# Fish Distribution and Abundance in Shallow Intertidal Habitats of Tarboo and North Dabob Bays

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# INTRODUCTION

## Background

The Tarboo and north Dabob Bay study area extends from the mouth of Tarboo Creek at the head of Tarboo Bay to include Broad Spit and Camp Discovery Creek in Dabob Bay to the south (Figure 1). The study area (hereafter referred to as Tarboo-Dabob Bay) may represent one of the highest quality and biologically important estuarine environments in Puget Sound. Three large saltmarsh spits extending from the sides of the bay create a diversity of hydraulic conditions and habitats. The southern most spits are considered the separation between Tarboo and Dabob Bay. Inside the spits, shallow mudflats and saltmarsh lagoons predominate. Outside of the spits, in Dabob Bay proper, the seafloor plunges to more than 500 feet deep and shorelines are generally comprised of the gravel and sand beaches typical of Hood Canal, with eelgrass beds occurring offshore. Numerous small streams along the shorelines enter Tarboo-Dabob Bay.

Figure 1. Tarboo-Dabob Bay study area looking south.

Unlike many other parts of Puget Sound, the Tarboo-Dabob estuary remains in remarkably pristine condition, with an abundance of high quality habitat for juvenile salmonids and a variety of marine fish. About 400 acres are protected as state-owned Natural Area Preserves, including the lower mile of Tarboo Creek and the coastal spits and adjoining upland forest. However, the existing preserves provide only piecemeal protection for the Tarboo-Dabob Bay ecosystem as a whole. With increasing development expected in the watershed in the decades ahead, a more comprehensive approach is needed to ensure that the water quality and aquatic habitats are protected over the long term.

In 2001, Northwest Watershed Institute initiated the Tarboo Watershed Assessment with 14 project partner organizations as the first step in a comprehensive conservation project. The purpose of the Tarboo Watershed Assessment was to conduct an integrated and science-based analysis of both Tarboo Creek and Tarboo-Dabob Bay to identify high priority protection and restoration projects that could be conducted with the participation of willing landowners. The assessment also aimed to obtain the baseline data necessary to monitor the health of the watershed over time.

A first step in the assessment was to gain an understanding of the distribution and abundance of fish species in the marine portion of the project area. In Tarboo-Dabob Bay, no previous fish surveys had been conducted, with the exception of surveys conducted by the Port Gamble S'Klallam Tribe at a single sample site in the southeast corner of the study area (Hirschi et al. 2003). In this survey, the mouth of Camp Discovery Creek was sampled by beach seine from December 2001 through October 2002 as part of survey of North Hood Canal tidal creeks and independent marshes. Hirschi et al. (2003) reported finding several Chinook salmon at this site. In addition, at many of their sample sites in Hood Canal they caught juvenile chum salmon in January and February. The unusually early occurrence of these chum along the shorelines suggested that they were the offspring of summer chum, which spawn one to two months earlier than fall chum. These findings further underscored the importance of investigating fish use within Tarboo-Dabob Bay, an area that may be especially important as non-natal rearing areas for juvenile salmonids.

Funding for this study was provided in part by the Jefferson County Marine Resources Committee (JCMRC) of Washington State. The JCMRC is composed of citizen representatives that were organized to address local marine issues and recommend protection and restoration actions to Jefferson County and other appropriate organizations. In 2003, the JCMRC identified Tarboo Bay-Dabob Bay as one of the three priority areas for conservation in Jefferson County.

### Objectives

The purpose of this study was to better understand fish use, distribution, and abundance in Tarboo-Dabob Bay during the spring and early summer seasons when salmonid were expected to be present in the estuary. This baseline information on fish use can then be used in regional and watershed-specific conservation and restoration efforts.

Specific objectives of the project were to:

1) Identify fish species using shallow intertidal shoreline areas during the February – July sampling period, when juvenile salmonids were most likely to be present.

2) Better understand the distribution and abundance of salmonids and principle forage fish in the study area in relation to general habitat types and seasonal change.

## METHODS

### Sampling sites and timing

Twenty-five survey sites were selected in Tarboo-Dabob Bay with the intent of sampling a diversity of shallow intertidal habitat types distributed throughout the project area (Table 1). Sites were classified into habitat types based on a recent literature review of the habitat preferences of salmonids (Anchor Environmental 2002; Simenstad 1983, 1985, 1991, 2000; Williams and Thom 2001). Saltmarsh-mudflats and stream deltas were considered the most important habitats, whereas the sand and gravel beaches areas typical of higher energy coastal spits and Dabob Bay shorelines were considered lower priority.

Sampling was conducted once a month for a one to three day period from February 2003 through July 2003. Sampling generally ranged from 4 to 8 hours a day. Because Tarboo Bay was too shallow to sample at moderate or low tides, we only sampled during the high tide periods when tidal elevation was at least 8 feet. Seven "standard" sites were sampled consistently every month, with the exception of two sites that were not sampled in July. Twenty "supplemental" sites were sampled as time and weather permitted (Table 1 and Figure 2).

## Field procedures

We used field procedures and net specifications developed by the Skagit System Cooperative Research Department. They developed a small net beach seine method for sampling shallow intertidal shoreline areas (Skagit System Cooperative Research Department 2003). We accessed sampling sites with a small skiff and outboard motor. The areas seined were typically less than 4 feet deep and had relatively homogenous habitat features such as: water depth and velocity, substrate, and vegetation. We employed an 80-foot long, 6-foot deep net with 1/8-inch knotless mesh and weighted bottom line and floating cork top line. To set the net, one person held one end of the net on the beach while the other played out the net from a floating tote while wading out from the beach (Figure 3). The net was set in a half circle "upstream" against the tide, with both ends ending at the beach. Two to four persons then pulled the net in to the beach (Figure 4). Small catches of fish were sampled directly from the net, while large numbers of fish were held for sampling in a bucket or in a pocket of the net draped inside a floating 3 by 4-foot frame of PVC pipe (Figure 5).

Three hauls were made at each sampling site. Each haul was located 20-60 meters apart along the beach. Fish were identified to species if possible, and total length measured for the first 10 to 20 fish of each species. Habitat variables were recorded for each set, including salinity, sea surface temperature, substrate composition and shoreline vegetation types. Data was entered onto a field data form (Appendix A), then into computer Excel spreadsheet format. The location of each sample site was recorded in the field using a handheld GPS and used to help map the site locations in GIS.

Table 1. Sampling sites listing habitat type and months sampled (dark boxes). Standard sites were sampled from January through June or July (in bold type).

| Site ID | Site Name | Habitat Type | Month sampled | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | | | Feb | Mar | April | May | June | July | |
| 1 | Broadspit Point | Spit | ■ | | | ■ | ■ | | 3 |
| 2 | Broadspit Lagoon | Saltmarsh | ■ | | | ■ | | | 2 |
| 3 | Broadspit Creek | Beach-stream | ■ | | ■ | ■ | ■ | | 4 |
| 4 | West Dabob Rocks | Beach | ■ | | ■ | ■ | ■ | ■ | 5 |
| 5 | West Dabob Landslide | Beach | ■ | | ■ | ■ | ■ | ■ | 5 |
| **6** | **Cabin Creek** | Beach-stream | ■ | ■ | ■ | ■ | ■ | ■ | 6 |
| 7 | South Spit Corner | Spit | ■ | | | | | | 1 |
| 8 | South Side of South Spit | Spit | | ■ | | | ■ | | 2 |
| 9 | South Spit Point | Spit | ■ | | ■ | | ■ | | 3 |
| **10** | **Spits Lagoon** | Saltmarsh | ■ | ■ | ■ | ■ | ■ | ■ | 6 |
| **11** | **North Spit Point South Side** | Spit | ■ | ■ | ■ | ■ | ■ | ■ | 6 |
| 12 | North Spit Point North Side | Spit | ■ | | ■ | | | | 2 |
| 13 | West Tarboo Bay Cove | Saltmarsh | | ■ | | | | | 1 |
| 14 | West Tarboo Floathouse | Mudflat | | ■ | ■ | ■ | | | 3 |
| **15** | **Tarboo Creek** | Mudflat-stream | ■ | ■ | ■ | ■ | ■ | ■ | 6 |
| **16** | **Spruce Creek** | Mudflat-stream | ■ | ■ | ■ | ■ | ■ | | 5 |
| **17** | **Boathouse Point** | Beach | ■ | ■ | ■ | ■ | ■ | ■ | 6 |
| 18 | Lagoon Creek | Mudflat-stream | ■ | ■ | ■ | | ■ | | 4 |
| 19 | Long Spit East Side South End | Saltmarsh | | ■ | | | ■ | | 2 |
| 20 | Long Spit East Side by Island | Saltmarsh | ■ | ■ | ■ | | ■ | | 4 |
| **21** | **Long Spit East Side Lobes** | Saltmarsh | ■ | ■ | ■ | ■ | ■ | | 5 |
| 22 | Long Spit Point East side | Spit | | | ■ | | | | 1 |
| 23 | Long Spit Point West side | Spit | | | | | ■ | | 1 |
| 24 | Long Spit Beach | Spit | ■ | | | ■ | ■ | | 3 |
| 25 | East Dabob Landslide | Beach-mudflat | ■ | | | ■ | ■ | | 3 |
| | Total Number of Surveys | | 19 | 13 | 16 | 15 | 19 | 7 | 89 |

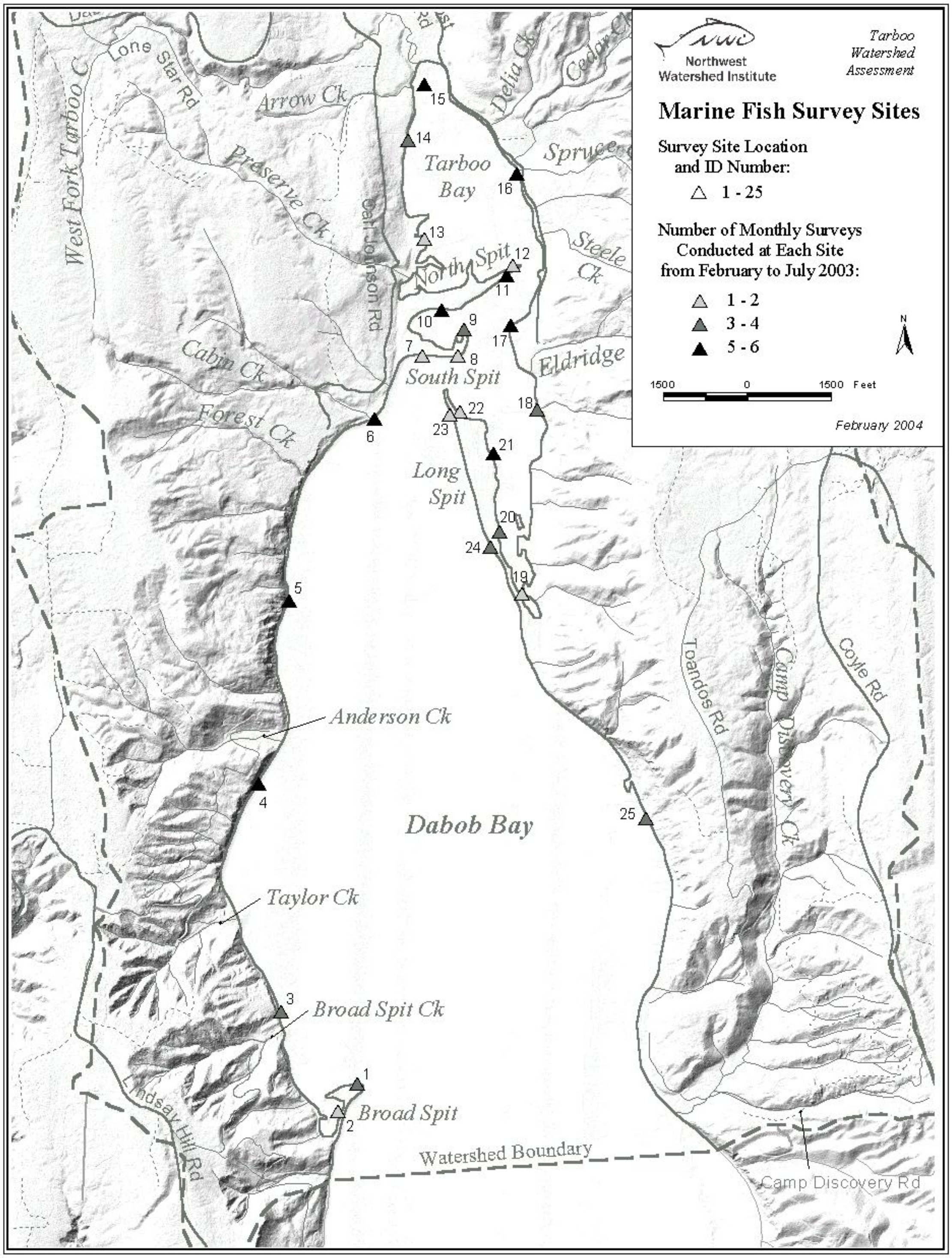


Figure 2. Survey site locations indicating number of surveys conducted at each site.

Figure 3. Setting the net in a semi-circle by playing it out from a floating tote.

Figure 4. Hauling in the net.

Figure 5. Sampling fish held within the PVC floating frame.

# RESULTS AND DISCUSSION

## General distribution, abundance, and seasonal change

A diversity of fish species was caught over the survey season. Table 2 lists the fish species caught at all sites, the percent of sites at which a species was found, and the total number of each species that was caught. Juvenile Chinook, coho, chum, and cutthroat trout were identified. Juvenile forage fish, including surf smelt, sand lance, and herring were caught. Six species of sculpin were identified. Because some sites were only sampled one or two times and others were sampled as many as six times, a comparison of the distribution and abundance of species using all data from all sites may be biased. Nevertheless, this data is informative in showing general patterns of species distribution and abundance.

Table 2. Total number of each fish species collected, and percent of the total sites at which the species was found (percent occurrence).

| Species | Percent occurrence | Total number |
|---|---|---|
| Coho salmon (Oncorhynchus kisutch) | 48 | 37 |
| Summer chum salmon (Oncorhynchus keta) | 96 | 6821 |
| Fall chum salmon (Oncorhynchus keta) | 88 | 18005 |
| Chinook salmon (Oncorhynchus tshawytscha) | 16 | 5 |
| Cutthroat trout (Oncorhynchus clarki clarki) | 28 | 11 |
| Pacific herring ( Clupea harengus pallasi) | 12 | 4 |
| Surf smelt (Hypomesus pretiosus) | 36 | 136 |
| Sand lance (Ammodytes hexapterus) | 20 | 182 |
| Bay pipefish (Syngnathus griseolineatus) | 24 | 10 |
| Flatfish (Psettichthys melanostictus) | 4 | 1 |
| Starry flounder (Platichthys stellatus) | 36 | 18 |
| Sand dab (Citharichthys sordidus) | 4 | 1 |
| Gunnel (Pholis sp.) | 20 | 11 |
| Shiner perch (Cymatogaster aggregata) | 64 | 6446 |
| Pacific snake prickeback (Lumpenus sagitta) | 68 | 755 |
| Three-spine stickleback (Gasterosteus aculeatus) | 32 | 15 |
| Buffalo sculpin ( Enophrys bison) | 4 | 1 |
| Great sculpin ( Myoxocephalus polyacanthocephalus) | 68 | 223 |
| Fluffy sculpin (Oligocottus snyderi) | 16 | 9 |
| Saddleback sculpin (Oligocottus rimensis) | 20 | 11 |
| Staghorn sculpin (Leptocottus armatus) | 100 | 772 |
| Tidepool sculpin (Oligocottus maculosus) | 8 | 6 |
| Sculpin sp. | 24 | 54 |

The abundance of fish caught changed dramatically over the season. Table 3 summarizes the total number of fish caught each month for selected species. This summary included only the seven standard sites – five of which were sampled every month, and two of which were sampled every month except July (when very few species and no salmonids were caught at other sites). The consistent sampling at multiple sites provided a reliable estimate of the change in abundance and use of shallow intertidal habitats over the season. However, without more extensive sampling of deeper water areas, we cannot determine whether the fish that were not sampled were in deeper water or out of Tarboo-Dabob Bay completely.

Table 3. Seasonal changes in abundance for selected fish species at standard sampling sites.

| | **Month sampled** | | | | | | **Total** |
|---|---|---|---|---|---|---|---|
| **Species** | **Feb** | **Mar** | **Apr** | **May** | **June** | **July** | **Catch** |
| Coho | 0 | 0 | 0 | 29 | 1 | 0 | 30 |
| Chinook | 0 | 1 | 1 | 1 | 1 | 0 | 4 |
| Summer chum | 357 | 232 | 255 | 1 | 0 | 0 | 845 |
| Fall chum | 0 | 5033 | 4795 | 160 | 0 | 0 | 9988 |
| Cutthroat | 0 | 0 | 4 | 3 | 0 | 0 | 7 |
| Surf smelt | 6 | 3 | 0 | 4 | 0 | 0 | 13 |
| Pacific herring | 0 | 0 | 0 | 1 | 2 | 0 | 3 |
| Sand lance | 0 | 0 | 5 | 0 | 0 | 0 | 5 |
| Shiner perch | 0 | 0 | 7 | 205 | 267 | 62 | 541 |
| Staghorn sculpin | 35 | 31 | 48 | 23 | 91 | 22 | 250 |
| Snake prickleback | 0 | 0 | 0 | 2 | 443 | 8 | 453 |

Chum salmon

Chum salmon were separated for identification purposes into summer and fall chum stocks based on timing and size of the fish. All chum sampled in February were considered for all intents and purposes to be summer chum (Figure 6). These chum were approximately 40 mm in length and were found to be the same size as summer chum that

Figure 6. Summer chum salmon juveniles sampled in February, 2003.

were being reared at the Quilcene Hatchery at the time. The fish we caught were probably wild summer chum since none of the Quilcene hatchery-reared summer chum were released until several weeks after our mid-February sampling (L. Tallis, pers. comm. 2003). In March, we observed two distinct size classes of chum, a newly emerged chum of about 35 mm, and chum about 55 mm. All chum over 50 mm were assumed to be summer chum due to their much greater size. During the April sampling, the distinct size differences began to break down. We continued to consider all chum over 50 mm as summer chum. However, a few noticeably larger chum of 60 to 70 mm were also observed and may have represented the true summer chum. In May, only one large 70 mm chum was found and was assumed to be a summer chum. If our identification of summer chum based on size and timing is correct, then summer chum inhabited Tarboo-Dabob Bay for over three months, from late January through early May.

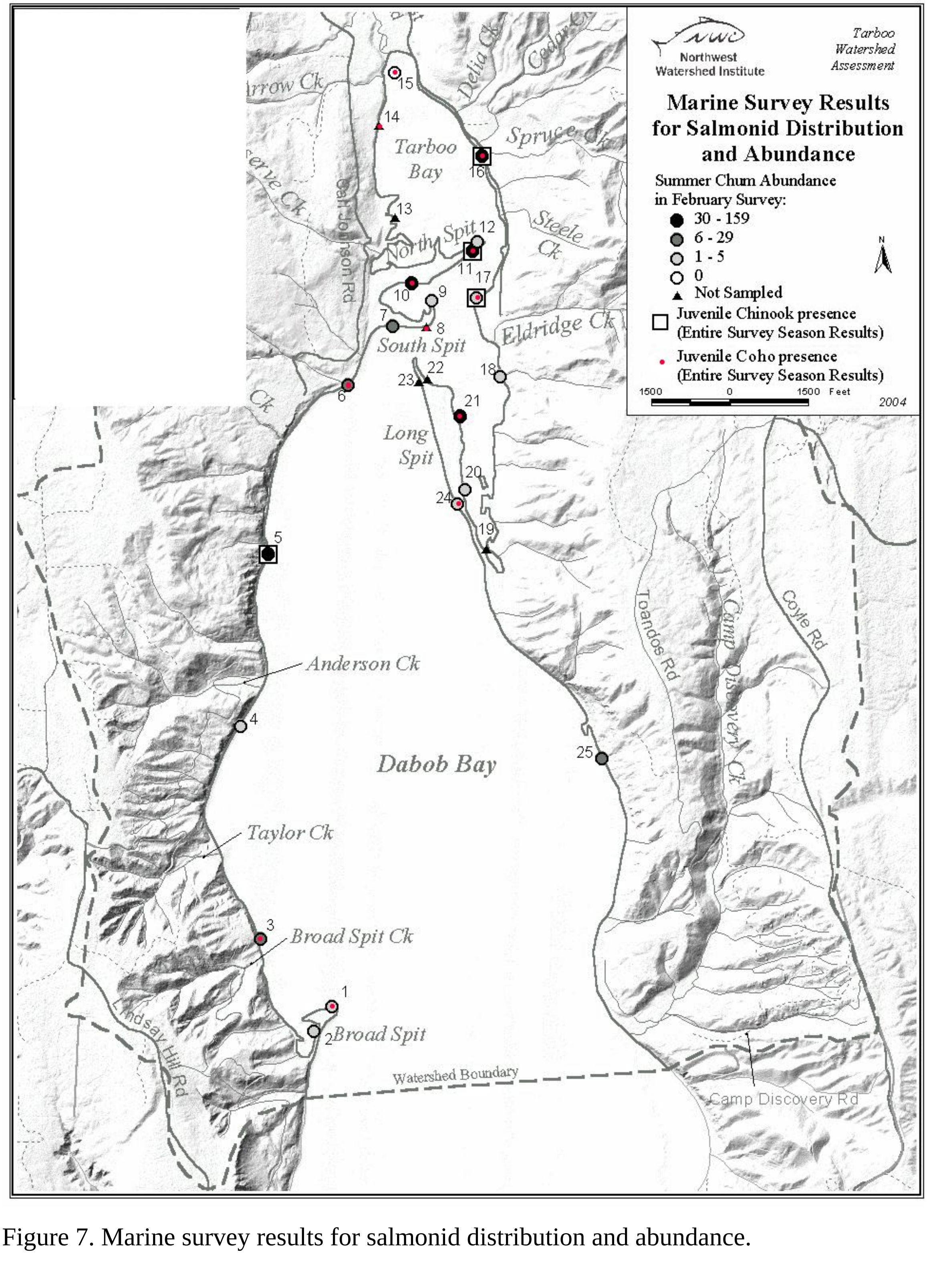


Figure 7. Marine survey results for salmonid distribution and abundance.

Summer chum had a surprisingly wide distribution. In the first month of sampling in February, summer chum salmon were found at all sites sampled except the mouth of Tarboo Creek (Figure 7). However, the catch was highly variable between hauls and between sites. A few fish were caught at most sites, with substantially higher numbers caught at a several sites. The relationship between chum abundance and habitat type was not obvious and the variability may simply have reflected the clumped distribution of fish that were traveling in schools. However, the highest numbers of fish caught in February were from saltmarsh lagoon sites that fish may have preferred. Especially considering the small size of these fish, it is striking to note that at low tide most of Tarboo Bay is completely de-watered mud flats and that at high tides fish move in on the high tide to populate the inner bay. We are planning to conduct statistical analysis to determine if summer chum were found in significantly higher numbers in certain types of habitat than others. This may help us answer the key question of whether summer chum are preferentially selecting areas such as Tarboo Bay for extended rearing.

On January 28, 2004, we started a second season of sampling at the seven standard sites (data not included in this report) and caught a few newly emerged chum with belly slits barely healed at sites 7,15,16. These were all sites located at the mouths of freshwater streams, two of which were inside Tarboo Bay. Either these fish were summer chum that traveled significant distances soon after emergence from natal streams such as the Big Quilcene River or alternatively, these fish may have represented an unusually early emergence of fall chum that spawned in local streams. Genetic testing is needed to confirm whether these chum salmon inhabiting the estuary in January and February are indeed summer chum. That finding would not be surprising according to the leading expert on Hood Canal summer chum salmon (C. Simenstad, personal communication 2003).

Coho salmon

Thirty-seven coho juveniles were caught at 12 sites over the survey season (Table 2 and Figure 7). The fish ranged from 38 –133 mm in length, with 8 coho under 41 mm. These results corroborate the finding of young-of-the-year coho in estuarine areas by Hirschi et al. (2003) and others.

Most of the coho were sampled during the May survey (Table 3). The timing corresponded to the timing of smolts out-migrating from Tarboo Creek. In a separate beach seine survey of the lower portion of Tarboo Creek, 115 coho smolts ranging in size from 76 to 152 mm were found on April 28; 33 coho were found in a subsequent survey on May 11; and no coho were sampled on May 25. In addition to a Tarboo Creek origin, two fish sampled in marine waters had clipped adipose fins, and may have come from the Quilcene hatchery or netpen rearing operation.

The broad size range of the coho sampled in lower Tarboo Creek and in Tarboo-Dabob Bay is remarkable, and may reflect a third life history strategy; to out-migrate after two winters in freshwater, instead of just one. This theory is supported by our observations of the sizes of coho juveniles in freshwater. During summer snorkel surveys, we found a small fraction of coho juveniles that were significantly larger than most of the other coho and were probably into their second year in freshwater.

Chinook salmon

Five Chinook salmon were found at four sites, three of which were located within Tarboo Bay (Table 2 and Figure 7). Chinook were caught for four months, from March to June (Table 3). They ranged in size from 37 mm (caught in March) to 80 mm (Figure 8). The 37 mm Chinook, and perhaps the others, probably out-migrated from Tarboo Creek. A small number of Chinook adults have been observed spawning in the lower mile of Tarboo Creek every season that the stream was surveyed between 1994 and 2003 (7 of ten years) (Bahls 2003). This population may have originated from a release of hatchery smolts from a rearing pond project in the Tarboo valley in the early 1990s. Sampling these small Chinook juveniles in Tarboo Bay adds further weight to the theory that these fish are naturally reproducing at some level.

Figure 8. Young-of-the-year Chinook salmon caught in Tarboo Bay.

Fall chum salmon

Fall chum were the most abundant fish sampled. During March and April, fall chum were "swamping" Tarboo-Dabob Bay, with approximately 10,000 fish caught at seven sites and about 20 times more fall chum than summer chum sampled during that period (Table 3). These fish probably originated in the Quilcene hatchery and hatcheries elsewhere in Hood Canal, as well as out-migrating from Tarboo Creek, where there is a strong naturally spawning population in the lower Creek (Bahls 2003).

Shiner Perch, Snake Prickleback, and Staghorn Sculpin

Three fish were relatively abundant later in the season. Numbers of Shiner perch peaked in May and June (Table 3). Although they were abundant, they were not as widespread as might be expected. Apparently, they come in to shallow water beaches during this time of year to bear live young, as most of the fish caught were young of the year or pregnant. The Snake prickleback seemed to prefer silt substrates. It was relatively scarce until June, when it was caught in abundance. This fish could easily be misidentified as a blenny (C. Moffett, pers. comm. 2003). Staghorn sculpin was the most ubiquitous species, sampled in moderate numbers at most sites throughout the season, with a peak in June. By July, these three species were the only species sampled.

Forage fish

We sampled low numbers of post larval sand lance, surf smelt, and Pacific herring at a low percentage of sites in Tarboo and Dabob Bays (Table 2 and 3). It is not surprising to find these fish, given recent forage fish surveys. In a comprehensive survey of the beaches of Eastern Jefferson County, Kevin Long of North Olympic Salmon Coalition, documented that some of the highest densities of forage fish spawning occurred along the shorelines of North Dabob Bay (K. Long, pers. comm. 2003). Adult forage fish were not found.

Three spine stickleback

A total of 15 three-spine sticklebacks were caught over the survey season (Figure 9). Surprisingly, this fish has not been found in intensive surveys in Tarboo Creek itself. Yet, the stickleback is quite common in slow, warm water sections of Chimacum Creek, immediately to the North of Tarboo Creek.

Figure 9. A large three-spine stickleback caught in Tarboo-Dabob Bay.

## SUMMARY AND RECOMMENDATIONS

This study provides the first comprehensive documentation of the use of Tarboo-Dabob Bay by a diversity of marine and anadromous fish species. Juvenile chum salmon were found along the shorelines at almost all sites as early as the first sampling in February 2003 and again in January of 2004. This early timing and the size of the chum indicate that they were probably summer chum. However, genetic analysis should be a high priority to confirm the stock identity. Summer chum may have been more abundant in salt marsh habitats than Dabob beaches, but catches were highly variable from site to site and more statistical analysis is needed to evaluate habitat preferences. By March and April, smaller fall chum seemed to swamp the system, perhaps with negative effects on summer chum. Most coho smolts were caught in May and most probably originated from Tarboo Creek, with a fraction originating from hatcheries. Low numbers of Chinook salmon juveniles were also found in Tarboo Bay from March through June. These Chinook may also have originated in Tarboo Creek, where small numbers of Chinook spawners have been documented annually since the early 1990s. A variety of other fish species was captured, with staghorn sculpin being the most ubiquitous. The survey results document that Tarboo Bay, with its extensive and diverse saltmarsh, mudflat, coastal spit, and beach habitats, is important nursery habitat for juvenile salmon and a diversity of marine fish.

This study has important implications for conservation. If the identification of summer chum is correct, regional restoration strategies for federal listed salmon, such as the Hood Canal Coordinating Council’s Salmon Recovery Strategy, need to recognize that summer chum may out-migrate from their natal stream and adjacent estuarine habitat within a matter of days or weeks to range widely in Hood Canal and spend up to three months in non-natal rearing areas. High quality non-natal estuaries like Tarboo-Dabob Bay may be more important habitats for summer chum survival than impacted natal estuaries. Furthermore, the findings here generally support the existing research that has found that stream mouths, mudflats, saltmarshes, and coastal spits are especially important habitats for salmonids (Anchor Environmental 2002). Finally, although many biologists have pointed out the importance of protecting shoreline and estuarine vegetation, protecting the water quality of the numerous small and large streams that enter the shoreline and provide the variable mix of fresh and saltwater for juvenile salmonids may be equally crucial.

## ACKNOWLEDGMENTS

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APPENDIX A. Nearshore Field Sampling Data Form

TARBOO WATERSHED PROJECT NEARSHORE FISH SAMPLING DATA FORM 2003

Northwest Watershed Institute, phone 503-235-2716

Location # ____ Name ______________________________________________ Date _________-03

Location Description ________________________________________________________________

GPS ________________ , _________________ Wind _____, Air $^{o}$C ____, Rain ____ %Cloud ______

Notes _______________________________________________________________________________

_____________________________________________________________________________________

| Variable | **Set 1** | **Set 2** | **Set 3** | **Set 4** |
|---|---|---|---|---|
| Time set | | | | |
| Time finish | | | | |
| Salinity (ppt) | | | | |
| Surface sea temp. ($^{o}$C) | | | | |
| Max. depth of set (m) | | | | |
| Set size (100%=1.0) | | | | |
| Substrate types (OR, SI, SA, GR, CO, BO, | | | | |
| Shoreline veg (Emerg. SM, Spit, Forest) | | | | |

| **Set#** | **Species** | **Total #** | **Total length** | | | | | | | | | |
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