Appendix 3

Area 06 - Douglas Gardner CU Chum Salmon

Coastland

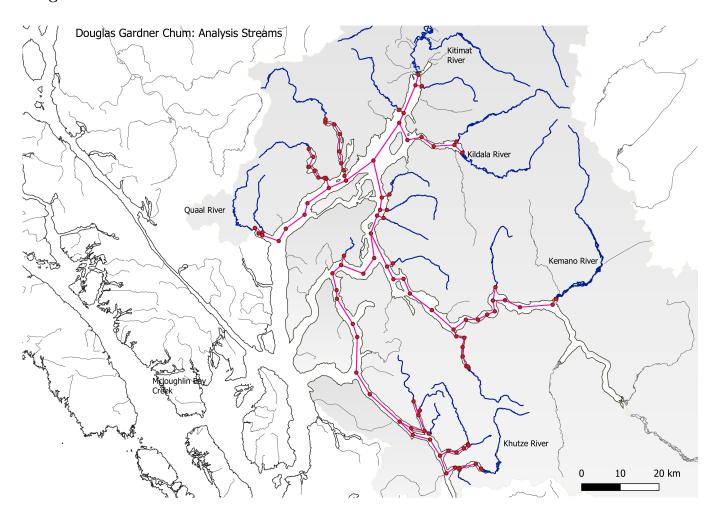
2022-12-07

Contents

Study area	2
Douglas Gardner CU	2
Summary figures	3
Escapement: Raw and filtered stream list	3
Hatchery Releases: Total and by release site	6
Metrics	8
Escapement, logged escapement, Z-scores, Pavg, and moving average	8
Moving average and LOESS fits	S
Means trends by enhancement rank	10
Recruits per spawners	11
Recruits per spawner by system	11
Log recruits per spawner by system by period	12
Log RPS comparison before and after enhancement	14
Bubbleplots of metric by inlet	15
Correlation analyses and Dendrograms	17
Cross correlation plots	17
Dendrogram cluster analysis	18
Tanglegrams to compare dendrograms	19
Pre- and post-enhancement correlation analyses	22
Statistical models	27
Candidate Models with AIC scores for log RPS and log escapement	27
Effects plots for top models for log RPS	28
Effects plots for top model for log escapement	29

Study area

Douglas Gardner CU



Summary figures

Escapement: Raw and filtered stream list

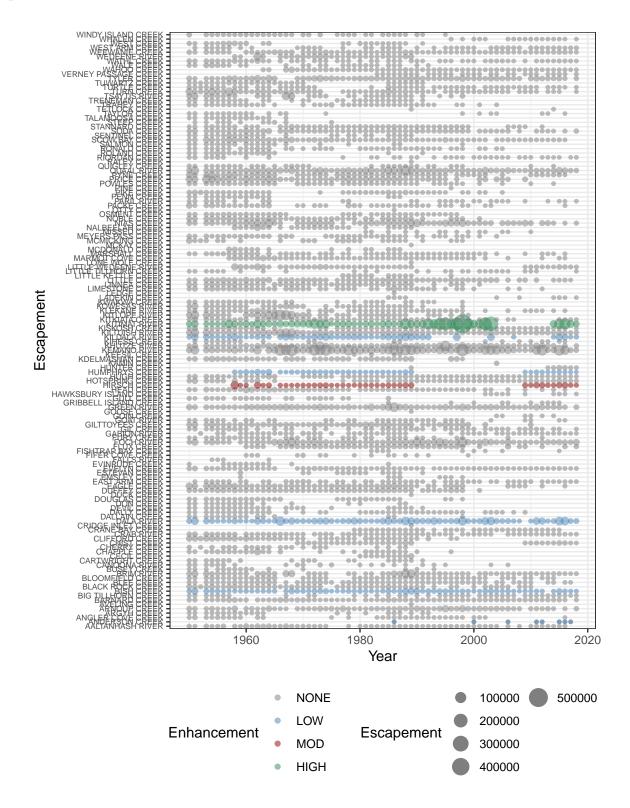


Figure 1: Escapement to all Douglas-Gardner chum streams in the PSE database, by enhancement rank.

Area 6 Escapement (filtered streams) **AALTANHASH RIVER BISH CREEK BRIM RIVER CRAB RIVER** DALA RIVER **EVELYN CREEK** 20000 **FOCH RIVER GILTTOYEES CREEK HEAD CREEK** HIRSCH CREEK **HUGH CREEK HUMPHRYS CREEK** N Ω **KEMANO RIVER** KHUTZE RIVER KILDALA RIVER Escapement 20000 KILTUISH RIVER KITIMAT RIVER KITKIATA CREEK 100000 KLEKANE RIVER LITTLE WEDEENE RIVER MARMOT COVE CREEK MARSHALL CREEK PIKE CREEK QUAAL RIVER SCOW BAY CREEK WATHL CREEK WEEWANIE CREEK Year Enhancement Level → HIGH → LOW → MOD → NONE

Figure 2: Escapement to filtered streams for Douglas-Gardner chum. Colour shows the stream enhancement level from the PSE database.

Table 1: Distance from Kitimat River (major enhancement location for chum systems included in analysis.

Stream	Dist. from enhancement
WATHL CREEK	4.470
BISH CREEK	11.998
DALA RIVER	32.303
KILDALA RIVER	34.146
HUGH CREEK	37.112
WEEWANIE CREEK	39.982
PIKE CREEK	41.635
FOCH RIVER	52.191
GILTTOYEES CREEK	52.216
CRAB RIVER	55.985
KITKIATA CREEK	63.528
EVELYN CREEK	64.768
QUAAL RIVER	65.544
KILTUISH RIVER	91.658
BRIM RIVER	97.710
KEMANO RIVER	111.829
MARMOT COVE CREEK	117.746
SCOW BAY CREEK	122.091
KLEKANE RIVER	124.855
HEAD CREEK	132.104
AALTANHASH RIVER	132.200
MARSHALL CREEK	133.004
KHUTZE RIVER	138.697

Hatchery Releases: Total and by release site

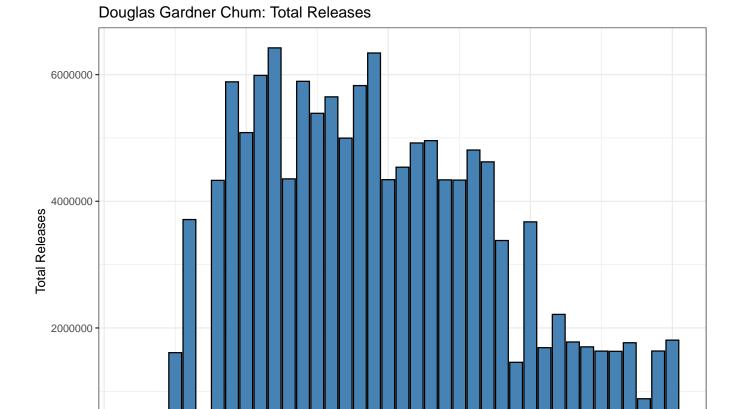


Figure 3: Total releases in the Douglas Gardner CU.

Release Year

Release site:Origin stock Bish Cr:Bish Cr Dala R:Dala R Hirsch Cr:Hirsch Cr Hirsch Cr:Kitimat Low+Hirsch Releases Humphreys Cr:Humphreys Cr Kildala R:Kildala R Kildala R:Kildala+Dala Kitimat R:Kitimat R 2000000 -Release Year

Chum: Douglas Gardner CU

Figure 4: Releases by release site:origin stock for chum in the Douglas Gardner CU.

Release Stage - Fed Fry

Metrics

Escapement, logged escapement, Z-scores, Pavg, and moving average

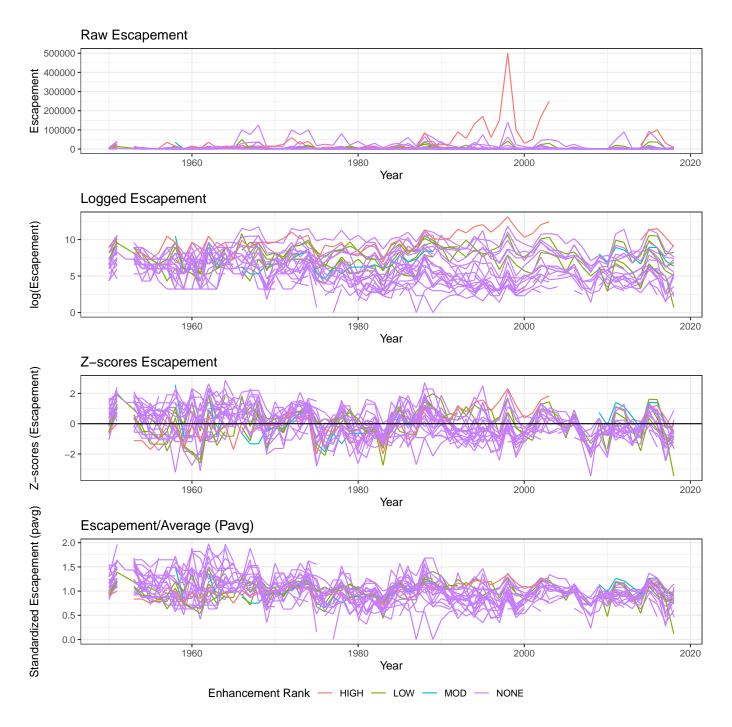


Figure 5: Various plots for escapement and transformations.

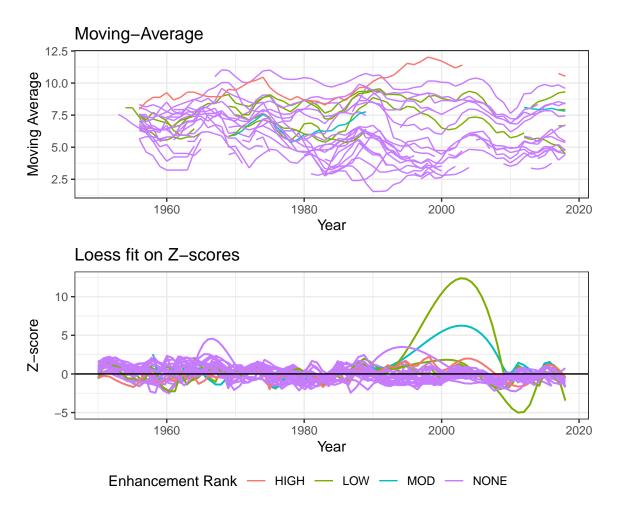


Figure 6: Moving average and LOESS fits on logged escapement by enhancement ranking.

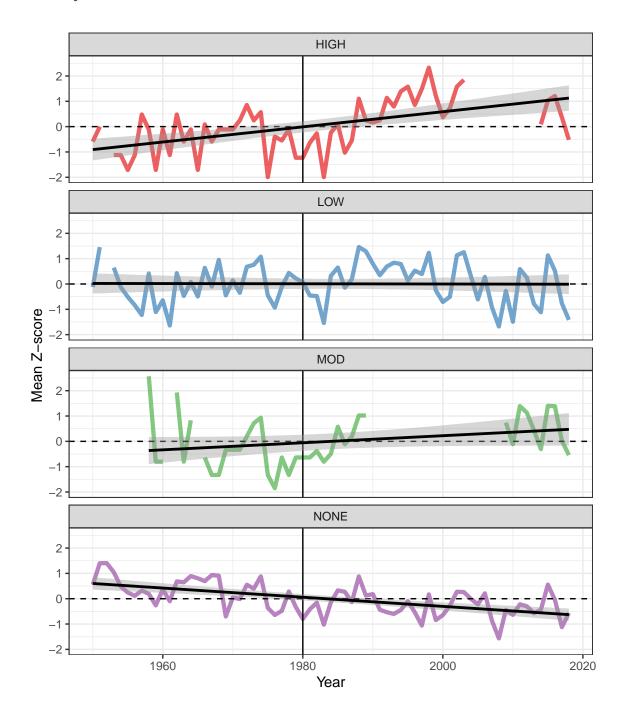


Figure 7: Douglas-Gardner chum: Mean Z-score for analysis streams by enhancement rank. Linear regression over all years with SE are shown.

Recruits per spawners

Recruits per spawner by system

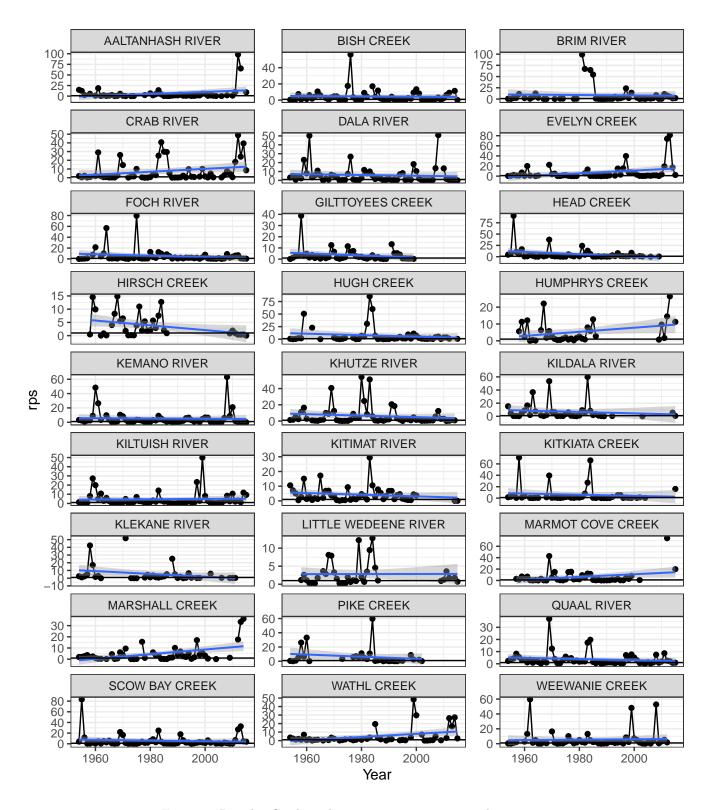


Figure 8: Douglas-Gardner chum: recruits per spawner by system.

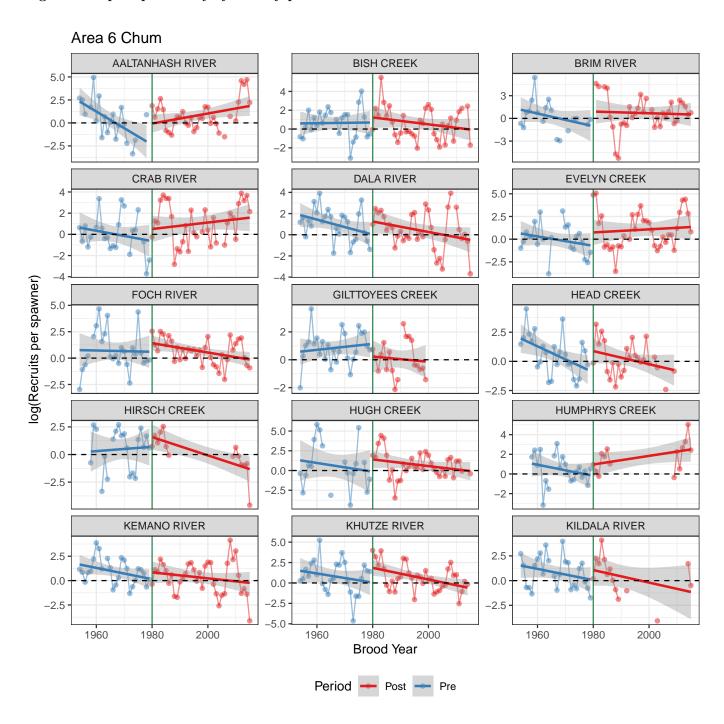


Figure 9: Douglas-Gardner chum: log recruits per spawner by system fitted with linear regression for the periods preand post-enhancement (Aaltanhash to Kildala).

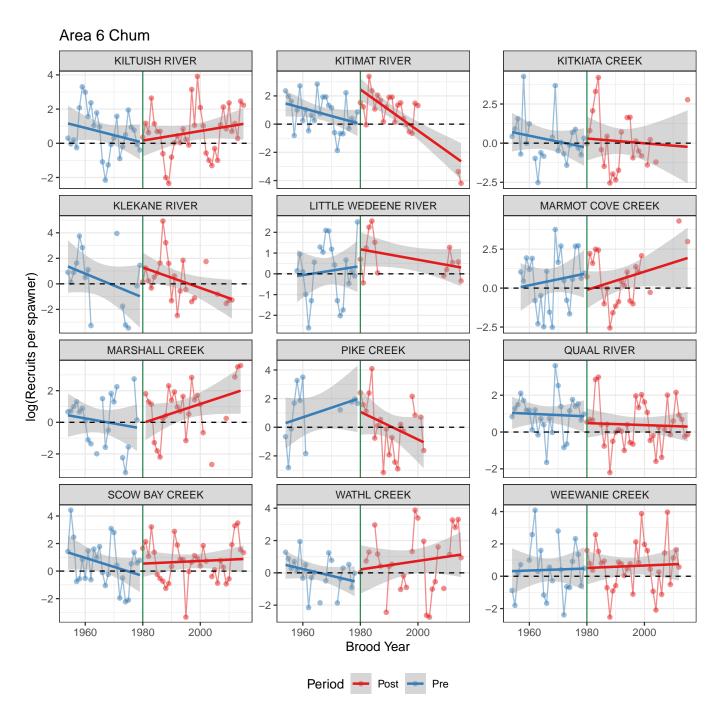


Figure 10: Douglas-Gardner chum: log recruits per spawner by system fitted with linear regression for the periods preand post-enhancement (Kiltuish to Weewanie).

Log RPS comparison before and after enhancement

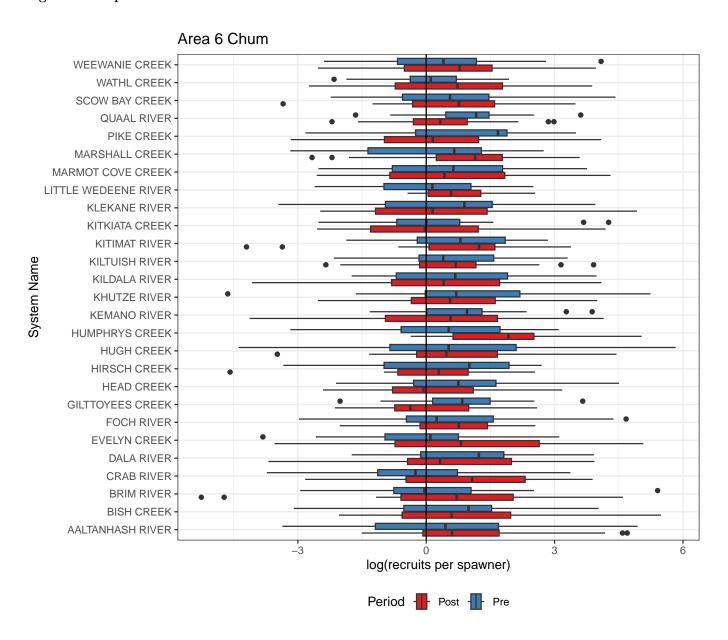


Figure 11: Douglas-Gardner chum: boxplot of log recruits per spawner by system.

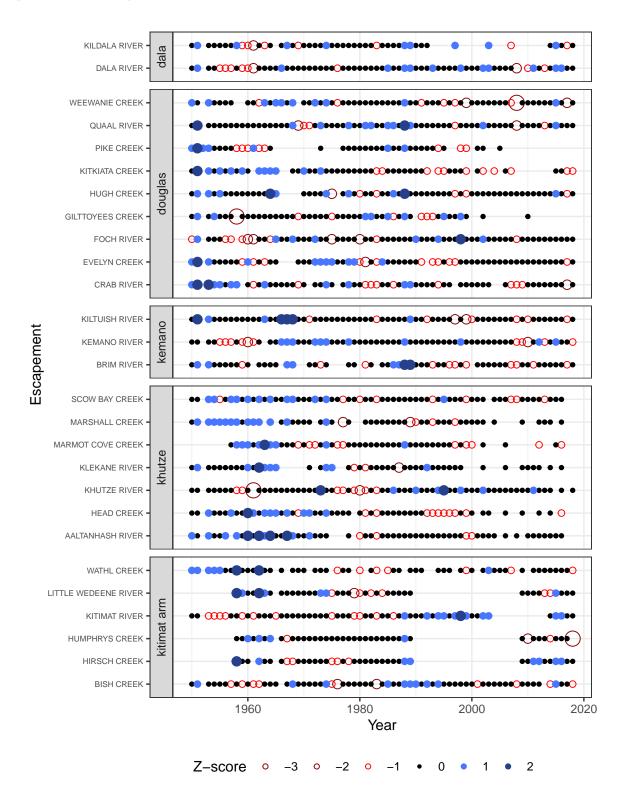


Figure 12: Escapement by inlet and z-score

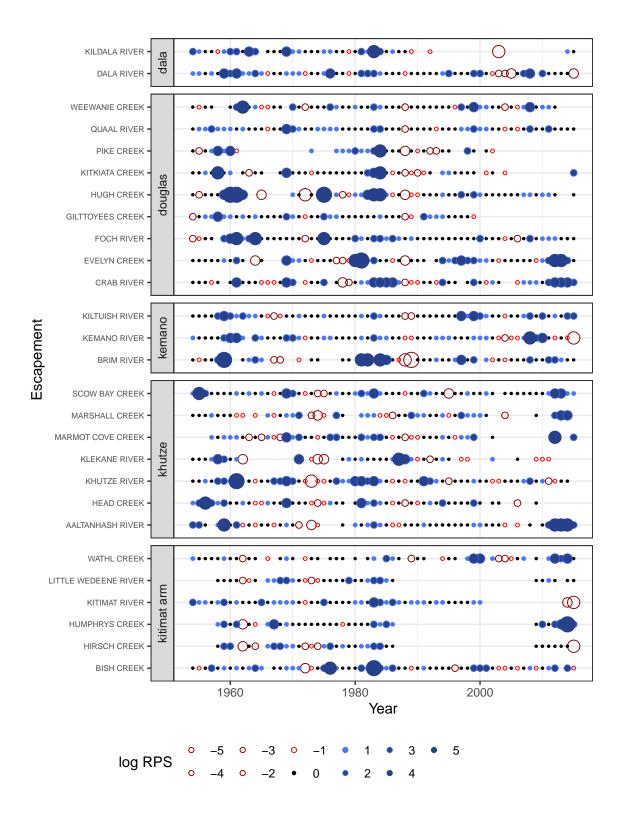


Figure 13: Escapement by inlet and log RPS

Correlation analyses and Dendrograms

Cross correlation plots

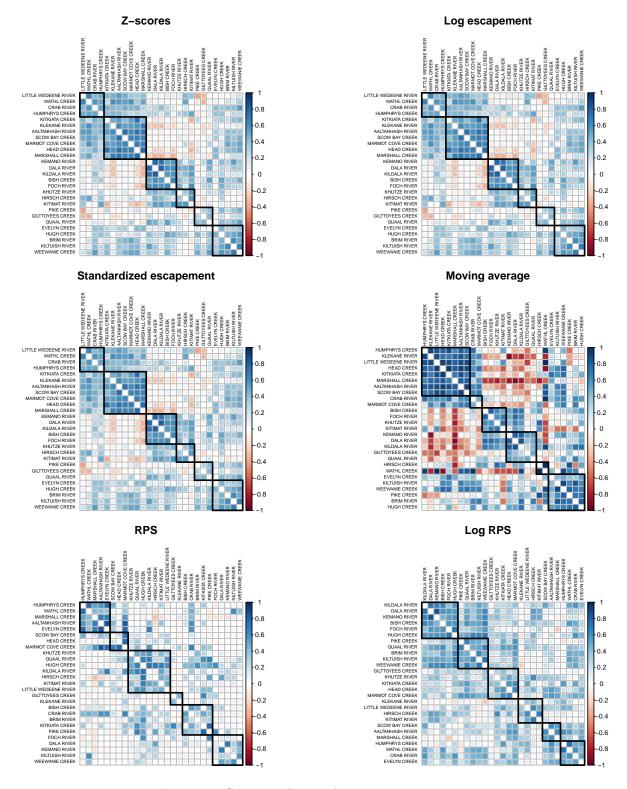


Figure 14: Cross correlation plots to compare metrics.

Dendrogram cluster analysis

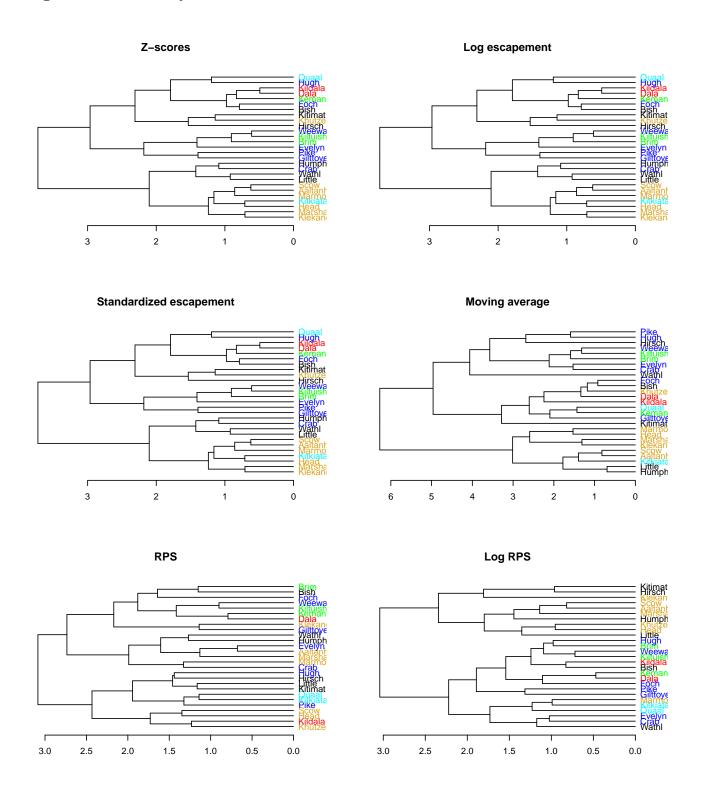


Figure 15: Dendrogram cluster analysis to compare uses of different metrics. Colours plotted by subinlet; Dala = red; Douglas = blue; Kemano = green; Khutze = yellow; Kitimat arm = black; Quaal = turquoise

Tanglegrams to compare dendrograms

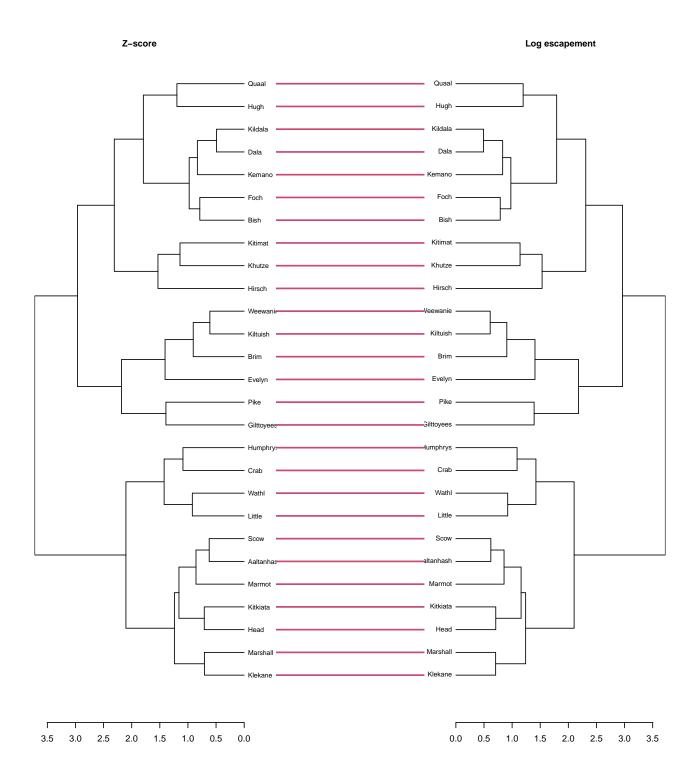


Figure 16: Tanglegram of z-score vs. logged escapements

Z-score Moving average

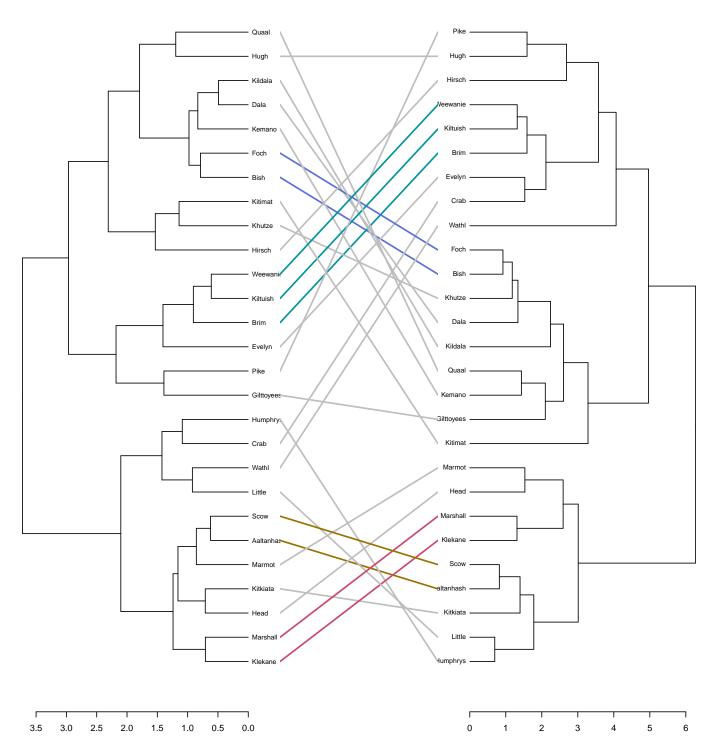


Figure 17: Tanglegram of z-score vs. moving average

Z-score Log RPS

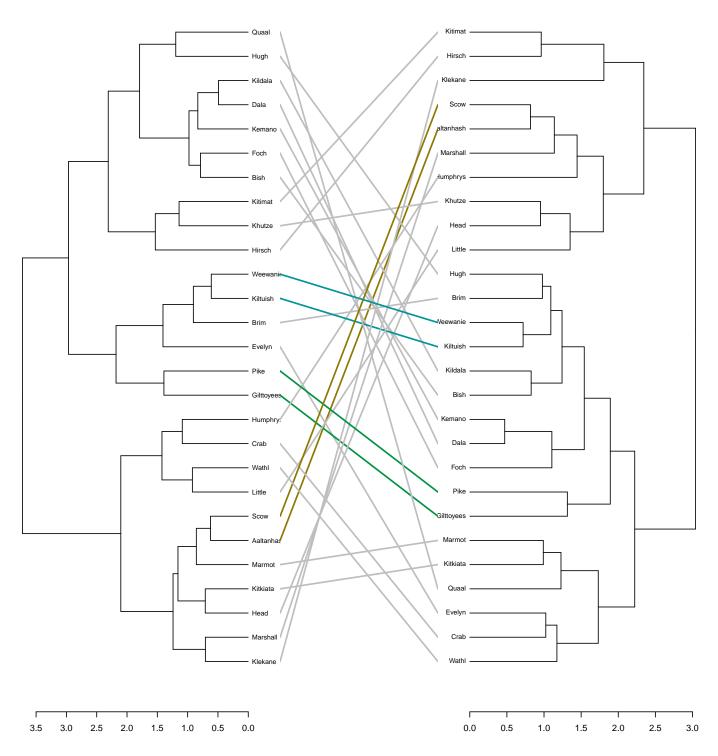


Figure 18: Tanglegram of z-score vs. Log RPS $\,$

Pre- and post-enhancement correlation analyses

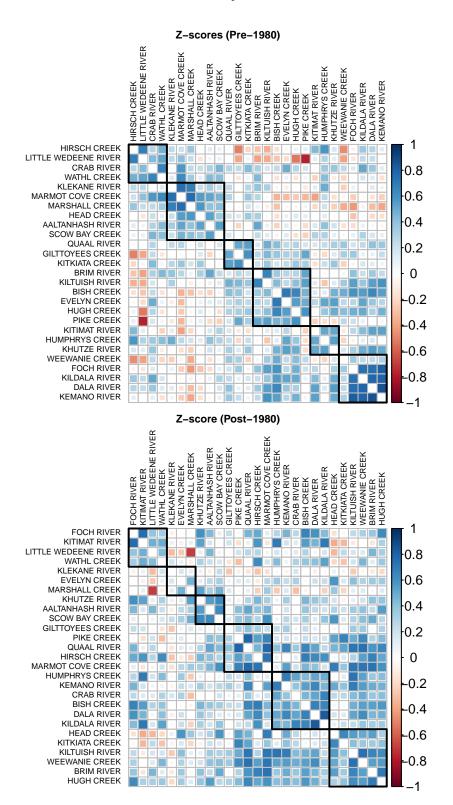


Figure 19: Cross correlation plots of z-scores to compare pre- and post-enhancement.

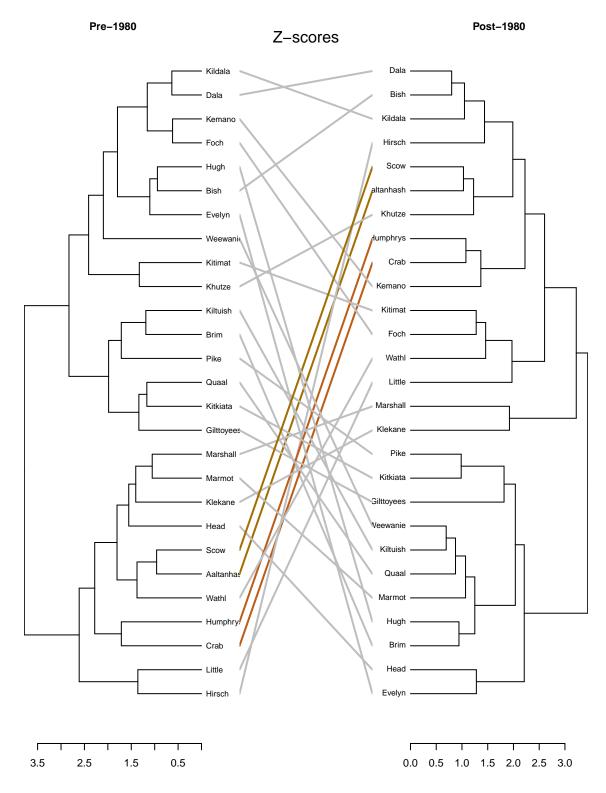


Figure 20: Tanglegram comparing z-scores pre- and post-enhancement (1980)

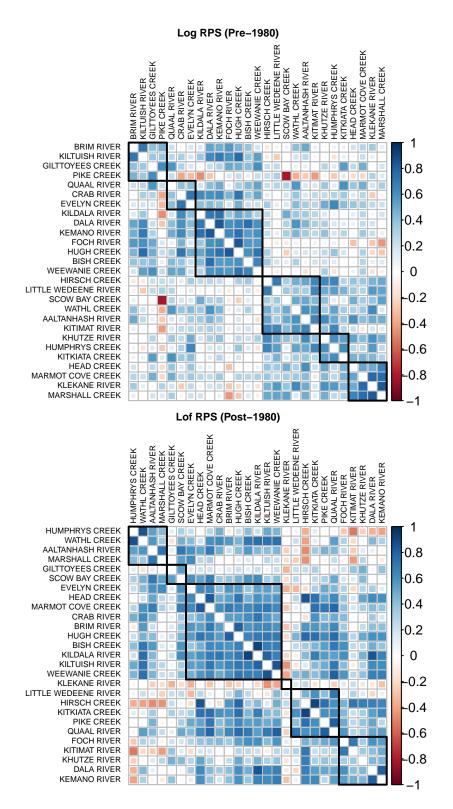


Figure 21: Cross correlation plots of Log RPS to compare pre- and post-enhancement.

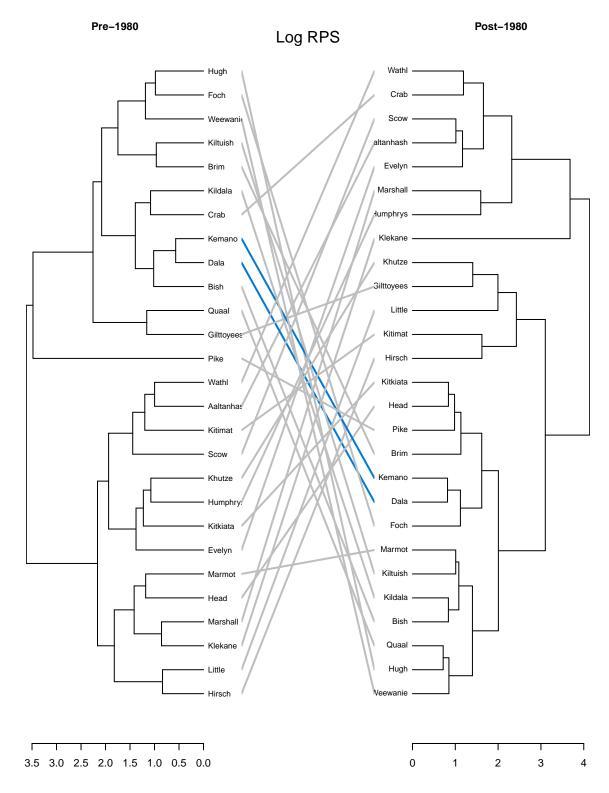


Figure 22: Tanglegram comparing Log RPS pre- and post-enhancement (1980)

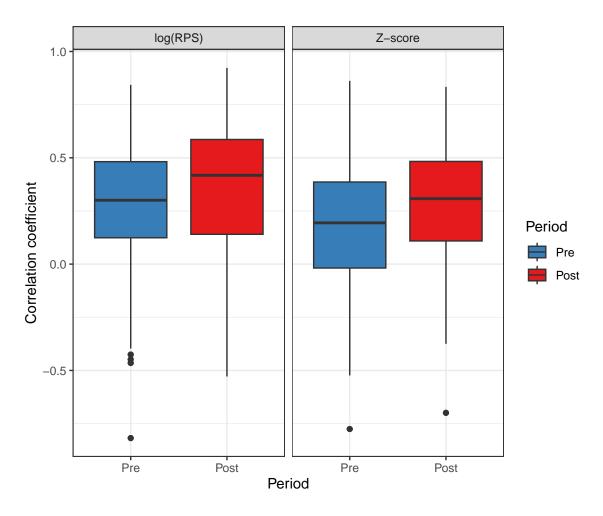


Figure 23: Comparison between correlation coefficients for all pairwise combinations of streams using Z-score and log(RPS) over the pre- and post-1980 periods.

Statistical models

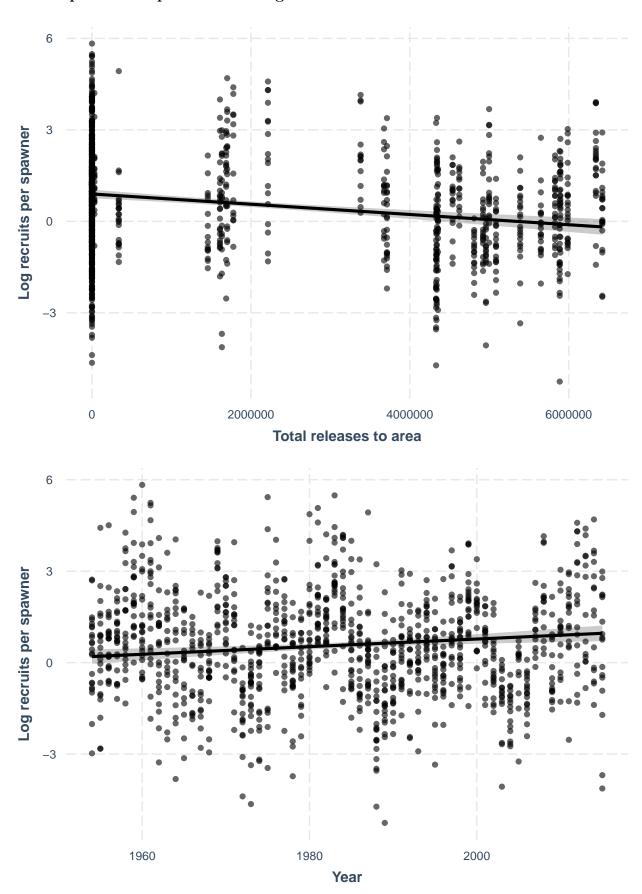
Candidate Models with AIC scores for log RPS and log escapement

Table 2: Candidate models for log RPS and distance from enhancement (dist), total releases (totrel), and year, with AIC scores.

Response	Candidate model	df	AIC
log RPS	$Log RPS \sim dist + totrel + year$	5	4640.250
log RPS	$Log RPS \sim dist + totrel$	4	4649.087
log RPS	Log RPS ~ dist	3	4674.840
log RPS	$Log RPS \sim dist + year$	4	4675.224
log RPS	$Log RPS \sim totrel + year$	4	5207.678
log RPS	$Log RPS \sim releases$	3	5213.524
log RPS	Log RPS ~ year	3	5237.491

Table 3: Candidate models for log escapement and distance from enhancement (dist), total releases (totrel), and year, with AIC scores.

Response	Candidate model	df	AIC
log escapement	$Log esc \sim dist + year$	4	5455.093
log escapement	$Log esc \sim dist + totrel + year$	5	5457.085
log escapement	$Log esc \sim dist + totrel$	4	5468.276
log escapement	Log esc ~ dist	3	5478.798
log escapement	$Log esc \sim year$	3	6220.673
log escapement	$Log esc \sim totrel + year$	4	6222.325
log escapement	Log esc ~ releases	3	6236.895



Effects plots for top model for log escapement

