INTERNATIONAL PACIFIC HALIBUT COMMISSION

Field manual for IPHC personnel aboard NMFS trawl surveys in 2018: Aleutian Islands and Bering Sea

PREPARED BY: IPHC SECRETARIAT (MAY 2018)

Note: This document outlines prescribed procedures for sampling and tagging Pacific halibut aboard NMFS groundfish trawl surveys in 2018. All personnel, schedule, communication, and otherwise proprietary information which appeared in the original manual used by IPHC, has been removed for confidentiality purposes.

Objectives and responsibilities

The main priority of IPHC personnel is to collect information from halibut caught during the survey. The IPHC biologist will work as an active member of a 6-person scientific team. Other members of the team will assist in halibut sampling when needed, and likewise, the IPHC representative will participate in the NMFS sampling as agreed upon between the IPHC sampler and the NMFS Field Party Chief (FPC) on board the vessel.

Specifically, the IPHC biologist will be responsible for the following:

1. Collect lengths on 100% of halibut brought aboard.
2. Wire tag all halibut in the 50% tagging sample that are assessed in either poor or excellent condition and that are <82 cm forklength. Do not tag those assessed as Dead, but DO record sex and maturity. Measure and release halibut that are in the tagging subsample but are ≥ 82 cm.
3. Obtain a fin clip from all tagged halibut before release. Do NOT obtain a fin clip from those assessed as Dead.
4. Collect standard biological information of halibut in the 50% otolith sample: otolith, sex, maturity, PHI.
5. Obtain fin clips and tissue samples from a subsample of the halibut retained for otolith extraction (Bering Sea only): i.e. 100 halibut each in the 20-39 cm and 40-60 cm size categories.
6. Coordinate sample collection with the NMFS stomach sampler. They will collect stomachs from halibut that IPHC selects for otoliths and they will use the otolith number as the unique identifier for the stomach sample.
7. Work with NMFS personnel to process the codend.
8. Contact one of the designated IPHC contacts at least once weekly and when in any port to report progress.
9. Send otoliths, forms, and samples to the IPHC office following instructions in the *Shipping* section of this manual.
10. Work with the data editor in the IPHC office to reconcile any data confusion that may arise.

Sampling overview

When you first arrive on the vessel -

- Meet with the other scientists and review your sampling plan so everyone knows what to expect.
- Work with the deck boss or FPC to find a halibut sampling/tagging spot on deck.
- Set up some kind of live tank next to your tagging station. This does not need to be fancy. You may be able to use totes already on deck for NMFS purposes or alternatively, you can purchase a plastic tote/container in port. Halibut often become more lively after time in a live tank so keeping it relatively small or having some other way to easily grab fish will be helpful. Keeping the halibut in baskets, and placing the baskets in the live tank works well to keep the halibut in good condition and the fish are easily grabbed for tag and release. A note on this - while using a live tank can help revive a lethargic fish in the short term,

recent research has suggested that use of more than a few minutes can have the opposite effect even if the release assessment is high. Use the live tank wisely.

- Set up your sampling/tagging station.
- Make sure the Excel spreadsheet for Form T-1 is set up correctly on the laptop.

The scientific team, including NMFS and IPHC personnel, will participate in a variety of deck duties. In the past, the IPHC sampler participated completely in sorting the catch (even if there were no halibut) prior to processing the halibut sample, but the tagging effort has altered that somewhat. Currently, the halibut sampler will work to sort the halibut out of the catch as quickly as possible, then process the 50% tagging sample prior to rejoining the rest of the NMFS team to complete the processing of the catch. It is helpful to enlist the help of the NMFS scientists in the initial sort of halibut if they are willing. The otolith sample can be left until later in the processing if needed.

Processing the halibut sample includes the following:

- Sort the halibut as quickly as possible out of the catch and into baskets.
- Select 1 out of every 2 halibut for the tagging sample using dice or stopwatch.
- Tagging sample - measure forklength, assess condition, assess PHI, tag, take a fin clip and release all fish that are in Excellent and Poor condition and that are < 82 cm forklength. On those assessed as Dead, collect fork length, sex, and maturity, and PHI information (Do not collect the otolith). On those ≥82 cm and still viable, measure forklength, assess PHI, and release as soon as possible. Record all data on Form T-1. Collected fin clips will be placed on Form FCtag and tag number will be recorded.
- Otolith sample - measure forklength, collect the otolith, sex, maturity, and PHI information. Record all data on Form T-1.
- Bering Sea only: Of the halibut from the otolith sample, there will be an opportunistic subsample of fin clips and tissue samples collected. Collect 100 fin clips and tissue samples from each of two categories: measuring ≥ 20 to ≤ 39 cm fork length and ≥ 40 to ≤ 60 cm fork length. Note that the fin and tissue samples are from the same fish. Collected fin clips will be placed on Form FCoto with the corresponding otolith number recorded in the box. Tissue samples will be placed in vials and the vial number will be recorded on Form T-1.

All information from Form T-1 will be entered into the IPHC laptop Excel spreadsheet. The data are sent to the office via e-mail at least every trip, and more often if requested. Additionally, data are copied onto a thumb drive as a backup to the laptop, and sent back to the office with the final paperwork at the end of each cruise. It is estimated that about 1200 halibut will be encountered on the routine stations in the Bering Sea and 700 in the Aleutian Islands. However, keep in mind that these estimates are very rough and the actual numbers tend to vary quite a bit.

Sub-sampling the catch

In the event that your vessel encounters a very large tow of halibut, you will be sub-sampling the catch. The cut-off between a whole haul and a sub-sampled tow is about 100 animals, i.e., for any tows that will yield a halibut sample well in excess of about 100 animals, including both otolithed and tagged fish, the sub-sampling protocol will be employed to bring the sample to as close to 100 halibut as possible.

Because we are including the tagging project which requires that halibut be released as soon as possible, the subsampling has been modified somewhat from previous years. The IPHC sampler will work to sort as many halibut as possible into baskets in the first few minutes after the codend has been dumped until there is an estimated 100 halibut sorted from the catch. An effort should be made to include halibut from different parts of the sorting table. The IPHC biologist will move to the tagging station, select the 50% tagging sample as described in the tagging section, and proceed with the sample. All halibut remaining unsorted will be measured for length and released as per the FPC's instructions but will not be part of the otolith or tagging samples. Important: If the catch is sub-sampled, indicate at the top of form T-1, and note in the logbook and on the trawl trip end form.

Sampling on crab tows, retows, and experimental tows

The Bering Sea survey is laid out in a 20x20 nmi grid pattern and the fishing stations are located at the center of each of these squares. In areas with high concentrations of crab, there are also stations at the corners of these squares. On those corner crab stations, length each halibut for the NMFS database as instructed by the FPC, but those fish will neither be processed for the otolith sample nor tagged. Additionally, stations that are fished early in the survey are sometimes fished again late in the survey if it is determined by the NMFS scientists that samples were insufficient the first time around (usually having to do with crab). IPHC requires only one sample, therefore do not process halibut for the IPHC sample on retowed stations as long as it was properly sampled the first time.

In all areas, there are sometimes experimental tows conducted, usually at the beginning or near the end of the cruise, corresponding to special projects or testing of the boat gear. Do not process halibut for the IPHC sample in these cases, although NOAA personnel may ask for assistance in processing halibut for a special collection or project, which is fine. Process halibut for the IPHC sample only in tows that are part of the standard groundfish survey.

Tagging halibut

Selecting the tagging subsample

When the codend is brought aboard, the halibut are sorted into baskets as quickly as possible. If there are a lot of fish, don't be shy in asking for help. Once you are satisfied that you have found all (or nearly all if the catch is large) halibut, move to your tagging location/station. The use of a live tank is very helpful in livening up a lethargic fish and for keeping halibut in good condition. Keep in mind that short term use of the tank will provide positive results, but there are diminishing returns after a few minutes. You may decide to immediately put the baskets in the tank and then sort them into tagging and otolith samples, or place the halibut to be tagged in the tank once they are selected, but before they have been processed.

To select which halibut will be tagged and which will be in the otolith sample, do the following. Working quickly, but making sure to be gentle with the halibut, select two fish, lay them out side by side and roll the dice. An even dice roll means that the halibut on the right is selected for tagging and an odd dice roll means that the halibut on the left is selected for tagging. Put the halibut not selected for tagging into a basket for processing later. Process the tagging sample. Once that is complete, you can return to help the NMFS scientists if needed. The fish selected for otoliths can be sampled at any time during haul processing.

Within the tagging sample, if the halibut is assessed in the Excellent or Poor categories and is <82 cm forklength, record the forklength, PHI, RelCnd, tag type and number, collect a fin clip, and release. If the halibut is assessed in the DEAD category, record the RelCnd, forklength, PHI, sex, and maturity on Form T-1, and set aside for later disposal as per the FPC's instructions.

Halibut ≥ 82 cm forklength have an equal chance of being in the otolith or tag subsample, but will not be tagged. So for halibut ≥ 82 cm selected for the tagging sample, record forklength, PHI, relcnd, and release as soon as possible without a tag. If the halibut is clearly not viable, also collect sex and maturity.

In summary:

- Sort the halibut out as quickly as possible into baskets.
- Move to your tagging station.
- Lay the halibut out two at a time.
- Roll the dice – an even roll=right, and odd roll=left to select your samples. *Note that if the opposite seems more intuitive to you, that's fine - just make sure it is the same for every haul.

Instructions for processing the tagging sample

Six pieces of information are collected for each halibut that is < 82 cm forklength: fork length, tag number, tag type, release condition, PHI, and fin clip.

- *Fork length (Frk len)*: Place the halibut on the board dark (eyed) side up, and put the nose gently against the closed end (at 0 cm). Let the fork of the tail fall onto the measuring board. Record the length to the nearest cm. (Measure all halibut in the tagging sample dark side up, even if dead and not tagged**). Only tag halibut that are <82 cm forklength.** Those ≥82 cm forklength, measure length, PHI, assess condition, and release if still viable. If already Dead, assess length, PHI, condition, sex, and maturity.
- *Tag type and number (Tag Type & Tag Num)*: Tag type and number will be printed on the tag itself
- *Release condition (Rel Cnd)*: Viability will be determined using the NMFS observer halibut release viability criteria for trawl vessels and includes three categories: Excellent (E), Poor (P), Dead (D). Criteria and a dichotomous key are included in this manual and also as laminated cheat sheets in your packet. You will be tagging and releasing halibut that are assessed as Excellent and Poor only. Those assessed as Dead will be measured for length, sex, and maturity, but are not tagged, assigned a tag number, or fin clipped. If you are unfamiliar with the observer viability criteria, it might be somewhat time-consuming at the beginning, but within a few attempts, it should become much easier.
- Prior hooking injury (PHI): Use the criteria in this manual to assess prior hooking injuries, if any. Use the Misc column on Form T-1.
- Fin clip: For halibut released with a tag, a fin clip will be collected after tagging, but before release using Form FCtag. Fin clips are small punches in the fin that should not affect the overall health of the animal. See instructions for taking fin clips in this manual.

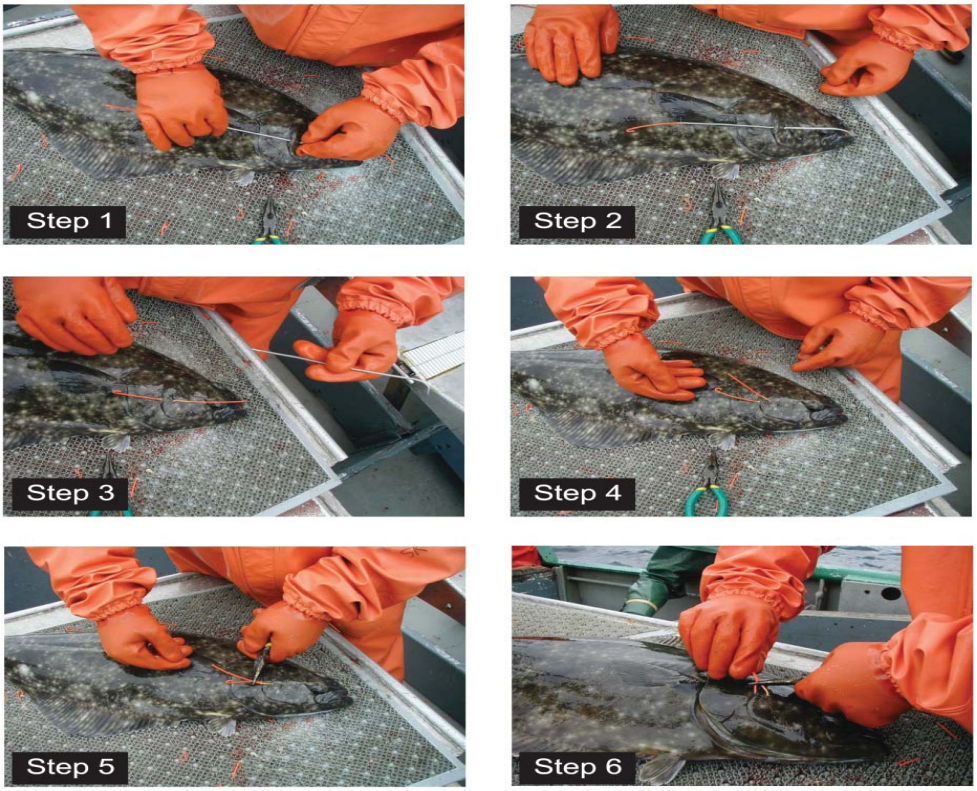
How to tag a halibut

You will be supplied with a block that has holes drilled to hold individual tags. The tags will be in rubber banded bundles of 10 or 25. Prior to the haul, prepare the tags by placing them sequentially in the block holes. It is important to use the tags in numerical order as much as

possible. Alternatively, a sampler in 2015 found that laying the tags in order on a strip of duct tape provided a safe and secure way to work with the tags. The bundle could be rolled up and stored when not on deck.

Tags are applied by first inserting the tag into the shank of the applicator needle. The needle is then inserted between the pre-opercular and the opercular bone of the cheek of the fish at an angle which permits the needle to pass between the two bones. The curvature of the needle causes it to pass around the pre-opercular bone and come out through the edge of the cheek. The tag is then pulled through the opening created by the needle and the two ends of the tag are folded together and twisted **AT LEAST FIVE TIMES** so a closed loose loop (allowing for growth) is created around the pre-opercular bone. The tag will usually be longer than is necessary and the excess should be cut off, being careful that the identification and number are not removed. There is a video of the procedure included on the laptop for reference. Note that in the video, the sampler punches the needle through first and then loads the tag which also works.

Record lost tags or missing tag numbers in the Remarks section of the Form T-1, with a note of explanation as to why the tag is not used (e.g. tag lost). Tag numbers must have all digits written out in each case.



Keep tagging until five halibut in a row are assessed in the DEAD category or all fish are processed, whichever occurs first. At this time, you can set aside your baskets and rejoin the NMFS crew if desired to help with the sorting and processing duties before returning to the halibut sample.

When you return to the halibut sample, keep in mind that the 50% tagged and otolithed protocol will remain in place. Halibut in the tagging sample that were not tagged, but are Dead should be recorded on the Form T-1 with a fork length (measured dark side up), relcnd, sex, and maturity.

Release viability criteria
There are laminated guides of the following information for use on deck.

Excellent: Fish is alive, showing no stress, and injuries, if any, are slight.
1. External injuries.
    - Superficial nicks or cuts on body.
    - Little (<10% of fin area) or no fraying of dorsal and anal fin.
    - Hemorrhaging (redness) of skin on white side limited to 5-10% of surface area.

2. Operculum pressure.
    - Fish is able to close operculum tightly for at least 5-10 seconds.
    - Muscle tone and physical activity.
    - Strong and lively, perhaps flopping around on deck if provoked.
    - Fish can tightly clench its jaw.

3. Bleeding.
    - No bleeding observed.

4. Gills and gill color.
    - Deep red in color.

Poor: Fish is alive, but showing signs of stress.
1. Injuries are apparent.
    - Body abrasions have damaged the skin but skin is still present, not missing.
    - Cuts and lacerations in body extend through skin just into flesh and are not deep.
    - Between 10 and 50% of dorsal and anal fins are frayed.
    - Slight bleeding from fin edges.
    - Approximately 10-25% of skin on white side of fish shows hemorrhaging.

2. Operculum pressure.
    - Fish closes operculum weakly and not sustained.
    - Weak, intermittent movement. May respond if stimulated or provoked.
    - Body is limp, but not in rigor mortis.

4. Bleeding.
    - Blood is continually flowing from gills, but not profusely.

5. Gills and gill color.
    - Deep to bright red in color.

Dead: No sign of life or, if alive, likely to die from severe injuries or suffocation.
1. Injuries are apparent.
    - Body cavity ripped open.
    - Internal organs exposed and damaged.
    - Cuts and lacerations in body extend deeply into the flesh.
    - Sediment in mouth.
    - Hemorrhaging in skin on 25% or more of white side.

2. Operculum pressure.
   - Fish does not close operculum.

3. Muscle tone and physical activity.
   - No sign of muscle tone (limp) or fish is in rigor (stiff).
   - Physical activity absent or limited to fin ripples or twitches.
   - Little, if any, response to stimuli.
   - Jaw is hanging open.

4. Bleeding.
   - Blood is flowing freely and continuously in large quantity from a torn or severed gill arch, or a body injury.

5. Gills and gill color.
   - Gills appear washed out, *e.g.*, dull red, pink, or white in color.

Dichotomous key to assess halibut release viability

1a. Fish is alive.....Go to 2a
1b. Fish is dead when sorted from the catch.....code **DEAD**
Fish is in rigor and lifeless, even if no apparent injuries. Gills appear washed out, i.e., dull red, pink, or white in color. Mouth may contain sediment.

2a. Body of fish appears uninjured, or has only minor injuries.....Go to 3a
2b. Injuries to fish are significant and obvious.....code **DEAD**
Body cavity is ripped open, exposing internal organs. Body tissue may be torn or ripped in a rough, ragged manner. Red hemorrhaging observed on 25% or more of the white side.

3a. Fish is able to close operculum when stimulated.....Go to 4a
Operculum is closed strongly or weakly, but pressure is evident. Operculum may not stay closed for long, though pressure may last up to 5 seconds or longer.
3b. Fish cannot close operculum, even when stimulated.....code **DEAD**

4a. Fish displays activity and has muscle tone .....go to 5a
Fish displays a minimal amount of activity, especially when stimulated. May be able to clench jaw tightly.
4b. Fish exhibits no muscle tone.....code **DEAD**

5a. Fish is not bleeding, or only slightly bleeding, if at all.....go to 6a
5b. Blood is flowing freely and continuously in large quantity (profusely).....code **DEAD**
Bleeding is coming from a torn or severed gill arch, or a body injury.

6a. Body injuries are minimal, perhaps difficult to find.....go to 7a
May consist of superficial nicks or cuts on body. Less than 10% of dorsal and anal fin area is frayed.
6b. Body injuries are readily apparent..... code **POOR**
Skin is damaged with abrasions. Cuts and lacerations in body extend through the skin and just barely into the flesh (not deeply). Dorsal and anal fin area is frayed between 10-50% Fin edges may be bleeding. Roughly 10-25% of the white side of fish shows red hemorrhaging.

7a. Operculum pressure is strong and sustained.....go to 8a
7b. Operculum pressure is weak and not sustained ..... code **POOR**

8a. Fish is strong and lively, displaying good muscle tone.....go to 9a
Fish is flopping around the deck, hard to control. Jaw may be tightly clenched, difficult to open.
8b. Fish appears weak..... code **POOR**
Movement is intermittent, perhaps occurring when provoked or stimulated. Body is limp.

9a. Fish is bleeding from gills..... code **POOR**
Blood is flowing continuously, slow and steadily, but not profusely. Gills are deep to bright red in color.
9b. No bleeding observed ..... code **EXCELLENT**
Gills are deep red in color.

Tag recaptures

In the odd event that a fish that was tagged this year in your survey region and is recovered at another station in that same region, and is still alive, on the Form T-1 record the tag number and the new viability (RelCnd), record R in the comment column, and "recapture" in the remarks column, then release the fish immediately. Note that the two regions are the Bering Sea and the Aleutian Islands. Do not include this fish in the 50/50 sample. Note that this is the fourth tagging year so make sure you are not releasing a fish that was tagged in another year.

If a fish that was tagged in an earlier year is recovered, retain the fish and follow the instructions in the *Tag Recovery* section in this manual. Tagged fish recovered during any tow, regardless of purpose code, are processed. Tag numbers issued for 2018 are as follows. If the recaptured fish is outside of these number ranges, then it is from a different year and you should process it as a tag recovery.

Otolith sample

The other 50% of the halibut caught will be processed as in previous years and includes sampling for:

- otoliths
- length
- sex
- maturity
- PHI
- 200 fish subsample for collection of fin clips and tissue (Bering Sea only)

Measuring the length

The length is a straight measurement from the tip of the nose to the fork of the tail. NMFS will be taking lengths on all halibut caught. This is separate from the IPHC sample although both sets of data can be collected at the same time. The NMFS length boards work the best for halibut. Place the halibut on the board white side up, and butt the nose against the closed end (at 0 cm). Let the fork of the tail fall on the measuring line. Measure the fish before cutting the otolith as this can sometimes distort the true length.

In the case of a fish too large to fit on the conventional board, butt the nose against a straight surface and make sure the fish is flat. Then mark where the fork of the tail lands on the surface, remove the fish and measure the length in a straight line with a tape measure. Never measure a halibut by placing a tape measure on the fish; the curve of the fish can distort the actual length significantly.

Record the length (in cm) in the *Frk Len* column of Form T-1 for every halibut brought aboard.

Sex determination

Differences in the sexes

The following table describes the differences between the males and females. Remove the gonad completely prior to assessing maturity.

Description	Males	Females
Color	Whitish color	Pinkish with or without veins
Shape	Multi-lobed oval or triangular mass with definitive flange or edge to the gonad	Cone-shaped and membrane covered. Granular eggs may be visible
Extrusion	Mature in-season male may extrude milt upon pressure to testes	Mature in-season female may extrude eggs upon pressure to ovaries
Internal Structure	Upon cutting similar internal structure as exterior	External membrane and upon cutting it may show eggs

Recording

Record either "M", "F", or "U" in the *Sex* column in the halibut detail portion of Form T-1 for every halibut in the 50% otolith sample. This refers to male, female, and unknown, respectively. "U" should not occur on the NMFS trawl surveys since the fish are completely intact when sampling. If the sex is unknown, please explain why in the Remarks.

Maturity assessment

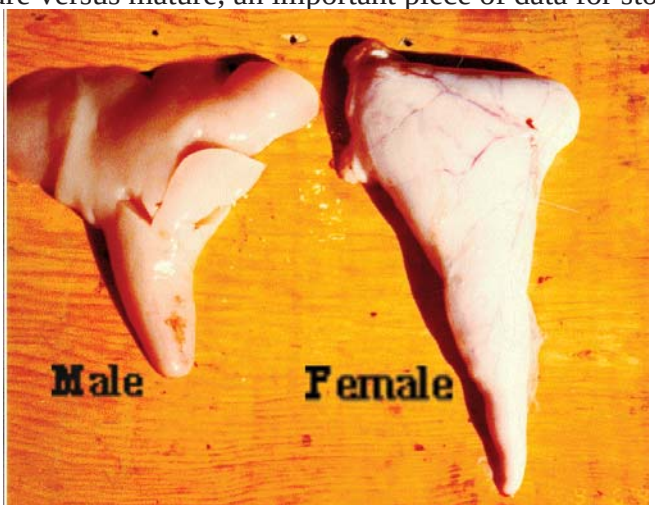
Female maturity stages

Remove the gonad from the fish to assess the maturity. First, examine external characteristics. The female gonad is paired and conical in shape. The gonad is attached internally to the fish by connective tissue. Connective tissue is located at the broad end of the cone, and is thicker and more opaque than the rest of the gonad. Do not mistakenly assess the external characteristics of the connective tissue. Look towards the point of the cone. External characteristics include color, development of capillaries, and membrane thickness.

After assessing the external characteristics, propose a hypothesis on the possible stage. Then cut open the gonad and examine the internal structure for egg development and membrane thickness. Compare your first analysis of the membrane thickness with the cross section of the gonad.

Visual characteristics of maturation stages vary between geographic locations and season. You may experience gonads that are between stages. If a gonad has multiple characteristics in different stages, choose the stage that has the most characteristics. If you can not decide, code the fish F (for female) and U (for unknown maturity). Do not force a gonad into a maturity stage if you

are unsure. It is important to realize that when you decide between a Stage 1 and Stage 4, you are coding a fish as immature versus mature, an important piece of data for stock assessment.



STAGE 1: IMMATURE

This halibut will not participate in the upcoming spawning season.

EXTERNAL CHARACTERISTICS:

- Ovaries small and firm, tightly packaged.
- Slight development of capillaries.

INTERNAL CHARACTERISTICS:

- Oocytes not visible to the naked eye. You may see the presence of white dots or a grainy appearance in the internal membrane. This is early development of eggs and still considered Stage 1. As the ovary progresses to Stage 2 the eggs become more developed. Stage 2 occurs when actual eggs become present.
- Membrane is extremely thin.

STAGE 2: MATURE

This halibut will participate in the next spawning.

EXTERNAL CHARACTERISTICS:

- Ovaries are reddish with numerous blood vessels.
- The blood vessels / capillaries are well developed and functional. They form elaborate branches and are usually purple in color.
- Eggs can be seen through the membrane. Membrane is thin and translucent.
- Ovary is larger than Stage 1.
- Eggs are not extruded with slight pressure.

INTERNAL CHARACTERISTICS:

- Eggs visible to the naked eye. Stage 2 includes a “ripening” process, and therefore the size of the eggs may be variable.
- Initially, the eggs are opaque in color, creating a “Cream of Wheat” appearance. As the development progresses, the eggs become large and clear. A small percentage of the eggs may be clear (10%).
- Cross section of membrane is thin.

Stage 3: Spawning

This halibut is spawning. Not typically seen in summer cruises.

External Characteristics:

- Ovaries are large and swollen.
- Membrane is thin and translucent.
- Eggs flow freely with slight or no pressure to the ovaries.
- Well developed vascular system.

Internal Characteristics:

- A large percentage of eggs are clear.
- Eggs are fully developed and the diameter is large (3 – 4 mm).

Stage 4: Resting

This fish has recently spawned and is preparing to return to Stage 2.

External Characteristics:

- The gonad is flabby, baggy, and collapsed. The gonad will "shrink" and firm up as it transitions back to Stage 2.
- The membrane color is opaque.
- Large, deflated blood vessels are visible.

Internal Characteristics:

- Cross section of membrane is thick.
- Resorbing eggs may be present.
- Early egg development may also be present. This gonad is preparing to return to a Stage 2 but still is considered a Stage 4. This internal characteristic is lowest priority. If developing eggs are present, check the membrane thickness and capillary development to confirm stage. If eggs are opaque or have a "*Cream of Wheat*" appearance, it should be coded Stage 2.

FEMALE MATURITY SUMMARY TABLE

Characteristic	Stage 1 Immature	Stage 2 Mature	Stage 3 Spawning	Stage 4 Resting
Ovary Consistency	Small, firm, tightly packaged	Larger then Stage 1	Swollen and large. Extruding eggs	Collapsed and flaccid or shrunken
Capillaries	Slight development	Well developed and branched, purple in color	Thin and small	Large and deflated
Membrane Thickness	Thinnest	Thinner	Thin	Thick
Egg Development	Not visible to naked eye. White dots Or grainy appearance of developing eggs	Visible. Egg color is opaque. Small percent may be clear (10%)	Visible. Fully developed and large in size (3 – 4 mm). Large percent are clear in color	No eggs present. Resorbing or developing eggs maybe present*
Membrane Color (highly variable)	Pink to red	Clear. Membrane is so thin that it represents the egg color	Clear. Membrane is so thin that it represents the egg color	Opaque

* You may find a shrunken ovary with early developing eggs that appears to be similar to Stage 1. Check membrane thickness and capillary development to confirm stage.

Male maturity stages

The defining characteristics are **listed in order of priority**.

STAGE 1: IMMATURE

This halibut will not participate in upcoming spawning season.

- The edges of the paired organs are smooth with no crenulations (*crenulated: having an irregularly wavy or serrate outline.*)
- Testes very small (usually < 5 cm across).
- Firm-textured. Internal texture is smooth in cross-section.

STAGE 2: MATURE

This halibut will participate in upcoming spawning season.

- Testes have crenulations.
- Soft, plump, and swollen in appearance.
- If sperm is detectable, the fish is mature.

Taking otoliths

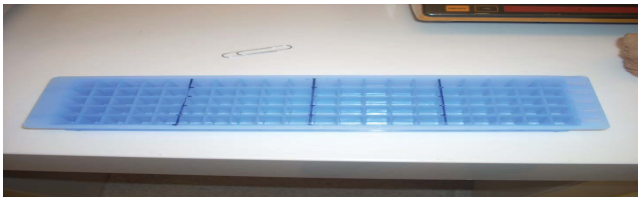
Age structures (otoliths) are to be taken from each halibut caught on each standard tow that falls within the otolithed fish sample or sub-sample, whichever the case may be. You will be using Tray Biens® and the box contains one hundred cells that are to be numbered sequentially from left to right and top to bottom. (Ignore the stamped numbering on the Tray Bien® as it doesn't start at 1 at the upper left.)

You will be supplied with Tray Bien® trays and lids, a tray holder, adhesive labels, paper stars, aluminum foil and Parafilm for covering the trays under the lids, a FoodSaver® vacuum sealer

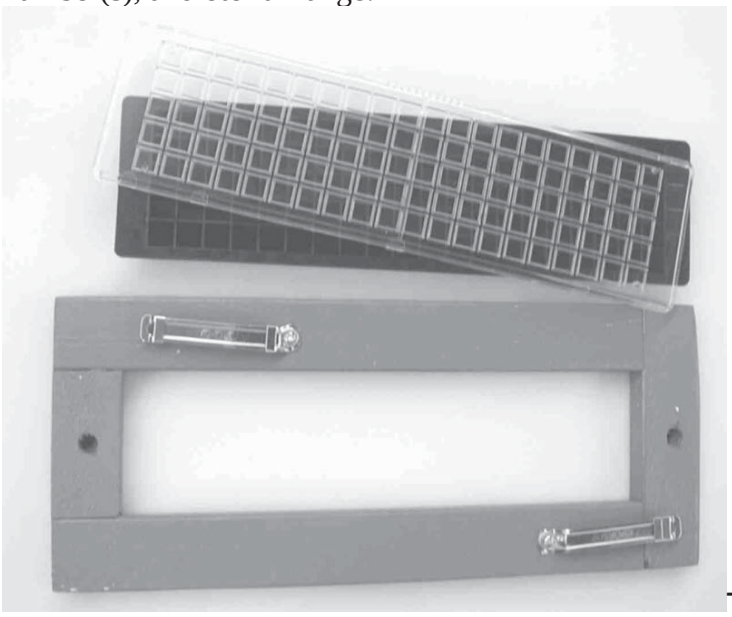
and bags for sealing filled trays, and boxes and pre-addressed USPS Priority Mail Merchandise Return labels for shipping. Tray Bien® trays are also used on the setline surveys, however, since your work environment is different from that of the setline vessels (e.g., no shack), procedures for collecting otoliths in Tray Bien® on the trawl survey will be slightly modified. Finding a spot to mount the tray bien holder and then lining it with the mesh provided in the gear kit should provide a stable surface. Instructions on the use of Tray Bien® trays and the vacuum sealer follow below.

Getting started

Secure your Tray Bien® holder to a table or work surface in a place that will not interfere with your paperwork and where the Tray Bien® is unlikely to accidentally spill. When you place a Tray Bien® in the holder, be sure it has the correct orientation; the embossed words "Tray Bien" will be on the right side. Use a permanent marker to mark the tray every 5th column to divide each row of cells into fives. This helps the age readers check that they're on the right cell number while reading.



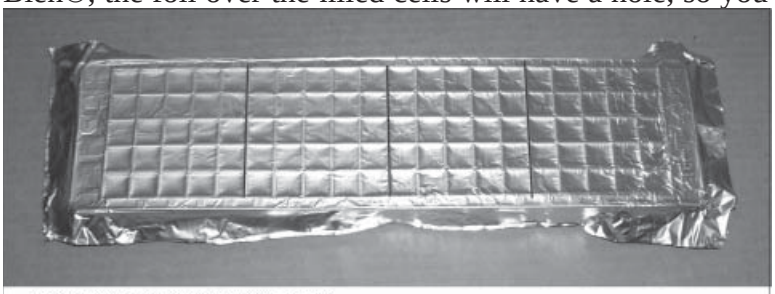
Place a paper star, indicating the first and last otolith numbers, in the first and last cell. Also put a paper star in the first and last cells collected on a trip. On these paper stars write the vessel code, trip, and otolith number. Before collecting otoliths, affix a label (in gear kit) to the lid. After the tray is filled, add the following information (**in pencil**) to the label: year, vessel code, trip number(s), and otolith range.



Tray Bien® and holder

Oto-juice and foil cover

'Oto-juice' is a mixture of water, alcohol, glycerin, and thymol. The oto-juice helps preserve and prepare otoliths for age-reading. You don't need much oto-juice in the Tray Bien® cells. Put just enough to cover the bottom of the cell with oto-juice and no more than ½ full. Do not fill the cells to the top with oto juice. After adding the oto-juice, press a piece of foil over the top of the Tray Bien®. Use a large enough piece so that it folds over the edges of the tray and stays in place. Press the foil so that the imprints of the cells are visible. *It may be helpful to mark the foil the same way you mark the Tray Bien® to divide each row of cells into fives.* You will be using the foil as a 'reverse blister-pack'. Some medications come in blister packs, which consist of a plastic tray with pills in the individual cells or depressions covered with foil; the medication is dispensed by pressing the pill through the foil. With the Tray Bien®, you will be pushing the otoliths through the foil into the individual cells. The foil will keep otoliths from falling out if the Tray Bien® is tipped over, and it will also prevent otoliths being put in the wrong cell. As you go along filling the Tray Bien®, the foil over the filled cells will have a hole, so you can see where the next empty cell is.



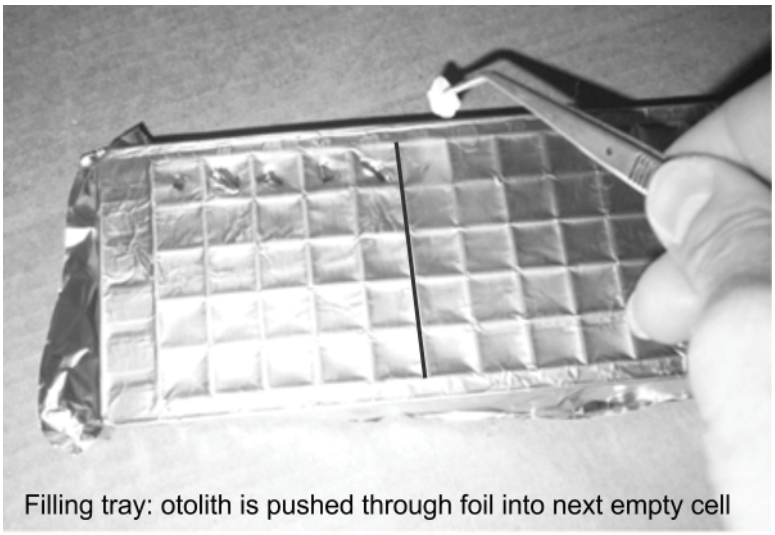
Fit foil over tray so cells are outlined

Filling the Tray Bien® with otoliths

Collect the left side otolith. Make sure otoliths are wiped clean (blood and membrane removed) before putting them in the cell**.** Record the cell number in the *Otolith Number* box of the Trawl Information Form T-1. If the left side otolith is lost, badly broken, or fully crystallized, do not take the right side otolith in its place. You do not have to skip the cell in the tray either. For any halibut for which an otolith is not taken because the otolith was crystallized, leave the corresponding *Otolith Number* field on Form T-1 blank or put a line through it and record a 'C' in the *Remarks* field. If it is partially crystallized, go ahead and collect it and note the otolith's condition in the *Remarks* field. You may collect a broken otolith if it is broken in four or fewer pieces, and at least one piece contains material from the center of the otolith to the edge. (Put all pieces in the cell). If an otolith is lost or shattered into more than 4 pieces, leave the *Otolith Number* field blank (or put a line through it) and note why the otolith was not collected in the *Remarks* field.

Collect both the right and left side otoliths from sinistral (left eyed) halibut and place them together in a tag envelope. Note the sinistral characteristic in the *Remarks* column of Form T-1 and do not assign an otolith number. Record the date, location, fork length, and sex in the appropriate fields of the tag envelope and record "sinistral" in the Tag Number field of the envelope.

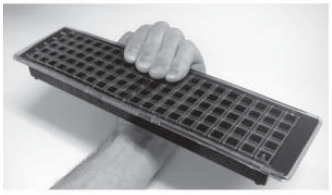
The otolith number on the Trawl Information Form T-1 must always correspond to the cell number (e.g., the 233rd otolith collected on a particular vessel in a single year will be in cell 33; the 488th will be in cell 88). Check this often. The foil will act as a guide to placing the otoliths in the correct cells. A hole in the foil over a cell indicates that there is already an otolith in the cell, so the next cell in the row without a hole in the foil is where the next otolith should go. If you have also drawn lines every 5th column on the foil, the lines will help you check the cell numbering.



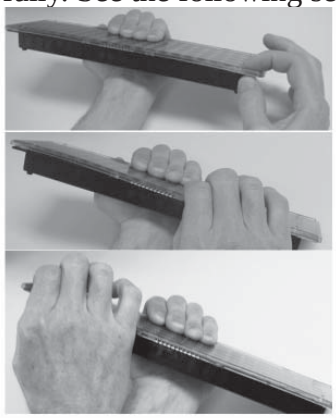
Filling tray: otolith is pushed through foil into next empty cell

Between hauls, cover the tray with its lid. There is bit of technique involved in closing a Tray Bien® properly and successfully. See the following series of pictures.

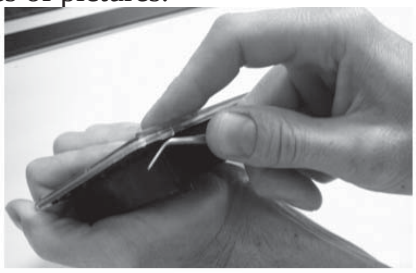
1. Place the Parafilm lining, orient the base so that the cell numbers are right-side-up from your perspective. Orient the lid so that 'grip' faces you.



2. Line up all tabs in the back and close the lid.



3. After checking to ensure that the tabs are all engaged, carefully press the front edge down, one tab at a time.



4. Forceps make a good tool, if the last corner doesn't close easily.

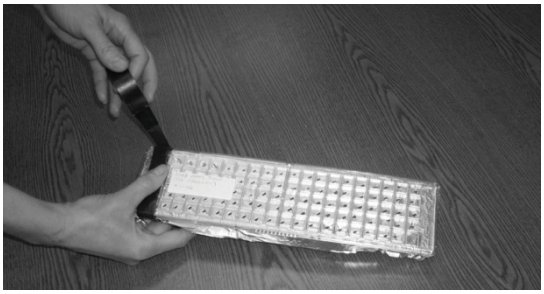
5. Add year, vessel name, otolith numbers, and dates collected to the label. Tape over sharp corners and pegs to prevent the bag from puncture. Finally, seal it up with the Foodsaver.

Ending a Tray Bien®

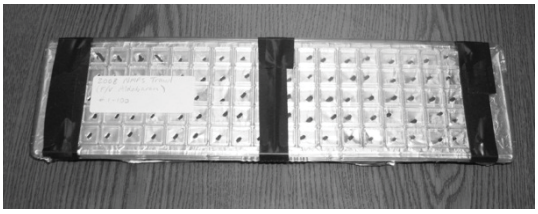
When the 100th cell in a Tray Bien® has been filled, it's time to prepare it to be sent to Seattle. Carefully remove the foil from the tray and replace with a piece of Parafilm®. Check to make sure otoliths are not stuck to the foil. If the tray has tipped at all, you may want to leave the foil in place and put the lid on over the foil. The Parafilm® may do a better job of keeping the otoliths in their proper cells, since if the holes in the foil are large enough, the otoliths could work their way through. If you are not comfortable removing the foil, you could also try putting a layer of Parafilm® over top of the foil, however it might be difficult to close the lid with both foil and film. Use your judgment.

Placing Parafilm® over a tray

Follow the instructions for closing the lid on a Tray Bien®. After the lid is closed and without obstructing the label, secure the lid with three strips electrical or masking tape—NOT DUCT TAPE. Use one piece of tape around the center and one piece at each end of the tray. **Be sure to tape over the little pegs (but please do not break off the pegs)** because the pegs will puncture the FoodSaver® bags.



Taping end of tray



Taped tray ready for vacuum sealing

How to use the FoodSaver®

1. Cut a bag to the appropriate length and seal one end.
2. Tape the center and ends of the Tray Bien® as shown and wrap the Tray Bien® in several paper towels or newspaper before placing it in a bag.
3. Place Tray Bien® in the bag.
4. Remove air and seal the tray in the bag.
5. With a Sharpie, write the oto numbers, vessel, and trip on the bag.

Shipping to the office

Send otoliths to the Seattle office when you have filled 28 trays or at the end of the trawl survey, whichever comes first. You will be provided with cardboard boxes that fit 28 Tray Bien®s and shipping labels.

Assessing prior hooking injuries

All halibut, regardless of which sample they land in, will be examined for the presence of Prior Hook Injuries (PHI), i.e. injuries that occurred if the fish was previously caught by hook-&-line gear. The fish may have been hooked recently, in which case the injury should be easily

noticed, or it may have happened some time ago, thereby allowing the injury to heal. These latter types are the most difficult to identify. Injuries will be observed primarily to the jaw, but may occur to the eye and eye socket, either by itself or in conjunction with a jaw injury. Do not count current or prior injuries to the tail and body which may have occurred during a trawl capture.

CONDITION OF HALIBUT & DESCRIPTION OF PRIOR HOOK INJURIES (PHI)

Injury Locations	Codes only apply to prior hook injuries, if any. Worst injury of jaw, eye, & eye socket prevails.				Did Not Check Or Can't Tell
	None (Code 1)	Minor (Code 2)	Moderate (Code 3)	Severe (Code 4)	Unknown (Code 9)
Jaw	No Injury	Jaw in one piece, not split or separated from head. Skin of lip may be torn, but jaw is intact.	Upper or lower jaw bone may be torn through, hanging from fish, or torn away on either side of the head. Tear may or may not include tearing through the cheek area. Lower or upper jaw may be split laterally, tearing through either snout or lower mouth.	Removal of hook has torn large flap from side of head, usually originating in cheek area. Flap, usually including part of jaw, is either hanging loosely or missing.	Did not examine the fish, or can't tell
Eyeball & Eye socket	No Injury	Eye socket may be torn, but eyeball is undamaged.	Eyeball punctured.		Did not examine the fish, or can't tell

Place the assessed code in the *Misc* column of Form T-1. The types and severity of injuries you may observe are described in the table above. You may find injuries in both locations that represent different degrees of severity. It is recommended that you record this fish with the code that represents the most severe condition. For example, a halibut that has a torn eye socket (Minor) and a split jaw (Moderate) would be recorded as Code 3 (Moderate). Likewise, a fish with an intact jaw (Minor) and a punctured eye (Moderate) would be recorded as a Code 3 (Moderate). A fish with a Severe jaw injury would be coded a 4, irregardless of the condition of the eye. Halibut with no perceptible injury at either location would be given a Code 1 (None). If you forget to check, or can't tell, record Code 9. Remember to check both sides of the head!

Fin clips and tissue samples

A piece of fin tissue ("fin clip") will be collected for DNA analysis from all released tagged fish in both survey regions (BS and AI). Fin clips and tissue samples will also be collected from a subsample of 200 halibut caught during the Bering Sea survey. The 200 halibut sampled should be distributed equally in two size classes: 100 fish between 20 cm and 39 cm in forklength (i.e.

equal or above 20 cm and below 40 cm in forklength) and 100 fish between 40 cm and 60 cm in forklength (i.e. equal or above 40 cm and below or equal to 60 cm in forklength). This is an opportunistic sample so no random sampling required. Sampling will commence at the beginning of the survey, and will continue until the requested total number of fish of that particular size class is achieved. Ideally, the samples will be taken from as few tows as possible. Maintain a simple tally sheet to keep track of bins.

Fin clips will be collected and dried on the provided filter paper for both tagged fish and the Bering Sea tissue subsample fish; the Bering Sea subsample fish will also be sampled for muscle tissue, which will be stored in individual vials of RNAlater solution.

Procedure for halibut fin clip retrieval and storage on filter paper

Complete drying of samples is essential to ensure good quality DNA (improperly dried/moldy samples produce degraded DNA).

Fin clip sampling sheets

These sheets are made of Whatman paper, a type of filter paper that effectively absorbs moisture which allows the fin to stick well to it. The printed layout of the sampling sheet will be different for fin clips from fish that will be tagged and released (Form FCtag) from that where fin clips from fish that are sampled for otoliths (Form FCoto).

Using the biopsy punch to collect fin clips

1. With the use of a 7 mm biopsy puncher (Fig. 1, left), take a small piece of fin tissue that can include some fin ray (Figs. 2-4).

2. To operate the puncher, press it down firmly on the fin and, while pressing down, rotate the puncher back and forth a few times. While still pressing down with the puncher, slide the fish towards you to separate it from the puncher and to make sure that the fin punch is still in the puncher.

3. Expel the fin punch onto the corresponding cell on the appropriate form: Form FCtag for released tagged fish or FCOto for the subsample of otolithed fish on the Bering Sea survey. The punch is expelled by pressing on the plunger, ensuring that the fin punch ends up close to the center of the cell. If the fin punch is stuck to the plunger and does not fall off, drag it on the paper to make sure it gets stuck (Fig. 5). Record either the otolith number or tag number in the same cell as the fin clip.

4. If you are having trouble with the form staying reasonably dry while out on deck, place the fin clips in a tray bien instead of directly on the form. Following the haul, find a dry space inside and transfer the fin clips to the paper. Always rinse the tray bien afterward so that it is ready for the next sample.

5. IMPORTANT: Clean the punch after fin clipping each fish by punching the provided ethanol-soaked sponge/filter paper a couple of times. Also, clean the green cutting mat with 70% ethanol by spraying it with the provided spray bottle.

6. Protect form with a clear plastic cover to avoid getting samples wet (Figure 6).
7. Move form with fin clips into drawer of plastic field desk for short-term storage.
8. Place form, once it is full, in a warm and dry place to dry completely.
9. Once the fin clips are dry, store each form inside a plastic sheet protector (i.e. one form per protector) that will contain two (2) small silica packs making sure that the packs are on the OPPOSITE side of the filter paper with the fin clips (Figure 7). Seal the plastic sheet with Scotch tape (Figure 8).

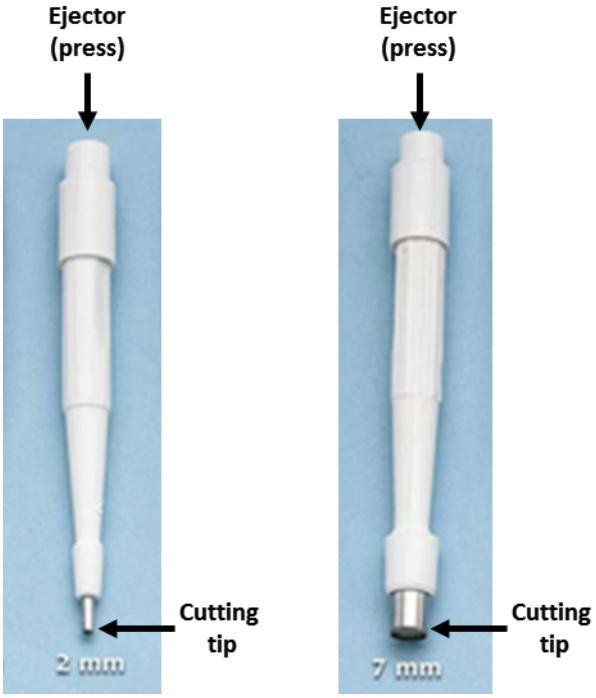


Figure 1. Biopsy punchers (left: 2 mm; right: 7 mm)

Figure 2. Selecting area on the dorsal or ventral fin to clip.

Figure 3. Selecting area to clip on caudal fin

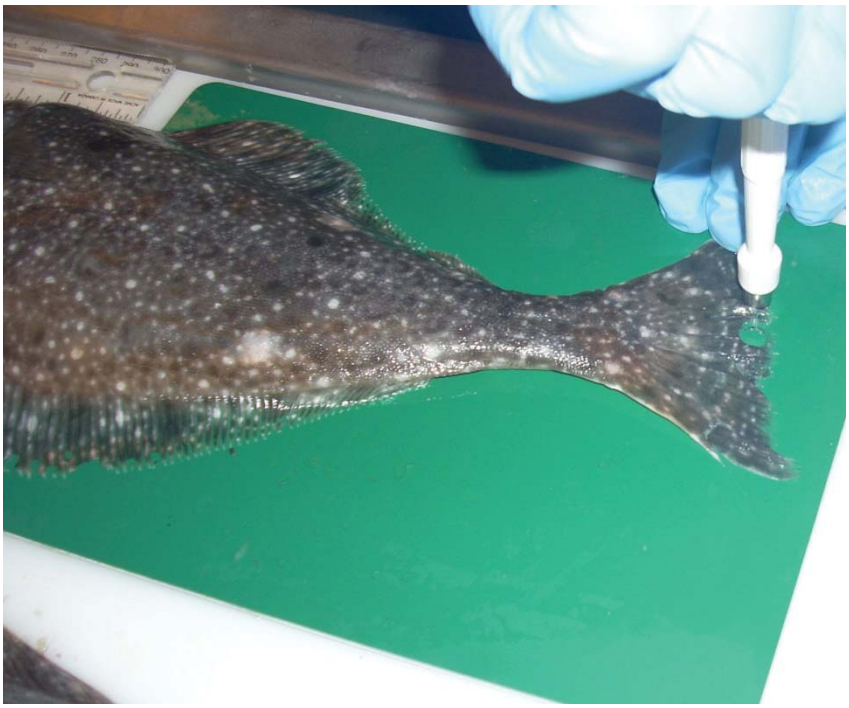


Figure 4. Taking fin clip (punch) from tail.

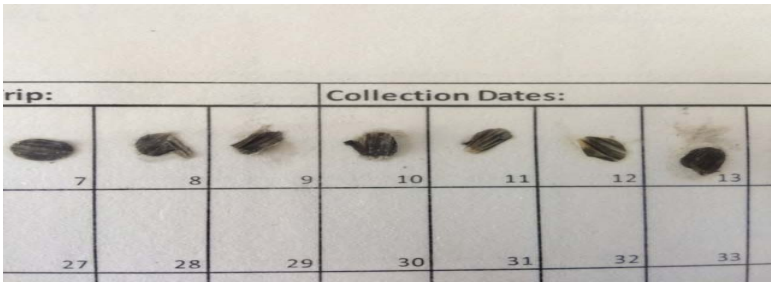


Figure 5. Fin clips (7 mm punches) on filter paper.

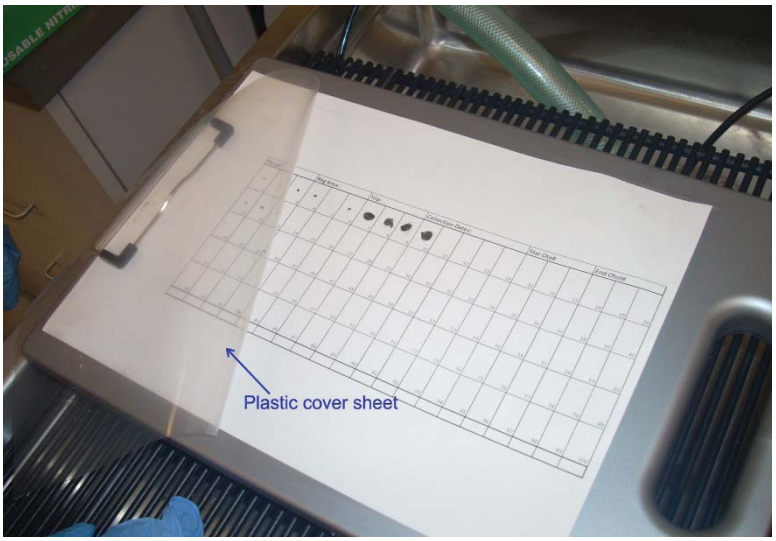


Figure 6. Fin clip form (filter paper printed with grid) and plastic cover

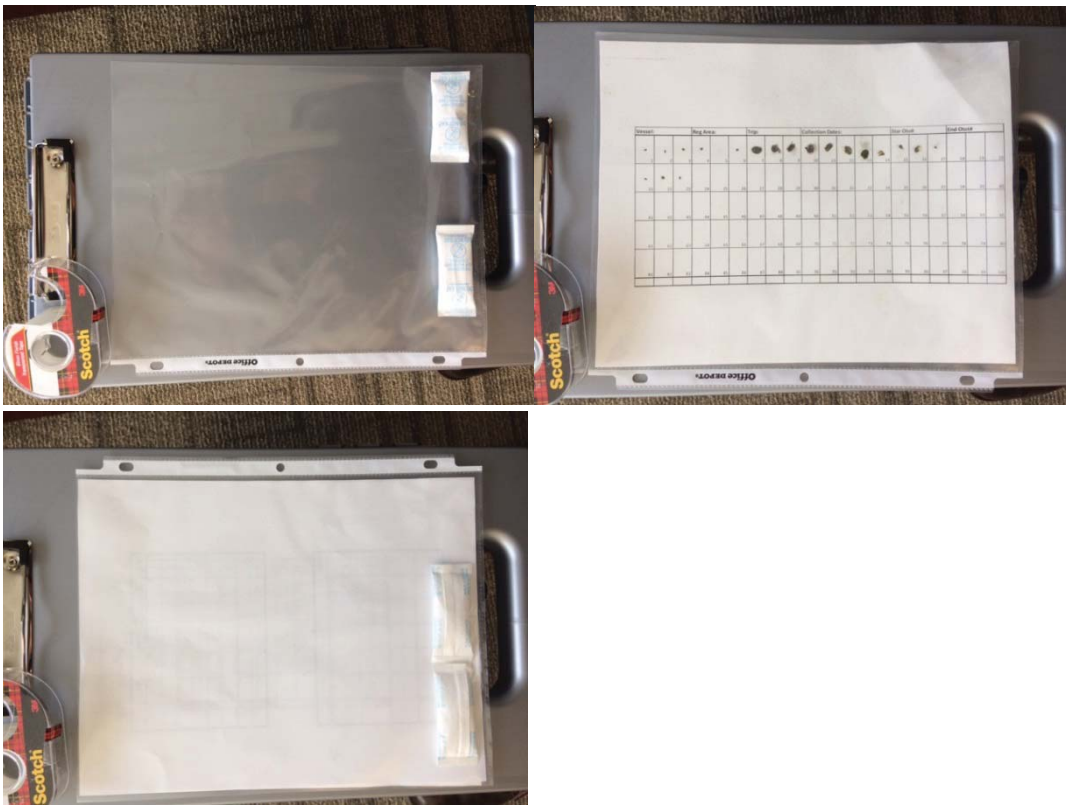


Figure 7. Plastic sheet protector containing silica packs.

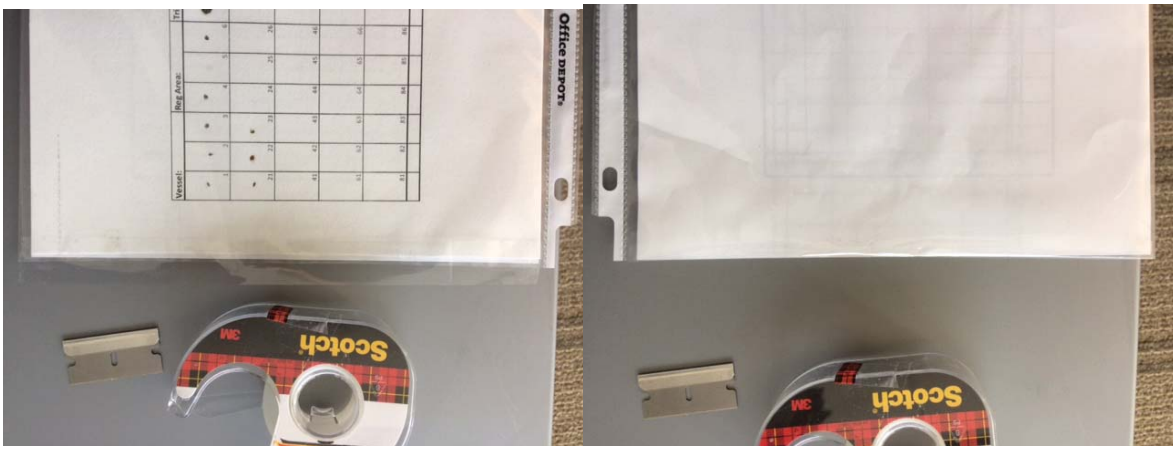


Figure 8. Using Scotch tape to seal the plastic sheet protector with the filter paper.

Procedure for extraction of muscle tissue samples

Muscle tissue samples will be collected for RNA extraction and for that purpose stored in an RNA-preserving solution called “RNAlater”. Tissue samples will be collected on the Bering Sea

survey only. A total of 200 halibut will be sampled in two size bins, i.e. 100 in each bin (20-40 cm, and 40-60 cm).

IMPORTANT: RNA is sensitive to degradation by enzymes known as ribonucleases. Ribonucleases or RNases are everywhere! RNases are very stable and difficult to inactivate. The most common sources of RNase contamination are hands (skin). To prevent contamination from sources external to the sample, wear gloves at all times.

Tissue extraction protocol

1. **<u>Muscle samples</u>.** Collect a muscle sample from the dorsal side of the fish, midway between lateral line and dorsal fin. Cut a 1/4 inch cube of flesh (NOT larger) through skin with sterile scalpel and remove with forceps making sure that there is NO SKIN. Place tissue with forceps inside a pre-labelled and pre-filled screw-cap tube containing 1mL of RNA*later* solution (Figures 11 and 12). The sample should be small enough to be fully submerged and to be able to freely tumble inside the solution.

2. Record vial number on Form T-1 in the *Tis Num* field.

   IMPORTANT: Scalpel and forceps must be wiped with the provided alcohol swabs every time a new fish is sampled for tissues.

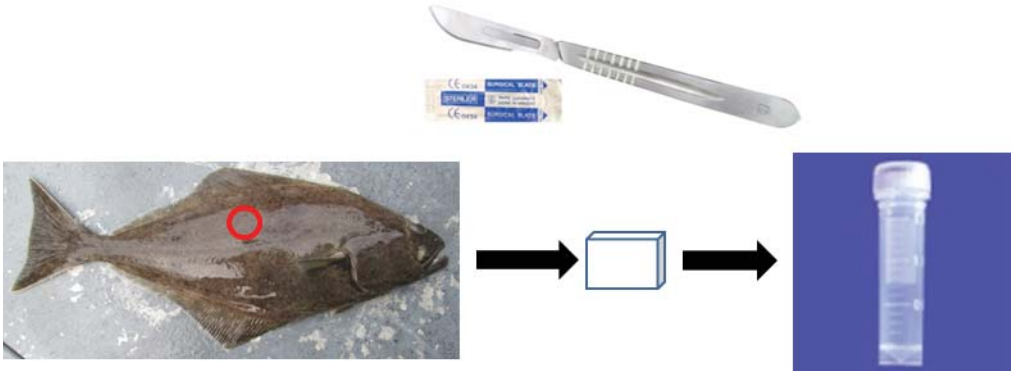


Figure 9. Overall scheme for removing a small piece of muscle tissue and placing it in screw cap tubes that are pre-labeled and pre-filled with an RNA preserving solution.

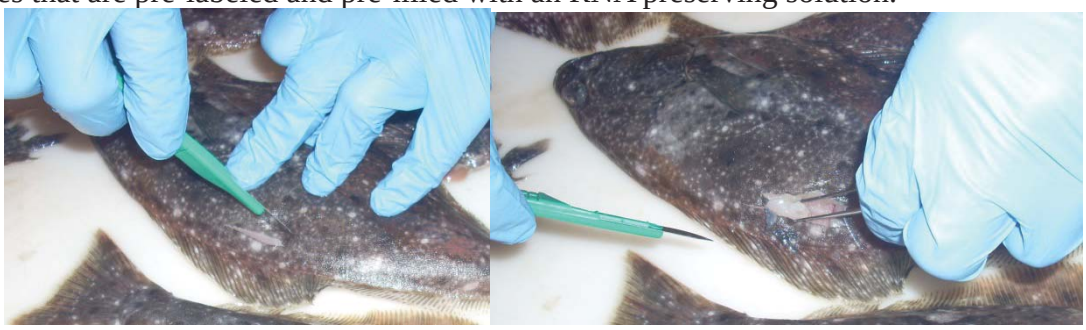


Figure 10. Procedure for extracting a piece of muscle tissue. Cut through skin with scalpel (left) and use forceps to remove the piece of muscle tissue (right). Tissue can be cut further until it is approximately a 1/4th inch cube.

Form FCoto example

Fin clip samples from sampled fish **Form: FCoto**

Record **otolith number** in the same cell as the fin clip Vessel: Vesteraalen - 94

074	075 	080 	083 	084 
085	086 			

Form FCtag example

Fin clip samples from released tagged fish **Form: FCtag**

Record letter prefix and tag number in the same cell as the fin clip sample Vessel: Sea Storm - 143
For recovered tagged fish, record tag number followed by "R" (for "recovered")

Y0722 	Y0723 	Z0021 	Z0022 	T3345 R
Y0724 				

Tag recovery

All halibut caught with a tag attached are sampled to obtain data on size, age, sex, and migration (with the previously described exception of tags released earlier in the 2018 survey by your vessel). Do not include recovered tagged halibut in either the tagging or otolith subsample. Record the capture of a tagged fish by putting an “R” in the *Com* column on Form T-1. This

code has priority over all other comment codes. Write the full tag number in the *Remarks* field (including leading zeros). Do NOT assign that fish an otolith number. Instead, mark a dash where the number would normally be recorded and fill in the remaining information.

Take both the right and left side otoliths regardless of condition and place them with the tag in a Tagged Fish Recovery Envelope. The shaded areas on the envelope are for in-office editing only. The envelopes are to be filled out in pencil making sure the information is legible. All the data are right justified. *Note: There will be no tag reward given for tags recovered during scientific charters with either the IPHC or NMFS.*

TAG NUMBER - Number as printed on the tag.

RECOVERY DATE - Date the fish was caught month, day, year

DEPTH - Depth the fish was caught in fathoms (note that NMFS records depth in meters so you will need to convert from meters to fathoms; 1.83 m = 1 fathom).

RECOVERY LOCATION - Place the fish was caught in Latitude and longitude.

FORK LENGTH - Length from head to fork of tail in centimeters.

SEX - Check male or female.

GEAR TYPE - Check recovery gear type.

LANDING PORT – Write in "NMFS survey".

PROCESSING AGENCY - print "Research".

OTOLITH NUMBER - leave blank (assigned in the lab).

VESSEL NUMBER - The vessel's ADF&G number.

VESSEL NAME - The vessel name.

NAME, STREET ADDRESS - If captain or crew would like release information, record their name and address.

REWARD – Leave this blank. The vessel will not receive a reward for any tags.

REWARD STATUS - N/A

Note that this section pertains to halibut that were tagged in a previous year. If you recover a halibut that was tagged earlier in your survey in 2017, refer to the *Tag recaptures* section in this manual for instructions.

Filling out the Trawl Halibut Information Form (Form T-1)

Use a new Trawl Halibut Information Form T-1 for each tow. If there are no halibut caught, use a form to record header information then write "no halibut" at the top. This is to confirm the absence of halibut in a certain tow when the data are being analyzed back at the office.

Sample all halibut from conventional tows regardless of whether the tow is "effective". If the tow is deemed "ineffective" by NMFS standards, then note this at the top of the data sheet for that haul. An exception to this is when the FPC deems the tow not only ineffective, but also

unsampleable and the contents are dumped straight away. This can sometimes occur if there are large boulders or objects in the codend that could damage the vessel if brought aboard. Such an occurrence should be noted in the logbook.

Fields used will be different depending on whether the halibut is part of the tagging or otolith sample, and whether a tissue sample is taken. Refer to each sampling section and the Form T-1 example page for further explanation.

Form fields

Header

YEAR: 2018

VESSEL: Vessel codes are in the cruise description sections near the beginning of this manual.

TRIP: Trip number 1, 2, 3

HAUL NO: same as NMFS haul number *****very important - this is the primary way we match IPHC data to NMFS data after the cruise.**

REGION: Trawl region – either BS for Bering Sea or AI for Aleutian Islands

Individual fish information

FRK LEN: Fork length in centimeters for all fish, both otolithed and tagged.

OTO NUM: Otolith number will apply to all fish in the otolith sample. For fish in the tagging sample, this field will be blank. Note that recovered wire tags (not the fish you have tagged on this survey) go with the tag in a tag redemption envelope. Do not assign that fish an otolith number in the tray bien series, but DO record the other information on your T-1 Form.

SEX: male = M, female = F, unknown = U. For otolithed fish, the U is used only in case of error, loss of fish before determination is made, or a can't tell situation because fish is too small. For those in the tagging sample but assessed as Dead, also record sex and maturity. Fill in the proper code for each fish instead of using down arrows to indicate a group of a certain gender.

MAT: Record the maturity of each fish as a scale for all otolithed fish (females 1-4, males 1-2). Write "U" in the maturity column if the fish's sex is not determined or the maturity stage of the fish cannot be determined with accuracy.

TIS NUM: Record the tissue sample vial number.

TAG TYPE: This will be either Y for all trawl survey vessels in 2018. Letter is printed on the tag.

TAG NUM: Tag number will be the number written directly on the tag that is being used. Write the letter and all digits each time.

REL CND: Record E, P, or D for Excellent, Poor, or Dead, respectively, for all fish in the tagging sample. Use the criteria and the key provided in this manual. (Note that only fish assessed as E or P and that are <82 cm forklength, will be tagged and released. Those assessed as D are processed like tagged fish, but not tagged and released).

MISC: Record the prior hook injury code for all halibut in both the otolith and tagging samples.

COM: leave blank except when there is a specific comment code applied: crystallized otolith (C), recovered tag (R), stomach sample (S). Only one comment code can be entered, in cases of multiple codes applying to a single fish, "R" takes precendence, followed by "C", then "S". Note all other comment codes for that fish in the Remarks field.

REMARKS: If a redeemed tag is being processed, record "R" in the Com field and write the tag number in the Remarks field. Do not record number of a recovered tag in the Tag Num field. Other comments can be recorded in this field, however note that this field is for informational purposes only and is not entered into the IPHC database.

Data entry on board the vessel

In 2018, IPHC sea samplers will be equipped with tablets and an attachable keyboard for data entry. This eliminates the need to share the NMFS computers on board. The IPHC tablets have been loaded with an Excel spreadsheet that mimics the Form T-1. Enter the data regularly so it doesn't stack up. At the end of each trip, e-mail the data to the IPHC office.

Regularly copy the updated Excel spreadsheet to a thumb drive for extra backup.

Logbook

The logbook is an important part of the recording process. It can be a valuable reference as to what occurred on the cruise, especially years down the road when the original biologists have moved on. So please take the time to be thorough.

At the very least, the logbook should include basic cruise information such as crew and scientist names, and type of gear and equipment used. It should be updated daily and consist of a summary of the day's activities including:

- haul number and type (e.g. standard, crab). Also note subsampled hauls.
- time set (equilibrium time)
- duration (minutes – you will probably need to convert from fractions of an hour)
- running daily total of halibut encountered (this may be different than other counts)
- running and daily total of halibut otolithed, measured and sexed for general sample
- running and daily total of halibut tagged
- running and daily total of tags recovered
- running and daily total of tissue samples

Haul information can be obtained from the Field Party Chief's computer printout after each haul or at the end of each day.

A summary is to be done daily which outlines totals for the day and for the trip thus far. Additionally, this is the place to record any problems encountered with sampling as well as any personal thoughts about the cruise, the progress being made, and communications with the office.

Form T-1 example

Rev (3/18)

Trawl Halibut Information Form (T-1)

Page _1__ of _1__
Date _____

Year	Vessel	Trip	Haul no.	Region
2018	VST	2	74	BS

Subsampled? Y [N]

Comment (Com) codes: C = crystallized otolith, R = tag recovery, S = Stomach sample
Tag Release Condition (RelCnd) codes: E = excellent, P = Poor, D = Dead

Frk len	Oto Num	Sex	Mat	Tis Num	Tag Num	Tag Type	Rel Cnd	Misc	Com	Remarks
22					8298	Y	E	1		
48					8299	Y	E	1		
62					8300	Y	P	2		
62					0601	Y	E	1		
27					0602	Y	P	1		
33		F	1				D	1		
41					0603	Y	E	1		
38					0604	Y	E	1		
105								2		
65					0605	Y	P	2		
42					0606	Y	E	1		
52		F	1					1	R	Tag Y0549, S
35	459	F	1	105				1		
107	460	M	2					2	S	
21	461	M	1	106				1	S	
41	462	M	2	107				1		
43	463	M	2	108				1		
110	-	F	2					2	C	
22	464	F	1					1		
35	465	F	1	109				1	S	
36	466	F	1	110				1		

Concluding each trip and the survey

After each trip

At the end of each trip, fill out a Trawl Trip End Form which summarizes your sampling for that trip. This is a good place to include any notes that may be useful to office staff pertaining to the samples or data. Entered data, as well as copies of the Trawl Trip End form should be e-mailed to IPHC

In summary - at the end of each trip:

- Complete the Trawl Trip End form
- E-mail completed data forms and Excel sheet trip data
- Send otoliths, fin clips, and tissue samples to IPHC via traceable method. *Note that sending of these items can be delayed until after the second trip if sample numbers are low.

Conclusion of the survey

All hard copy data and the tablet are to be hand-carried back to the IPHC office following the cruise or sent via a traceable method. This includes tablet, forms T-1, data thumb drive, logbook, any tags collected, and the Trawl Trip End forms. All biological samples are to be sent via traceable method upon conclusion of the cruise, not left in the gear tote for shipping with NOAA gear. All remaining gear can be left in the action packer. Make sure the inside of the action packer is left dry and tidy.

Arrangements need to be made to get the action packer back to the IPHC office and this is also the sampler's responsibility. Ordinarily, the FPC will agree to ship the gear box back with the other NMFS gear post season so check to make sure this is an agreeable solution.

If you are in the Bering Sea, the non-IPHC vessel has been tagging halibut as well. Please plan to meet with them at the conclusion of the cruise to collect their data and gear. Send the data forms back with your own. Note that those forms are the only record of those tagged fish. The gear can be shipped back with the other action packer.

Appendix. Tagging halibut on the non-IPHC vessel (Bering Sea)

This section describes the selection of halibut and the tagging procedure for the trawl vessel not staffed with an IPHC sampler. In 2018, this includes the Bering Sea survey only. The tagging data will be recorded on Form TT-1 supplied by IPHC. The form and tagging supplies are in the little action packer sent up with the rest of the gear.

Sorting and selecting for tagging

The goal is to randomly select approximately 50% of the halibut from each tow for the tagging sample. The other 50% will be processed normally, i.e. measured and released.

When the codend is brought aboard, sort the halibut as quickly as possible into baskets. Once you are satisfied that you have found all (or nearly all if the catch is large) halibut, use a random method to select 50% of the baskets for potential tagging. These methods may include:

- Dice: Choose two baskets at a time and number them 1 and 2. Roll the dice and if the number showing is odd, choose basket 1, and if it's even, choose basket 2. Repeat this procedure until all baskets have been divided.
- Wristwatch: Choose two baskets at a time as explained in option (a). Think of the watch as having four quandrants, e.g. divide the face into four parts 0-15, 16-30, 31-45, and 46-60. Look at your watch and if the second hand (or seconds) is in quadrant 1 or 3 (odd), then choose basket 1, if the second hand is in quandrant 2 or 4 (even), choose basket 2. Repeat until all baskets have been divided.
- Stopwatch: Choose two baskets at a time as explained in option (a). Then you can use the odd/ even method by stopping and starting the stopwatch and using the seconds.
- Any other method where each basket has an equal chance of being selected without bias.

If there is only one basket, lay two fish out at a time and use one of the methods above to choose one of those fish for the tagging sample. Repeat until the entire basket has been sorted. If there is an odd number, the last basket/fish is number 1.

Keeping the halibut happy while on deck

The use of some kind of live tank to hold the baskets of fish until they are ready to be tagged is very helpful in keeping halibut in good condition and reviving those that may be struggling. This can be as simple as a tote with some seawater in it. In many past cases, the totes on deck for crab sampling have been used and work well.

Measuring the forklength

All fish in the tagging sample will be measured and recorded on Form TT-1, but only those < 82 cm forklength will be tagged. For halibut $\geq$ 82 cm, measure and release as soon as possible. Halibut that are not in the tagging sample, do not need to be recorded on Form TT-1.

Assessing release condition

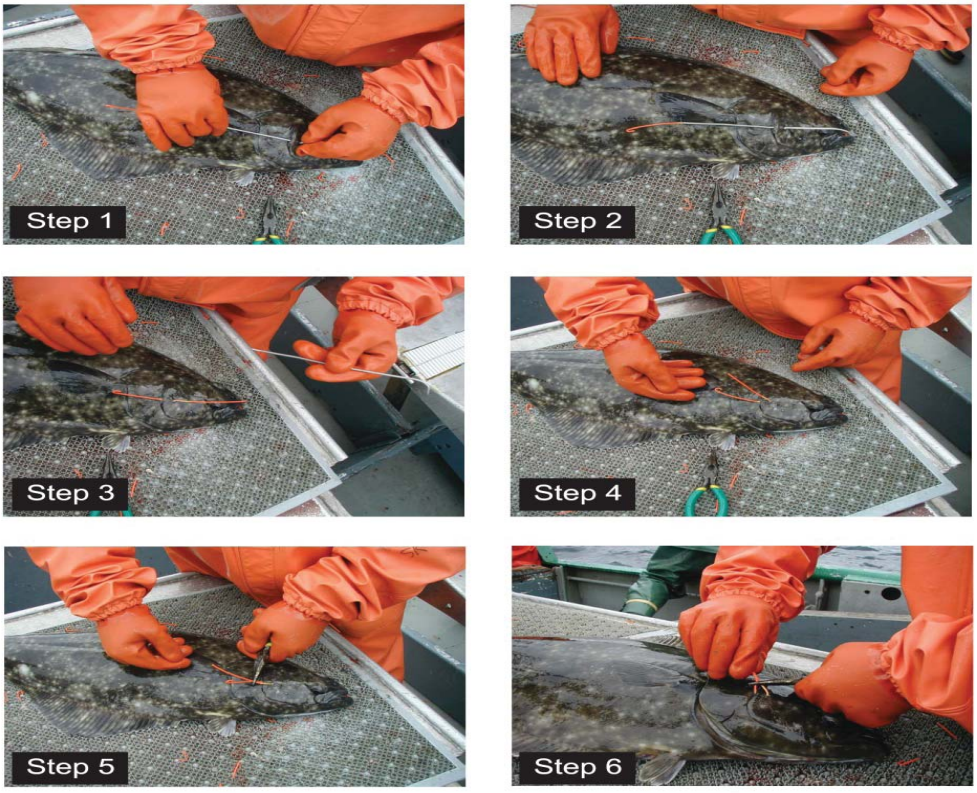
Assess the condition of each halibut to be tagged using the observer condition criteria: Excellent (E), Poor (P), and Dead (D) and record on Form TT-1 in the *Cond* column. Within the tagging sample, if the halibut is assessed in the *Excellent* or *Poor* categories, and is <82 cm forklength, that halibut will be tagged and released. If the halibut is assessed as *Dead*, record the condition, but do not tag.

Tagging a halibut

The tags will be in rubber banded, consecutively numbered bundles of 10. Prior to the haul, prepare the tags by laying them out sequentially. One method that works well for this is laying them out on the sticky side of duct tape. This keeps them from flopping around and they are easy to roll up and store for later if not all of the tags are used. It is important to use the tags in numerical order as much as possible.

Tags are applied by first inserting the tag into the shank of the applicator needle. The needle is then inserted between the pre-opercular and the opercular bone of the cheek of the fish at an angle which permits the needle to pass between the two bones. The curvature of the needle causes it to pass around the pre-opercular bone and come out through the edge of the cheek. The tag is then pulled through the opening created by the needle and the two ends of the tag are folded together and twisted **AT LEAST FIVE TIMES** so a closed loose loop (allowing for growth) is created around the pre-opercular bone. The tag will usually be longer than is necessary and the excess should be cut off, being careful that the identification and number are not removed.

Record discarded or missing tag numbers in the Remarks section of the Form TT-1, with a note of explanation as to why the tag is not used (e.g. tag lost). Tag numbers must have all digits written out in each case. Gently release tagged halibut as soon as possible.



Keep tagging until five halibut in a row are assessed in the DEAD category or all fish are processed, whichever occurs first. At this time, you can set aside your baskets and rejoin the rest of the crew if desired to help with the sorting and processing duties before returning to the halibut sample. When you return to the halibut sample, continue to record the rest of the selected halibut on Form TT-1. They will have a Cond of Dead, and a forklength, but no tag number.

Assessing condition (Cond)

Observer-used release viability criteria
There are laminated guides of the following information for use on deck.

Excellent: Fish is alive, showing no stress, and injuries, if any, are slight.
1. External injuries.
   - Superficial nicks or cuts on body.
   - Little (<10% of fin area) or no fraying of dorsal and anal fin.
   - Hemorrhaging (redness) of skin on white side limited to 5-10% of surface area.

2. Operculum pressure.
   - Fish is able to close operculum tightly for at least 5-10 seconds.
   - Muscle tone and physical activity.
   - Strong and lively, perhaps flopping around on deck if provoked.
   - Fish can tightly clench its jaw.

3. Bleeding.
   - No bleeding observed.

4. Gills and gill color.
   - Deep red in color.

Poor: Fish is alive, but showing signs of stress.
1. Injuries are apparent.
   - Body abrasions have damaged the skin but skin is still present, not missing.
   - Cuts and lacerations in body extend through skin just into flesh and are not deep.
   - Between 10 and 50% of dorsal and anal fins are frayed.
   - Slight bleeding from fin edges.
   - Approximately 10-25% of skin on white side of fish shows hemorrhaging.

2. Operculum pressure.
   - Fish closes operculum weakly and not sustained.
   - Weak, intermittent movement. May respond if stimulated or provoked.
   - Body is limp, but not in rigor mortis.

4. Bleeding.
   - Blood is continually flowing from gills, but not profusely.

5. Gills and gill color.
   - Deep to bright red in color.

Dead: No sign of life or, if alive, likely to die from severe injuries or suffocation.
1. Injuries are apparent.
   - Body cavity ripped open.
   - Internal organs exposed and damaged.
   - Cuts and lacerations in body extend deeply into the flesh.

- Sediment in mouth.
- Hemorrhaging in skin on 25% or more of white side.

2. Operculum pressure.
   - Fish does not close operculum.

3. Muscle tone and physical activity.
   - No sign of muscle tone (limp) or fish is in rigor (stiff).
   - Physical activity absent or limited to fin ripples or twitches.
   - Little, if any, response to stimuli.
   - Jaw is hanging open.

4. Bleeding.
   - Blood is flowing freely and continuously in large quantity from a torn or severed gill arch, or a body injury.

5. Gills and gill color.
   - Gills appear washed out, *e.g.*, dull red, pink, or white in color.

Dichotomous key to assess halibut release viability

1a. Fish is alive.....Go to 2a
1b. Fish is dead when sorted from the catch.....code **DEAD**
Fish is in rigor and lifeless, even if no apparent injuries. Gills appear washed out, i.e., dull red, pink, or white in color. Mouth may contain sediment.

2a. Body of fish appears uninjured, or has only minor injuries.....Go to 3a
2b. Injuries to fish are significant and obvious.....code **DEAD**
Body cavity is ripped open, exposing internal organs. Body tissue may be torn or ripped in a rough, ragged manner. Red hemorrhaging observed on 25% or more of the white side.

3a. Fish is able to close operculum when stimulated.....Go to 4a
Operculum is closed strongly or weakly, but pressure is evident. Operculum may not stay closed for long, though pressure may last up to 5 seconds or longer.
3b. Fish cannot close operculum, even when stimulated.....code **DEAD**

4a. Fish displays activity and has muscle tone .....go to 5a
Fish displays a minimal amount of activity, especially when stimulated. May be able to clench jaw tightly.
4b. Fish exhibits no muscle tone.....code **DEAD**

5a. Fish is not bleeding, or only slightly bleeding, if at all.....go to 6a
5b. Blood is flowing freely and continuously in large quantity (profusely).....code **DEAD**
Bleeding is coming from a torn or severed gill arch, or a body injury.

6a. Body injuries are minimal, perhaps difficult to find.....go to 7a
May consist of superficial nicks or cuts on body. Less than 10% of dorsal and anal fin area is frayed.
6b. Body injuries are readily apparent..... code **POOR**
Skin is damaged with abrasions. Cuts and lacerations in body extend through the skin and just barely into the flesh (not deeply). Dorsal and anal fin area is frayed between 10-50% Fin edges may be bleeding. Roughly 10-25% of the white side of fish shows red hemorrhaging.

7a. Operculum pressure is strong and sustained.....go to 8a
7b. Operculum pressure is weak and not sustained ..... code **POOR**

8a. Fish is strong and lively, displaying good muscle tone.....go to 9a
Fish is flopping around the deck, hard to control. Jaw may be tightly clenched, difficult to open.
8b. Fish appears weak..... code **POOR**
Movement is intermittent, perhaps occurring when provoked or stimulated. Body is limp.

9a. Fish is bleeding from gills..... code **POOR**
Blood is flowing continuously, slow and steadily, but not profusely. Gills are deep to bright red in color.
9b. No bleeding observed ..... code **EXCELLENT**
Gills are deep red in color.

Tag recaptures

In the odd event that a fish that was tagged on either vessel in the Bering Sea trawl survey in 2018 is recovered at a nearby station, on the Form TT-1, record the tag number and the viability (Cond), record "R" in the Com field, write “recapture” in the remarks column, and release the fish immediately even if the fish is assessed as Dead. Do not include this fish in the 50/50 sample. Note that this is the fourth tagging year so make sure you are not releasing a fish that was tagged in 2015-2017. The same type of tags were used in those years, but the numbers are unique. The tag number can therefore be used to determine whether the tag is from a previous year or a different survey.

Filling out Form TT-1

On the following page is an example of Form TT-1. The paper used for the forms is Terraslate which is a vinyl-like paper that is waterproof and resists tearing, so there should not be a problem with durability. Either pen and pencil can be used.

You can use each form for multiple hauls as long as they are all within the same trip. For each form, please fill out the header information, even if it is the same as the last form, along with page number.

The fields are as follows:

Header - Year: 2018

Header - Vessel code

Header - Trip: Survey leg (1-3)

Header - Region: BS

Haul Number: The vessel haul number

Fork length: in centimeters

Tag type: Y - all tags are type Y this year

Tag number: the number printed on the tag

Cond: Release condition which will be one of three - E, P, D

Com: Comments field used only if a tag has been recovered from a previous year

Remarks: freeform field for notes/explanations

Sending data and supplies to IPHC

After each trip (preferrably) the data needs to be sent to IPHC via a traceable method. Since there is scheduled to be overlap between the two vessels, the best way to accomplish this is probably to meet with the IPHC sampler and turn the datasheets over. If overlap doesn't happen, please contact the Dutch Harbor port sampler to arrange to have them send the data.

For all other supplies, please put them in the little action packer provided and give to the IPHC sampler so he/she can include the supplies with their own. If that isn't possible, label the action packer clearly (IPHC) and arrange to have it shipped back to Seattle with the other survey gear. IPHC will be contacted when it arrives.

Trawl tagging information form (Form TT-1)
(non-IPHC staffed vessel)

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Year	Vessel	Trip	Region
2018	162	2	BS

Comment (Com) codes: R = tag recovery
Fish condition (Cond) codes: E = excellent, P = Poor, D = Dead (dead fish are measured but not tagged)

Haul Number	Fork length	Tag type	Tag Number	Cond	Com	Remarks
14	26	Y	7450	P		
14	83			-		
15	65	Y	7451	E		
15	64	Y	7452	E		
15	68	Y	7453	E		
15	65	Y	7454	E		
15	22			D		
15	45	Y	7456	E		Tag 7455 - lost tag
15	51	Y	7457	E		
16	17			D		
17	105			-		
17	33	Y	7458	E		
17	62	Y	7459	P		
17	61		7305	P	R	Recapture