Life-cycle models as salmon restoration tools

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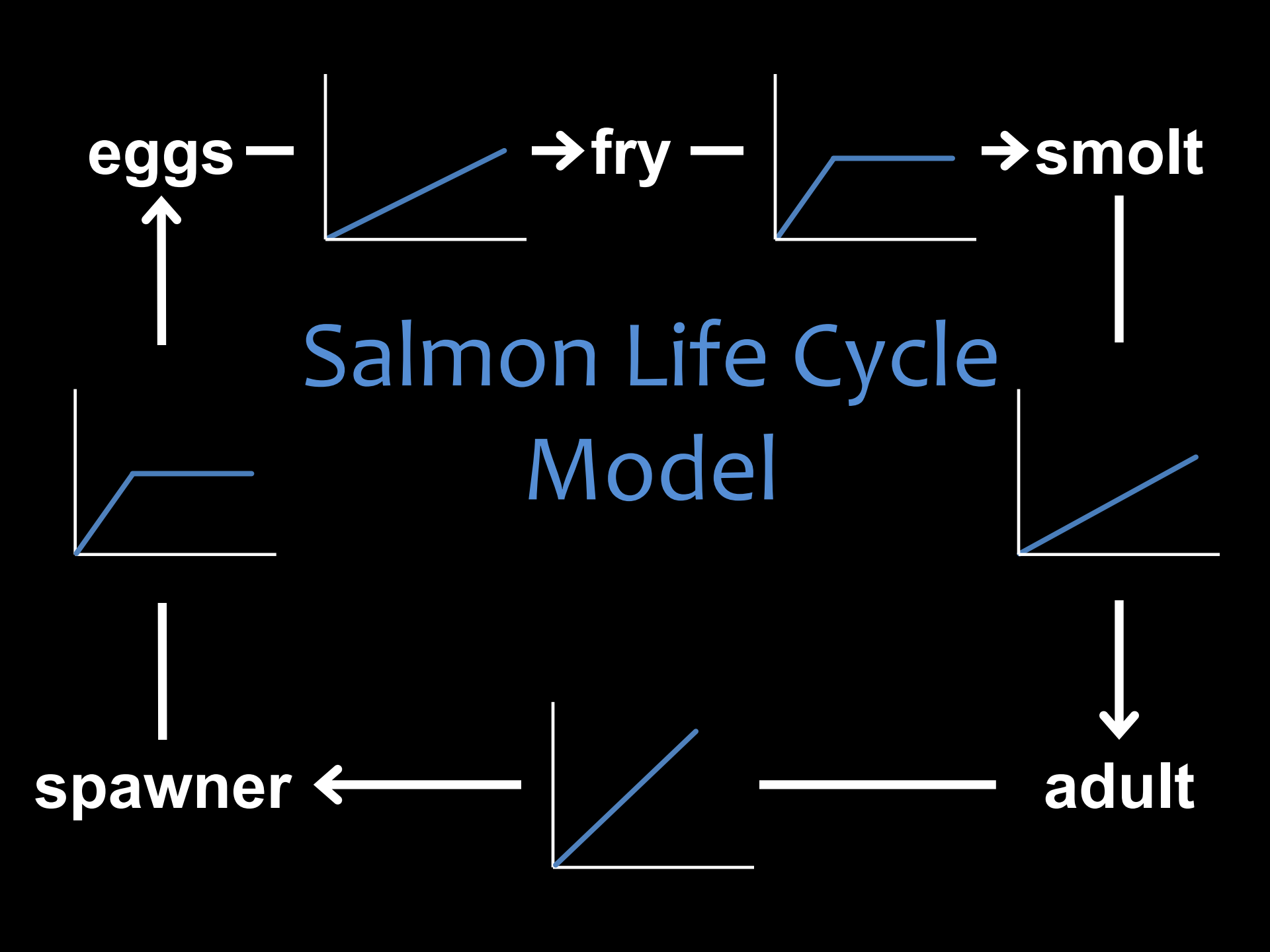
eggs
fry
smolt
Salmon Life Cycle
spawner
adult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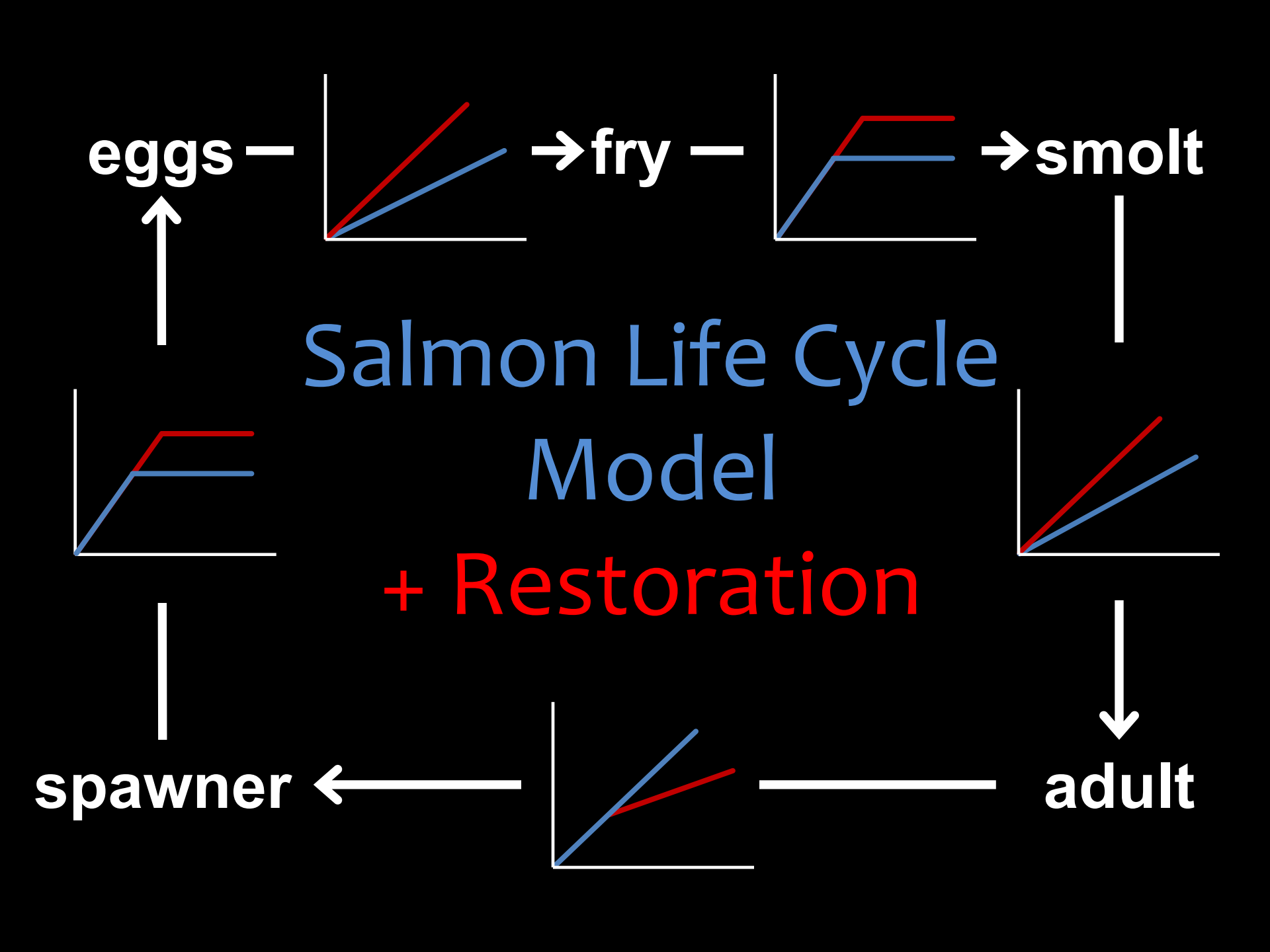
eggs
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Salmon Life Cycle Model
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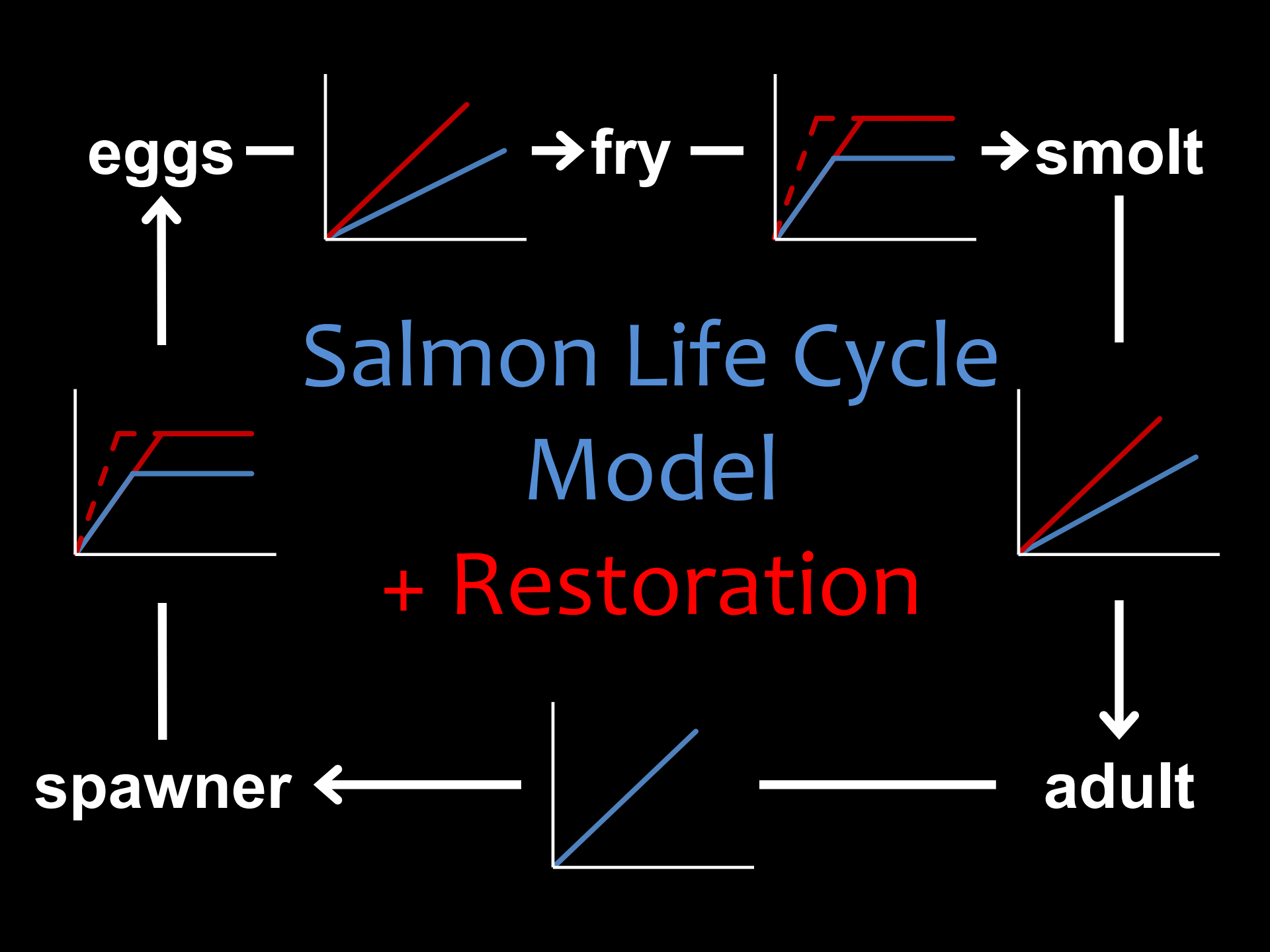
eggs
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Salmon Life Cycle
Model
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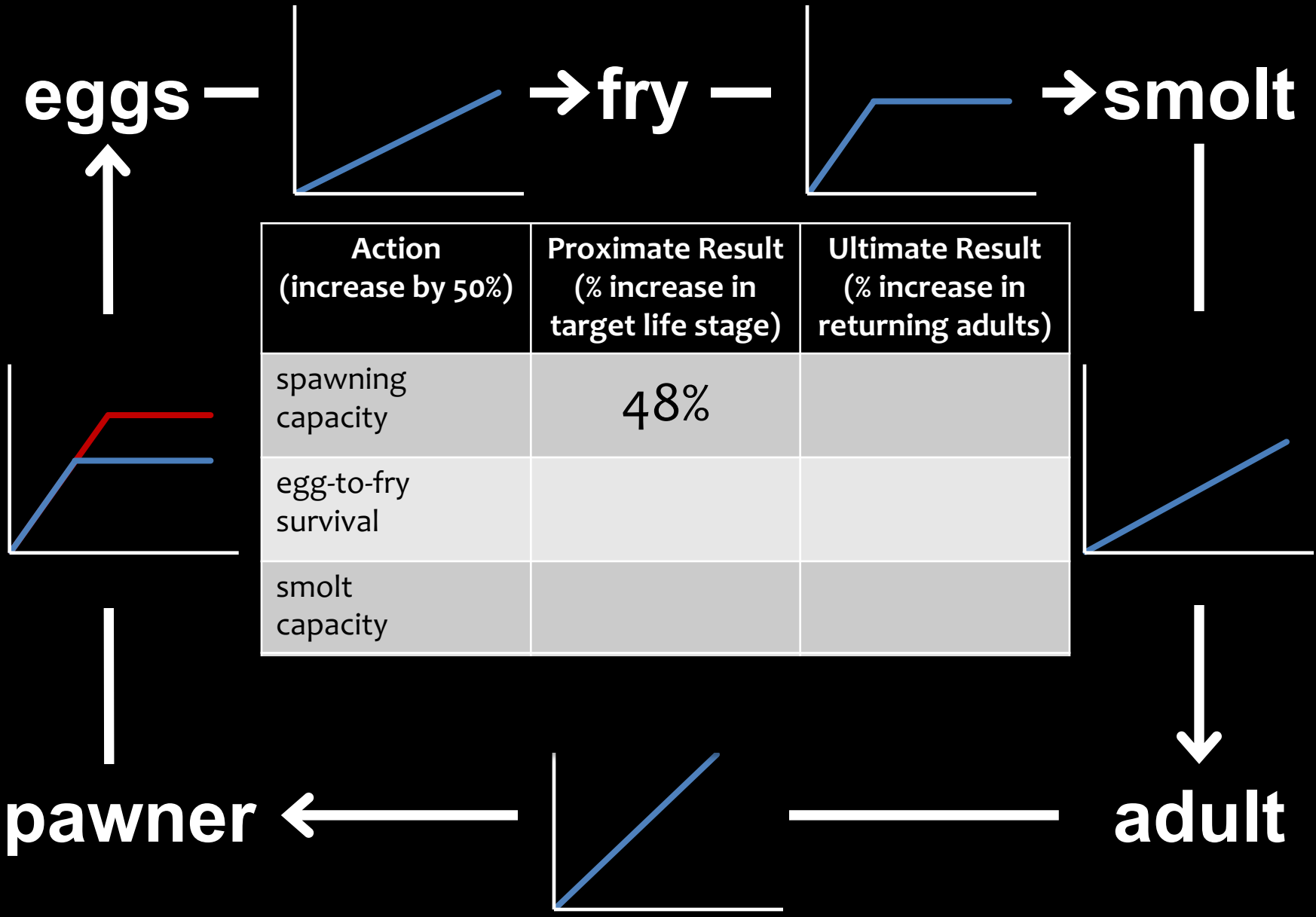
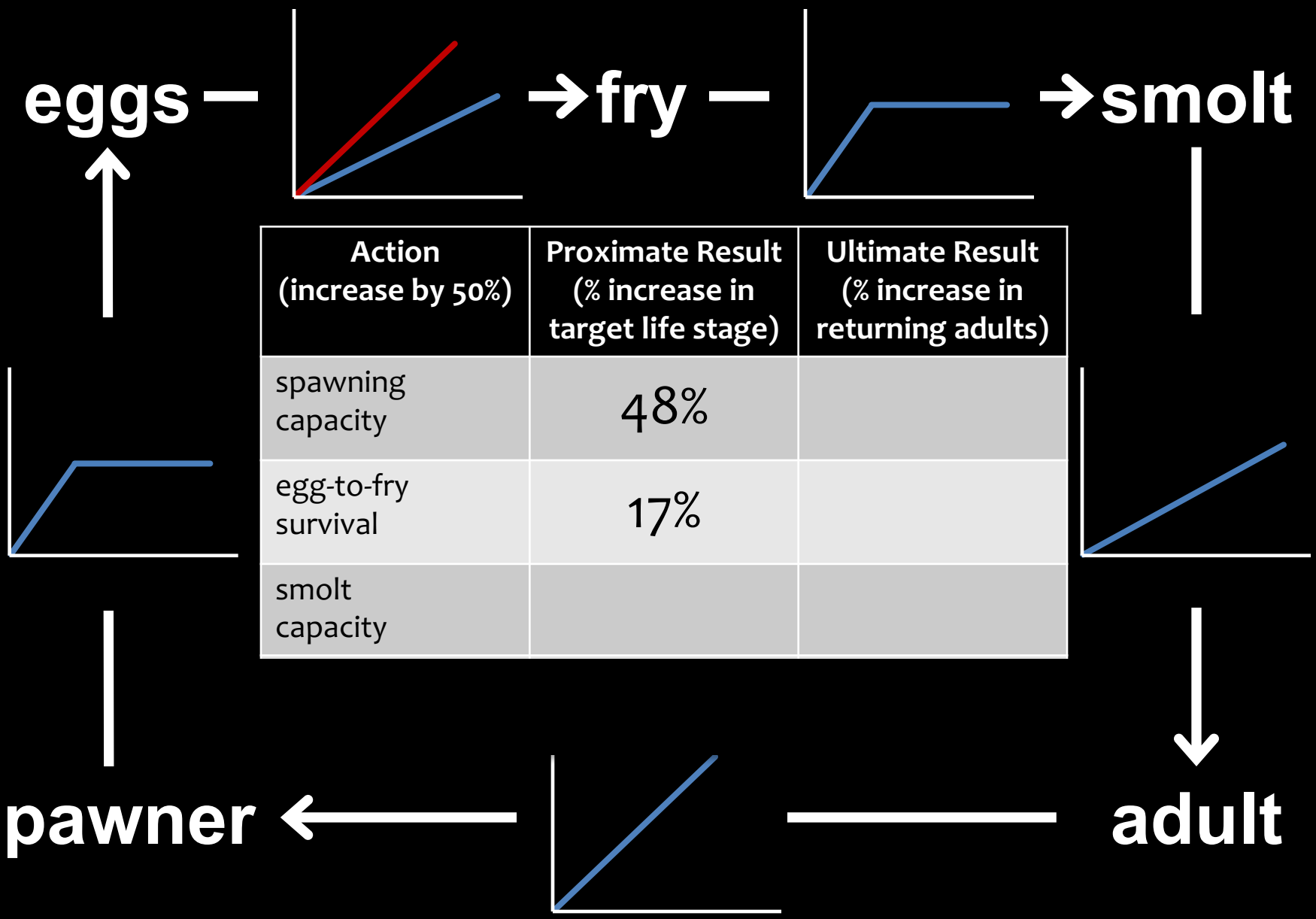
adult

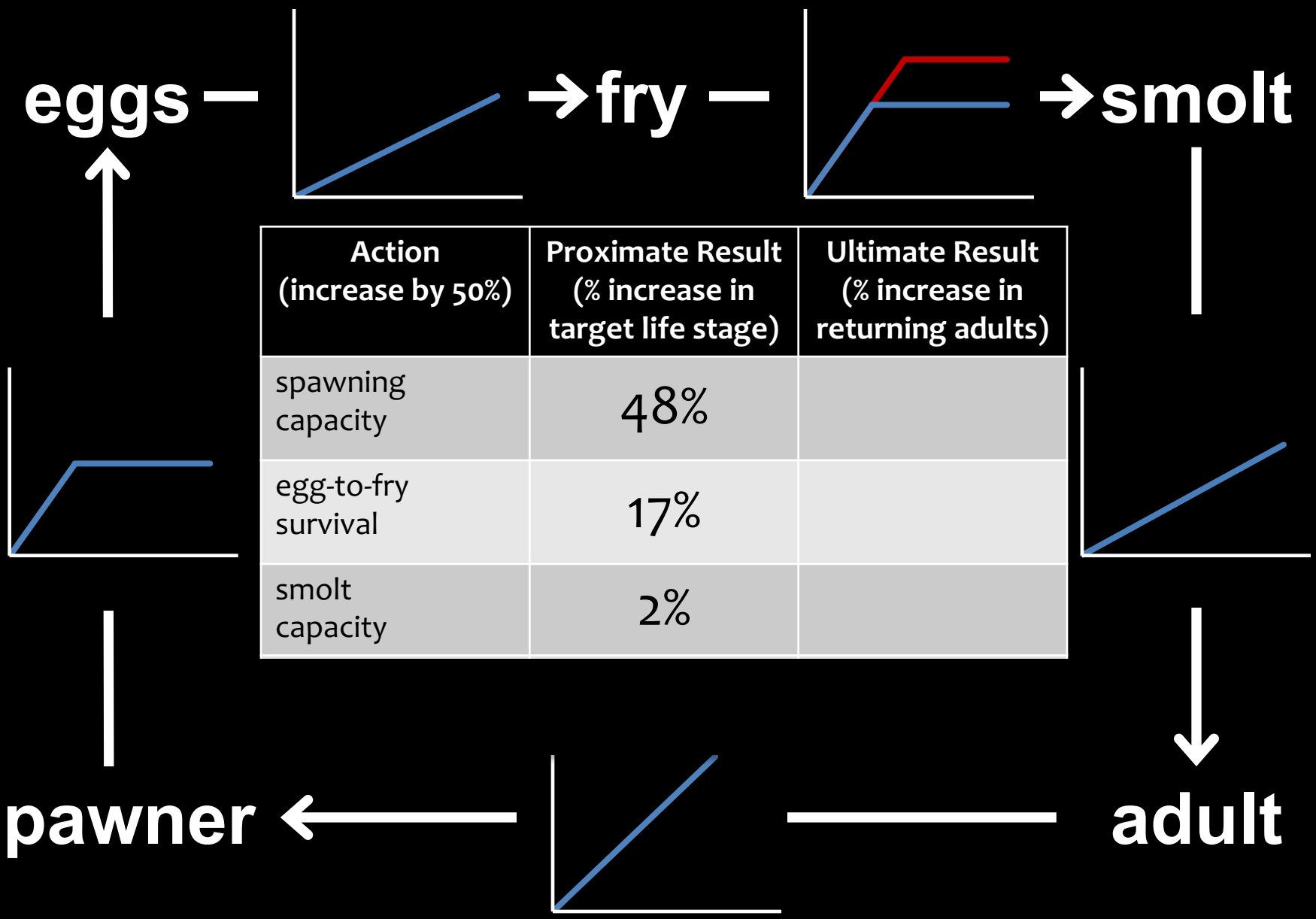
A toy model: Scenario 1



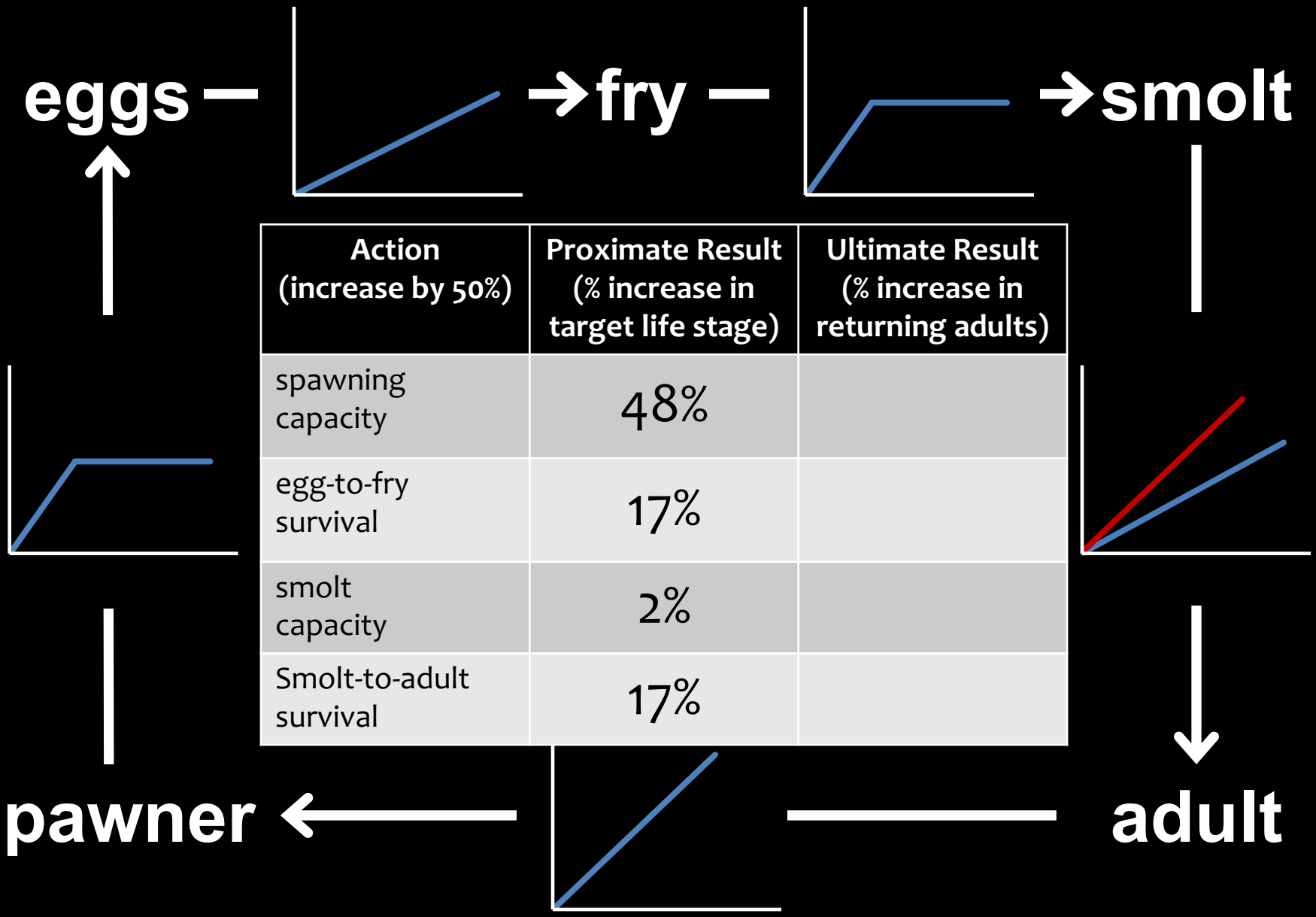
Action (increase by 50%)	Proximate Result (% increase in target life stage)	Ultimate Result (% increase in returning adults)
spawning capacity	48%	
egg-to-fry survival		
smolt capacity		



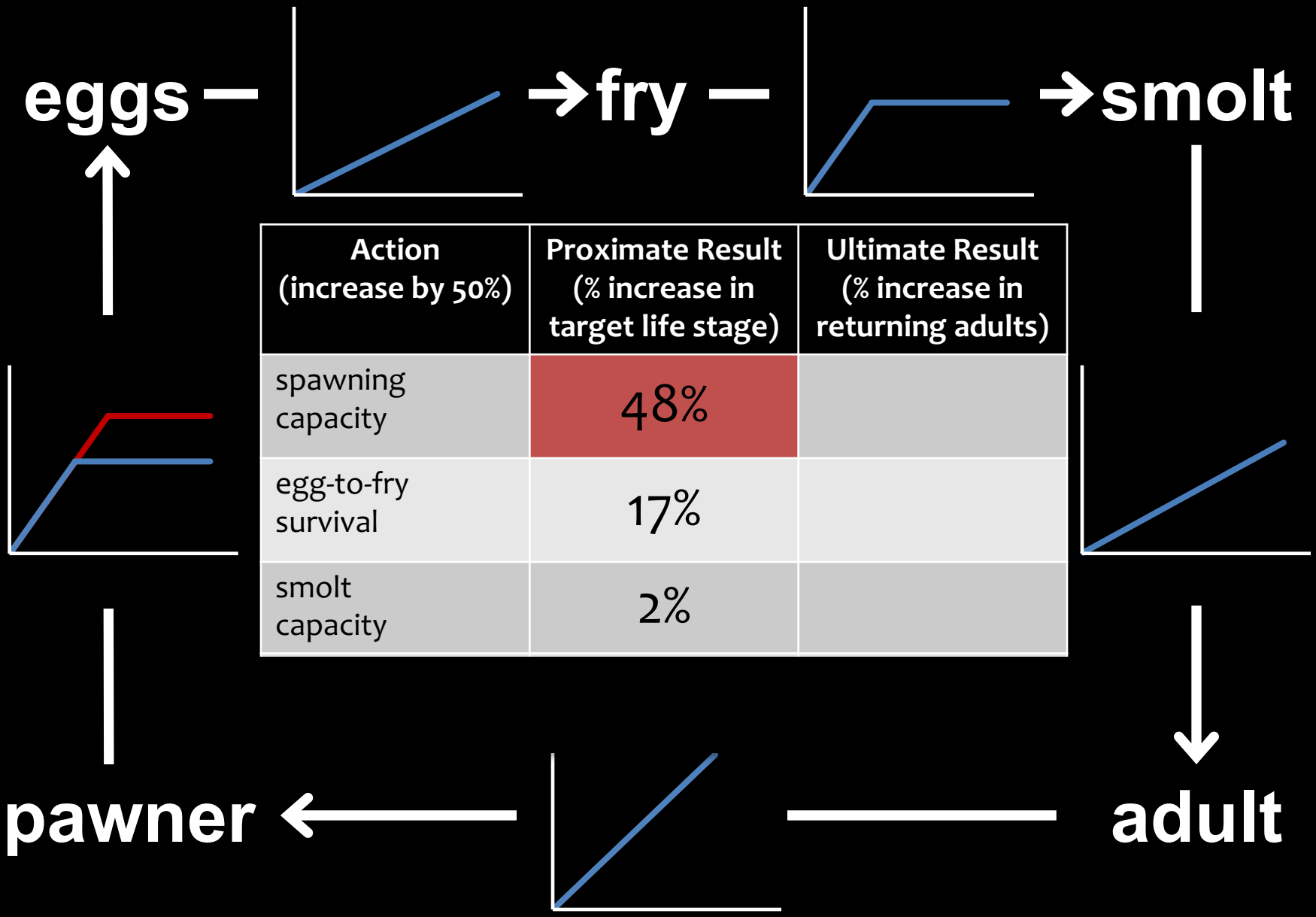
Action (increase by 50%)	Proximate Result (% increase in target life stage)	Ultimate Result (% increase in returning adults)
spawning capacity	48%	
egg-to-fry survival	17%	
smolt capacity		



Action (increase by 50%)	Proximate Result (% increase in target life stage)	Ultimate Result (% increase in returning adults)
spawning capacity	48%	
egg-to-fry survival	17%	
smolt capacity	2%	

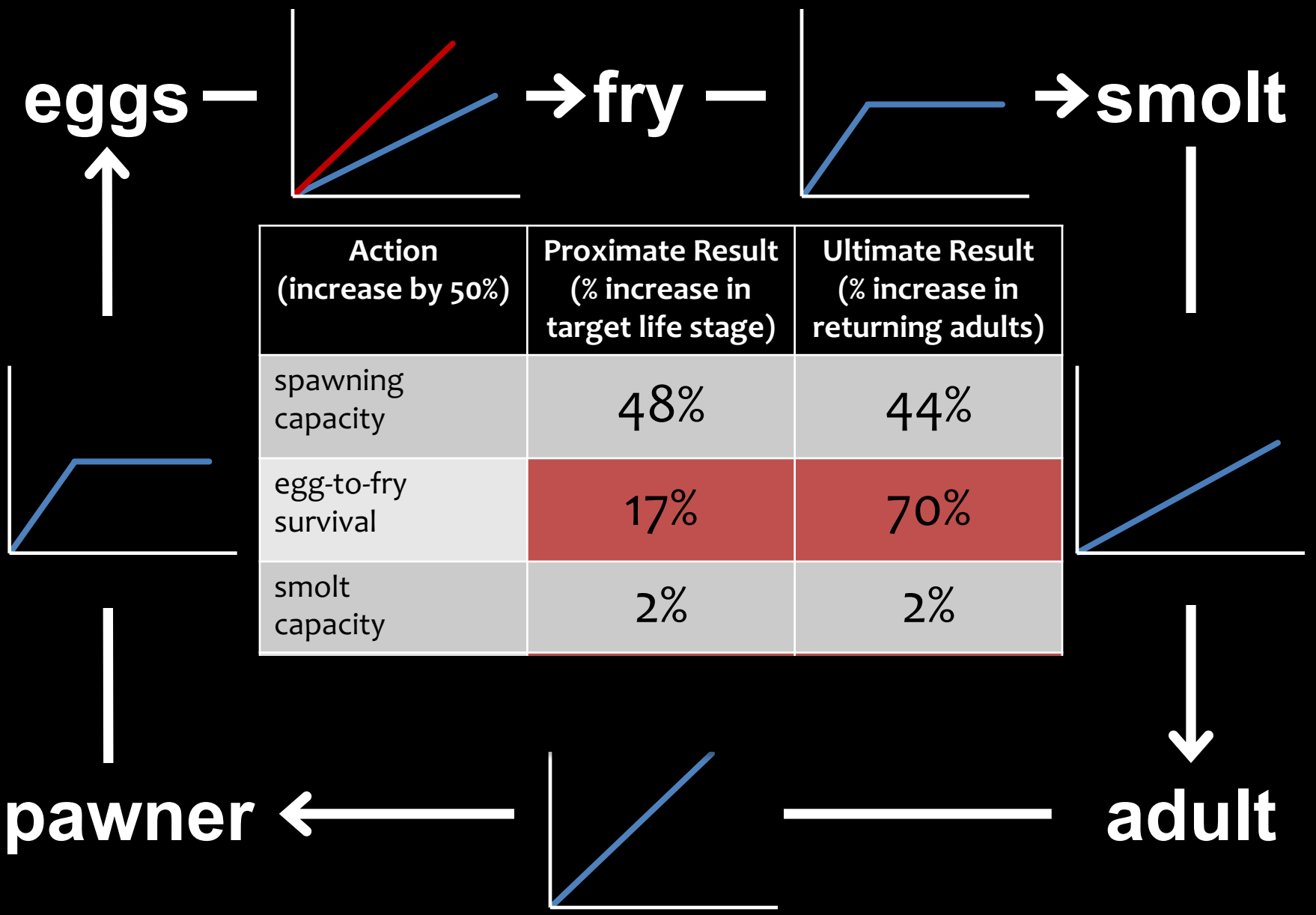


Action (increase by 50%)	Proximate Result (% increase in target life stage)	Ultimate Result (% increase in returning adults)
spawning capacity	48%	
egg-to-fry survival	17%	
smolt capacity	2%	
Smolt-to-adult survival	17%	



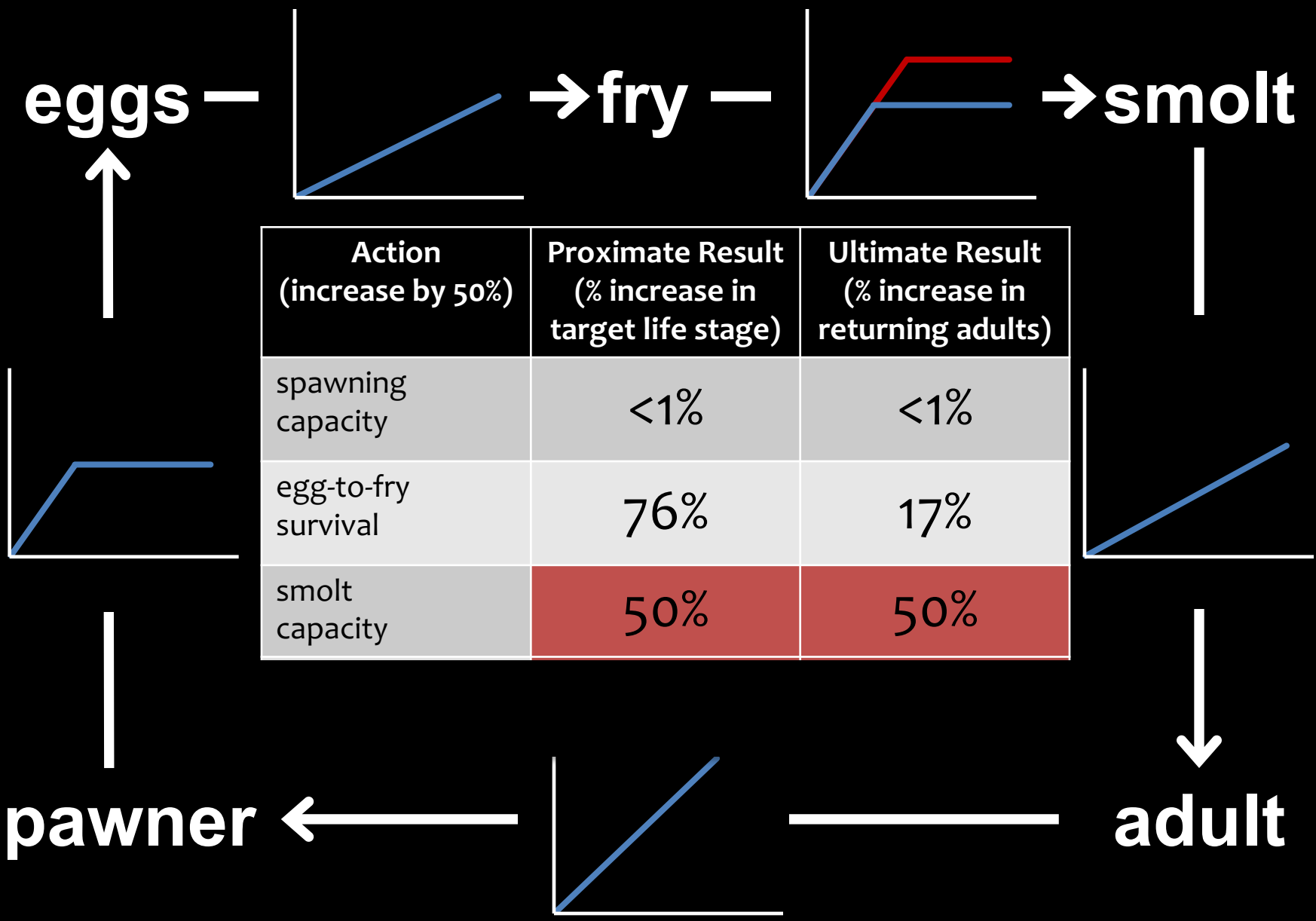
Action (increase by 50%)	Proximate Result (% increase in target life stage)	Ultimate Result (% increase in returning adults)
spawning capacity	48%	
egg-to-fry survival	17%	
smolt capacity	2%	

Do the proximate and ultimate goals align?



Action (increase by 50%)	Proximate Result (% increase in target life stage)	Ultimate Result (% increase in returning adults)
spawning capacity	48%	44%
egg-to-fry survival	17%	70%
smolt capacity	2%	2%

A toy model: Scenario 2

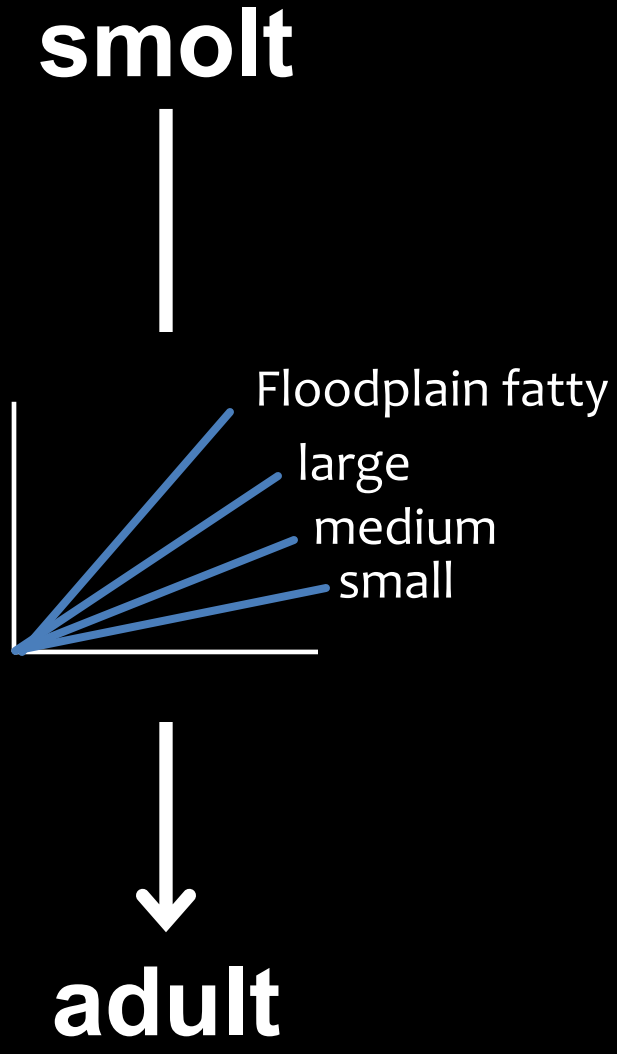


Action (increase by 50%)	Proximate Result (% increase in target life stage)	Ultimate Result (% increase in returning adults)
spawning capacity	<1%	<1%
egg-to-fry survival	76%	17%
smolt capacity	50%	50%

Why the difference? Context Matters

	Scenario 1: spawning capacity limited		Scenario 2: rearing capacity limited	
Action (increase by 50%)	**Proximate Result (% increase in target life stage)**	**Ultimate Result (% increase in returning adults)**	**Proximate Result (% increase in target life stage)**	**Ultimate Result (% increase in returning adults)**
spawning capacity	48%	44%	<1%	<1%
egg-to-fry survival	17%	70%	76%	17%
smolt capacity	2%	2%	50%	50%

But Corey, what about the "Floodplain Fatties"?



Floodplains are important if they increase survival at subsequent life stages

Action (increase by 50%)	Proximate Result (% increase in target life stage)	Ultimate Result (% increase in returning adults)	Proximate Result (% increase in target life stage)	Ultimate Result (% increase in returning adults)
spawning capacity	48%	44%	<1%	<1%
egg-to-fry survival	17%	70%	76%	17%
smolt capacity	2%	2%	50%	50%
Smolt-to-adult survival	17%	76%	17%	76%

What Models Tell Us

Static models (e.g. Skagit Chinook LFA) can identify habitats and life-history types that are limiting recovery

Dynamic models (e.g. OR Coast Coho LCM) can also evaluate population performance

Increasing life-history diversity increases population stability, as is “statistically inevitable” (Doak et al. 1998)

Proximate & Ultimate Goals of restoration should align

- *Restoration will have minimal effect if later life-stages are limiting*

Life-Cycle Models can identify restoration actions with the greatest Benefit to Ultimate Goals

- *Identify actions that contribute to viability goals; some actions may benefit abundance goals but not diversity goals (and visa versa)*

Life-history diversity is good, but often not adequately measured

- *Need estimates of LH-specific marine survival (otoliths, PIT tags)*