Appendix B

As a property of the definition of covariance $\sigma(aX, bY) = ab\,\sigma(x, y)$
and $\sigma(x + a, y) = \sigma\,(x, y)$, where *a* and *b* are constants,

$S_{12\,within}$ refers to selection differentials estimated from within treatment standardized trait (*z*) values and within treatment relative fitness (*w*) values.
Therefore,

$$1)\ S_{12\,within} = \sigma\left(\left(\frac{z-\bar{z}_{12}}{\sigma_{12}}\right), \frac{w}{\bar{W}_{12}}\right)$$

where *z* and *w* are individual trait and fitness values respectively; $\bar{z}_{12}$ is the mean trait *z* in treatment 12, where both interacting species are present; σ_{12} is the standard deviation of trait *z* in treatment 12, and $\bar{W}_{12}$ is the mean fitness (*w*) in treatment 12.

$$2)\ \sigma\left\{\left(\frac{z-\bar{z}_{12}}{\sigma_{12}}\right), \frac{w}{\bar{W}_{12}}\right\} = \sigma\left\{\left(\frac{z}{\sigma_{12}} - \left(\frac{\bar{z}_{12}}{\sigma_{12}}\right)\right), \frac{w}{\bar{W}_{12}}\right\}$$

$\bar{z}_{12}$, σ_{12}, and $\bar{W}_{12}$ are effectively constants. Therefore,

$$3)\ \sigma\left\{\left(\frac{z}{\sigma_{12}}\right) - \left(\frac{\bar{z}_{12}}{\sigma_{12}}\right), \frac{w}{\bar{W}_{12}}\right\} = \left(\frac{1}{\sigma_{12}}\right)\left(\frac{1}{\bar{W}_{12}}\right)\sigma(z, w)$$

Similarly, $S_{12\,across}$ refers to selection differentials estimated from trait values and fitness that have been standardized and relativized across all treatments. Therefore,

$$4)\ S_{12\,across} = \sigma\left\{\left(\frac{z-\bar{z}}{\sigma_z}\right), \frac{w}{\bar{W}}\right\}$$

Where *z* and *w* are individual trait values and fitnesses in treatment 12 as in 1) above; $\bar{z}$ is the grand mean trait value averaged across all individuals in the experiment; σ_z is the standard deviation of trait *z* across the entire experiment, and $\bar{W}$ is the grand mean fitness averaged across all individuals in the experiment.

$$5)\ \sigma\left\{\left(\frac{z-\bar{z}}{\sigma_z}\right), \frac{w}{\bar{W}}\right\} = \sigma\left\{\left(\frac{z}{\sigma_z} - \frac{\bar{z}}{\sigma_z}\right), \frac{w}{\bar{W}}\right\}$$

$\bar{z}$, σ_z, and $\bar{W}$ are effectively constants. Therefore:

$$6)\ \sigma\left\{\left(\frac{z}{\sigma_z} - \frac{\bar{z}}{\sigma_z}\right), \frac{w}{\bar{W}}\right\} = \left(\frac{1}{\sigma_z}\right)\left(\frac{1}{\bar{W}}\right)\sigma(z, w)$$

Equations 3 and 6 can now be used to convert $S_{12\,across}$ into the more conventional $S_{12\,within}$

$S_{12\,within} = \left(\frac{1}{\sigma_{12}}\right)\left(\frac{1}{\bar{W}_{12}}\right)\sigma(z, w)$ and $S_{12\,across} = \left(\frac{1}{\sigma_z}\right)\left(\frac{1}{\bar{W}}\right)\sigma(z, w)$

Therefore, $S_{12\,within} = \left(\frac{1}{\sigma_{12}}\right)\left(\frac{1}{\bar{W}_{12}}\right) * S_{12\,across}\bar{W} = \left(\frac{\sigma_z}{\sigma_{12}}\right)\left(\frac{\bar{W}}{\bar{W}_{12}}\right)S_{12\,across}$

In cases where trait distributions are equal across treatments:
$S_{12\,within} = \left(\frac{\bar{W}}{\bar{W}_{12}}\right)S_{12\,across}$