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**Using better maps to make better maps for Alaska’s salmon streams [DRAFT]**February 3, 2023  
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*This is the second in a series of two opinion articles addressing the state of freshwater salmon habitat mapping efforts in Alaska. The first article is for a more general audience and may be accessed here \_\_\_\_\_\_\_\_\_\_\_\_:, while the second below is for a more technical audience.*

In the first of this two-article series, I made the case for modernizing our approach to mapping Alaska’s salmon streams. In this second article, I will outline the technologies that we may use to do so. As part of efforts to design and execute a systematic approach for expanding the anadromous waters catalog (AWC) in the Kenai Borough region, I’ve come up against a series of technical questions on how to best proceed. My intention is to outline these questions here and share them with a small audience of experts to solicit ideas and feedback. There are lots of techniques to approach the challenge of uncovering yet-unidentified salmon streams, and if we are successful, I hope that that they will applicable statewide.

If you’ve made it through that first paragraph, thank you for your time and assistance! Now, onwards.

*The need for a systematic approach*

To select field survey sites to expand the AWC, many of us working in the field may rely on word of mouth, local databases, or visually searching the map for places where the existing AWC streams end while the stream channel continues upstream. The lack of a systematic approach is by nature inefficient, as frequently field biologists are uncertain if many miles of additional salmon habitat lay upstream from their survey location.

Moose creek trib example, approach used by naïve types like me

Pic, circle fieldwork site, known stream channel, awc channel

After a half dozen days of fruitless bushwhacking to search for unidentified salmon streams, I began looking for better ways to approach this challenge.

In Fall 2022 I stumbled across reports from a project in southeast Alaska that used more advanced mapping approaches to estimate the uppermost points of anadromy within a watershed. Field biologists traveled to a subset of these predicted locations and performed “end of anadromy surveys,” also called, “last fish observations” (LFO). These data along with other geographic and hydrologic data fed a predictive model with very strong numbers: the map predicted *presence* of fish correctly at the most-upstream reach in 86.7% of cases, and correctly predicted *absence* in 98.7% of cases, within ± 66 m (Romey and Martin 2022). These numbers suggest enormous potential to be of help to field biologists looking to add new miles to the AWC.

Pic, link

Along with extensive fieldwork, the approach requires access to a geospatial product called NetMap. (also link to slideshow from AWRA 2019)

*The NHD+ and NetMap?*

I encountered other researchers using alternative approaches to the challenge of identifying undiscovered salmon streams at the Mat-Su Salmon Science Symposium in Palmer on November xx – xx, 2022.

Using the publicly available geospatial product NHD+ (National Hydrography Database plus), ADF&G researchers identified all points throughout select watersheds where stream gradient was ≥ 12% and assumed this as a barrier to upstream migration. When superimposed with the existing AWC map, this approach reveals many miles of likely salmon streams and lakes not yet included in the AWC.

The method has its pros and cons. The relatively simple filter can be applied without complex modeling to an existing public geospatial product

With acc

\A few summers ago, a call came into our office about a just-cleared property near a local creek. Neighbors were concerned that the land-clearing had disturbed wetlands and streams that feed into a nearby anadromous stream. Land clearing and developments of this nature are not infrequent at the suburban-rural boundary of southcentral Alaska, and usually they in compliance with permitting requirements. Here, however, it was unclear what we were walking into.

We arrived to find a quarter-mile length of freshly ditched and straightened stream denuded of riparian and benthic structure. We found dozens of juvenile coho salmon and Dolly Varden residing both above and below the excavated section of stream, which we later successfully nominated to the Alaska Department of Fish and Game's (ADF&G) Anadromous Waters Catalog (AWC).

Now that this particular stream is included on the map, in the future if a developer submits plans to local permitting offices those plans would typically be reviewed for compliance with a Fish Habitat Permit from ADF&G, and reviewers will ideally make recommendations to help mitigate impacts of the planned development.

Identifying a salmon stream post-hoc after it has been bulldozed is a situation no one wants to see. Not landowners, not neighbors, not the general public, and not the fish. Arguably not every single wild salmon stream is destined for indefinite preservation as we balance the needs of growing communities and wild fish habitat in our backyards. But we owe it to ourselves to have good information about where wild salmon live to make informed decisions.

So how do we prevent this sort of uninformed travesty from repeating in more yet-unidentified salmon streams? What can we do to at least get these streams on the map?

Currently, Alaska regulations are such that we assume streams and lakes are not salmon-bearing unless otherwise proven. For our bulldozed example above, for this stream to have appeared beforehand on the Anadromous Waters Catalog map the following would have to have occurred:

* Someone would have had to known that this tiny stream existed and might have salmon
* Someone would gain permission from the landowner to visit the property
* Someone would perform a field survey to determine the presence or absence of salmon
* The data would be submitted to ADF&G review as a nomination to the Anadromous Waters Catalog

other option would be to reverse assumption of axndromy, e.g. bm1, but for now until then…

we want to encourage this behavior. how can we help create a treasure map to send out volunteers?'

'etc

use map approach . touch on netmap vs / and nhd approaches…

lots of other easons to have more complete awc: upstream distance used to prioritize culverts … read more on adfg site

one day I hope we might be able to use modeled maps as the map layer rather than solely ground-truthed streams ections. this approach has been highly successful for wetlands mapping

No one

future technique: ground-truth model, when model is good, use for permitting purposes

to do - decide on best approach/model options: a.) use ~12% gradient on NHD+ as upper estimate ( can use other features from NHD?) b.) use NetMap/statistical approach

It is estimated that less than half of Alaska's freshwater salmon habitat is documented and mapped; and as a result these streams and lakes lack the legal protection afforded by inclusion in the Alaska Department of Fish and Game's (ADF&G) Anadromous Waters Catalog. When environmental impacts are reviewed prior to development projects, undocumented anadromous streams do not require a Fish Habitat Permit issued by ADF&G. As a result, thousands of stream miles outside of protected areas are vulnerable to development impacts such blockages from road crossings, erosion and runoff from impervious surfaces, and riparian denudement. Threats to these undocumented anadromous habitats come from both small scale developments such as driveway crossings as well as on a large scale such as a mining developments. In order to nominate salmon habitat for inclusion in the Anadromous Waters Catalog, ADF&G requires in-person visual confirmation of anadromous fish at the site location. The work requires hands-on fieldwork by fisheries technicians and volunteers, frequently via little-traveled routes crossing a complex patchwork of land ownership.

Thesis chapters Proof of concept for creating and using "treasure map" with volunteer labor

Existing municipal, state, and federal laws - how and where are there gaps, how could it change? Focus on regional examples in misc places Exploration for how to reverse assumptions on anadromy - what would it take for legal framework to change such that we assume waters "are" anadromous unless evidence suggests otherwise? Upstream: lit review of headwater contributions and their function in downstream nutrition

In working to solve local challenges, the question we should be asking is “do our environmental standards serve local needs?”

Explorers are those of us who see maps and think, "There most be more to it than what's shown here…"