

List of all substitutions of ITS2 base pairs during the evolution of the Ulvales.

Helix 1

6/13: **A-U** - plesiomorphic status in the Ulvales

6/13: A-U => **G-C** in *Ulva reticulata* clade; **NHS**

6/13: A-U => **C-G** in *Gloeotilopsis* sp. ACOI; **NHS**

7/12: **C-G** - plesiomorphic status in the Ulvales

7/12: U-A => **C-G** in *Pseudoneochloris marina*; **HS**

7/12: U-A => **C-G** in *Monostroma*; **HS**

7/12: U-A => **C-G** in *Gloeotilopsis* sp. ACOI + *G. sarcinoidea* UTEX 1710; **HS**

7/12: C-G => **C*A** in *Percursaria percursa* AY016305

7/12: C-G => **A*C** in *Acrochaete* + '*Umbraulva japonica*', further changes in all taxa excluding '*Umbraulva japonica*'

7/12: C-G => **C*A** in Capsosiphonaceae + Gomontiaceae

7/12: $\approx 3 \times N \times N \Rightarrow N \times N$ (the total number cannot be estimated precisely due to their high substitution frequency) as an example:

7/12: **C*A** => **U-A** in *Protomonostroma undulatum*

8/11: **C-G** - plesiomorphic status in the Ulvales

8/11: C-G => **G-C** in *Ulva*; **NHS** - further changes in *U. lactuca* clade, *U. muscoides*

8/11: C-G => **U-A** in *Percursaria*; **HS**

8/11: **C-G** => **U-A** in Gomontiaceae; **HS**

8/11: U-A => **C-G** in *Pseudoneochloris marina*; **HS**

8/11: U-A => **C-G** in *Gloeotilopsis* sp. M3284; **HS**

8/11: U-A => **C-G** in *Gloeotilopsis paucicellularis*; **HS**

8/11: **G-C** => **G-U** in *Ulva muscoides*; **NHS**

8/11: U-A => **U-G** in Ulvales sp. EF595507 + Ulvales sp. EF595508 + Ulvales sp. EF595509; **NHS**

8/11: $\approx 8 \times N \times N \Rightarrow N \times N$ (the total number cannot be estimated precisely due to their high substitution frequency) as an example:

8/11: C-G => **U*U** in *Acrochaete heteroclada*

8/11: $\approx 3 \times N \times N \Rightarrow N \times N$ (the total number cannot be estimated precisely due to their high substitution frequency) as an example:

8/11: **A*C** => **A-U** in *Kornmannia*

9/10: **C-G** - plesiomorphic status in the Ulvales

9/10: C-G => **G-C** in '*Blidingia minima*' EF595512; **NHS**

9/10: C-G => **U-A** in *Gloeotilopsis* sp. ACOI; **NHS**

9/10: $\approx 5 \times N \times N \Rightarrow N \times N$ (the total number cannot be estimated precisely due to their high substitution frequency) as an example:

9/10: C-G => **C*C** in *Collinsiella*

20/41: **G-U** - plesiomorphic status in the Ulvales

20/41: G-U => **G-C** in *Gloeotilopsis* clade; **HS**

20/41: G-U => **G-C** in Bolbocoleonaceae; **HS**

21/40: **G-C** - plesiomorphic status in the Ulvales

21/40: G-C => **A-U** in *Acrochaete viridis*; **NHS**

21/40: G-C => **G-U** in Bolbocoleonaceae; **HS**

21/40: G-C => **G-U** in *Acrochaete heteroclada*; **HS**

22/39: **C-G** - plesiomorphic status in the Ulvales

22/39: C-G => **U-G** in *Gloeotilopsis* clade excluding *Gloeotilopsis* sp. M3284; **HS**

22/39: C-G => **U-G** in Capsosiphonaceae excluding *Protomonostroma undulatum*; **HS**

22/39: C-G => **U-G** in *Monostroma*; **HS**

23/38: **C-G** - plesiomorphic status in the Ulvales

23/38: C-G => **U-A** in *Kornmannia*; **NHS**

23/38: C-G => **G-C** in *Collinsiella*; **NHS**

Helix 2

PAR 1

PAR 2

REV 1

REV 2

PAR 3

hPAR 1

hPAR 2

hPAR 3

Helix 2

26/35: C-G - plesiomorphic status in the Ulvales

26/35: C-G => U-G in '*Pseudendoclonium basiliense*'; NHS

27/34: C-G - plesiomorphic status in the Ulvales

27/34: C-G => U-G in *Monostroma arcticum* + *M. nitidum*; HS

27/34: C-G => U-G in Capsosiphonaceae; HS

27/34: C-G => U-G in *Ulva tanneri*; HS

hPAR 4

28/33: C-G - plesiomorphic status in the Ulvales

28/33: C-G => G-C in Kornmanniaceae + Bolbocoleonaceae; NHS

29/32: A-U - plesiomorphic status in the Ulvales

29/32: A-U => G-C in Ulvaceae; NHS

30/31: G-C - plesiomorphic status in the Ulvales

30/31: G-C => C-G in Gomontiaceae excluding *Chamaetrichon capsulatum* and '*Pseudendoclonium basiliense*'; HS

30/31: G-C => C-G in *Acrosiphonia*; HS

30/31: C-G => U-A in *Monostroma*; NHS

30/31: G-G => U-G in '*Pseudendoclonium basiliense*'

30/31: G-C => G-A in *Chamaetrichon capsulatum*

30/31: G-C => G-A in *Capsosiphon groelandicus*

PAR 4

Helix 3

53/122: G-C - plesiomorphic status in the Ulvales

53/122: G-C => A-U in Gomontiaceae (marine/ brackish) + *Ulothrix zonata*; NHS

54/121: U-A - plesiomorphic status in the Ulvales

54/121: U-A => A-U in Kornmanniaceae + Bolbocoleonaceae; HS

54/121: U-A => A-U in *Collinsiella*; HS

54/121: U-G => A-U in *Gloeotilopsis sarcinoidea* UTEX 1710; HS

54/121: U-A => C-G in Ulvaceae; NHS

54/121: U-A => U-G in *Gloeotilopsis* clade; HS

54/121: U-A => U-G in '*Blidingia minima*' AJ000206; HS

54/121: U-A => C-A in '*Blidingia minima*' EF595512

PAR 5

CONV 1

CONV 2

hPAR 5

55/120: U-A - plesiomorphic status in the Ulvales

55/120: U-A => A-U in *Acrosiphonia*; HS

55/120: G-C => A-U in *Kornmannia*; HS

55/120: U-A => G-C in Kornmanniaceae; HS

55/120: U-A => G-C in '*Blidingia minima*'; HS

55/120: U-A => U-G in *Gloeotilopsis sarcinoidea* UTEX 1710; HS

55/120: U-A => U-G in *Monostroma* excluding *M. grevillei* AJ000205; HS

55/120: U-A => U-G in *Ulva* + *Percursaria* + *Ulvaria*; HS

CONV 3

PAR 6

hPAR 6

hREV 1

55/120: U-G => U-A in *Ulva californica* AJ234315; HS

55/120: U-A => U-C in Bolbocoleonaceae

55/120: U-A => G-A in *Pseudoneochloris marina*

55/120: U-A => U-U in *Capsosiphon groelandicus*

55/120: U-A => U-U in '*Umbraulva japonica*'

57/119: A-C - plesiomorphic status in the Ulvales

57/119: ≈6* N-N => N-N (the total number cannot be estimated precisely due to their high substitution frequency) as an example:

57/119: A-C => G-C in *Pseudoneochloris marina*

Helix 3

58/118: C*A or A*A - plesiomorphic status in the Ulvales

58/118: C-G => U-G in *Ulva*; HS - further changes in *Ulva lactuca* clade + *U. muscoides* +

hREV 2

U. taeniata + *U. reticulata* clade + *U. californica* AB280867 +
Ulva sp. EU933983

hPAR 7

58/118: U-G => C-G in *Ulva lactuca* clade + *U. muscoides* + *U. taeniata* + *U. reticulata*

clade + *U. californica* AB280867 + *Ulva* sp. EU933983; HS -
further change in *U. californica* AB280867

hREV 3

58/118: C-G => U-G in *U. californica* AB280867; HS

58/118: C*C => U-G in *Kornmannia*

58/118: C*A => C-G in Ulvaceae

58/118: A*A => C-G in *Pseudoneochloris marina*

59/117: G-C - plesiomorphic status in the Ulvales

59/117: G-C => G-U in *Acrochaete* sp. EF595429; HS

hPAR 8

59/117: G-C => G-U in *Ulva tanneri*; HS

59/117: G-C => G-U in *Ulva flexuosa* + *Ulva californica* AJ234315; HS

59/117: G-C => G-U in *Ulva linza* AJ012276, AJ000203 + *U. prolifera* +

hREV 4

U. lactuca clade + *U. muscoides* + *U. taeniata* +
U. reticulata clade + *U. californica* AB280867 +
Ulva sp. EU933983; HS - further changes in *U. taeniata*,
U. fasciata + *U. pertusa*

hREV 5

59/117: G-U => G-C in *Ulva fasciata* + *Ulva pertusa*; HS

hPAR 9

59/117: G-U => G-C in *Ulva taeniata*; HS

59/117: ≈2* N-N => N*N (the total number cannot be estimated precisely due to their high substitution frequency)
as an example:

59/117: G-C => G*G in *Pseudoneochloris marina*

59/117: G*G => G-U in *Kornmannia*

60/116: C-G - plesiomorphic status in the Ulvales

60/116: C-G => U-G in *Blidingia chadefaudii*; NHS

60/116: C-G => C*C in '*Umbraulva japonica*'

60/116: C-G => C*U in *Acrochaete* sp. EF595429

60/116: C-G => C*U in Bolbocoleonaceae

62/114: U*U or U-G - plesiomorphic status in the Ulvales

62/114: U-G => C-G in Kornmanniaceae; HS

hPAR 10

62/114: U-G => C-G in Ulvaceae; HS

62/114: ≈4* N-N => N*N (the total number cannot be estimated precisely due to their high substitution frequency)
as an example:

62/114: C-G => C*C in *Ulva stenophylla*

62/114: U*U => C-G in Gomontiaceae marine/brackish

62/114: U*U => U-A in '*Blidingia minima*'

63/113: G-C - plesiomorphic status in the Ulvales

63/113: G-C => G-U in *Ulvales* EF595507; HS

hPAR 11

63/113: G-C => G-U in *Acrochaete* sp. EF595429; HS

63/113: G-C => G-U in *Ulva reticulata* clade; HS

63/113: G-C => G*G in *Acrochaete* sp. EF595413, *Acrochaete* sp. EF595372, '*Umbraulva japonica*'

67/110: C-G - plesiomorphic status in the Ulvales

67/110: C-G => U-A in *Kornmannia*; NHS

Helix 3

68/109: **U-G** - plesiomorphic status in the Ulvales

68/109: **U-G** => **C-G** in Bolbocoleonaceae; **NHS**

68/109: **U-G** => **A*G** in Ulvaceae

72/108: **G-C** - plesiomorphic status in the Ulvales

72/108: **G-C** => **G-U** in Capsosiphonaceae + Gomontiaceae; **HS**

72/108: **G-C** => **G-U** in Kornmannia; **HS**

72/108: **G-C** => **G-U** in *Ulva*; **HS** - futher changes in *U. muscoides* + *U. taeniata*

hPAR 12

72/108: **G-U** => **G-C** in *Ulva muscoides* + *Ulva taeniata*; **HS**

hREV 6

73/107: **G-C** - plesiomorphic status in the Ulvales

73/107: **G-C** => **G-U** in *Acrochaete repens*; **NHS**

74/106: **C-G** - plesiomorphic status in the Ulvales

74/106: **C-G** => **U-A** in *Acrochaete heteroclada*; **NHS**

75/105: **A-U** - plesiomorphic status in the Ulvales

75/105: **A-U** => **C-G** in Ulvaceae; **NHS**

75/105: **A-U** => **A*C** in Kornmanniaceae + Bolbocoleonaceae

75/105: **A*C** => **A-U** in Kornmannia

77/103: **C-G** - plesiomorphic status in the Ulvales

77/103: **C-G** => **G*G** in *Pseudoneochloris marina*

78/102: **U-A** - plesiomorphic status in the Ulvales

78/102: **U-A** => **G-C** in Kornmanniaceae; **HS**

78/102: **U-A** => **G-C** in Ulvaceae; **HS**

PAR 7

78/102: **G-C** => **G-U** in '*Umbraulva japonica*', *Acrochaete* sp. EF595429, *Acrochaete* sp. EF595413, *Acrochaete* sp. EF595372; **NHS**

79/101: **G-C** - plesiomorphic status in the Ulvales

79/101: **G-C** => **A-U** in Kornmannia; **NHS**

79/101: **G-C** => **A*C** in *Ulva*, *Ulvaria*, *Percursaria*

80/100: **C-G** - plesiomorphic status in the Ulvales

80/100: **C-G** => **U-G** in *Acrochaete* + '*Umbraulva japonica*'; **NHS**

84/97: **G-C** - plesiomorphic status in the Ulvales

84/97: **G-C** => **G*G** in Ulvaceae

84/97: **G*G** => **G-U** in *Ulva tanneri*

84/97: **G*G** => **G-U** in *Ulva prolifera*, *U. linza* AJ012276, AJ000203

90/93: **A-U** - plesiomorphic status in the Ulvales

90/93: **A-U** => **G-C** in Gomontiaceae (marine/ brackish); **NHS**

90/93: **A-U** => **G-U** in '*Umbraulva japonica*', *Acrochaete* sp. EF595429, *Acrochaete* sp. EF595413, *Acrochaete* sp. EF595372; **NHS**

91/92: **G-C** - plesiomorphic status in the Ulvales

91/92: **G-C** => **G-U** in Gomontiaceae (marine/ brackish); **HS**

91/92: **G-C** => **G-U** in *Urospora* sp. AY476812 + *Urospora wormskioldii*; **HS**

hPAR 13

Helix 3

Helix 3

Helix 4

125/129: **G-C** - plesiomorphic status in the Ulvales

125/129: **G-C** => **A-U** in Gomontiaceae (marine/ brackish); **NHS**

125/129: **G-C** => **G-U** in *Percursaria*; **NHS**

126/128: **G-C** - plesiomorphic status in the Ulvales

126/128: **G-C** => **G-U** in Kornmanniaceae + Bolbocoleonaceae; **HS**

126/128: **G-C** => **G-U** in Gomontiaceae (marine/ brackish) + *Ulothrix zonata*; **HS**

hPAR 14

Helix 4	126/128: G-C => G-U in <i>Acrochaete</i> + ' <i>Umbraulva japonica</i> '; HS	hPAR 14
	126/128: G-C => G-U in <i>Ulva muscoides</i> ; HS	
	126/128: G-C => G-U in <i>Ulva lactuca</i> clade; HS	