

# Ghost Runs: management and status assessment of Pacific salmon returning to British Columbia's central and north coasts

Michael H.H. Price<sup>1</sup>, Christopher T. Darimont<sup>1,2</sup>, Nicola F. Temple<sup>1</sup> and S. Misty MacDuffee<sup>1</sup>

<sup>1</sup>Raincoast Conservation Foundation PO Box 2429 Sidney, BC Canada, <sup>2</sup>Dept of Environmental Studies, University of California, Santa Cruz, CA, USA

## Introduction

**Spawner escapement targets** were created to ensure adequate numbers of spawning salmon and are considered widely relevant today. The ability to meet these targets provides a way to evaluate whether basic management strategies have been achieved.

**Annual monitoring** by Canada's Department of Fisheries and Oceans (DFO) informs: stock status; abundance trends; exploitation rates; and productivity. Data are useful for harvest models, harvest decisions and conservation plans.

## Objectives

- to evaluate the ability to achieve **spawner escapement targets** since 1950.
- to examine DFO's **annual monitoring efforts** since 1950.

## Methods

Monitoring efforts and escapement data were examined for commercially managed salmon in coastal British Columbia's Management Areas 3-10 (Fig. 1) between 1950 and 2005.

- Spawning records classed into three categories: *indicator streams*, *non-indicator streams*, or *streams without information*.
- Annual escapement in *indicator streams* were averaged by decade, compared to the target escapement, and classed as: *meets target*, *depressed*, *very depressed*, or *unknown*.
- We used AIC to evaluate which factors influenced the decisions to drop streams from monitoring efforts.
- Additionally, we evaluated the proportion of newly-established Conservation Units (CUs) captured in contemporary monitoring efforts.

Decade	Assessment	Chinook	Coho	Sockeye	Chum	Pink Even	Pink Odd
1950	Escapement	81 635	194 286	1 214 571	480 042	1 539 823	1 870 768
	Meets Target (%)	19	15	25	22	23	14
	Depressed (%)	11	21	28	37	17	15
	Very Depressed (%)	30	42	30	37	50	61
	Unknown (%)	41	21	15	4	11	11
1960	Escapement	71 320	192 022	1 529 056	472 922	4 339 656	2 034 378
	Meets Target (%)	15	15	18	18	44	20
	Depressed (%)	11	21	40	41	21	24
	Very Depressed (%)	48	36	40	39	26	50
	Unknown (%)	26	27	3	0	9	6
1970	Escapement	57 216	116 404	1 949 039	523 603	3 445 347	1 982 724
	Meets Target (%)	0	9	23	22	52	15
	Depressed (%)	22	15	38	39	24	42
	Very Depressed (%)	67	64	40	39	20	36
	Unknown (%)	11	12	0	0	5	6
1980	Escapement	77 077	104 189	2 841 318	512 508	3 648 158	4 257 666
	Meets Target (%)	7	9	25	12	41	42
	Depressed (%)	19	33	40	45	33	33
	Very Depressed (%)	67	48	35	43	26	24
	Unknown (%)	7	9	0	0	0	0
1990	Escapement	109 286	40 858	2 648 937	615 140	3 644 587	3 367 981
	Meets Target (%)	11	15	20	16	29	29
	Depressed (%)	22	9	23	20	41	32
	Very Depressed (%)	56	9	50	57	26	32
	Unknown (%)	11	67	8	6	5	8
2000	Escapement	62 116	62 246	1 407 130	716 146	3 697 642	4 769 329
	Meets Target (%)	7	18	20	20	51	54
	Depressed (%)	15	3	5	27	11	17
	Very Depressed (%)	26	6	48	24	21	6
	Unknown (%)	52	73	28	29	17	23
Management goal		210 175	444 000	2 218 250	1 092 000	4 384 000	4 384 000

\* Management goal is Fisheries and Ocean's Canada annual escapement target (MTE).

Table 1. Average escapement by species, decade and associated status in indicator streams (n=215)

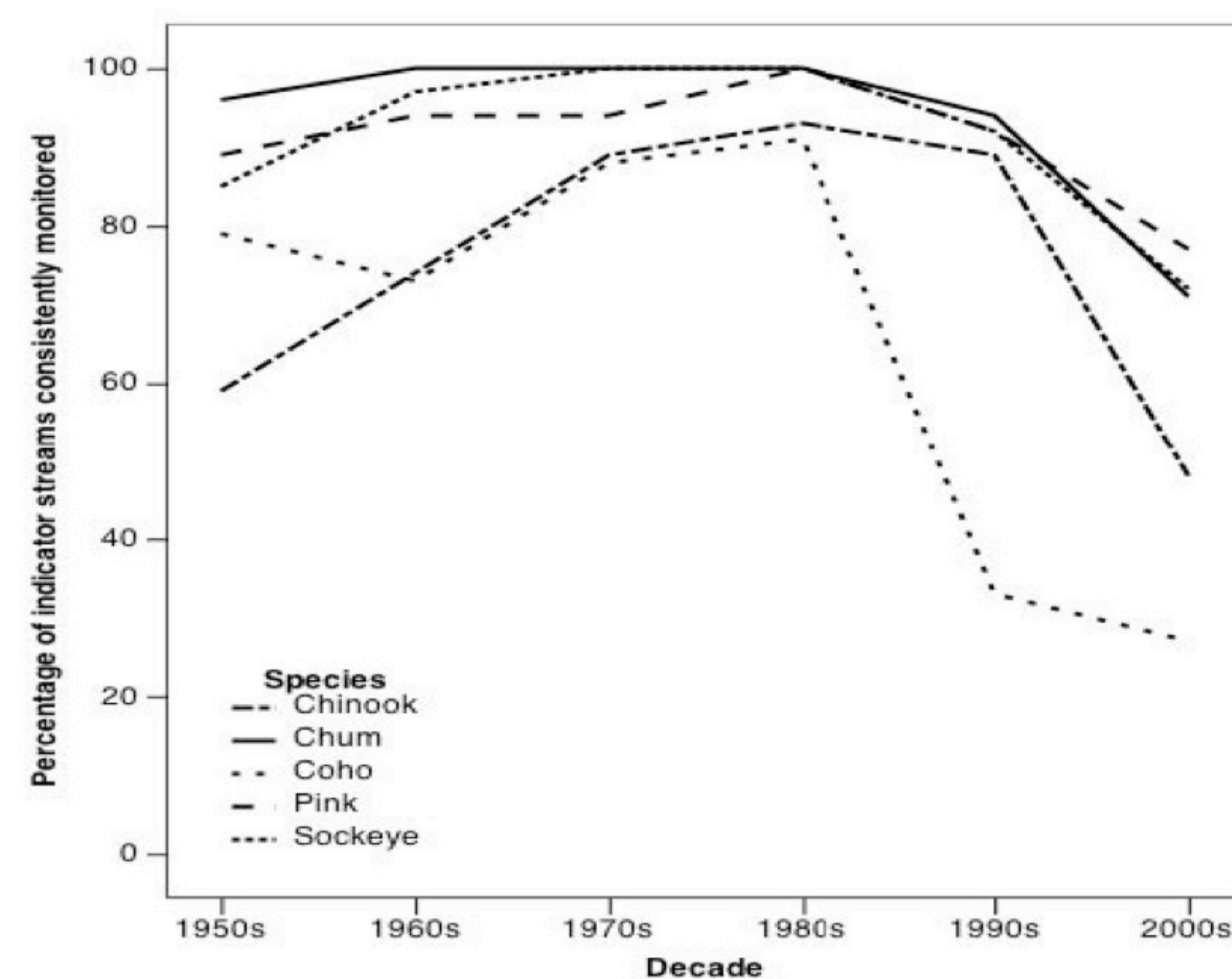


Figure 2. Decadal trends in monitoring effort for salmon indicator streams (n=215) on BC's central and north coasts 1950-2005

## Results

### Meeting Target Escapements

- < 4% of monitored streams consistently met decadal targets since 1950.
- Chinook, chum and sockeye were depressed or very depressed in > 50% of streams 2000-2005 (85%, 72% and 73% respectively).

### Escapement Monitoring

- Only 30% of 2,592 identified salmon-bearing streams were monitored at least once in the last 55 years
- *Indicator streams* (n=215) comprise only 8% of salmon-bearing streams.
- Continual erosion of monitoring effort over the decades (Fig 2); by 2005 only 137 indicator streams were monitored
- Monitoring is highest for sockeye and Chinook (13%) and lowest for coho (2%).

The status and size of runs were the best predictors of monitoring cessation; *depressed* or *very depressed* runs, especially those with smaller average run size, were most likely to be dropped from monitoring.

### Conservation Unit monitoring

CU enumeration effort (minimum one stream/CU monitored) ranged from 13% of sockeye CUs to 88% of pink CUs, with an average of 28%.

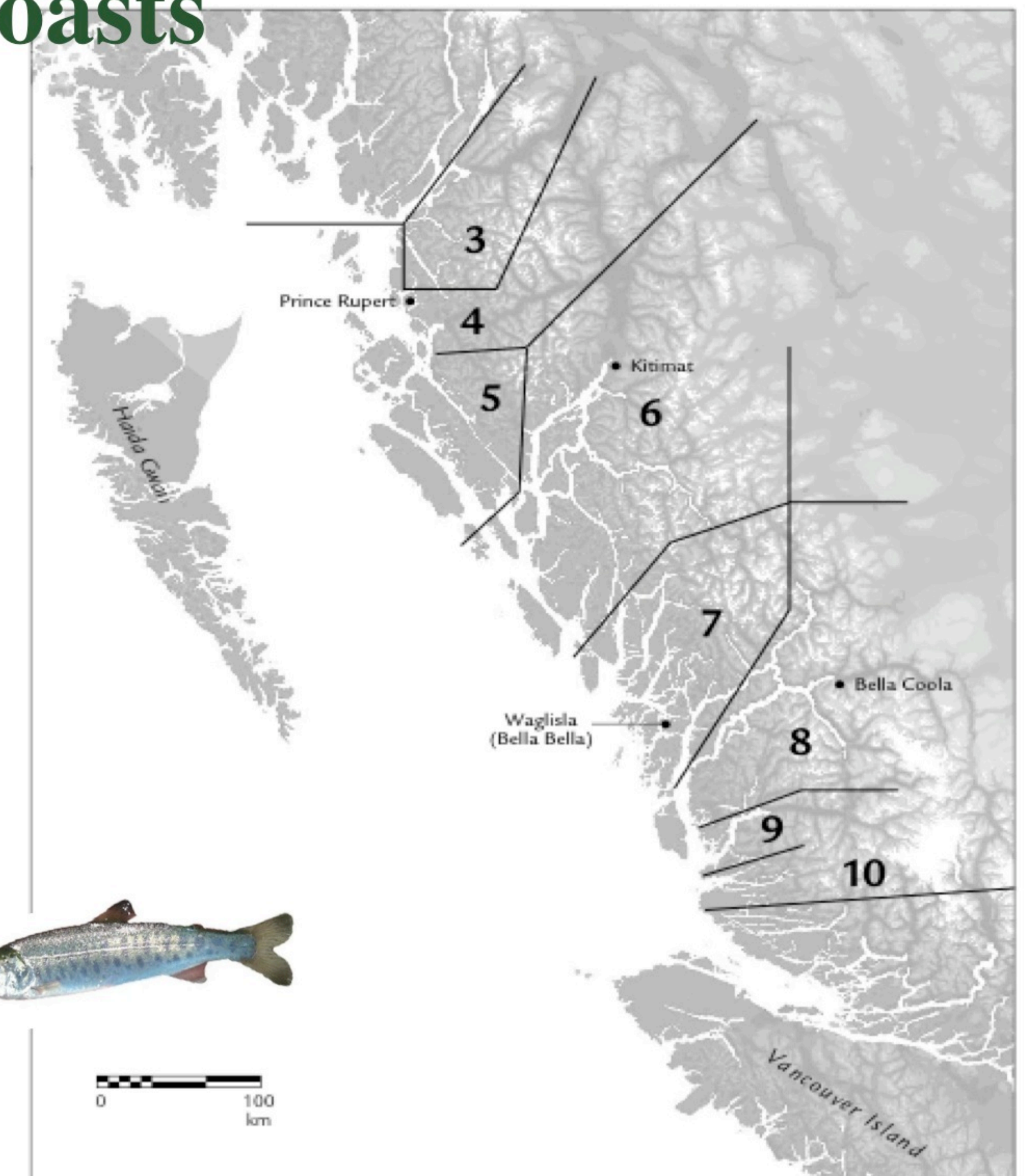


Fig. 1. Study Area encompassing salmon fishery Management Areas 3-10 on BC's central and north coasts.

## Discussion

Spawner escapements have repeatedly fallen short of DFO's targets over the last six decades, resulting in a diminished status for all species in nearly every decade.

Monitoring efforts have been eroding since the 1980s and in a highly biased manner that contributes to a 'shifting baseline' syndrome. For example, the percentage of runs classed as *diminished* during 2000-2005 was 35%; yet, if runs classified likewise in the previous decade were included (instead of dropped), the percentage increases to 72%.

Adequate monitoring of Conservation Units needs to occur if these populations are regarded as distinct and important.

### Conservation Implications

- Small spawning streams, now largely unmonitored, far out-number larger systems in this region, and likely contribute dis-proportionately to ecosystem productivity and evolutionary processes.
- Declining enumeration effort and one biased to larger, healthier runs gives a skewed evaluation of population health and undermines fishery and conservation decisions.
- If current exploitation levels and monitoring efforts remain unchanged, BC's central and north coasts might only support *Ghost Runs* - diminished or extirpated runs, abandoned from monitoring, that once flourished with salmon.

### Future work

- Do spawner reductions equate to nutrient deficits?
- Nutrient budgets and paleo studies that quantify contributions from salmon
- Influencing fishery policy to consider wildlife and ecosystem objectives in harvest levels