

Bio-Economic Model of Genomic Technologies as a Fishery Management Tool

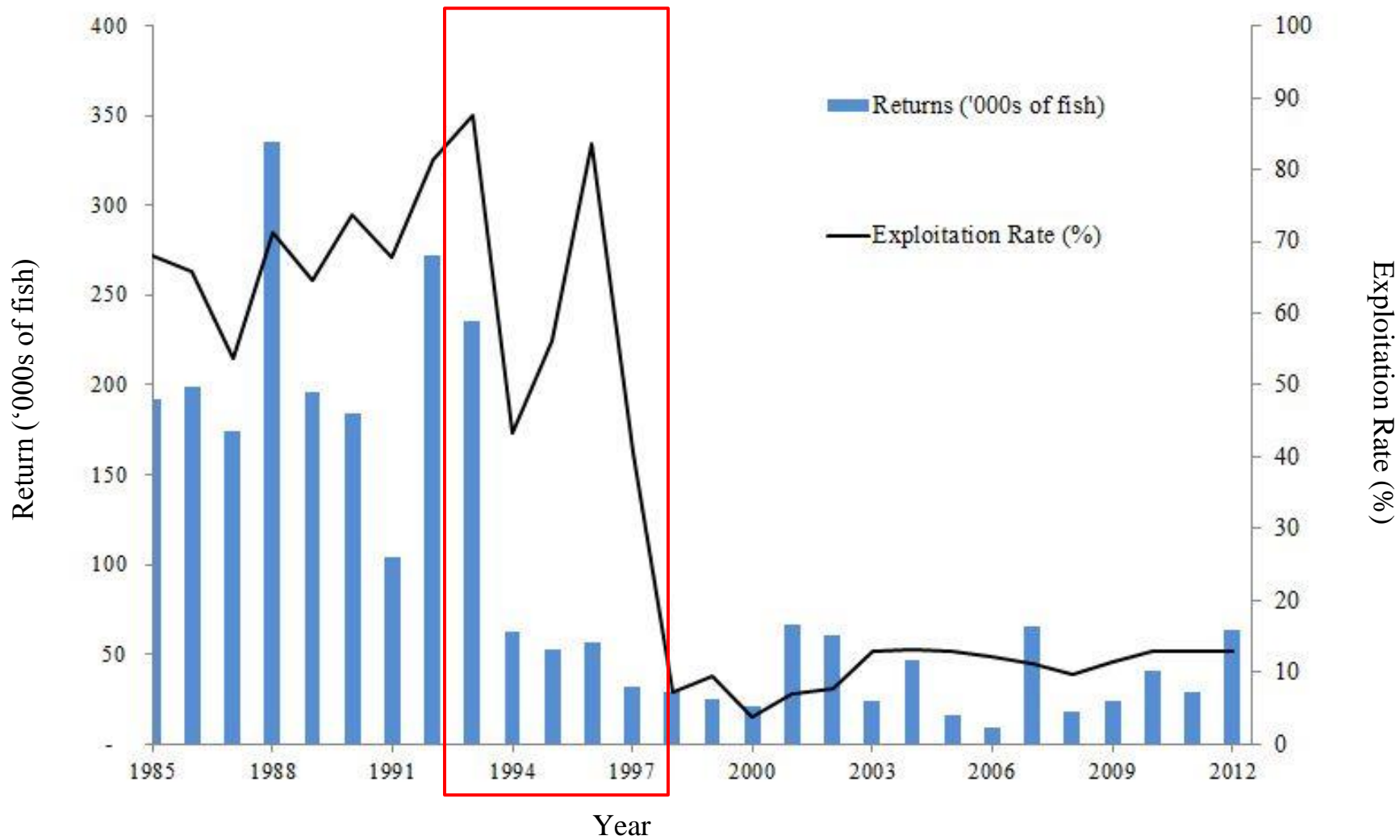
Interior Fraser Coho case study

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Study Question

What are the values of the genomic technologies in taking coho off of the endangered species list?

1. What are the means in which genomic technologies improve production of wild and hatchery coho?
2. What are the benefits and costs associated with technological implementation and how do they differ from those of the coded-wire tagging program?
3. How does this improved production generate more revenue to commercial fisheries?

Parentage Based Tagging (PBT)

- Individuals from hatcheries are genotyped and matched to the genotypes of prospective parents
- Indicates river or hatchery of origin
- Changes in marine survival over time
 - Prone to disease
 - Straying
 - Fecundity

Genetic Stock Identification (GSI)

- Used in mixed stock fisheries to identify individuals in the sample to their population
- Useful in detecting changes of stock abundance found within a fishing area
- Reduce bycatch of endangered stocks and maximize harvest of abundant stocks

Methods: Biological Sub-Model



**Escapement
Data (DFO)
1987-2012**

**Hatchery
Release Data
(RMPC)**

**Ricker
Recruitment
Parameters**

**Recruitment
2013-2050**

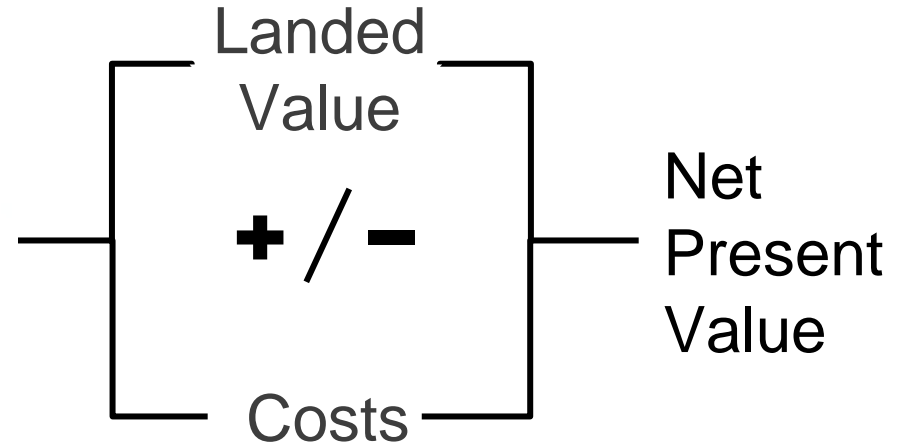


Scenario Modelling - Intermediary Results

		Coded Wire Tagging		Genome Based Tagging	
Productivity		Bycatch (%)	Hatchery Survival (%)	Bycatch (%)	Hatchery Survival (%)
(1995-2012)	Low	13	1.5	9	2.25
	Mid	13	3.0	9	4.5
(1987-1994)	High	13	4.5	9	6.75

Economic Sub-Model

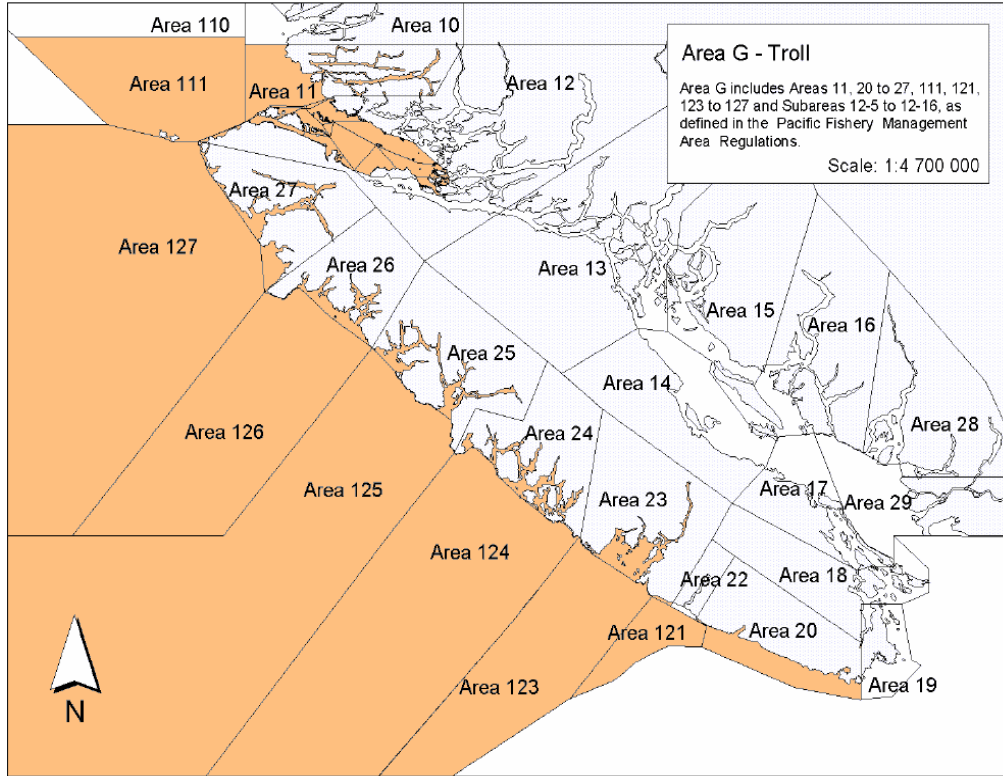
Recovery
Objective:
40,000
Spawners



Economic Model- Intermediary Results

	Coded Wire Tagging		Genome Based Tagging	
Productivity	Recruits ('000s of fish)	Catch ('000s of fish)	Recruits ('000s of fish)	Catch ('000s of fish)
Low	44.7	No Fishery	46.7	No Fishery
Mid	102	52.5	107.2	55.6
High	181.3	124.4	189.6	130.6

Fishing revenues and costs



Costs

Variable Fishing costs:

- Fuel
- Labour
- Food
- Gear and Repairs
- License Fees

No Capital Costs

Costs of Technology Implementation per Year

	Coded Wire Tagging		Genome Based Tagging	
	Number of Fish	Cost	Number of Fish	Cost
Juvenile Marking	~ 28,000 (10% of releases)	\$0.21/Fish	~210 (70 Fish per hatchery)	\$20/Fish
Fishery Recovery and Reading	~ 250	\$5 / Fish	~ 250	\$20 / Fish
Escapement Recovery and Reading	~ 1000	\$5 / Fish	Included in Broodstock	
Total		\$ 12,210		\$ 9,200

Results: Net Present Value

	Coded Wire Tagging	Genome Based Tagging	
Productivity	Net Present Value (\$'000s)	Net Present Value (\$'000s)	Value of Genomic Technologies (\$'000S)
Low	-265	-199	65
Mid	3,695	4,092	477
High	15,157	18,134	976

Discussion and Future Development

- Production of coho is highly dependent on marine survival
- Even in the absence of fishing, genomic-based technologies can provide the same information to managers at a cheaper cost;
- Additional benefits from improved production will accrue to recreational angling industry, the largest fishing industry in BC in terms of participation and economic impact;
- Analysis may be extrapolated to encompass all BC coho fisheries.

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Costs	Amount (\$)
Wages for Skipper	1,201
Wages for Crew	764
Fleet and Gear Repairs	430
Gas	700
Food	75
Skipper Bonus	371
Salmon Troll (AT) Licence	120,000

Parameter	Amount
Price/kg (\$)	3.02
Average weight (kg)	3.46
Area F Troll Harvest in 2009 (H)	220,436
Total coho run in 2009 (R)	327,636
Active boat-weeks in Area F troll fishery in 2009	750
Weeks of Fishing for coho in 2009	12

	Alpha	Beta	R ²
Low (1995-2012)	0.978	40554.4	0.373
Middle	1.474	90,793	NA
High (1985-1994)	1.971	141,043	0.309