WINCHESTER TIDELANDS MONITORING REPORT

March 2000 – June 2001

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Research Reserve

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Abstract

Oregon Watershed Enhancement Board funded monitoring (Grant Number 99-372) of the Winchester Tidelands was conducted between March 2000 and June 2001. These efforts represented a continuation of existing monitoring activities begun in July 1998. Monitoring was focused on anadromous fish use of the upper estuary in both natural and restored habitats. Marsh productivity in a number of salt marshes was measured including, for the first time, the Kunz Marsh restoration site.

Adult Coho Migration

Peak adult coho migration occurred from December 14-17, during the only large freshet of the fall. Adult coho made up only 6% of fish trapped with the remaining 94% being jacks. Since the trap was not designed to catch jacks, this does not represent the ratio of adults to jacks in the system. Stream flows were far below normal for the rain year and spawning surveys conducted between December and January showed no sigh of successful spawning. Since no tagged fish were observed, a population estimate of spawning escapement could not be made.

Juvenile Salmonid Migration

Coho migration into the upper estuary was low throughout most of the fall and winter due to drought conditions and record low stream flows, but a peak did occur at the end of February. Peak spring migration occurred in March. The total number of migrants for the year was 6383. Those fish that migrated into the upper estuary in the fall and winter had longer residence times than spring migrants. Residence times for coho using the upper estuary ranged from a few days (for late spring migrants) to a few weeks or months (for late fall and early spring migrants).

Ultrasonic Telemetry Pilot Study

By the end of June, of the eight juvenile coho implanted with ultrasonic transmitters that left the upper estuary, four survived to leave South Slough. Of the coho that survived to the middle estuary, 67% survived to be detected at the mouth of South Slough. For those coho that survived, it took an average of six days to move through the middle and lower estuary, with interesting similarity in behavior. Movement seaward was always with an ebb tide, although coho were observed to maintain position through a tide cycle.

Marsh Plant Biomass

Marsh above-biomass totals ranged between 600 and 800g m^{-2} for all index marshes sampled and showed a high level of consistency throughout each of the three sampling years. Below-ground biomass totals ranged between 3500 and 8000g m^{-2} for all six of the reference marshes sampled. Biomass totals from the restored Kunz Marsh showed an inverse relationship to marsh height. The high marsh above and below ground biomass totals were significantly lower than control marshes.

Introduction

Monitoring of juvenile coho use in the upper estuary of South Slough began in 1998 with GWEB support. After two years of intensive monitoring some important discoveries regarding juvenile coho life-history strategies were made: a significant percentage of the total outmigrating population entered the upper estuary much earlier than previously described; coho entering the estuary as fry or fall/winter migrants had longer estuarine residence times than those following the typical spring migration pattern; residence times of up to four months were documented for juveniles and even longer for fry; and there is a high level of connectivity between all the habitats that together for the upper estuary (Miller and Sadro 2000). This information has placed increased importance on the value of upper estuarine habitats for efforts designed to aid the record of coho salmon.

Land Use Within South Slough

The Winchester Tidelands are an approximately 50 acre component of the South Slough National Estuarine Research Reserve. Located in the upper estuary of South Slough's western arm (Figure 1), the Winchester Tidelands historically consisted of highly productive estuarine channels, mudflats, and salt marshes. During the early part of the century, along with much of Oregon's other wetlands, the majority of

these tidelands were diked and drained for agricultural use. This transformation resulted in a large loss of complexity and diversity in channel and marsh structure greatly affecting fish and fish prey habitat.

By the late 1960's, diminishing agricultural interest in the South Slough left much of the converted marsh lands fallow. Without regular maintenance of the culverts and tidegates over time, limited tidal exchange began in the former tidal wetlands. Under these conditions the Winchester Tidelands slowly transformed into a series of "restricted circulation" diked tidal wetlands characterized by limited tidal flooding, constructed drainage ditches, and mixed plant communities of exotic pasture grasses and native salt marsh vegetation (Cornu 1998).

In 1996 the Winchester Tidelands Restoration Project, designed to restore tidal wetland features functionally benefiting anadromous fish, was implemented. Focus was on correcting for historic saltmarsh subsidence and restoration of tidal channel complexity. Various techniques were employed to increase tide channel complexity and restore full tidal circulation to salt marshes (increasing their productivity). These efforts resulted in the removal of earthen dikes from five degraded coastal wetland sites. In one 12 acre site (Kunz Marsh), a series of three experimental marsh cells and a control cell were established at fixed elevations in order to test the hypothesis that rates of habitat recovery can be accelerated by physical correction for historic subsidence.

Methods

Study Area

The South Slough watershed is a 19,300 acre sub-basin of the Coos Bay estuary (Figure 1). Mean Monthly discharge of Winchester Creek, the principle tributary, ranges from less than 2cfs during summers to over 200cfs during winter flood conditions. The estuary is well mixed and flushing is rapid with salinities ranging from fresh water (0ppt) to full sea water (34ppt) seasonally.

Adult Coho Spawning Escapement

An adult trap spanning Winchester Creek was constructed just below the head of tide. The trap is exposed to approximately one meter of tidal flux and consists of a weir made with metal pickets leading into a live trap box. The trap box opening was fitted with a device to inhibit fish from swimming out during periods of flooding and high tide when fish orientation to current might reverse. The trap was checked daily between mid October and late January and all coho found were sexed, measured, and marked with numbered tags prior to being released above the trap. Spawning surveys were conducted in the reaches of the middle and west forks of Winchester Creek, Dalton Creek, and Anderson Creek during the period of adult migration.

Residence Time of Dye-marked Recaptures

All juvenile coho were dye-marked on the ventral surface from just anterior to the pectoral fins to just posterior of the ventral fins. Recaptured fish were also given a unique mark each time they were recaptured. All fish were dye-marked using a needle-less dental injector with either alcian blue (a copper phthalocyanine derivative) at a concentration of 6.4×10^{-2}g/ml water, or India ink. New marks were applied at three-day intervals, permitting finer resolution of residence time for fish subsequently recaptured. The number of days since initial capture for fish subsequently recaptured was calculated from the mid-point of the three day period assigned to each dye-mark.

In order to locate as many marked coho as possible and determine residence times in other habitats, sampling occurred at several other sites within the upper estuary (refer to Figure 1):

1) Cox Pond (315m downstream of the migrant trap) was sampled at one-month intervals from November 2000 to May 2001. Fish were given a unique dye-mark with a subcutaneous injection of Alcian Blue.
2) In the tidal channel 1.5 km downstream of the migrant trap, a 25 m beach seine was used to sample fish at one to four week intervals. Fish were given a unique dye-mark with a subcutaneous injection of India Ink.

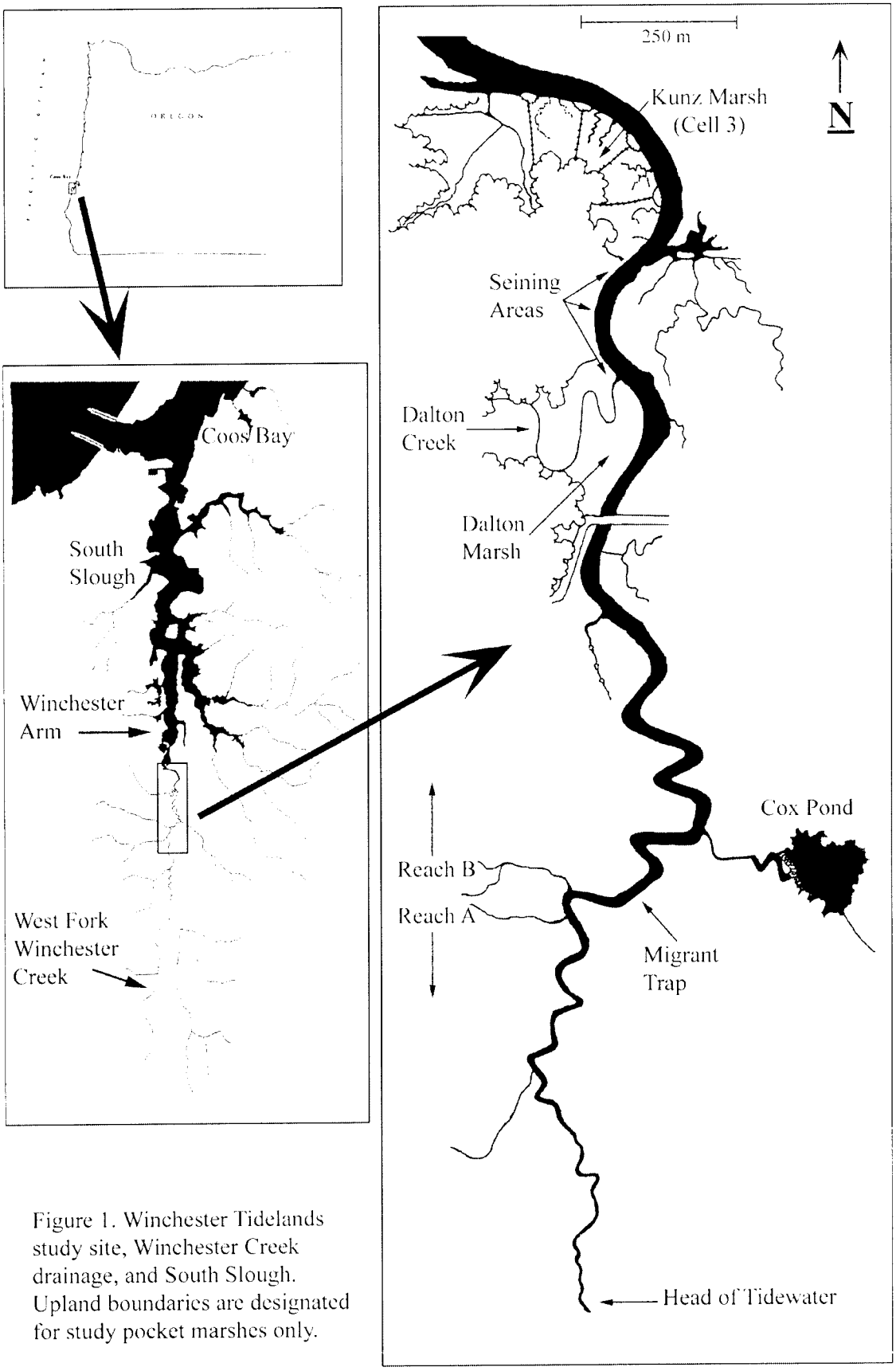

Figure 1. Winchester Tidelands study site, Winchester Creek drainage, and South Slough. Upland boundaries are designated for study pocket marshes only.

3) Kunz Marsh (Cell 3), 1.8 km below the migrant trap, fish that migrated from the adjacent tidal channel and utilized the marsh during high tide were sampled at monthly or more frequent intervals. Fish were sampled by placing the bag of a modified 50 m seine over the principal drainage channel in one of four experimentally restored cells of Kunz Marsh at high spring tide. Fish became trapped in the bag as water drained from the marsh during ebb flow. Beginning April 2000, Kunz marsh was sampled at two to four week intervals during the nighttime spring tides. Fish were given a unique dye-mark with a subcutaneous injection of India Ink.

Size, Growth and Condition Factor of Migrants and Recaptured Fish

Fork length of all juvenile coho caught was recorded. Wet weight was measured to the nearest 0.1g using an Ohaus "Scout" balance, and condition factor was calculated from length and weight data using the formula:

$KFL = (\text{weight} \times \text{length}^{-3}) \times 10^5$

Ultrasonic Telemetry Pilot Study

Twelve juvenile coho ranging between 130 and 150mm were implanted with a Vemco brand ultrasonic transmitter. Each transmitter emitted a unique pulse coded signal approximately every 30 seconds. Fish were anesthetized using MS-222, a 1.0 cm incision was made ventrally just anterior to the anus and the tag inserted into the body cavity. The wound was closed using absorbable sutures and the fish allowed to recover in a flow-though live box located in the field. After five to eight hours of post-operative recovery the incision was inspected and fish behavior evaluated. If all appeared normal the fish was released.

Four Vemco brand ultrasonic receivers were placed throughout the length of South Slough. The first receiver was located just North of the Kunz Marsh at the lowermost edge of the upper estuarine zone. The second receiver was placed in the channel off Crown Point in the middle estuarine zone. The third and fourth receivers were placed on either side of the Charleston bridge channel near the mouth of South Slough. All receivers were checked every two to four weeks and any logged data downloaded.

Results and Discussion

Coho salmon adult returns

The Winchester Creek adult trap was operated continuously from October 1 through January 14, 2001. Table 1 summarizes catch totals. The majority of fish trapped were male jack coho (1998 brood year); only three females were trapped. Two tagged jacks subsequently swam downstream and were recaptured, indicating the adult weir was not a total barrier to all jacks and that some fish may have passed above the trap uncounted.

Table 1. Number of coho and chinook salmon trapped at Winchester Creek adult trap during the 2000-2001 run year.

Species	Sex	Number Trapped	Passed Above Trap
Coho	female	3	3
	male (> 515 mm)	2	2
	(≤ 515 mm)	74	73
Chinook female		3	3
	male	1 (jack)	0

Four chinook salmon were also trapped; three females were tagged and passed above the trap and the one male (jack) was not passed.

Most fish were trapped over a four day period (Dec. 14-17) that corresponded with the first freshet during the fall (Figure 2). Except for a short interval of higher stream flow in mid-December, low precipitation and very low stream flows were the predominant conditions throughout the trapping period.

Three spawning surveys were conducted on West Fork Winchester Creek between early December and mid-January, and one survey was conducted on Middle Fork Winchester Creek in late December. No live fish, no carcasses and no redds were observed. The lack of any observed spawning activity or coho fry in Winchester Creek suggests there may have been no successful spawning in fall 2000. This can probably be attributed to very low stream flows during the spawning period. Fish may not have been able to ascend past beaver dams that are typically breached during higher stream flows.

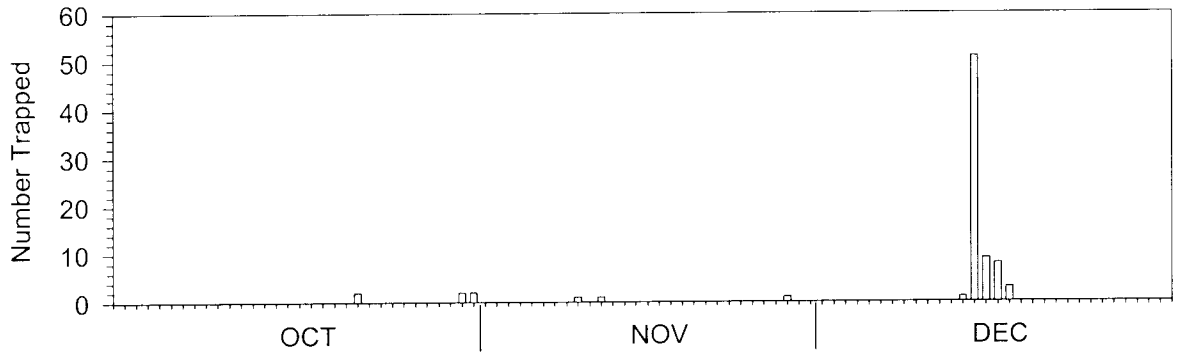

Figure 2. Run timing of coho salmon trapped at the Winchester Creek adult trap during 2000

Salmonid outmigration and residence

There were 6383 estimated coho migrants in the 1998 brood year (Figure 3) and movement into the upper estuary occurred during spring of 2000 and fall through spring of 2001. Fourteen percent of all the migrants entered the estuary as fry, 23.5% were fall and winter migrants, and 62.6% were spring migrants. Movement into the estuary during all of the fall and most of the winter was low due to extremely low stream flows. Stream flows increased slightly at the end of February which corresponded with the peak of fall/winter migrants. Spring migrants peaked in mid March but did not taper off until the end of May.

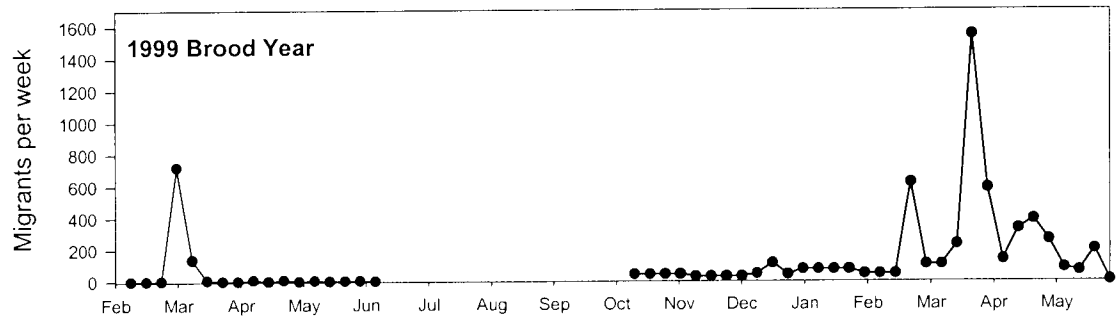

Figure 3. Run timing of juvenile coho salmon at the Winchester Creek migrant trap during 2000-2001

A distribution of mark-recaptured coho differentiated by when they first entered the upper estuary shows distinct differences in patterns of residence time (Figure 4). Those coho that entered the estuary earlier in the year had a higher probability of residing longer. A first order linear regression of cumulative percent for those fish entering the estuary in the fall/winter showed 50% of migrants residing at least 40 days and 75% of migrants residing at least 75 days, with some individuals residing over four months. The same analysis for spring migrants showed 50% of the

population residing at least 15 days and 75% of the population residing at least 30 days, with some individuals residing over 1 ½ months.

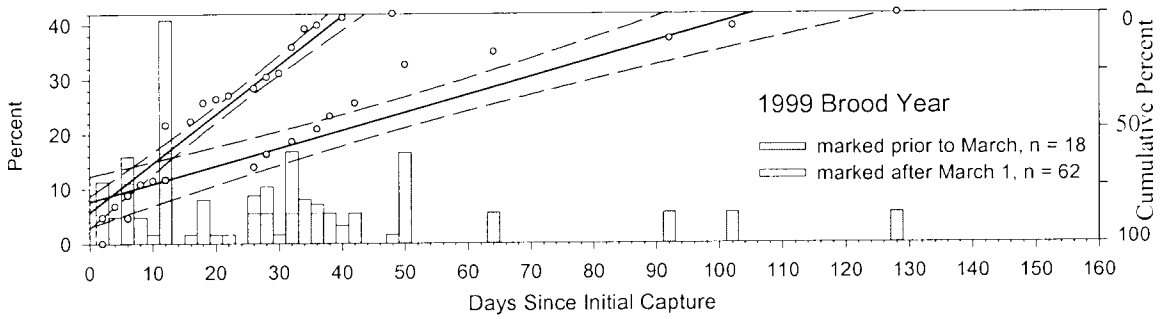

Figure 4. Residence time of juvenile coho caught at the migrant trap and subsequently recaptured seining in the Winchester Tidelands area.

There was considerable variation in condition factor of juvenile coho both spatially and temporally. Coho located in the upper watershed prior to migrating had the highest condition factor (Figure 5). The lowest condition factor was record for migrants as they first entered the upper estuary and were caught at the migrant trap. This drop in condition (as much as 20%) is due to the process of migrating and physiologically adapting to life in salt water. Once coho had resided in the estuary for some period of time they were able to increase their condition factor by 10 to 20%. Coho captured foraging in the restored Kunz Marsh after a high tide cycle were found to have the highest condition factor of any of the estuarine habitats.

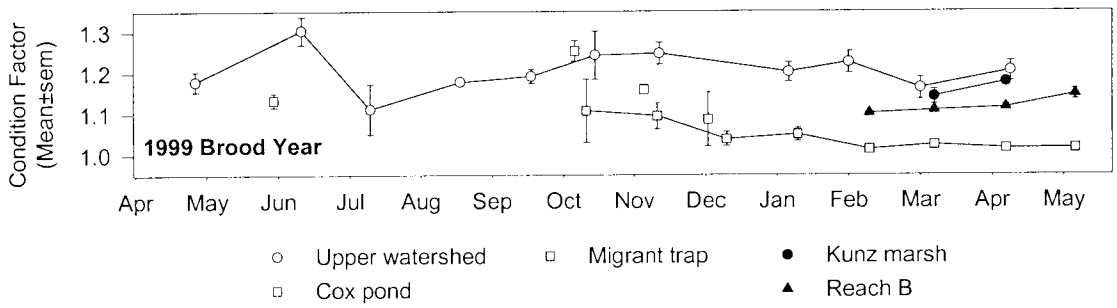

Figure 5. Condition factor of juvenile coho caught at various times of the year from different habitats.

I March low numbers of coho were first observed using the restored marshes at high tide (figure 6). Peak coho use of the marshes occurred in April for both the 1998 and 1999 brood years. Coho abundance in the restored marshes declined after April until the end of May when they are no longer caught in the marshes but are still present in the tidal channel in low numbers. It is unclear if there is differential use of the marshes by timing of migration or if the peak merely reflects the relative abundance of coho in the system. It is possible that fall/winter migrants have the same proportion of marsh use as spring migrants, but that their density in the system is so low that detection is reduced.

The condition factor of coho caught foraging in the restored marshes was significantly higher than fish caught in the adjacent tidal channel. Gut fullness was observed to be high and it was presumed this difference in condition factor was representative of instantaneous foraging success. Coho that were caught in the marshes and held 24 hours (allowing for evacuation of the gut) showed a significant decline (up to 8.5%) in condition factor (Figure 7). There was no significant difference in condition factor between those coho held 24 hours after foraging in a restored marsh and those coho caught in the adjacent tidal channel.

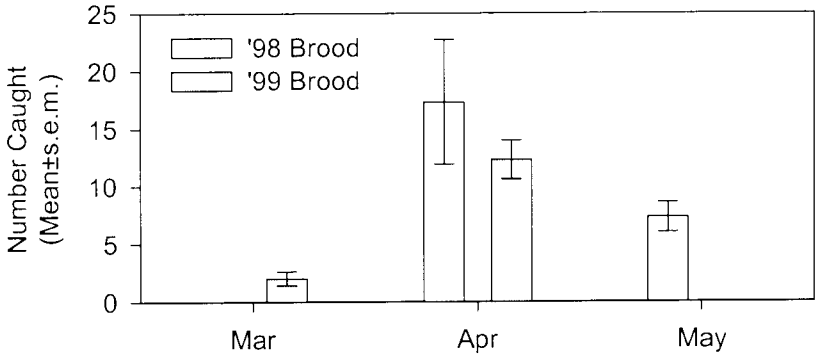

Figure 6. Mean catch of juvenile coho from a low marsh cell in the restored Kunz Marsh during one high tide cycle.

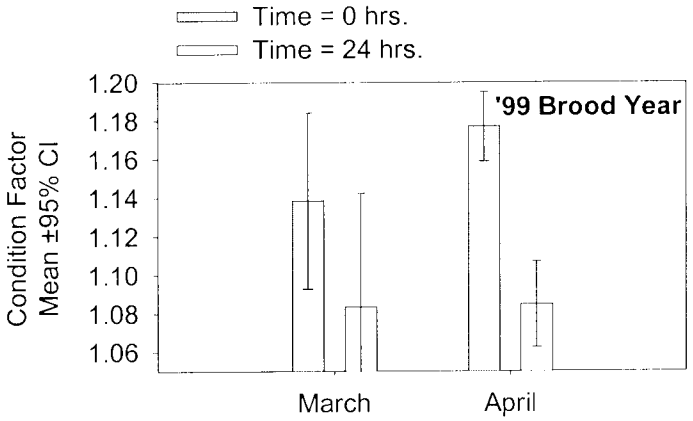

Figure 7. Condition factor of juvenile coho caught foraging within a low cell of the restored Kunz Marsh immediately after capture and 24 hours later.

Ultrasonic Telemetry

The pilot study tracking juvenile coho through the middle and lower estuary using ultrasonic telemetry is currently ongoing and the data represented herein is current through 7 July 2001. The average size of juvenile coho implanted with an ultrasonic transmitter was 144mm. Sixty-six percent of all implanted coho survived long enough to be detected by the uppermost receiver. Of the coho that left the upper estuary, 75% survived to be detected off Crown Point in the middle estuary. Of the coho that survived to the middle estuary, 67% survived to be detected at the mouth of South Slough. There was 50% survival between the upper estuary and the mouth of South Slough. We can not differentiate between handling related mortality and predation. However, other studies have shown that the probability of an implanted fish dying from complications related to surgery diminish dramatically with time. Thus, if a fish survived long enough to be detected in the middle estuary it is unlikely that it would experience handling related mortality.

The four coho that survived to the mouth of South Slough exhibited some important consistencies in their migration toward the ocean (Figure 8). All moved relatively rapidly toward the middle estuary after leaving the upper estuary. Two coho (Tags 1 and 2) spent at least two days migrating back and forth between the middle and lower estuary. One coho (Tag 4) spent very little time in the middle estuary but did spend four days in or around the lower estuary. One coho (Tag 7) spent 1½ days in or near the middle estuary and very little time in the lower estuary.

There was no apparent difference in movement during periods of darkness or light. However, there was a strong effect of tidal current on direction of migration. All coho moved toward the mouth of the estuary on ebbing tides. Similarly, coho usually moved up-steam with flooding tides; however, at times

they were observed holding their position through a flood tide. One coho (Tag 2) traversed the 7 km from the upper estuary to the mouth of South Slough on an ebbing tide in less than four hours.

These results are very encouraging and will allow us to tailor a future expanded study to accurately track juvenile coho as they migrate through the whole South Slough estuary on a much finer scale.

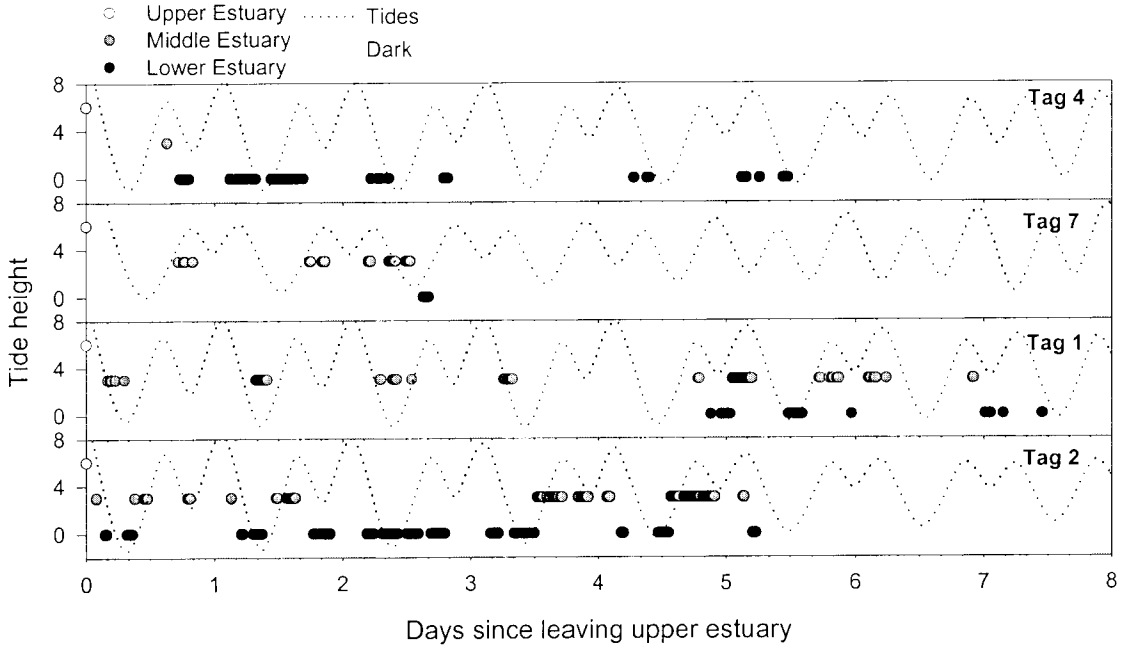

Figure 8. Detection of fish implanted with ultrasonic transmitters at middle and lower estuary receivers.

Marsh Plant Biomass

Above ground biomass totals for 2000 ranged between 600 and 800g m^{-2} for all six of the reference marshes sampled. There was no significant difference in above-ground biomass totals between different marshes or for an individual marsh over time (Figure 9). This indicates that after three years interannual variation is low.

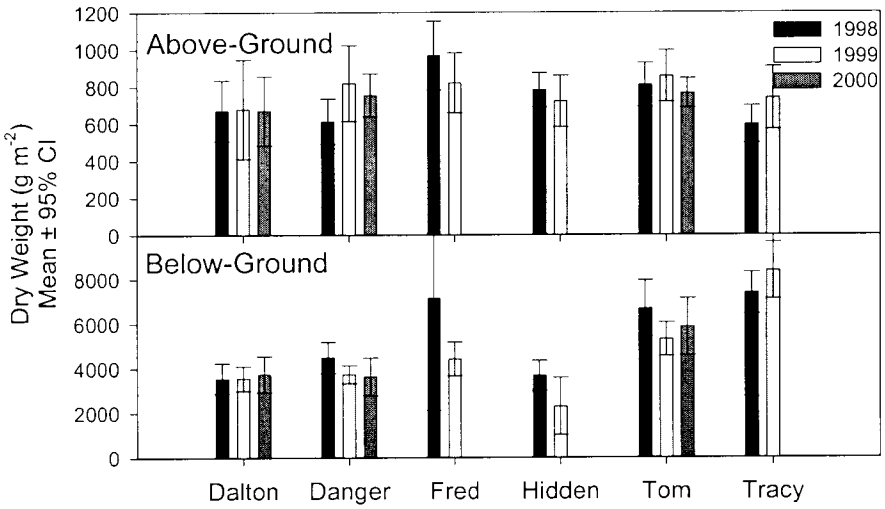

Figure 9. Above and below ground biomass totals for reference marshes located in or near the Winchester Tidelands area for 1998-2000.

Below-ground biomass totals for 2000 ranged between 3500 and 8000g m^{-2} for all six of the reference marshes sampled (Figure 9). Biomass totals for Tom and Tracy marshes were slightly higher than the other four reference marshes for all three years. There was no significant difference in biomass totals for any individual marsh over time indicating low interannual variation.

Biomass levels in the developing Kunz Marsh restoration cells followed expected patterns. There was a direct correlation between marsh height and both above and below-ground biomass (Figure 10). The high marsh cell had significantly higher above and below-ground biomass levels than the mid and low marsh cells. While the mean above and below-ground biomass levels were lower in the low marsh cells than the mid marsh cell the difference was not significant. The above ground biomass in the high marsh cell was slightly less than 400g m^{-2}, half the value of both the control marshes. The below-ground biomass of the high marsh cell was significantly lower than only one of the two control marshes. It is unclear why the below-ground biomass between the two control marshes would be significantly different.

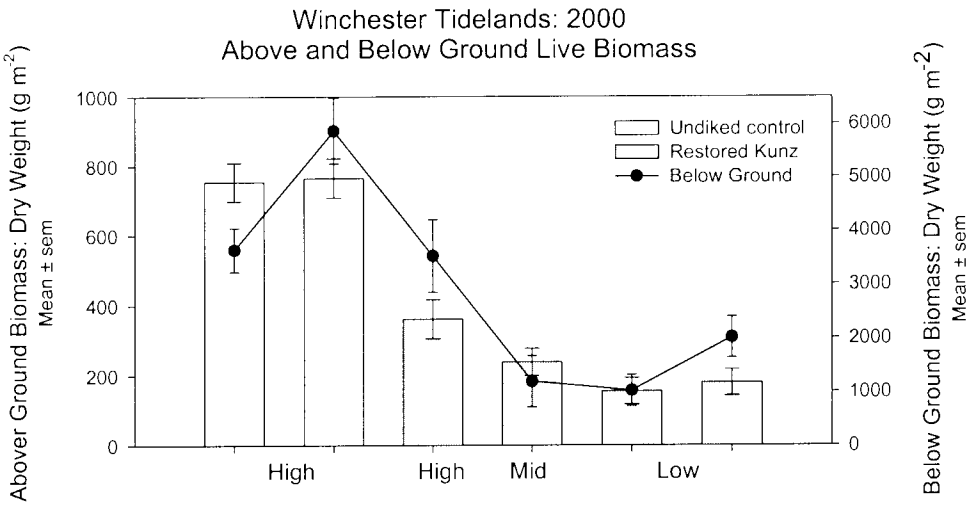

Figure 10. Above and below ground biomass totals for the high, mid, and low Kunz Marsh restoration cells and two high marsh control sites.

Acknowledgements

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