The Proportional Natural Influence (PNI) Concept and Its Use for Monitoring Supplementation Projects

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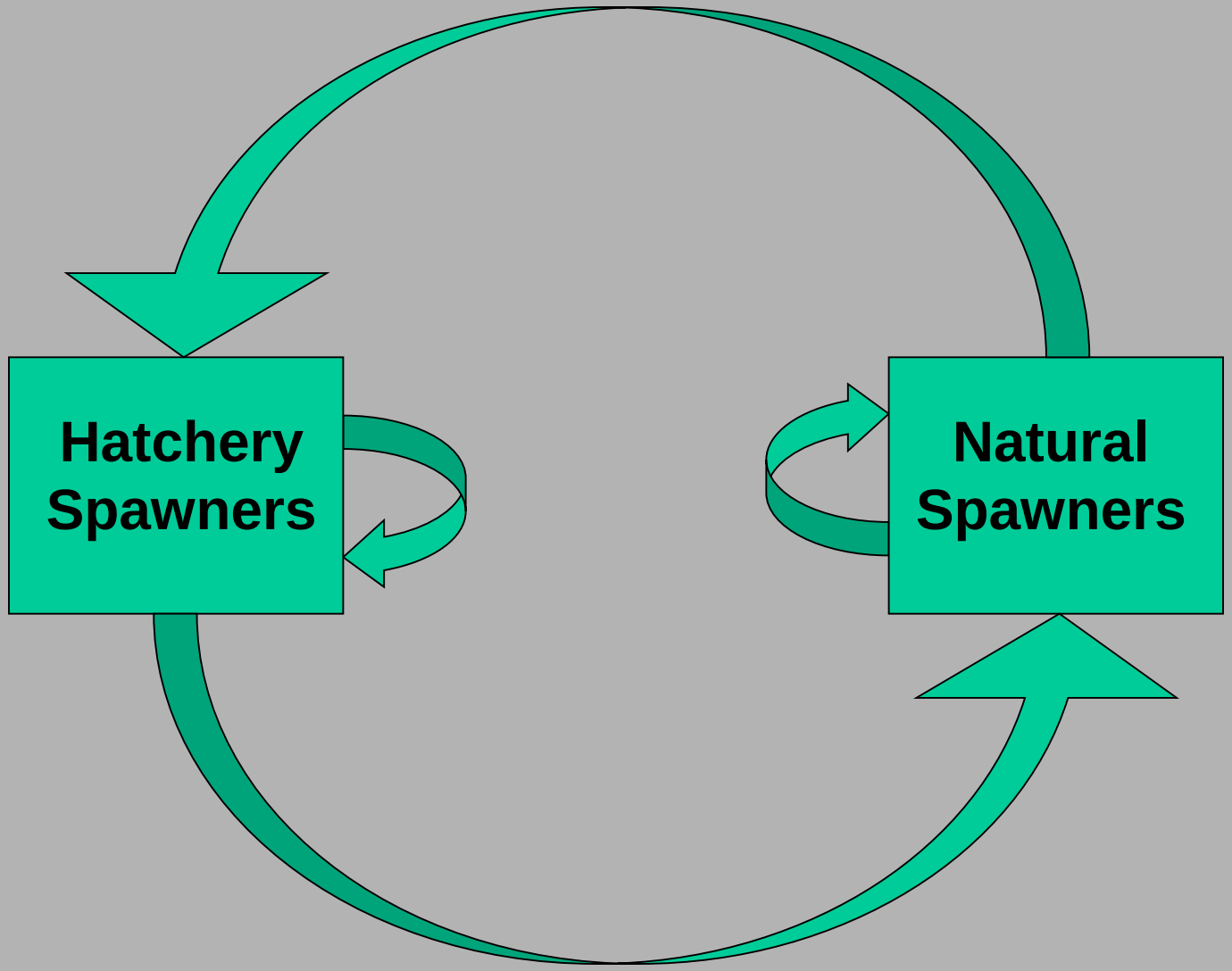
Gene Flow in a Population in an Integrated Hatchery Program

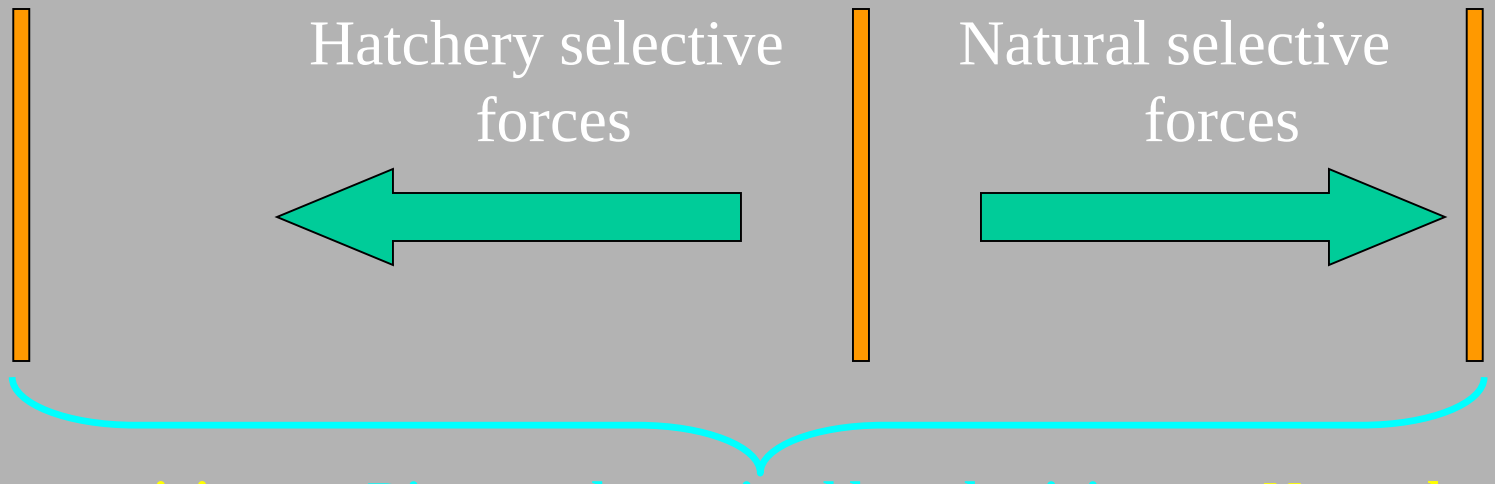
(modified from Lynch and O'Hely, 2001)



An integrated population lives in two environments with distinct optima.

Natural selection in each tugs the population characteristics toward its optimum.

Change toward hatchery optimum is called domestication.



The population will eventually reach an equilibrium point somewhere between the optima.

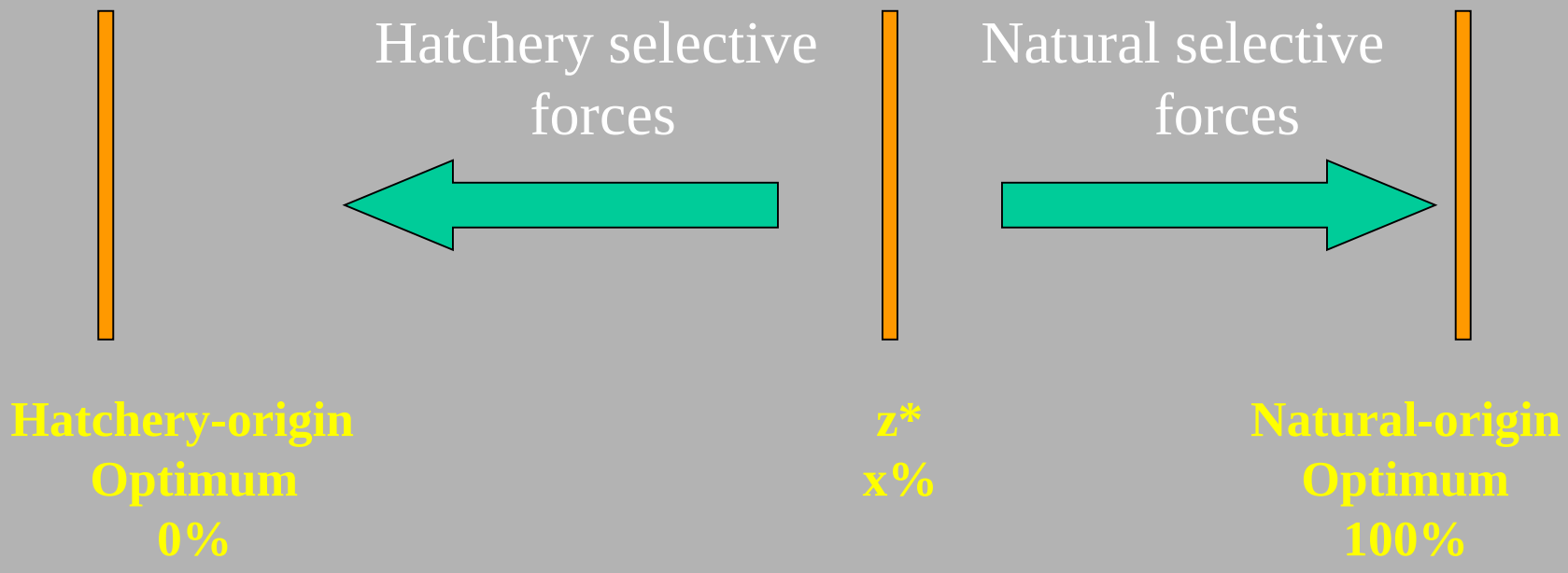
Ford (2002) Stabilizing Selection Model of Integrated Hatchery Program

The equilibrium point *in absolute terms* is determined by: 1) optima, 2) selection strength, 3) variance, 4) heritability, and 5) gene flow rates (N to H, H to N).

The equilibrium point *in relative terms* is determined *mainly* by: gene flow rates (N to H, H to N).

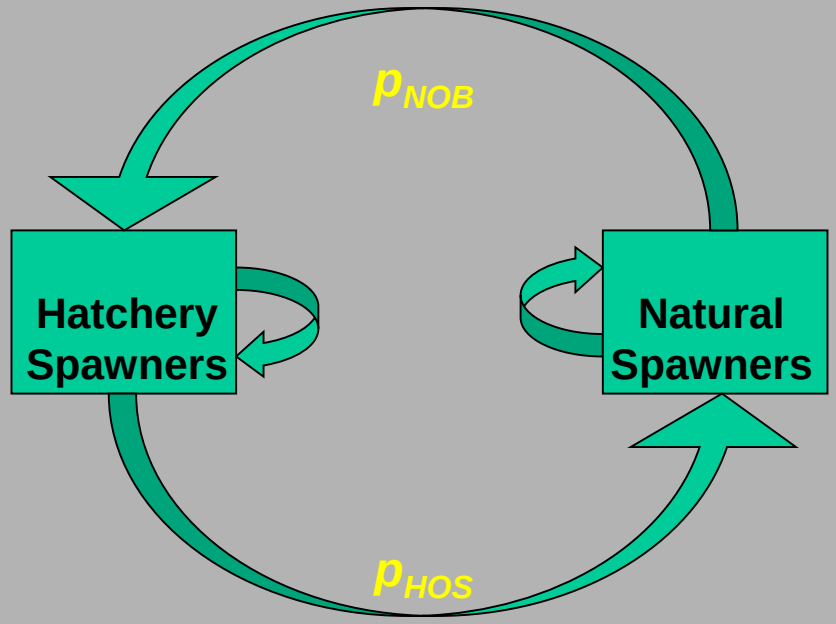
The population will eventually reach a relative equilibrium point (z*) between the optima that depends mainly on the gene flow levels.

In other words, how domesticated it becomes depends on gene flow in the two directions.



z^* is approximated well by the ratio

$$\frac{p_{NOB}}{p_{NOB} + p_{HOS}}$$



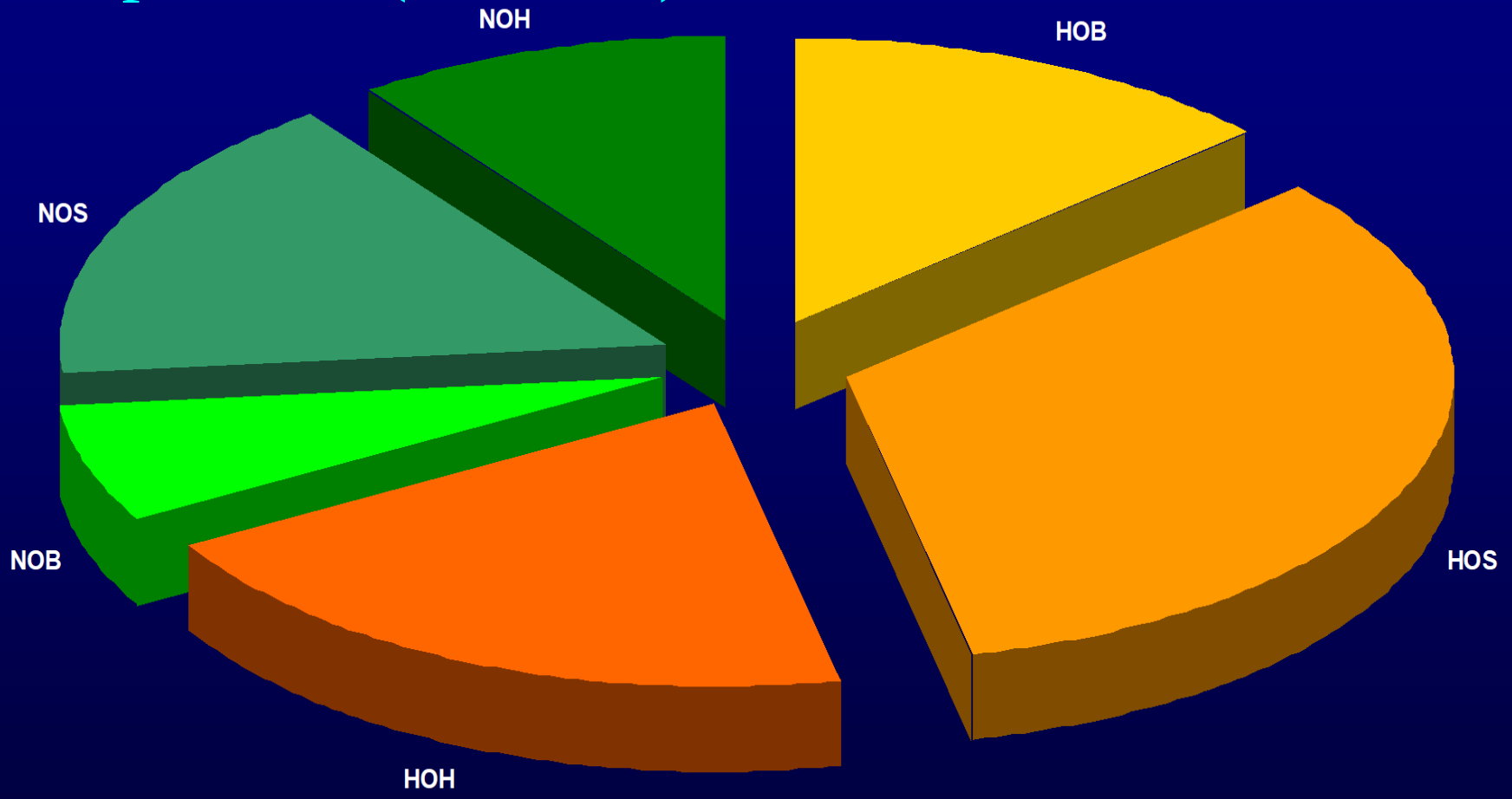
p_{NOB} = proportion of broodstock consisting of natural-origin fish

p_{HOS} = proportion of fish spawning naturally consisting of hatchery-origin fish

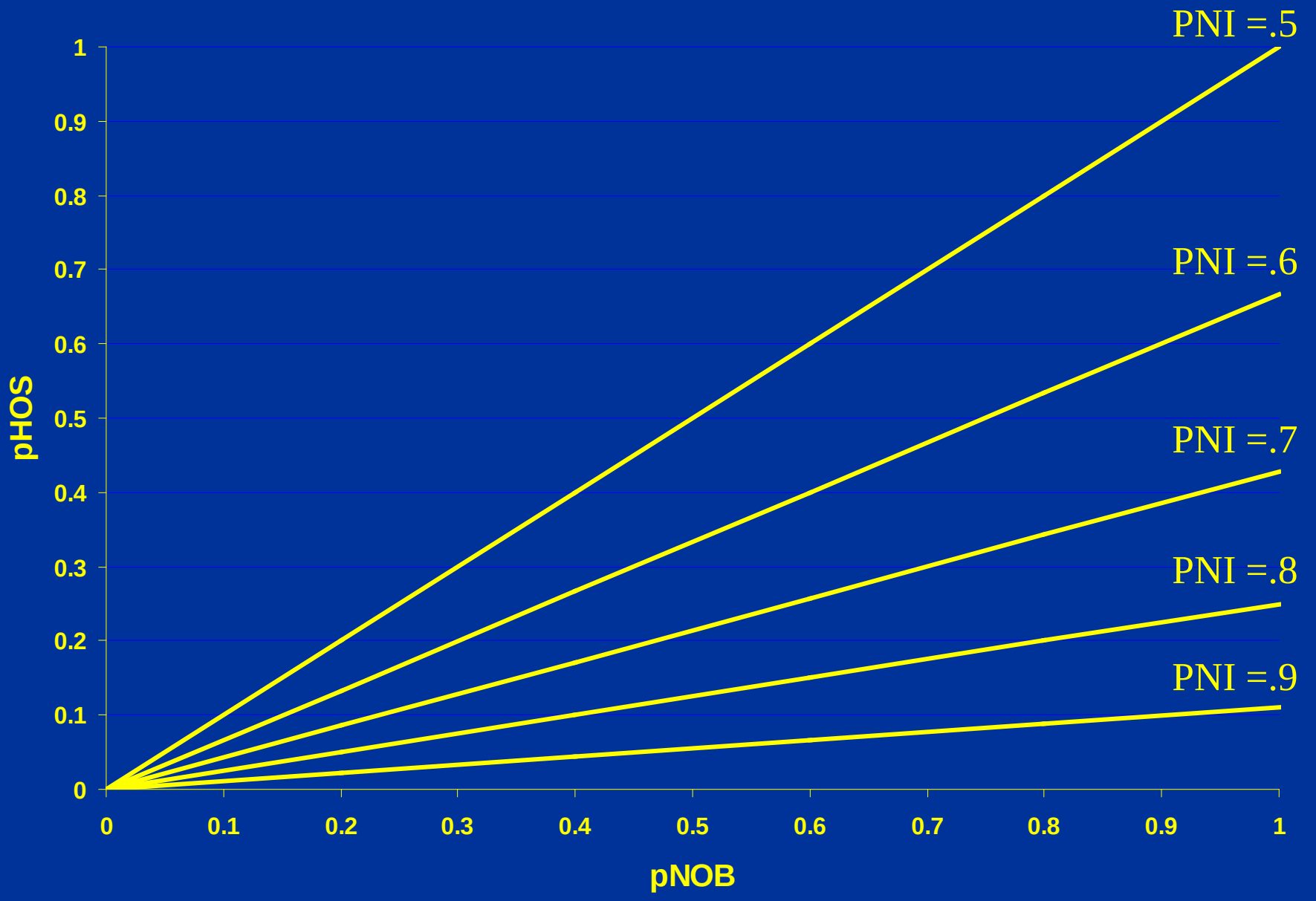
This ratio is called *proportionate natural influence* or PNI.

Caveat: proportions need to reflect per capita productivity of natural-origin and hatchery-origin fish

Composition of Returning Adults in an Integrated Population (Detailed)



Effect of pNOB and pHOS on Proportionate Natural Influence



Importance of PNI Concept

Important part of HSRG Guidelines

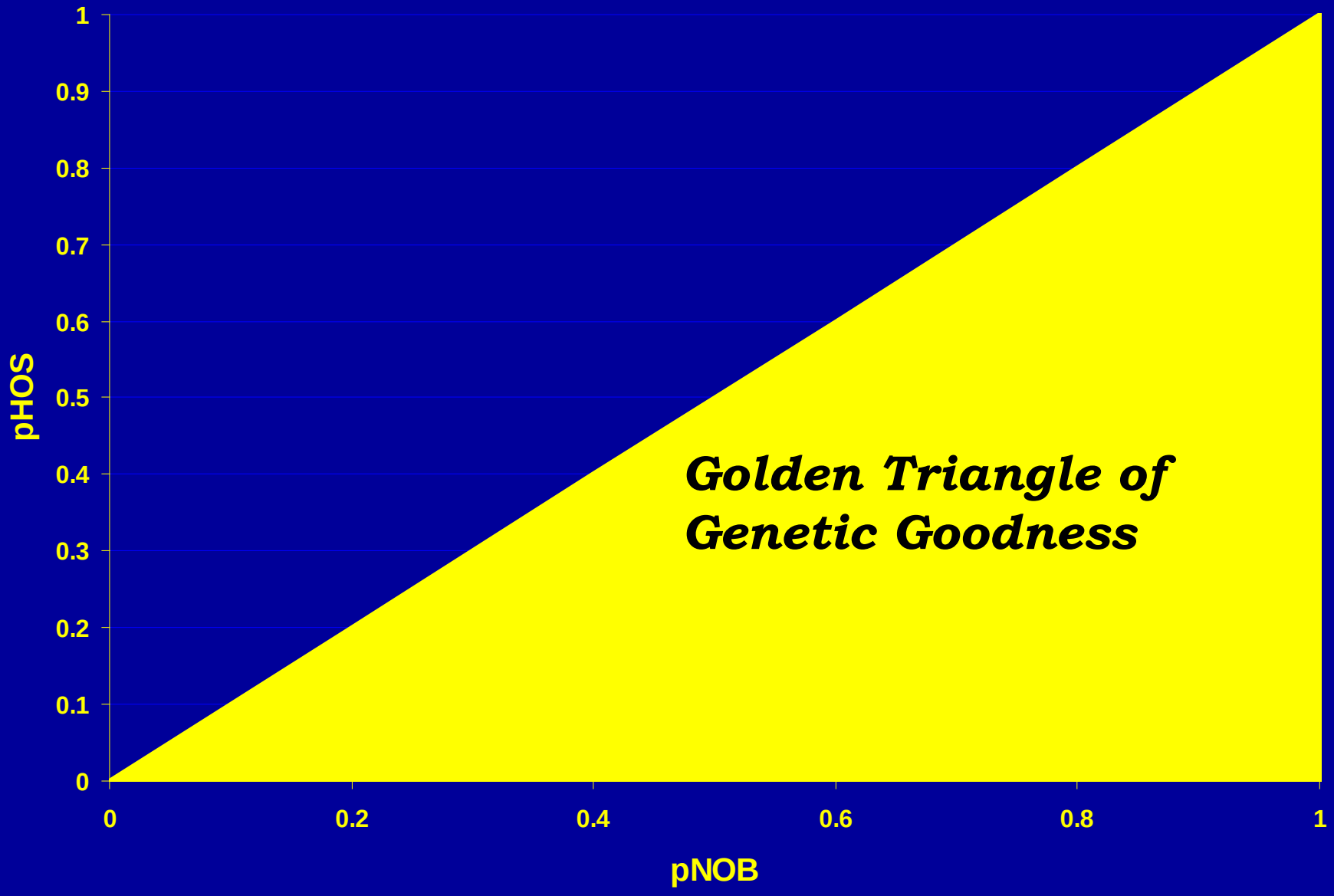
Key part of hatchery reform process and associated tools (AHA)

Unifying element for management of integrated hatchery programs

Justification for existing approaches to supplementation

Useful measure for supplementation monitoring

Effect of pNOB and pHOS on Proportionate Natural Influence



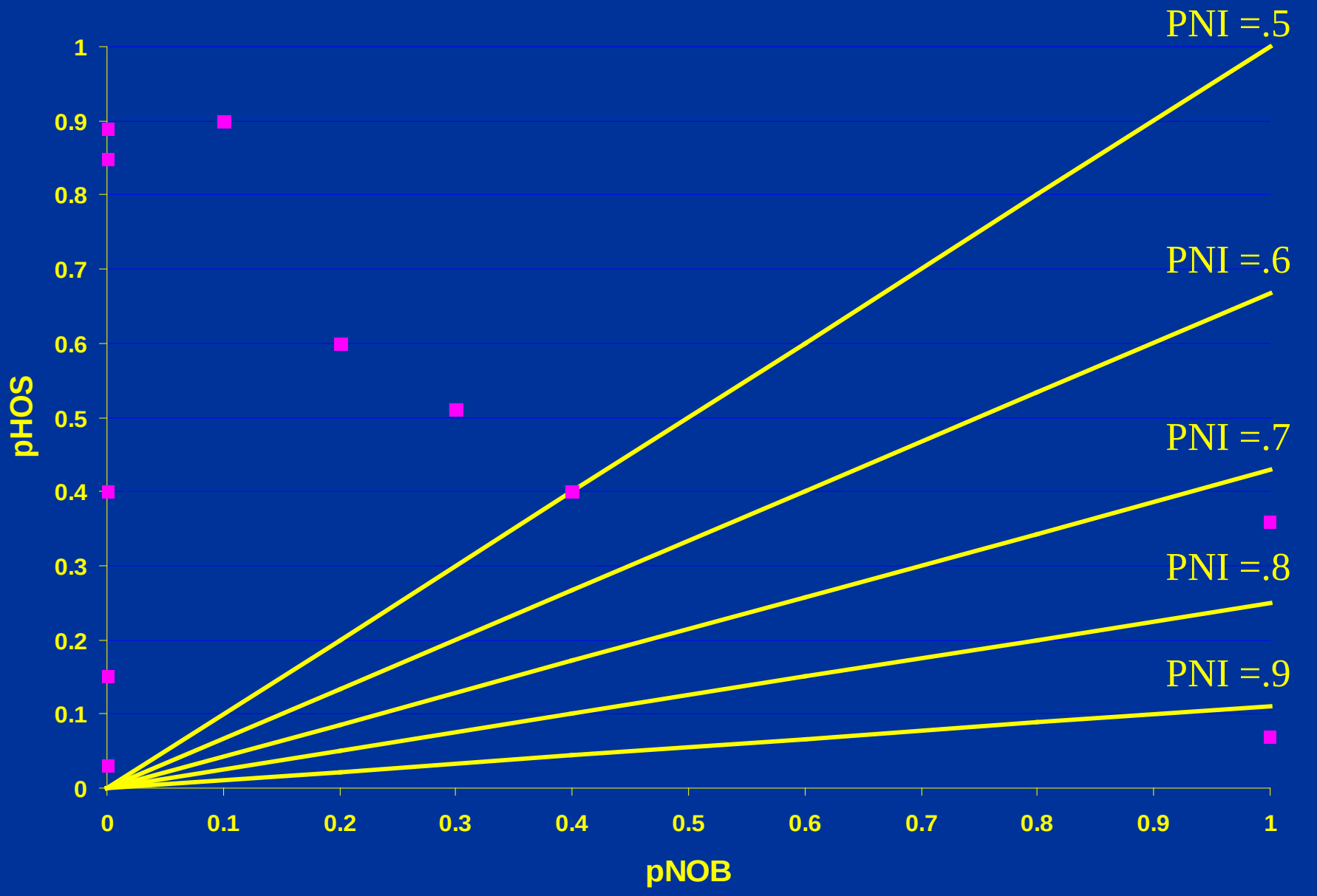
Managing to Achieve a Specified PNI

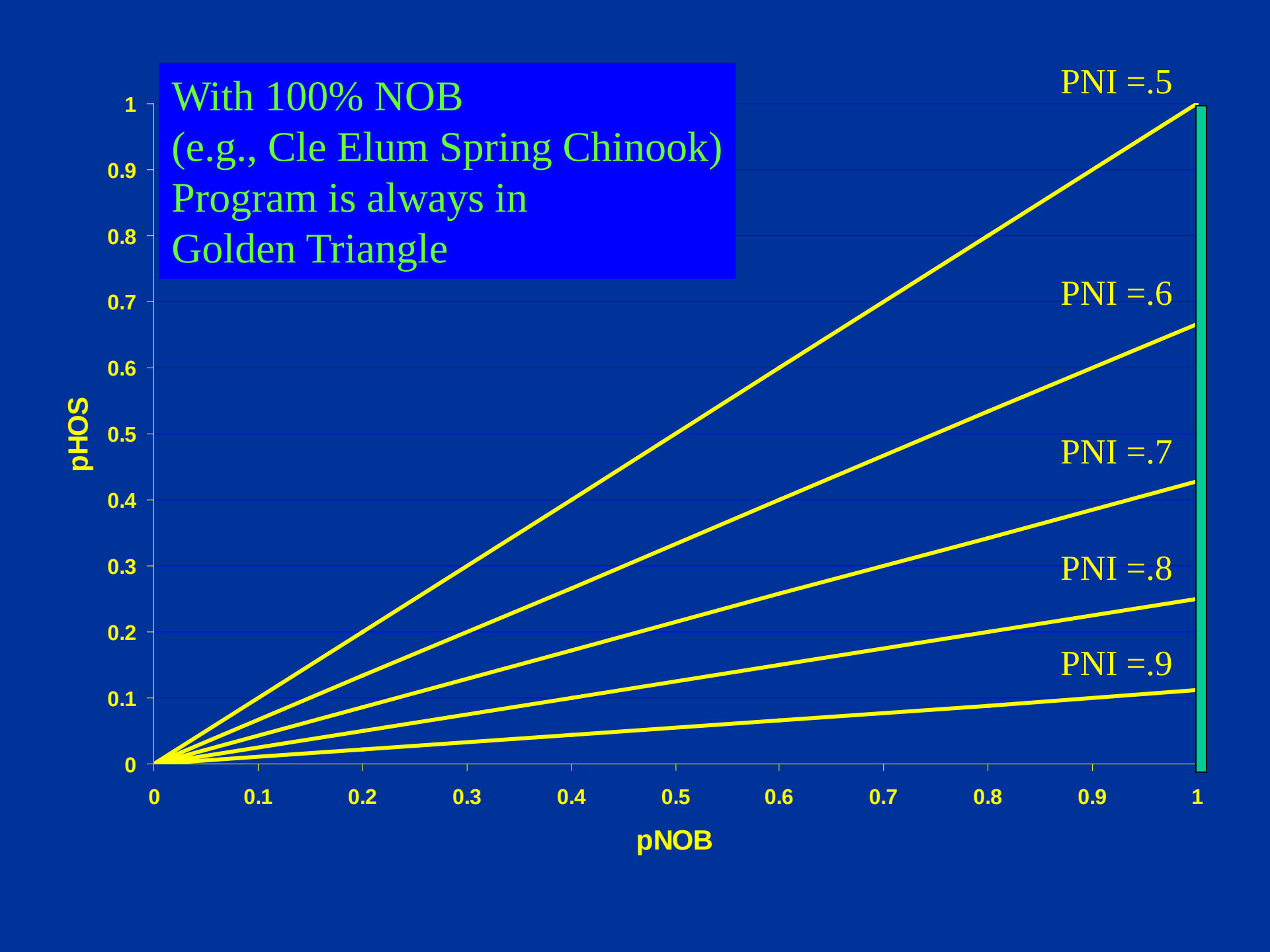
Ability to identify fish by origin

Ability to control pNOB and pHOS

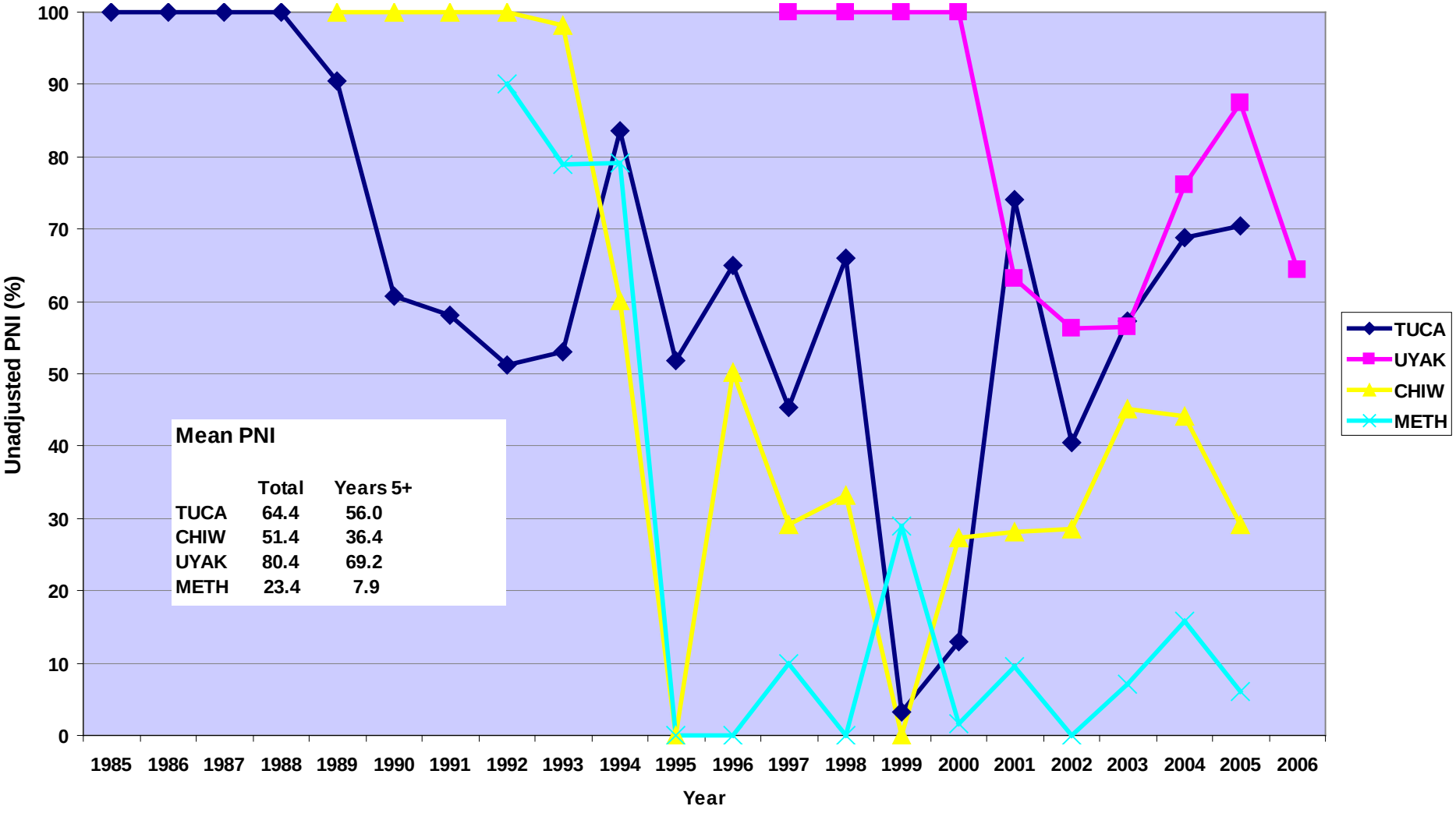
Scaling program size and harvest rates to basin productivity and capacity

Current PNI in Some Puget Sound Chinook Programs




With 100% NOB
(e.g., Cle Elum Spring Chinook)
Program is always in
Golden Triangle
PNI =.5
PNI =.6
PNI =.7
PNI =.8
PNI =.9
pHOS
pNOB
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

Supplementation Projects Vary Widely in PNI



Key Research Areas for Ford Model and Refinement of PNI Concept

Assumptions about selection in the two environments

Equilibrium vs. short-term behavior

Single-trait vs. multiple traits

Fundamental model assumptions

Acknowledgments

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