A. <u>Project Summary</u>

Applicant Organization: International Pacific Halibut Commission (IPHC).
Project Title: Improving discard mortality rate estimates in the Pacific halibut by integrating handling practices, physiological condition and post-release survival

S-K Research Priority: The proposed research addresses Priority #3 – "Techniques for Reducing Bycatch and other Adverse Impacts" by investigating discard mortality in the Pacific halibut fishery through studies designed to understand the influence of handling practices and physiological condition of the fish on post-release survival.

Project Location: Gulf of Alaska. IPHC Regulatory Area 3B.

Requested Project Period: September 1, 2017 – August 31, 2019

Funding Requested: $286,121

Name and Title of Principal Investigators: [1] Dr. Josep V. Planas, Biological and Ecosystem Science Program Head, IPHC (Lead PI); [2] Dr. Nathan Wolf, Assistant Professor, Alaska Pacific University; [3] Claude Dykstra, Research Biologist, IPHC; [4] Dr. Tim Loher, Research Scientist, IPHC; [5] Dr. Bradley Harris, Assistant Professor, Alaska Pacific University.

Collaborating partners: [1] Dr. Ian Stewart, Quantitative Scientist, IPHC; [2] Dr. Allan Hicks, Quantitative Scientist, IPHC.

Species/Resources Addressed: This project addresses the directed Pacific halibut (*Hippoglossus stenolepis*) fishery in the Gulf of Alaska. The results of this project will assist in revising estimates of discard mortalities and will consequently influence the catch levels of the directed fishery.

Description of Proposed Activities

The main objectives of this project are to address the important issue of discard mortality rates (DMRs) of Pacific halibut in the directed and non-directed longline fisheries and to refine current estimates of post-release survival in incidentally caught Pacific halibut. In order to accomplish these objectives, the relationship between fish handling practices and fish physical and physiological condition and survival post-capture as assessed by tagging will be investigated.

The IPHC accounts for all mortalities or removals of Pacific halibut in its assessment of the stock, including bycatch as well as the incidental mortality from the commercial halibut fisheries (also known as wastage). Estimates of incidental mortality influence the output of the stock assessment and, consequently, the catch levels of the directed fishery. Prohibited Species Catch limits set by the North Pacific Fishery Management Council (NPFMC) requires that all Pacific halibut caught in non-directed fisheries must be discarded at sea, and these fisheries may be closed when Pacific halibut catch limits are reached.

The NPFMC has identified DMRs in the Pacific halibut fishery as a research priority. The proposed project will directly address this recommendation by providing new scientific information to improve current estimates of DMRs.

The specific objectives of this project include (1) evaluation of the effects of fish handling practices on injury levels and their association with the physiological condition of captured Pacific halibut, (2) investigations on the effects of fish handling methods and associated injury level and physiological condition on post-release survival, (3) application of electronic monitoring in associating fish handling methods to survival in vessels without observer coverage and (4) development of non-invasive methods for quantifying measurable physiological factors indicative of stress and physiological disturbance.

Anticipated Benefits/Outcomes

This project will help refine current estimates of DMRs in the directed Pacific halibut fishery by investigating the relationship between hook release methods, injury levels, physiological condition and survival post-release. This project will develop and implement quantitative measurable factors that are linked to fish handling practices and to fish physiological condition and ultimately to survival in order to improve current DMR estimates. In addition, given the reliance of DMR estimates on observer coverage rates in the non-halibut fisheries, this project will pioneer the use and application of electronic monitoring to associate fish handling methods with survival. The proposed research may help control and reduce incidental mortality and, consequently, will decrease possibilities for non-halibut fishery closures due to exceeded discard limits.

B. <u>Project Description</u>

Background

1. Project Goals and Objectives

The proposed research falls within the scope of **Priority #3 – Techniques for Reducing Bycatch and other Adverse Impacts**. Specifically, the proposed research addresses discard mortality in the Pacific halibut fishery through studies designed to understand the influence of handling practices and physiological condition of the fish on post-release survival.

The IPHC has been responsible for the management of the Pacific halibut (*Hippoglossus stenolepis*) stocks within the Convention waters of the United States and Canada for nearly one hundred years. Information on all halibut removals is integrated by IPHC, providing annual estimates of total mortality from all sources for its stock assessment and related analyses. Bycatch and wastage of Pacific halibut, as defined by the incidental catch of fish in non-target fisheries and by the mortality that occurs in the directed fishery (i.e. fish discarded for sublegal size or for regulatory reasons), respectively, represent important sources of mortality that can result in significant reductions in exploitable yield in the directed fishery. Due to regulatory requirements, all Pacific halibut that are caught as bycatch or that are of sublegal size in the targeted fishery cannot be retained and must be returned to the sea without sustaining additional injury (Trumble et al., 1993). The entire discarding process involves: first, the capture of the fish (by hooking in case of the longline fishery); second, the handling of the fish by members of the fishing boat and; finally, the release of the fish back into the ocean. Along the discarding process, Pacific halibut will receive injuries and will be subjected to a variety of influencing factors that will affect their survival potential after release. Individual variability in terms of survival (or its opposite, mortality) after release to the sea will be expected depending on the level of injuries and stresses incurred during the discarding process as well as on the biological characteristics of the fish (e.g., physiological condition or status). Therefore, an accurate understanding of the types and relative levels of injuries and stresses that fish are exposed to during the discarding process in relation to the biological characteristics of the fish can be instrumental in helping better estimate the probability of survival (or mortality) during the entire discarding process (Davis, 2002).

Discard mortality rates (DMRs) are calculated from data that are collected by observers regarding the release viability or injury characteristics of Pacific halibut post-capture and are used to estimate the percentage of incidentally-caught fish that die after release. Currently, post-capture DMR estimates are based on qualitative assessments of the physical condition of the fish (e.g., minor/moderate/severe/dead for longline gear) and have a certain degree of uncertainty associated with them, which represents a source of uncertainty in the estimation of total mortality within current stock assessment models. In practice, assigned DMRs and their uncertainty translate into *a priori* adjustments to expected mortality in each upcoming year, and to the catch limits that are thereafter assigned to each harvest sector. Given current low halibut yields relative to long-term mean productivity, this potential to translate uncertainty into catch limit reductions can place undue hardship on some sector(s) relative to others. Therefore, there is an urgent need to improve our estimates of DMR as well as to provide strategies to improve survival of incidentally-caught Pacific halibut after release.

Following upon initial studies of post-release mortality of longline-caught Pacific halibut in relation to injury type (Peltonen, 1969), in the early 1990s the IPHC conducted studies designed to relate injuries associated with capture events with survival post-release in the Pacific halibut longline fishery. Kaimmer (1994) reported that the survival rates of fish caught and subjected to manual hook removal (i.e. careful shake) were higher than fish subjected to automatic hook removal (i.e. hook stripper), with the latter method producing more severe injuries and resulting in decreased growth rates in the surviving fish. In a subsequent study, Kaimmer and Trumble (1998) reported on the survival rate of fish released from the hook by various techniques and classified under different condition codes according to the extent of the hook removal injuries and other descriptors of condition (i.e. bleeding and gill color, evidence of predation and muscle tone). The results of that study revealed that condition codes closely followed the hook removal injuries observed in the fish and, importantly, that survival rates were higher in fish in excellent condition when compared to fish in the poor and dead conditions, setting the ground for the use of condition codes as predictors of survival (Kaimmer and Trumble, 1998). As a result of this research, current estimates of survival of discarded fish are based exclusively on visual assessment of the external condition of individual fish, as measured by injury levels, activity, responsiveness, etc.

It has been well recognized that fish condition assessments that incorporate additional levels of information on the physiological characteristics of captured fish have improved power of predictability of survival in discarded fish (Davis, 2010; ICES, 2014). It is important to indicate, on one hand, that the physiological condition of the captured fish may influence their susceptibility to the stress associated with capture and handling events and, hence, their potential for survival after release. On the other hand, different capture and handling procedures can elicit different physiological responses in the fish to cope with the ensuing stress, which may also influence their survival after release. These two aspects are important because they drive most of the variability that is observed in estimates of discard survival (ICES, 2014). Therefore, it is important to measure physiological indicators of stress and condition in a quantitative manner in relation to capture and handling events in order to understand their influence on survival after release. Full condition assessments incorporating physiological parameters can then be used as a predictive tool to estimate discard survival rates (or alternatively DMRs) if properly calibrated with the results of direct survival or behavioral studies (e.g., tagging and telemetry studies).

Typically, **fish condition** has been expressed as the relationship between fish weight (W) and length (L) under the assumption than heavier fish are in better condition (i.e. fitter) than lighter fish (Bolger and Connolly, 1989). The two most commonly used condition factor indexes are Fulton's condition index ($K = W/L^3$) and the relative condition index ($K_n = W/\widehat{W}$; that expresses measured W in relation to calculated $\widehat{W}$ from a population-derived W-L relationship), with both indexes based on weight and length characteristics. Condition factor indices offer the benefit of being calculated with measures that can be taken from live fish and, therefore, are compatible with subsequent survival studies. A recent study performed at IPHC showed that K_n is better correlated than K with the hepatosomatic index (HSI; used as an indirect estimate of energy levels in the liver but that requires sacrificing the fish for its measure) (IPHC report, in preparation). However, despite their use to infer the condition of fish, condition factors or HSI do not provide a direct nor accurate measure of the energy levels present in the fish, which are a determinant of fitness. The recent development and demonstrated use of a non-invasive device

("Fatmeter") to measure the fat or energy levels of the fish that is based on microwave technology and that can be used on live fish (Crossin and Hinch, 2005) has provided the means to incorporate energy level measurements in field studies involving capture, handling and release of fish. At IPHC, Fatmeter-derived energy levels in the flesh of live adult Pacific halibut have been positively correlated with K_n and HSI determinations (IPHC report, in preparation), validating its use in physiological condition determinations in this species. Therefore, physiological condition of captured and handled fish, incorporating stress and disturbance parameters in the blood, can be measured in a quantitative manner and used to associate capture and handling events with post-release survival.

It is fair to state that the qualitative tests used to assess the viability of bycatch and sublegal size Pacific halibut are limited in their ability to accurately assess physical and physiological disturbances in a manner that can predict post–release survival with a reasonable degree of precision; thereby adding significantly to the uncertainty of total mortality estimates within stock assessment models. Evaluation of physiological stress indicators, such as circulating levels of stress hormones (e.g., cortisol and catecholamines such as epinephrine and norepinephrine) or compounds associated with the secondary stress response (e.g., glucose, sodium, potassium, lactic acid), offers a potential method by which physical, physiological, and perceived disturbances associated with catch events can be assessed and quantified in individual fish in a manner that recognizes the systemic nature of disturbance (Barton 2002). In addition to providing this integrated quantitative metric, improvement of the current vitality assessment methods with measurements of stress indicators may provide more precise estimates of post-release survival than the current vitality assessment methods alone. Research into the relationships between the stress response, metabolism, osmoregulation, body condition, the immune response, growth, and reproductive success in a variety of marine and freshwater fish species (Barton 2002, Jentoft et al. 2005, Haukenes and Buck 2006, Hosoya et al. 2006, Hur et al. 2007, Fast et al. 2008) has allowed for increased understanding of the physiological mechanisms linking stress to decreased physiological and physical performance and, consequently, the utility of physiological indicators of the stress response in predicting survival.

Plasma cortisol is the most commonly used stress indicator in fish (Bertollo et al. 2010 and references therein). Presumably, this is due to the relative ease with which plasma samples can be obtained and the rapid time course of increase in plasma concentrations of cortisol following the induction of a stressor (Haukenes and Buck 2006). However, the blood sampling procedure itself can be a source of stress for subjects, thereby resulting in potential increases of plasma cortisol levels possibly as a result of sampling artifacts (Bertotto et al. 2010). Consequently, the use of stress indicators, such as cortisol, to evaluate probability of survival in bycatch and sublegal size halibut may benefit from the development of a non-invasive sampling matrix that a) can provide an accurate indication of the magnitude of the stress response, b) does not inherently influence the stress response, and c) can be applied quickly and easily in a field setting. In particular, skin mucus has great potential as a sampling matrix for stress indicators to evaluate survival probability in Pacific halibut. Mucus sampling can be conducted quickly and easily in field settings, and, unlike plasma samples, mucus samples can be collected in a relatively non-invasive fashion; thereby decreasing the likelihood of the sampling procedure influencing the stress response. In a recent study, Bertotto et al. (2010) examined cortisol levels in plasma and mucus from three different fish species (European sea bass (*Dicentrarchus labrax*), common carp (*Cyprinus carpio*), and rainbow trout (*Oncorhynchus mykiss*)) following the introduction of a physical stressor. The authors observed significant increases in cortisol levels in plasma and mucus, found a significant correlation in the cortisol levels in plasma and mucus, and concluded that mucus cortisol is a viable candidate for measuring stress in fish. To our knowledge, no previous studies have evaluated the potential use of skin mucus for stress indicator measurements in Pacific halibut in field or controlled experimental settings.

In Pacific halibut, limited information is available regarding the measurement of physiological stress indicators in relation to stressful events. In one of the first reported studies, increased handling time in Pacific halibut was characterized by elevated plasma levels of potassium, sodium and glucose (Oddsson et al., 1994). In a later study, exposure to air and high temperatures in 1- and 2-yr-old Pacific halibut was reported to result in a rapid (within the first 30 min of exposure) elevation of cortisol, glucose, lactate, sodium and potassium levels in plasma (Davis and Schreck, 2005). However, these authors failed to observe a correspondence between the primary and secondary indicators measured and mortality rates in captive experiments (Davis and Schreck, 2005). Importantly, no studies have investigated to date the effects of capture and handling techniques on physiological stress indicators and physiological condition and their relationship with post-release survival in the field.

The rationale of the proposed research is based on the notion that by understanding the relationship between handling practices, injury levels and physiological condition, on one hand, and between these and post-release survival, on the other hand, estimates of DMR could be improved. An important underlying topic in this proposal is to better understand how a detailed assessment of physiological condition prior to release can improve our estimates of survival after release. This research will attempt to develop and introduce quantitative measurable factors that are linked to fish handling practices, physiological condition and ultimately survival in order to improve current DMR estimates.

For the above-stated reasons, the **main goal** of the proposed research is to *understand the relationship between fish handling practices and fish physical and physiological condition and survival post-capture as assessed by tagging in order to better estimate post-release survival in incidentally-caught Pacific halibut in directed and bycatch longline fisheries*.

<u>Specific Objectives</u>

1. Evaluation of the effects of hook release techniques (careful shaking, hook straightening, gangion cutting and automatic hook stripping) on injury levels and association with the physiological condition of captured Pacific halibut.
2. Investigations on the effects of hook release techniques and associated injury levels and physiological condition on post-release survival.
3. Application of electronic monitoring in associating hook release techniques to survival in vessels without observer coverage.
4. Development of non-invasive methods for measuring the levels of physiological factors indicative of stress and physiological disturbance.

<u>Deliverables</u>

1. Injury profile for different hook release techniques.

2. Physiological assessment of hook release techniques: fish condition index at post-capture.
3. Assessment of post-release survival in relation to hook release techniques, associated injury levels and physiological condition of halibut released in excellent condition.
4. Assessment of post-release survival in relation to size.
5. Electronic monitoring of hook release techniques and associated injury levels and projected survival.
6. Information on stress and physiological disturbance indicators in the mucus, a non-invasive sample that is easy to collect.
7. Establish the basis of a rapid assay for measurement of stress and physiological disturbance indicators in the mucus for its use in the field.

2. Project Impacts

The proposed research, by investigating the relationship between hook release methods, injury levels, physiological condition and survival post-release, will help **refine current estimates of DMRs** in the directed Pacific halibut fishery. Given that the incidental mortality from the commercial halibut fisheries (also known as wastage) and bycatch fisheries is included as part of the total removals that are accounted for in the IPHC's stock assessment, changes in the estimates of incidental mortality will influence the output of the stock assessment and, consequently, the catch levels of the directed fishery. Therefore, the proposed research can have a direct impact in improving the socio-economic aspect of the directed Pacific halibut fisheries by directly benefiting fishers. Importantly, the results of this project will inform on the handling techniques that, in relation to the physiological condition and size of the fish, will be associated with the **highest survival rates**. Therefore, **best practices** for the reduction or control of discard mortality rates will be able to be developed and implemented. The proposed research may help control and reduce incidental mortality and, consequently, will reduce possibilities for fishery closures due to exceeded discard limits.

3. Evaluation of the Project

The progress and success of the project will be evaluated continuously against the deliverables that were described above (Section 1: Project Goals and Objectives) at the bi-annual project meetings (see Section 7). Importantly, the project will be externally monitored and evaluated by scientific and stakeholder groups that currently evaluate research and management activities of IPHC: the Scientific Review Board, the Research Advisory Board and the Management and Strategy Advisory Board. Meetings with IPHC advisory bodies will take place annually. In addition, evaluation of the progress and success of the project will also be conducted by annual meetings (to coincide with project meetings) with other stakeholder groups that represent fishers and fishing communities that directly or indirectly depend on the Pacific halibut fishery (e.g., Alaska Longline Fishermen's Association, North Pacific Fisheries Association, Pacific States Marine Fisheries Commission; see Letters of Support). Evaluation of the scientific merit and success of the proposed research will also take place through the publication of the results in reputed peer-review journals and in the presentation of the results in scientific and fisheries-related conferences as well as the Electronic Monitoring Workshop.

Evaluation steps: a) Project confirmation of deliverables; b) Presentation of progress and results to IPHC advisory bodies; c) Presentation of progress and results to stakeholder groups; d)

Submission of research articles to peer-reviewed publications; e) Presentation of results in scientific and fisheries-related conferences.

4. Need for Government Financial Assistance

Although the project provides substantial non-federal contributions (matching funds), financial assistance is specifically requested for research activities and personnel needs that cannot be funded otherwise by the participating institutions in this project. Specifically, federal funding requested is for survival assessment by tagging, electronic monitoring, hiring of necessary additional personnel to conduct field and land-based research, and also for conducting the fish holding studies and physiological determinations. No additional funding has been requested from other sources. The successful completion of this project is dependent on the provision of funding from federal and non-federal (matching) sources as this project falls directly within one of the priorities of the current Saltonstall-Kennedy Research Program as well as within the research priorities of the NPFMC.

5. Federal, State, and Local Government Activities and Permits.

IPHC conducts extensive field studies in Alaska annually, abiding by all state, federal, and Coast Guard requirements. Additionally, all operations will carry a Letter of Acknowledgement from NMFS's Alaska Fisheries Science Center specific to the work, and incidental bird take permits from the USFWS. All standard post cruise reporting requirements (research fish landing tickets etc.) will be observed.

6. Statement of Work.

a) Project Design:

As stated above, the main overarching goal of this research proposal is to understand the relationship between hook release techniques and fish physical and physiological condition with survival post-capture as assessed by tagging (Objectives 1 and 2; Tasks 1 and 2) in order to better estimate post-release survival of discarded fish in the directed Pacific halibut longline fishery (wastage) and other longline fisheries that incidentally catch Pacific halibut. The earliest studies linking longline injury post-release survival employed "J" hooks (Peltonen, 1969) and studies linking release methods with post-release survival of Pacific halibut were conducted using small (13/0) circle hooks (Kaimmer and Trumble, 1998), both of which are unlike the large (16/0) circle hooks that comprise roughly 75% of the fishing effort applied in the directed Pacific halibut longline fisheries. Furthermore, physiological stress and disturbance indicators have not been measured and quantified previously in relation to release methods, hook injury levels, and post-release survival in the Pacific halibut. Therefore, the proposed studies aim at providing quantifiable measurable factors that are linked to fish handling practices and to fish physiological condition and ultimately to survival in the Pacific halibut. In addition, electronic monitoring will be investigated as a means to obtain information on release methods employed by commercial fishers and to facilitate the association of release methods with injury levels, physiological condition, and post release survival in vessels without observer coverage (Objective 3; Task 3). Furthermore, exploration of non-invasive detection methods of physiological stress and disturbance indicators will be conducted to develop fast, simple, and accurate physiological monitoring to be used in the field (Objective 4; Task 4). Finally, the implication of revised DMRs for estimating removals of Pacific halibut in longline fisheries, for stock assessment and the harvest policy will be assessed.

Description of tasks:

Task 1. Evaluation of the effects of hook release techniques on injury levels and association with the physiological condition of captured Pacific halibut. The work proposed involves evaluating the effects of different release techniques on injury levels and associated physiological condition levels using the large (16/0) circle hooks used in the Pacific halibut longline fishery.

- *Fish capture*. One vessel chartered to operate in Alaskan waters (within IPHC´s Regulatory Area 3B) will be used for the study. The fishing location will be selected based on the potential to catch adult fish of both legal (82 cm and above in length) and sub-legal (under 82 cm in length) sizes at rates that facilitate efficient completion of project goals. Functionally, however, the fleet has a tendency to discard fish under 84 cm to avoid landing fish that would appear to be sublegal (owing to shrinkage) post icing. Therefore, discard fish are considered to be all fish under 84 cm in length. The vessel will operate following the standard practices of the commercial Pacific halibut fleet; namely, in terms of the procedures and times of setting, soaking, and hauling baited longline gear. Average line soaking times used in the commercial fleet will be adopted. Two (2) fishing trips consisting of six (6) fishing days per trip will be targeted. On each day, three (3) hauls of eight (8) standard skates (i.e., 100 hooks) each will be targeted for a total of two hundred and eighty eight (288) skates of gear. Vessel will need to have a secondary roller with automatic hook-removal setup inboard of the outboard roller. Based on IPHC's survey data from 2016 in Regulatory Area 3B and the proposed effort, we estimate to catch a total of 1,864 fish, with 1,229 fish at or under 84 cm and 635 fish over 84 cm in length.
- *Hook release techniques*. Pacific halibut will be released from the hook using three different careful release methods as well as by the use of automated hook-stripping devices (i.e. hook stripper), yielding a total of four (4) treatments. The careful release methods used will be: careful shaking, hook straightening, and gangion cutting (approved under IPHC regulation and described in detail in Kaimmer and Trumble, 1998). Hook release with the use of automated hook-stripping devices will also be evaluated given that, although this is not an accepted hook release method, it occurs nevertheless whenever fish fail to be manually unhooked. The rate at which this occurs in both directed and non-directed longline fisheries is currently unknown, but patterns associated with the occurrence of prior-hooking injuries (Dykstra 2016) suggests that hook-stripping may be more prevalent than is currently assumed and may also vary spatially. Given that hook-stripping is likely to induce the highest DMRs in longline fisheries and that its occurrence might be easy to quantify via electronic monitoring, obtaining baseline data for this release method is important. In order to evenly distribute the release treatments throughout the course of the experiment, release methods will be randomly assigned by skate, within each set of gear, so that each haul will consist of two skates of each release method.
- *Hook injury assessment*. All landed fish corresponding to each of the hook release techniques or treatments will be measured for length and weight, examined to record the extent of the hook injury, sampled for blood and their physiological condition will be assessed. We will follow the hook injury classification scheme initially outlined by Kaimmer (1994) and expanded by Kaimmer and Trumble (1998) into 14 different categories (i.e. injury codes) corresponding to four major severity levels (e.g., minor, moderate, severe, and dead). Only fish that are 84 cm or less in length will be tagged.
- *Blood sampling*. After assessing injury levels of Pacific halibut released using each of the four above-mentioned treatments, a blood sample (approximately 1-2 ml) will be taken for each fish from the caudal vein with the use of heparinized hypodermic needles and syringes and stored

on ice until centrifugation. At regular intervals, blood samples from several fish will be centrifuged on board in microcentrifuge tubes at 1,500 x g for 30 min at room temperature using a small field centrifuge (Eppendorf). Plasma samples will be separated from the cellular component of the blood with the use of a Pasteur pipette, transferred to new pre-labeled microcentrifuge tubes and kept frozen in dry ice until they can be stored at -80 C. The procedure to retrieve blood samples and the amount of blood extracted are routine and will not impinge any negative effects on the condition of the fish nor on their survival. Prior to centrifugation, extracted blood samples will be used for hematocrit (i.e. percentage of red blood cells in the blood relative to the volume) determinations by filling glass capillary tubes with blood and centrifuging them in a field capillary centrifuge.

- *Monitoring of environmental conditions*. In addition to recording the time elapsed between hook removal and return of tagged fish back into the ocean, sea bottom temperature will be recorded with the use of dataloggers (Star Oddi DST centi-TD), as well as ambient temperature, light intensity on deck and sea state (Beaufort scale).
- *Assessment of physiological condition*. The physiological condition of each selected fish from each of the four release techniques with associated injury levels will be determined in two different ways. First, we will calculate two different condition factor indices (i.e. Fulton's K, relative K) that express differently the relationship between length and weight and that have been recently used to evaluate the condition of landed Pacific halibut (IPHC report, in preparation). Second, we will calculate the energy (fat) levels by using a microwave-based device (Distell Fish Fatmeter, model 692, Distell, West Lothian, Scotland) that is applied directly onto the skin of the fish allowing energy determinations in the musculature without the need to sample tissue (Fig. 1). This is a direct, non-invasive and harmless measure of energy levels that can be taken from live fish (Donaldson et. al, 2010, Sang et. al, 2009) and that has also been recently used at IPHC to measure fish condition and shown to correlate well with relative K condition index as well as with the hepatosomatic index (IPHC report, in preparation). Surface body temperature will be recorded with the use of a hand-held infrared thermometer.

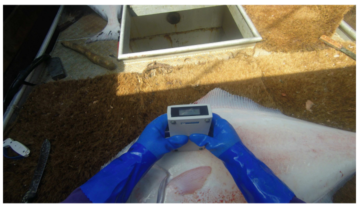

Fig. 1. Use of the Fish Fatmeter in field studies in Pacific halibut (Photo by B. Ortiz)

- *Blood plasma measures*. The levels of stress and physiological disturbance indicators (e.g., cortisol, catecholamines, lactate, glucose, sodium and potassium ions, osmolarity and pH, hematocrit) will be measured in the blood plasma samples of selected fish by release technique with associated injury levels and condition indexes. The plasma levels of cortisol and catecholamines, as endocrine indicators of stress responses, will be measured by enzyme linked immunoabsorbent assay (ELISA; 2-CAT Research Elisa Kit, Labor Diagnostika Nord, Germany) at IPHC. The levels of lactate and glucose, as biochemical indicators of catabolic responses to stress, will be measured directly in the plasma samples by standard commercial colorimetric assay kits at IPHC. The plasma levels of sodium and potassium ions, osmolarity and pH will be measured by blood gas analysis (to be done in collaboration with NMFS).

Task 2. Investigations on the effects of fish handling methods and associated injury level and physiological condition on post-release survival. In order to evaluate the survival of discarded fish, two types of tagging approaches will be used: 1) mark-and-recapture of released fish with wire tags and 2) biotelemetric monitoring of released fish with the use of satellite-transmitting electronic archival tags equipped with accelerometers.

- *Mark and recapture of released fish with wire tags*. All selected fish (84 cm or less) from each of the release techniques that have associated injury level and physiological condition will be tagged using wire tags, as previously described (Forsberg et al., 2016). In brief, wire tags are inserted between the opercular bones of the eyed side of the fish and the two ends of the tag are twisted together around the operculum. The use of wire tags will allow for the long-term assessment of survival in the ocean; however, it is worth-noting that we do not expect to recover enough wire tags within the study's stated period to formally estimate rates associated with various survival covariates, and that estimates of survival rates using this approach are confounded by natural mortality and unreported recaptures. A total of ~300 fish will be tagged per treatment.
- *Biotelemetric monitoring of released fish with the use of satellite-transmitting archival tags*. A group of 80 fish that are determined to be in excellent condition (e.g., minor injury category) will also be tagged with Wildlife Computers (Redmond, Washington) sPAT archival tags equipped with accelerometers in order to evaluate post-release mortality. Only a single viability category will be studied due to the high cost of these tags. Here, we have chosen the excellent category because it represents the vast majority of targeted-fishery discards and, hence, the bulk of assumed mortality. Additionally, uncertainty regarding the survivorship of halibut that are discarded in excellent condition has the greatest impact upon current estimates of survivorship in the remaining viability categories. This is because the latter estimates have been derived by comparing tag recovery rates from fish tagged within these categories to the rate of recovery of tags from excellent fish, assuming a "known" excellent-fish survival rate. Tagged fish will not be released in the presence of whales.

  The architecture and internal programming of sPAT tags was developed in 2015 in cooperation with the tag manufacturer for the explicit purpose of indexing post-release mortality of sublegal-size halibut captured in Bering Sea trawl fisheries (*see* S-K funded project 15AKR013); tag calibration and parameterization based on field data was accomplished in 2016. The halibut-dedicated version of the sPAT is an epoxy-cast electronic tag shaped much like a small microphone, containing accelerometers in three axes, wet-dry detection capabilities, an automatic release mechanism, and a satellite transmitter. The tag measures 124 mm in length and 38 mm in diameter, is slightly buoyant in seawater, and is attached to the host fish via a dart-and-tether system that has been successfully employed since 2002, on halibut as small as 51 cm in length. Sensor data are captured and stored at 15-second intervals and compiled into summary data via onboard processing. Upon reaching the surface – after either the tag's pre-specified attachment period or upon premature release – the sPAT's position is determined via satellite and 2-hour summaries of rapid increases in tag tilt ("knockdowns") and percentage of time that the tag was tilted beyond a pre-specified threshold are reported. If physically recovered, the full high-resolution data archive can be downloaded. The accelerometer data allow for determination of whether premature tag release was consistent with a mortality event or represented an attachment failure that would invoke removal from the study's effective sample size. For putative mortalities, the data may further provide information regarding the time-course and dynamics associated with mortality events (Fig. 2) that may be correlated to fish size, condition, or environmental parameters at time of capture.

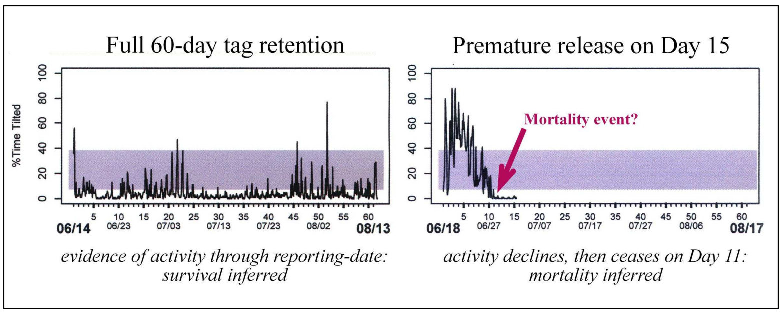

Figure 2. Satellite-broadcast accelerometer data from sPATs applied to two halibut incidentally captured and released from Bering Sea trawl vessels in 2016. The data are compiled over 2-hour periods and indicate the amount of time that the tags were tilted more than 50° past vertical. This threshold was established using field data from longline-captured halibut so as to indicate sustained swimming while rarely being triggered by tidal currents in the study area. Tags were programmed to detach after 60 days. The fish on the left retained its tag throughout the 60-day period and was therefore designated as having survived; note that the sustained activity throughout that period and immediately prior to tag detachment. The tag from the fish on the right detached prematurely and the fish was therefore assumed to have died; its data are consistent with the hypothesis that mortality occurred three days prior to tag release.

We will tag 80 halibut under 84 cm in length with sPATs programmed to detach and report after 150 days at liberty. Although this exceeds the 60-day survival period currently being used to study trawl DMR, current data indicate that shorter period survivorship can be accurately calculated using longer time-series data. The longer recording period will allow us to conduct standard DMR analysis while expanding the scope of the work to gain greater insight into time-course to recovery or normal behavior or delayed mortality in individuals whose records exceed 60 days. No field data currently exist with respect to these aspects of post-release physiology. Tags will be randomly distributed among individuals in the excellent category and the number of tags used (80) will allow us to be able to estimate survival with a confidence level of 95% and a margin of error of 8%. Sex of all tagged individuals will be determined using established ultrasonic techniques (Loher and Stephens 2011). As a visual summary, the workflow of activities between fish handling practices, fish physiological condition and survival as assessed by tagging is shown in Fig. 3.

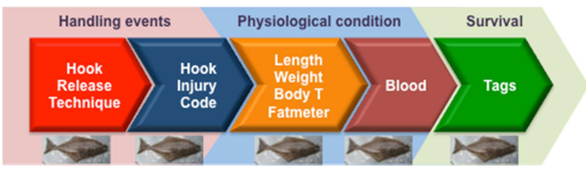

Figure 3. Schematic diagram of the workflow of activities in Tasks 1 and 2.

<u>Task 3. Application of electronic monitoring (EM).</u> The North Pacific Fishery Management Council (NPFMC) is responsible for the collection of fisheries-dependent data used in catch

estimation for the fixed gear groundfish and halibut fisheries in Alaska. On vessels larger than 57’, fishery observers collect these data, which include counting, measuring, and assigning viability codes (i.e., categorize physical damage and responses to physical stimuli) to discarded halibut. The NPFMC has established its intention to integrate EM tools into the Observer Program (Al-Humaidhi, et. al., 2016) in order to collect data on the small vessel (<57’) component of the fixed gear fleets, and is on track for final implementation of camera systems into catch accounting in 2018. Pilot EM systems have been shown to be good at detecting release methods of fish, but are less effective in determining the condition of the fish (Al-Humaidhi et al, 2016) as EM does not always capture imagery from both sides of the fish, nor can EM be used to determine physical responses of the fish to stimuli. The work proposed under this project will develop a profile of injuries associated with different release methods, while at the same time quantifying the accuracy of EM in enumerating release methods, and fish conditions (Fig. 4). Both of these aspects are necessary to transform EM imagery into useable/actionable data.

- *Installation of EM System.* A standard 3-camera EM system used in the current pre-implementation trial by NMFS will be installed on the chartered vessel (Archipelago Marine Research Ltd).
- *Development of injury profile by release method.* Halibut caught on fixed gear will be evaluated for viability and subsequent survival for the three allowable release methods: a) hook straightening, b) cutting the gangion by the hook, c) careful shaking; as well as: d) removal via a hook stripper (crucifier) which occasionally happens when halibut make it past the gaffer.
- *Evaluation of EM data.* Reviewers will record release method and condition of released halibut. This data set will be compared to those collected by personnel at sea as part of their tagging efforts (equivalent to the human observer data).

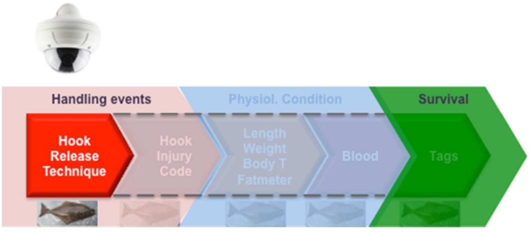

Figure 4. Schematic diagram of the workflow of activities in Task 3.

Task 4. Development of non-invasive methods for measuring the levels of physiological factors indicative of stress and physiological disturbance. The proposed work will involve a controlled experiment to explore the use of mucus cortisol concentration as a stress indicator in Pacific halibut with the potential for use in evaluating probability of survival in bycatch and sublegal size fish. Unlike plasma samples, mucus samples can be collected in a relatively non-invasive fashion, thereby decreasing the likelihood of the sampling procedure influencing the stress response. In addition, mucus sampling can be conducted quickly and easily in field settings.

- *Fish capture.* One vessel chartered to operate in Alaskan waters (within IPHC´s Regulatory Area 3A) will be used for fish capture. During September 2017, 16 – 24 adult Pacific halibut will be caught by jigging natural and artificial baits on the seafloor near Seward, AK. Only adult halibut between 20 and 31 inches will be brought onboard and kept for use in the experiment. This size range has been selected both to minimize the potential for variations in cortisol response in study subjects due to size (Barcellos et al. 2012) and as representative of fish of commercially-sublegal size. Once on board, fish will immediately be placed in onboard holding tanks for transfer to the UAF Seward Marine Center (Seward, AK) where all experimental work will be conducted. During holding, 50% of the water in the tanks will be replaced twice every hour to maintain dissolved oxygen concentrations and water temperature at levels resembling sea surface conditions (Haukenes and Buck 2006).

- *Animal housing and care*. Fish will be housed in 6 ft. x 3 ft. circular tanks (approximate filled volume = 580 US gallons) at the UAF Seward Marine Center (Seward, AK). Fish will be randomly assigned to tanks, and no more than 3 fish will occupy each tank. Water temperature and dissolved oxygen level will be kept constant and waste will be removed using an open flow through seawater system that will draw water from Resurrection Bay. Photoperiod will be standardized on a 12:12 light:dark regime. During the entire course of the experiment, the fish will be fed a fishmeal-based pellet diet once daily at a rate of 1 kg feed/kg fish. Haukenes and Buck (2007) observed elevated plasma cortisol levels in Pacific halibut sampled 10 days after the introduction of a stressor. In order to allow increased cortisol levels caused by the capture, transport, and acclimation to the experimental housing to return to baseline levels, the fish will be left undisturbed (except for feeding) for a period of no less than 30 days. Fish will also be left undisturbed (except for feeding) between experiment subcomponents.
- *Magnitude and rate of cortisol absorption and elimination in mucus*. Captive halibut will be randomly divided into three groups. Individuals from two of the groups will receive intraperitoneal injections of different doses of cortisol (0.1 μg/g of fish and 0.01 μg/g of fish). Individuals from the third group will act as a control, receiving intraperitoneal injections of sterile phosphate buffered saline (Espelid et al. 1996). Blood and mucus will be sampled from three parallel fish in the three groups at 0, 0.5, 2, 5, 24, 36, 48, and 72 hours after injection. In order to reduce handling stress, the individuals exposed to cortisol or control injections for 72 hours will be housed in the same tank and injected first. In the same fashion, the 48, 36, 24, 5, 2, 0.5, and 0 hour groups will be housed in separate tanks, each of which will be injected at successive pertinent times. Blood and mucus sampling for plasma and mucus cortisol levels will occur at the same time for all fish. For each tissue and treatment group, changes in cortisol concentration over time will be examined using repeated measures analysis of variance. Mann-Whitney U tests will be used to compare of the magnitudes of maximum cortisol levels between tissues and treatment groups, and Pearson's linear regression will be used to correlate cortisol values between tissues. Plasma and mucus cortisol values from the control group will be used to ensure the validity of results from both these experimental studies and the field studies described in Task 1.
- *Stress induction experiments*. Adrenocorticotrophic hormone (ACTH) is secreted rapidly in response to stress and acts on the adrenal cortex to stimulate the release of cortisol (Belanger et al. 2001). *In vivo* ACTH administration can be used as a tool to artificially stimulate cortisol release; thereby allowing for comparison between resting and stimulated cortisol levels and examinations of the cortisol rates of increase in unique tissues. While *in vivo* ACTH administration has been used to elicit cortisol responses in yellow perch (*Perca flavescens;* Girard et al. 1998) and white sturgeon (*Acipenser transmontanus*; Belanger et al. 2001), there is no information on the effect of ACTH on plasma cortisol in Pacific halibut and very little information on the ACTH dose–response relationship in any fish species. To examine cortisol rates of increase in plasma and mucus in response to ACTH administration, captive halibut will be randomly divided into three groups. Individuals from two of the groups will receive intraperitoneal injections of 1ml of Ringers solution containing 0.5 μM or 5 μM ACTH (Belagner et al. 2001). Individuals from the third group will act as a control, receiving intraperitoneal injections of 1ml of Ringers solution. Blood and mucus will be sampled from

three parallel fish in the three groups at 0, 0.5, 2, 5, 24, 36, 48, and 72 hours after injection. In order to reduce handling stress, the individuals exposed to ACTH or control injections for 72 hours will be housed in the same tank and injected first. In the same fashion, the 48, 36, 24, 5, 2, 0.5, and 0 hour groups will be housed in separate tanks, each of which will be injected at successive pertinent times. Blood and mucus sampling for plasma and mucus cortisol levels will occur at the same time for all fish. For each tissue and treatment group, changes in cortisol concentration over time will be examined using repeated measures analysis of variance, and Mann-Whitney U tests will be used to compare of the magnitudes of maximum cortisol levels between tissues and treatment groups. Pearson's linear regression will be used to correlate cortisol values between tissues. Post-injection plasma concentrations of ACTH will not be measured in this study. Plasma and mucus cortisol values from the control group will be used to ensure the validity of results from both these experimental studies and the field studies described in Task 1.

- *Blood and mucus sampling and sample processing*. Blood samples (approximately 1-2 ml) will be collected from the caudal vein using heparinized hypodermic needles and syringes and centrifuged immediately in microcentrifuge tubes at 1,500 x g for 30 min at room temperature. Plasma samples will be separated from the cellular component of the blood using a Pasteur pipette, transferred to new pre-labeled microcentrifuge tubes and stored at -80 C for analysis. Samples of skin mucus (approximately 1-2 ml) will be collected by gently scraping the side of the fish with a cotton swab or small plastic rod (Fig. 5) and stored at -80 C for analysis
- *Cortisol extraction and analysis*. Plasma cortisol levels will be measured by enzyme linked immunoabsorbent assay (ELISA; 2-CAT Research Elisa Kit, Labor Diagnostika Nord, Germany) at Alaska Pacific University. Mucus cortisol levels will be measured following Bertotto et al. (2010). Following Bertotto et al. (2010) and Mercado et al. (2016), mucus samples will be thawed and diluted with phosphate buffered saline (1:2). Mucus cortisol levels will also be measured by enzyme linked immunoabsorbent assay (ELISA; Demeditec Diagnostics, GmbH, Kiel, Germany) at Alaska Pacific University.

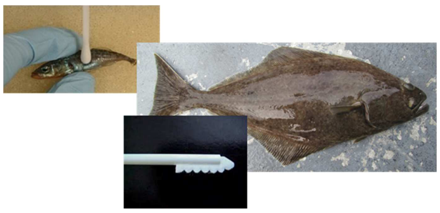

Figure 5. Gentle mucus extraction by swabs. Top left, example of a mucus sample taken from a stickleback with the use of a cotton swab. Bottom, example of small plastic mucus collector that will be used to extract skin mucus samples in Pacific halibut.

b) Description of personnel responsibilities:
The IPHC will represent the lead organization for this project. IPHC is an international organization that is responsible for the management of the Pacific halibut (*Hippoglossus stenolepis*) stocks within the Convention waters of the United States and Canada. IPHC has had a long history of conducting research on biological aspects of the Pacific halibut that impact stock assessment and is perfectly suited for undertaking the task of leading this project. The administrative and financial aspects of the project will be managed by IPHC. The project is composed of several principal investigators, two project collaborators and hired personnel to conduct specific technical-oriented tasks in the project.

Principal investigators (PIs)
[1] *Dr. Josep Planas* is the lead PI and will take responsibility for project coordination, administration and reporting. Dr. Planas will work with other PIs and project collaborators on all the tasks that will be performed. Dr. Planas will work directly with PI Claude Dykstra in Task 1 on physiological condition and disturbance indicators, with PIs Dr. Tim Loher and Mr. Claude Dykstra in Task 2 on conventional tagging and survival estimation through electronic tagging, with PI Claude Dykstra in Task 3 on electronic monitoring and with PIs Dr. Nathan Wolf and Dr. Bradley Harris in Task 4 on physiological indicator assessment of stress in captive studies. [2] *Mr. Claude Dykstra* will share responsibility with PI Dr. Josep Planas in Task 1 and will take the main responsibility for Task 3 on electronic monitoring working together with PI Dr. Josep Planas. He will also participate in Task 2 working together with PIs Dr. Josep Planas and Dr. Tim Loher. [3] Dr. *Tim Loher* will take the main responsibility for Task 2 on deployment of electronic tags and subsequent survival estimation, working together with PIs Dr. Josep Planas and Mr. Claude Dykstra. [4] Dr. *Nathan Wolf* and [5] Dr. *Bradley Harris* will share the main responsibility for Task 4 on the development of non-invasive methods for measuring the levels of physiological factors indicative of stress and physiological disturbance and will work together with PI Dr. Josep Planas.

Project collaborators
[1] *Dr. Ian Stewart* and [2] *Dr. Allan Hicks* will assist in evaluating the implications of the study's results with respect to DMR-based estimation of removals in the Pacific halibut fishery, in the context of halibut stock assessment and the harvest policy.

Personnel funded through the proposal
Hired sea samplers will participate in the collection of biological data from fish captured and released by the different assessed methods and in tagging. An MSc student and a student technician will participate in setting up and conducting the captive experiments and in the collection and analysis of biological samples from these experiments.

Distribution of tasks among the participants (responsible person underlined)

- Task 1. <u>Josep Planas</u>/<u>Claude Dykstra</u>
- Task 2. <u>Tim Loher</u>/Josep Planas/Claude Dykstra
- Task 3. <u>Claude Dykstra</u>/Josep Planas
- Task 4. <u>Nathan Wolf</u>/<u>Bradley Harris</u>/Josep Planas
- Monitoring, assessment, and harvest policy implications. <u>Ian Stewart</u>/<u>Allan Hicks</u>.

c) <u>Results Dissemination Plan</u>:
Project outcome will be written initially in the form of internal IPHC technical reports and reports in the annual Reports of Assessment and Research Activities that are publically available upon publication in the IPHC website (<u>www.iphc.int/library/raras.html</u>). Subsequently, these reports will be revised and formatted for submission as peer-review publications targeted to the fisheries scientific community in journals such as the ICES Journal of Marine Science, Frontiers in Marine Science, Canadian Journal of Fisheries and Aquatic Science, or more broad-based journals such as PLoS ONE. In addition to these specialized publications, more accessible documents will be produced to inform the general public regarding the main outcome of this

project. News releases both internally from IPHC as well externally from news organizations will be produced to the same effect. An important outcome of the project will be a training manual that will incorporate recommendations and procedures related to minimizing DMRs and that will be targeted to the fishing community as well as to fishery observers. The produced results from the proposed task on electronic monitoring will be disseminated by the production of videos showing different release techniques with their associated injuries and physiological sampling and tagging procedures to assess survival post-release. These videos will be posted in the IPHC website and will be used to train observers and sea samplers.

Dissemination items:

- IPHC technical and RARA reports available through the IPHC website.
- Peer-reviewed publications for the scientific fisheries community.
- Non-technical documentation of the outcome of the project for the general public.
- News releases on the outcome of the project.
- Communication of results from the project to scientific and fisheries conferences.
- Training manual.
- Videos describing procedures developed in the project available through the IPHC website.

d) Project Milestones and Timelines:

The project milestones are related to the completion of the various tasks and include the reporting and preparation for dissemination as well as the outreach activities planned throughout the 2 years of the project, as detailed by quarters and beginning in Sept. 2017. Tasks include, when required, the names of the individuals responsible (Josep Planas: JP; Claude Dykstra: CD; Tim Loher: TL; Nathan Wolf: NW; Bradley Harris: BH; Ian Stewart: IS; Allan Hicks: AH).

Task	**Year 1 Q1**	**Year 1 Q2**	**Year 1 Q3**	**Year 1 Q4**	**Year 2 Q1**	**Year 2 Q2**	**Year 2 Q3**	**Year 2 Q4**
Project meetings (PIs/collab.)								
Task 1 PIs: JP/CD								
Task 2 PI: TL								
Task 3 PI: CD								
Task 4 PIs:NW/BH								
Assessment and Harvest Policy Col.:IS/ AH								
Advisory Body Meetings								

Stakeholder Meetings								
Report prep.								
Publication								
Outreach								

The expected *deliverables* from the outcome of the project are the following:

- Injury profiles for different hook release techniques.
- Physiological assessment of hook release methods: fish condition index at post-capture.
- Assessment of post-release survival in relation to hook release methods and physiological condition as well as in relation to fish size.
- Information on electronic monitoring of hook release techniques and associated survival estimates.
- Information on stress and physiological disturbance indicators in the mucus and establishment of a rapid assay for its use in the field.
- Assessment of the impact of results on stock monitoring assessment and harvest policy.
- Dissemination products (reports, publications, conference presentations, news releases).
- Training (training manual, MSc and technician student training)

7. Project Management.

IPHC will represent the lead organization for this project. IPHC has had a long history of conducting research on biological aspects of the Pacific halibut that impact stock assessment and is perfectly suited for undertaking the task of leading this project. IPHC has actively and successfully participated previously in federal and non-federal funded research projects. The administrative and financial aspects of the project will be managed by IPHC. PIs from two different institutions, IPHC and Alaska Pacific University (Anchorage, AK), participate in this collaborative project and the knowledge and expertise of their respective PIs is complementary and, as a result, a synergistic outcome is expected from this research interaction. The curriculum vitae of PIs and collaborators that participate in this project are attached to this application under Support. Document.

Principal investigators (PIs)

The project will be led by [1] *Dr. Josep V. Planas* from IPHC and will take responsibility for project coordination, administration and reporting. Dr. Planas is currently Program Head of the Biological and Ecosystems Science Program at IPHC. Prior to his recent post at IPHC, Dr. Planas developed his career in fish physiology in the Academic field and has had extensive experience leading and managing research projects, both at national and international levels. In this project, Dr. Planas will work directly with other PIs in Tasks 1 to 4. [2] *Dr. Tim Loher* is a Research Scientist at IPHC. Dr. Loher has extensive experience with the tagging of halibut, both *in situ* and in captive holding. He has been responsible for the tagging of ~700 wild halibut using archival tags, has worked to refine deployment protocols for both external and surgically-implanted tags and to develop methods for non-invasive sex and maturity determination, and the parameterization and interpretation of accelerometry data in the context of halibut survival and behavior. Dr. Loher and will be responsible mostly for Task 2. [3] *Mr. Claude Dykstra* is a Research Biologist at IPHC. Mr. Dykstra is a biologist with extensive experience in field research with Pacific halibut and specifically in the application and development of condition indices for Pacific halibut. Mr. Dykstra also has extensive experience with contracting and working with fishing vessels on research projects. Mr. Dykstra will be responsible mostly for Task 3. [4] *Dr. Nathan Wolf* is Assistant Professor of Marine and Environmental Science and Principal Researcher at the Fisheries, Aquatic Science & Technology (FAST) Laboratory at Alaska Pacific University. Dr. Wolf has extensive experience conducting controlled experiments with captive animals to examine physiological processes. Dr. Wolf will be responsible for Task 4, together with Dr. Harris. [5] *Dr. Bradley Harris* is Associate Professor and Director of the Fisheries, Aquatic Science & Technology (FAST) Laboratory at Alaska Pacific University. Dr. Harris has abundant experience managing and participating in research studies on the ecology of Pacific halibut and other fish species. Dr. Harris will share responsibility for Task 4 with Dr. Wolf.

Project collaborators
[1] *Dr. Ian Stewart* is a Quantitative Scientist at IPHC and will work together with [2] *Dr. Allan Hicks*, also a Quantitative Scientist at IPHC, on the implications of the results generated by this project on mortality estimate inputs into stock assessment as well as on harvest policy.

8. Participation by Persons or Groups other than the Applicant.
The stakeholder groups that have expressed interest in the project (Section 3; see Letters of Support), as well as others that may join prior to or during the progress of this project, will participate in the project through annual meetings that will coincide with the project's meetings (see timeline of activities, Section 6).

9. Outreach and Education.
The following outreach and education activities are intended to fulfill NOAA's mission to protect the Nation's natural resources:

- To inform the fishing industry on the progress and outcome of the project through the stakeholder and advisory boards. Summary documents by project team members will be prepared for this purpose.
- To inform user groups (i.e. NPFMC, EM group) on the progress and outcome of the project through reports and in person presentations at their meetings.
- To inform the fisheries community through publication of documents (either technical documents or peer-review publications in journals) and also through presentations at relevant venues and conferences.
- To send news releases at the beginning and end of the project to broadly advertise the objectives of the project in a first instance and to, once available, publicize the results of the project to the media.
- To prepare a Story Map Journal (https://storymaps.arcgis.com/en/app-list/) that pictures the entire collection of components of the project, from capture and handling events in the fisheries, to assessing physiological condition of the fish, to its survival at sea after release and impacts of estimates of survival on stock assessment and harvest policy. This presentation could be made publically available through media outlets currently in place at IPHC and APU (webpage, Twitter, Facebook) and also sent specifically to schools and centers to be informed about the research conducted and its importance for the fisheries, with the supporting presence of one of the PIs.

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OMB Approval

Number:0648-

0538 Expiration

Date: 11/30/2018

Environmental Compliance Questionnaire for National Oceanic and Atmospheric Administration Federal Financial Assistance Applicants

This form is to be used in conjunction with Funding Opportunity Announcements (FOA) from the National Oceanic and Atmospheric Administration (NOAA). You must refer to the specific FOA for complete eligibility and application requirements. This form addresses information requirements specific to compliance with the National Environmental Policy Act ("NEPA"; 42 U.S.C. §§4321- 4370).

NEPA requires federal agencies to complete an environmental analysis for all major federal actions, including funding non-federal projects through federal financial assistance awards where Federal participation in the funded activity is expected to be significant. This *Environmental Compliance Questionnaire for National Oceanic and Atmospheric Administration Federal Financial Assistance Applicants* (Questionnaire) is used by NOAA to collect information about proposed activities for NEPA and other environmental compliance requirements associated with the proposed project, such as federal consultations.

You are only required to provide the information from this Questionnaire that is specified in the FOA to which you are applying. The FOA may present these questions in one of two ways:

1) The applicable questions are inserted directly into the FOA with reference to the OMB Approval Number (0648-0538) for this form; or
2) The FOA will specify which questions (e.g. 1, 2) an applicant must answer, with the entire OMB-approved Questionnaire attached to the FOA.

Submit the information according to the instructions in the FOA. If you do not answer in sufficient detail, NOAA may consider the application to be incomplete. If a question is not applicable to your proposed activity, answer "N/A" or explain why the requested information is not relevant.

Project Information

1. Describe the proposed activity, including:
    - its purpose, objectives, and goals;
    - graphics (i.e. figures, photographs), site plans, plan diagrams, models, etc.;
    - sampling, collection, or observation protocols and operational procedures;
    - any proposed mitigation or monitoring measures and protocols;
    - a description and plan diagram of the proposed impact area, if the proposed activity involves construction, restoration, dredging, excavation, and/or fill;
    - a description (i.e. specifications) of the equipment or structures (e.g. scientific monitoring equipment, deployment platforms, etc.) that would need to be temporarily or permanently placed in the environment.

Purpose, objectives and goals

The main objectives of this project are to address the important issue of discard mortality rates (DMRs) of Pacific halibut in the directed and non-directed longline fisheries and to refine current estimates of post-release survival in incidentally caught Pacific halibut. In order to accomplish these objectives, the relationship between fish handling practices and fish physical and physiological condition and survival post-capture as assessed by tagging will be investigated.

The IPHC accounts for all mortalities or removals of Pacific halibut in its assessment of the stock, including bycatch as well as the incidental mortality from the commercial halibut fisheries (also known as wastage). Estimates of incidental mortality influence the output of the stock assessment and, consequently, the catch levels of the directed fishery. Prohibited Species Catch limits set by the North Pacific Fishery Management Council (NPFMC) requires that all Pacific halibut caught in non-directed fisheries must be discarded at sea, and these fisheries may be closed when Pacific halibut catch limits are reached.

The NPFMC has identified DMRs in the Pacific halibut fishery as a research priority. The proposed project will directly address this recommendation by providing new scientific information to improve current estimates of DMRs.

The specific objectives of this project include (1) evaluation of the effects of fish handling practices on injury levels and their association with the physiological condition of captured Pacific halibut, (2) investigations on the effects of fish handling methods and associated injury level and physiological condition on post-release survival, (3) application of electronic monitoring in associating fish handling methods to survival in vessels without observer coverage and (4) development of non-invasive methods for quantifying measurable physiological factors indicative of stress and physiological disturbance.

Sampling, collection, or observation protocols and operational procedures

For Task 1 ("Evaluation of the effects of hook release techniques on injury levels and association with the physiological condition of captured Pacific halibut"), all captured Pacific halibut caught by each of the four hook release techniques or treatments will be measured for length and weight, examined to *record the extent of the hook injury, sampled for blood and their physiological condition will be assessed by length/weight relationships and by non-invasive indirect fat analysis using a Fish Fatmeter device. In Task 2 ("Investigations on the effects of fish handling methods and associated injury level and physiological condition on post-release survival"), a subset of the captured Pacific halibut (fish of 84 cm in length or less) will be selected for tagging with wire tags and 80 of these fish with sPAT archival tags to assess survival. In Task 3 ("Application of electronic monitoring"), EM will be used to record release methods and condition of released halibut. In Task 4 ("Development of non-invasive methods for measuring the levels of physiological factors indicative of stress and physiological disturbance"), adult Pacific halibut will be captured and acclimated to captive conditions in tanks at the UAF Seward Marine Center (Seward, AK), subjected to stress and blood and mucus samples will be collected for analysis.*

Tagged fish from Task 2 will be monitored with the use of satellite-transmitting electronic archival tags equipped with accelerometers upon detachment and surfacing. Fish in Task 4 will be monitored continuously throughout the experiment.

2. List the species of plants and animals that are the subjects of the proposed activity, and describe the numbers (by species, age, sex, stock, location, etc.) to be targeted.
   The subject species of the proposed activity is the Pacific halibut (Hippoglossus stenolepis). The proposal involves targeting approximately 1,900 fish Pacific halibut of mixed sexes (50% females) captured by a charter vessel in the central-Western portion of the Gulf of Alaska (IPHC Regulatory Area 3B) as part of Task 1. In addition, the proposal also involves capturing 16 – 24 adult Pacific halibut near Seward, AK for captive experiments to be conducted at the Seward Marine Center.

3. List species that would be transplanted or introduced at the site or in its immediate vicinity, and specify whether any would be non-native. Specify which non-native species could be introduced incidentally and how.
   No species will be transplanted or introduced.

4. List hazardous substances (as defined by [29 CFR 1910.120(a)(3)]) that may be released into the environment or used during the proposed activity.
   No hazardous substances will be used or released.

5. List hazardous wastes (as defined by [40 CFR 261.3]) that may be generated during the proposed activity.
   No hazardous wastes will be generated.

6. List unique or unknown risks to human health or the environment from the proposed activity.
   No risks to human health will originate from the proposed activity.

7. List any individuals, groups, or organizations that may disapprove of or oppose the proposed activity, and describe the circumstances of their disapproval or opposition.
   None.

8. If the proposed activity is a continuation of an on-going project, describe any changes to the proposed activity since it was initiated, including progress toward achieving its objectives/goals. Include information and attach reports from previous years.
   This proposed activity is new.

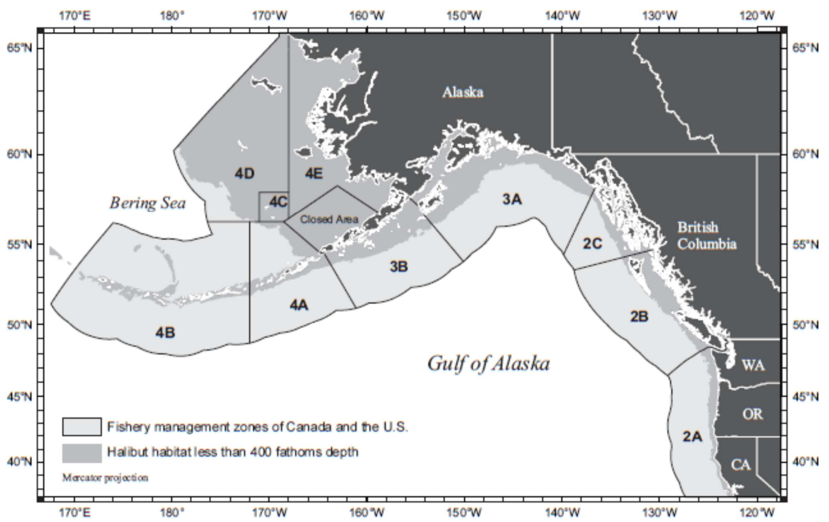
9. If the applicant does not receive funding from NOAA, would the applicant conduct the proposed activity anyways?
The applicant would be able to fund some of the work but without the requested funding from NOAA the work would be incomplete and the results inconclusive.

Project Location

10. Describe the proposed activity's location, including geographic coordinates, river mile markers, etc. and indicate whether it includes unique geographic areas of notable recreational, ecological, scientific, cultural, historical, scenic, or aesthetic importance (Examples include, but are not limited to: coral reefs; marine protected areas; national marine sanctuaries; essential fish habitat; habitat area of particular concern; critical habitat designated under the Endangered Species Act; park or refuge lands; wild or scenic rivers; wetlands; prime or unique farmland; sites listed on the National Register of Natural Landmarks; sites listed or eligible for the National Register of Historic Places; sites that are ecologically significant or critical areas including areas that are normally inundated by water or areas within the 100-year flood plain).
One vessel chartered to operate in Alaskan waters (within IPHC´s Regulatory Area 3B; see figure below) will be used for the study. The fishing location will be selected based on the potential to catch adult fish of both legal (32 inches and above in length) and sub-legal (under 32 inches in length) sizes at rates that facilitate efficient completion of project goals.

11. Would the proposed activity degrade or disturb previously undisturbed areas?
No.

12. Provide maps and graphics of the project location, if available.
Figure illustrating the IPHC Regulatory Areas, including Regulatory Area 3B in Alaska, where most of the project will be conducted:



13. If there are previous or ongoing uses of the proposed activity's site, or other issues, that make it likely that contaminants may be uncovered and/or disturbed by the proposed activity, describe

the previous or ongoing uses or other issues of the site, potential contaminant, and the circumstances that may uncover and/or disturb the contaminants.
No contaminants may be uncovered and/or disturbed by the proposed activity.

Project Timeframe

14. Specify the proposed start date and duration of the proposed activity.
September 1, 2017 – August 31, 2019. 24 months.

15. Provide proposed activity schedules, including:

- implementation dates of major elements of the proposed activity;
- frequency of activities within the project schedule (e.g. once per week, 10 days per month, daily);
- deployment and recovery schedules of equipment or structures that would be temporarily or permanently placed in the environment.

The temporal distribution of tasks is shown below, with the first quarter (Q1) of year 1 starting in September, 2017:

Task	Year 1 Q1	Year 1 Q2	Year 1 Q3	Year 1 Q4	Year 2 Q1	Year 2 Q2	Year 2 Q3
Task 1	■	■	■	■	■		
Task 2		■	■	■	■	■	
Task 3	■	■	■	■	■	■	
Task 4	■	■	■	■	■	■	■

Fish capture and sample and observation collection related to Tasks 1 and 3 will take place during the two proposed chartered trips. Sample processing and analysis as well as EM and satellite transmission data will take place on a daily basis. Fish collection related to Task 4 will likely take place during a single chartered trip and experimentation, monitorization and sample collection and analysis of captive fish will take place on a daily basis.

No equipment or structures will be temporarily or permanently placed in the environment.

Project Partners, Permits, and Consultations

16. If the proposed activity would be conducted in partnership with NOAA or require NOAA' s direct involvement, activity, or oversight, describe NOAA' s involvement, activity, or oversight, including the name of the office or program that is involved.
Not applicable.

17. List all other interested or affected Federal, state, and local agencies; Tribal governments, nongovernmental organizations; minority or economically disadvantaged communities; and individuals. Describe listed entities involvement, activity, or oversight regarding the proposed activity.
As stated in the project narrative, we count on the support of various organizations with direct interest and participation in the Pacific halibut fisheries (e.g., Alaska Longline Fishermen's

Association, North Pacific Fisheries Association, Pacific States Marine Fisheries Commission, Alaska Fisheries Science Center - National Marine Fisheries Service; see Letters of Support in Supporting Documentation). These organizations will provide guidance towards evaluating the progress of the project and ensuring its success by meeting annually with the project consortium.

18. List all federal, state, or local permits, authorizations, waivers, determinations, or ongoing consultations that would be required for the proposed activity to comply with all applicable environmental laws and regulations. Provide the date the permit, authorization, waiver, or determination was obtained or would be obtained. Provide copies of the permits, authorizations, waivers, or determinations you have secured.
All operations will carry a Letter of Acknowledgement from NMFS's Alaska Fisheries Science Center specific to the work, and incidental bird take permits from the USFWS (see current permit as Appendix I to this document). All standard post cruise reporting requirements (research fish landing tickets etc.) will be observed.

19. Identify the lead Federal agency, if applicable, and whether any NEPA document has been completed or is in process for the proposed activity.
Not applicable.

Project Details

National Marine Fisheries Service

20. If the proposed activity is a continuation of an on-going project, provide information/reports for previous years addressing the following:

- The number of fish and other species that were collected for the activity/monitoring needs;
- any impacts to protected species, including takes (as defined by 50 CFR 216.3, 50 CFR 222.102, and 1
- any impacts to sensitive or protected habitats, including critical habitat that has been identified under the Endangered Species Act or essential fish habitat that has been identified under the Magnuson-Stevens Fishery Conservation Management Act (Magnuson-Stevens Act);
- and the number of non-target fish/invertebrates/protected species (listed by species) that were incidentally captured.

The proposed activity is new and is not a continuation of an on-going project.

21. What amount (total numbers and/or weight) of fish or invertebrates are proposed to be caught? What is the size (weight, length, and age class) of each species?
In Tasks 1 to 3, we estimate to catch a total of 1,864 fish, with 1,229 fish at or under 84 cm and 635 fish over 84 cm in length. These numbers are based on IPHC's survey data from 2016 in Regulatory Area 3B and the effort proposed for this particular project. The ages of fish captured will likely range from 7 to 15 yrs and weights will likely range from 7-8 lbs to 10-15 lbs in males and from 10 to 25-30 lbs in females based on trends in weight-at-age for male and female Pacific halibut captured in Area

3B by the IPHC setline survey (http://iphc.int/publications/rara/2015/RARA2015_11Assessmenddatasources.pdf).

In Task 4, we will aim at catching 16 – 24 adult Pacific halibut between 20 and 31 inches in length in order to minimize the potential for variations in stress response in study subjects due to size.

22. If targeted fish would be under the minimum size limit or is the applicant applying for an exemption to the minimum size limit, explain why an exemption is necessary to conduct the proposed activity.
Targeted fish in Task 2 will be 84 cm of less in length because the objective of this task is to investigate post-release survival of fish discarded at sea because of their sublegal size.

23. If any organisms would be released alive, how many of each species would be tagged, measured, or sampled? What is the probability of individuals surviving after being handled (e.g., tagged, measured) and released (e.g., percent of live or dead fish)?
Targeted fish in Task 2 will be released after tagging in order to investigate post-release survival and we estimate that approximately 1,230 fish at or under 84 cm will be tagged and released. Of note, 80 of these fish will be tagged with sPAT archival tags equipped with accelerometers. To determine the probability of survival capture and handling events is precisely one of the objectives of this project.

24. If the proposed activity involves commercial fishing, would the proposed activity be for research purposes only? If fish would be retained for sale or personal consumption, quantify the amount of each species that would be sold or used for personal consumption.
Although performed in a chartered commercial vessel, the proposed activity is designed for research purposes. For all fish captured, the relationship between hook release techniques, injury classification and physiological condition will be assessed. Fish at or under 84 cm will be subsequently tagged and released to investigate survival and approximately 1,230 fish are expected to fall within this category. Fish over 84 cm in length will be retained for sale by IPHC and approximately 635 fish are expected to fall within this category.

25. What type and size of gear would be used? Describe any differences between proposed research gear and currently regulated gear.
The gear used will be similar to the gear used in the IPHC survey: fixed gear with standard 1,800 ft skates, each with 100 16/0 circle hooks and with 18 ft spacing between gangions.

26. If using fixed fishing gear, how many traps, pots, gillnets, or other fixed gear would be used during the course of the study? Would new gear be added to the water or would existing, permitted fishing gear be used? If new gear would be added to the water, how many extra vertical lines would be associated with any fixed gear such as traps, pots, or gillnets? What lengths of gillnet would be used (e.g. number of nets per string, gillnet panel lengths, etc.)?
A total of two hundred and eighty eight (288) skates of fixed gear will be used.

27. Would the fishing gear being used conform to appropriate take reduction plan regulations under the Marine Mammal Protection Act (e.g. Atlantic Large Whale Take Reduction Plan, Harbor Porpoise Take Reduction Plan, Bottlenose Dolphin Take Reduction Plan, etc.) and other

appropriate fishery regulations (e.g. sea turtle gear requirements)? If not, explain the differences and the reason for the discrepancy.
Not applicable.

28. How long would the fishing gear be deployed? List average soak time for each gear type.
The fixed gear is deployed for a minimum of 5 hrs and a maximum of 24 hrs. Average soak time would be approximately 12 hrs.

29. What is the proposed number of gear hauls for each gear type (e.g., trawl gear, fixed gear, etc.)?
The number of gear hauls is three per day, with each haul consisting of eight standard skates. With 12 proposed days of fishing, a total of 36 hauls are targeted.

30. What is the proposed duration and speed of each tow for mobile gear, such as trawl gear?
Not applicable.

31. If trawls are proposed to be used, would a turtle exclusion device (TED) or marine mammal exclusion device be used?
No trawls will be used.

32. If the applicant is applying for an exemption to any of the following, please explain what the exemptions would be and why the exemption is necessary for the proposed activity:

- Fishing gear restrictions;
- Other regulatory requirements such as Days At Sea (DAS), Total Allowable Catch (TAC), and/or possession limits;
- Use areas closed to proposed activities (e.g., fishery management closed area, habitat closed area, etc.);
- Any closed or otherwise restricted fishing seasons.

Not applicable.

33. If the proposed activity would increase fishing effort, describe the extent of the increase.
Not applicable.

34. How many proposed fishing days are there within the year for each gear type?
The proposed activity involves 12 fishing days in two trips (six fishing days per trip).

35. Is the target species listed as endangered, threatened, or otherwise protected species (under Federal and/or state law; e.g. Endangered Species Act and/or Marine Mammal Protection Act, etc.)?
Not applicable.

36. If the proposed sampling involves the use of sonic tags, acoustic surveys, or any other specialized gear that may introduce sound, provide a description of the noise(s), including frequency (Hz), amplitude (dB), what angle (or degrees) radius the noise may travel from the source, and other relevant technical specifications.
Not applicable.

37. List non-target species that may occur in the proposed sampling area, and specify how many of each

non-targeted species are expected to be caught?

With the proposed effort, based on hook status calculated in IPHC Survey, the following non-target species and the number of fish caught would be expected to be caught:

- Pacific cod: 983
- Sablefish: 67
- Yellow Irish Lord: 115
- Big skate: 78
- Arrowtooth flounder: 112
- Longnose skate: 75

National Environmental Satellite Data and Information Systems

38. Would the proposed activity create high levels of noise for an extended period of time?

    No.

39. Would the proposed activity require large amounts of water or electricity for an extended period of time?

    No.

40. Would any fuel be used for the proposed activity during development or long term operation, including for powering small fuel cells?

    Yes, for fueling the research vessel used for Task 1 (capture and handling events) and Task 4 (stress experiments in captivity).

41. Would the proposed activity, during development or long term operation, change the scenery or viewshed in the project vicinity, require large amounts of outdoor lighting, or create unusual odors?

    No.

42. Would the proposed activity, during development or long term operation, change transportation infrastructure or increase local traffic?

    No.

43. Would the proposed activity, during development or long term operation, change characteristics of the atmosphere or contribute to ozone-depletion?

    No.

44. If the proposed activity involves installing equipment or antennas on buildings or property, has the owner of the property granted written approval for the use of their property? If yes, provide copies of the approvals.

    Not applicable.

45. If the proposed activity involves installing equipment, how would the equipment get to its final location (i.e. would gasoline or diesel engine vehicles be used)?

    Not applicable.

46. If biological agents would be used, specify how the proposed activity would meet all conditions of

the Biosafety Level 1 (BL1) standard from the most current version of the National Institutes of Health (NIH) and the Center for Disease Control and Prevention (CDC) Biosafety in Microbiological and Biomedical Laboratories (BMBL) guidelines.

Not applicable.

47. Does the proposed activity consist solely of software research and manipulation?
No

48. If the proposed activity requires airplane or balloon/sonde flights (e.g. investigations over Arctic Sea ice using satellite and aircraft altimetry), would the proposed activity use a previously scheduled flight or sea voyage, or would a special trip be required?

    Not applicable.

49. If the proposed activity involves installing equipment or antennas that would require structural support, describe the nature and extent of such support.

    Not applicable.

50. If the proposed activity has electromagnetic properties or creates electromagnetic fields, specify how those aspects would comply with the Institute of Electrical and Electronics Engineers (IEEE) standard C95.1-1991 (recognized by the American National Standards Institute (ANSI)), or newer guidance.

    Not applicable.

51. If the proposed activity involves ionizing radiation, specify:

    - whether the appropriate radiation safety authority has been consulted or when consultation would occur;
    - the results of the radiation safety authority’s review;
    - how the proposed activity complies with NOAA’s U.S. Nuclear Regulatory Commission (NRC) materials license #05-11997-01

    Not applicable.

52. If the proposed activity involves lasers, specify how the proposed activity would meet the American National Standards Institute (ANSI) safety standards Z136.1-2000 and Z136.6-2000, or newer

    Not applicable.

guidance.

53. If the proposed activity involves satellite sensors and experiments with radioactive materials, specify and include:

- whether NASA has evaluated the payload or when the evaluation would occur;
- the results of the evaluation (i.e. whether the proposed project is categorized as a Routine Payload On Expandable Launch Vehicles, as evaluated by the current version of NASA Routine Payload Environmental Checklist GSFC Form 23-78 and NASA Flight Projects Environmental Checklist GSFC Form 23-74);
- a copy of the evaluation, if available.

Paperwork Reduction Act Statement

Because this Questionnaire is intended for members of the public, NOAA must use the Questionnaire in accordance with the Paperwork Reduction Act ("PRA"; 44 U.S.C. §§ 3501– 3521). Congress passed the PRA to minimize the paperwork burden for non-federal entities and members of the public that can result from the collection of information by or for the federal government. The PRA is administered by the Office of Management and Budget (OMB), which has reviewed and approved the Questionnaire (OMB Approval No. 0648-0538).

Public reporting burden for this collection of information is estimated to be a maximum of 3 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other suggestions for reducing this burden to NOAA NEPA Coordinator, NOAA Office of Program Planning and Integration, SSMC 3, Room 15700, 1315 East West Highway, Silver Spring, MD 20910. The information collection does not request any proprietary or confidential information.
No confidentiality is provided.

Notwithstanding any other provisions of the law, no person is required to respond to, nor shall any person be subjected to a penalty for failure to comply with, a collection of information subject to the requirements of the Paperwork Reduction Act, unless that collection of information displays a currently valid OMB Control Number.

APPENDIX 1 (NEPA Questionnaire): USFW Permit

DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE
Migratory Bird Permit Office
1011 E. Tudor Rd (MS-201) - Anchorage, AK 99503
Tel: 907-786-3693 Fax: 907-786-3927
Email: permitsR7MB@fws.gov

FEDERAL FISH AND WILDLIFE PERMIT

2. AUTHORITY-STATUTES
16 USC 703-712

REGULATIONS
50 CFR PART 13
50 CFR 21.27
50 CFR 21.21

1. PERMITTEE

INTERNATIONAL PACIFIC HALIBUT COMMISSION
ATTN: TRACEE GEERNAERT
2320 WEST COMMODORE WAY, SUITE 300
SEATTLE, WA 98199
U.S.A.

RECEIVED
MAY 18 2015
IPHC

3. NUMBER
MB057716-0

4. RENEWABLE	5. MAY COPY
☒ YES ☐ NO	☒ YES ☐ NO
6. EFFECTIVE 05/13/2015	7. EXPIRES 03/31/2018

8. NAME AND TITLE OF PRINCIPAL OFFICER (If #1 is a business)
TRACY GEERNAERT
SURVEY COORDINATOR

9. TYPE OF PERMIT
SPECIAL PURPOSE - SALVAGE WITH IMPORT/EXPORT

10. LOCATION WHERE AUTHORIZED ACTIVITY MAY BE CONDUCTED

SALVAGE AUTHORITY: FEDERAL WATERS OFF ALASKA.
IMPORT AUTHORITY: ANY PORT DESIGNATED UNDER 50 CFR 14.12 and ALL NON-DESIGNATED PORTS IN

11. CONDITIONS AND AUTHORIZATIONS:

A. GENERAL CONDITIONS SET OUT IN SUBPART D OF 50 CFR 13, AND SPECIFIC CONDITIONS CONTAINED IN FEDERAL REGULATIONS CITED IN BLOCK #2 ABOVE, ARE HEREBY MADE A PART OF THIS PERMIT. ALL ACTIVITIES AUTHORIZED HEREIN MUST BE CARRIED OUT IN ACCORD WITH AND FOR THE PURPOSES DESCRIBED IN THE APPLICATION SUBMITTED. CONTINUED VALIDITY, OR RENEWAL, OF THIS PERMIT IS SUBJECT TO COMPLETE AND TIMELY COMPLIANCE WITH ALL APPLICABLE CONDITIONS, INCLUDING THE FILING OF ALL REQUIRED INFORMATION AND REPORTS.

B. THE VALIDITY OF THIS PERMIT IS ALSO CONDITIONED UPON STRICT OBSERVANCE OF ALL APPLICABLE FOREIGN, STATE, LOCAL, TRIBAL, OR OTHER FEDERAL LAW.

C. VALID FOR USE BY PERMITTEE NAMED ABOVE.

D. Authorized to salvage migratory birds found dead in which the permittee had no part in killing. Any endangered or threatened species must be turned over to the U.S. Fish and Wildlife Service within 48 hours of collection or return to port. Any dead bald eagle or golden eagle salvaged must be reported within 48 hours to the National Eagle Repository at (303) 287-2110 and to the issuing migratory bird permit office at 907-786-3693. The Repository will provide directions for shipment of these specimens.

For a list of threatened and endangered species in your state, visit the U.S. Fish and Wildlife Service's Threatened and Endangered Species System (TESS) at: http://www.fws.gov/endangered.

E. You may not salvage and must immediately report to the U.S. Fish and Wildlife Service Office of Law Enforcement any dead or injured migratory birds that you encounter that appear to have been poisoned, shot, electrocuted, have collided with industrial power generation equipment, or were otherwise injured as the result of potential criminal activity. See USFWS OLE contact information below.

F. You are also authorized to import and export migratory birds salvaged under this permit. Additional authorization is required to import and export bald eagles, golden eagles, threatened and endangered species, and species listed under CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora).

G. All wildlife must be imported and exported through a wildlife designated port of entry/exit unless you have obtained a separate exception to designated port permit from the USFWS Office of Law Enforcement.

H. You must notify the USFWS Wildlife Inspector at the port of import or export **up to 3 days prior to import or export**. See the attached Standard Conditions for Migratory Bird Import/Export Permits for procedures specific to your activity.

I. You must declare your specimens to USFWS using USFWS Declaration for Importation or Exportation of Fish or Wildlife (Form 3-177;

☒ ADDITIONAL CONDITIONS AND AUTHORIZATIONS ALSO APPLY

12. REPORTING REQUIREMENTS

You must submit an annual to your Regional Migratory Bird Permit Office report each year, even if you had no activity.

ISSUED BY	TITLE	DATE
[signature]	PERMIT SPECIALIST, MIGRATORY BIRD PERMIT OFFICE - REGION 7	05/13/2015

Data Sharing Plan

Data generated under this project will be made discoverable by and accessible to the general public in a timely fashion.

1. Types of information collected.
   a) Length and weight information on captured fish.
   b) Environmental data (bottom temperature, deck temperature, sea condition).
   c) Hook removal injury codes (14 different codes; Kaimmer and Trumble, 1998).
   d) Injury severity levels (4 different codes; minor, moderate, severe, dead; Kaimmer and Trumble, 1998).
   e) Electronic monitoring data.
   f) Blood samples and analyses (plasma levels of stress and physiological disturbance indicators: cortisol, catecholamines, lactate, glucose, sodium, potassium, osmolarity, pH).
   g) Physiological condition indicators: condition factor indices (Fulton's K, relative K) and lipid levels as derived from Fish Fatmeter readings.
   h) Wire tagged fish and information on returns.
   i) sPAT tagged fish and satellite data on accelerometer.

2. Data Management Plan

The IPHC Setline Survey has already in place a data management plan that involves the collection at sea of gear information, catch information and biological measures (e.g., length) that are recorded in paper data forms. Electronic data entry of data collected at sea with the use of electronic tablets is currently being developed and will likely be available for at sea data collection for this project. All collected data are then introduced into a dedicated database and metadata files are created to incorporate additional data such as aging data among other types of data. Additional fields will be created to incorporate the additional data indicated above. Biological data resulting from blood and physiological condition analyses will be introduced into the project's database and added to the metadata file with individual information on every fish.

Tag release data would be introduced in an already existing tagging database that would be linked to the metadata tables containing all other entries. In addition, broadcast data from sPATs, representing the raw data format, will be decoded into binned summary files that, upon analysis, will be incorporated into a dedicated database, the construction of which is currently underway at IPHC by our Technology Group.

Public access to the database will be through the IPHC webpage (http://www.iphc.int) and should be made available within six months from the completion of the project.

Budget Narrative – <u>Organization 1 – International Pacific Halibut Commission (IPHC)</u>

Personnel (Federal Share) - none
No salary expenses are requested for IPHC project participants (Josep V. Planas, Claude Dykstra, Tim Loher, Ian Stewart, Allan Hicks).

Fringe Benefits (Federal Share)- none

Travel (Federal), $4.220
Year 1:

Sample collection in captive experiment, Seward AK (2 people): $1.840

Airfare Seattle - Anchorage	$900
Rental car	$320
Hotel Seward 2 days	$320
Per diem 3 days Seward	$300

Year 2:

PI Meeting, Anchorage AK (3 people): $2.380

Airfare Seattle - Anchorage	$1350
Hotel Anchorage 2 days	$480
Per diem 3 days Anchorage	$450
Misc travel	$100

Equipment (Federal) - none

Supplies (Federal), $190.274

Wire tags. Total: $2.060
- Floy wire tags ($1 x 1.500) = $1.500
- Wire tag applicators ($16 x 35) = $560

Accelerometer tags. Total: $167.850
- Wildlife Computers sPAT tags ($2.000 x 80) = $160.000
- Givmar Tagging darts ($80 x 90) = $7.200
- VER Sales nicopress sleeves ($1,25 x 160) = $200
- Floy leaders, printed ($5 x 90) = $450

Assays for blood determinations. Total: $15.864
- Cortisol ELISA ($270 x 12): $3.240
- Catecholamine ELISA ($400 x 12): $4.800
- Lactate, Glucose Kits ($326 x 24): $7.824

General laboratory supplies. Total: $4.500.

Contractual (Federal), $24.886

Satellite transmissions of accelerometer tag data. Total: $14.000
- Argos testing ($35 x 80) = $2.800
- Argos platform and data transfer ($140 x 80) = $11.200

Blood gas analyses. Total: $2.500

Rental and installation of electronic monitoring system in chartered vessel. Total: $8.386
- Equipment rental ($999 x 1 month): $999
- Installation costs: $4.552
- Data review: $2.835.

Other (Federal), $3.840

Shipping costs. Total: $3.840
- sPAT tags: $2.240
- Samples: $1.600

Total Direct Charges IPHC: Federal: $223.220

Total Indirect Charges IPHC: Federal: None

Total Charges IPHC: Federal: $223.220

Other Support/In kind Contributions for Organization 1 – International Pacific Halibut Commission:

Personnel/Salaries, $86,799

Principal lead investigator Josep Planas will dedicate 4 months of time (2 months each fiscal year) during the course of this project (total cost $38,986). The other two principal investigators from IPHC (Claude Dykstra, Tim Loher) will dedicate each 2 months of time (1 month each fiscalyear) during the course of the project, (Claude Dykstra $15,802; Tim Loher: $18,8792; total cost combined $34,594).

A lead sampled will be hired for 15 days ($316 x 15 days = $4.736) and two second samplers will also be hired for 15 days ($283 x 15 days x 2 samplers = $8.482).

Personnel/Fringe Benefits, $27,897

The fringe benefit rate is 20% of salary, with $13,567 covering fringe benefits including employer portion of FICA/FICAMED for Josep Planas (PI) and $12,927 for Claude Dykstra and Tim Loher. Fringe benefit ratios vary based on employer-provided health care for spouse and dependents. Fringe benefits for lead sampler correspond to $503 ($34 x 15 days) and for the two second samplers correspond to $900 ($30 x 15 days x 2 samplers).

Supplies, $21.902

Bait: $21.902

Contractual, $87.808

Vessel charter:

- Vessel contract payments: $85.160
- P&I Insurance: $200
- Gear Maintenance: $2.448

Total Other Support provided by International Pacific Halibut Commission for this project is: $224,406

Budget Narrative – Organization 2 – Fisheries, Aquatic Science and Technology (FAST) Laboratory at Alaska Pacific University (APU):

Personnel (Federal Share) – Partial support for Nathan Wolf (NW) and Bradley Harris (BH), MSc student, and student technician: **$18,875**

Year 1:

NW - 0.5 months of support at $11,550/month: $5,775
BH - 0.5 months of support at $11,550/month: $5,775
MSc Student – 2.25 months of support at $2,500/month: $5,625
Student Technician – 2 months of support at $850/month: $1,700

Year 2:

No salary expenses are requested for APU project participants in year 2.

Fringe Benefits (Federal Share) - 10% fringe benefits on partial support for NW and BH: **$1,155**

Year 1:

NWolf - 10% Fringe Cost on 0.5 months of support at $11,550/month: $577
BHarris - 10% Fringe Cost on 0.5 months of support at $11,550/month: $577

Year 2:

No fringe benefits are requested for APU project participants in year 2.

Travel (Federal), $4.867

Year 1:

Sample collection and captive experiment, Seward AK (12 round trips for 2 people): $4.867

Mileage Anchorage - Seward (253 miles RT @ $ 0.54/mile): $1639
Per diem – Seward (12 days @ $269): $3,228

Year 2:

No travel funds are requested for APU project participants in year 2.

Equipment (Federal) - none

Supplies (Federal) - $3,799

Assays for blood determinations. Total: $2,700

- Cortisol ELISA ($270 x 10): $2,700

General laboratory supplies. Total: $1,099

Contractual (Federal), $26,000

Vessel charter for halibut capture (5 days @ $1,800/day): $9,000

Captive experimental, lab, and office facilities at the Seward Marine Center: $17,000

Other (Federal): none

Total Direct Charges APU: Federal: $54,697

Total Indirect Charges APU: Federal: $8,205

APU indirect charges (15% of $54,696.74): $8,205

Total Charges APU: Federal: $62,901

Other Support/In kind Contributions for – Organization 2 – Fisheries, Aquatic Science and Technology (FAST) Laboratory at Alaska Pacific University (APU):

Personnel/Salaries, $97,960

Nathan Wolf (NW) and Bradley Harris (BH) will each dedicate 3 months of time (1 month each in year 1 and 2 month each in year 2) during the course of this project (total cost $69,300).

The Fisheries Science and Aquatic Technologies Laboratory at Alaska Pacific University will dedicate 1 year of MSc student tuition (approximately $10,660) and stipend ($18,000) to a student working on this project (total $28,660).

Personnel/Fringe Benefits, $13,860

The fringe benefit rate is 10% of salary, with $13,860 covering fringe benefits for the 6 months (combined total) of salary time dedicated by NW and BH

Supplies, $1,500.00

General Laboratory supplies: $1,500

Indirect Charges APU, $2,735

APU indirect charges (5% of $54,696.74): $2,735

Total Other Support provided by the Fisheries Aquatic Science and Technology Laboratory at Alaska Pacific University for this project is: $116,055

Budget tables:

IPHC

BUDGET CATEGORIES	1st Year		2nd Year		1st + 2nd Year	
Object Class Categories	**Federal**	**Non-Federal**	**Federal**	**Non-Federal**	**Federal**	**Non-Federal**
a. Personnel	0	49826	0	36973	0	86799
b. Fringe Benefits	0	14584	0	13313	0	27897
c. Travel	1840	0	2380	0	4220	0
d. Equipment	0	0	0	0	0	0
e. Supplies	174410	21902	15864	0	190274	21902
f. Contractual	24886	87808	0	0	24886	87808
g. Construction	0	0	0	0	0	0
h. Other	3840	0	0	0	3840	0
i. Total Direct Charges	204976	174120	18244	50286	223220	224406
j. Indirect Charges	0	0	0	0	0	0
TOTALS	**204976**	**174120**	**18244**	**50286**	**223220**	**224406**

APU

BUDGET CATEGORIES	1st Year		2nd Year		1st + 2nd Year	
Object Class Categories	**Federal**	**Non-Federal**	**Federal**	**Non-Federal**	**Federal**	**Non-Federal**
a. Personnel	18875	51760	0	46200	18875	97960
b. Fringe Benefits	1155	4620	0	9240	1155	13860
c. Travel	4867	0	0	0	4867	0
d. Equipment	0	0	0	0	0	0
e. Supplies	3799	1500	0	0	3799	1500
f. Contractual	17500	0	8500	0	26000	0
g. Construction	0	0	0	0	0	0
h. Other	0	0	0	0	0	0
i. Total Direct Charges	46197	57880	8500	55440	54697	113320
j. Indirect Charges	6930	2310	1275	425	8205	2735
TOTALS	**53126**	**60190**	**9775**	**55865**	**62901**	**116055**

PROJECT TOTALS

BUDGET CATEGORIES	1st Year		2nd Year		1st + 2nd Year	
Object Class Categories	**Federal**	**Non-Federal**	**Federal**	**Non-Federal**	**Federal**	**Non-Federal**
a. Personnel	18875	101586	0	83173	18875	184759
b. Fringe Benefits	1155	19204	0	22553	1155	41757
c. Travel	6707	0	2380	0	9087	0
d. Equipment	0	0	0	0	0	0
e. Supplies	178209	23402	15864	0	194073	23402
f. Contractual	42386	87808	8500	0	50886	87808
g. Construction	0	0	0	0	0	0
h. Other	3840	0	0	0	3840	0
i. Total Direct Charges	251173	232000	26744	105726	277917	337726
j. Indirect Charges	6930	2310	1275	425	8205	2735
TOTALS	**258102**	**234310**	**28019**	**106151**	**286121**	**340461**