Supplement

Here we consider the stability conditions for the ancestral state in which the population has neither the sexual conflict allele (causing either Mother's Curse or Father's Curse) nor the restorer allele.

Model 4 Mitochondrial Mother's Curse with a Z-linked restorer

For this model the fitnesses are:

Females		Z	z
	M	1	1
	m	$1{+}s_f$	$1{+}s_f$

Males		ZZ	Zz	zz
	M	1	1	1
	m	$1{-}s_m$	$1{-}s_m{+}s_z/2$	$1{-}s_m{+}s_z$

so the m mitochondrial type has advantage s_f for females and disadvantage s_m for males (assuming s_f, $s_m > 0$). The z allele has no effect in females but restores male fitness by an amount $s_z/2$ in heterozygotes and s_z in zz homozygotes. Letting the frequencies of the m and z alleles be p_m and p_z, we see that near the point (p_m=0, p_z=0) the linkage-disequilibrium-like term describing the association between p_m and p_z is negligible, and descriptions of initial frequency dynamics can ignore this term. As a consequence, we can determine the stability of this point from the recursions in the two allele frequencies:

$$p_m' = \frac{p_m(s_f+1)}{p_m s_f+1}$$

$$p_z' = \frac{1}{3}\left[\frac{p_z[p_m(s_f+1)-p_m+1}{p_m(s_f+1)- p_m+1}\right] + \frac{2}{3}\left[\frac{p_m(s_f+1)}{p_m s_f+1}\right]$$

To examine the stability characteristics of this model, at the point ($p_m = 0$, $p_z = 0$), we determine the leading eigenvalue of the Jacobian matrix:

$$J = \begin{pmatrix} \frac{\partial m'}{\partial m} & \frac{\partial m'}{\partial z} \\ \frac{\partial z'}{\partial m} & \frac{\partial z'}{\partial z} \end{pmatrix}$$

Evaluating the Jacobian at ($p_m = 0$,p_z=0) yields a leading eigenvalue of s_f+1, showing that whenever $s_f > 0$, this corner equilibrium is unstable and the Mother's Curse mitochondrial type will invade. When the m mitochondrial type gets to fixation, which it will do relatively quickly, the z allele behavior can be determined by examining the (p_m=1,p_z=0) corner equilibrium. This is unstable whenever s_z>0, implying that the restorer allele will invade. The actual dynamics in the middle of this phase space is a bit more complex, and can be seen in Figure 2 of the main text.

Model 6 Father's Curse with Y allele driving an autosomal female-deleterious allele

For this model the fitnesses are:

Females		AA	Aa	aa
		1	$1{-}s_f/2$	$1{-}s_f$

Males		AA	Aa	aa
	Y	1	1	1
	y	1	$1{+}s_m/2$	$1{+}s_m$

The recursion for the autosomal a allele is:

$$p_a{}' = \frac{1}{2}\left[\frac{[p_a - p_a(p_a+1)\frac{s_f}{2}]}{1-p_a s_f} + \frac{[p_a(p_a+1)p_y\frac{s_m}{2} + p_a]}{p_a p_y s_m + 1}\right]$$

The recursion for the y allele is:

$$p_y{}' = \left[\frac{(p_a s_m + 1)p_y}{p_a p_y s_m + 1}\right]$$

Evaluating the Jacobian at $p_a = 0$, yields a leading eigenvalue of $(p_y s_m - s_f + 4)/4$, showing that a female advantageous allele can invade if $s_f < 0$ as $p_y \rightarrow 0$.

Model 7 Father's Curse with Y allele driving an X-linked female-deleterious allele

For this model the fitnesses are:

Females		*XX*	*Xx*	*xx*
		1	1-s_f/2	1-s_f

Males		*X*	*x*
	Y	1	1
	y	1	1+s_m

Here the recursion for the X-linked x allele is:

$$p_x{}' = \frac{1}{2}\left[\frac{[s_f p_x^2 + (s_f - 2)p_x]}{2p_x s_f - 2} + \frac{[p_x p_y s_m + p_x]}{p_x p_y s_m + 1}\right]$$

And the recursion for the Y-linked y allele is:

$$p_y{}' = \left[\frac{(p_x s_m + 1)p_y}{p_x p_y s_m + 1}\right]$$

Stability analysis proceeds as above, solving the leading eigenvalue of the linearized recursion. Provided the $p_x > 0$, this eigenvalue is simply 1+s_m, implying that the Father's Curse allele can invade when there is a fitness advantage to the sons, even at the fitness expense s_f to the daughters. While the increase in frequency of y is monotonic, if s_f is sufficiently large, the x allele is lost, and at this point, the Father's Curse y allele becomes effectively neutral and it stops increasing in frequency. This can also be seen in the phase diagram of Figure 3.

Model 8 W-autosomal nuclear Mother's Curse

Here the female's fitness is improved by a novel allele (w) of the strictly female-transmitted W chromosome, and the a allele at an autosomal locus restores male fitness by s_m/2 in *Aa* heterozygotes and by amount s_m in *aa* homozygotes. The full model has these fitnesses:

Females		*AA*	*Aa*	*aa*
	W	1	1	1
	w	1	1+s_f/2	1+s_f

Males	*AA*	*Aa*	*aa*
	1	1-s_m/2	1-s_m

Here the recursion for the w allele frequency is entirely determined by females, and is:

$$p_w{}' = \left[\frac{(p_a s_f + 1)p_w}{p_a p_w s_f + 1}\right]$$

And the recursion for the autosomal restorer allele is:

$$p_w{}' = \frac{1}{2}\left[\frac{[p_a - p_a(p_a + 1)\frac{s_m}{2}]}{1 - p_a s_m} + \frac{[p_a(p_a + 1)p_w\frac{s_f}{2} + p_a]}{p_a p_w s_f + 1}\right]$$

Stability conditions have already been established for Model 6, and here we have the *w* allele invading only if it can drive a sexually antagonistic autosomal allele (female-favoring and male-disfavoring). Whenever the *w* allele goes to fixation, the *a* allele is also fixed, although allele frequencies need not change monotonically. If the *a* allele is lost, the fitnesses collapse to all being 1, and further selection on the *w* allele is arrested (and its dynamics will be neutral).

Model 9 W-Z nuclear Mother's Curse

Here, as in Model 8, the female's fitness is improved by a novel allele (*w*) of the strictly female-transmitted W chromosome, and the *z* allele at a Z-linked locus restores male fitness by $s_m/2$ in *Zz* heterozygotes and by amount s_m in *zz* homozygotes. As mentioned above, the model is formally identical to Model 7, replacing the Y locus with the W locus, and flipping the sex labels. The full model has these fitnesses:

Females		*Z*	*z*
	W	1	1
	w	1	$1+s_f$

Males	*ZZ*	*Zz*	*zz*
	1	$1-s_m/2$	$1-s_m$

Here the recursion for the Z-linked *z* allele is:

$$p_z' = \frac{1}{2}\left[\frac{[p_z p_w s_f + p_z]}{p_z p_w s_f + 1}\right] + \frac{2}{3}\left[\frac{[s_m p_z^2 + (s_m - 2)p_z]}{2p_z s_m - 2}\right]$$

And the recursion for the W-linked *w* allele is:

$$p_w{}' = \left[\frac{(p_z s_f + 1)p_w}{p_z p_w s_f + 1}\right]$$

The dynamics and conditions for invasion of the nuclear Mother's Curse are identical to the conditions for invasion of Model 7, the Father's Curse with an X-linked locus having the sexual conflict. Here, the *w* allele can fail to fix if the z allele is first lost.