Tucannon: Summary of CHaMP Metrics and Modeled Products

- CHaMP metrics are directly measured at each CHaMP site according to probabilistic sampling design. Metric included in this summary are:
  - Sinuosity
  - Substrate < 2 mm
  - Substrate < 6 mm
- Modeled products are built from CHaMP data and additional mechanistic or empirical knowledge, assessed at each CHaMP Site
  - Habitat Suitability Index (HSI)
  - Net Rate of Energy Investment (NREI)

CHaMP Metrics and Modeled Products: Summaries by Assessment Unit

- Estimated Population Distributions of CHaMP Metrics and Modeled Products, by Assessment Unit
  - Aka “GRTS Rollups”
  - Metrics from CHaMP sites were used to estimate the mean and standard deviations for the entire Assessment Unit
  - Design based statistical estimations are used to estimate population level responses and corresponding standard errors at spatial scales larger than individual CHaMP site
    - Using R-package spsurvey
    - Estimates are robust and unbiased
    - No distributional assumptions required
  - References:

    - Stevens Jr DL, and Olsen AR (2004). Spatially balanced sampling of natural resources. J Am Stat Assoc, 99:465, 262-278, DOI: 0.1198/016214504000000250.
    - Kincaid TM, Olsen AR (2013). Spsurvey: spatial survey design and analysis. R package version 2.6. URL: http://www.epa.gov/nheerl/arm/.

CHaMP Metrics and Modeled Products: Continuous Estimates

- Model assisted regression models were generated to make spatially continuous estimates at all points along continuous stream networks
  - Required for continuous response map generation
  - Metrics and products are “extrapolated” beyond measured points
  - CHaMP metrics and modeled products are empirically fit to globally available attributes (GAA).
  - Model assisted regression used to account for non-uniform sample inclusion probabilities
    - R-package “survey”

  - Model details in appendix.

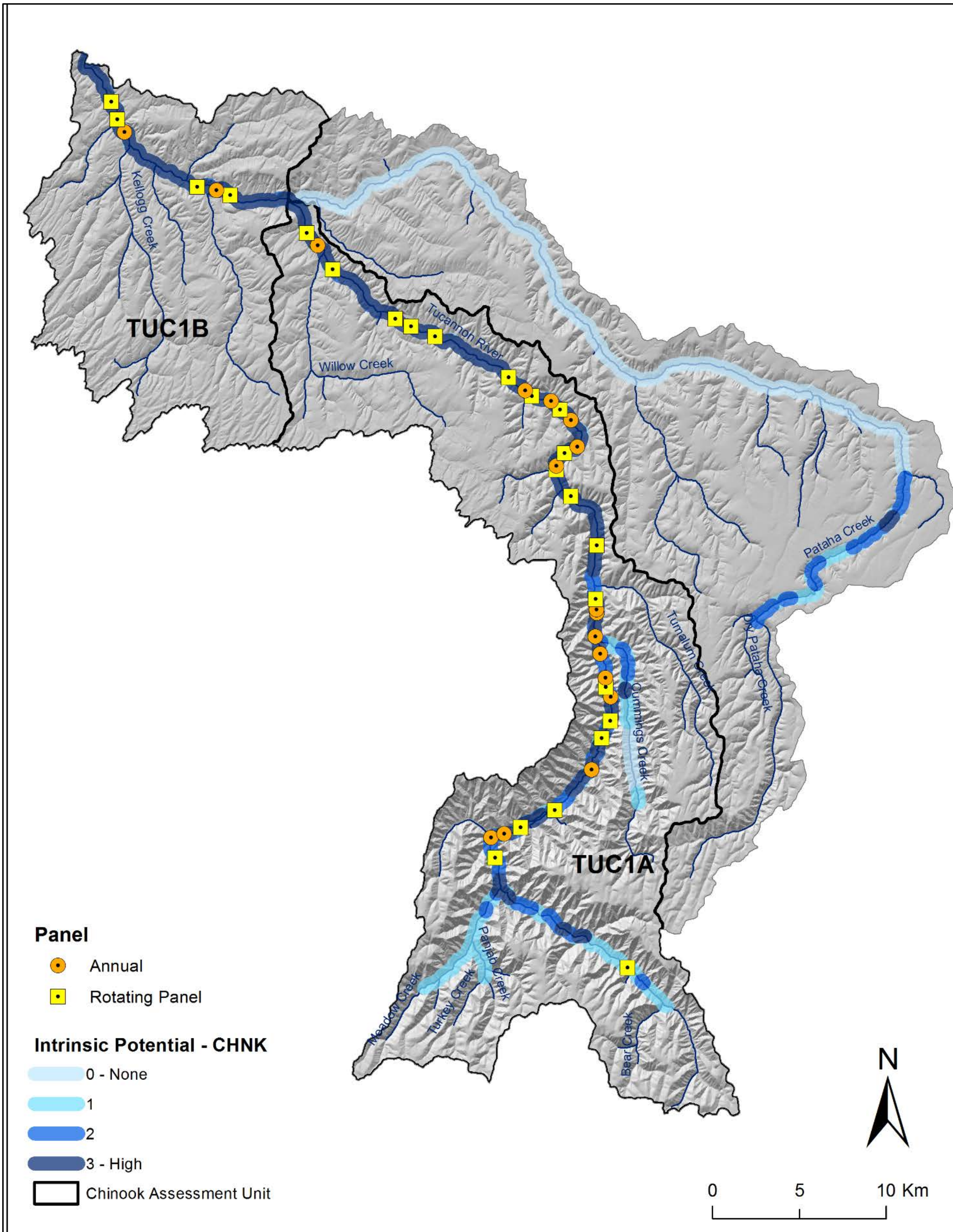
  - References

    - Lumley T (2004). Analysis of complex survey samples. J Stat Software 9(1): 1-19.
    - Lumley T (2012). Survey: analysis of complex survey samples. R package version 3.28-2.
    - Nahorniak M, Larsen DP, Volk C, Jordan CE (2015) Using Inverse Probability Bootstrap Sampling to Eliminate Sample Induced Bias in Model Based Analysis of Unequal Probability Samples. PLoS ONE 10(6): e0131765. doi:10.1371/journal.pone.0131765

Summary by Chinook Assessment Unit

Tucannon: Summary of CHaMP Metrics and Modeled Products

Chinook Intrinsic Potential



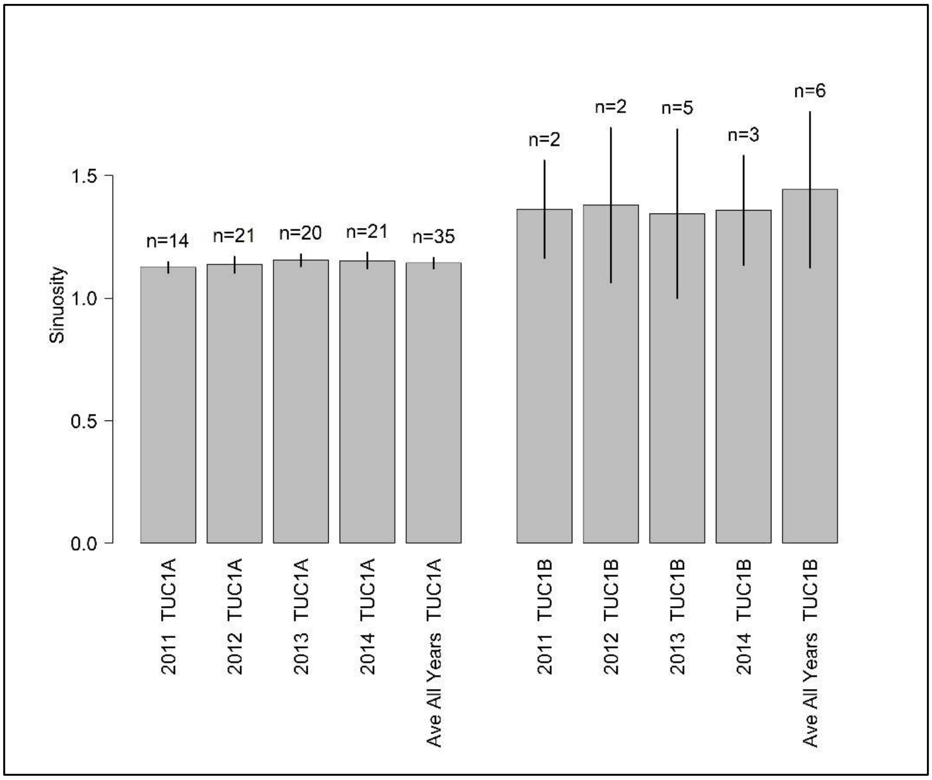
CHaMP Metrics

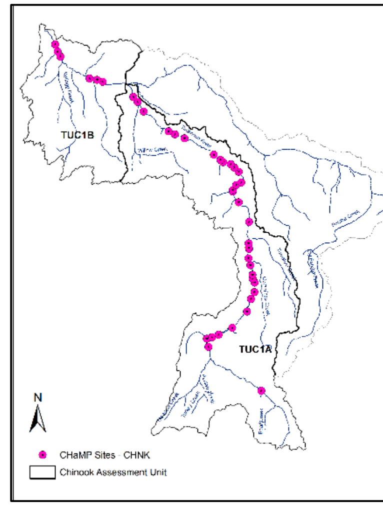
- **Sinuosity (Sin)**
  - Ratio of the thalweg length to the straight line distance between the start and end points of the thalweg.

- **Substrate > 2 mm and Substrate < 6 mm**
  - Average percentage of pool tail substrates comprised of fine sediment <2 mm and < 6 mm, respectively.
  - **Details**
    - Substrates metrics are directly measured by CHaMP crews as the percentage of 50 substrate observations less than 2mm or 6mm, respectively, measured at each of three grid locations (150 total observations per site), at the pool tail of each channel unit.
    - Additional details available at: https://www.monitoringmethods.org/Method/Details/868

Sinuosity

- Source: CHaMP Metrics (www.champmonitoring.org)
- Definition: Ratio of the thalweg length to the straight line distance between the start and end points of the thalweg.

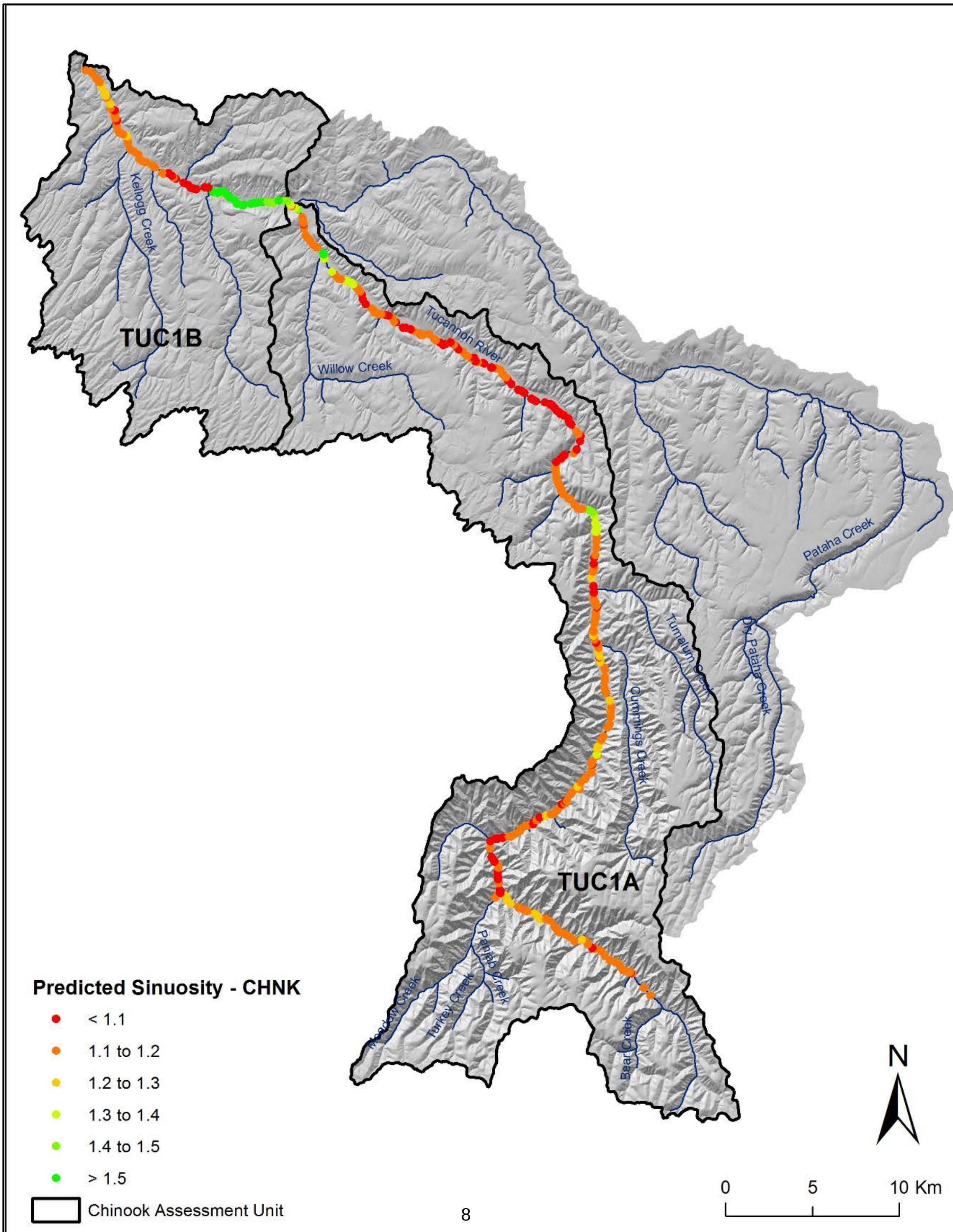




Sub Population	Visit Year	N	Mean	St Dev
All.Sites	2011	16	1.154	0.1
	2012	23	1.172	0.131
	2013	25	1.2	0.202
	2014	24	1.183	0.127
	Average of All Years	41	1.197	0.204
TUC1A	2011	14	1.125	0.053
	2012	21	1.137	0.077
	2013	20	1.155	0.07
	2014	21	1.153	0.087
	Average of All Years	35	1.143	0.079
TUC1B	2011	2	1.362	0.107
	2012	2	1.379	0.185
	2013	5	1.345	0.36
	2014	3	1.357	0.175
	Average of All Years	6	1.442	0.357

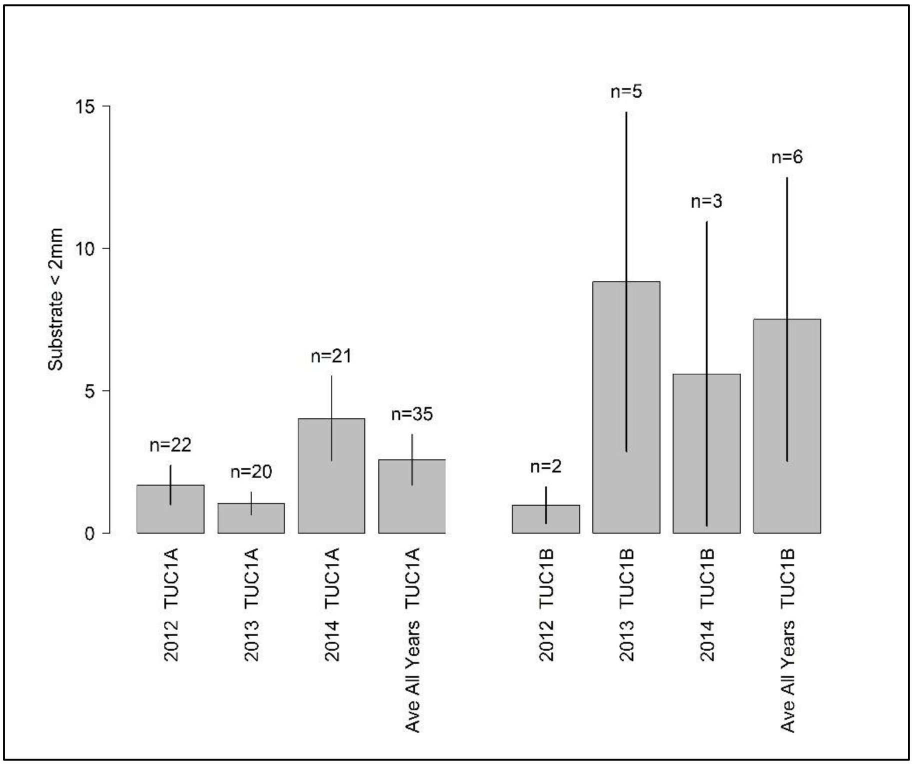
Sinuosity

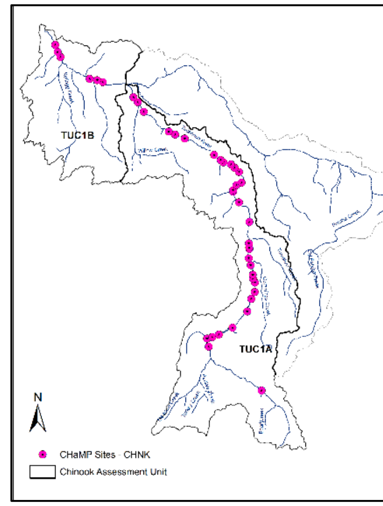
- Source: CHaMP Metrics (www.champmonitoring.org)
- Definition: Ratio of the thalweg length to the straight line distance between the start and end points of the thalweg.



Substrate < 2 mm

- Source: CHaMP Metrics (www.champmonitoring.org)
- Definition: Average percentage of pool tail substrates comprised of fine sediment <2 mm

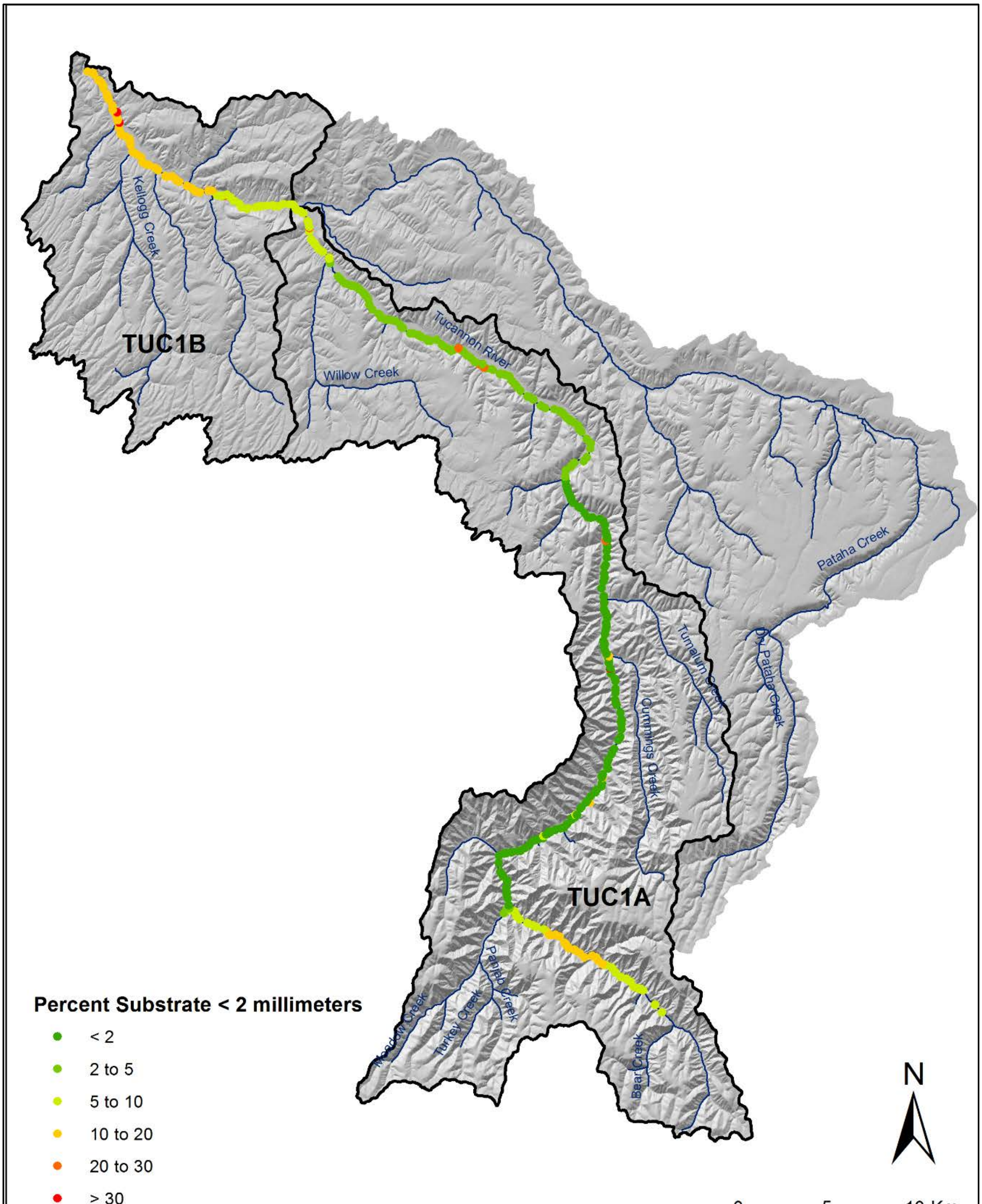




Sub Population	Visit Year	N	Mean	St Dev
All.Sites	2012	24	1.59	1.746
	2013	25	2.892	5.023
	2014	24	4.255	3.681
	Average of All Years	41	3.469	4.443
TUC1A	2012	22	1.691	1.86
	2013	20	1.041	1.135
	2014	21	4.02	3.193
	Average of All Years	35	2.576	2.475
TUC1B	2012	2	0.982	0.375
	2013	5	8.829	7.467
	2014	3	5.595	5.534
	Average of All Years	6	7.503	7.835

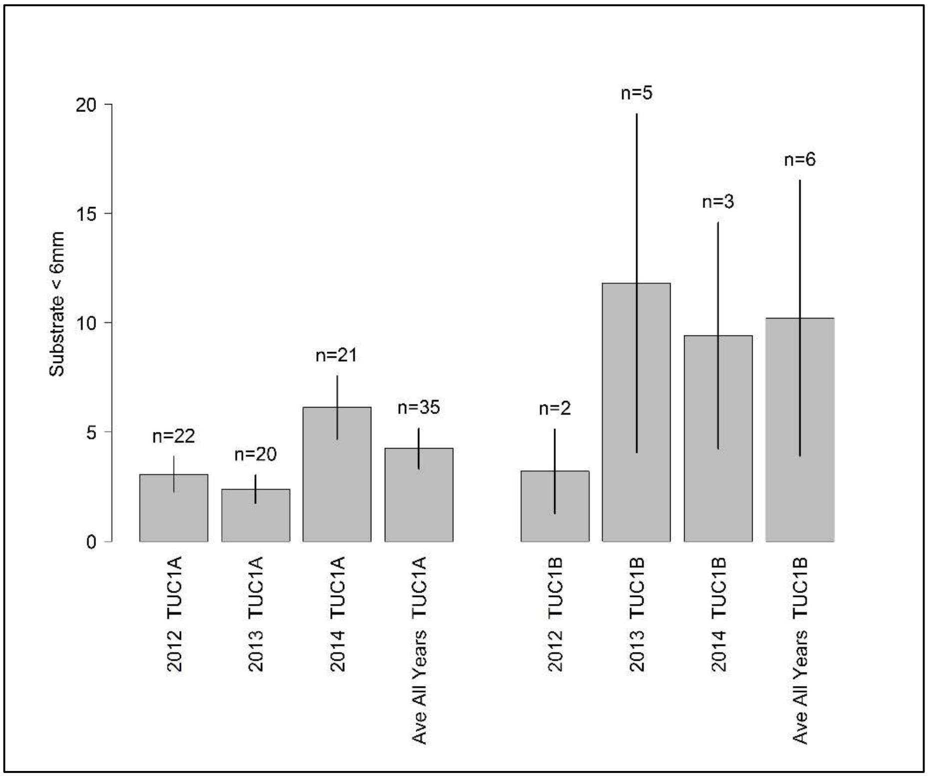
Substrate < 2 mm

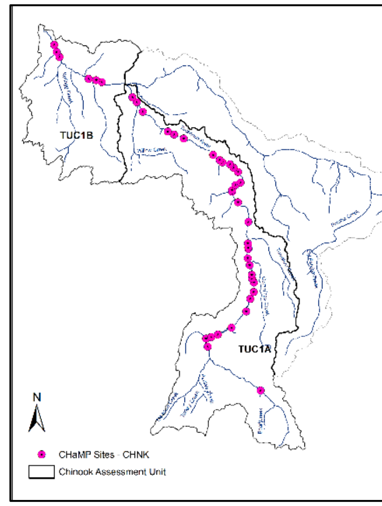
- Source: CHaMP Metrics (www.champmonitoring.org)
- Definition: Average percentage of pool tail substrates comprised of fine sediment <2 mm



Substrate < 6 mm

- Source: CHaMP Metrics (www.champmonitoring.org)
- Definition: Average percentage of pool tail substrates comprised of fine sediment <6 mm

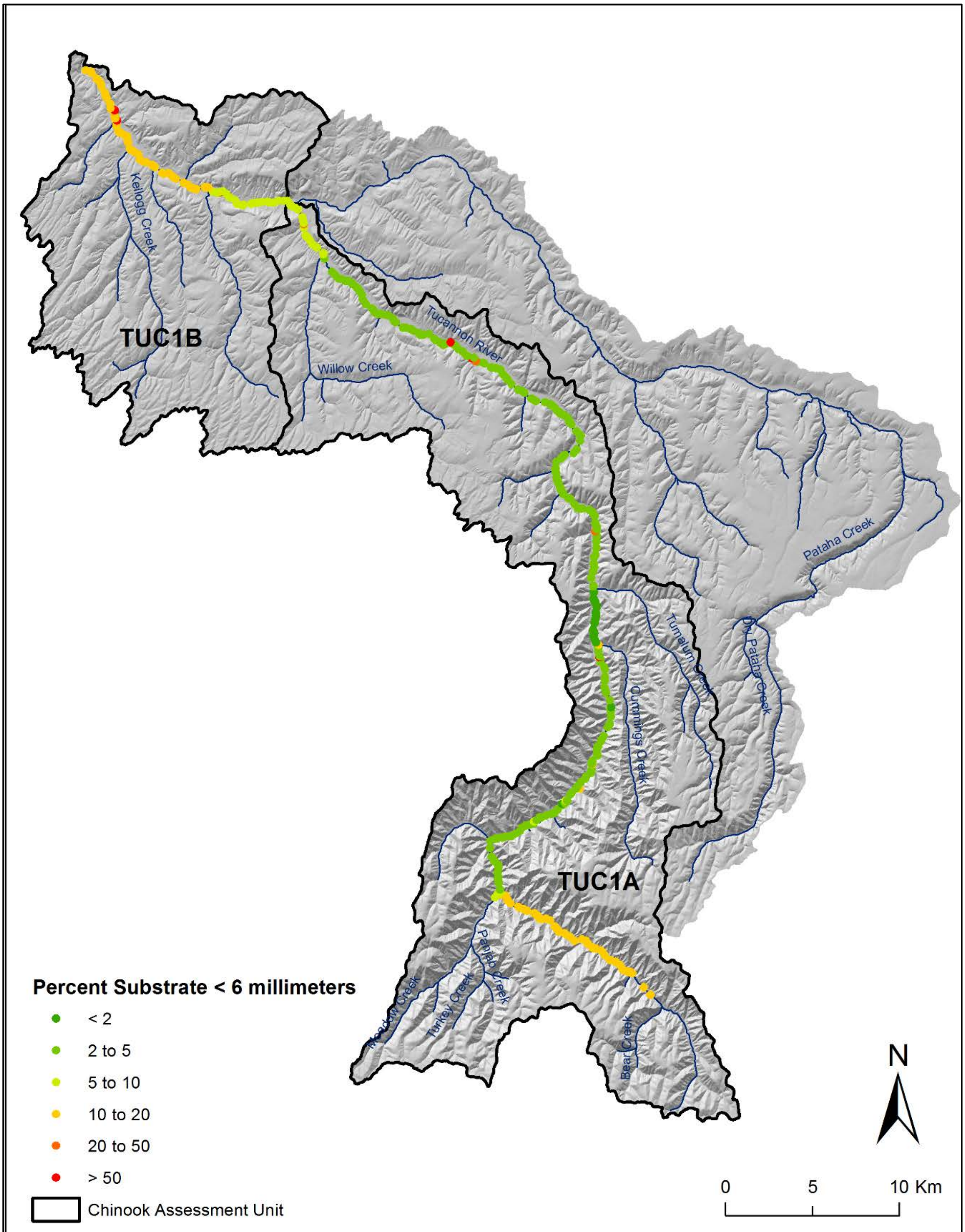




Sub Population	Visit Year	N	Mean	St Dev
All.Sites	2012	24	3.088	2.183
	2013	25	4.636	6.081
	2014	24	6.613	3.856
	Average of All Years	41	5.336	5.073
TUC1A	2012	22	3.068	2.311
	2013	20	2.394	1.779
	2014	21	6.124	3.265
	Average of All Years	35	4.255	2.733
TUC1B	2012	2	3.208	1.134
	2013	5	11.823	8.809
	2014	3	9.408	5.454
	Average of All Years	6	10.219	8.896

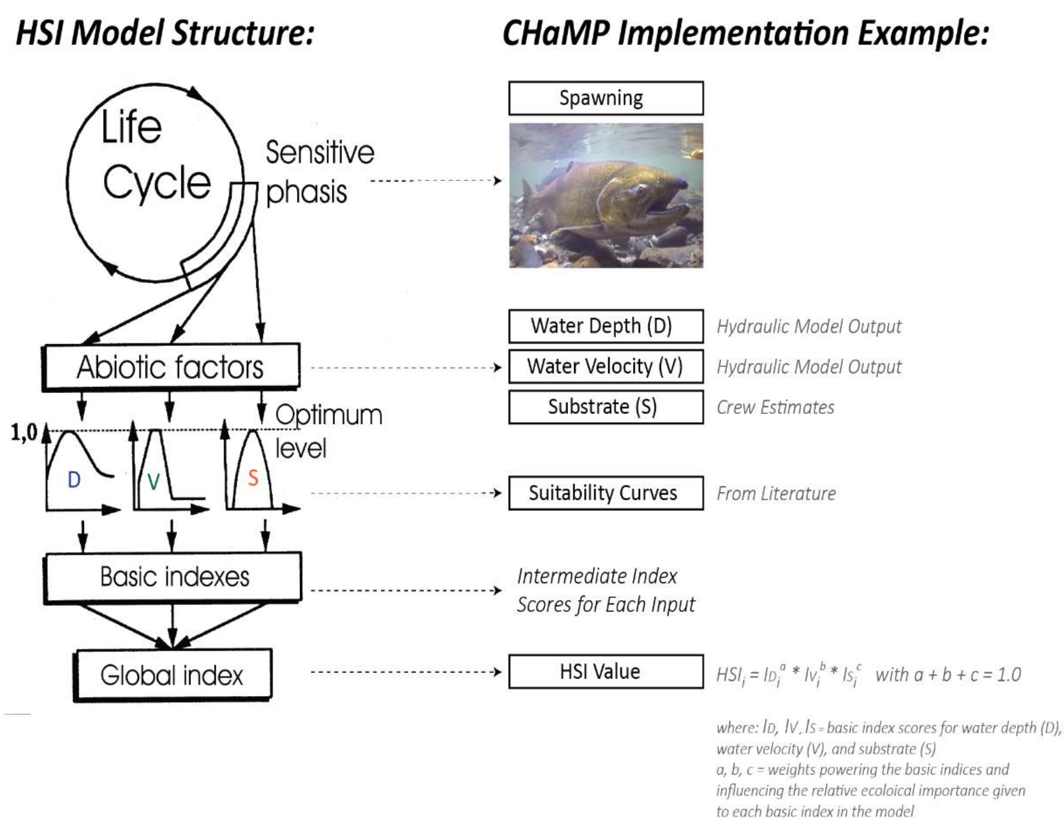
Substrate < 6 mm

- Source: CHaMP Metrics (www.champmonitoring.org)
- Definition: Average percentage of pool tail substrates comprised of fine sediment <6 mm



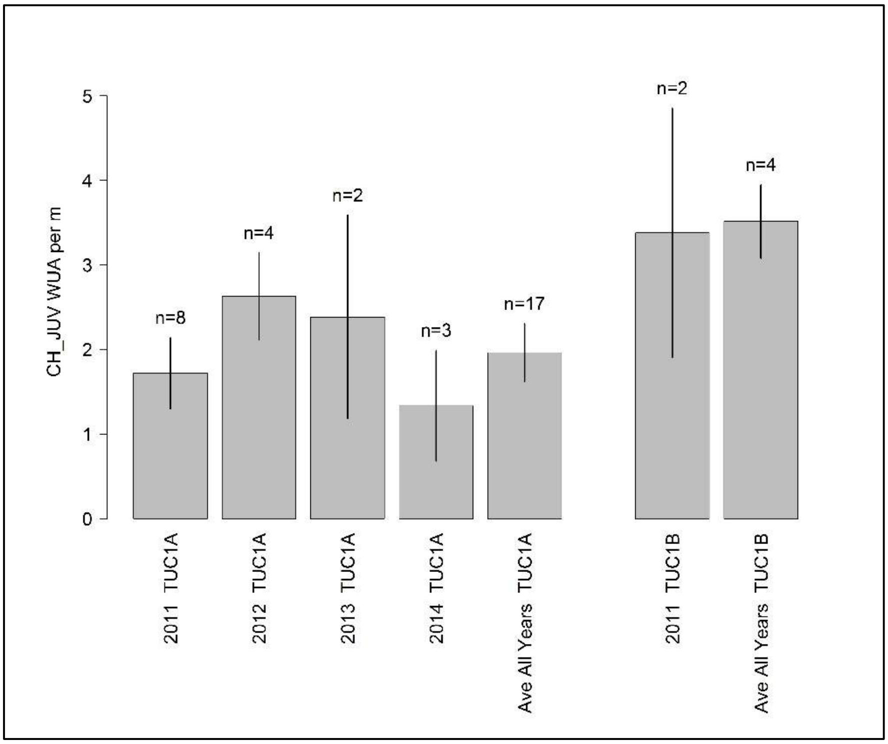
CHaMP Modeled Products: Habitat Suitability Index

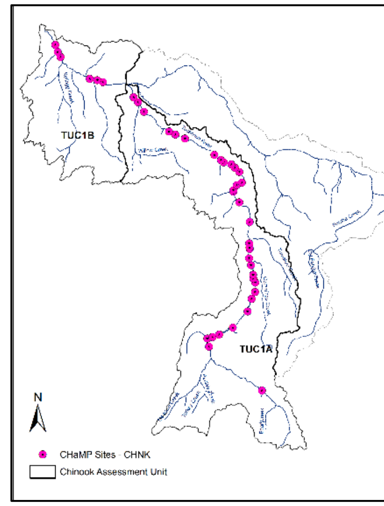
- **Habitat Suitability Index Metrics:**
  - Suitable habitat area (m^2) per meter of stream length for:
    - Steelhead Juvenile Weighted Usable Area per Meter
    - Steelhead Spawner Weighted Usable Area per Meter
    - Chinook Juvenile Weighted Usable Area per Meter
    - Chinook Spawner Weighted Usable Area per Meter
- Details
  - Modeled from CHaMP Data
  - Inputs to HSI Models
    - Site level hydraulic models which yield detailed field estimates of velocity and depth.
    - Substrate (D50)
    - Habitat Suitability Index Curves
      - Based on expert judgement
      - See Appendix



Chinook Juvenile Weighted Usable Area

- Source: Habitat Suitability Index (HSI) Model
- Definition: Suitable habitat area (m^2) per meter of stream length for Juvenile Chinook

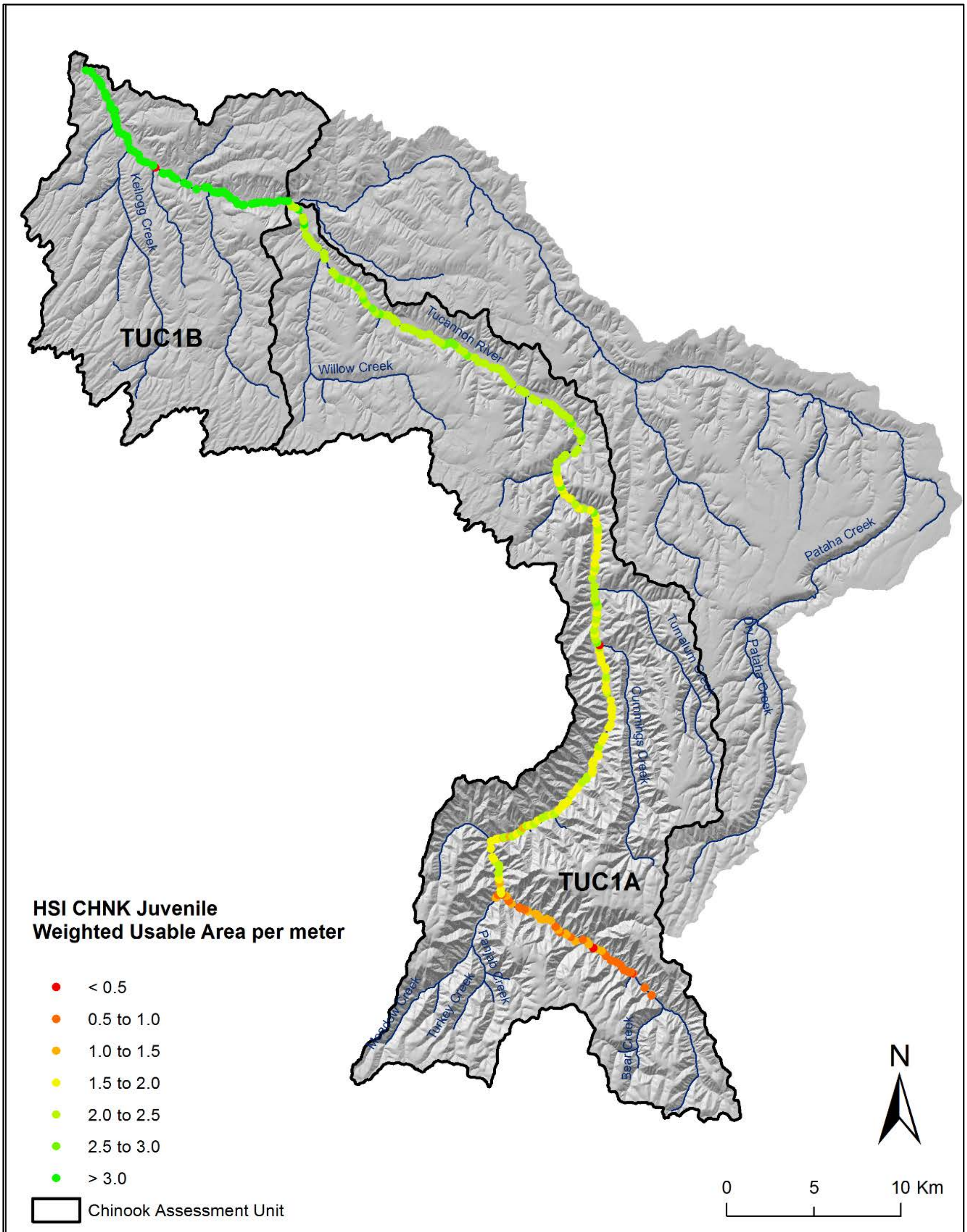




Sub Population	Visit Year	N	Mean	St Dev
All.Sites	2011	10	1.932	0.809
	2012	4	2.631	0.642
	2013	3	3.193	0.433
	2014	4	1.441	0.734
	Average of All Years	21	2.371	0.959
TUC1A	2011	8	1.719	0.552
	2012	4	2.631	0.642
	2013	2	2.384	0.772
	2014	3	1.335	0.615
TUC1A	Average of All Years	17	1.963	0.732
TUC1B	2011	2	3.379	0.789
	Average of All Years	4	3.514	0.469

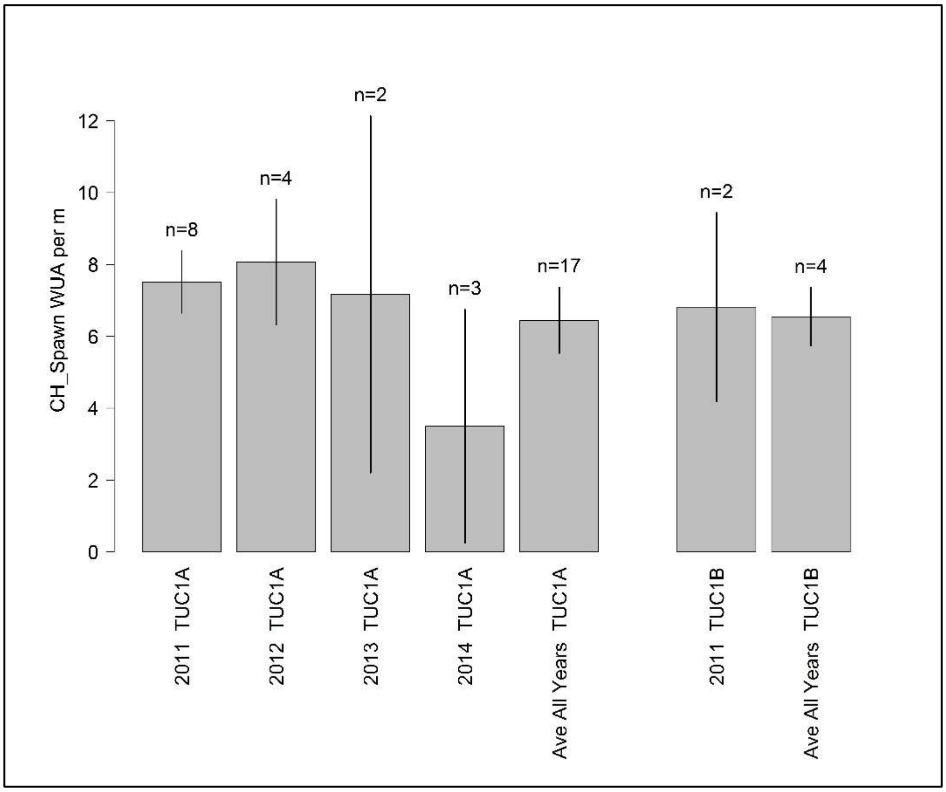
Chinook Juvenile Weighted Usable Area

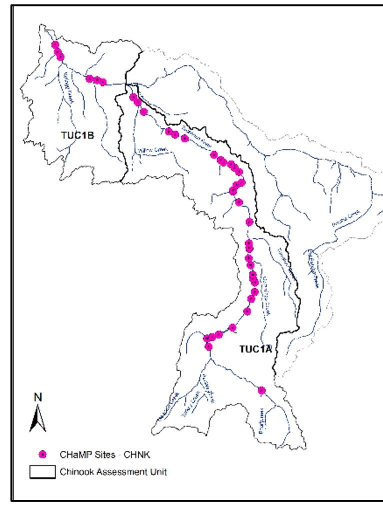
- Source: Habitat Suitability Index (HSI) Model
- Definition: Suitable habitat area (m^2) per meter of stream length for Juvenile Chinook



Chinook Spawner Weighted Usable Area

- Source: Habitat Suitability Index (HSI) Model
- Definition: Suitable Spawning habitat area (m^2) per meter of stream length for Chinook

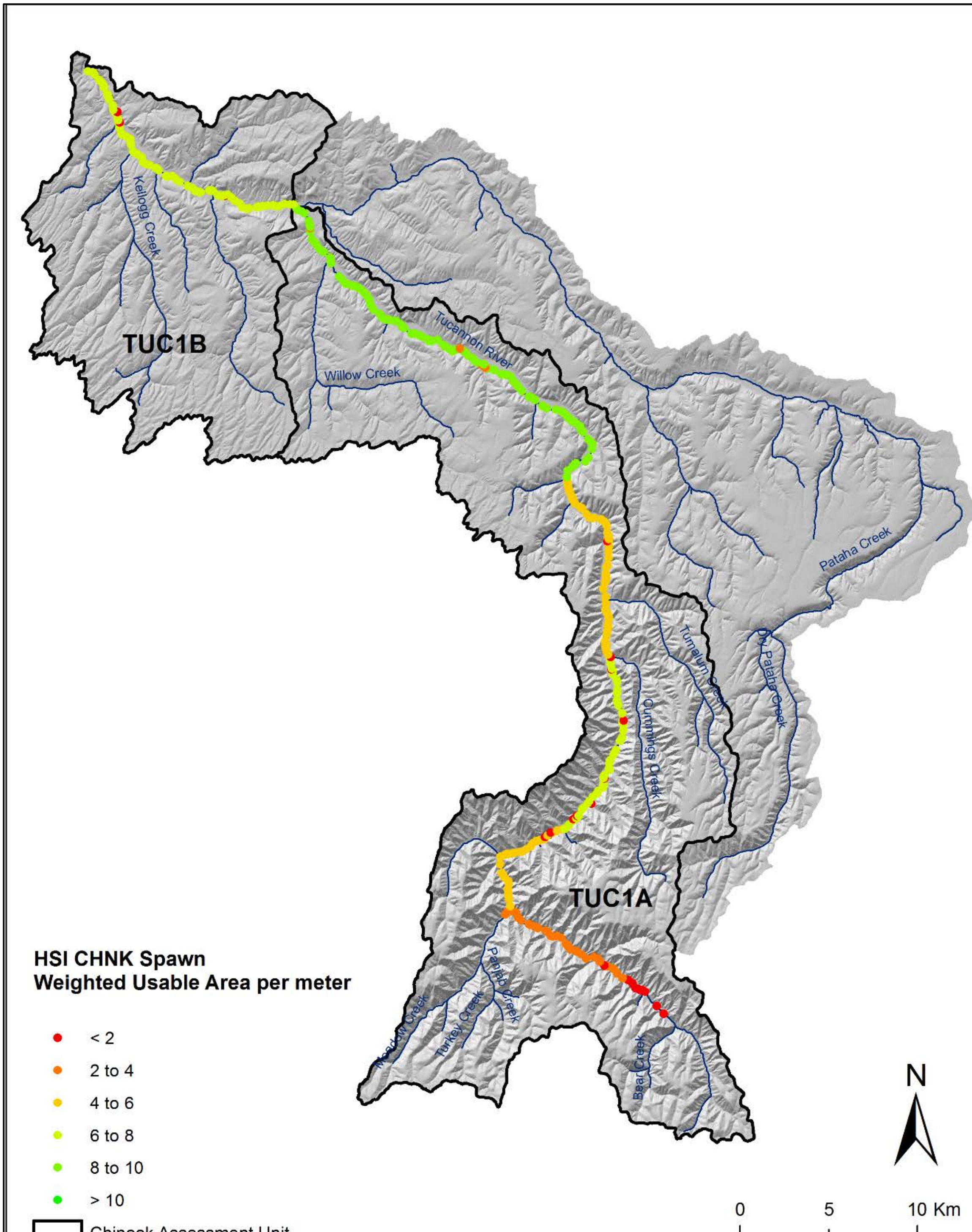




Sub Population	Visit Year	N	Mean	St Dev
All.Sites	2011	10	7.424	1.448
	2012	4	8.066	1.762
	2013	3	7.057	1.188
	2014	4	3.65	2.734
	Average of All Years	21	6.476	1.996
TUC1A	2011	8	7.513	1.432
	2012	4	8.066	1.762
	2013	2	7.172	3.189
	2014	3	3.497	2.743
	Average of All Years	17	6.45	2.268
TUC1B	2011	2	6.816	1.404
	Average of All Years	4	6.548	0.85

Chinook Spawner Weighted Usable Area

- Source: Habitat Suitability Index (HSI) Model
- Definition: Suitable Spawning habitat area (m^2) per meter of stream length for Chinook

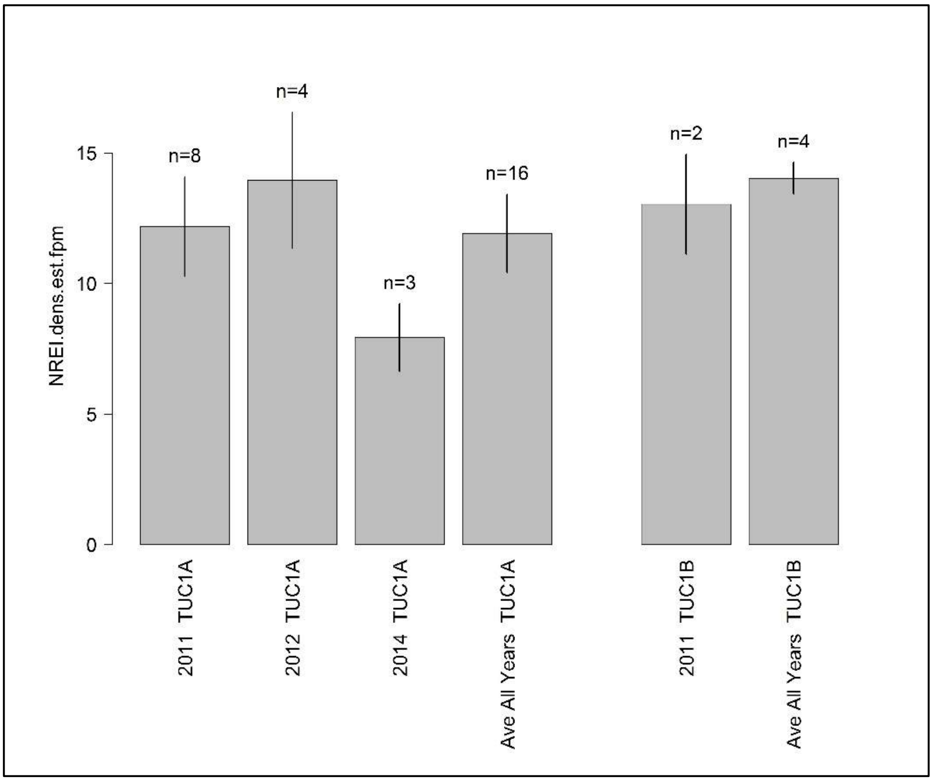


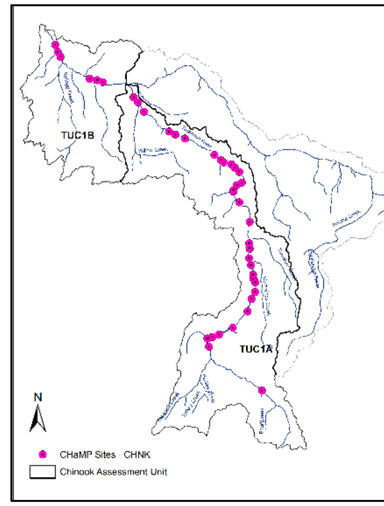
CHaMP Modeled Products: NREI Capacity

- **Net rate of energy intake (NREI) :**
  - Juvenile salmonid capacity per meter
    - The carrying capacity of juvenile salmonid per meter of stream
- **Details**
  - NREI carrying capacity is a modeled metric. Carrying capacity is estimated based on an energy balance model, where the energy required to occupy a stream location (swimming costs, SC) is compared to the energy available from prey drift at that same location (gross rate of energy intake, GREI)
  - Inputs to NREI Model
    - Site level hydraulic models which yield detailed field estimates of velocity and depth.
      - Based on detailed CHaMP surveyed of bathymetry, as discharge (Q) and surface roughness (D84).
    - Temperature
    - Drift
    - Fish Characteristics
- References:
  - Hayes, J. W., N. F. Hughes, and L. H. Kelly. 2007. Process-based modelling of invertebrate drift transport, net energy intake and reach carrying capacity for drift-feeding salmonids. Ecological Modelling **207**:171-188.
  - See appendix for additional references

Juvenile Salmonid Capacity

- Source: Net Rate of Energy Intake (NREI) Model
- Definition: Carrying capacity (fish/m^2) per meter of stream length

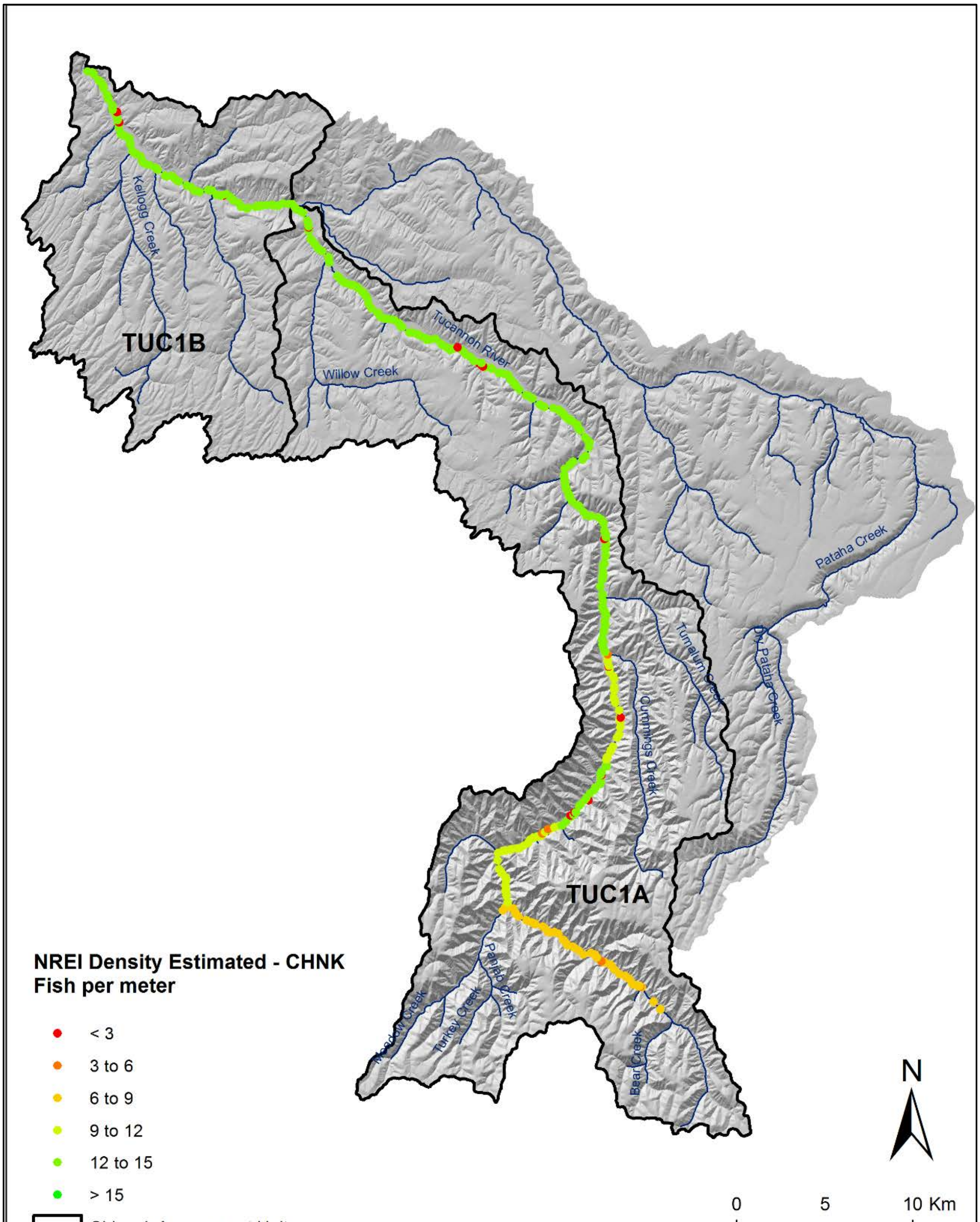




Sub Population	Visit Year	N	Mean	St Dev
All.Sites	2011	10	12.291	2.396
	2012	4	13.956	2.668
	2013	2	14.488	0.182
	2014	4	8.34	2.23
	Average of All Years	20	12.479	2.739
TUC1A	2011	8	12.182	2.518
	2012	4	13.956	2.668
	2014	3	7.928	1.528
	Average of All Years	16	11.924	2.963
TUC1B	2011	2	13.036	1.022
	Average of All Years	4	14.032	0.805

Juvenile Salmonid Capacity

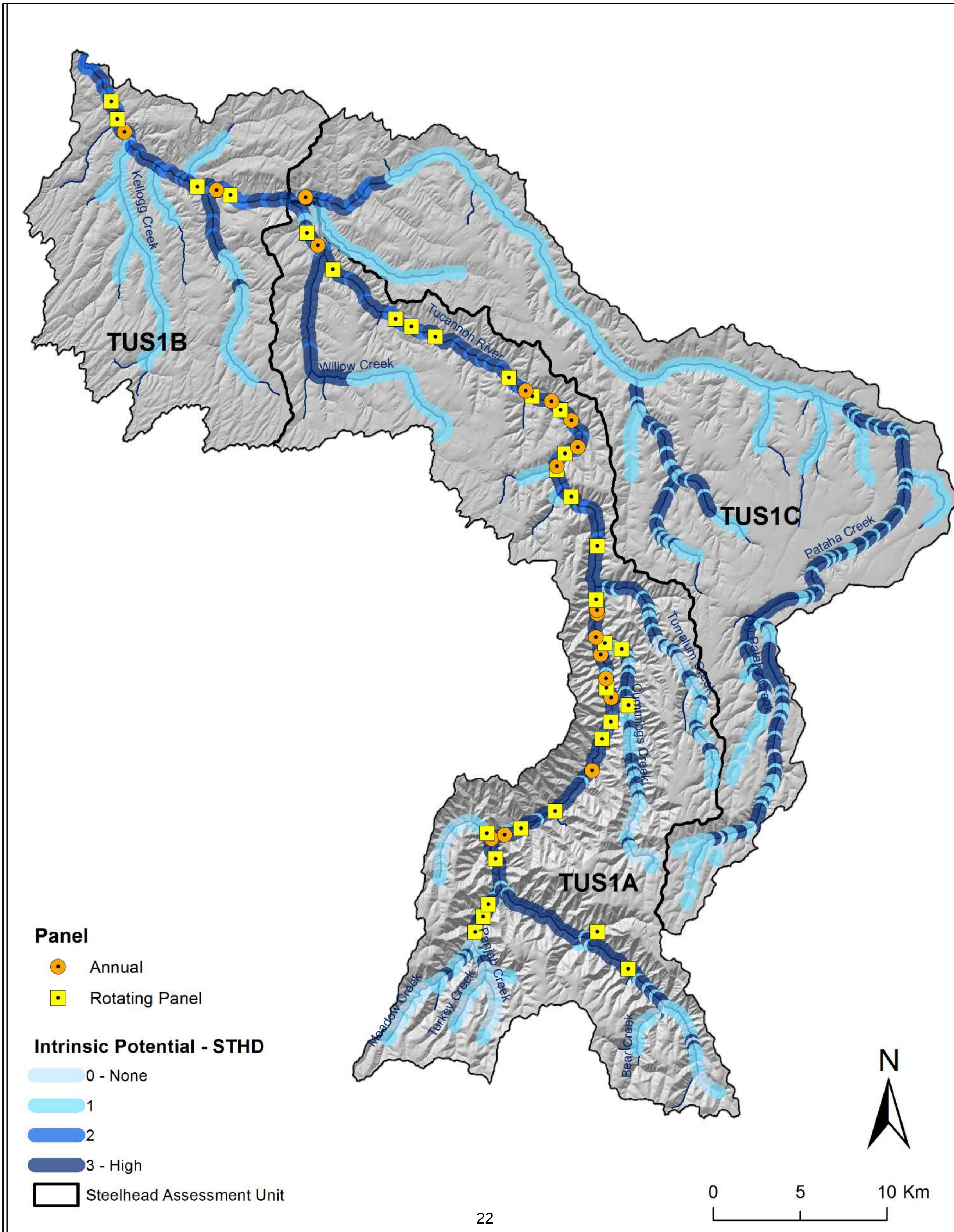
- Source: Net Rate of Energy Intake (NREI) Model
- Definition: Carrying capacity (fish/m^2) per meter of stream length



Summary by Steelhead Assessment Unit

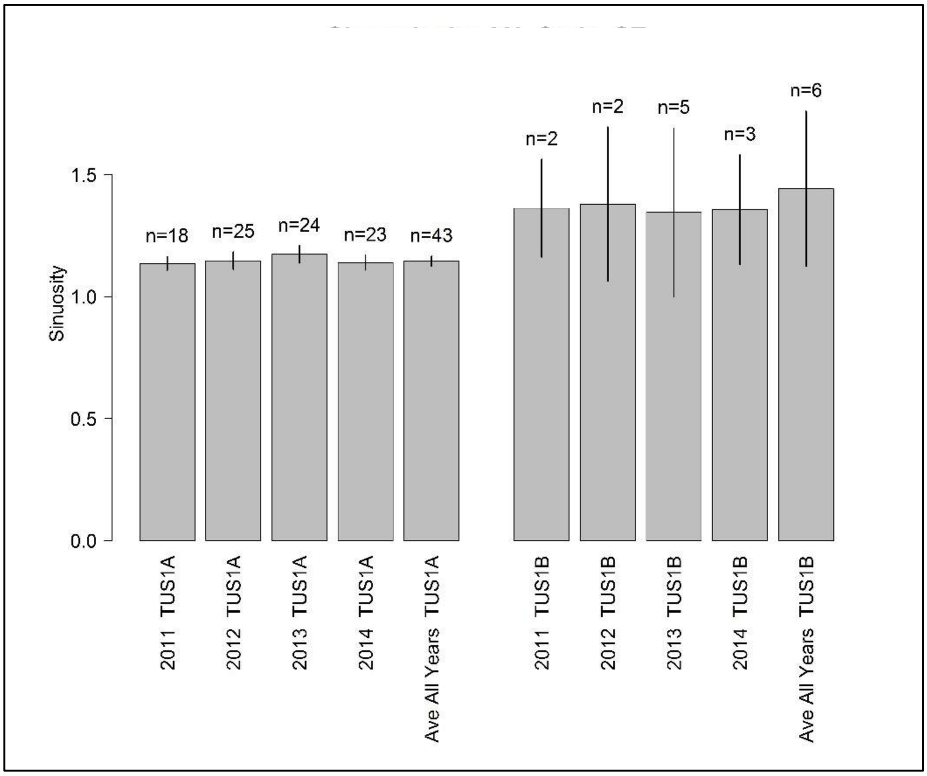
Tucannon: Summary of CHaMP Metrics and Modeled Products

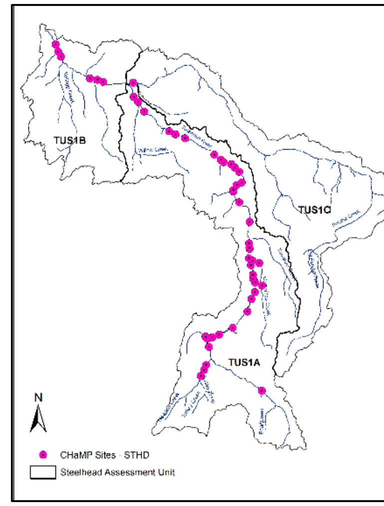
Steelhead Intrinsic Potential



Sinuosity

- Source: CHaMP Metrics (www.champmonitoring.org)
- Definition: Ratio of the thalweg length to the straight line distance between the start and end points of the thalweg.

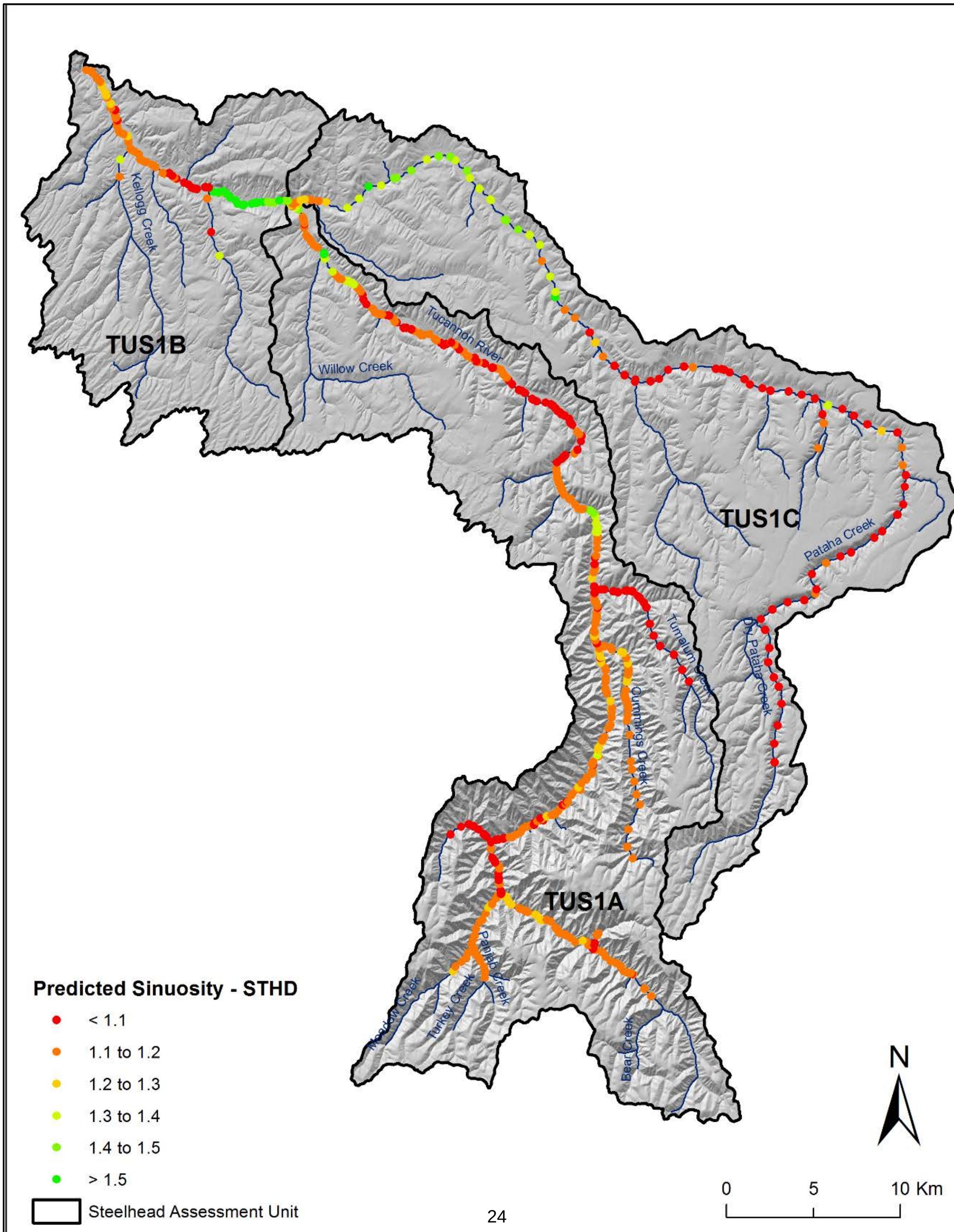




Sub Population	Visit Year	N	Mean	St Dev
All.Sites	2011	21	1.156	0.104
	2012	28	1.171	0.134
	2013	30	1.201	0.191
	2014	26	1.165	0.121
	Average of All Years	50	1.187	0.189
TUS1A	2011	18	1.136	0.077
	2012	25	1.147	0.098
	2013	24	1.173	0.099
	2014	23	1.139	0.083
	Average of All Years	43	1.145	0.089
TUS1B	2011	2	1.362	0.107
	2012	2	1.379	0.185
	2013	5	1.345	0.36
	2014	3	1.357	0.175
	Average of All Years	6	1.442	0.357
TUS1C	2011	1	1.08706	
	2012	1	1.08463	
	2013	1	1.09587	
	Average of All Years	1	1.08918667	

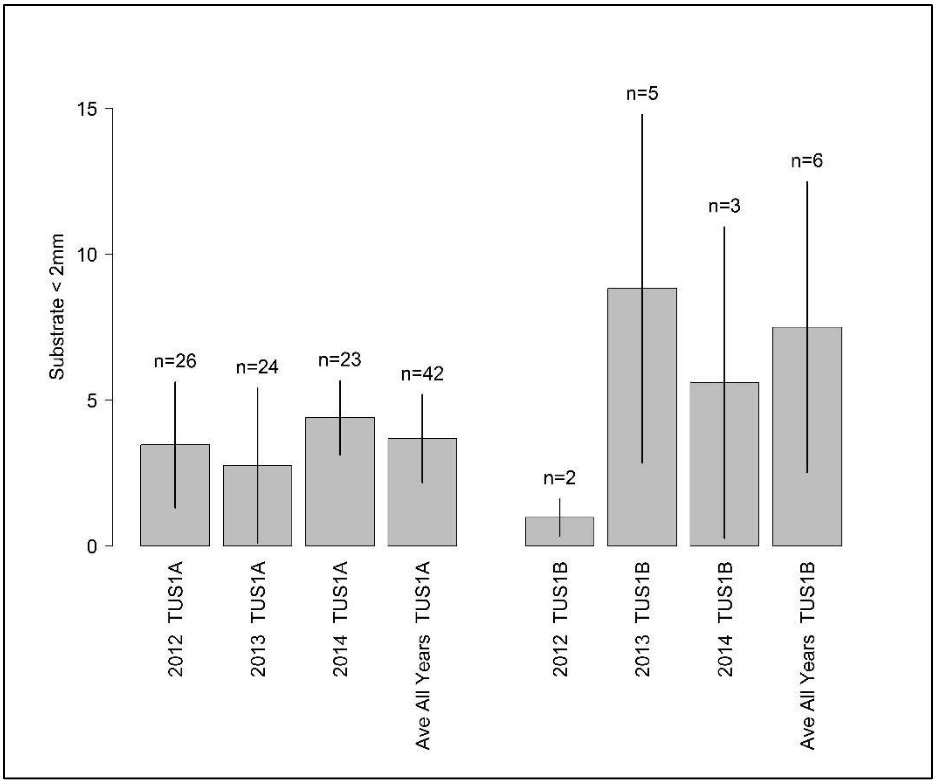
Sinuosity

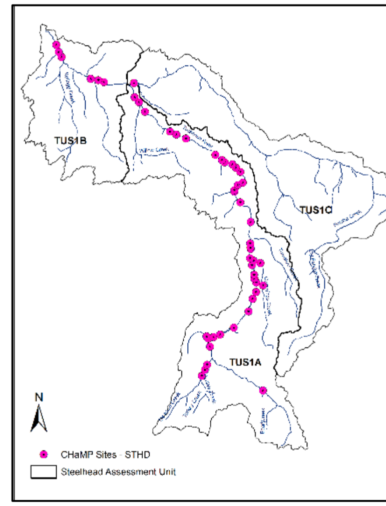
- Source: CHaMP Metrics (www.champmonitoring.org)
- Definition: Ratio of the thalweg length to the straight line distance between the start and end points of the thalweg.



Substrate < 2mm

- Source: CHaMP Metrics (www.champmonitoring.org)
- Definition: Average percentage of pool tail substrates comprised of fine sediment <2 mm

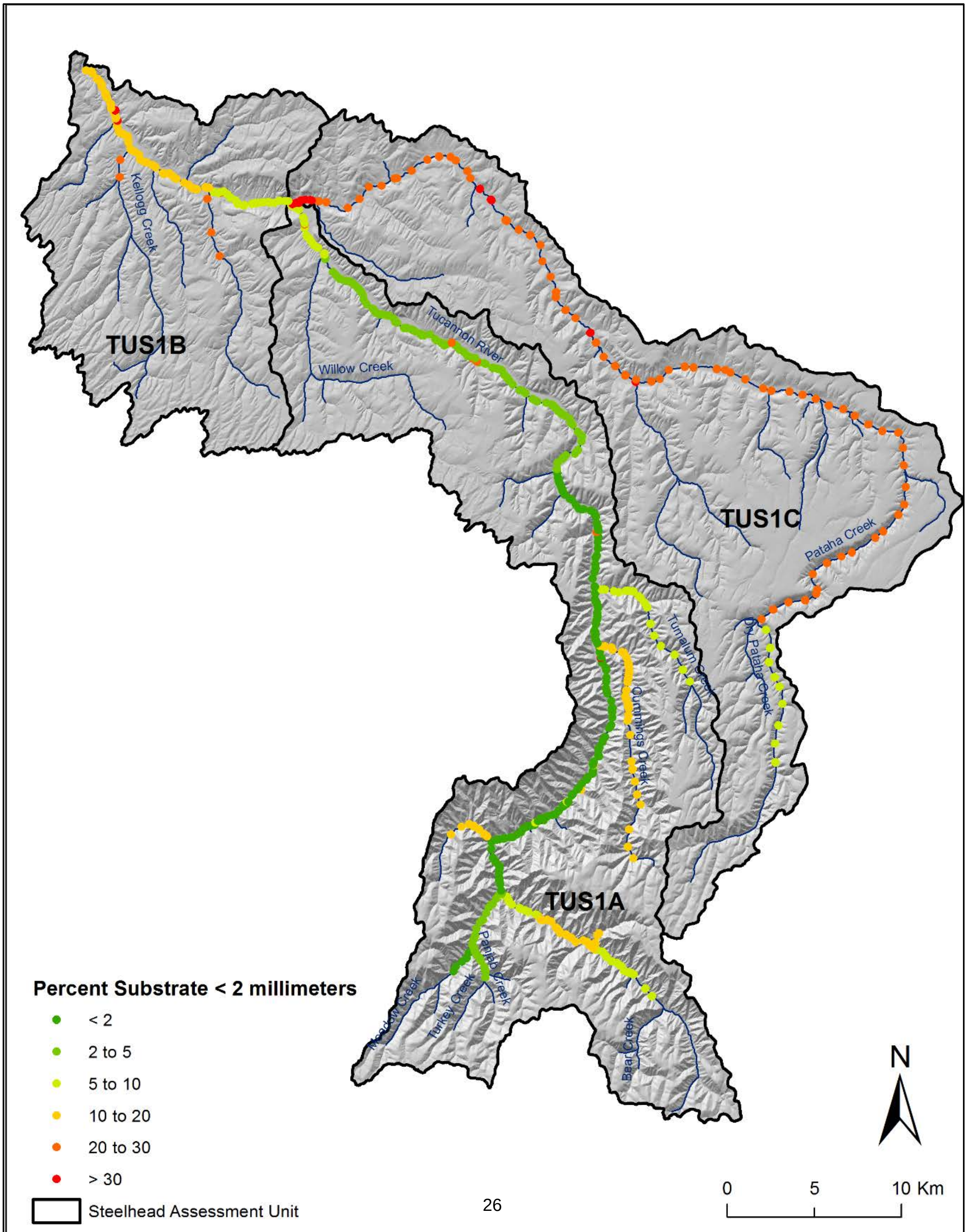




Sub Population	Visit Year	N	Mean	St Dev
All.Sites	2012	29	4.682	9.175
	2013	30	4.959	8.468
	2014	26	4.541	3.353
	Average of All Years	49	5	7.335
TUS1A	2012	26	3.466	6.055
	2013	24	2.76	6.544
	2014	23	4.402	2.917
	Average of All Years	42	3.685	5.129
TUS1B	2012	2	0.982	0.375
	2013	5	8.829	7.467
	2014	3	5.595	5.534
	Average of All Years	6	7.503	7.835
TUS1C	2012	1	39.50099	
	2013	1	52.9685	
	Average of All Years	1	46.234745	

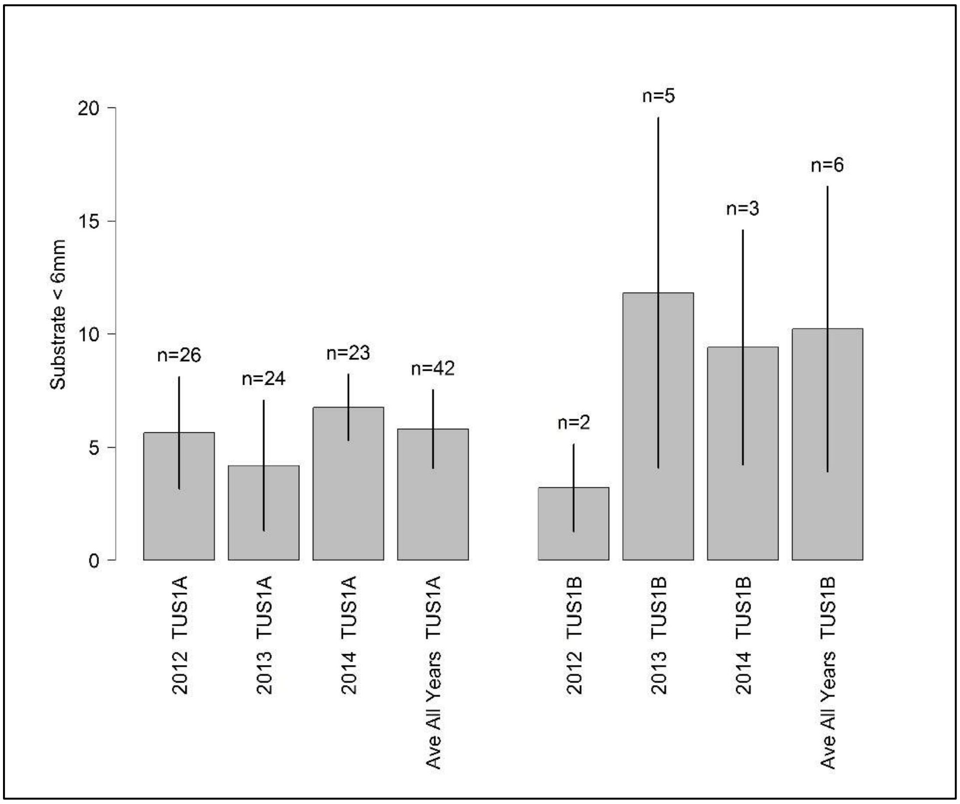
Substrate < 2mm

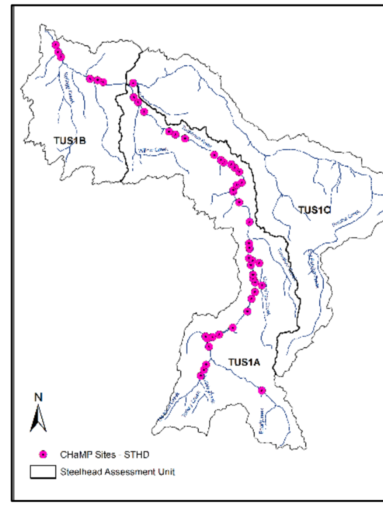
- Source: CHaMP Metrics (www.champmonitoring.org)
- Definition: Average percentage of pool tail substrates comprised of fine sediment <2 mm



Substrate < 6 mm

- Source: CHaMP Metrics (www.champmonitoring.org)
- Definition: Average percentage of pool tail substrates comprised of fine sediment <6 mm

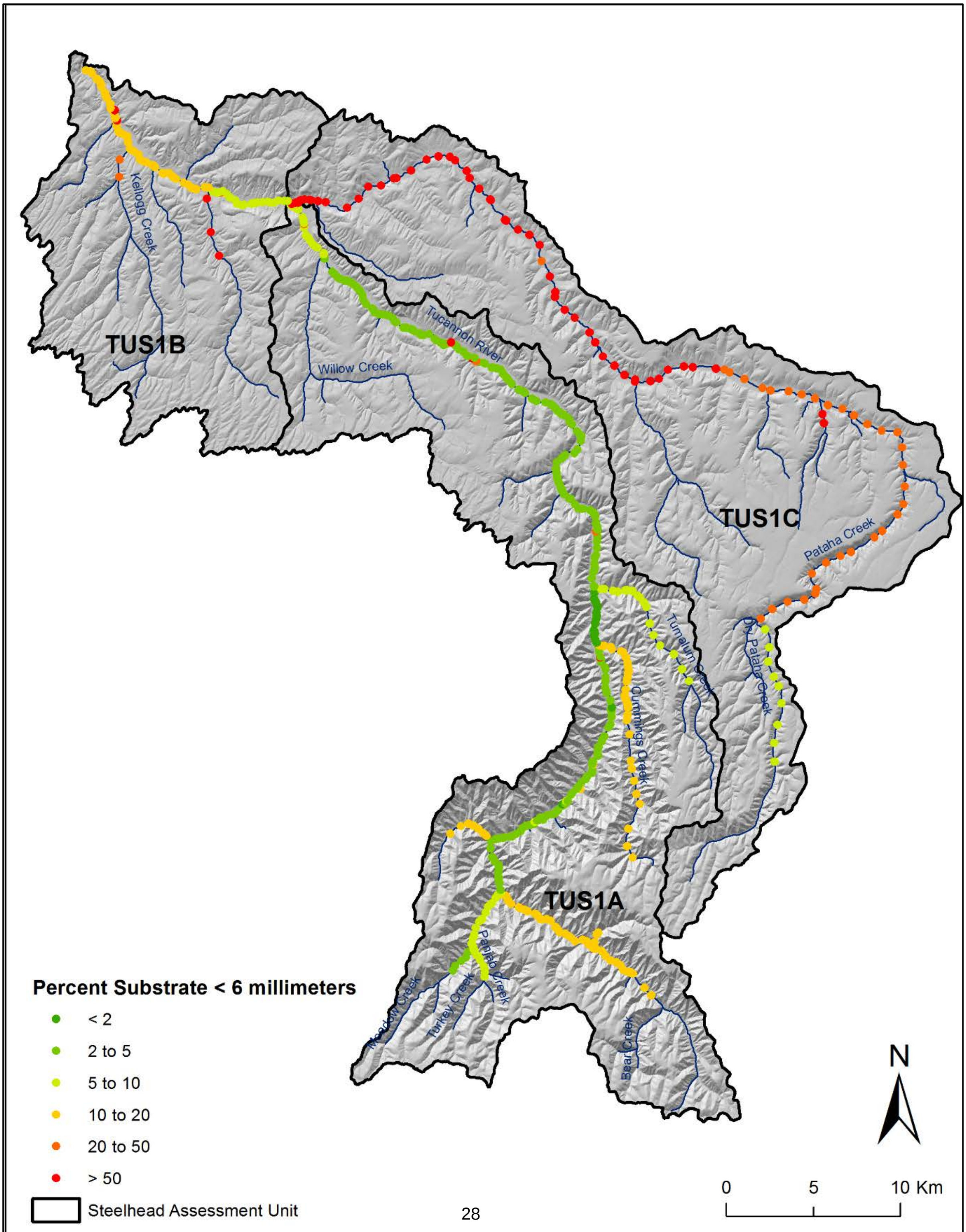




Sub Population	Visit Year	N	Mean	St Dev
All.Sites	2012	29	6.841	9.61
	2013	30	6.694	9.18
	2014	26	7.062	3.662
	Average of All Years	49	7.196	7.913
TUS1A	2012	26	5.64	6.924
	2013	24	4.197	7.073
	2014	23	6.751	3.228
	Average of All Years	42	5.809	5.84
TUS1B	2012	2	3.208	1.134
	2013	5	11.823	8.809
	2014	3	9.408	5.454
	Average of All Years	6	10.219	8.896
TUS1C	2012	1	41.17219	
	2013	1	53.9685	
	Average of All Years	1	47.570345	

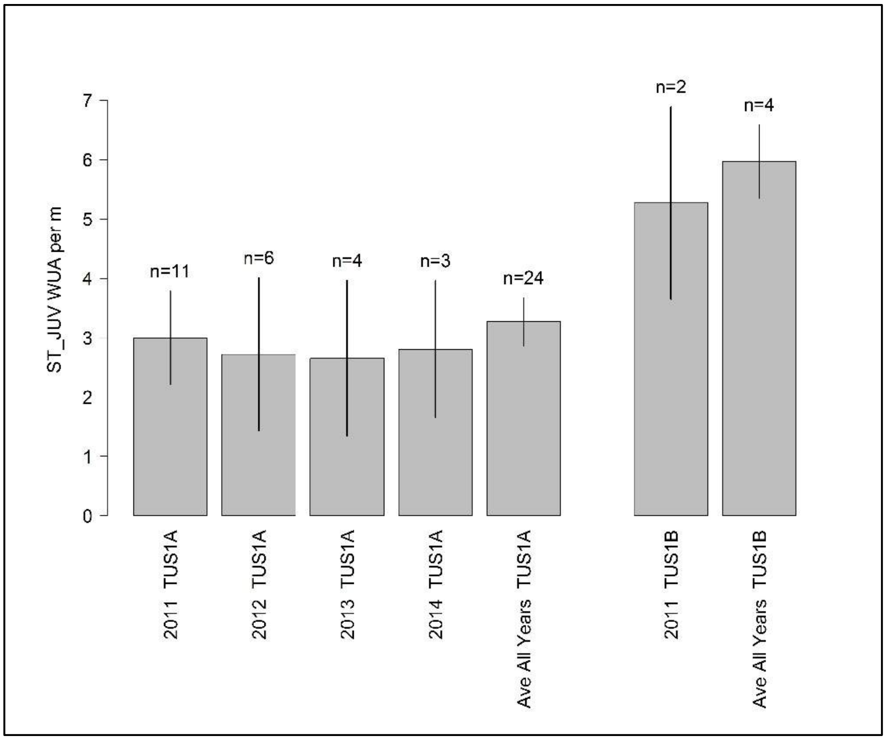
Substrate < 6 mm

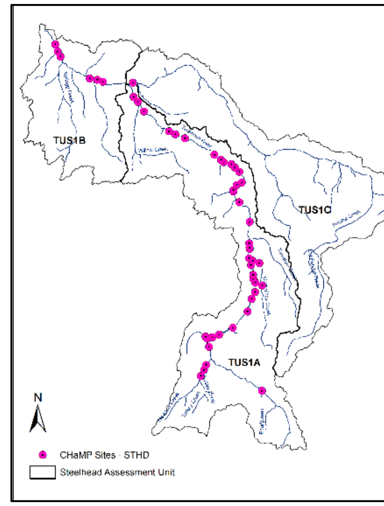
- Source: CHaMP Metrics (www.champmonitoring.org)
- Definition: Average percentage of pool tail substrates comprised of fine sediment <6 mm



Steelhead Juvenile Weighted Usable Area

- Source: Habitat Suitability Index (HSI) Model
- Definition: Suitable habitat area (m^2) per meter of stream length for Juvenile Chinook

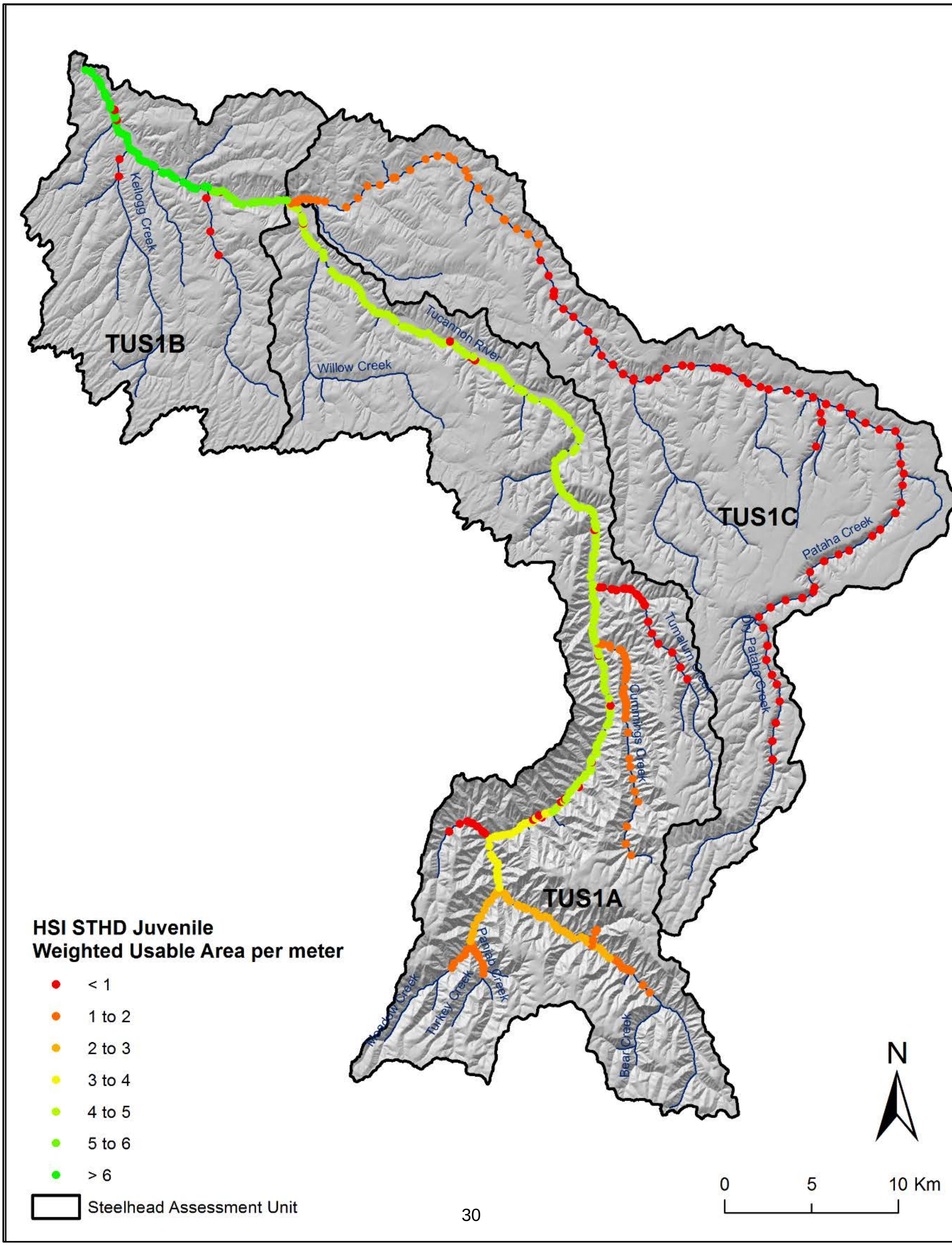




Sub Population	Visit Year	N	Mean	St Dev
All.Sites	2011	14	3.129	1.547
	2012	6	2.72	1.668
	2013	5	4.994	2.162
	2014	4	2.917	1.132
	Average of All Years	29	3.766	1.789
TUS1A	2011	11	2.999	1.392
	2012	6	2.72	1.668
	2013	4	2.655	1.458
	2014	3	2.806	1.07
	Average of All Years	24	3.271	1.497
TUS1B	2011	2	5.271	0.867
	Average of All Years	4	5.972	0.745
TUS1C	2011	1	1.19152817	

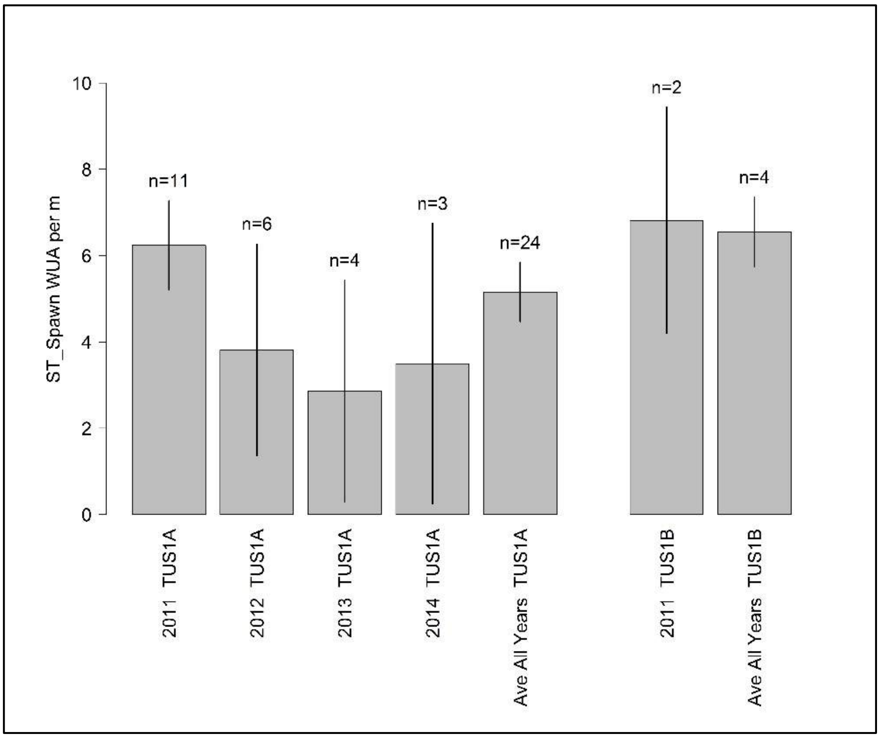
Steelhead Juvenile Weighted Usable Area

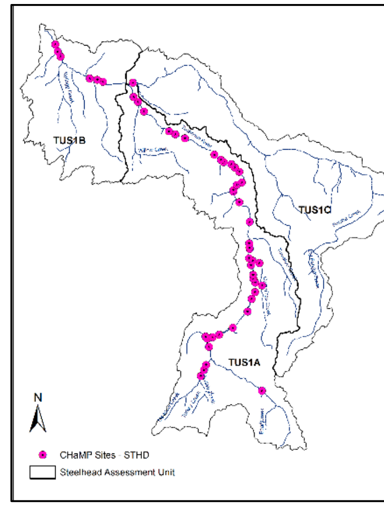
- Source: Habitat Suitability Index (HSI) Model
- Definition: Suitable habitat area (m^2) per meter of stream length for Juvenile Chinook



Steelhead Spawner Weighted Usable Area

- Source: Habitat Suitability Index (HSI) Model
- Definition: Suitable Spawning habitat area (m^2) per meter of stream length for Steelhead

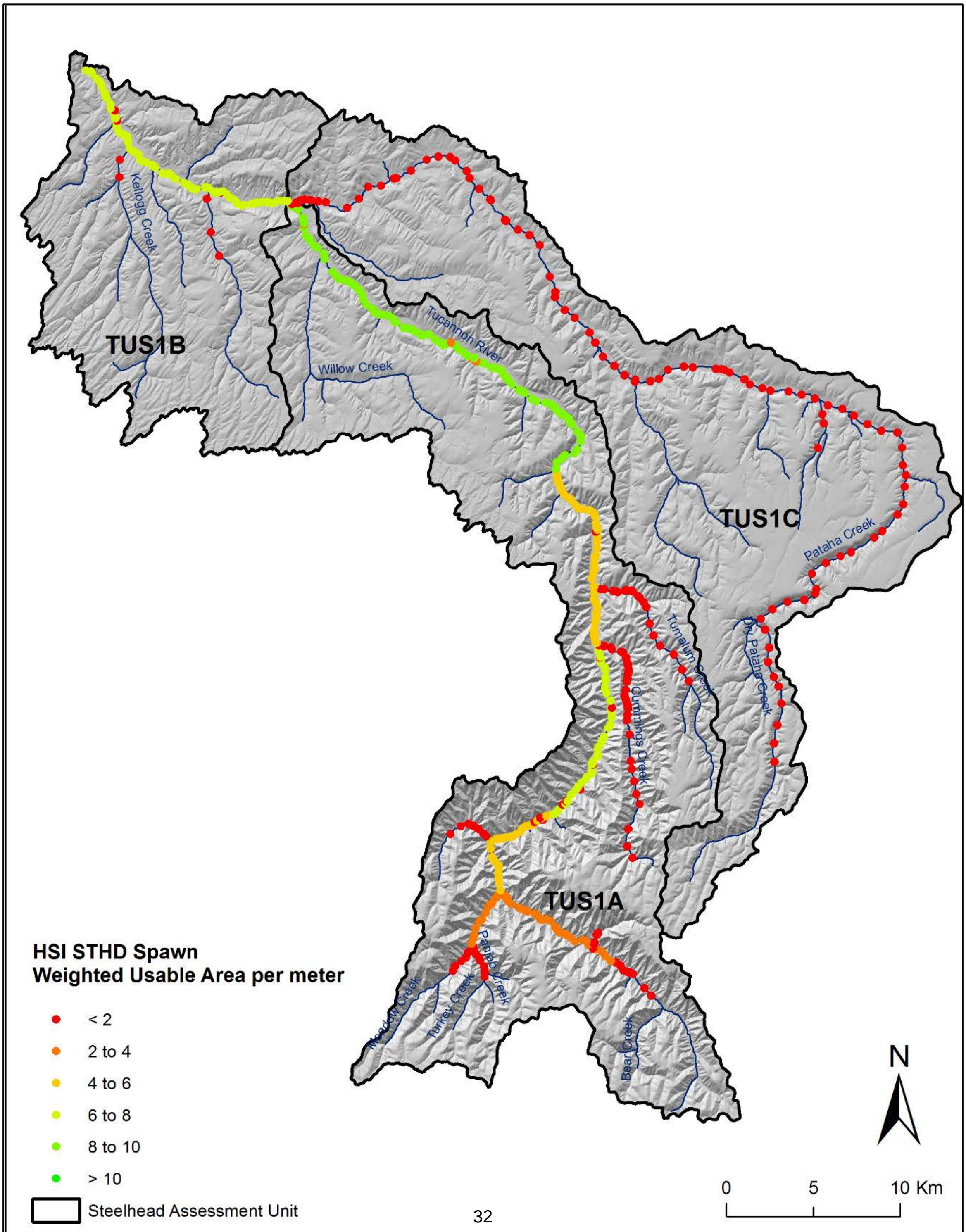




Sub Population	Visit Year	N	Mean	St Dev
All.Sites	2011	14	5.97	3.051
	2012	6	3.815	3.144
	2013	5	5.327	2.757
	2014	4	3.648	2.735
	Average of All Years	29	5.302	2.834
TUS1A	2011	11	6.24	2.913
	2012	6	3.815	3.144
	2013	4	2.865	2.875
	2014	3	3.495	2.744
	Average of All Years	24	5.155	2.982
TUS1B	2011	2	6.816	1.405
	Average of All Years	4	6.547	0.85
TUS1C	2011	1	0.20001102	

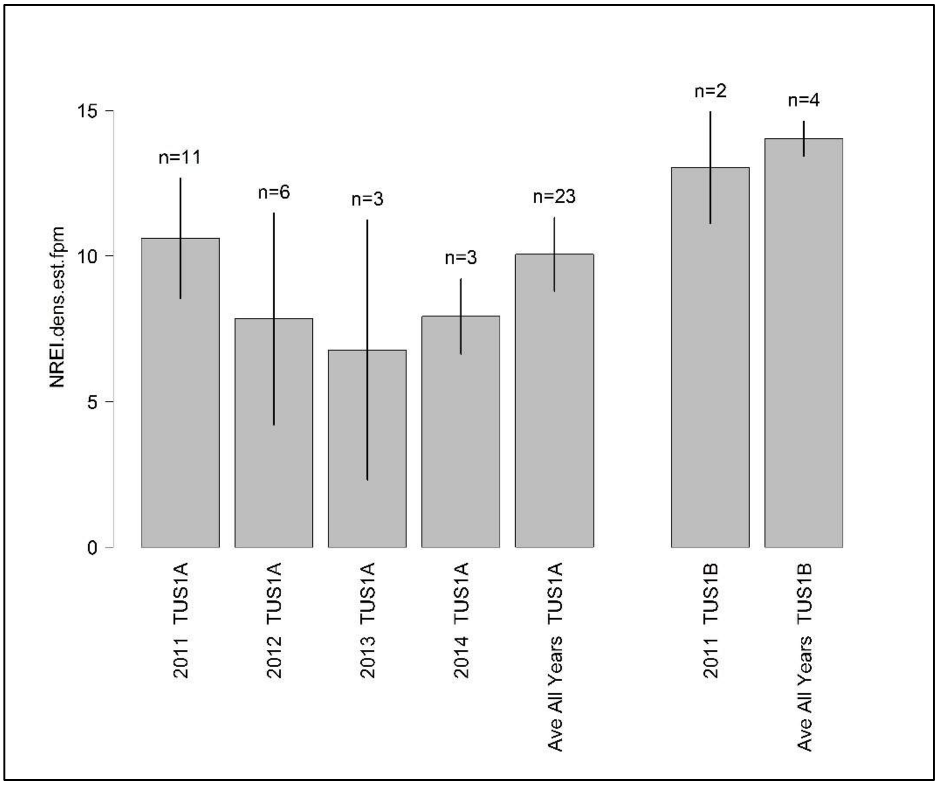
Steelhead Spawner Weighted Usable Area

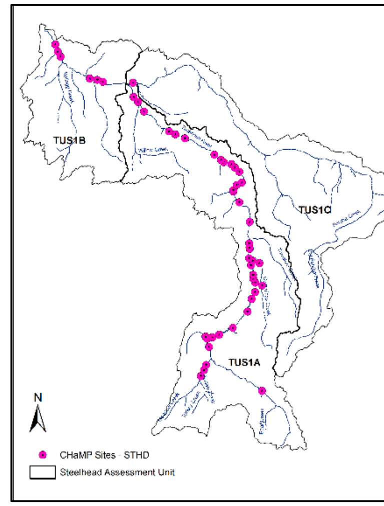
- Source: Habitat Suitability Index (HSI) Model
- Definition: Suitable Spawning habitat area (m^2) per meter of stream length for Steelhead



Juvenile Salmonid Capacity

- Source: Net Rate of Energy Intake (NREI) Model
- Definition: Carrying capacity (fish/m^2) per meter of stream length

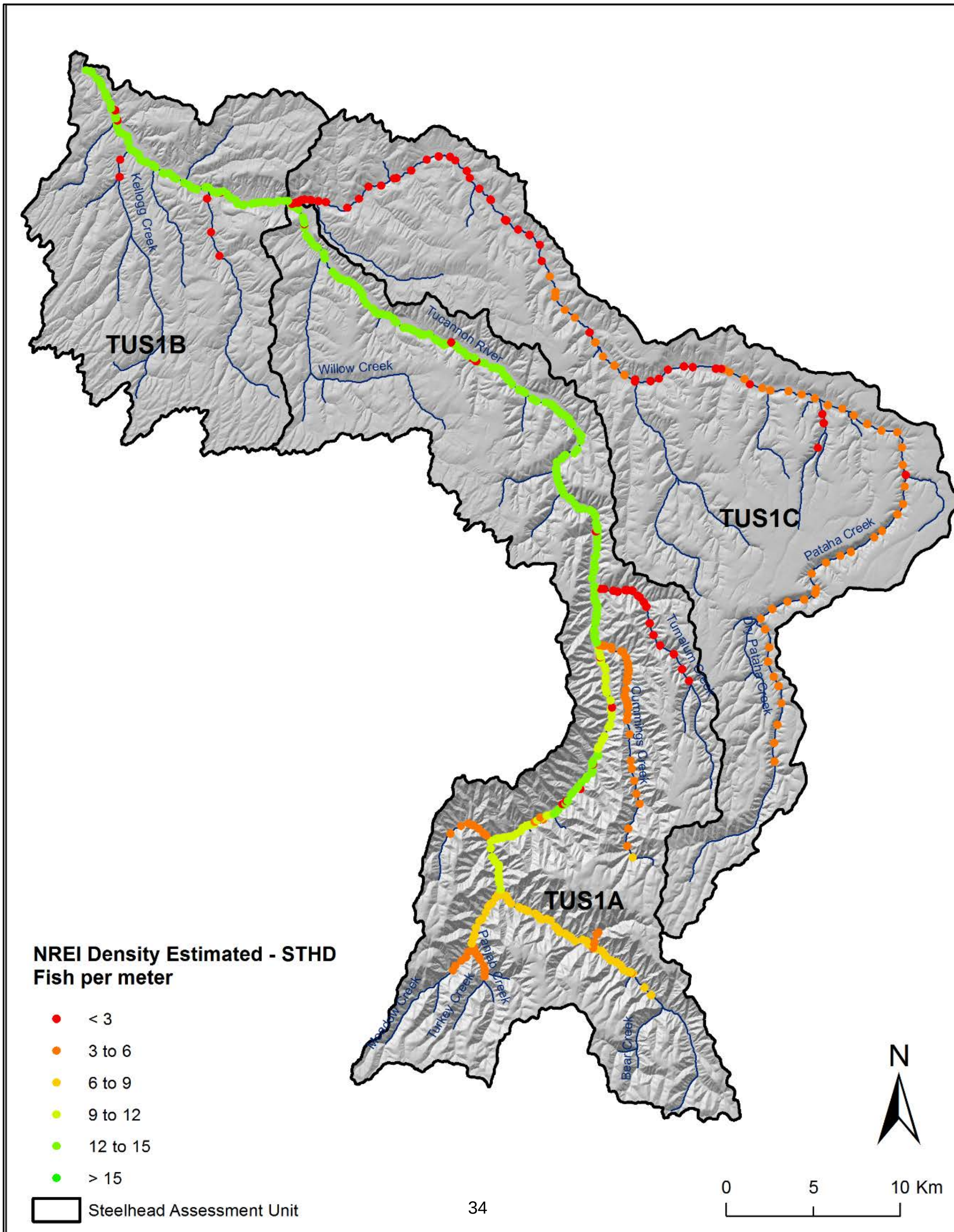




Sub Population	Visit Year	N	Mean	St Dev
All.Sites	2011	14	10.479	4.052
	2012	6	7.839	4.59
	2013	4	11.452	4.472
	2014	4	8.34	2.23
	Average of All Years	28	10.694	4.15
TUS1A	2011	11	10.609	3.946
	2012	6	7.839	4.59
	2013	3	6.776	3.712
	2014	3	7.928	1.528
TUS1A	Average of All Years	23	10.058	4.138
TUS1B	2011	2	13.036	1.022
	Average of All Years	4	14.032	0.805
TUS1C	2011	1	3.71317777	

Juvenile Salmonid Capacity

- Source: Net Rate of Energy Intake (NREI) Model
- Definition: Carrying capacity (fish/m^2) per meter of stream length

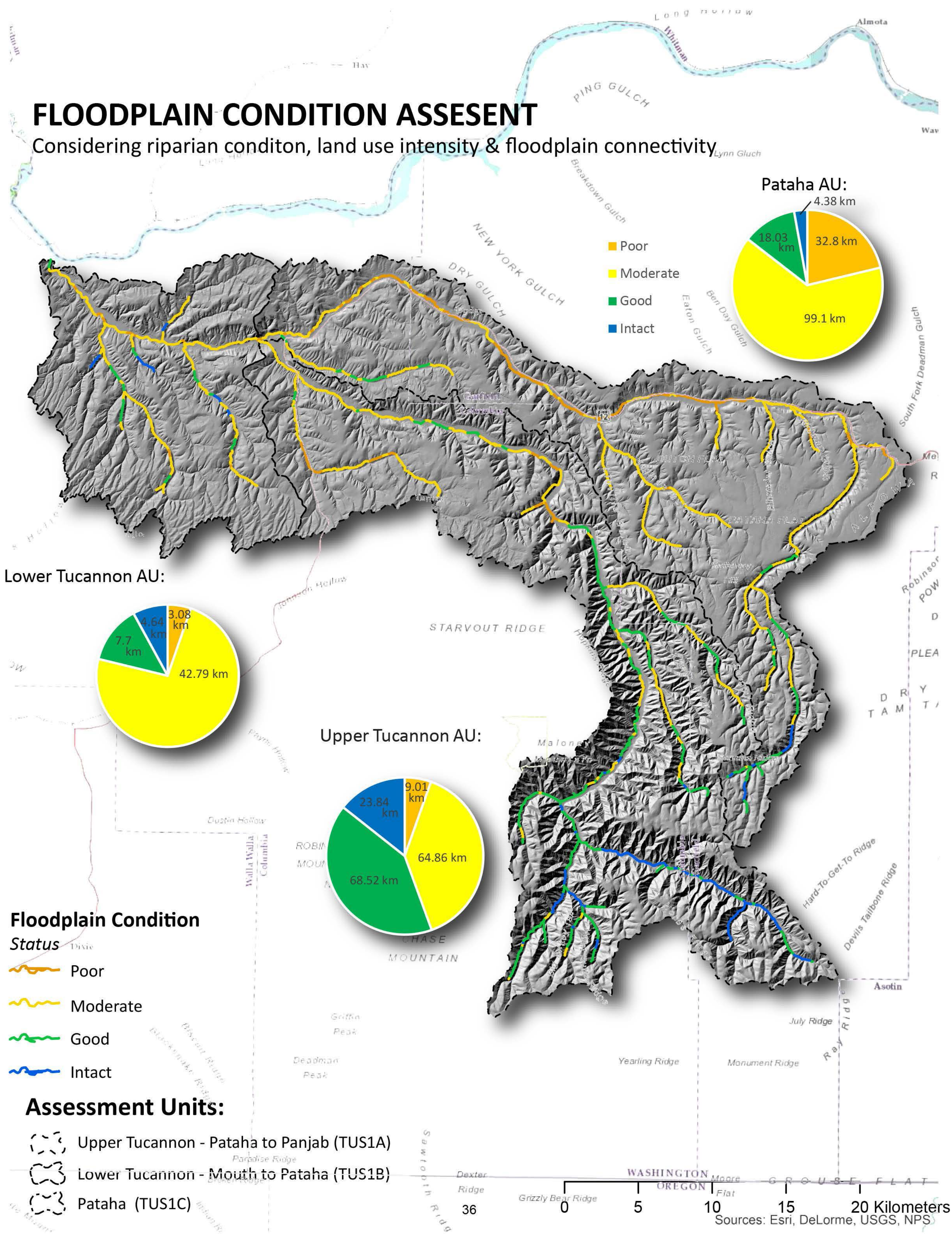


Limiting Factor: Floodplain Condition

To address this limiting factor, we developed a process to model floodplain condition using three, equally weighted inputs relevant to a condition assessment: riparian vegetation condition, land use intensity, and fragmentation due to transportation infrastructure. The output is a polyline representing the hydrographic network that is attributed with values from 0 to 10. These values represent the relative condition of the floodplain, where values near 10 are the areas of floodplain that are in the best condition within the watershed, and values closer to 0 are the areas within the watershed where the floodplain is in the worst condition based on the metrics described below.

Metrics

- RVCA – A riparian vegetation condition assessment (RVCA) is first performed. RVCA models the deviation of existing riparian vegetation coverage from modelled historic or potential riparian vegetation cover. A raster surface is created for the extent of the floodplain that models this riparian vegetation condition. The RVCA analysis is performed using LANDFIRE Existing Vegetation Type (EVT) and Biophysical Settings (BPS) layers. This data can be downloaded at http://landfire.gov/.
- LAND USE INTENSITY – Land use intensity is modelled using the National Land Cover Dataset (NLCD). The various types of land cover represented in this dataset are recoded to reflect the intensity of the land use with respect to floodplains and riparian corridors. For example, urbanization is considered the most intense land use, and open water whereas riparian vegetation are considered to have no intensity. A raster surface is created modelling this land use intensity to the extent of the floodplain for use in the analysis. The NLCD data is available for download at http://www.mrlc.gov/.
- FLOODPLAIN CONNECTIVITY – Floodplain connectivity, or fragmentation due to transportation infrastructure is an input layer that is derived using a polygon of the floodplain extent, and polylines of transportation infrastructure (i.e. freeways, highways, and railroads) which were downloaded from several sources (generally through the state of Washington). An analysis is performed where the two layers are intersected, splitting the floodplain polygon using the transportation network. The individual polygons that do not intersect the stream network are considered disconnected, and those that do intersect the stream network are considered connected. This layer is converted to a raster surface, and the three raster surfaces are then used in the model to produce the final output.

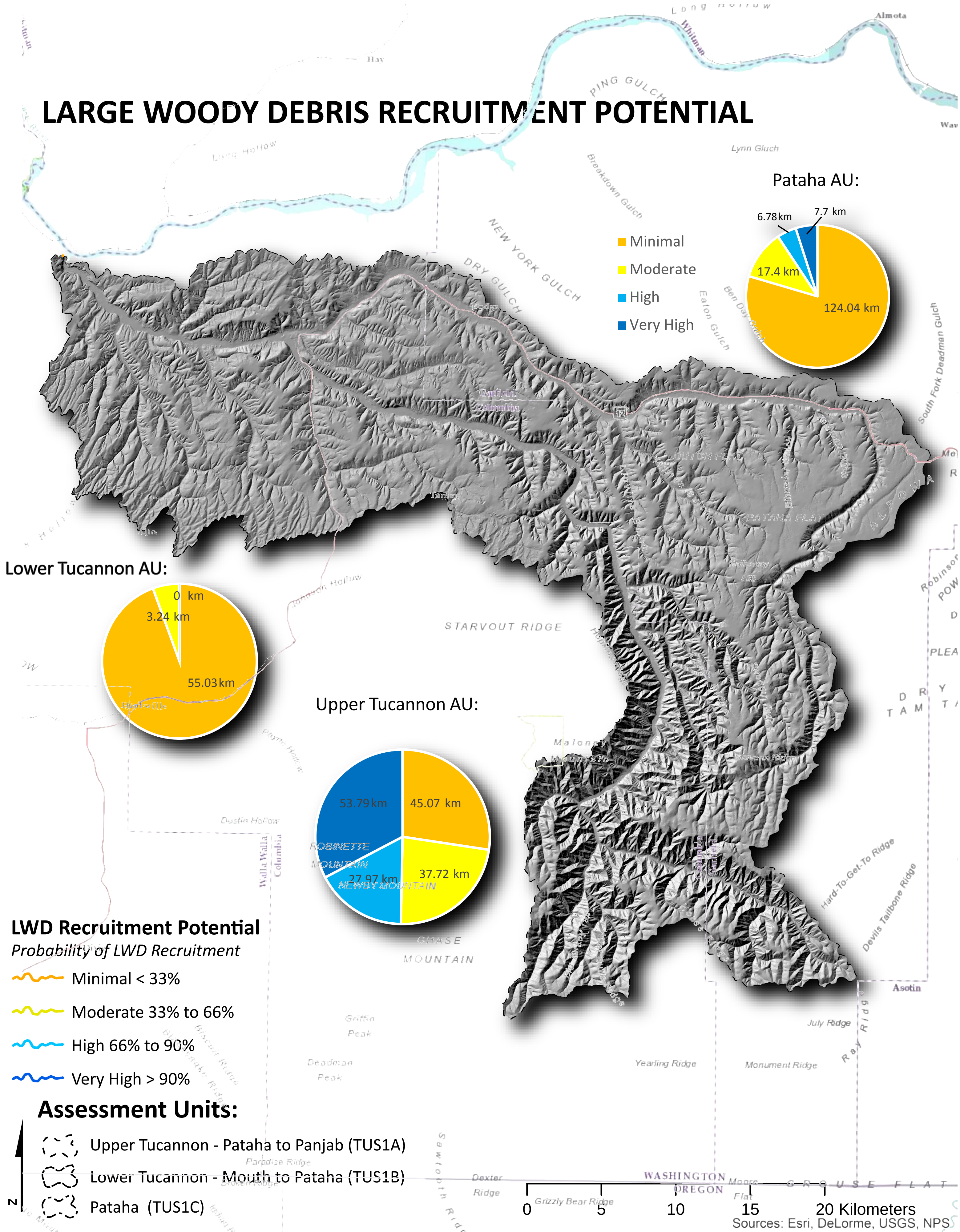

FLOODPLAIN CONDITION ASSESENT
Considering riparian conditon, land use intensity & floodplain connectivity
Pataha AU:
4.38 km
32.8 km
18.03 km
99.1 km
Poor
Moderate
Good
Intact
Lower Tucannon AU:
3.08 km
4.64 km
7.7 km
42.79 km
Upper Tucannon AU:
9.01 km
23.84 km
64.86 km
68.52 km
Floodplain Condition
Status
Poor
Moderate
Good
Intact
Assessment Units:
Upper Tucannon - Pataha to Panjab (TUS1A)
Lower Tucannon - Mouth to Pataha (TUS1B)
Pataha (TUS1C)
N
0
5
10
15
20 Kilometers
Sources: Esri, DeLorme, USGS, NPS
Long Hollow
Almota
Whitman
PING GULCH
Lynn Gulch
Breakdown Gulch
NEW YORK GULCH
DRY GULCH
Eaton Gulch
Ben Day Gulch
South Fork Deadman Gulch
STARVOUT RIDGE
Johnson Hollow
Dustin Hollow
Walla Walla
Columbia
CHASE
MOUNTAIN
Griffin Peak
Deadman Peak
Hard-To-Get-To Ridge
Devils Tailbone Ridge
Asotin
July Ridge
Ray Ridge
Yearling Ridge
Monument Ridge
WASHINGTON
OREGON
Moore Flat
GROUSE FLAT
Dexter Ridge
Grizzly Bear Ridge
Sawtooth Ridge
Paradise Ridge

Limiting Factor: Large Woody Debris

To address this limiting factor, we developed a process that uses LANDFIRE dataset vegetation inputs and a DEM to model the probability that large woody debris (LWD) will be recruited on a reach by reach basis. The output is a stream network where each segment has an associated value (between 0 and 1) that represents the relative probability that wood will be recruited from that reach. A value of 1 represents the highest probability of contributing wood at the reach scale.

Metrics

- BANKFULL CHANNEL POLYGON – A bankfull channel polygon is derived for use in the model using the NHD 24k hydrography network and a regression for bankfull channels within the Columbia River Basin developed by Beechie and Imaki (2014). A euclidean distance raster is generated using the bankfull channel as an input to determine distance from the channel in the model.
- 10 METER DIGITAL ELEVATION MODEL (DEM) – The 10m DEM is used to create a Topographic Index (TI, also known as a Topographic Wetness Index), which is a raster surface that can be used as a proxy for shallow landslide potential. In this model we used the National Elevation Dataset (NED) 10 meter DEM produced by the USGS.
- LANDFIRE EVH – The LANDFIRE Existing Vegetation Height (EVH) raster is a 30m raster, available nationally, that represents the height of the existing vegetation of the landscape. Each cell represents the average vegetation height within that area, and values are binned into height categories. This layer is used to determine where vegetation is tall enough to actually reach the channel in the model. This data is available for download at http://landfire.gov/.
- LANDFIRE EVC – The LANDFIRE Existing Vegetation Cover (EVC) raster is a 30m raster, available nationally, that represents the percent of vegetative cover on the landscape. The data is broken into bins for each 10 percent increase, and the cell value represents the percentage of the area that is covered by vegetation. This layer provides a proxy for vegetation density in the model. This data is available for download at http://landfire.gov/.
- LANDFIRE VDIST – The LANDFIRE Vegetation Disturbance (VDIST) layer is a 30 meter raster, available nationally, that displays the type and severity and timing of disturbance on the landscape. This disturbance can be either anthropogenic or natural. This layer is used in the model to increase probability of wood recruitment in areas that have seen disturbance such as wildfire. This data is available for download at http://landfire.gov/.

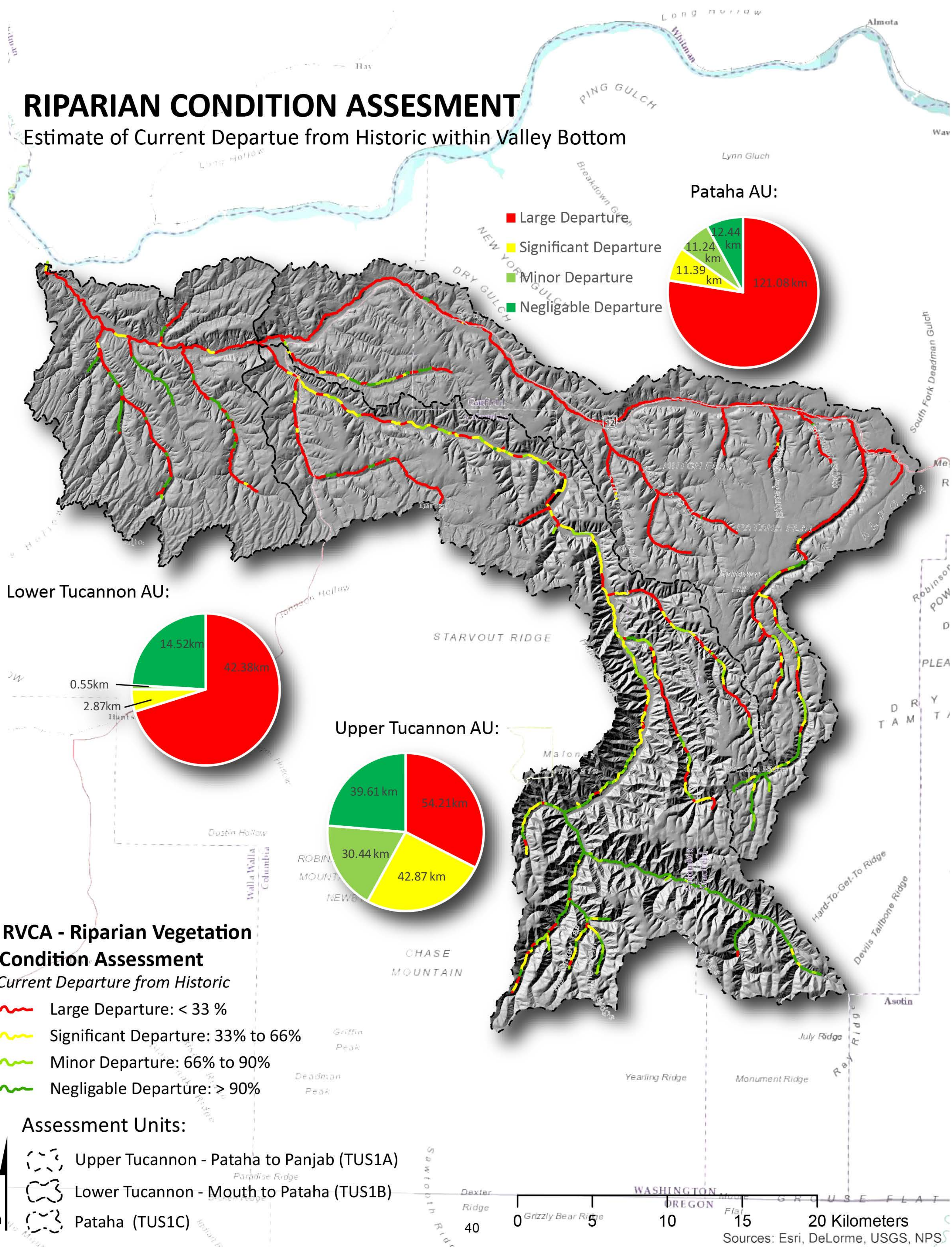

LARGE WOODY DEBRIS RECRUITMENT POTENTIAL
Pataha AU:
Minimal
Moderate
High
Very High
6.78 km
7.7 km
17.4 km
124.04 km
Lower Tucannon AU:
0 km
3.24 km
55.03 km
Upper Tucannon AU:
53.79 km
45.07 km
27.97 km
37.72 km
LWD Recruitment Potential
Probability of LWD Recruitment
Minimal < 33%
Moderate 33% to 66%
High 66% to 90%
Very High > 90%
Assessment Units:
Upper Tucannon - Pataha to Panjab (TUS1A)
Lower Tucannon - Mouth to Pataha (TUS1B)
Pataha (TUS1C)
0
5
10
15
20 Kilometers
Sources: Esri, DeLorme, USGS, NPS
STARVOUT RIDGE
NEW YORK GULCH
DRY GULCH
WASHINGTON
OREGON
Asotin
Almota

Limiting Factor: Riparian Vegetation

To address this limiting factor, the Riparian Vegetation Condition Assessment (RVCA) model was used. RVCA models the deviation of existing riparian vegetation coverage from modelled potential (historic) riparian vegetation cover. The output is a line network which represents the stream network, where each segment of the network has an associated value representing the proportion of historic riparian vegetation currently present on the landscape. In addition, the likely cause for degradation is determined and applied to each segment of the line network.

Metrics

- LANDFIRE EVT – The LANDFIRE Existing Vegetation Type (EVT) layer is a 30 meter resolution land cover raster derived from Landsat satellite imagery. The EVT categorizes current land cover into different vegetation types, several of which are considered riparian vegetation. This dataset is used to determine the existing extent of riparian vegetation along hydrographic networks. This data is available for download at http://landfire.gov/.
- LANDFIRE BPS – The LANDFIRE Biophysical Settings (BPS) layer is a 30 meter resolution land cover raster that models the types of vegetation that were likely dominant on the landscape prior to European settlement. This model is based on current biophysical environment (i.e. soils, aspect, precipitation, etc.) as well as estimates of historic disturbance regimes. Like the EVT, certain vegetation types are categorized as riparian, and the layer is used to determine the possible historical extent of riparian vegetation. This data is available for download at http://landfire.gov/.
- NHD 24k Hydrographic Network – The National Hydrography Dataset (NHD) is a vector dataset produced by the U.S. Geological Survey (USGS). A medium resolution version (1:24,000) is nationally available and was selected for use in the RVCA model. These NHD networks include attributes that enabled us to subset the network to the perennial component to perform the analysis. This data is available for download at http://viewer.nationalmap.gov/viewer/.
- Valley Bottom Polygon – the valley bottom polygon is a metric that is automatically derived using a Digital Elevation Model (DEM) and a hydrographic network. After automatically deriving the polygon, it is manually edited to achieve a desired degree of accuracy. The valley bottom are the low lands associated with a stream network and represent the maximum possible extent of riparian vegetation. A description of the tool used to create the valley bottom polygons and the output data are available at https://sites.google.com/a/joewheaton.org/et-al/nhd-network-builder-and-vbet.


RIPARIAN CONDITION ASSESMENT
Estimate of Current Departue from Historic within Valley Bottom
Pataha AU:
Large Departure
Significant Departure
Minor Departure
Negligable Departure
121.08 km
11.39 km
11.24 km
12.44 km
Lower Tucannon AU:
42.38km
14.52km
0.55km
2.87km
Upper Tucannon AU:
54.21km
42.87 km
30.44 km
39.61 km
RVCA - Riparian Vegetation Condition Assessment
Current Departure from Historic
Large Departure: < 33 %
Significant Departure: 33% to 66%
Minor Departure: 66% to 90%
Negligable Departure: > 90%
Assessment Units:
Upper Tucannon - Pataha to Panjab (TUS1A)
Lower Tucannon - Mouth to Pataha (TUS1B)
Pataha (TUS1C)
N
0
5
10
15
20 Kilometers
Sources: Esri, DeLorme, USGS, NPS
STARVOUT RIDGE
CHASE MOUNTAIN
WASHINGTON
OREGON
Almota
Asotin
Hard-To-Get-To Ridge
Devils Tailbone Ridge
South Fork Deadman Gulch
July Ridge
Yearling Ridge
Monument Ridge
Dustin Hollow
Lynn Gluch
PING GULCH
DRY GULCH

Remotely-sensed temperature model metric development overview

Daily maximum stream temperature from CHaMP stream temperature logger were summarized as 8-day average max stream temperatures for sites in the Tucannon River basin. These temp summaries were used along with remotely-sensed Land Surface Temperature data from NASA's MODIS satellite to parameterize linear models used to estimate 8-day mean and maximum temperature for each confluence-to-confluence stream reach in the basin. Temperature models were built for each year. A Leave-One-Out bootstrap was used to generate error metrics.

Model structure: 8DMaxTemp ~ LST + LST^2 + JulianDay + Elevation

Number of logger sites, Root Mean Squared Error of Prediction (°C), and model R-squared for each year:

	N	RMSEP	R^2
2011	10	1.19	0.92
2012	20	1.84	0.88
2013	17	1.96	0.77

Estimated temperatures were then compared to exceedance thresholds, and the percentage of total days in exceedance for the period of 20 July – 31 August was calculated. Means (and standard errors of the means) of those percentages across each Assessment Unit were calculated. These summaries were then compared to surevey –design based estimates for each Assessment Unit.

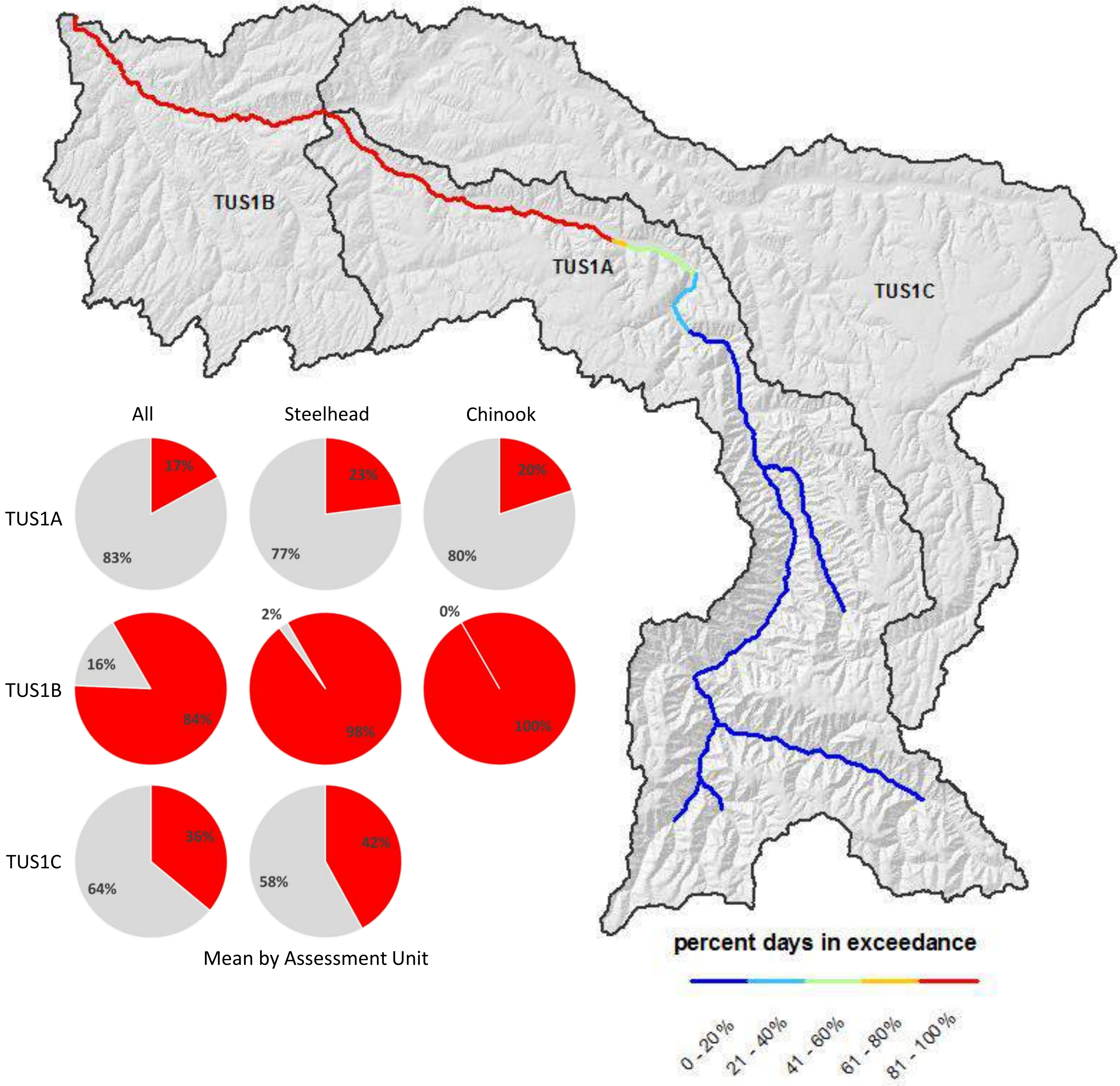
Spatial data: The stream network is NHD+ 1:100k, paired down to exclude first order streams.

Projection: Albers Equal Area Conic

Datum: North American 1983

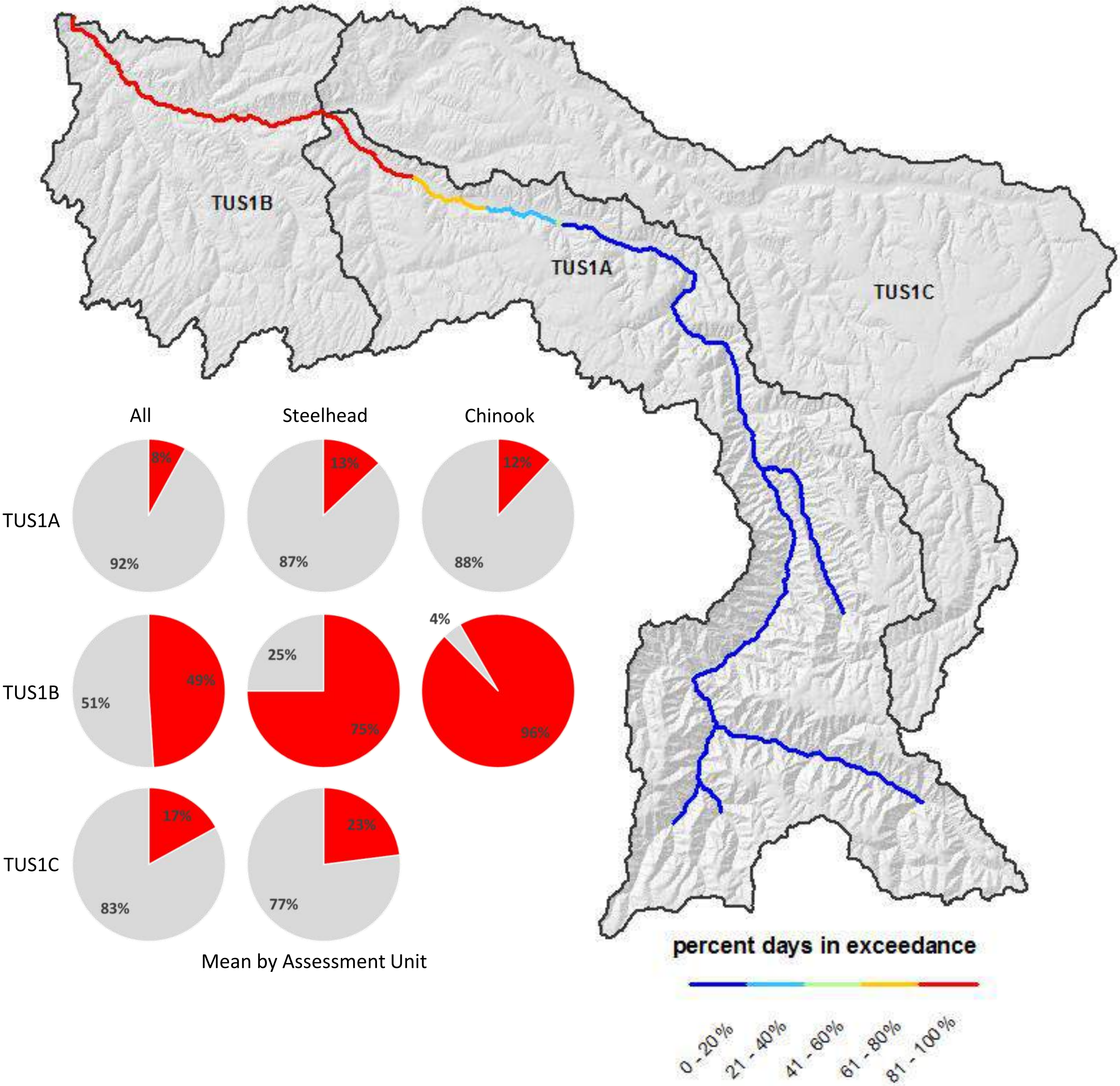
Tucannon River 2011

Percent summer days (20 July – 31 August) in exceedance of 18°C maximum stream temperature
Chinook extent



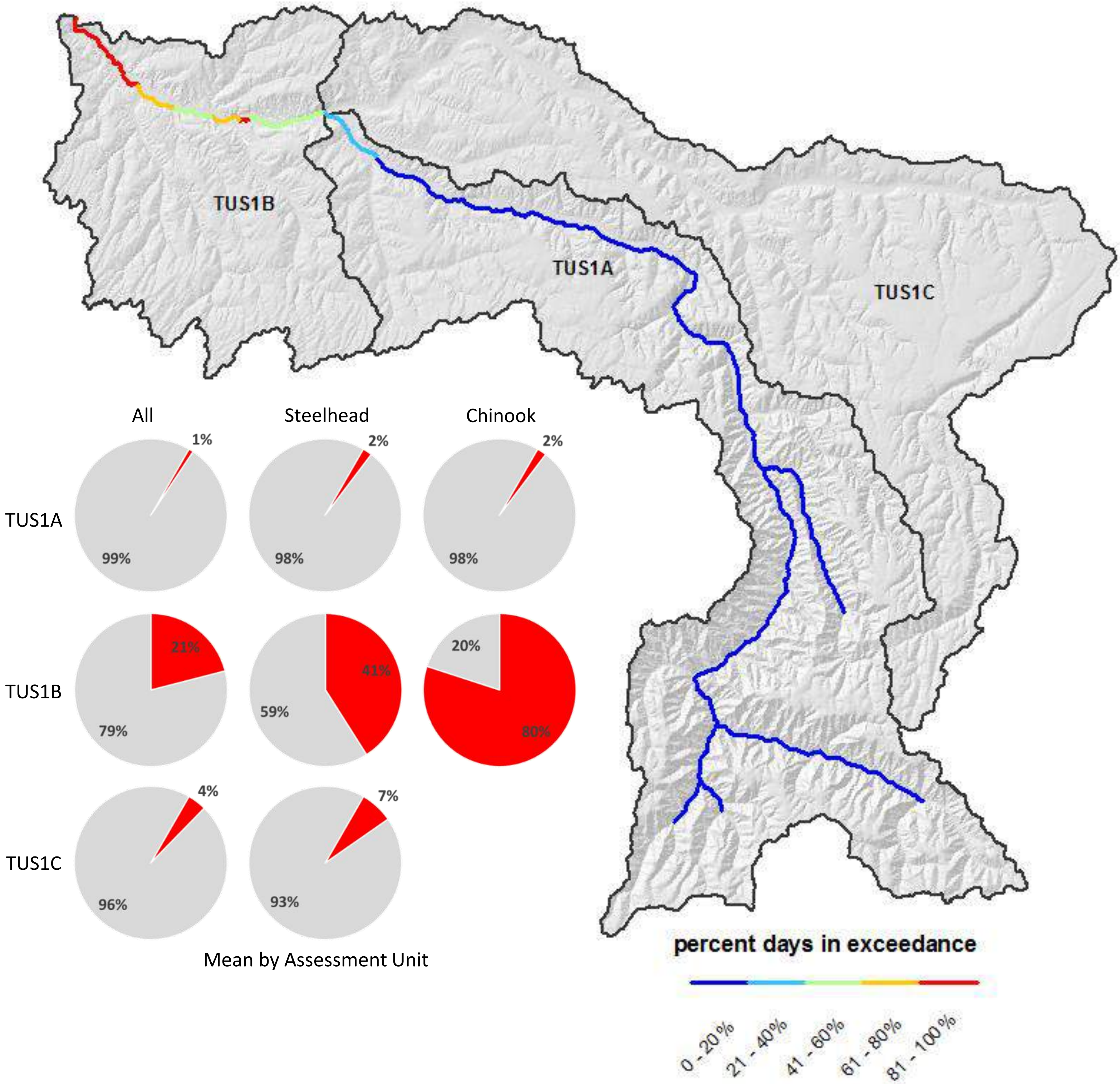
Tucannon River 2011

Percent summer days (20 July – 31 August) in exceedance of 20°C maximum stream temperature
Chinook extent



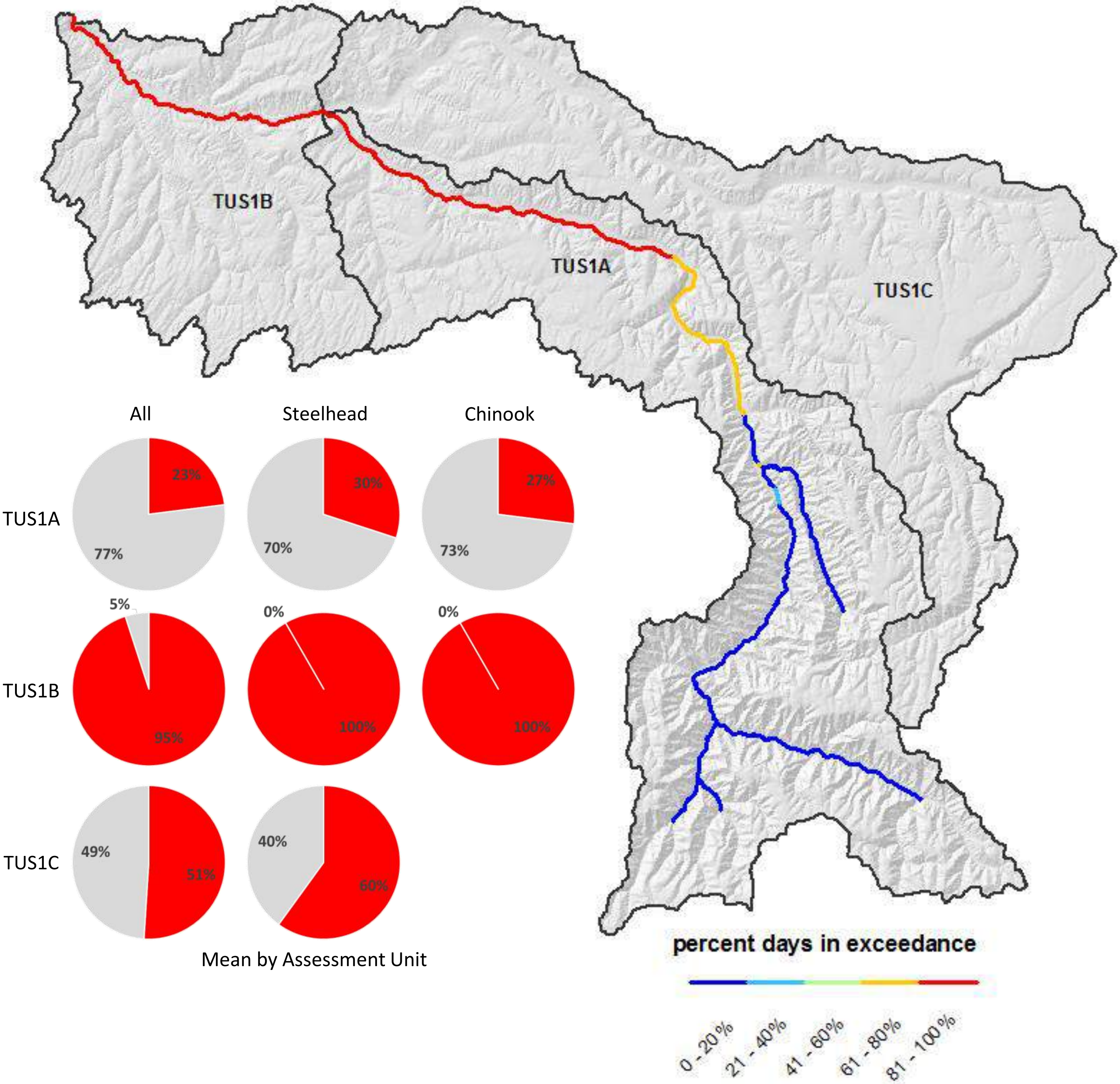
Tucannon River 2011

Percent summer days (20 July – 31 August) in exceedance of 22°C maximum stream temperature
Chinook extent



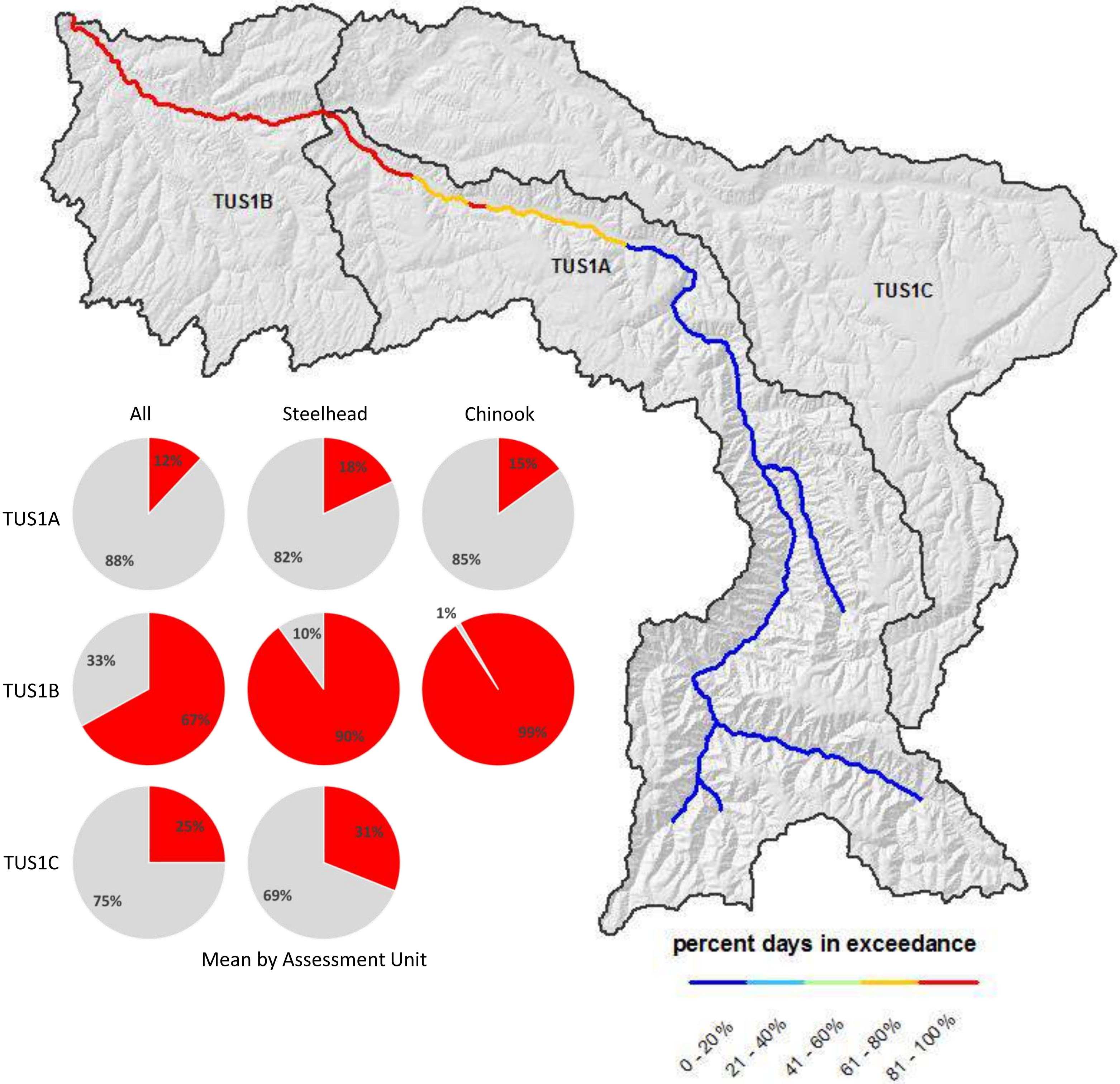
Tucannon River 2012

Percent summer days (20 July – 31 August) in exceedance of 18°C maximum stream temperature
Chinook extent



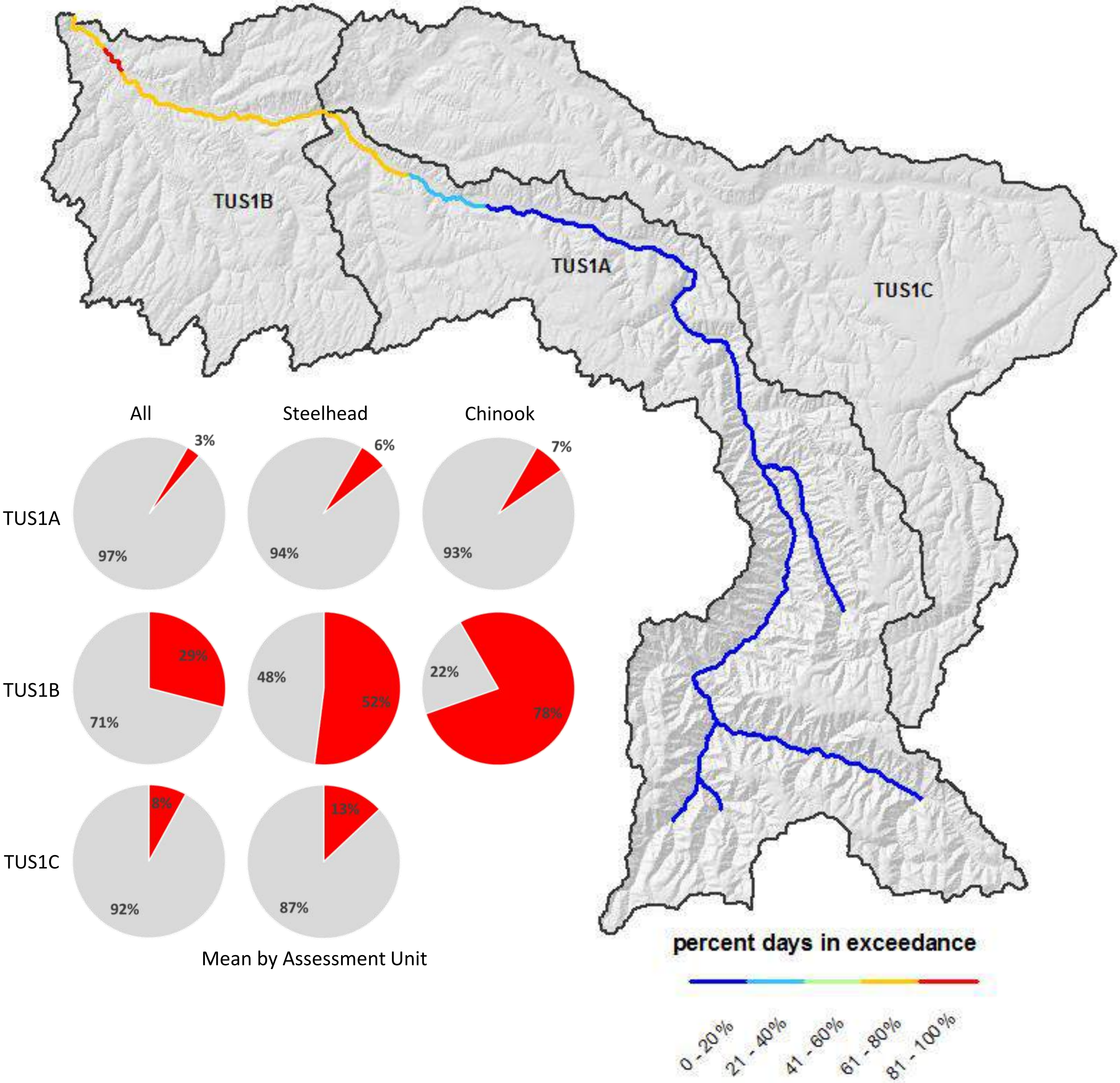
Tucannon River 2012

Percent summer days (20 July – 31 August) in exceedance of 20°C maximum stream temperature
Chinook extent



Tucannon River 2012

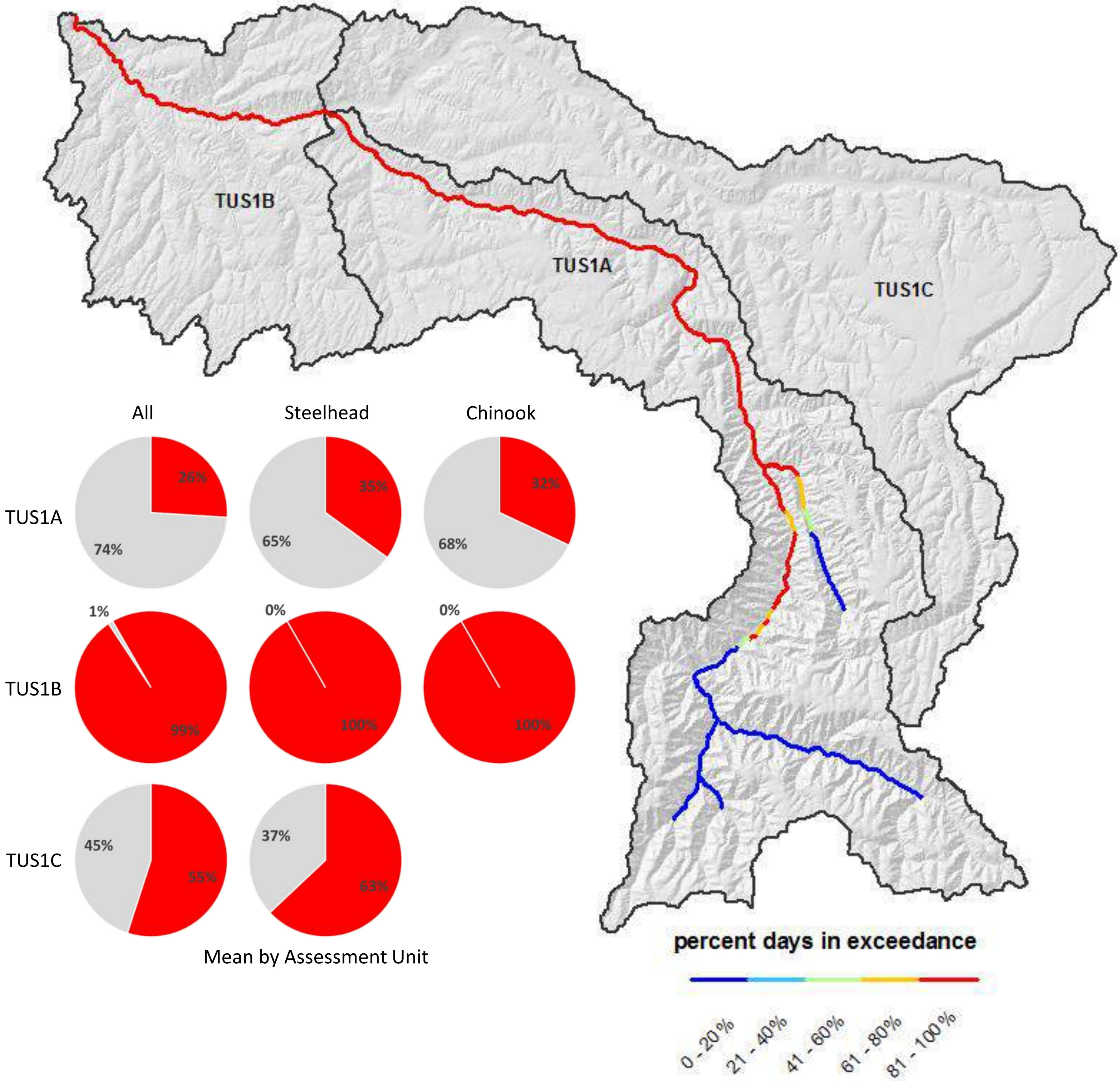
Percent summer days (20 July – 31 August) in exceedance of 22°C maximum stream temperature
Chinook extent



Mean by Assessment Unit

Tucannon River 2013

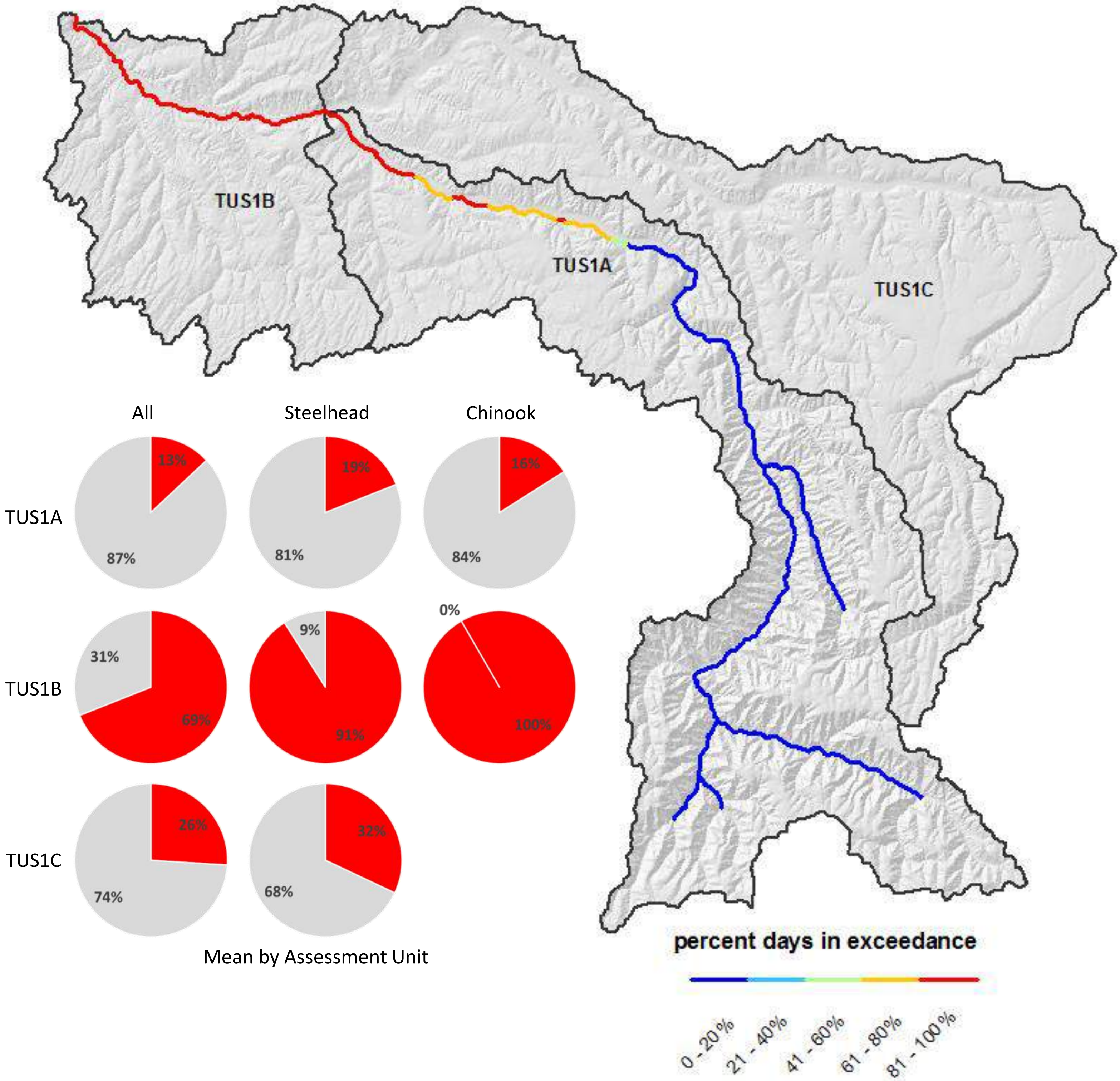
Percent summer days (20 July – 31 August) in exceedance of 18°C maximum stream temperature
Chinook extent



Mean by Assessment Unit

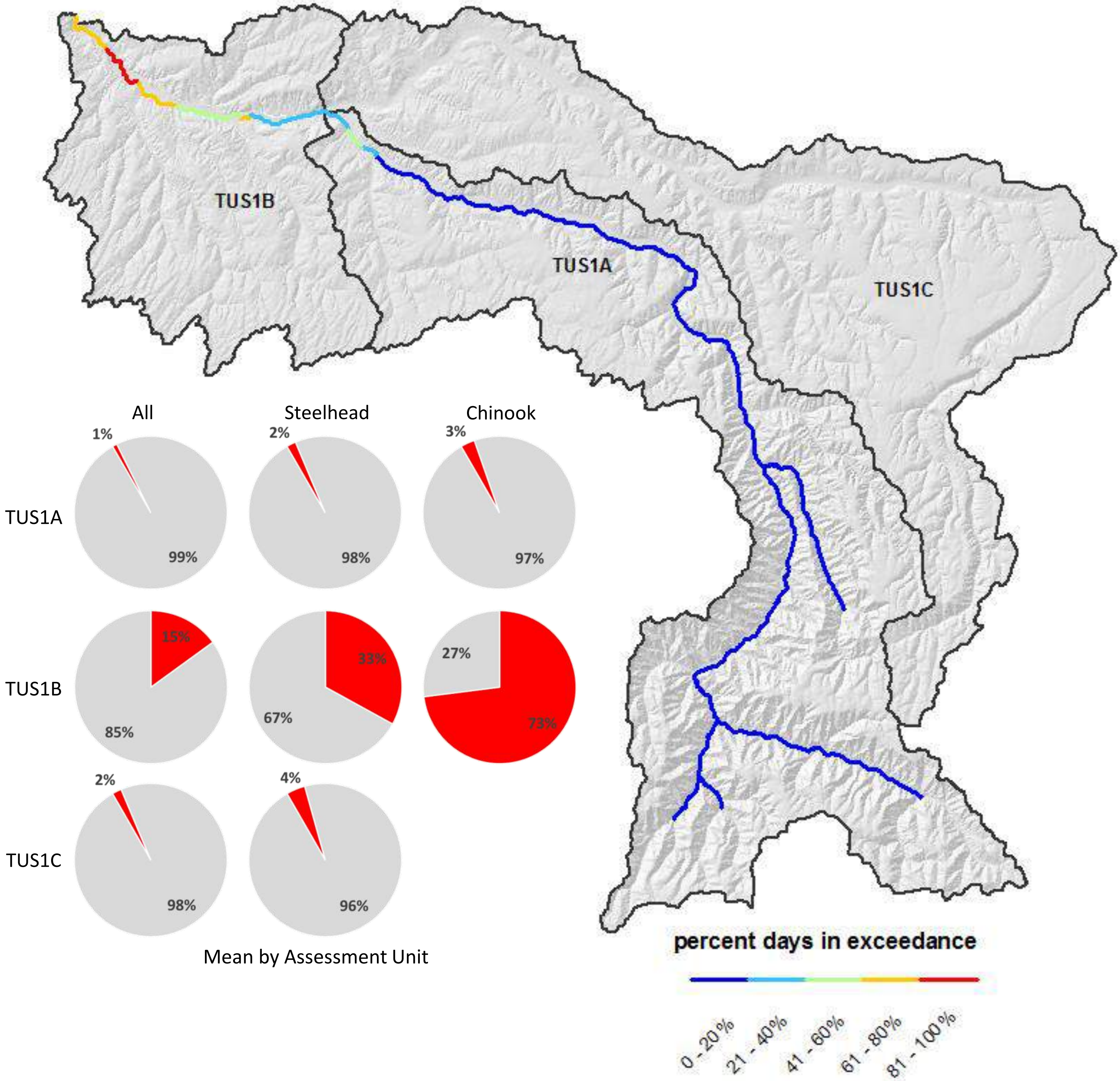
Tucannon River 2013

Percent summer days (20 July – 31 August) in exceedance of 20°C maximum stream temperature
Chinook extent



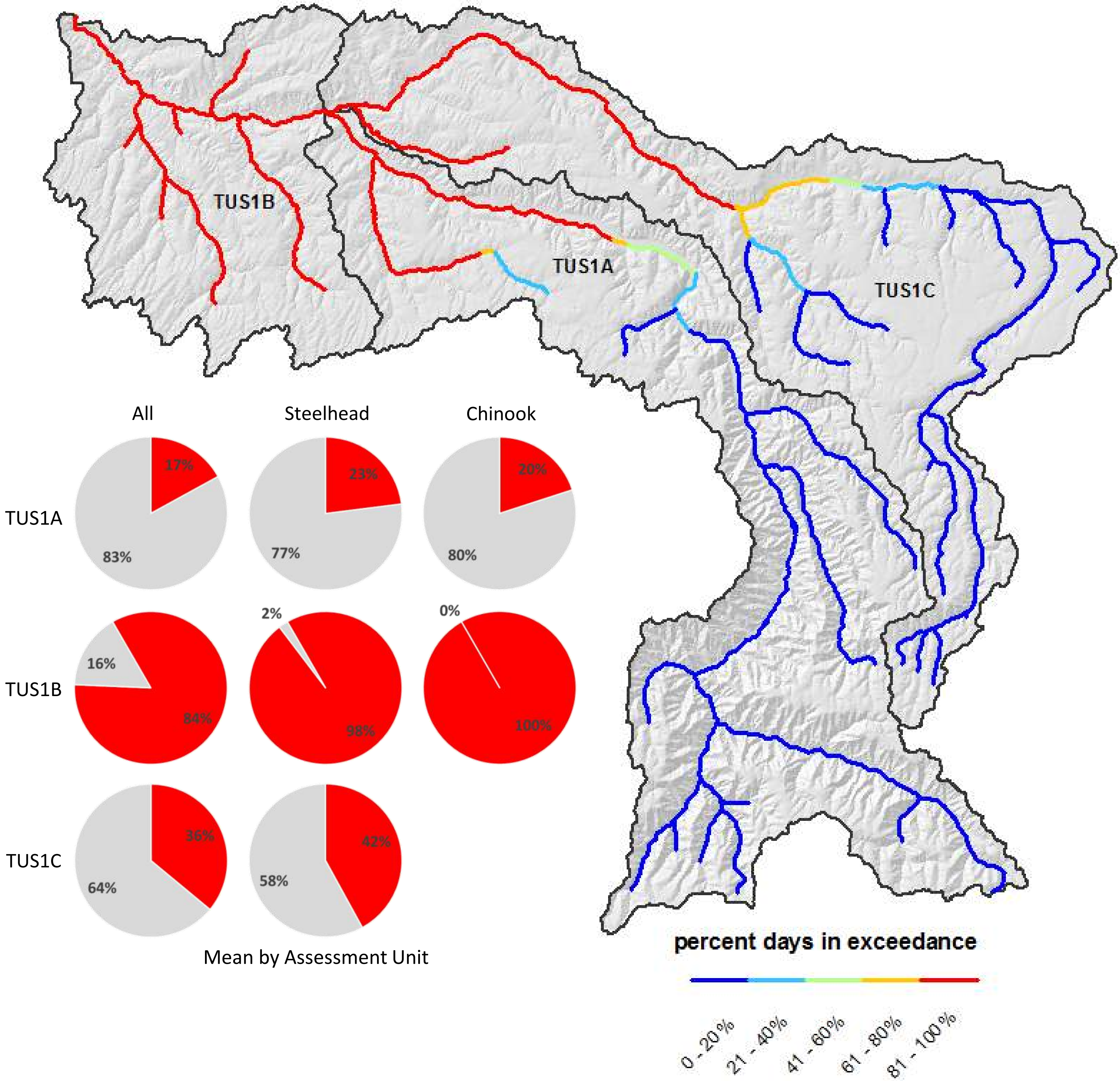
Tucannon River 2013

Percent summer days (20 July – 31 August) in exceedance of 22°C maximum stream temperature
Chinook extent



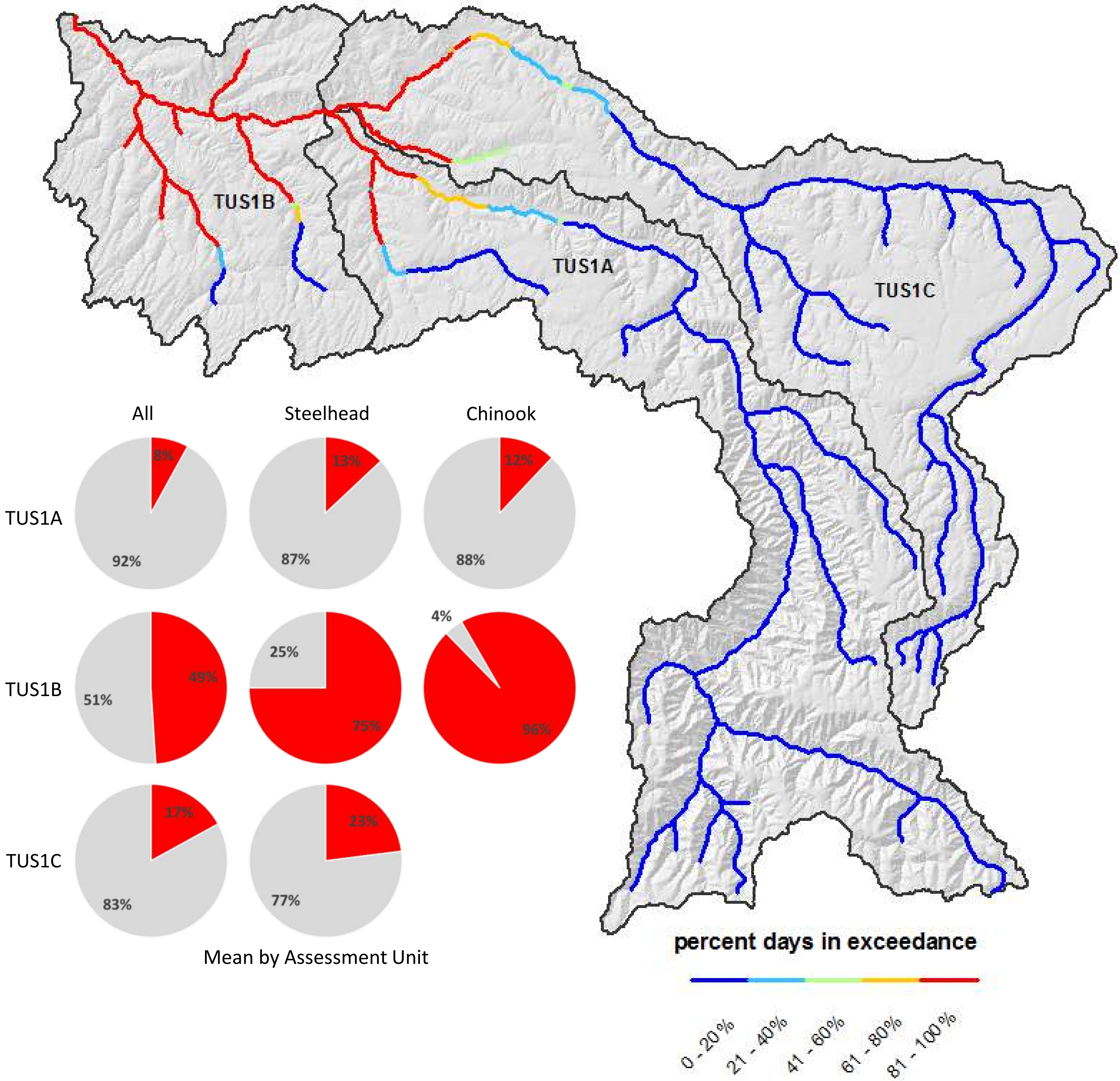
Tucannon River 2011

Percent summer days (20 July – 31 August) in exceedance of 18°C maximum stream temperature
Steelhead extent



Tucannon River 2011

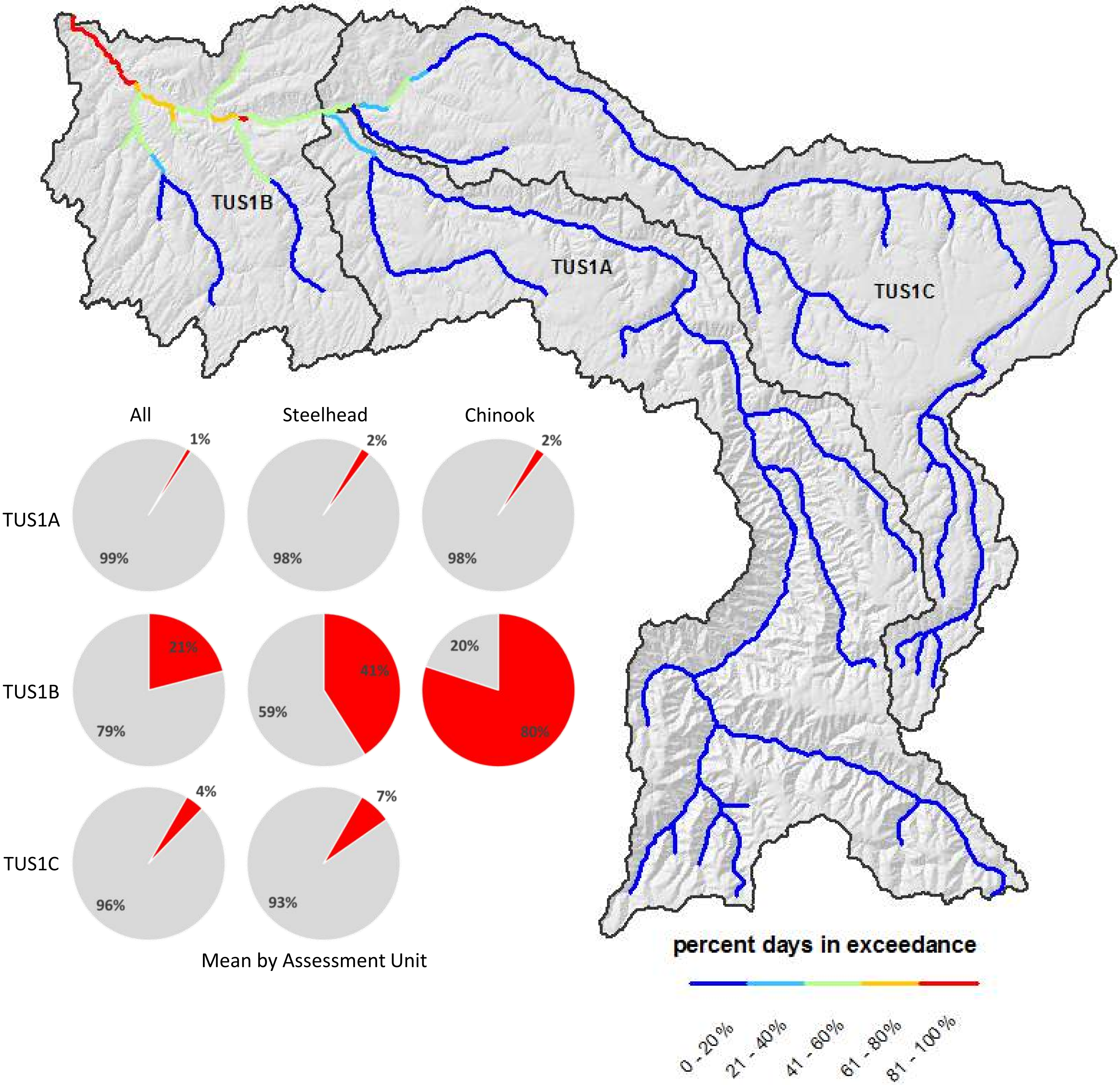
Percent summer days (20 July – 31 August) in exceedance of 20°C maximum stream temperature
Steelhead extent



Mean by Assessment Unit

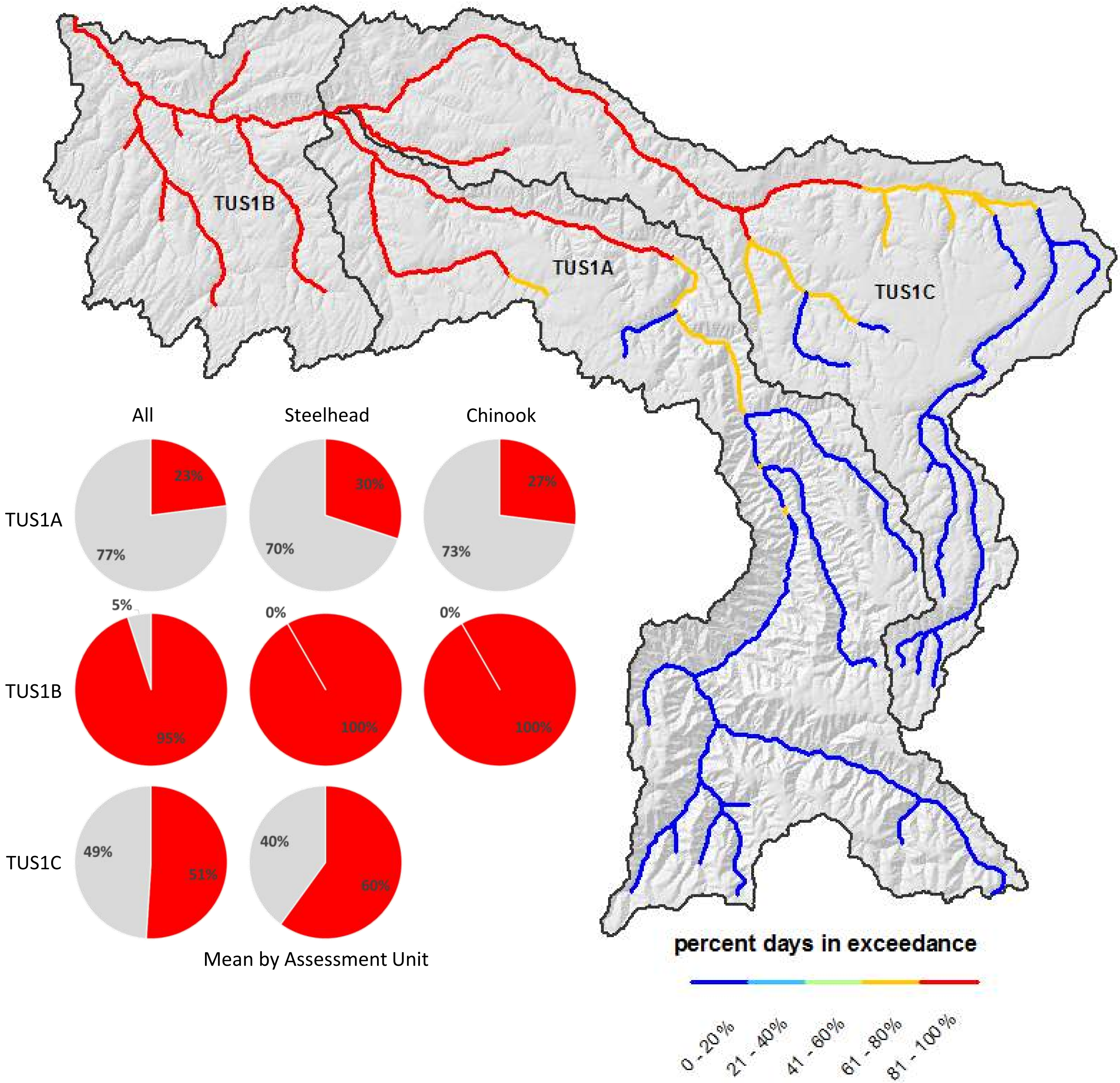
Tucannon River 2011

Percent summer days (20 July – 31 August) in exceedance of 22°C maximum stream temperature
Steelhead extent



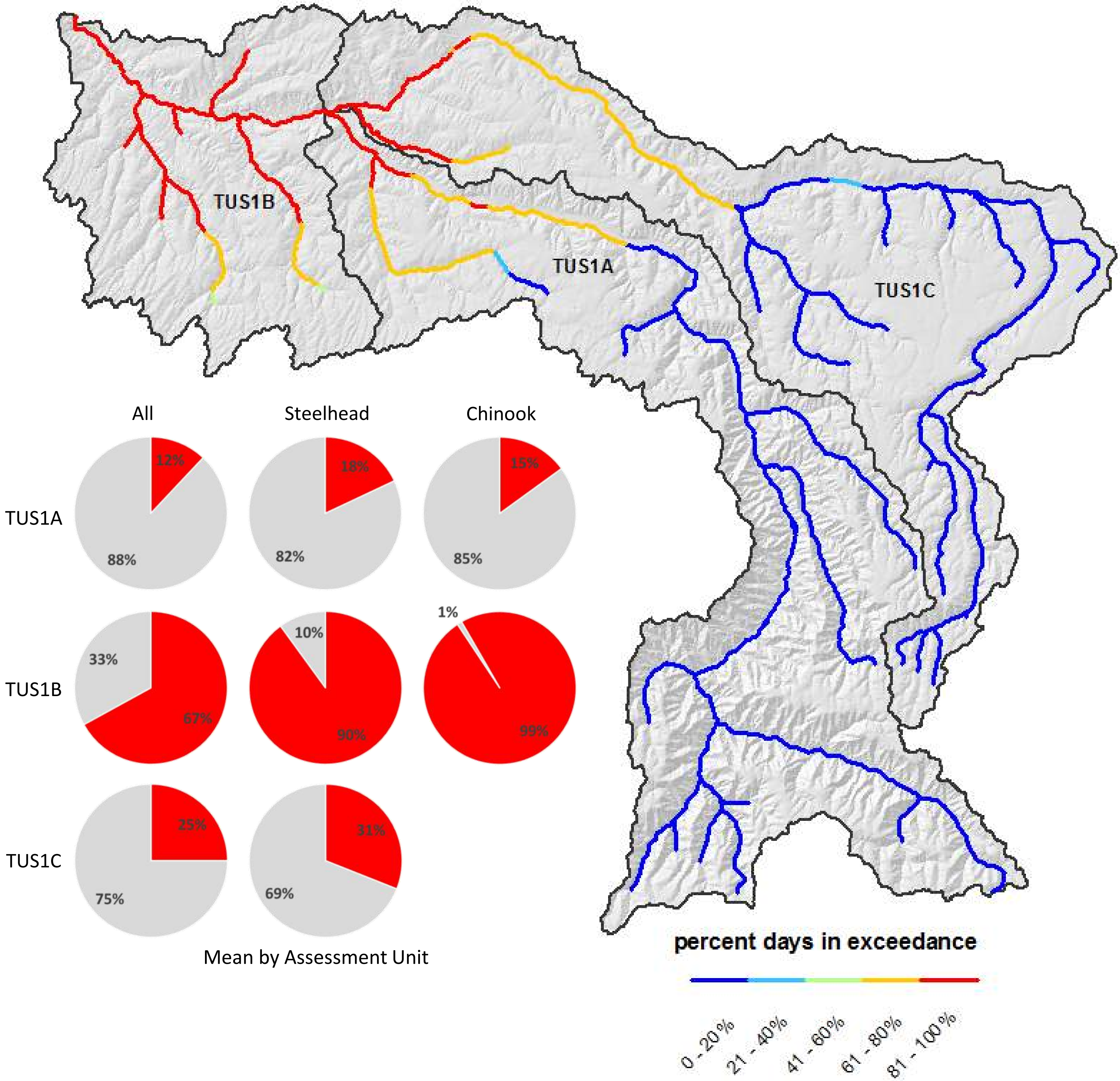
Tucannon River 2012

Percent summer days (20 July – 31 August) in exceedance of 18°C maximum stream temperature
Steelhead extent



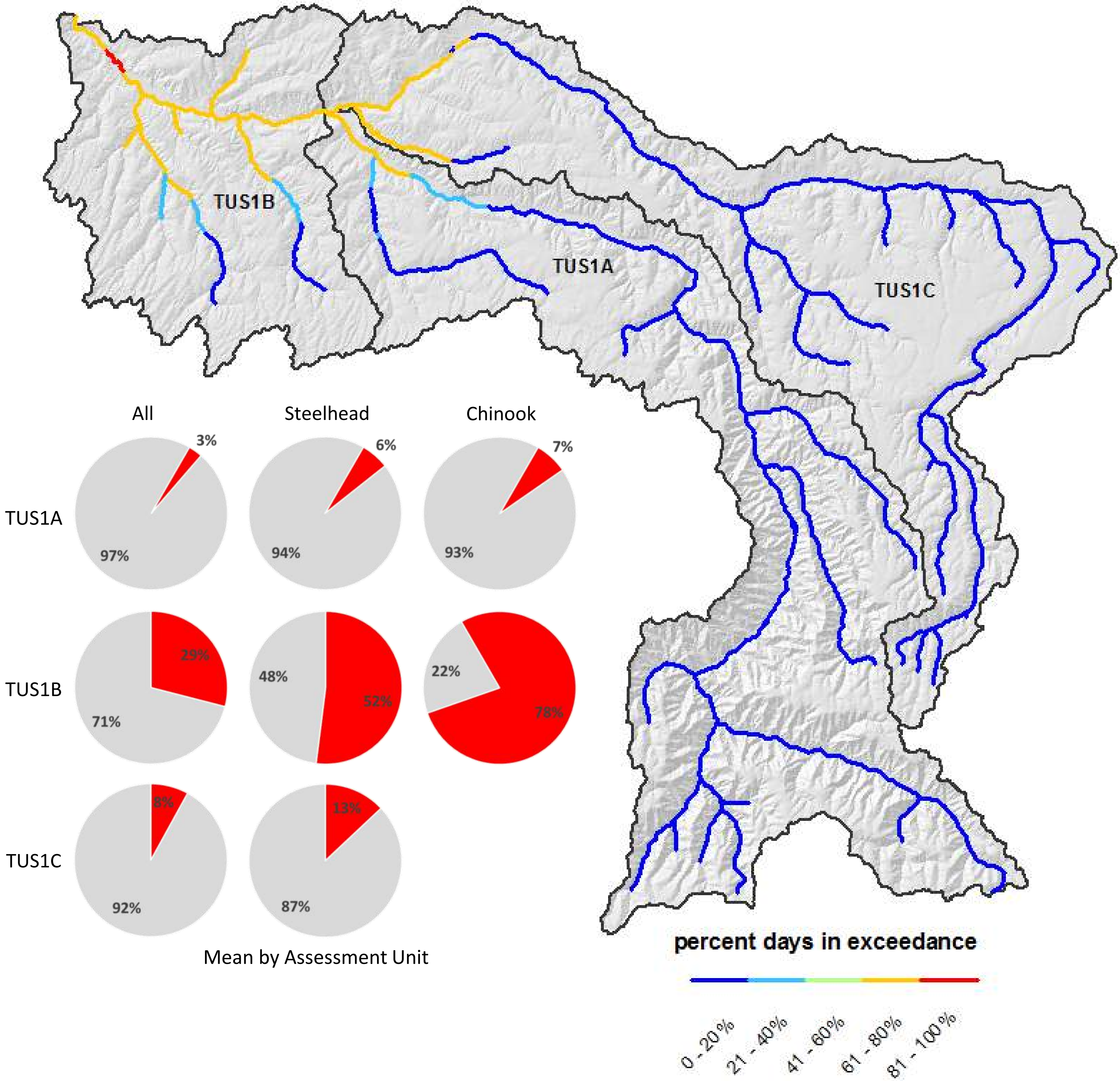
Tucannon River 2012

Percent summer days (20 July – 31 August) in exceedance of 20°C maximum stream temperature
Steelhead extent



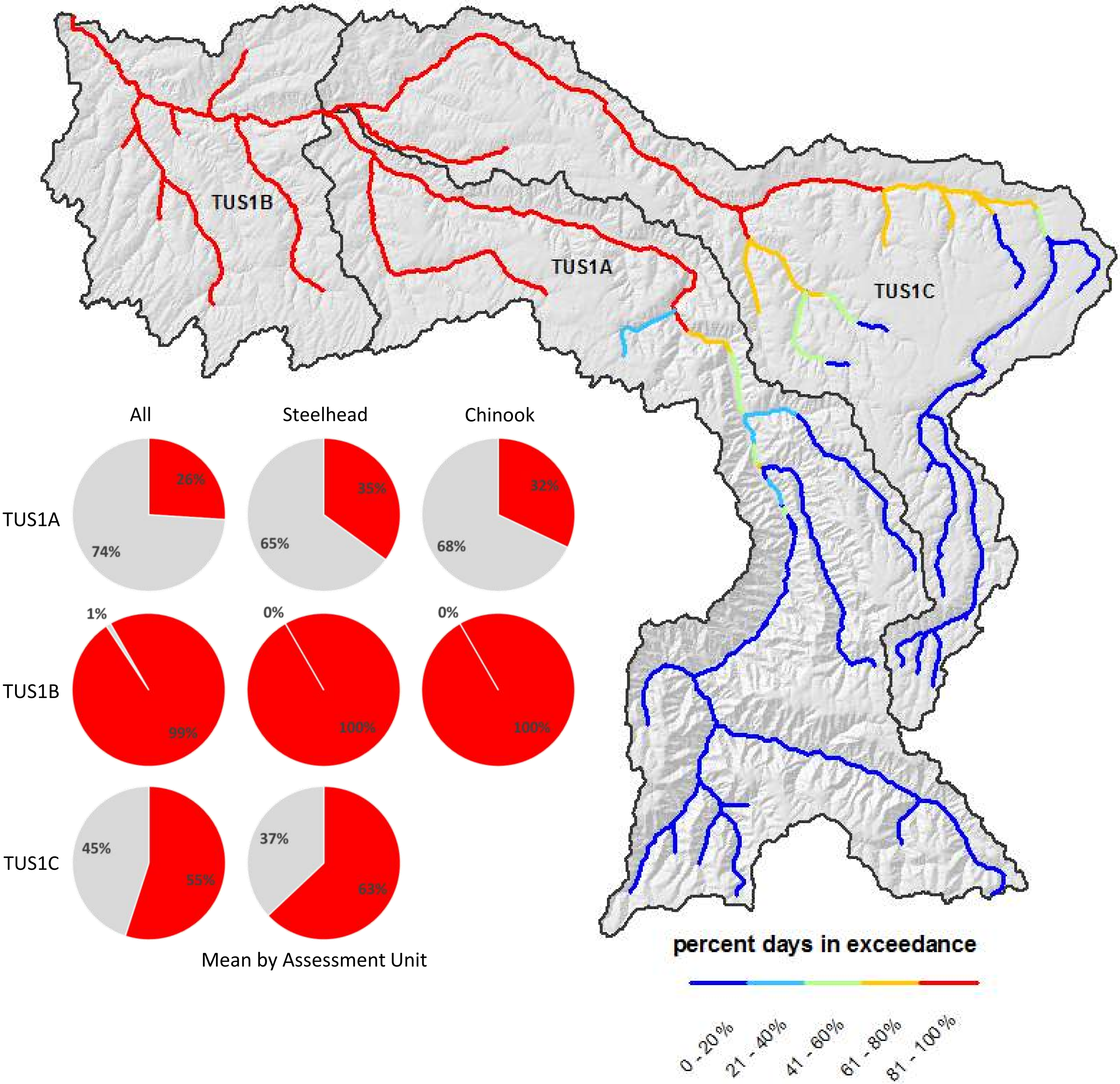
Tucannon River 2012

Percent summer days (20 July – 31 August) in exceedance of 22°C maximum stream temperature
Steelhead extent



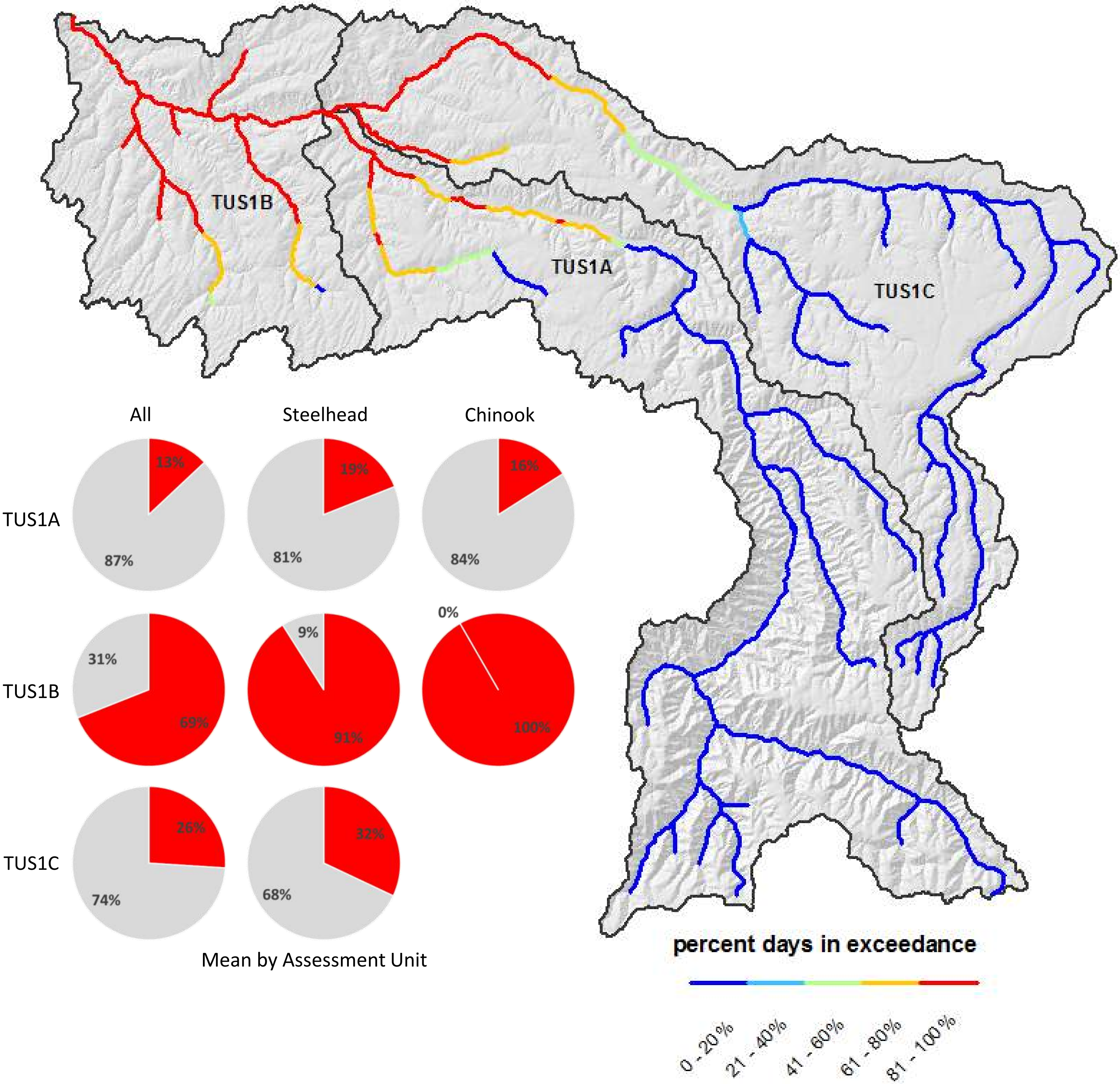
Tucannon River 2013

Percent summer days (20 July – 31 August) in exceedance of 18°C maximum stream temperature
Steelhead extent



Tucannon River 2013

Percent summer days (20 July – 31 August) in exceedance of 20°C maximum stream temperature
Steelhead extent



Tucannon River 2013

Percent summer days (20 July – 31 August) in exceedance of 22°C maximum stream temperature
Steelhead extent