	789.565	–0.565	0.577
HU × FSUI × MA_s	–502.562	797.808	–0.630	0.535
LL × FSUI × MA_s	–936.552	791.886	–1.183	0.249
HDHU × FSUI × MA_s	–211.400	800.116	–0.264	0.794
HDLL × FSUI × MA_s	–288.807	797.640	–0.362	0.721
HULL × FSUI × MA_s	–617.758	808.883	–0.764	0.453
HDHULL × FSUI × MA_s	–269.497	950.413	–0.284	0.779
HD × UI × A_{rem}	–11.186	22.078	–0.507	0.617
HU × UI × A_{rem}	–12.158	22.090	–0.550	0.587
LL × UI × A_{rem}	–13.232	22.110	–0.598	0.555

HDHU × UI × A_{rem}	–7.734	22.093	–0.350	0.729
HDLL × UI × A_{rem}	–13.820	22.253	–0.621	0.540
HULL × UI × A_{rem}	–12.423	22.099	–0.562	0.579
HDHULL × UI × A_{rem}	–2.492	30.577	–0.081	0.936
HD × FSUI × A_{rem}	–12.282	22.064	–0.557	0.583
HU × FSUI × A_{rem}	–13.710	22.080	–0.621	0.541
LL × FSUI × A_{rem}	–20.248	22.097	–0.916	0.369
HDHU × FSUI × A_{rem}	–11.052	22.083	–0.500	0.621
HDLL × FSUI × A_{rem}	–12.966	22.251	–0.583	0.566
HULL × FSUI × A_{rem}	–14.707	22.110	–0.665	0.512
HDHULL × FSUI × A_{rem}	–3.773	30.576	–0.123	0.903
HD × MA_s × A_{rem}	–25.102	47.695	–0.526	0.604
HU × MA_s × A_{rem}	–27.788	47.690	–0.583	0.566
LL × MA_s × A_{rem}	–29.520	47.735	–0.618	0.542
HDHU × MA_s × A_{rem}	–26.147	47.676	–0.548	0.589
HDLL × MA_s × A_{rem}	–32.241	48.124	–0.670	0.509
HULL × MA_s × A_{rem}	–29.236	47.736	–0.612	0.546
HDHULL × MA_s × A_{rem}	–5.007	66.482	–0.075	0.941
UI × MA_s × A_{rem}	–26.308	47.637	–0.552	0.586
FSUI × MA_s × A_{rem}	–28.596	47.606	–0.601	0.554
HD × UI × A_{rem} × MA_s	23.487	47.749	0.492	0.627
HU × UI × A_{rem} × MA_s	25.787	47.745	0.540	0.594
LL × UI × A_{rem} × MA_s	27.678	47.790	0.579	0.568
HDHU × UI × A_{rem} × MA_s	15.991	47.773	0.335	0.741
HDLL × UI × A_{rem} × MA_s	29.179	48.187	0.606	0.551
HULL × UI × A_{rem} × MA_s	26.638	47.810	0.557	0.583
HDHULL × UI × A_{rem} × MA_s	4.699	66.551	0.071	0.944
HD × FSUI × A_{rem} × MA_s	26.102	47.721	0.547	0.590
HU × FSUI × A_{rem} × MA_s	29.214	47.722	0.612	0.546
LL × FSUI × A_{rem} × MA_s	47.096	47.770	0.986	0.334
HDHU × FSUI × A_{rem} × MA_s	23.295	47.744	0.488	0.630
HDLL × FSUI × A_{rem} × MA_s	26.744	48.192	0.555	0.584
HULL × FSUI × A_{rem} × MA_s	32.677	47.877	0.683	0.501
HDHULL × FSUI × A_{rem} × MA_s	7.616	66.553	0.114	0.910

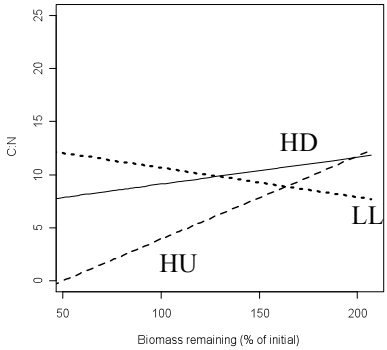
Figure A13.2. Interaction plots for IID × AID × A_{rem} × MA_s for MA_s levels of (a–i) 0.2 nmol g^{-1} h^{-1}, (j–r) 0.5 nmol g^{-1} h^{-1} and (s–aa) 0.8 nmol g^{-1} h^{-1} for IID within SR_1 (a–c, j–l, s–u), SR_2 (d–f, m–o, v–x) and SR_3 (g–i, p–r, y–aa). Algal identity and invertebrate species mixtures are indicated in each panel.



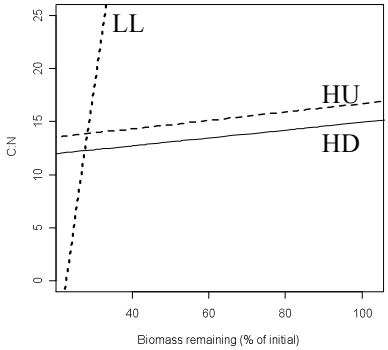
(j) FS



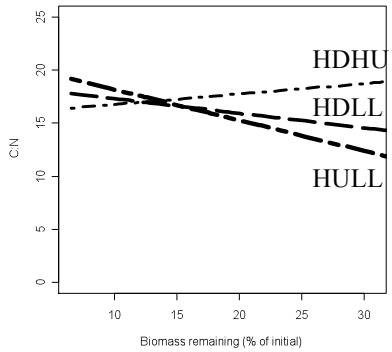
(k) UI



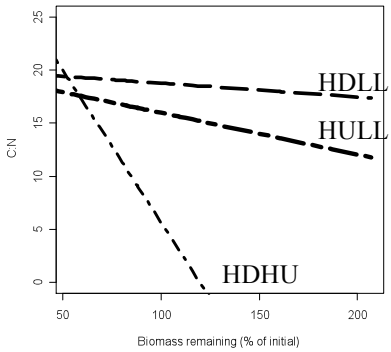
(l) FSUI



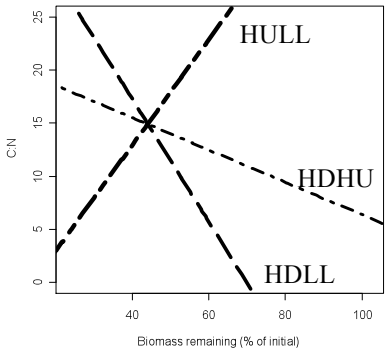
(m) FS



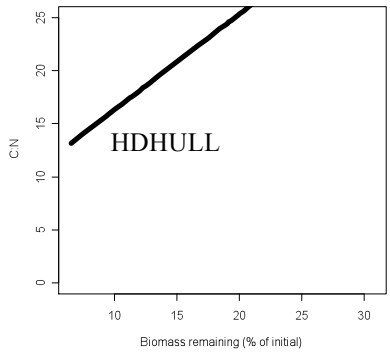
(n) UI



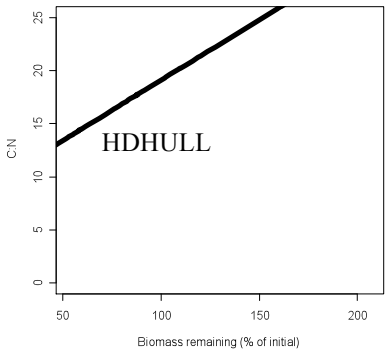
(o) FSUI



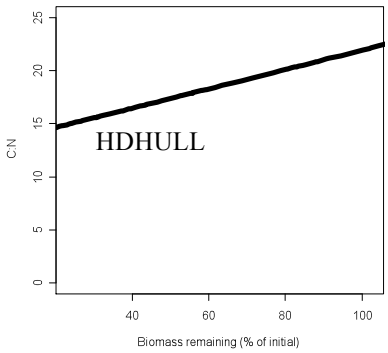
(p) FS



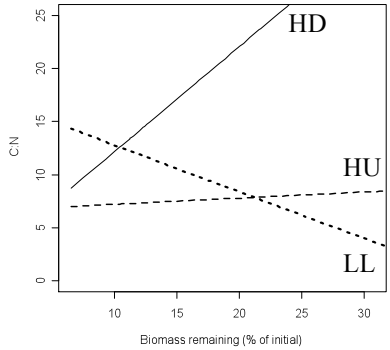
(q) UI



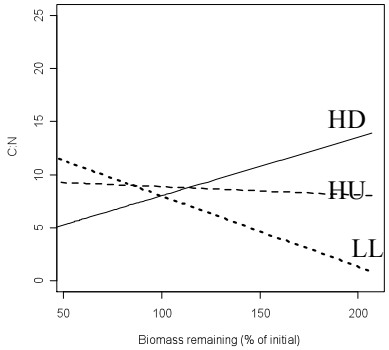
(r) FSUI



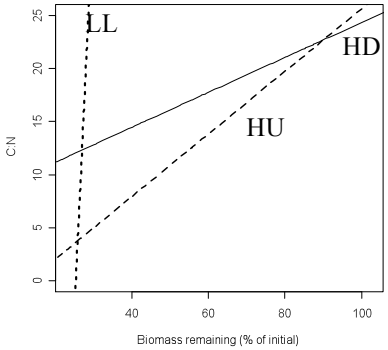
(s) FS



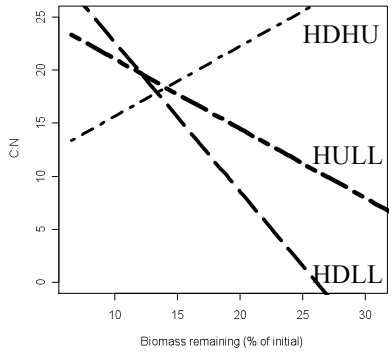
(t) UI



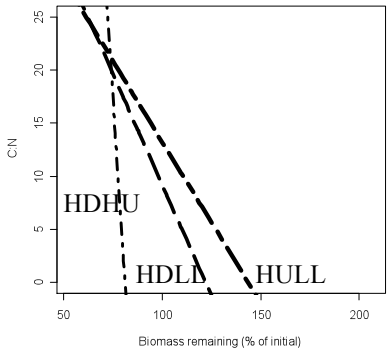
(u) FSUI



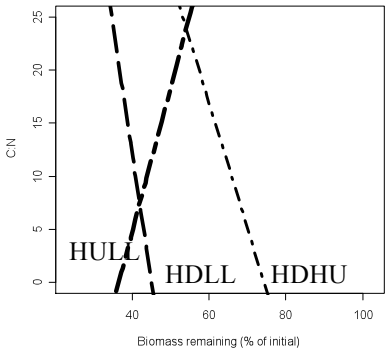
(v) FS



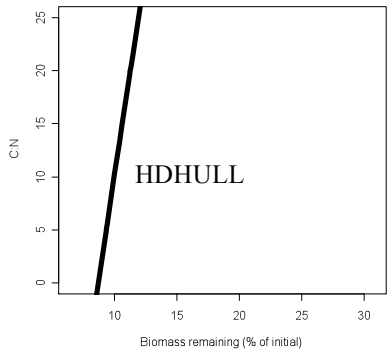
(w) UI



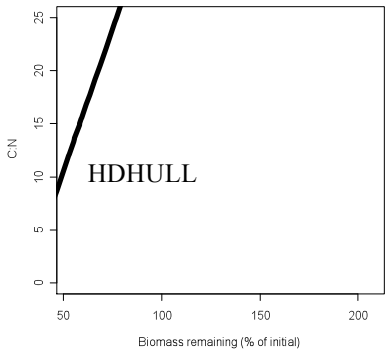
(x) FSUI



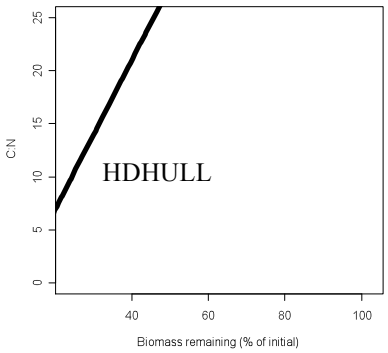
(y) FS



(z) UI



(aa) FSUI



Model A14

Form of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation (incorporating FS_{rem} as a variance covariate) for the effects of IID on $C{:}N_{FS}$.

(a) $C{:}N_{FS}$ ~ as.factor(IID)+ FS_{rem} + MA_{FS}
+ as.factor(IID): FS_{rem}
+ as.factor(IID): MA_{FS}
+ FS_{rem}: MA_{FS}
+ as.factor(IID): FS_{rem}: MA_{FS}

(b) $C{:}N_{FS}$ ~ as.factor(IID),
weights = varExp(form = ~ FS_{rem}), method = "ML"

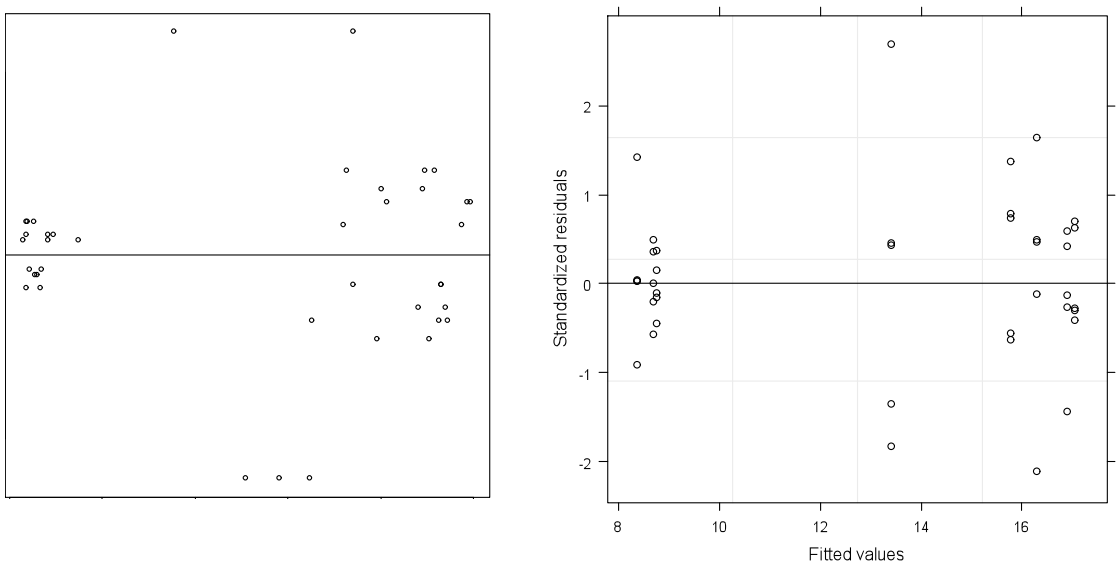


Figure A14.1. Standardized residuals vs fitted values of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation.

Coefficient Table A14

	Value	SE	t-value	p-value
(Intercept)	13.419	0.489	27.418	<0.0001
HD	–4.711	0.635	–7.423	<0.0001
HU	–5.027	0.526	–9.563	<0.0001
LL	–4.637	0.661	–7.018	<0.0001
HDHU	2.894	0.656	4.409	<0.0001
HDLL	3.502	0.710	4.929	<0.0001
HULL	2.369	0.666	3.560	0.001
HDHULL	3.658	0.812	4.503	<0.0001

Model A15

Form of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation (incorporating IID as a variance covariate) for the effects of IID on $C{:}N_{UI}$.

(a) $C{:}N_{UI}$ ~ as.factor(IID)+ UI_{rem} + MA_{UI}
+ as.factor(IID): UI_{rem} +
+ as.factor(IID): MA_{UI}
+ UI_{rem}: MA_{UI}
+ as.factor(IID): UI_{rem}: MA_{UI}

(b) $C{:}N_{UI}$ ~ as.factor(IID)+ UI_{rem} + MA_{UI}
+ as.factor(IID): UI_{rem}
+ as.factor(IID): MA_{UI}
+ UI_{rem}: MA_{UI}
+ as.factor(IID): UI_{rem}: MA_{UI},
weights = varIdent(form = ~ 1|as.factor(IID)), method = "ML"

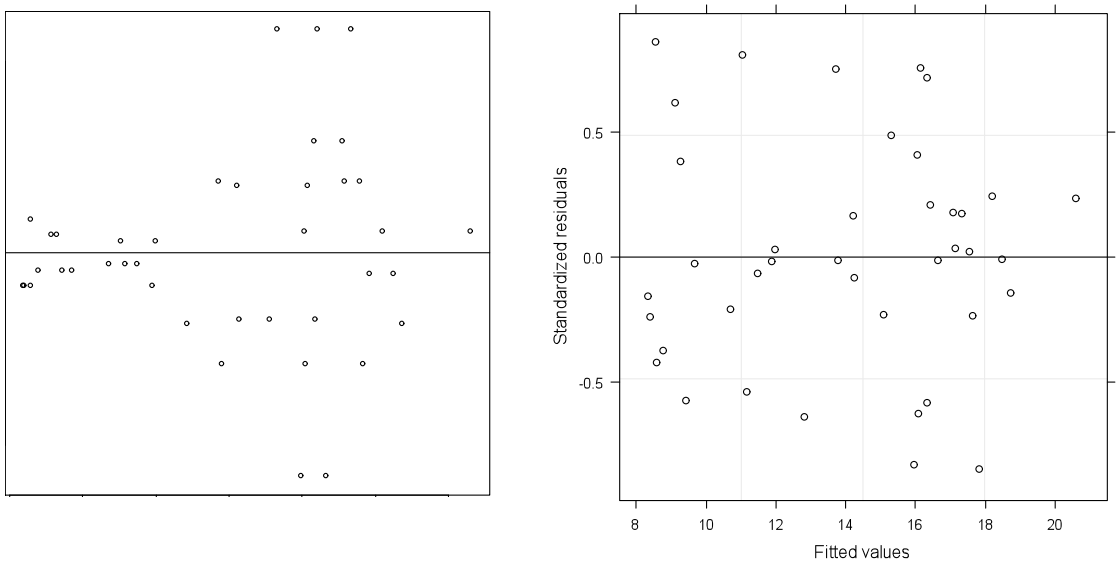


Figure A15.1. Standardized residuals vs fitted values of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation.

Coefficient Table A15

	Value	SE	t-value	p-value
(Intercept)	101.096	67.750	1.492	0.174
HD	–87.756	67.886	–1.293	0.232
HU	–127.581	68.138	–1.872	0.098
LL	–89.668	68.120	–1.316	0.225
HDHU	–390.746	92.725	–4.214	0.003
HDLL	–132.472	68.107	–1.945	0.088
HULL	–120.888	108.346	–1.116	0.297
HDHULL	–53.419	75.388	–0.709	0.499
UI_{rem}	–0.726	0.609	–1.193	0.267
MA_{UI}	–199.730	142.184	–1.405	0.198
HD × UI_{rem}	0.702	0.611	1.150	0.284
HU × UI_{rem}	0.948	0.610	1.553	0.159
LL × UI_{rem}	0.763	0.613	1.245	0.248
HDHU × UI_{rem}	4.661	1.010	4.615	0.002
HDLL × UI_{rem}	1.387	0.616	2.253	0.054
HULL × UI_{rem}	1.129	1.121	1.007	0.343
HDHULL × UI_{rem}	0.137	0.771	0.178	0.863
HD × MA_{UI}	186.207	142.430	1.307	0.227
HU × MA_{UI}	244.903	142.571	1.718	0.124
LL × MA_{UI}	203.773	142.939	1.426	0.192
HDHU × MA_{UI}	847.634	196.224	4.320	0.003
HDLL × MA_{UI}	302.640	143.133	2.114	0.067
HULL × MA_{UI}	279.092	238.311	1.171	0.275
HDHULL × MA_{UI}	119.861	162.270	0.739	0.481
UI_{rem} × MA_{UI}	1.714	1.251	1.370	0.208
HD × UI_{rem} × MA_{UI}	–1.615	1.254	–1.288	0.234
HU × UI_{rem} × MA_{UI}	–2.001	1.253	–1.597	0.149
LL × UI_{rem} × MA_{UI}	–1.843	1.259	–1.463	0.182
HDHU × UI_{rem} × MA_{UI}	–10.156	2.145	–4.736	0.002
HDLL × UI_{rem} × MA_{UI}	–3.062	1.269	–2.412	0.042
HULL × UI_{rem} × MA_{UI}	–2.598	2.458	–1.057	0.321
HDHULL × UI_{rem} × MA_{UI}	–0.308	1.668	–0.185	0.858

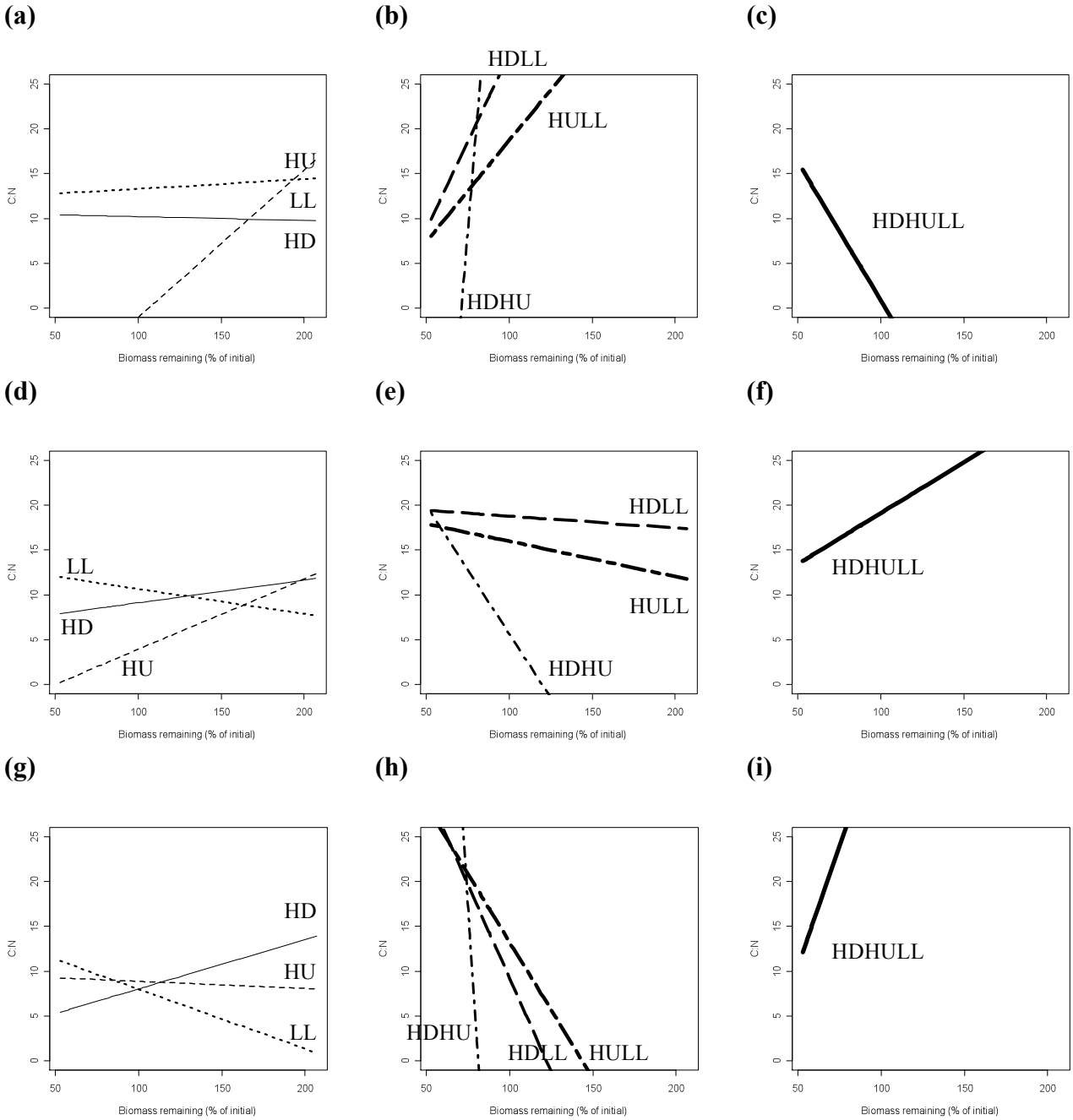


Figure A15.2. Interaction plots for IID × UI_{rem} × MA_{UI} for MA_{UI} levels of (a–c) 0.2 nmol g^{-1} h^{-1}, (d–f) 0.5 nmol g^{-1} h^{-1} and (g–i) 0.8 nmol g^{-1} h^{-1}. Invertebrate species mixtures are indicated in each panel.

Model A16

Form of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation (incorporating MA_{FSUI} as a variance covariate) for the effects of IID on $C{:}N_{FSUI}$.

a) $C{:}N_{FSUI}$ ~ as.factor(IID)+ $FSUI_{rem}$ + MA_{FSUI}
+ as.factor(IID): $FSUI_{rem}$
+ as.factor(IID): MA_{FSUI}
+ $FSUI_{rem}$: MA_{FSUI}
+ as.factor(IID): $FSUI_{rem}$: MA_{FSUI}

b) $C{:}N_{FSUI}$ ~ as.factor(IID),
weights = varPower(form = ~ MA_{FSUI}), method = "ML"

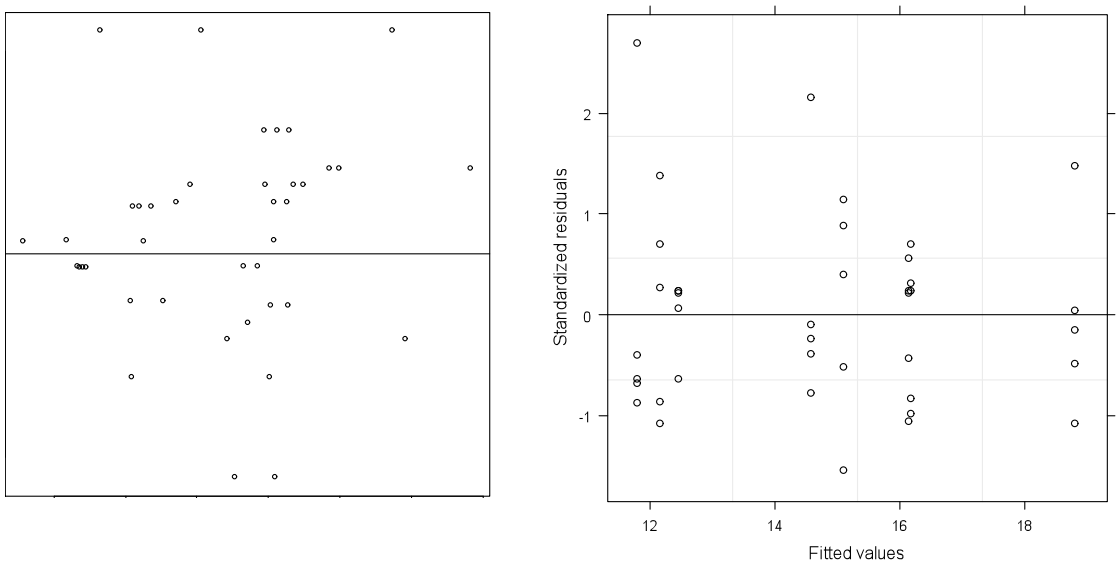


Figure A16.1. Standardized residuals vs fitted values of (a) the initial linear regression model and (b) the minimal adequate linear regression model with GLS estimation.

Coefficient Table A16

	Value	SE	t-value	p-value
(Intercept)	16.158	0.810	19.937	<0.0001
HD	–3.697	1.156	–3.197	0.003
HU	–1.576	1.357	–1.161	0.254
LL	–4.354	1.096	–3.973	<0.0001
HDHU	–3.987	1.346	–2.963	0.006
HDLL	2.676	1.183	2.263	0.031
HULL	0.036	1.122	0.032	0.975
HDHULL	–1.039	1.267	–0.820	0.419