



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Office of Marine and Aviation Operations
Marine Operations Center - Pacific
2002 SE Marine Science Drive
Newport, OR 97365

August 04, 2016

MEMORANDUM FOR: ^{FOR} Commander Brian W. Parker, NOAA
Commanding Officer, Marine Operations Center - Pacific

FROM: ; LCDR/NOAA
Lieutenant Commander Joshua J. Slater, NOAA
Chief of Operations, Marine Operations Center - Pacific

SUBJECT: Amendment 1 to final project instructions, *Bell M. Shimada*
SH-16-10: 2016 California Current Ecosystem (CCE16)

Please amend project instructions SH-16-10, dated June 28, 2016, as follows:

1) Section II. C. 7 - Operations/Biological Data Collection:

Add: Insert the following paragraph as Section II.C.7:

During Leg 3 of this project, pairs of digital x-ray images (dorsal and lateral aspects) might be obtained by NWFSC personnel for samples of hake, rockfish, myctophids, and other species of opportunity, spanning their observed size ranges, up to a maximum field of view of 14"x17". These images will be paired with camera images of the individual fish on a length measurement board (dorsal and lateral aspects) and measurements of standard length, weight, and sex. The x-ray generator will be secured in the controlled environment room, and **no one** will be in the room while the machine is in use. The x-ray operator and all other personnel will be outside of the x-ray room, and with no direct line-of-sight to the machine, when the x-ray generator is making an exposure. Also, the door to the room shall be closed as much as possible, being only slightly ajar enough to allow the cord for the remote operating device to pass through. Additionally, the operator will verbally announce to all personnel outside of the x-ray room that an x-ray exposure is about to occur. When the x-ray machine is not in use, the x-ray generator will be unplugged. X-ray procedures are to be followed as outlined in **Appendix 1**.

Reason: Safety concerns were raised by OMAO and SECO regarding established protocols for x-ray machine installation and use that couldn't be addressed prior to ship's departure. After consultation with an outside consultant and a few dose-rate estimate simulations, it has been determined that x-ray machine use on this ship, and for this project, would cause negligible x-ray exposure hazards to ship and/or scientific personnel as long as: 1) no one is in the x-ray room while the x-ray machine is actively x-



raying; 2) the door is at the most only slightly ajar and the operator is outside the room and behind the door while the x-ray machine is in use; and 3) no one has direct line-of-sight to the machine while the x-ray machine is in use. Given these three conditions, the steel bulkhead of the room should provide adequate shielding from the machines use, as described for this project.

2) Section : Appendices

Add: Insert the following language at the end of the Project Instructions, as Appendix 1.

Appendix 1 - NWFSC X-ray protocol and procedures

NWFSC X-Ray Basics

Settings Summary:

While on project SH-16-10, the United Radiology Systems Model PXP-40HF X-Ray will be operated with the parameters listed below. As this X-ray was purchased and received just prior to the beginning of this project, and full range of animals have not yet been imaged using this equipment, the supplier recommendations were used to predict settings. Field testing of the equipment with different types of animals will likely lead to modifications to these settings, as we learn how to operate. For this project, the x-ray machine will NOT be operated in excess of the following settings:

- 1) Operating voltage: not to exceed 70 kVp
- 2) Current: 7mAs
- 3) Exposure time: 0.12 sec
- 4) Distance, source to image (SID): 40 inches (102 cm)
- 5) Number of samples per week: ≤ 120 per day
- 6) Inside the Constant Environment Room, secured for sea.

Preparation and Operation of Radiograph (fish X-Ray imaging)

RADIOGRAPHING FISH (X-Ray machine imaging)

Current Kirchhoff-ray mode model input is a digital file of length (x), height (y), and width (z) coordinates (Figure 2) that are obtained from lateral and digital radiographs of fish bodies and swimbladders. The goal is to image the body and swimbladder in their 'natural' shape and orientation. Capturing high contrasts around the perimeter of soft tissue structures is somewhat different than clearly imaging skeletal structures in diagnostic radiographs of injured bones (Figure 2).

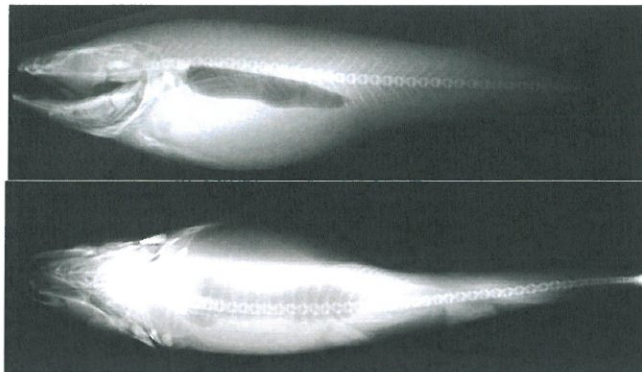


Figure 2. Lateral (upper) and dorsal (lower) radiographs of walleye pollock (*Theragra chalcogramma*). The swimbladder is the dark organ located below the vertebral column.

X-Ray machine Installation:

1. X-Ray generator (PXP-40HF) will be mounted on a stand with a 2'x2' plywood board on the bottom. The distance between the source and the base will be about 40", but can be adjusted as needed. The unit will be placed in the constant temperature room on the Vessel (most likely on the outboard side of the room). The four wheels on the bottom of the stand will be locked and the stand will also be tied down to ensure its stability during the cruise (Figure 3A).
2. The X-Ray generator will be securely fastened to the horizontal bar of the stand with a screw of 4-Point Knob (Figure 3B).
3. A lead sheet will be placed below the stand to protect any personnel directly below the X-Ray generator in the X-Ray beam axis direction.
4. The digital flat panel receiver (17"x14") will be placed on top of the plywood with a plastic sheet covering the top face of the flat panel (Figure 3C).
5. While in use, the door of the constant temperature room will be ajar (slightly open), allowing the operator to exit the space and trigger remotely, so that there is no line of sight between the generator and the operator, or anyone else.

Samples Preparation (pre- X-Ray Operation):

Things to do before starting:

1. Take samples from the trawl catch (dead or moribund).
2. Prepare support wedges for dorsal exposures. The easiest method is to use chunks of rolled, wet paper toweling. Paper towel is fairly opaque and does not obscure the perimeter of the fish body. The length and diameter of the chunks depend on fish size. Fish are propped up using paper towel chunks on opposite sides of the body.
3. Choose a numbering system and prepare identification numbers using radiograph tape, letters, or even pieces of paperclip.
4. Decide how many fish to expose on a single plate. The number of fish depends on the size of the receiver relative to the size of the fish. It is best to get both dorsal and lateral exposures on the same plate. If doing both exposures of a single fish on the same plate, use lead blockers to cover unexposed area. Remember to block all exposed areas in subsequent exposures.

5. Notify all personnel that X-ray operations are beginning and that caution should be used in transiting through the area. Specifically, note that operating the X-ray generator is a potential laser/high voltage hazard. Anyone fitted with a pacemaker must remain away from the x-ray generator when in use.
6. Operator should don dosimeter before powering on unit and wear for duration of image collection session.

X-Ray Operation:

1. Turn on the X-ray machine system:
 - a. Put battery pack into the panel and place the flat panel on top of the plywood board.
 - b. Put the battery pack into WiFi Access Box and place in the constant temperature room.
 - c. Turn on the laptop computer and the data acquisition program will start automatically.
 - d. Turn on X-Ray generator:
 - i. Connect power plug and turn on line switch. Default settings should be displayed = 5 mAs (4-7 mA), kVp = 50 (40-60).
 - ii. Pre-heating procedures: before collecting images and after long period of non-use, to ensure safety and longevity of the x-ray tube it is recommended that the user:
 1. Operate machine with low kV values (50kV 5mAs) three times in a row. Then, follow this up with higher value (70 kV 5mAs) exposures, also three times in a row.
 2. These “pre-heating” exposures must also follow safety precautions outlined below (#3 of this section).
 - iii. Adjust settings for imaging fish:
 1. Expected ranges for emit peak voltage (kVp) would be between 40-60 kVp, and the current (mA) would be 4-7 mAs.
 - a. Approximate settings match those of small animal or human extremities (i.e. paw or hand).
 - b. However, the optimum settings vary from animal to animal and will be decided during the data (image) acquisition.
2. Transfer fish to the flat plate (digital flat panel receiver, 17”x14”). Arrange for dorsal exposure first: make sure fish is straight and upright.
3. Radiograph fish:
 - a. Prepare unit for exposure by pressing hand switch to the 1st step (PREP step). The “READY” LED light should be lit at this time.
 - b. Operator should then:
 - i. Don thyroid shield and lead apron, ensuring dosimeter is outside lead apron.
 - ii. Step outside the constant temperature room, close the door as much as is practicable, allowing space only for the cable run.

- iii. Stand a minimum of 6 feet (~2 m) from the X-ray source, outside the constant temperature room, and out of line of sight of the X-ray source
 - iv. Ensure all personnel are clear of the immediate vicinity (at least 6 ft away), and that no one has direct line-of-sight to x-ray generator.
 - v. Audibly announce that an X-ray image will be taken
 - c. Press the hand switch to the 2nd step (Exposure step) to produce an exposure. During this time the “X-RAY” LED light will be lit.
 - d. The “Wait” LED light will be lit until the unit is ready for the next exposure.
 - e. Multiple exposures may be produced in rapid succession, but the “WAIT” light must be off before attempting. At higher mAs settings (greater than 50 mAs), try to avoid producing more than three exposures consecutively and wait for 3 minutes between multiple exposure sessions to prevent overheating of the machine.
4. Data collection and quality control:
- a. Enter the necessary information into the data acquisition program and make sure the ID number is unique.
 - b. Mark radiograph images with identification number and date.
 - c. Record all animal information. Record all settings (kVp, mA, exposure time, and distance from object to X-Ray head). Visually inspect edge contrast on digital images and adjust settings as needed to provide high quality images, especially for swimbladders.
 - d. Check digital images and make sure they have good quality.
5. Repeat steps to take lateral exposure. Fish should be lying horizontal and straight.
6. Make sure that EACH fish is clearly numbered on the filename and that the fish order is the SAME on lateral and dorsal radiographs. Make sure the dorsal and lateral images have unique filenames.

Post X-Ray Operation:

1. After all radiograph operations are complete, shut down the X-Ray machine system:
 - a. Turn off the X-Ray generator and unplug the generator power.
 - b. Take the batteries off the flat panel and the WiFi Access Box, and put the battery dummy-packs back to flat panel and the WiFi Access Box.
 - c. Shutdown the laptop.
2. Communicate with crew that X-ray operations are secure.
3. Check X-Ray radiation dose readings sampled with X-Ray badges regularly (practically after each leg) to make sure the operators and nearby scientists and ship crew are safe from X-Ray radiation.

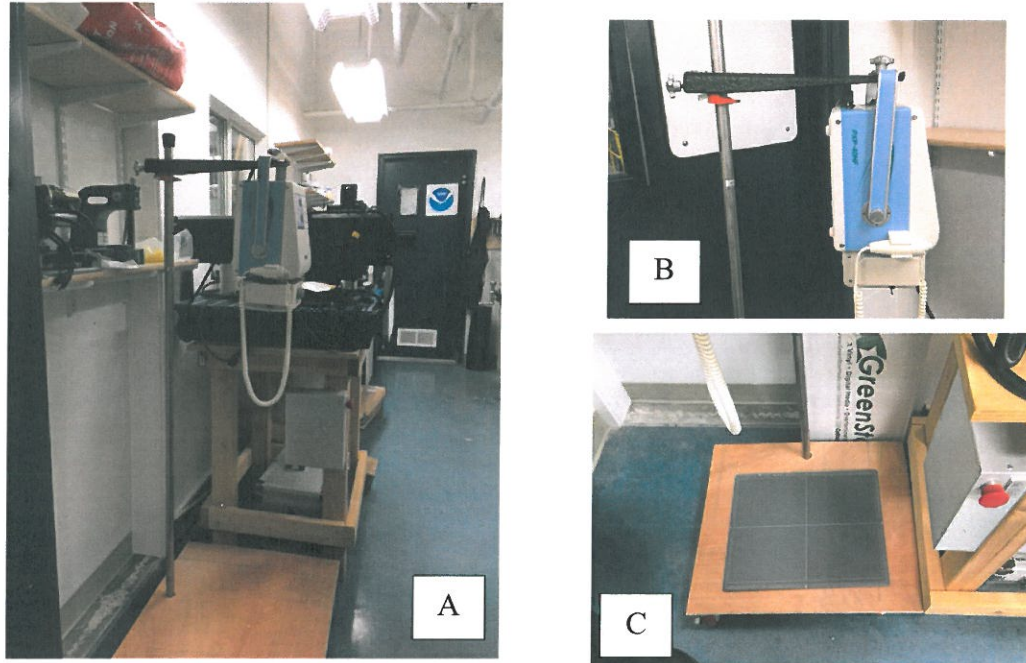


Figure 3. Photo of the X-Ray generator (PXP-40HF) on an adjustable stand (A). The foot print of the base (plywood) is 2' x 2'. The distance between the source and the base will be about 40". The X-ray generator with the stand will be placed in the constant temperature room on the Vessel (most likely on the outboard side of the room). The four wheels on the bottom of the stand will be locked and the stand will also be tied down to ensure its stability during the cruise. The X-Ray generator will be securely fastened to the horizontal bar of the stand with a screw of 4-Point Knob (B). The 17" x 14" digital receiver (flat panel) will be placed on top of the plywood board (C).

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Joe C Bishop
APPROVED

DISAPPROVED

LET'S DISCUSS

*Acting Commanding Officer
Marine Operations Center - Pacific
8/5/2016*