GEAR MODIFICATIONS FOR 2003 MAINSTEM COLUMBIA RIVER SPRING CHINOOK LIVE-CAPTURE FISHERIES

Effects of mesh size on catch of spring Chinook

- Although we have not yet statistically compared CHS CPUE by mesh size, CPUE tends to decrease with decreasing mesh size (see table):

Summary of catch rate, condition, and survival for CHS captured in various springtime live capture test fisheries, 2000-2002.

Mesh size	3.5[a]	4.5[b]	5.0[c]	5.5[d]	6.0[e]	6.75[f]	8.0[g]	SE w/5.5[h]
N	343	413	49	213	106	51	836	92
CPUE[i]	1.40	2.34	2.35	3.63	4.61	1.81	Not reported	4.06
Immediate Mortality[j]	5 (1.5%)	12 (2.9%)	1 (2.0%)	7 (3.3%)	0 (0%)	7 (13.7%)	8 (1.0%)	4 (4.3%)
Total Mortality[k]	N/A	1 of 56 (1.8%)	2 (4.1%)	4 of 80 (5.0%)	8 (7.6%)	N/A	51.3%	7 (7.6%)
Capture Condition[l]	1: 80% 2: 2% 3: 13% 4: 2% 5: 4%	1: 72% 2: 2% 3: 21% 4: 0% 5: 5%	1: 45% 2: 0% 3: 49% 4: 2% 5: 4%	1: 49% 2: 4% 3: 39% 4: 2% 5: 6%	1: 48% 2: 5% 3: 38% 4: 5% 5: 4%	1: 63% 2: 19% 3: 9% 4: 0% 5: 9%	1: 87% 2: 8% 3: 4% 4: 1% 5: 1%	1: 38% 2: 1% 3: 50% 4: 1% 5: 10%
General Method of capture[m]	Tooth-tangle	Max	Max to pre-opercle	Max to pre-opercle	Pre-opercle to wedged	Opercle to wedged	Wedged	Same as 5.5

Note: The information shown above is pooled from various test and experimental fisheries conducted over three years. Many factors varied between these studies, including study protocol, people involved (fishers and agency staff), and data collected.

[a] CPUE and immediate mortality from 2000 & 2001 test fishing and 2001 permit fishery

[b,d] CPUE and immediate mortality from 2001 permit fishery and 2002 test fishing; total mortality from 2002 test fishery

[c,e,h] All data from 2002 test fishery

[f] CPUE and immediate mortality from 2000 & 2001 test fishery

[g] Data from WDFW portion of 2001 joint study

[i] Standardized to 150-fathom net length. Depth not standardized; drift times and methodologies vary throughout the studies. CPUE generally represents one drift made with 150-fathoms of gear with total soak time <50 minutes.

[j] Defined as fish that could not be recovered thus died on-board. Data for 3.5” and 4.5” mesh includes 3:1 hang ratios which appear to cause excessive tangling and increased mortality.

[k] For 2002 test fishery: total mortality after 48 hours (including immediate mortality); for 8” mesh: “long-term” mortality as calculated from various tag returns

[l] Standard ranking scale. 3.5” from 2001 permit fishery and 2001 test fishery, 4.5” and 5.5” from 2001 permit fishery and 2002 test fishery, 6.75” from 2001 test fishery

[m] From data collected in 2002 test fishery and general observation

- Some 4" and 4.25" mesh was fished on a very limited basis during the 2001 permit fishery in violation of the study design. Effort was 19 drifts of 4" (75 fathoms) that captured 11 adult spring chinook and 0 steelhead. Thirty-four (34) drifts with 75 fathoms of 4.25" captured 46 adult spring chinook and 6 steelhead. Capture conditions were not recorded on enough fish to be informative.

Effects of mesh size on catch of steelhead

- Test fishing by ODFW in 2002 was designed to target CHS. By-catch of STH was minimal (57 fish in comparable nets; 147 total handle). We do not have enough data to make statistical comparisons of STH CPUE, capture condition, or short-term survival by mesh size (see table):

Summary of catch rate, condition, and survival for STH captured in various springtime live capture test fisheries, 2000-2002.						
Mesh size	3.5[a]	4.5[b]	5.0[c]	5.5[d]	6.0[e]	SE w/5.5[f]
N	105	93	7	45	13	9
CPUE[g]	0.44	0.52	0.34	0.75	0.56	0.40
Immediate Mortality[h]	15 (14.3%)	12 (12.9%)	0 (0.0%)	9 (20.0%)	1 (7.8%)	0 (0.0%)
Total Mortality[i]	N/A	4 of 14 (28.6%)	0 (0.0%)	6 of 15 (40.0%)	2 (15.4%)	2 (22.2%)
Capture condition[j]	1: 63% 2: 3% 3: 16% 4: 0% 5: 18%	1: 53% 2: 3% 3: 23% 4: 4% 5: 18%	1: 100% 2: 0% 3: 0% 4: 0% 5: 0%	1: 39% 2: 14% 3: 20% 4: 7% 5: 20%	1: 50% 2: 0% 3: 33% 4: 8% 5: 8%	1: 40% 2: 20% 3: 30% 4: 0% 5: 10%
Method of capture[k]	Tooth-tangle to max	Max to opercle	Max to opercle	Opercle to wedged	Wedged	Same as 5.5

Note: The information shown above is pooled from various test and experimental fisheries conducted over three years. Many factors varied between these studies, including study protocol, people involved (fishers and agency staff), and data collected.

[a] CPUE and immediate mortality from 2000 & 2001 test fishing and 2001 permit fishery

[bad] CPUE and immediate mortality from 2001 permit fishery and 2002 test fishing; total mortality from 2002 test fishery

[clef] All data from 2002 test fishery

[g] Standardized to 150-fathom net length. Depth not standardized; drift times and methodologies vary throughout the studies

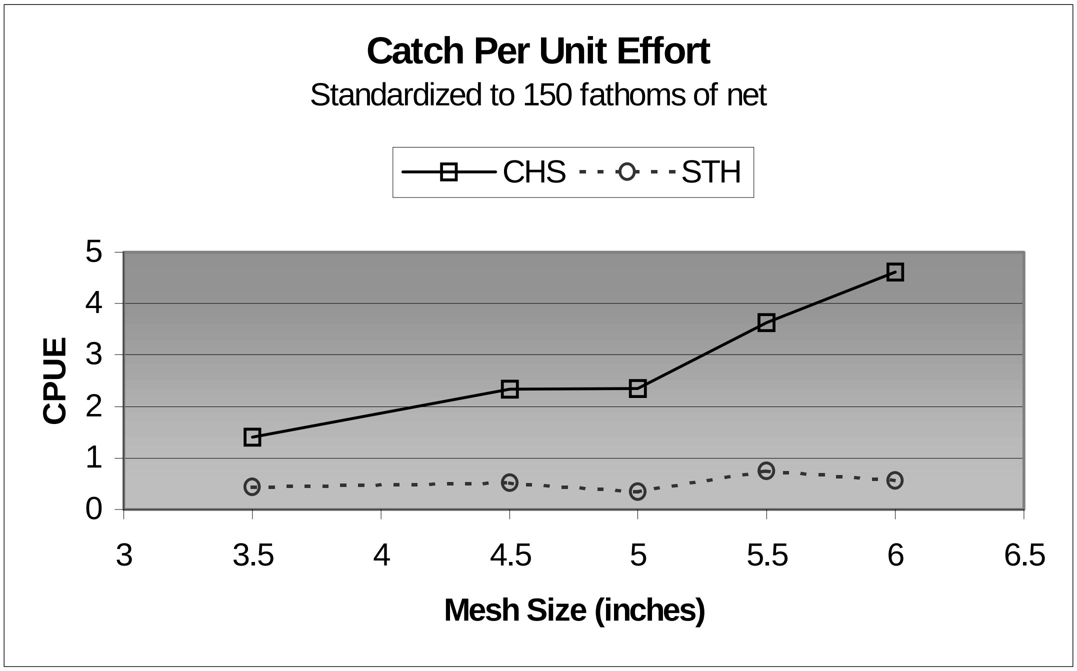
[h] Defined as fish that could not be recovered thus died on-board. Data for 3.5" and 4.5" mesh includes 3:1 hang ratios which appear to cause excessive tangling and increased mortality.

[i] From 2002 test fishery: total mortality after 48 hours (includes immediate mortality);

[j] Standard ranking scale. 3.5" from 2001 permit fishery and 2001 test fishery, 4.5" from 2001 permit fishery and 2002 test fishery, 5.5" from 2001 permit fishery and 2002 test fishery

[k] From data collected in 2002 test fishery and general observation

- Based on discussions with a few experienced fishermen and the limited data we have (see figure), it is possible that STH handle will not be significantly reduced unless mesh is <3.5” or greater than 7.75”. However, based on what we know about CHS, we can assume that smaller mesh will result in improved condition at capture and survival.



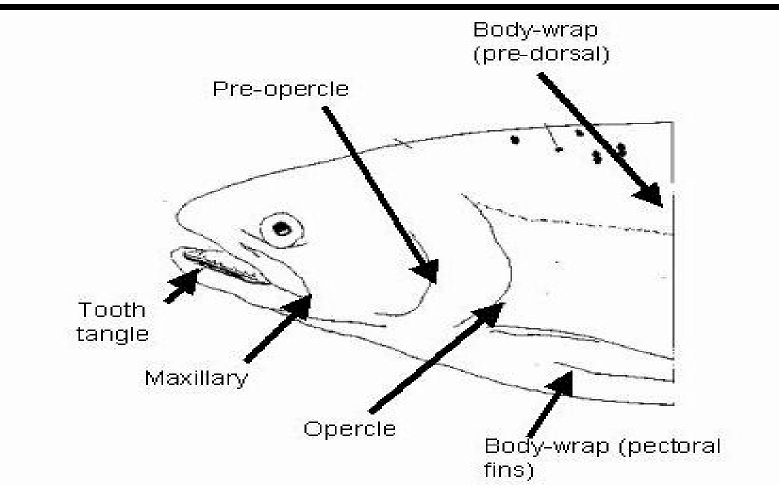


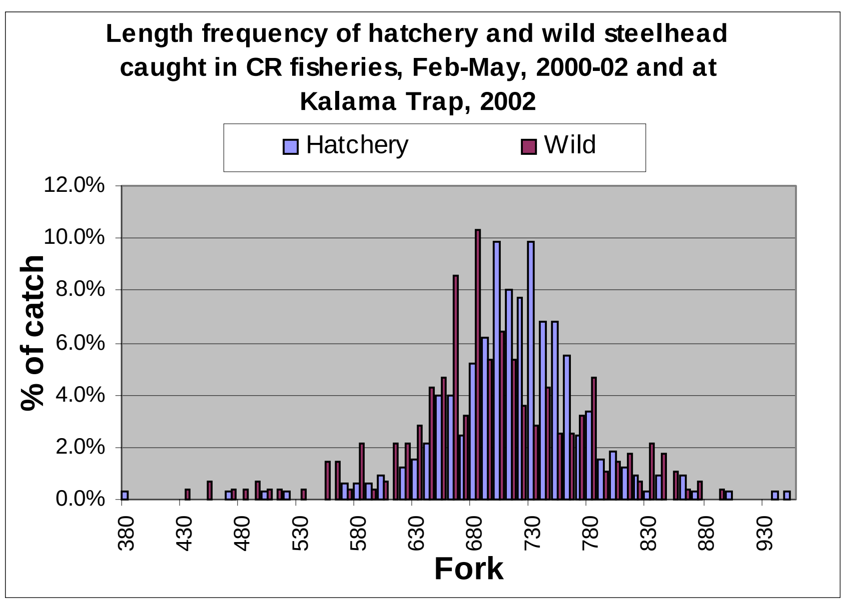
Figure X. Common locations of entanglement in tangle- and gill nets. Tooth and maxillary entaglement is most benign. Pre-opercle and opercle capture is most severe due to clamping of opercles. Body capture can result in scale- and slime loss. Immediate mortality is low but can contribute to long-term mortality.

- Tooth tangle and maxillary capture cause the least amount of physical damage to the fish. Capture from the maxillary to pre-opercle area is still fairly benign. Capture between the pre-opercle and opercle causes gill clamping and suffocation. Fish captured in this manner can be revived using the recovery box and will be graded in good condition at release thus showing little immediate mortality but the 2002 test fishery demonstrated that short-term mortality can be elevated. Capture past the opercle results in gilling the fish causing suffocation and substantial physical damage to the gill structure. Wedging (capture by the body) results in physical damage by means of scale and slime layer loss. Wedging also shows relatively little immediate mortality but substantial delayed mortality.

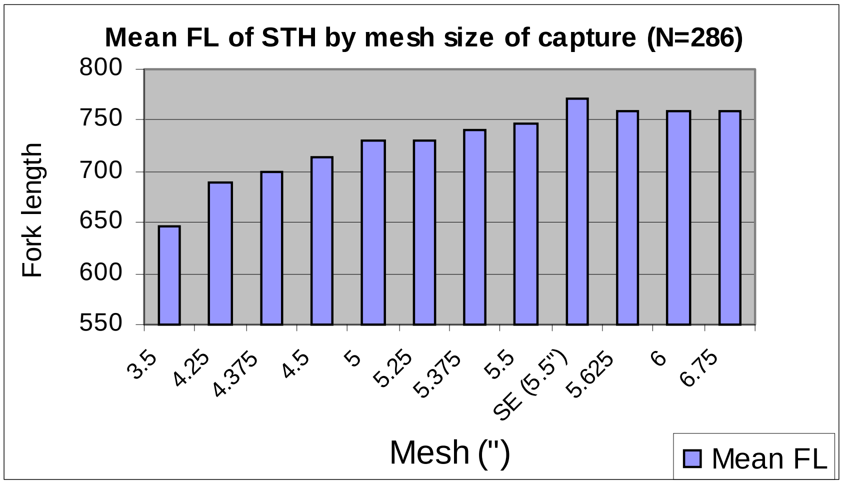
- Another effect of the capture method comes into play when the fisher is removing the fish from the gear. A fish captured by the face, anterior to the pre-opercle, can be removed relatively quickly and with little harm to the fish or gear. Fish that are gilled are generally held by the gills as mesh is removed, often forcibly. This can cause serious trauma to the fish. Fish that are wedged are often pulled through the mesh, again usually held by the gills, removing scales and slime. Another option for removing a wedged fish is to "pop" it through the gear by holding the mesh and jerking, causing the fish to be slammed or dropped onto the boat deck causing physical damage.

- To determine the effects of capture on steelhead, we compiled length and capture method information (mesh and method of entanglement) from various sources that hopefully represent steelhead that were, or will be encountered in spring commercial fisheries. Data sources include: 2002 CR sport harvest, 2000-02 live-capture test fisheries, and Kalama trap data (Rawding model memo; 6/12/02).

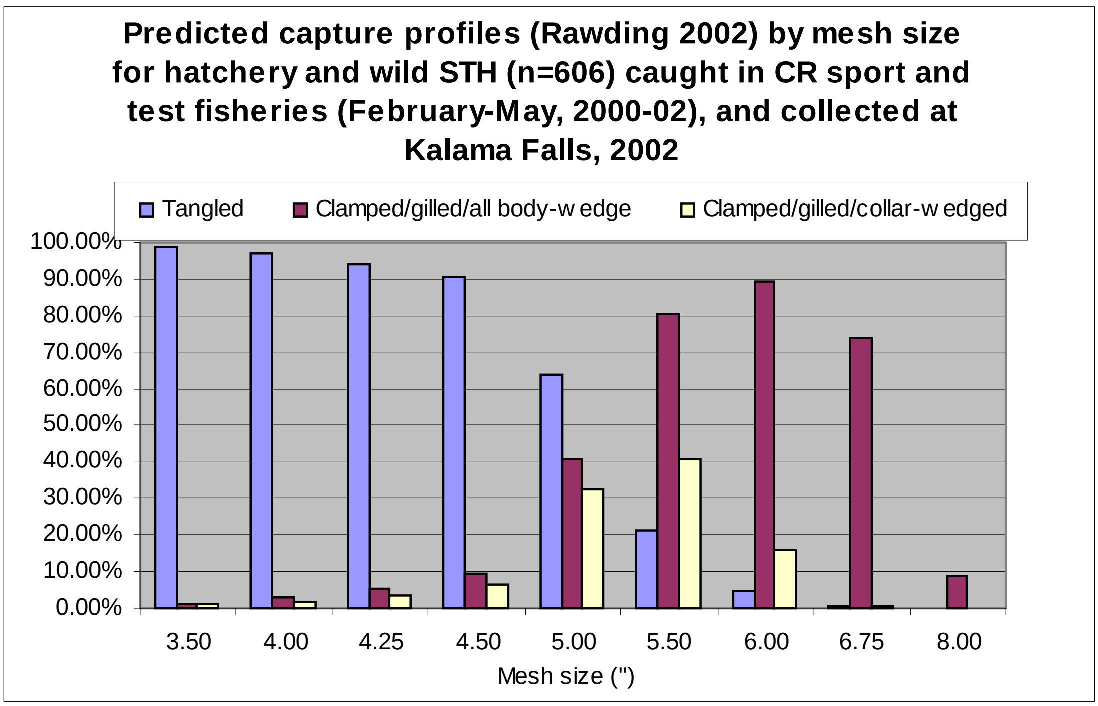
- Length-frequencies of hatchery and wild STH were similar. Hatchery STH (n=325) averaged 715 mm. Wild steelhead (n=281) were somewhat smaller on average at 693 mm. The combined average (n=606) was 705 mm.



- Average size of STH tended to increase with increasing mesh size.



- Applying Dan Rawding's STH length-girth relationships to the larger data set predicts the anticipated effect of different mesh sizes on how STH are captured.

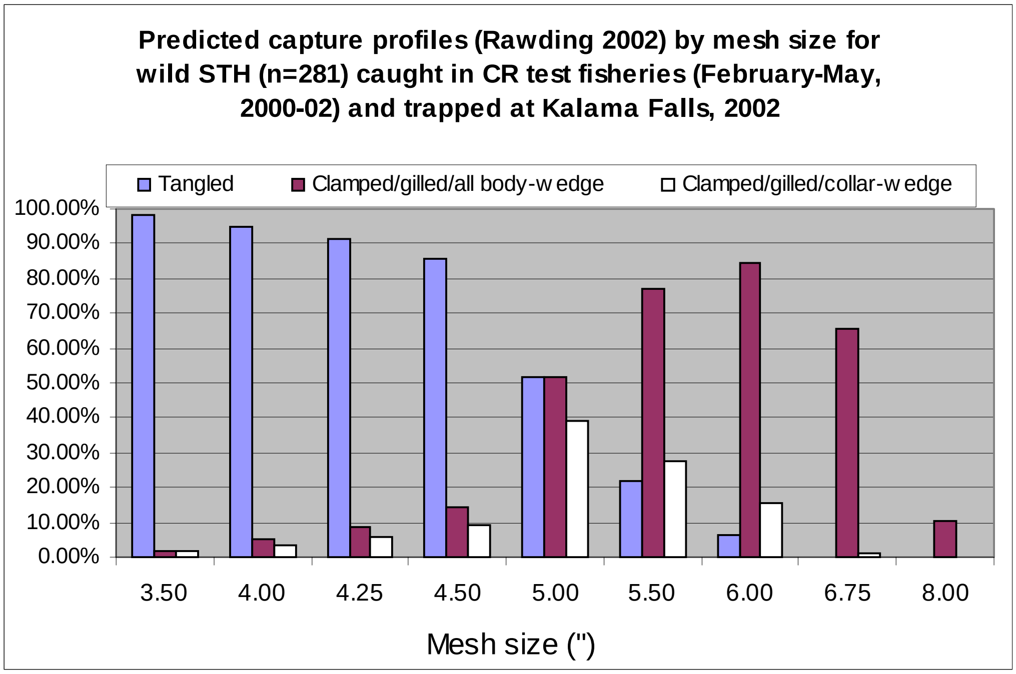


- We split the capture methods out by fish that would be **tangled** (caught anterior to the pre-opercle i.e. maxillary and teeth), **clamped-gilled-collar wedged** (caught from pre-opercle anterior to the pectoral girdle), and **clamped-gilled-any body wedging** (caught from pre-opercle posterior to the maximum body depth (i.e. dorsal fin) which was estimated as 133% of girdle girth).

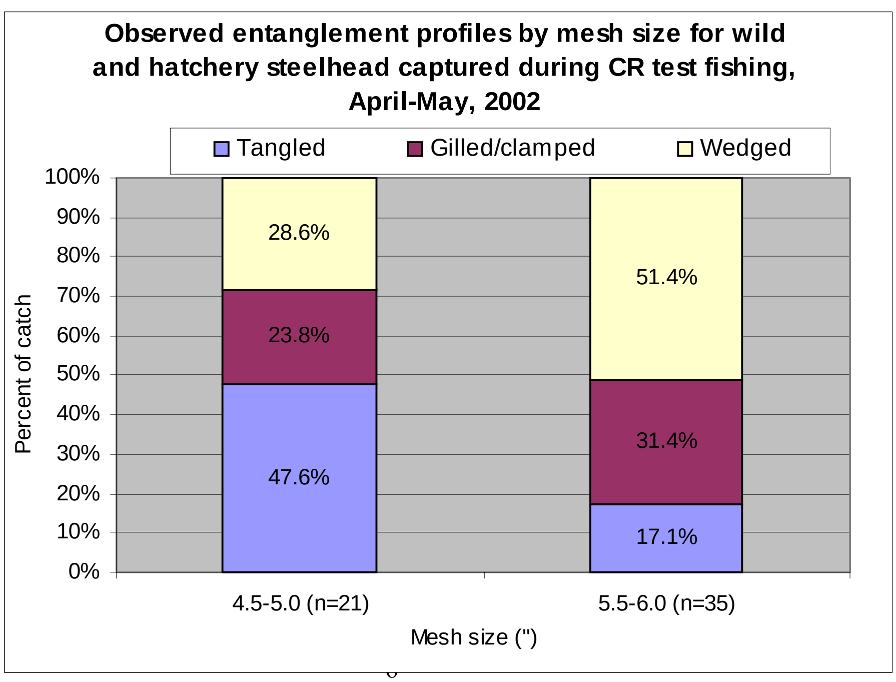
- The greatest changes in the head morphometry-mesh relationships occur in the 4.25" to 5.5" range. Meshes outside this range have limited effect on capture profiles because of STH length frequencies. The greatest gain in entanglement vs. damaging capture is predicted to occur by dropping from 5.5" mesh to 4.5". Using 4.5" instead of 5.5" mesh would theoretically result in an 8-fold reduction in damaging capture methods for all STH. Little additional gain occurs by dropping to smaller mesh sizes.

Interestingly, the relationships also predict limited handle of STH with 8.0" gear, something that has been well documented. In fact, the predicted 10% handle is probably high, which indicates the 1.3 factor applied to Dan Rawding's data to estimate maximum body width is reasonable.

- Results were similar for wild fish only:

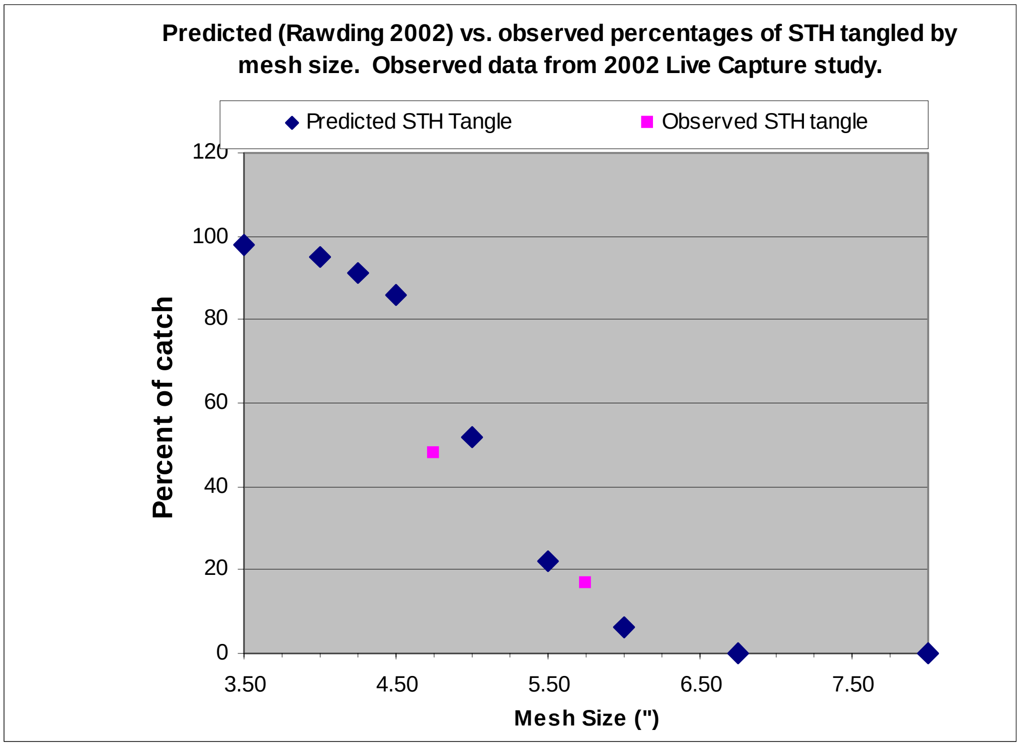


- Observed capture profiles were similar to predicted profiles for a sample of hatchery and wild STH (n=56; 2002 live capture study). If anything, observed values tended towards less tangling than predicted values. We speculate this is an artifact of web stretch, hanging variations, fishing conditions, etc. that are impossible to account for. Dan attempted to account for web stretch in his relationships, but this is a difficult



parameter to estimate.

- Observed STH capture profiles and Rawding's girth measurements are based on small sample sizes (observed ~20 STH/mesh, girth measurements n=10).



Other effects of mesh size selection

- Visibility of the net increases with decreasing mesh size.
- Smaller mesh generally reduces efficiency therefore requiring increased fishing time to achieve same catch of target stocks or species.
- Smaller mesh may need to be lighter denier to be efficient and therefore may not last as long under the rigors of fishing.

Steelhead excluder net

- The excluder net tested by ODFW in 2002 consisted of 25 fathom of 9.75" stretched mesh over 5.5" mesh. The large mesh was 9 meshes deep (5.85') and the small mesh was 85 meshes deep (~34'). Total net depth was ~39.85' which is on the high end of common net depth in the fishery (30-40'). The excluder represented 14% of total net depth.
- Total sampling catch for this net was 88 CHS and 10 STH (8.8:1.0). Ratios of CHS:STH for 4.5", 5.0", 5.5", and 6.0" were 4.1:1.0, 7.8:1.0, 5.3:1.0, and 8.3:1.0. We do not have enough data to determine how STH handle will be affected by requiring an excluder. It seems to depend on where and how fishing occurs and factors such as phase and influence of tide.
- Some fishermen have supported incorporation of an excluder, particularly if they could use existing mesh sizes (9-9.75") commonly used in sturgeon fisheries. The general consensus is that it won't significantly reduce CHS catches, as they tend to run deeper than STH. The exception is in shallow "drifts" (more common in Zone 3)

where the excluder would represent a significant portion of the effective fishing depth of the net. The excluder is opposed by some fishermen in this area. Of the 88 CHS caught in the excluder test net in 2002, 1 CHS and 0 STH were caught in the 9.75" mesh (87 CHS and 10 STH in the 5.5" mesh).

- Some fishermen have expressed interest in using "weed lines" or droppers similar to a bobber-type net (similar to what is used on smelt gill nets) rather than a large-mesh excluder. Although it would complicate regulations, we could incorporate an "either-or" rule. Setting minimum standards rather than a single type of legal excluder would provide fishers with greater flexibility in net design options, promote experimentation, and give fishers a sense of ownership in the process. Allowing for multiple excluder options would also provide the opportunity to evaluate more than one method via data collected in the observation program.
- There is general support by fishermen for allowing increased net length to compensate for reduced efficiency due to an excluder. For example, 150 fathom * 1.15%=~170 fathom. This increase in net length would theoretically still yield a quicker pick time since the catch would hopefully consist of less STH and more CHS.
- The cost of adding an excluder is about $290-$330 ($40-80 for web and $250 for labor). This represents about 17% of the cost of a complete new net ($1750; see below).
- We have heard some arguments that an excluder net would be difficult to hang/repair.

Miscellaneous

- A statistical analysis of catches during the 2002 demonstration fishery showed no significant differences of either chinook or steelhead between daylight and nighttime fishing.
- Total cost of a new net is approximately:

➢ Small mesh	(1.5x4, 4.5"*100md*350 fthms=53#'s web*$11.00/#)	$583
➢ Leadline	(150 fthms 65# river type; 78#'s*2.05/#)	$160
➢ Corkline	(150 fthms 3/8" herring; 1.5 spools)	$157
➢ Corks	(BL-2; 300*$1.30 each)	$390
➢ Bridle line	(1/4")	$36
➢ Hanging twine	(#15; 4#'s*$9.40; #18; 4#'s*8.65)	$72
➢ Labor		<u>$350</u>
		$1,748
➢ Excluder mesh	(#16, 12"x3-6 md@300 fthms=5#'s web*$8.00/#)	$40-80
➢ Excluder labor		<u>$250</u>
		$2038-2078
		$1438-1478 (w/o labor)

(Prices provided by Sheila Garber (Englund Marine) 8/14/02)

- Based on an estimated average income for the 2002 CHS fishery, a new net represents 6.5-23.0% of gross annual income:
  (14,643 CHS landed/107 fisherman average*15.7#/fish*$4.20/# = ($9,024/fisher)/net cost) (6.5% for new small mesh net w/o labor; ~7.0% for excluder net web w/o other supplies or labor; 19.4% for new small-mesh net with labor; 23% for all new excluder with labor).

- Due to the cost, fishermen would probably appreciate some between-season consistency in mesh size requirements. We have heard mixed opinions on how long a net can last ranging from 1-3 years.
- Ex-vessel value of 2002 demonstration fishery is estimated at about $1 million ($9,024*107 fishers =$965,600)

Potential recommendations for Compact consideration

- Net specifications:
  - 4.25" mesh (stretched measure)
    - Provides significant gain in predicted capture method profiles
    - Predicted to nearly eliminate damaging capture
    - Consistent with observed capture profiles
    - More likely to have a reasonable CHS CPUE. As suggested by CPUE data, adopting 3.5" could reduce efficiency to the point of effectively killing the fishery. Many pros (stable market value) and cons (additional fishing costs incurred over time, user group conflicts) are associated with the increase in fishing time necessary to access allocation as a result of a decrease in catch efficiency. We don't feel that reducing the efficiency of the gear to the point where costs outweigh benefits is in anyone's best interest.
    - Smaller than the 4.4" absolute limit identified by Rawding
    - Compromise between user groups
  - Option for excluder with increased net length (+25 fathom) as compensation
    - If top 6' of net is excluder, this represents 1/6th of rough average net depth (36'), 25 fathoms is an addition of 1/6th to 150 fathoms.
  - Minimum excluder mesh size 12"
    - For ease of construction, fishers may opt for 12.75" (divisible by 4.25"). 12" is a fairly common mesh size, fishers may have this on hand.
  - No regulations on stringer/slackers in 2003.
  - Strongly encourage fishers to limit hang ratio to ≤2.5:1 (in 25%)

- Regulation changes suggested by enforcement personnel and/or fishers include:
  - Painted corks at 10- or 25-fathom intervals
  - One net/boat (helps with enforcement but may be a large burden on fishers)
  - Disqualification of permit for violations
  - No gaffing allowed
  - Modification of the fin-clip definition (drop "in it's entirety")
  - Maintain 45 minute total soak time
  - Monofilament or multi-filament mesh (fisher's choice)
- Adopt a standardized recovery box system, preferably a design which has been developed to accommodate chinook and scientifically proven to reduce immediate mortality rates (i.e. 48" box). Due to the confusion surrounding adoption of the initial recovery boxes sizes, any requirements for larger boxes should probably be phased in over time.

- Increase professionalism of the observation/monitoring program. This includes providing adequate equipment, safety gear, and training for observers specific to the lower Columbia River and commercial fishery situations. Management decisions should account for limitations of the observation program and safety of the observers.

- Provide pre-season training for fishers regarding findings and results of the 2002 fishery.

- Limit night fishing time to a couple hours before and after dawn and dusk.

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August 16, 2002