

Colour lightness of butterfly assemblages across North America and Europe

– Supporting Information –

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Appendix S1: Editing of databases.

Editing of databases was necessary because of different taxonomic classifications in Brock *et al.* (2003, colouration data, ref. 47) and Scott (1997, distribution data, ref. 55).

- a) Seven contour maps that contained distribution data of two or more subspecies that are classified as species in colouration data were split.

Split distribution maps	Assigned colouration data
<i>Aneae troglodyta</i> ssp. <i>aidea</i> , <i>floridalis</i>	<i>Aneae aidea</i> <i>Aneae troglodyta</i>
<i>Anthanassa frisia</i> ssp. <i>frisia</i> , <i>tulcis</i>	<i>Anthanassa frisia</i> <i>Anthanassa tulcis</i>
<i>Colias scudderi</i> ssp. <i>gigantea</i> , <i>scudderi</i>	<i>Colias gigantea</i> <i>Colias scudderi</i>
<i>Erora laeta</i>	<i>Erora laeta</i> <i>Erora quaderna</i>
<i>Fixenia favonius</i> ssp. <i>ontario</i> , <i>autolycus</i> , <i>ilavia</i>	<i>Satyrium favonius</i> (part) <i>Satyrium ilavia</i>
<i>Papilio glaucus</i> ssp. <i>canadensis</i> , <i>glaucus</i>	<i>Papilio canadensis</i> <i>Papilio glaucus</i>
<i>Plebejus glandon</i>	<i>Plebejus glandon</i> <i>Plebejus podarce</i>

- b) Contour maps of species or subspecies that were combined to assign colouration data of one species.

Combined contour maps	Assigned colouration data
<i>Chlosyne acastus</i> ssp. <i>neumogeni</i> , <i>sabina</i>	<i>Chlosyne acastus</i>
<i>Chlosyne acastus</i> ssp. <i>acastus</i> , <i>vallismortis</i> , <i>dorothyi</i>	
<i>Chlosyne gryneus</i> ssp. <i>gryneus</i> , <i>sweadneri</i>	<i>Chlosyne gryneus</i>
<i>Chlosyne gryneus</i> ssp. <i>siva</i>	
<i>Chlosyne gryneus</i> three ssp. with brown US of HW	
<i>Chlosyne gryneus</i> ssp. <i>thornei</i> , <i>loki</i>	
<i>Euphydryas chalcedona</i> long-valva-prong ssp.	<i>Euphydryas chalcedona</i>
<i>Euphydryas chalcedona</i> short-valva-prong ssp.	
<i>Fixenia favonius</i> ssp. <i>favonius</i>	<i>Satyrium favonius</i>
<i>Fixenia favonius</i> ssp. <i>ontario</i> , <i>autolycus</i> (<i>ilavia</i> excluded)	
<i>Papilio machaon</i> northern ssp.	<i>Papilio machaon</i>
<i>Papilio machaon</i> southern ssp.	
<i>Polygonia gracilis</i> ssp. <i>gracilis</i>	<i>Polygonia gracilis</i>
<i>Polygonia gracilis</i> ssp. <i>zephyrus</i>	

c) Colouration that were averaged to be assigned to the distribution data of a species complex:

Species complex	Assigned colouration data
<i>Apodemia mormo</i> complex	<i>Apodemia mormo</i> <i>Apodemia mejicanus</i> <i>Apodemia virgulti</i> <i>Apodemia duryi</i>
<i>Callophrys affinis</i> complex	<i>Callophrys affinis</i> <i>Callophrys perplexa</i>
<i>Celastrina ladon</i> complex	<i>Celastrina ladon</i> <i>Celastrina neglecta</i> <i>Celastrina idella</i> <i>Celastrina neglectamajor</i>
<i>Colias alexandra</i> complex	<i>Colias alexandra</i> <i>Colias christina</i>
<i>Colias hecla</i> complex	<i>Colias hecla</i> <i>Colias canadiensis</i>
<i>Colias nastes</i> complex	<i>Colias nastes</i> <i>Colias tyche</i>
<i>Erebia disa</i> complex	<i>Erebia disa</i> <i>Erebia mancinus</i>
<i>Erebia mackinleyensis</i> complex	<i>Erebia mackinleyensis</i> <i>Erebia magdalena</i>
<i>Euphilotes battoides</i> complex	<i>Euphilotes battoides</i> <i>Euphilotes baueri</i> <i>Euphilotes bernadino</i> <i>Euphilotes ellisi</i> <i>Euphilotes glaucon</i>
<i>Euphilotes enoptes</i> complex	<i>Euphilotes enoptes</i> <i>Euphilotes mojave</i> <i>Euphilotes ancilla</i>
<i>Neonympha aerolata</i> complex	<i>Neonympha aerolata</i> <i>Neonympha helicta</i>
<i>Pieris oleracea</i> complex	<i>Pieris oleracea</i> <i>Pieris marginalis</i>
<i>Speyeria atlantis</i> complex	<i>Speyeria atlantis</i> <i>Speyeria hesperis</i>

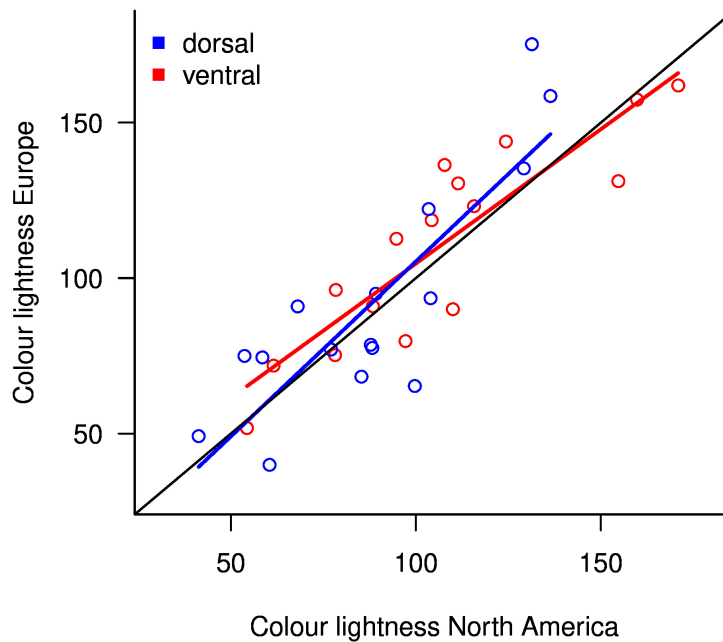
Appendix S2: List of butterfly species of North America.

Lyc a e n i d a e	P l e b e j u s i c a r i o i d e s	C a r i a i n o	N y m p h a l i s a n t i o p a	P a p i l i o t r o i l u s
A t l i d e s h a l e s u s	P l e b e j u s i d a s	C e r c y o n i s m e a d i i	N y m p h a l i s c a l i f o r n i c a	P a p i l i o z e l i c a o n
C a l l o p h r y s a f f i n i s	P l e b e j u s l u p i n u s	C e r c y o n i s o e t u s	N y m p h a l i s v a u a l b u m	P a r n a s s i u s s m i n t h e u s
C a l l o p h r y s a u g u s t i n u s	P l e b e j u s m e l i s s a	C e r c y o n i s p e g a l a	O e n e i s a l b e r t a	
C a l l o p h r y s e r y p h o n	P l e b e j u s n e u r o n a	C e r c y o n i s s t h e n e l e	O e n e i s b o r e	P i e r i d a e
C a l l o p h r y s f o t i s	P l e b e j u s o p t i l e t e	C h l o s y n e a c a s t u s	O e n e i s c h r y x u s	A b a e i s n i c i p p e
C a l l o p h r y s g r y n e u s	P l e b e j u s p o d a r c e	C h l o s y n e c a l i f o r n i c a	O e n e i s j u t t a	A n t e o s c l o r i n d e
C a l l o p h r y s h e n r i c i	P l e b e j u s s a e p i o l u s	C h l o s y n e c y n e a s	O e n e i s m a c o u n i i	A n t e o s m a e r u l a
C a l l o p h r y s h e s s e l i	P l e b e j u s s h a s t a	C h l o s y n e d e f i n i t a	O e n e i s m e l i s s a	A n t h o c h a r i s c e t h u r a
C a l l o p h r y s i r u s	S a t y r i u m a c a d i c a	C h l o s y n e f u l v i a	O e n e i s n e v a d e n s i s	A n t h o c h a r i s l a n c e o l a t a
C a l l o p h r y s j o h n s o n i	S a t y r i u m a u r e t o r u m	C h l o s y n e g a b b i i	O e n e i s p o l i x e n e s	A n t h o c h a r i s m i d e a
C a l l o p h r y s l a n o r a i e n s i s	S a t y r i u m b e h r i i	C h l o s y n e g o r g o n e	O e n e i s u h l e r i	A n t h o c h a r i s s a r a
C a l l o p h r y s m c f a r l a n d i	S a t y r i u m c a l a n u s	C h l o s y n e h a r r i s i i	P a r a m a c e r a a l l y n i	A p h r i s a s t a t i r a
C a l l o p h r y s m o s s i i	S a t y r i u m c a l i f o r n i c a	C h l o s y n e h o f f m a n n i	P h y c i o d e s b a t e s i i	A s c i a m o n u s t e
C a l l o p h r y s n i p h o n	S a t y r i u m c a r y a e v o r u s	C h l o s y n e j a n a i s	P h y c i o d e s c o e y t a	C o l i a s a l e x a n d r a
C a l l o p h r y s p e r p l e x a	S a t y r i u m e d w a r d s i i	C h l o s y n e l a c i n i a	P h y c i o d e s g r a p h i c a	C o l i a s b e h r i i
C a l l o p h r y s p o l i o s	S a t y r i u m f a v o n i u s	C h l o s y n e l e a n i r a	P h y c i o d e s m y l i t t a	C o l i a s c a n a d i e n s i s
C a l l o p h r y s s h e r d a n i i	S a t y r i u m f u l g i n o s a	C h l o s y n e n y c t e i s	P h y c i o d e s o r s e i s	C o l i a s c h r i s t i n a
C a l l o p h r y s s p i n e t o r u m	S a t y r i u m i l a v i a	C h l o s y n e p a l l a	P h y c i o d e s p a l l i d a	C o l i a s e u r y t h e m e
C a l l o p h r y s x a m i	S a t y r i u m k i n g i	C h l o s y n e t h e o n a	P h y c i o d e s p h a o n	C o l i a s g i g a n t e a
C a l y c o p i s c e c r o p s	S a t y r i u m l i p a r o p s	C h l o s y n e w h i t e y i	P h y c i o d e s p i c t a	C o l i a s h a r f o r d i i
C a l y c o p i s i s o b e o n	S a t y r i u m p o l i n g i	C o e n o n y m p h a h a y d e n i i	P h y c i o d e s p u l c h e l l a	C o l i a s h e c l a
C e l a s t r i n a i d e l l a	S a t y r i u m s a e p i u m	C o e n o n y m p h a t u l l i a	P h y c i o d e s t h a r o s	C o l i a s i n t e r i o r
C e l a s t r i n a l a d o n	S a t y r i u m s y l v i n u s	C y l l o p s i s g e m m a	P o l a d r y a s a r a c h n e	C o l i a s m e a d i i
C e l a s t r i n a n e g l e c t a	S a t y r i u m t e t r a	C y l l o p s i s p e r t e p i d a	P o l a d r y a s m i n u t a	C o l i a s n a s t e s
C e l a s t r i n a n e g l e c t a m a j o r	S a t y r i u m t i t u s	D a n a u s e r e s i m u s	P o l y g o n i a c o m m a	C o l i a s p a l a e n o
C u p i d o a m y n t u l a	S t r y m o n a l e a	D a n a u s g i l i p p u s	P o l y g o n i a f a u n u s	C o l i a s p e l i d n e
C u p i d o c o m y n t a s	S t r y m o n a v a l o n a	D a n a u s p l e x i p p u s	P o l y g o n i a g r a c i l i s	C o l i a s p h i l o d i c e
E c h i n a r g u s i s o l a	S t r y m o n i n t a p a	D r y a s i u l i a	P o l y g o n i a i n t e r r o g a t i o n i s	C o l i a s t y c h e
E l e c t r o s t r y m o n a n g e l i a	S t r y m o n m a r t i a l i s	D y m a s i a d y m a s	P o l y g o n i a o r e a s	E u c h l o e a u s o n i d e s
E r o r a l a e t a	S t r y m o n m e l i n u s	E m e s i s a r e s	P o l y g o n i a p r o g n e	E u c h l o e c r e u s a
E r o r a q u a d e r m a	Z i z u l a c y n a	E m e s i s z e l a	P o l y g o n i a s a t y r u s	E u c h l o e l o t t a
E u m a e u s a t a l a		E n o d i a a n t h e d o n	S a t y r o d e s a p p a l a c h i a	E u c h l o e o l y m p i a
E u p h i l o t e s a n c i l l a	N y m p h a l i d a e	E n o d i a p o r t l a n d i a	S a t y r o d e s e u r y d i c e	E u r e m a b o i s d u v a l i a n a
E u p h i l o t e s b a t t o i d e s	A d e l p h a b r e d o w i i	E r e b i a c a l l i a s	S i p r o e t a s t e l e n e s	E u r e m a d a i r a
E u p h i l o t e s b a u e r i	A g l a i s m i l b e r t i	E r e b i a d i s a	S p e y e r i a a d i a s t e	E u r e m a m e x i c a n a
E u p h i l o t e s b e r n a d i n o	A g r a u l i s v a n i l l a e	E r e b i a d i s c o i d a l i s	S p e y e r i a a p h r o d i t e	E u r e m a s a l o m e
E u p h i l o t e s e l l i s i	A n a r t i a j a t r o p h a e	E r e b i a f a s c i a t a	S p e y e r i a a t l a n t i s	G a n y r a j o s e p h i n a
E u p h i l o t e s e n o p t e s	A n e a e a i d e a	E r e b i a l a f o n t a i n e i	S p e y e r i a c a l l i p p e	K r i c o g o n i a l y s i d e
E u p h i l o t e s g l a u c o n	A n e a e a n d r i a	E r e b i a m a c k i n l e y e n s i s	S p e y e r i a c o r o n i s	N a t h a l i s i o l e
E u p h i l o t e s m o j a v e	A n t h a n a s s a f r i s i a	E r e b i a m a g d a l e n a	S p e y e r i a c y b e l e	N e o p h a s i a t e r l o o i i
E u p h i l o t e s r i t a	A n t h a n a s s a t e x a n a	E r e b i a m a n c i n u s	S p e y e r i a d i a n a	P h o e b i s a g a r i t h e
E u p h i l o t e s s p a l d i n g i	A n t h a n a s s a t u l c i s	E r e b i a o c c u l t a	S p e y e r i a e d w a r d s i i	P h o e b i s p h i l e a
F e n i s e c a t a r q u i n i u s	A p o d e m i a d u r y i	E r e b i a p a w l o s k i i	S p e y e r i a e g l e i s	P h o e b i s s e n n a e
G l a u c o p s y c h e l y g d a m u s	A p o d e m i a h e p b u r n i	E r e b i a r o s s i i	S p e y e r i a h e s p e r i s	P i e r i s m a r g i n a l i s
H a b r o d a i s g r u n u s	A p o d e m i a m e j i c a n u s	E r e b i a v i d l e r i	S p e y e r i a h y d a s p e	P i e r i s o l e r a c e a
H e m i a r g u s c e r a u n u s	A p o d e m i a m o r m o	E r e b i a y o u n g i	S p e y e r i a i d a l i a	P i e r i s r a p a e
H y p o s t r y m o n c r i t o l a	A p o d e m i a n a i s	E u n i c a m o n i m a	S p e y e r i a m o r m o n i a	P i e r i s v i r g i n i e n s i s
L e p t o t e s c a s s i u s	A p o d e m i a p a l m e r i	E u n i c a t a t i l a	S p e y e r i a n o k o m i s	P o n t i a b e c k e r i i
L e p t o t e s m a r i n a	A p o d e m i a v i r g u l t i	E u p h y d r y a s c h a l c e d o n a	S p e y e r i a z e r e n e	P o n t i a o c c i d e n t a l i s
L y c a e n a a r o t a	A s t e r o c a m p a c e l t i s	E u p h y d r y a s e d i t h a	T e x o l a e l a d a	P o n t i a p r o t o d i c e
L y c a e n a c u p r e u s	A s t e r o c a m p a c l y t o n	E u p h y d r y a s g i l l e t t i i	V a n e s s a a n n a b e l l a	P o n t i a s i s y m b r i i
L y c a e n a d i o n e	A s t e r o c a m p a l e i l i a	E u p h y d r y a s p h a e t o n	V a n e s s a a t a l a n t a	P y r i s i t i a d i n a
L y c a e n a d o r c a s	B i b l i s h y p e r i a	E u p t o i e t a c l a u d i a	V a n e s s a c a r d u i	P y r i s i t i a l i s a
L y c a e n a e d i t h a	B o l o r i a a l a s k e n s i s	E u p t o i e t a h e g e s i a	V a n e s s a v i r g i n i e n s i s	P y r i s i t i a n i s e
L y c a e n a g o r g o n	B o l o r i a a l b e r t a	G y r o c h e i l u s p a t r o b a s		P y r i s i t i a p r o t e r p i a
L y c a e n a h e l l o i d e s	B o l o r i a a s t a r t e	H e l i c o n i u s c h a r i t h o n i a	P a p i l i o n i d a e	Z e r e n e c e s o n i a
L y c a e n a h e r m e s	B o l o r i a b e l l o n a	H e r m e u p t y c h i a s o s y b i u s	B a t t u s p h i l e n o r	Z e r e n e e u r y d i c e
L y c a e n a h e t e r o n e a i	B o l o r i a c h a r i c l e a	J u n o n i a c o e n i a	B a t t u s p o l y d a m a s	
L y c a e n a h y l l u s	B o l o r i a e p i t h o r e	J u n o n i a e v a r e t e	E u r y t h i d e s m a r c e l l u s	
L y c a e n a m a r i p o s a	B o l o r i a e u n o m i a	J u n o n i a g e n o v e v a	P a p i l i o a n d r a e m o n	
L y c a e n a n i v a l i s	B o l o r i a f r e j a	L i b y t h e a n a c a r i n e n t a	P a p i l i o a n d r o g e u s	
L y c a e n a p h l a e a s	B o l o r i a f r i g g a	L i m e n i t i s a r c h i p p u s	P a p i l i o a r i s t o d e m u s	
L y c a e n a r u b i d u s	B o l o r i a i m p r o b a	L i m e n i t i s a r t h e m i s	P a p i l i o b r e v i c a u d a	
L y c a e n a x a n t h o i d e s	B o l o r i a k r i e m h i l d	L i m e n i t i s l o r q u i n i	P a p i l i o c a n a d e n s i s	
M i n i s t r y m o n a z i a	B o l o r i a n a t a z h a t i	L i m e n i t i s w e i d e m e y e r i i	P a p i l i o c r e s p h o n t e s	
M i n i s t r y m o n c l y t i e	B o l o r i a p o l a r i s	M a r p e s i a p e t r e u s	P a p i l i o e u r y m e d o n	
M i n i s t r y m o n l e d a	B o l o r i a s e l e n e	M e g i s t o c y m e l a	P a p i l i o g l a u c u s	
P a r r h a s i u s m - a l b u m	C a l e p h e l i s a r i z o n e n s i s	M e g i s t o r u b r i c a t a	P a p i l i o i n d r a	
P h a e o s t r y m o n a l c e s t i s	C a l e p h e l i s b o r e a l i s	M e m p h i s g l y c e r i u m	P a p i l i o m a c h a o n	
P h i l o t e s s o n o r e n s i s	C a l e p h e l i s m u t i c u m	M e s t r a a m y m o n e	P a p i l i o m u l t i c a u d a t a	
P h i l o t i e l l a s p e c i o s a	C a l e p h e l i s n e m e s i s	N e o m i n o i s r i d i n g s i i	P a p i l i o o m y t h i o n	
P l e b e j u s a c m o n	C a l e p h e l i s p e r d i t a l i s	N e o n y m p h a a r e o l a t a	P a p i l i o p a l a m e d e s	
P l e b e j u s e m i g d i o n i s	C a l e p h e l i s v i r g i n i e n s i s	N e o n y m p h a h e l i c t a	P a p i l i o p o l y x e n e s	
P l e b e j u s g l a n d o n	C a l e p h e l i s w r i g h t i	N e o n y m p h a m i t c h e l l i i	P a p i l i o r u t u l u s	

Appendix S3: List of butterfly species of Europe.

Lyc a e n i d a e	P s e u d a r i c i a n i c i a s	E r e b i a a l b e r g a n u s	M e l a n a r g i a a r g e	A r t o g e i a k r u e p e r i
Agriades glandon	P s e u d o p h i l o t e s a b e n c e r r a g	E r e b i a c a l c a r i a	M e l a n a r g i a g a l a t h e a	A r t o g e i a m a n n i i
Agro diaetus admetus	P s e u d o p h i l o t e s b a r b a g i a e	E r e b i a c a s s i o i d e s	M e l a n a r g i a i n e s	A r t o g e i a n a p i
Agro diaetus ainsae	P s e u d o p h i l o t e s b a t o n	E r e b i a c h r i s t i	M e l a n a r g i a l a c h e s i s	A r t o g e i a r a p a e
Agro diaetus amanda	P s e u d o p h i l o t e s b a v i u s	E r e b i a c l a u d i n a	M e l a n a r g i a l a r i s s a	C o l i a s a l f a c a r i e n s i s
Agro diaetus aroaniensis	P s e u d o p h i l o t e s p a n o p t e s	E r e b i a d i s a	M e l a n a r g i a o c c i t a n i c a	C o l i a s a u r o r i n a
Agro diaetus damon	P s e u d o p h i l o t e s v i c r a m a	E r e b i a e m b l a	M e l a n a r g i a r u s s i a e	C o l i a s c a u c a s i a
Agro diaetus dolus dolus	Q u e r c u s i a q u e r c u s	E r e b i a e p i p h r o n	M e l i t a e a a e t h e r i c a	C o l i a s c h r y s o t h e m e
Agro diaetus escheri	S a t y r i u m a c a c i a e	E r e b i a e p i s t y g n e	M e l i t a e a a r d u i n n a	C o l i a s c r o c e a
Agro diaetus fabressei	S a t y r i u m e s c u l i	E r e b i a e r i p h y l e	M e l i t a e a c i n x i a	C o l i a s e r a t e
Agro diaetus galloi	S a t y r i u m i l i c i s	E r e b i a e u r y a l e	M e l i t a e a d i a m i n a	C o l i a s h e c l a
Agro diaetus humedasa	S a t y r i u m p r u n i	E r e b i a f l a v o f a s c i a t a	M e l i t a e a d i d y m a	C o l i a s h y a l e
Agro diaetus iphigenia	S a t y r i u m s p i n i	E r e b i a g o r g e	M e l i t a e a p h o e b e	C o l i a s m y r m i d o n e
Agro diaetus nephohtamen	S a t y r i u m w a l b u m	E r e b i a g o r g o n e	M e l i t a e a t r i v i a	C o l i a s n a s t e s
Agro diaetus pyrenaicus	S c o l i t a n t i d e s o r i o n	E r e b i a h i s p a n i a	M e l l i c t a a s t e r i a	C o l i a s p a l a e n o
Agro diaetus ripartii ripartii	T a r u c u s b a l c a n i c u s	E r e b i a l e f e b v r e i	M e l l i c t a a t h a l i a	C o l i a s p h i c o m o n e
Agro diaetus thersites	T a r u c u s t h e o p h r a s t u s	E r e b i a l i g e a	M e l l i c t a a u r e l i a	C o l o t i s e v a g o r e
Agro diaetus violeta	T h e c l a b e t u l a e	E r e b i a m a n t o	M e l l i c t a b r i t o m a r t i s	E l p h i n s t o n i a p e n i a
Albulina orbitulus	T o m a r e s b a l l u s	E r e b i a m e d u s a	M e l l i c t a d e i o n e	E u c h l o e a u s o n i a
Aricia agestis	T o m a r e s n o g e l i i	E r e b i a m e l a m p u s	M e l l i c t a p a r t h e n o i d e s	E u c h l o e b e l e m i a
Aricia artaxerxes	T u r a n a n a e n d y m i o n	E r e b i a m e l a s	M e l l i c t a v a r i a	E u c h l o e i n s u l a r i s
Aricia morronensis	U l t r a a r i c i a a n t e r o s	E r e b i a m e o l a n s	M i n o i s d r y a s	E u c h l o e t a g i s
Cacyreus marshalli	V a c c i n i i n a o p t i l e t e	E r e b i a m n e s t r a	N e o h i p p a r c h i a f a t u a	G o n e p t e r y x c l e o p a t r a
Callophrys avis	Z i z e e r i a k n y s n a	E r e b i a m o n t a n a	N e o h i p p a r c h i a s t a t i l i n u s	G o n e p t e r y x f a r i n o s a
Callophrys rubi		E r e b i a n e o r i d a s	N e p t i s r i v u l a r i s	G o n e p t e r y x r h a m n i
Celastrina argiolus	N y m p h a l i d a e	E r e b i a n i v a l i s	N e p t i s s a p p h o	L e p t i d e a d u p o n c h e l i
Chilades trochylus	A g l a i s u r t i c a e	E r e b i a o e m e	N y m p h a l i s a n t i o p a	L e p t i d e a m o r s e i
Cupido carswelli	A p a t u r a i l i a	E r e b i a o r i e n t a l i s	N y m p h a l i s p o l y c h l o r u s	L e p t i d e a s i n a p i s - r e a l i
Cupido lorquini	A p a t u r a i r i s	E r e b i a o t t o m a n a	N y m p h a l i s v a u a l b u m	P i e r i s b r a s s i c a e
Cupido minimus	A p a t u r a m e t i s	E r e b i a p a l a r i c a	N y m p h a l i s x a n t h o m e l a s	P o n t i a c a l l i d i c e
Cupido oiris	A p h a n t o p u s h y p e r a n t u s	E r e b i a p a n d r o s e	O e n e i s b o r e	P o n t i a c h l o r i d i c e
Cyaniris semiargus	A r a s c h n i a l e v a n a	E r e b i a p h a r t e	O e n e i s g l a c i a l i s	P o n t i a d a p l i d i c e - e d u s a
Eumedonia eumedon	A r e t h u s a n a a r e t h u s a	E r e b i a p l u t o	O e n e i s j u t t a	Z e g r i s e u p h e m e
Everes alcetas	A r g y n n i s a d i p p e	E r e b i a p o l a r i s	O e n e i s n o r m a	
Everes argiades	A r g y n n i s a g l a j a	E r e b i a p r o n o e	P a r a r g e a e g e r i a	
Everes decoloratus	A r g y n n i s e l i s a	E r e b i a r h o d o p e n s i s	P o l y g o n i a c - a l b u m	
Glauco ps yche alexis	A r g y n n i s l a o d i c e	E r e b i a s c i p i o	P o l y g o n i a e g e a	
Glauco ps yche melanops	A r g y n n i s n i o b e	E r e b i a s t h e n n y o	P r o c l o s s i a n a e u n o m i a	
Iolana iolas	A r g y n n i s p a n d o r a	E r e b i a s t i r i u s	P r o t e r e b i a a f r a	
Kretania eurypilus	A r g y n n i s p a p h i a	E r e b i a s t y x	P s e u d o c h a z a r a a n t h e l e a	
Kretania psylorita	B o l o r i a a q u i l o n a r i s	E r e b i a s u d e t i c a	P s e u d o c h a z a r a c i n g o v s k i i	
Laeops is roboris	B o l o r i a g r a e c a	E r e b i a t r i a r i a	P s e u d o c h a z a r a g e y e r i	
Lampides boeticus	B o l o r i a n a p a e a	E r e b i a t y n d a r u s	P s e u d o c h a z a r a g r a e c a	
Leptotes pirithous	B o l o r i a p a l e s	E r e b i a z a p a t e r i	P s e u d o c h a z a r a o r e s t e s	
Lycaena alciphron	B r e n t h i s d a p h n e	E u r o d r y a s a u r i n i a	P s e u d o t e r g u m i a f i d i a	
Lycaena candens	B r e n t h i s h e c a t e	E u r o d r y a s d e s f o n t a i n i i	P y r o n i a b a t h s e b a	
Lycaena dispar	B r e n t h i s i n o	H i p p a r c h i a a l c y o n e	P y r o n i a c e c i l i a	
Lycaena helle	C h a r a x e s j a s i u s	H i p p a r c h i a a r i s t a e u s	P y r o n i a t i t h o n u s	
Lycaena hippothoe	C h a z a r a b r i s e i s	H i p p a r c h i a c r e t i c a	S a t y r u s a c t a e a	
Lycaena otto mana	C h a z a r a p r i e u r i	H i p p a r c h i a f a g i	S a t y r u s f e r u l a	
Lycaena phlaeas	C l o s s i a n a c h a r i c l e a	H i p p a r c h i a n e o m i r i s	V a n e s s a a t a l a n t a	
Lycaena thersamon	C l o s s i a n a d i a	H i p p a r c h i a s e m e l e	V a n e s s a c a r d u i	
Lycaena thetis	C l o s s i a n a e u p h o r y s n e	H i p p a r c h i a s y r i a c a	V a n e s s a v i r g i n i e n s i s	
Lycaena tityrus	C l o s s i a n a f r e i j a	H i p p a r c h i a v o l g e n i s		
Lycaena virgaureae	C l o s s i a n a f r i g g a	H y p o d r y a s c y n t h i a	P a p i l i o n i d a e	
Lysandra albicans	C l o s s i a n a p o l a r i s	H y p o d r y a s i d u n a	A r c h o n a p o l l i n u s	
Lysandra bellargus	C l o s s i a n a s e l e n e	H y p o d r y a s i n t e r m e d i a	I p h i c l i d e s p o d a l i r i u s	
Lysandra coridon	C l o s s i a n a t h o r e	H y p o d r y a s m a t u r n a	P a p i l i o a l e x a n o r	
Lysandra hispana	C l o s s i a n a t i t a n i a	H y p o n e p h e l e l u p i n a	P a p i l i o h o s p i t o n	
Maculinea alcon	C o e n o n y m p h a a r c a n i a	H y p o n e p h e l e l y c a o n	P a p i l i o m a c h a o n	
Maculinea arion	C o e n o n y m p h a c o r i n n a	I n a c h i s i o	P a m a s s i u s a p o l l o	
Maculinea nausithous	C o e n o n y m p h a d o r u s	I s s o r i a l a t h o n i a	P a m a s s i u s m n e m o s y n e	
Maculinea telejus	C o e n o n y m p h a g a r d e t t a	K a n e t i s a c i r c e	P a m a s s i u s p h o e b u s	
Meleageria daphnis	C o e n o n y m p h a g l y c e r i o n	K i r i n i a c l i m e n e	Z e r y n t h i a c e r i s y	
Neolysandra coelestina	C o e n o n y m p h a h e r o	K i r i n i a r o x e l a n a	Z e r y n t h i a p o l y x e n a	
P lebejus argus	C o e n o n y m p h a l e a n d e r	L a s i o m m a t a m a e r a	Z e r y n t h i a r u m i n a	
P lebejus argyrognomon	C o e n o n y m p h a o e d i p p u s	L a s i o m m a t a m e g e r a		
P lebejus idas	C o e n o n y m p h a p a m p h i l u s	L a s i o m m a t a p e t r o p o l i t a r	P i e r i d a e	
P lebejus pylaon	C o e n o n y m p h a r h o d o p e n s i s	L i b y t h e a c e l t i s	A n t h o c h a r i s b e l i a	
P lebicula dorylas	C o e n o n y m p h a t h y r s i s	L i m e n i t i s c a m i l l a	A n t h o c h a r i s c a r d a m i n e s	
P lebicula golgus	C o e n o n y m p h a t u l l i a	L i m e n i t i s p o p u l i	A n t h o c h a r i s d a m o n e	
P lebicula nivescens	D a n a u s c h r y s i p p u s	L i m e n i t i s r e d u c t a	A n t h o c h a r i s g r u n e r i	
Polyommatus eroides	D a n a u s p l e x i p p u s	L o p i n g a a c h i n e	A p o r i a c r a t a e g i	
Polyommatus eros	E r e b i a a e t h i o p e l l a	M a n i o l a j u r t i n a	A r t o g e i a b r y o n i a e	
Polyommatus icarus	E r e b i a a e t h i o p s	M a n i o l a n u r a g	A r t o g e i a e r g a n e	

Appendix S4: Correlation of colour lightness data of North America and Europe.



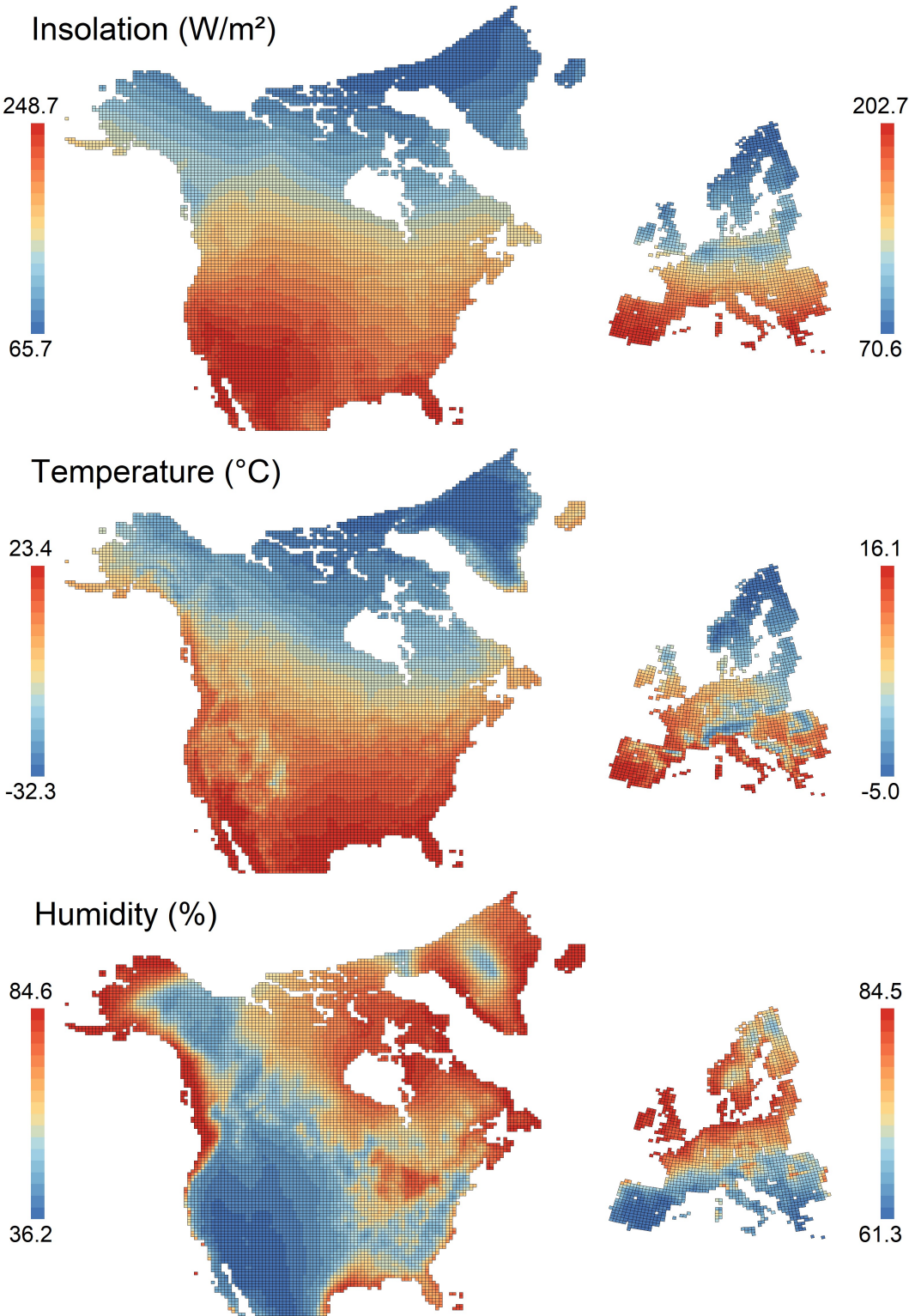
Dorsal and ventral images of 16 butterfly species were depicted in both Brock *et al.* (2003, ref. 47) and Tolman & Lewington (2009, ref. 48). Colour lightness values of the two sources were highly correlated (major axis regression: dorsal $r^2 = 0.96$, ventral $r^2 = 0.98$, $p < 0.001$) and the slopes did not differ from 1 (lines forced through the origin, $p > 0.05$, R package *smatr*).

Species: *Coenonympha tullia*, *Colias hecla*, *Colias nastes*, *Colias palaeno*, *Danaus plexippus*, *Erebia disa*, *Lycaena phlaeas*, *Nymphalis antiopa*, *Nymphalis vaualbum*, *Oeneis bore*, *Oeneis jutta*, *Papilio machaon*, *Plebejus idas*, *Vanessa atalanta*, *Vanessa cardui*, *Vanessa virginiensis*.

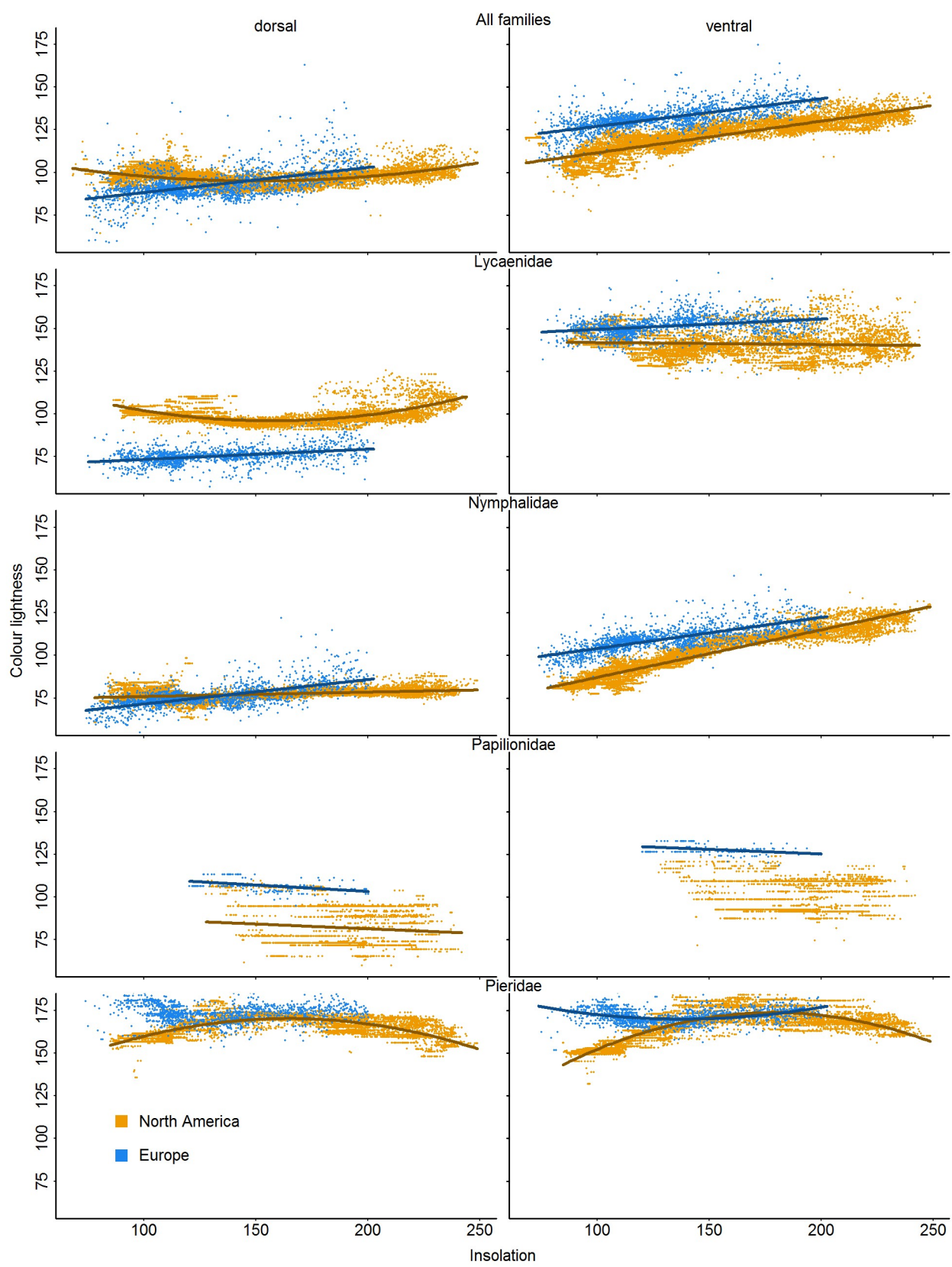
Appendix S5: Number of species and grid cells (butterfly assemblages) in North America and Europe. The number of grid cells with at least five species, which were used in the statistical analysis, are also given. Number of species does not differ between datasets containing grids cells with all species and at least five species, except for European Papilionids where one species (*Papilio hospiton*) dropped out.

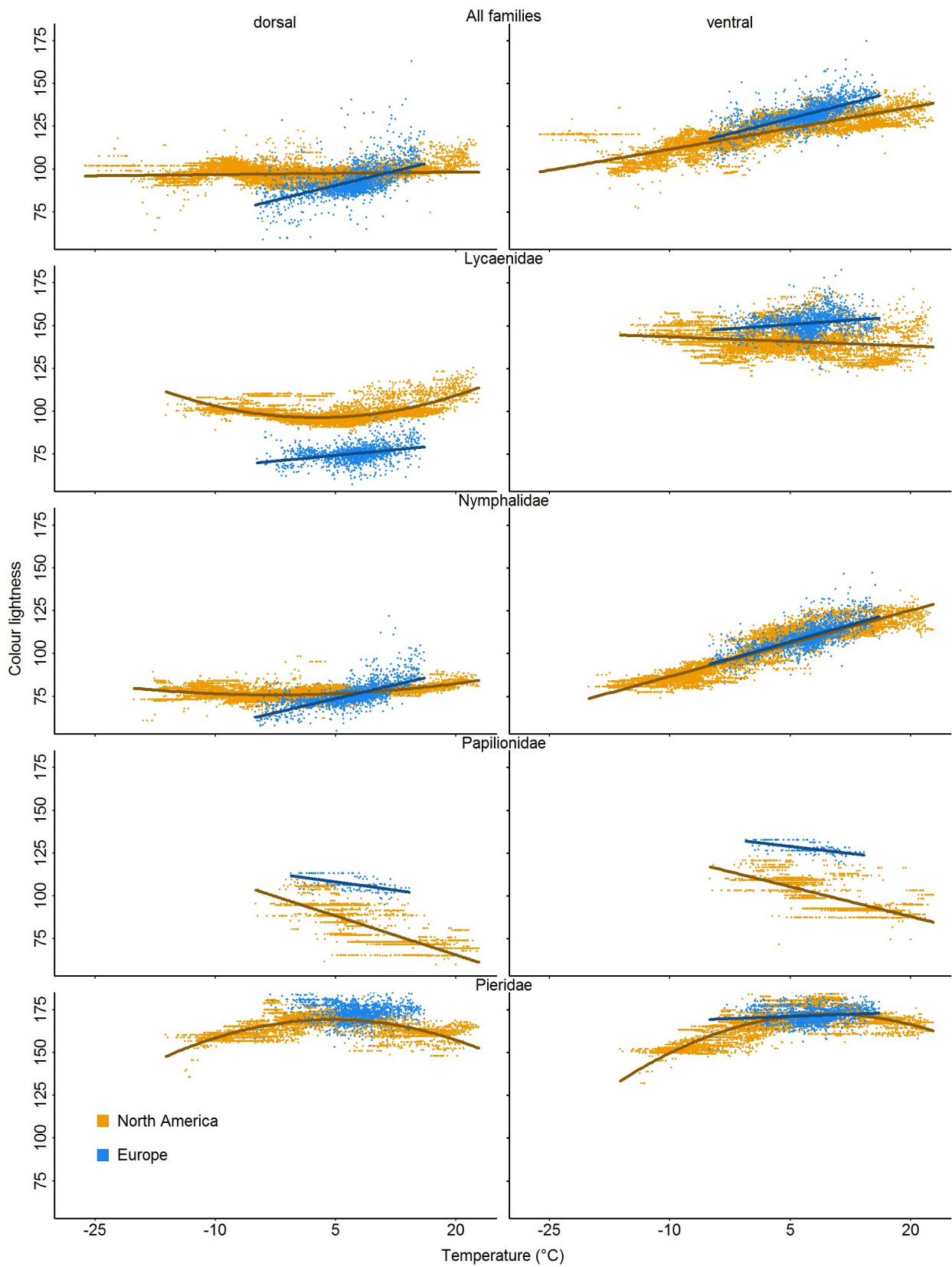
Family	North America			Europe		
	Species	Grid cells		Species	Grid cells	
		All species	≥ 5 species		All species	≥ 5 species
All	330	9,220	8,499	326	1,939	1,840
Lycaenidae	96	8,686	6,526	98	1,870	1,546
Nymphalidae	164	9,160	8,274	177	1,899	1,757
Papilionidae	21	6,824	2,364	11	1,418	169
Pieridae	49	9,128	5,971	40	1,856	1,465

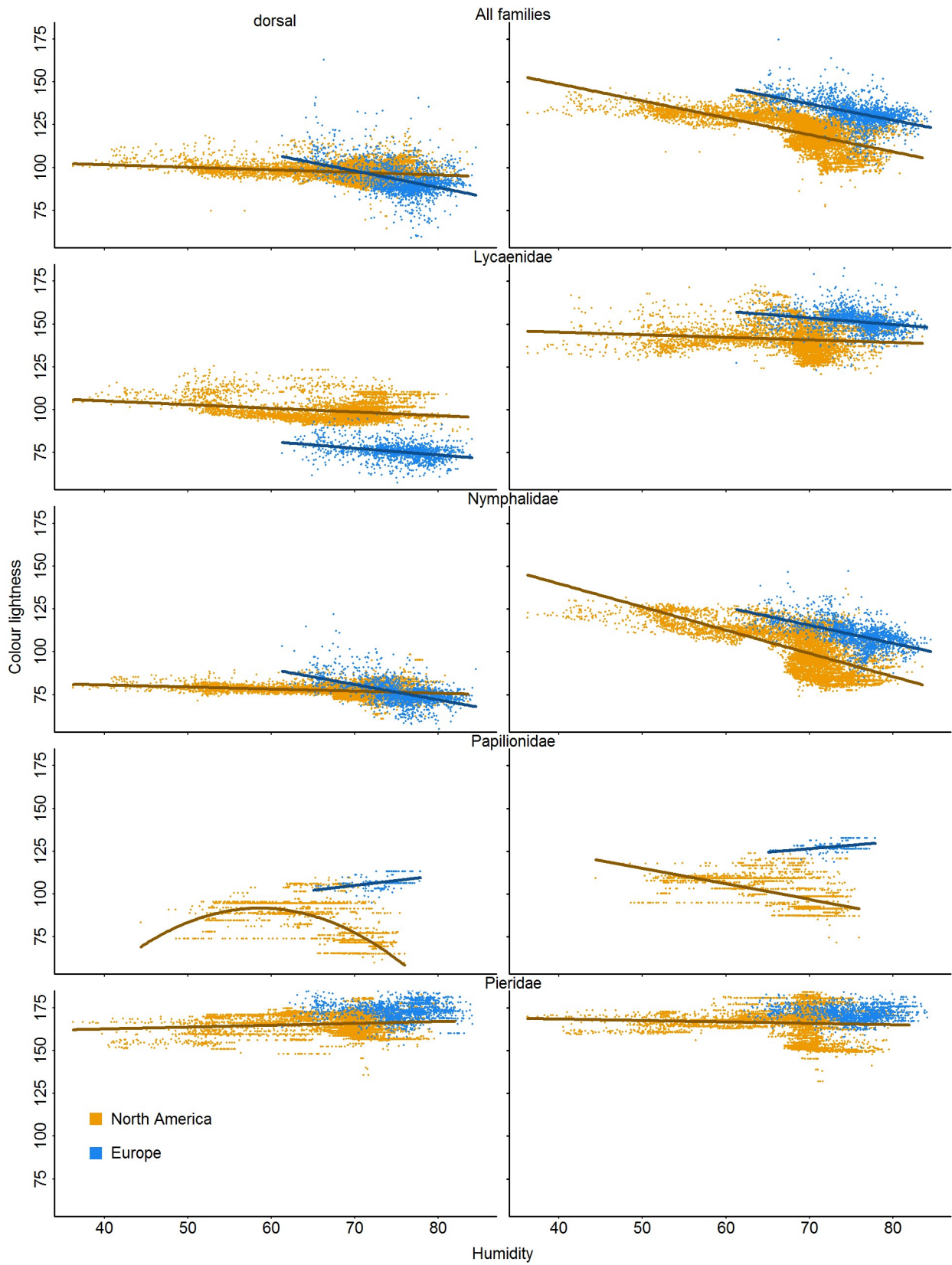
Appendix S6: Maps of environmental variables.



Appendix S7: The effect of the environmental variables insolation, temperature and humidity on the colour lightness of butterfly families. Shown are scatterplots and regressions.







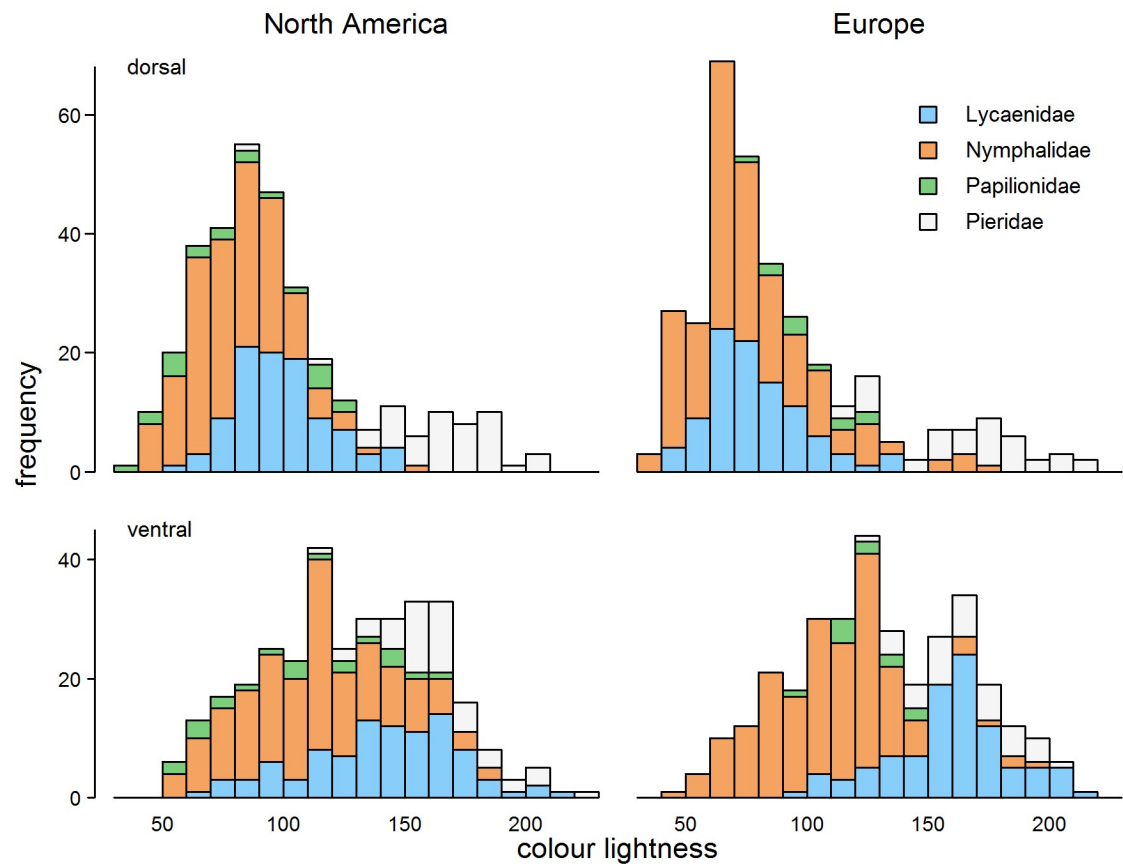
Appendix S8: Statistics of linear and quadratic generalized least-squares regressions between the colour lightness of butterfly assemblages across North America and Europe and the three potential environmental drivers temperature, insolation and humidity. Models were fitted with a Gaussian spatial correlation structure of geographical coordinates to account for spatial autocorrelation. Models were computed for the complete datasets of each continent and separately for the major butterfly families. Direction of the effects (+/–) and r^2 values are given for each model. If Δr^2 (quadratic r^2 – linear r^2) was > 0.1 , a quadratic shape (U- or hump-shaped) of the relationship was assumed; otherwise a linear shape was assumed, as also indicated by the inserted pictograms. Only assemblages with at least five species were included in this analysis. Level of significance was set to 0.001 (n.s. = not significant). Highest r^2 values for the assumed relationship in each family and continent are highlighted in bold. Different shapes of the relationships compared with the results presented in Table 1 of the main text are highlighted in grey.

Variable	Family	Side	North America				Europe			
			Linear r^2	Quadratic r^2	Δ r^2	Shape	Linear r^2	Quadratic r^2	Δ r^2	Shape
INSOLATION	All	Dorsal	+ 0.00	+ 0.07	0.07		+ 0.15	+ 0.17	0.01	
		Ventral	+ 0.42	- 0.43	0.01		+ 0.29	- 0.29	0.00	
	Lycaenidae	Dorsal	+ 0.02	+ 0.15	0.13		+ 0.08	+ 0.09	0.01	
		Ventral	- 0.00	+ 0.03	0.03		+ 0.05	- 0.07	0.02	
	Nymphalidae	Dorsal	+ 0.05	+ 0.09	0.04		+ 0.27	+ 0.27	0.00	
		Ventral	+ 0.68	- 0.71	0.03		+ 0.36	- 0.37	0.01	
	Papilionidae	Dorsal	- 0.01	+ 0.03	0.02		- 0.11	+ 0.11	0.00	
		Ventral	- 0.00	+ 0.05	0.05		- 0.09	- 0.09	0.00	
	Pieridae	Dorsal	+ 0.00	- 0.25	0.25		n.s.	+ 0.04	0.04	
		Ventral	+ 0.17	- 0.44	0.27		n.s.	+ 0.06	0.05	
TEMPERATURE	All	Dorsal	+ 0.01	+ 0.03	0.02		+ 0.17	+ 0.22	0.04	
		Ventral	+ 0.34	- 0.34	0.00		+ 0.29	+ 0.29	0.01	
	Lycaenidae	Dorsal	+ 0.02	+ 0.16	0.14		+ 0.07	+ 0.11	0.04	
		Ventral	- 0.01	+ 0.01	0.00		+ 0.03	- 0.03	0.00	
	Nymphalidae	Dorsal	+ 0.04	+ 0.10	0.06		+ 0.29	+ 0.33	0.04	
		Ventral	+ 0.57	- 0.57	0.00		+ 0.33	+ 0.34	0.01	
	Papilionidae	Dorsal	- 0.24	+ 0.24	0.00		- 0.15	- 0.16	0.01	
		Ventral	- 0.19	+ 0.19	0.00		- 0.15	n.s.	0.00	
	Pieridae	Dorsal	+ 0.00	- 0.21	0.21		n.s.	+ 0.01	0.01	
		Ventral	+ 0.19	- 0.35	0.16		+ 0.01	+ 0.02	0.01	
HUMIDITY	All	Dorsal	- 0.01	+ 0.02	0.01		- 0.10	+ 0.14	0.04	
		Ventral	- 0.19	- 0.20	0.01		- 0.14	+ 0.15	0.01	
	Lycaenidae	Dorsal	- 0.02	+ 0.05	0.03		- 0.06	+ 0.07	0.00	
		Ventral	- 0.01	+ 0.01	0.00		- 0.04	- 0.05	0.01	
	Nymphalidae	Dorsal	- 0.02	+ 0.02	0.00		- 0.15	+ 0.18	0.02	
		Ventral	- 0.24	- 0.25	0.01		- 0.17	+ 0.17	0.00	
	Papilionidae	Dorsal	- 0.10	- 0.14	0.04		+ 0.10	+ 0.11	0.01	
		Ventral	- 0.11	- 0.13	0.02		+ 0.07	+ 0.09	0.01	
	Pieridae	Dorsal	+ 0.00	- 0.01	0.01		n.s.	n.s.	0.00	
		Ventral	- 0.00	- 0.01	0.01		n.s.	+ 0.02	0.02	

Appendix S9: Comparisons between dorsal and ventral colour lightness.

Family	Study region	Dorsal	Ventral	df	t	p
All	North America	98.12	127.55	657.89	-10.61	< 0.001
	Europe	89.22	130.95	647.38	-14.40	< 0.001
Lycaenidae	North America	99.21	140.57	156.82	-11.03	< 0.001
	Europe	78.92	159.11	184.64	-25.30	< 0.001
Nymphalidae	North America	79.44	109.84	265.19	-10.66	< 0.001
	Europe	76.85	108.08	351.72	-10.83	< 0.001
Papilionidae	North America	80.86	104.86	38.08	-2.37	< 0.05
	Europe	100.82	123.68	19.85	-3.63	< 0.01
Pieridae	North America	165.35	163.03	95.42	0.51	0.608
	Europe	166.05	165.20	71.79	0.16	0.88

Appendix S10: Histograms of colour lightness values.



Distribution of colour lightness values separated according to study region, dorsal and ventral side, and butterfly families.