Appendix 1. Detailed computations for the examples using artificial data presented in Fig. 2. The data are showing (a) maximum expression of trait-convergence assembly pattern (TCAP), (b) trait-divergence assembly pattern (TDAP), or (c) both TCAP and TDAP.

(a) TCAP only

Trait matrix B with 10 OTUs by 1 trait:
1
2
3
4
5
6
7
8
9
10

Matrix E with ecological variables (4 communities x 1 variable):
1
2
3
4

Resemblance matrix (D_E) between community sites based on the ecological variables:
0
1 0
2 1 0
3 2 1 0

Matrix T with trait averages at community level (4 communities x 1 trait):
2.5
4.5
6.5
8.5

Matrix T with normalized traits at community level (4 communities x 1 trait adjusted to unit length):
0.210538
0.378968
0.547399
0.715829

Resemblance matrix (D_T) between communities based on normalized matrix T:
0
0.16843 0
0.336861 0.16843 0
0.505291 0.336861 0.16843 0

ro(TE)= 1

Similarity matrix between 10 OTUs, based on 1 trait:
1
0.888889 1
0.777778 0.888889 1
0.666667 0.777778 0.888889 1
0.555556 0.666667 0.777778 0.888889 1
0.444444 0.555556 0.666667 0.777778 0.888889 1
0.333333 0.444444 0.555556 0.666667 0.777778 0.888889 1
0.222222 0.333333 0.444444 0.555556 0.666667 0.777778 0.888889 1
0.111111 0.222222 0.333333 0.444444 0.555556 0.666667 0.777778 0.888889 1
0 0.111111 0.222222 0.333333 0.444444 0.555556 0.666667 0.777778 0.888889 1

Crisp belonging (matrix C) of 10 OTUs (rows) in 10 types (columns):
1 0 0 0 0 0 0 0 0 0
0 1 0 0 0 0 0 0 0 0
0 0 1 0 0 0 0 0 0 0
0 0 0 1 0 0 0 0 0 0
0 0 0 0 1 0 0 0 0 0
0 0 0 0 0 1 0 0 0 0
0 0 0 0 0 0 1 0 0 0
0 0 0 0 0 0 0 1 0 0
0 0 0 0 0 0 0 0 1 0
0 0 0 0 0 0 0 0 0 1

Fuzzy belonging (matrix U) of 10 OTUs (rows) in 10 types (columns):

0.2	0.177778	0.155556	0.133333	0.111111	0.0888889	0.0666667	0.0444444	0.0222222	0
0.150943	0.169811	0.150943	0.132075	0.113208	0.0943396	0.0754717	0.0566038	0.0377358	0.0188679
0.118644	0.135593	0.152542	0.135593	0.118644	0.101695	0.0847458	0.0677966	0.0508475	0.0338983
0.0952381	0.111111	0.126984	0.142857	0.126984	0.111111	0.0952381	0.0793651	0.0634921	0.047619
0.0769231	0.0923077	0.107692	0.123077	0.138462	0.123077	0.107692	0.0923077	0.0769231	0.0615385
0.0615385	0.0769231	0.0923077	0.107692	0.123077	0.138462	0.123077	0.107692	0.0923077	0.0769231
0.047619	0.0634921	0.0793651	0.0952381	0.111111	0.126984	0.142857	0.126984	0.111111	0.0952381
0.0338983	0.0508475	0.0677966	0.0847458	0.101695	0.118644	0.135593	0.152542	0.135593	0.118644
0.0188679	0.0377358	0.0566038	0.0754717	0.0943396	0.113208	0.132075	0.150943	0.169811	0.150943
0	0.0222222	0.0444444	0.0666667	0.0888889	0.111111	0.133333	0.155556	0.177778	0.2

Pooled performance matrix X’ (4 communities x 10 types) after fuzzy-weighting by the selected traits.

0.564826	0.594293	0.586025	0.543859	0.469947	0.396035	0.322122	0.24821	0.174298	0.100385
0.352344	0.415935	0.479526	0.50922	0.507167	0.474344	0.410753	0.347162	0.28357	0.219979
0.219979	0.28357	0.347162	0.410753	0.474344	0.507167	0.50922	0.479526	0.415935	0.352344
0.100385	0.174298	0.24821	0.322122	0.396035	0.469947	0.543859	0.586025	0.594293	0.564826

Resemblance matrix (D_X) between communities based on composition of types:

0			
0.37538	0		
0.716237	0.355905	0	
1.0591	0.716237	0.37538	0

Statistics:
TCAP: ro(TE)= 1
Both TCAP and TDAP: ro(XE)= 0.999675
TDAP: ro(XE.T)= 0
ro(XT)= 0.999675

(b) TDAP only

Trait matrix B with 10 OTUs by 1 traits:
1
2
3
4
5
6
7
8
9
10

Matrix E with ecological variables (4 communities x 1 variable):
1
2
3
4

Resemblance matrix (D_E) between community sites based on the ecological variables:
0
1 0
2 1 0
3 2 1 0

Matrix T with trait averages at community level (4 communities x 1 traits):
5.5
5.5
5.5
5.5

Matrix T with normalized traits at community level (4 communities x 1 traits adjusted to unit length):
0.5
0.5
0.5
0.5

Resemblance matrix (D_T) between communities based on normalized matrix T:

0
0 0
0 0 0
0 0 0 0

ro(TE)= 0

Similarity matrix between 10 OTUs, based on 1 traits:

1
0.888889 1
0.777778 0.888889 1
0.666667 0.777778 0.888889 1
0.555556 0.666667 0.777778 0.888889 1
0.444444 0.555556 0.666667 0.777778 0.888889 1
0.333333 0.444444 0.555556 0.666667 0.777778 0.888889 1
0.222222 0.333333 0.444444 0.555556 0.666667 0.777778 0.888889 1
0.111111 0.222222 0.333333 0.444444 0.555556 0.666667 0.777778 0.888889 1
0 0.111111 0.222222 0.333333 0.444444 0.555556 0.666667 0.777778 0.888889 1

Crisp degrees of belonging (matrix C) of 10 OTUs (rows) in 10 types (columns):

1 0 0 0 0 0 0 0 0 0
0 1 0 0 0 0 0 0 0 0
0 0 1 0 0 0 0 0 0 0
0 0 0 1 0 0 0 0 0 0
0 0 0 0 1 0 0 0 0 0
0 0 0 0 0 1 0 0 0 0
0 0 0 0 0 0 1 0 0 0
0 0 0 0 0 0 0 1 0 0
0 0 0 0 0 0 0 0 1 0
0 0 0 0 0 0 0 0 0 1

Fuzzy degrees of belonging (matrix U) of 10 OTUs (rows) in 10 types (columns):

0.2	0.177778	0.155556	0.133333	0.111111	0.0888889	0.0666667	0.0444444	0.0222222	0
0.150943	0.169811	0.150943	0.132075	0.113208	0.0943396	0.0754717	0.0566038	0.0377358	0.0188679
0.118644	0.135593	0.152542	0.135593	0.118644	0.101695	0.0847458	0.0677966	0.0508475	0.0338983
0.0952381	0.111111	0.126984	0.142857	0.126984	0.111111	0.0952381	0.0793651	0.0634921	0.047619
0.0769231	0.0923077	0.107692	0.123077	0.138462	0.123077	0.107692	0.0923077	0.0769231	0.0615385
0.0615385	0.0769231	0.0923077	0.107692	0.123077	0.138462	0.123077	0.107692	0.0923077	0.0769231
0.047619	0.0634921	0.0793651	0.0952381	0.111111	0.126984	0.142857	0.126984	0.111111	0.0952381
0.0338983	0.0508475	0.0677966	0.0847458	0.101695	0.118644	0.135593	0.152542	0.135593	0.118644
0.0188679	0.0377358	0.0566038	0.0754717	0.0943396	0.113208	0.132075	0.150943	0.169811	0.150943
0	0.0222222	0.0444444	0.0666667	0.0888889	0.111111	0.133333	0.155556	0.177778	0.2

Pooled performance matrix X’ (4 communities x 10 types) after fuzzy-weighting by the selected traits.

0.281319	0.343834	0.406349	0.468864	0.499634	0.499634	0.468864	0.406349	0.343834	0.281319
0.2954	0.361044	0.426688	0.458434	0.458434	0.458434	0.458434	0.426688	0.361044	0.2954
0.312668	0.38215	0.413896	0.445642	0.445642	0.445642	0.445642	0.413896	0.38215	0.312668
0.352542	0.386441	0.420339	0.420339	0.420339	0.420339	0.420339	0.420339	0.386441	0.352542

Resemblance matrix (D_X) between communities based on composition of types:

0			
0.0736792	0		
0.109199	0.0496909	0	
0.177348	0.117074	0.0765555	0

Statistics:
TCAP: ro(TE)= 0
Both TCAP and TDAP: ro(XE)= 0.971951
TDAP: ro(XE.T)= 0.971951
ro(XT)= 0

(c) Both TCAP and TDAP

Trait matrix B with 10 OTUs by 1 traits:
1
2
3
4
5
6
7
8
9
10

Matrix E with ecological variables (4 communities x 1 variable):
1
2
3
4

Resemblance matrix (D_E) between community sites based on the ecological variables:
0
1 0
2 1 0
3 2 1 0

Matrix T with trait averages at community level (4 communities x 1 traits):
2.5
5.5
5.5
5.5

Matrix T with normalized traits at community level (4 communities x 1 traits adjusted to unit length):
0.253837
0.55844
0.55844
0.55844

Resemblance matrix (D_T) between communities based on normalized matrix T:

```
     0
0.304604   0
0.304604   0   0
0.304604   0   0   0
```

ro(TE)= 0.447214

Similarity matrix between 10 OTUs, based on 1 traits:

```
1
0.888889   1
0.777778   0.888889   1
0.666667   0.777778   0.888889   1
0.555556   0.666667   0.777778   0.888889   1
0.444444   0.555556   0.666667   0.777778   0.888889   1
0.333333   0.444444   0.555556   0.666667   0.777778   0.888889   1
0.222222   0.333333   0.444444   0.555556   0.666667   0.777778   0.888889   1
0.111111   0.222222   0.333333   0.444444   0.555556   0.666667   0.777778   0.888889   1
0          0.111111   0.222222   0.333333   0.444444   0.555556   0.666667   0.777778   0.888889   1
```

Crisp degrees of belonging (matrix C) of 10 OTUs (rows) in 10 types (columns):

```
1   0   0   0   0   0   0   0   0   0
0   1   0   0   0   0   0   0   0   0
0   0   1   0   0   0   0   0   0   0
0   0   0   1   0   0   0   0   0   0
0   0   0   0   1   0   0   0   0   0
0   0   0   0   0   1   0   0   0   0
0   0   0   0   0   0   1   0   0   0
0   0   0   0   0   0   0   1   0   0
0   0   0   0   0   0   0   0   1   0
0   0   0   0   0   0   0   0   0   1
```

Fuzzy degrees of belonging (matrix U) of 10 OTUs (rows) in 10 types (columns):

0.2	0.177778	0.155556	0.133333	0.111111	0.0888889	0.0666667	0.0444444	0.0222222	0
0.150943	0.169811	0.150943	0.132075	0.113208	0.0943396	0.0754717	0.0566038	0.0377358	0.0188679
0.118644	0.135593	0.152542	0.135593	0.118644	0.101695	0.0847458	0.0677966	0.0508475	0.0338983
0.0952381	0.111111	0.126984	0.142857	0.126984	0.111111	0.0952381	0.0793651	0.0634921	0.047619
0.0769231	0.0923077	0.107692	0.123077	0.138462	0.123077	0.107692	0.0923077	0.0769231	0.0615385
0.0615385	0.0769231	0.0923077	0.107692	0.123077	0.138462	0.123077	0.107692	0.0923077	0.0769231
0.047619	0.0634921	0.0793651	0.0952381	0.111111	0.126984	0.142857	0.126984	0.111111	0.0952381
0.0338983	0.0508475	0.0677966	0.0847458	0.101695	0.118644	0.135593	0.152542	0.135593	0.118644
0.0188679	0.0377358	0.0566038	0.0754717	0.0943396	0.113208	0.132075	0.150943	0.169811	0.150943
0	0.0222222	0.0444444	0.0666667	0.0888889	0.111111	0.133333	0.155556	0.177778	0.2

Pooled performance matrix X’ (4 communities x 10 types) after fuzzy-weighting by the selected traits.

0.564826	0.594293	0.586025	0.543859	0.469947	0.396035	0.322122	0.24821	0.174298	0.100385
0.2954	0.361044	0.426688	0.458434	0.458434	0.458434	0.458434	0.426688	0.361044	0.2954
0.312668	0.38215	0.413896	0.445642	0.445642	0.445642	0.445642	0.413896	0.38215	0.312668
0.352542	0.386441	0.420339	0.420339	0.420339	0.420339	0.420339	0.420339	0.386441	0.352542

Resemblance matrix (D_X) between communities based on composition of types:

0			
0.535769	0		
0.530934	0.0496909	0	
0.530934	0.117074	0.0765555	0

Statistics:
TCAP: ro(TE)= 0.447214
Both TCAP and TDAP: ro(XE)= 0.476253
TDAP: ro(XE.T)= 0.396071
ro(XT)= 0.996232

Appendix 2a. Traits revealing TDAP maximally related to nitrogen levels and the corresponding PFTs (groups of species) identified by cluster analysis. See trait labels in Table 1. Since the traits are ordinal, the values are average ranks.

	PFTs		
Traits	1	2	3
	(n=20)	(n=51)	(n=10)
pi	357	544	86
he	435	521	328
la	580	296	366
sh	405	389	708

Appendix 2b. Traits revealing TDAP maximally related to grazing levels and the corresponding PFTs (groups of species) identified by cluster analysis. See trait labels in Table 1. Since the traits are ordinal, the values are average ranks.

	PFTs		
Traits	a	b	c
	(n=20)	(n=43)	(n=18)
tx	442	205	666
ts	481	234	565
ll	565	208	494

Appendix 3. Plant traits in woody plant species colonizing Araucaria forest patches of different development stages. See trait labels and scales in Table 2. Traits in bold revealed TDAP maximally related to forest patch size. The trait averages for the PFTs (groups of species) identified by cluster analysis are indicated. The values for traits *sn* and *ds* are average ranks.

	PFTs					
Traits/PFTs	PFT1 (n=6)	PFT2 (n=6)	PFT3 (n=7)	PFT4 (n=11)	PFT5 (n=5)	PFT6 (n=3)
dr	0.00	0.00	1.00	0.00	0.00	1.00
ye	0.00	0.00	0.00	0.00	1.00	0.00
vi	0.00	1.00	0.00	0.00	0.20	1.00
bl	0.00	0.67	0.57	1.00	0.40	1.00
ss	5.80	2.56	3.65	5.96	4.99	4.96
sn	23.42	25.83	12.14	14.59	26.50	22.50
ds	25.42	14.17	13.43	20.77	25.60	17.67
ar	0.33	0.00	0.00	0.09	0.00	0.00
be	0.50	1.00	0.00	0.91	0.60	0.00
ot	0.17	0.00	0.00	0.00	0.40	0.00
or	0.33	0.00	0.29	0.09	0.00	0.00
re	0.33	0.33	0.29	0.18	0.40	0.67
wh	0.17	0.00	0.00	0.00	0.00	0.00
gr	0.00	0.00	0.00	0.00	0.20	0.00
br	0.17	0.00	0.00	0.09	0.00	0.00
dr	0.00	0.00	1.00	0.00	0.00	1.00
ye	0.00	0.00	0.00	0.00	1.00	0.00