Pacific Halibut Multiregional Economic Impact Assessment (PHMEIA): summary of progress

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PURPOSE

To provide an update on the International Pacific Halibut Commission (IPHC) economic study, including progress on developing the economic impact assessment model, state of the collection of primary economic data from Pacific halibut dependent sectors, and plan for the year ahead, and to reiterate the need for active participation of the IPHC stakeholders in developing the necessary data for analysis.

BACKGROUND

Under the Convention, the IPHC's mandate is *optimum* management of the Pacific halibut resource, which necessarily includes an economic dimension. Fisheries economics is an active field of research around the world in support of fisheries policy and management. Adding the economic expertise to the IPHC Secretariat, the IPHC has become the first regional fishery management organization (RFMO) in the world to do so.

The goal of the IPHC economic study is to provide stakeholders with an accurate and all-sectors-encompassing assessment of the economic impact of the Pacific halibut resource in Canada and the United States of America. The intention of this update is to inform on the project progress and reiterate the need for active participation of the IPHC stakeholders in developing the necessary data for analysis.

The economic effects of changes to harvest levels can be far-reaching. Fisheries management policies that alter catch limits have a direct impact on commercial harvesters, but at the same time, there is a ripple effect through the economy. Industries that supply commercial fishing vessels with inputs, generally referred to as *backward-linked industries*, rely on this demand when making decisions related to their production levels and expenditure patterns. For example, vessels making more fishing trips purchase more fuel and leave more money in a local grocery store that supplies crew members' provisions. More vessel activity means more business to vessel repair and maintenance sector or gear suppliers. An increase in landings also brings more employment opportunities, and, as a result, more income from wages is in circulation. When spending their incomes, local households support local economic activity that is indispensable to coastal communities' prosperity.

Changes in the domestic fisheries output, unless fully substituted by imports, are also associated with production adjustments by industries relying on the supply of fish, such as seafood processors. Similarly to the directly affected sector, any change in production by the *forward-linked industry* has a similar ripple effect on its suppliers. The complete path of landed fish, from the hook to the plate, also includes seafood wholesalers and retailers, and, in the case of highly-prized fish such as Pacific halibut, services. Traditionally, the vast majority of Pacific halibut is consumed at white-tablecloth restaurants. Any adjustment in gross revenue generated by these industries resulting from a change in the supply of directly affected fish is further magnifying the economic impact of management decision altering harvest levels.

Similar effects are attributed to the recreational fishing sector. By running their businesses, charter operators generate demand for fuel, bait fish, boat equipment, and fishing trip provisions. They also create employment opportunities and provide incomes that can be spent locally, supporting various local businesses. What is more, anglers themselves contribute to the economy by creating demand for goods and services related to their fishing trips. A number of sectors support tourism relaying on the Pacific halibut fishing, both guided or unguided. These include lodging, local retailers, or restaurants.

Besides shaping a complex combination of local effects, the industries' interlinked nature is generating cross-regional impacts. Economic benefits from the primary area of the resource extraction are leaked when inputs are imported, when wages earned by non-residents are spent outside the place of employment, or when earnings from quota holdings flow to non-resident beneficial owners. At the same time, the inflow of economic benefits to the local economies from outside is occurring when products are exported or local businesses are bringing tourism cash to the region.

Understanding the multiregional impacts of changes to fisheries sectors is now more important than ever considering how globalized it is becoming. Fish harvested on the other side of the globe can be easily found on the shelf or on the menu in the United States or Canada, competing with domestically produced seafood. The United States and Canada imported seafood worth over USD 28.8 billion (CAD 37.4 billion) in 2018 (Statistics Canada, 2020a; US Census, 2020b). On the production side, the origin of inputs to any sector is increasingly distant, implying a gradual shift of economic activity supported by fisheries and seafood industries abroad. While generally cost-effective, such high exposure to international markets makes seafood accessibility fragile to perturbations, as shown by the covid-19 outbreak (OECD, 2020). Fisheries are also at the forefront of exposure to the accelerating impacts of climate change. A rapid increase of the water temperature of the coast of Alaska, termed *the blob*, is affecting fisheries (Cheung and Frölicher, 2020) and may have a profound impact on Pacific halibut distribution. Thus analyzing the sector in a broader context is crucial.

Update on the model development

Economic impacts are typically estimated with the use of an input-output (IO) model. The traditional IO model is used to investigate how changes in final demand affect economic variables such as output, income and employment or contribution to the region's gross domestic product (GDP). This is known as impact analysis. With an adjustment for the shock type, the model can also demonstrate the magnitude of changes in supply-constrained industries such as total allowable catch (TAC) constrained fisheries. Adopting a multiregional approach, the model accommodates the cross-regional trade. The IO model can also be extended to the so-called social accounting matrix (SAM). Adopting SAM, the calculated effects account for labor commuting patterns and residency of beneficial owners of production factors, and as a result, the flow of earnings between regions.

The Pacific halibut multiregional economic impact assessment (PHMEIA) model is a multiregional SAM model describing economic interdependencies between sectors and regions developed with a specific purpose of assessing the economic contribution of Pacific halibut resource to the economy of the United States and Canada. The adopted methodology is an extension from the multiregional SAM model for Southwest Alaska developed by Seung, Waters, and Taylor (2019) and draws on a few decades' worth

of experience in developing IO models with applications to fisheries (for review of relevant literature, please refer to the economic study section on the IPHC website, subsection *Review of economic impact assessment models focused on the fisheries sector*).

The model reflects the interdependencies between eleven major sectors and two Pacific halibut-specific sectors. These include the Pacific halibut fishing sector, as well as the forward-linked Pacific halibut processing sector.[1] The inclusion of the Pacific halibut charter sector is underway. The list of industries considered in the PHMEIA model, as well as the primary commodities they produce, is available in **Table 1**.

The model accounts for interregional spillovers. These represent economic stimulus in the regions other than the one in which the exogenous change is considered. This allows accommodation of increasing economic interdependence of regions and nations. The model considers three primary Pacific halibut producing regions, as well as residual regions to account for cross-boundary effects of fishing in the Pacific Northwest:

- Alaska (AK)
- West Coast (WC – including WA, OR and CA)
- British Columbia (BC)
- Rest of the US (RUS)
- Rest of Canada (ROC)
- Rest of the world (ROW)[2]

By accounting for the economic linkages among these six regions, the study shows the importance of multiregional approaches to measuring economic impacts more accurately. This is particularly important in the context of shared resources and joint management, such as the case of collective management of Pacific halibut by the IPHC. The economic metrics derived from the PHMEIA model range from total economic impact on output along the value chain to impacts on employment and incomes, as well as contribution to the GDP and households' prosperity.

The model adopts a recently published multiregional generalized RAS (MRGRAS) updating technique (Temursho, Oosterhaven and Alejandro, 2019) to develop an up-to-date model that can incorporate partial information on its components while continuing to conform to the predefined balanced structure. This technique can make the multiregional model consistent with aggregated national data[3] and include

[1] As noted by Steinback and Thunberg (2006), there are number of seafood substitutes available to buyers. Thus including impacts beyond processors and wholesalers could be misleading considering that it is unlikely that supply shortage would result in a noticeable change in retail level gross revenues. Data limitations dictate the exclusion of wholesale buyers from the assessment of forward-linked effects.

[2] The ROW region in the model is considered exogenous. This implies that the trade relations with the ROW are not affected by the changes to the Pacific halibut sector considered in this project. While, the full inclusion of ROW component allows for assessment of impact outside Canada and the United States if trade with ROW was to be considered responsive to changes in Pacific halibut sector activity, this is not typically seen in the literature.

[3] For example, data from the National Economic Accounts (NEA). NEA data provide a comprehensive view of national production, consumption, investment, exports and imports, and income and saving. These statistics are best known by summary measures such as gross domestic product (GDP), corporate profits, personal income and spending, and personal saving.

up-to-date estimates from a limited number of focus sectors. For more details on the methodological approach, please refer to the economic study section on the IPHC website (subsection Methodological annex).

The current version of the model is based solely on secondary data sources.[4] As such, the results are conditional on the adopted assumptions for the components for which data were not available. In order to improve the accuracy of the assessment, the IPHC intends to incorporate into the model primary economic data collected directly from members of Pacific halibut dependent sectors (see *Update on the identification of available data sources and primary data collection*), applying the so-called partial-survey method (Miller and Blair 2009, pp. 303). **The subsequent revisions of the model incorporating IPHC-collected data will bring improved estimates on the Pacific halibut sectors' economic impact**.

The model is operational and available for 2014, 2016, and 2018. For more details on the SAM application to the assessment of the impact of the Pacific halibut resource on the economies of Canada and the United States, please refer to the economic study section on the IPHC website (subsection *PHMEIA model*).

[4] I.e. data collected by other parties, not the IPHC.

Table 1. Industries and commodities considered in the PHMEIA model.

	Industry	Primary commodity produced
1	Pacific halibut fishing	Pacific halibut
2	Other fish and shellfish fishing	Other fish and shellfish(1)
3	Agriculture and natural resources (ANR)	Agriculture and natural resources
4	Construction	Construction
5	Utilities	Utilities
6	Pacific halibut processing	Seafood
7	Other fish and shellfish processing	Seafood
8	Food manufacturing (excluding seafood)	Food(2)
9	Manufacturing (excluding food manufacturing)	Manufactured goods (excluding food)
10	Transport	Transport
11	Wholesale	Wholesale
12	Retail	Retail
13	Services (including public administration)	Services (including public administration)
14	Pacific halibut charter sector(2)	Pacific halibut fishing trips

Notes: (1)In the case of Canada case, other fish and shellfish commodity include, besides wild capture production, also aquaculture output produced by aquaculture industry that is a part of the ANR industry. Other fish and shellfish processing industry in the US component, on the other hand, draws more on the ANR commodity that includes aquaculture output. As a result, the misalignment between model components is not concerning as linking these is based on the trade of aggregated seafood commodity. (2)There is a slight misalignment between model components related to the allocation of beverage and tobacco product manufacturing products that, in some cases, are considered non-durable goods and lumped with the food commodity. In the case of the US component, this misalignment is corrected with the use of additional data available from the AMS. No correction is performed for the ROW component, but the global production of beverage and tobacco products is considered of minor importance compared to other food commodities. (2)Inclusion of the Pacific halibut charter sector is underway, the current version of the model accounts only for the economic impact associated with sectors related to commercial Pacific halibut fishing.

Update on the identification of available data sources and primary data collection

The current version of the model is built using a broad set of secondary data sources. These include region-specific commercial fishing outputs in terms of value (DFO, 2020; NOAA, 2020a), wholesale value[5] (AgriService BC, 2018; COAR, 2020), employment and wages[6] (AK DLWD, 2020; Statistics Canada, 2020c), out-of-state employment (Kreiger and Whitney, 2020), seafood trade (NOAA, 2020b; Statistics Canada, 2020a). Additional data are available on recreational harvest and participation in recreational angling (ADFG, 2020; RecFIN, 2020), subsistence and research harvest (IPHC, 2020a). More details on fisheries-related secondary data sources can be found in the economic study section on the IPHC website (subsection *Fisheries-related economic statistics*).

The social accounting matrix, even if built with the purpose of assessing a limited number of sectors (i.e. Pacific halibut dependent industries in this case), also requires input on supply and use by all industries in the economy, as well as supplementary data on household accounts to provide insight into the demographics of the workforce that builds the market for supply and demand of labor and trade

[5] Not available for the US West Coast (confirmed with NOAA NWFSC, personal communication).
[6] Not available for the US West Coast (confirmed with NOAA NWFSC, personal communication).

data to link model components. The following sources serve as a base for the up-to-date estimates (list not exhaustive):

- US Bureau of Economic Analysis (BEA) industry accounts supplemented by BEA Regional Data resources (BEA, 2020) - the USA model component
- United States Census Bureau's Annual Survey of Manufactures (ASM) (US Census 2020a) – complementary statistics on manufacturing establishments
- Provincial-level supply and use tables published by Statistics Canada (Statistics Canada, 2020b) – the Canadian model component
- World Input-Output Tables (Timmer *et al.*, 2015) - base for the rest of the world component
- US Trade provided by the U.S. Census Bureau (US Census, 2020b)
- Canadian International Merchandise Trade Database (Statistics Canada, 2020a)

More accuracy of the results can be achieved by incorporating into the model primary economic data collected directly from members of Pacific halibut dependent sectors. An essential input to the SAM model is data on production structure (i.e. data on the distribution of revenue between profit and expenditure items). Currently, the model uses estimates from species-based NOAA model for Alaska for 2014 (Seung, Waters and Taylor, 2019), as well as Pacific halibut sector estimates for the West Coast provided directly by the authors of the NOAA input-output model for the Pacific Coast fisheries (Leonard and Watson, 2011; Pacific halibut estimates not published). No equivalent detail model is available for British Columbia, although some partial statistics are derived from Edwards and Pinkerton (2020).[7]

A series of surveys to gather information from commercial fishers and processing plant operators has been announced at the AM96. To expand the current model's scope, a survey aimed at charter business owners has been announced at the IM96. The draft survey form has been discussed with a small focus group consisting of charter business owners from all IPHC regions who advised on the questionnaire's clarity and suitability.

New, web-based survey forms are available:

- Here, for Pacific halibut commercial harvesters;
- Here, for Pacific halibut processors;
- Here, for Pacific halibut charter business owners.

IPHC stakeholders are encouraged to fill relevant survey form and contribute to the assessment of the importance of the Pacific halibut resource to the economy of Canada and the United States of America.

Note on data discrepancies

Several discrepancies in crucial economic statistics have been identified. For example, the 2018 Alaska Pacific halibut output value ranges from USD 79.2 mil., as reported by the Alaska Fisheries Information

[7] Edwards and Pinkerton (2020) provide estimates of average operational and fixed cost. These are used to derive value added related to Pacific halibut fishing used in the model.

Network (AKFIN, 2020), to USD 88.1 mil., as reported in the Commercial Operator's Annual Reports (COAR, 2020). Data from fish tickets available through the eLandings (confidential) suggest Pacific halibut output of about USD 78 mil., but there are tickets with missing price data suggesting the need for extrapolation of prices for estimating the total fisheries output value. British Columbia output value ranges from CAD 44.1 mil. reported by the Province of British Columbia (AgriService BC, 2018) to CAD 55.4 mil reported by the Fisheries and Oceans Canada (DFO, 2020). The best effort is made to identify the best data sources for model inputs. Additionally, a table with data comparison between sources will be prepared for verification and/or model input adjustments.

Note on data on Pacific halibut value along the supply chain

The complete path of landed fish, from the hook to the plate, includes, besides harvesters and processors, also seafood wholesalers and retailers, and in the case of highly-prized fish such as Pacific halibut, services when it is served in restaurants. Any change in gross revenue generated by these industries as a result of a change in the supply of directly affected fish is further magnifying the economic impact of management decision altering harvest levels.

Isolating data on Pacific halibut wholesale and retail is challenging as no relevant statistics have been identified. However, it is important to note that there are many seafood substitutes available to buyers. Thus, including economic impacts beyond processors and wholesalers could be misleading when considering that it is unlikely that supply shortage would result in a noticeable change in retail level gross revenues (Steinback and Thunberg, 2006).

Note on primary data collection in the time of the crisis

Recent perturbations in the markets caused by covid-19 serve as an additional argument for considering the broader economic dimension of Pacific halibut's contribution to regional economies. Widespread closure of restaurants, the Pacific halibut's biggest customers, diminished the demand for fish, particularly high-quality fresh fish that fetch higher prices. Lower prices, down in 2020 by up to 30% compared with the previous year (Stremple, 2020), caused a slow first half of the season (Ess 2020). Less harvest activity has repercussions in the economy beyond the harvest sector as it affects also harvest sector suppliers and downstream industries that rely on its output. Outbreaks of covid-19 in fish processing plants (Estus, 2020; Krakow, 2020) also affect economic activity generated regionally by this directly related to the Pacific halibut supply sector. Moreover, seafood processors incur additional costs associated with protective gear, testing, and quarantine accommodations (Ross, 2020; Sapin and Fiorillo, 2020; Welch, 2020).

The pandemic is thought to be a major impediment to successful primary data collection in 2020. The survey's announcement happened shortly before the covid-19 outbreak that shifted the focus of participants to the Pacific halibut fishery. An intensified effort to reach out to commercial vessel operators was made starting July when the IPHC fisheries data specialists (ports) distributed a paper version of the survey. To this date, however, too few responses have been received to make reliable estimates for the sector.

The new edition of the IPHC economic survey has been announced at the IM96. It allows the participants to the Pacific halibut fisheries (commercial and charter sector) to fill the form for 2020, but also retrospectively submit information for 2019. We leave the choice to the survey participants, noting the benefits of filling for both years:

- Data for 2019, covering pre-covid-19 operations, can be considered a baseline suitable for drawing conclusions under normal circumstances and using for predictions.
- Data for 2020, covering an abnormal year of operations, can be used to assess losses incurred by the Pacific halibut sectors, but also sectors' resilience to unfavorable exogenous circumstances. If the project continues and data for 2021 are collected, the project could inform on the response to the crisis and undertake an analysis of the path to recovery.

Note on the inclusion of the recreational sector in the PHMEIA model

There are two components to consider when attempting to assess the full scope of the Pacific halibut resource's economic impact occurring as a result of recreational fishing activities. The first is the contribution to the economy by the charter sector that provides service to anglers. These include services directly related to angling, for example, providing a boat, trip supplies and guides, but also not directly related, for example, hospitality services in case of fly-in lodges that specialize in serving customers interested in Pacific halibut fishing. The economic impact is generated by the sector's demand for inputs from other industries, including manufacturing, professional services (accounting, marketing, etc.) and demand for labor. Assessment of the charter sector economic impact typically requires surveying charter business owners on their revenues and expenditures.

The second component is the contribution of anglers themselves by creating demand for goods and services related to their fishing trips. This includes expenses related to the travel that would otherwise not be incurred (e.g. auto rental, fuel cost, lodging, food, site access fees), as well as money spent on durable goods that are associated with recreational fishing activity, e.g. rods, tackle, outdoor gear, boat purchase, etc. This component applies to both guided and unguided recreational fishing. Assessment of anglers' contribution to the economy typically requires surveying private anglers on their fishing-related expenditures and fishing preferences.

Note on economic impact assessment of subsistence fishing

Previous research suggested that noncommercial or nonmarket oriented fisheries contribution to national GDP is often grossly underestimated, particularly in developing countries (e.g., Zeller, Booth, and Pauly 2006). Subsistence fishing is also important in traditional economies, often built around indigenous communities. Wolfe and Walker (1987) found that there is a significant relationship between the percentage of native population in the community and reliance on wildlife as for a food source in Alaska. However, no comprehensive assessment of the economic contribution of the subsistence fisheries to the Pacific northwest is available. The only identified study, published in 2000 by Wolfe (2000), suggest that the replacement value of the wild food harvests in rural Alaska may be between 131.1 and 218.6 million dollars, but it does not distinguish between different resources and assumes equal replacement expense per lb. Aslaksen et al. (2008) proposed an updated estimate for 2008 based

on the same volume, noting that transportation and food prices have risen significantly between 2000 and 2008 and USD 7 a pound is a more realistic replacement value. This gives the total value of USD 306 million, but the approach rely upon the existence of a like-for-like replacement food (in terms of taste and nutritional value), which is arguably difficult to accept in many cases (Haener *et al.*, 2001) and ignores the deep cultural and traditional context of halibut in particular (Wolfe, 2002). A more recent study by Krieg, Holen, and Koster (2009) suggests that some communities may be particularly dependent on wildlife, consuming annually up to 899 lbs per person, but no monetary estimates are derived. Moreover, although previous research points to the presence of sharing and bartering behavior that occurs in many communities (Wolfe, 2002; Szymkowiak and Kasperski, 2020), the economic and cultural values of these networks have yet to be thoroughly explored.

Glance at the preliminary results

This section summarizes the preliminary outcomes of the PHMEIA model. It is important to note that these are based on **the current version of the model incorporating only secondary data sources**. As such, **the results are conditional on the adopted assumptions for the components for which data were not available and are subject to change**.

The current results incorporate the following changes in comparison to the results presented at the IM96:

- Estimates are revised following a new release of data on NEA accounts for the United States (October-November 2020) and Canada (November 2020).
- The estimates fully incorporate described flows of earnings related to Pacific halibut sector.
- The model incorporates revised production structure for the WC Pacific halibut fishing sector (based on NOAA provided estimates) and for the British Columbia sector (incorporating data on fixed and operational cost from the literature).[8]

The preliminary results suggest that Pacific halibut commercial fishing's total estimated impact in 2018 amounts to USD 281 mil. (CAD 364) in GDP, USD 176 mil. (CAD 228 mil.) in labor income (including estimated USD 21.5 mil / CAD 27.9 mil in wages in the Pacific halibut fishing sector), 4,453 in jobs, and USD 179 mil (CAD 232 mil.) in households income and over USD 666 mil. (CAD 863 mil.) in output. This is about 5.1 times the fishery output value of USD 129 mil. (CAD 168 mil.) recorded for 2018 (DFO, 2020; NOAA, 2020a). The estimate is the total economic impact, the sum of the direct, indirect, and induced effects from changes to the Pacific halibut fishing sector, as well as indirect and induced effects associated with forward-linked industries (Pacific halibut processing sector).

The results suggest that the revenue generated by Pacific halibut at the harvest stage accounts for only a fraction of economic activity that would be forgone if the resource was not available to fishers in the pacific northwest. Besides supporting production by other industries, the sector also contributes to the GDP of Canada and the United States and has a considerable impact on employment in both countries.

[8] Previous version of the model assumed transferability of production structure between regions and adopted estimates for Alaska to other regions. Revised production structure incorporating region-specific information suggest that the value added accounts for a considerably bigger share of landed value in British Columbia than in Alaska. This is one of the main reasons behind changes in the final estimates.

Understanding such a broad scope of impacts is essential for designing policies with desired effects depending on regulators' priorities.

Moreover, the results suggest that incorporating Pacific halibut specific outflows has a considerable impact on results. **Table 2** shows the estimates of economic impact on households in Alaska from the final model contrasted with estimates from the model that does not account for cross-regional flows of earnings. While 1USD of Pacific halibut output in Alaska could generate USD 0.54 USD for Alaskan households, out-of-state employment[9] and flow related to beneficial ownership of Pacific halibut fishing rights in Alaska (i.e. quota holdings) cause this estimate to drop to USD 0.39.

The study's main contribution is the first consistent estimation of both backward and forward-linked effects of fisheries supply changes in a multiregional setup tracing the transmission of impacts internationally.[10] By linking multiple spatial components, the model offers a better understanding of the impacts of changes in shared stock supply.

The complexity of Pacific halibut supply-side restriction in the form of region-based allocations suggests the need for a tool enabling regulators to assess various combinations of TAC allocations. To address this, the results are complemented by an interactive web-based application allowing users to estimate and visualize joint effects based on custom changes simultaneously applied to all IPHC-managed Pacific halibut producing areas. The preliminary version of the tool is available here.

http://iphcecon.westus2.cloudapp.azure.com:3838/ModelApp_azure/

The current version of the tool accounts only for the commercial sector, inclusion of the recreational component is underway.

Besides providing economic impact estimates for broadly-defined regions, the PHMEIA model results can inform the community impacts of the Pacific halibut resource throughout its range. However, while the quantitative analysis is conducted with respect to components that involve monetary transactions, Pacific halibut's value is also in its contribution to the diet through subsistence fisheries and importance to the traditional users of the resource. To native people, traditional fisheries constitute a vital aspect of local identity and a major factor in cohesion. One can also consider the Pacific halibut's existence value as an iconic fish of the Pacific Northwest. While these elements are not quantified at this time, recognizing such an all-encompassing definition of the Pacific halibut resource contribution, the project echoes a broader call to include the human dimension into the research on the impact of management decisions, as well as changes in environmental or stock conditions.

[9] These are preliminary estimates incorporating average out-of-state employment in *Fishing, Hunting and Trapping* sector published by the ADFG (Kreiger and Whitney, 2020). For more accurate results, out-of-state employment in Pacific halibut fishing sector will be estimated from the IPHC economic survey.

[10] While a study analyzing the impact of Pacific salmon fisheries on the economy of both the USA and Canada using the IO approach was identified (Gislason *et al.*, 2017), the models therein are disconnected and do not offer the consistency of an integrated multiregional model.

Table 2 Effect of incorporating Pacific halibut specific outflows - impact on households per 1 USD of Pacific halibut output in Alaska.

	Model with no Pacific halibut specific outflows	Model with Pacific halibut specific outflows
Households in Alaska	0.54	0.39
WC households	0.09	0.16
RUS households	0.31	0.38

Notes: Impacts on households in Canada omitted.

OBJECTIVES

Table 3 summarizes the progress to-date against the IPHC economic study objectives.

Table 3. The study objectives – summary of progress

Objective	**Status***
Item 1: Survey of previous studies and existing information	**---**
Item 1.a: Literature review	**COMPLETED**
Item 1.b: Description of ongoing regular data collection programs	**COMPLETED**
Item 1.c: Collection of primary data – commercial sector survey	**IN PROGRESS**
Item 1.d: Collection of primary data – charter sector survey	**IN PROGRESS**
Item 2: Comprehensive qualitative structural description of the current economics of the Pacific halibut resource	**---**
Item 2.a: Description of the economics of the Pacific halibut commercial sector	**COMPLETED**
Item 2.b: Description of the economics of the Pacific halibut recreational sector	**IN PROGRESS**
Item 2.c: Description of the economics of other Pacific halibut sectors (bycatch, subsistence, ceremonial, research, non-directed)	**IN PROGRESS**
Item 3: Quantitative analysis of the economic impact of the directed Pacific halibut fishery	**---**
Item 3.a: Methodology – a model of the economy	**COMPLETED**
Item 3.b: Methodology – inclusion of the commercial sector in the SAM	**IN PROGRESS**
Item 3.c: Methodology – inclusion of the recreational sector in the SAM	**IN PROGRESS**
Item 3.d: Methodology – economic value of the subsistence use	**See note on the collaboration proposal**
Item 4: Account of the geography of the economic impact of the Pacific halibut sectors	**---**
Item 4.a: Visualization of region-specific economic impacts	**IN PROGRESS**
Item 5: Analysis of the community impacts of the Pacific halibut fishery throughout its range, including all user groups	**---**
Item 5.a: Community impacts assessment of the Pacific halibut fishery	**Data-dependent**

Item 6: Summary of the methodology and results of the IPHC study in comparison to other economic data and reports for the Pacific halibut resource, other regional fisheries, and comparable seafood industry sectors	**---**
Item 6.a: Putting methodology into perspective	**IN PROGRESS**
Item 6.b: Putting results into perspective	

* All items marked as COMPLETED are subject to updates based on the direction of the project and evolution of the situation in the Pacific halibut fisheries.

Extensions depending on availability of inputs

Assessment of community impacts

While some of the local communities particularly rely on fishing-related economic activities, extending the proposed SAM model to the community level (or any other spatial scale) requires significant investment in identifying the economic relationships between different sectors or industries (including both seafood and non-seafood industries) within each broader-defined region, this including deriving estimates on intra-regional trade in commodities and flow of earnings. It is an appealing extension of the current model, but not a feasible avenue for the project with its current time frame.

At this time, for increasing spatial resolution of assessed economic impacts, a simplified approach is suggested. The community impacts can be evaluated based on local exposure to the region's Pacific halibut economic impact, using calculated multiplier effects. Key metrics to consider here are created employment opportunities, wages brought to local circulation, and inflow of capital from outside through offering recreational fishing opportunities. It is also essential to consider the changes in quota distribution. In a system based on transferable quotas, small remote fishing communities are more likely to sell their quota, and what follows is a disproportional economic impact on the spatial scale. Loss of fisheries opportunities in small indigenous communities can be an unintended consequence of quota systems (Carothers, Lew, and Sepez 2010; Szymkowiak, Kasperski, and Lew 2019). Residency of Alaskan quota owners, down to the owner’s address, can be searched using CFEC Public Search Application. Canadian quotas (L fishery), which are vessel-based, can be allocated based on vessel owner’s residency, searchable in Canadian Register of Vessels available through Transport Canada’s Vessel Registration Query System.

While the specifics of the methodology for this component of the study are yet to be determined, the results could be delivered at, for example, port-level, considerably increasing the resolution of the assessed economic impacts. More granularity in results would, however, require more detailed data on revenue from landed harvest. Such data are currently available only for Alaska.[11] Request for access to individual trip revenue data for the US West Coast is pending. For British Columbia, the IPHC is

[11] IPHC has access to fish ticket data for Alaska through eLandings portal (https://elandings.alaska.gov/).

planning to adopt a calculation method based on IPHC-collected logbook data and monthly prices for Prince Rupert and Port Hardy from IPHC Fishery-Independent Setline Survey (FISS) sales.[12]

Study of recreational demand

It is important to note that while it is reasonable to assume that changes in harvest limits have a relatively proportional impact on production by commercial fishers (unless these are dramatic and imply fleet restructure), the effects on the recreational sector are not so straightforward.

A separate study estimating changes in saltwater recreational fishing participation as a response to the changing recreational harvest limits is necessary if the stakeholders are interested in policy impact rather than snapshot economic assessment. Such studies typically require surveying recreational fishers.

There is scope for collaboration here with the NOAA Alaska Fisheries Science Center, where there is ongoing work on estimating the marginal value of a Pacific halibut from the charter fishing sector in Alaska.

If the project was to continue beyond two years, the IPHC could consider surveying recreational fishers. The charter owners who participated in the charter survey pilot implied willingness to help with, e.g., distributing a link to the IPHC survey inquiring about their customers' fishing preferences. How to reach private anglers partaking in unguided fishing was not researched at this time.

Suggested extensions beyond the 2-year time frame

Expanding the static SAM model to a computable general equilibrium model

Relaxing the assumption of fixed technical coefficients by specifying these coefficients econometrically as a function of relative prices of inputs is one of the most compelling extensions to the static IO or SAM models. Such models, generally referred to as computable general equilibrium (CGE) models, require however extensive research to develop credible functional relationships between prices and consumption that would guide economic agents' behavior in the model.

The CGE approach is a preferred way forward when expanding the model usability and considering applying it in conjunction with the Pacific halibut management strategy evaluation (IPHC, 2020b). The dynamic model is well suited to analyze the impact of a broad suite of policies or external factors that would affect the stock over time.

[12] It is important to note that adopting this method, bias is expected with respect to smaller operations, aboriginal licenses, and landings outside main ports (ports other than Prince Rupert and Port Hardy).

Improving the granularity of the SAM model

As mentioned earlier, extending the proposed SAM model by disaggregating currently proposed regions into smaller components would require significant investment in identifying the economic relationships between sectors within each broader-defined region.

However, a good understanding of localized effects could be beneficial to policymakers that are often concerned about community impacts. Fisheries policies have a long history of disproportionally hurting smaller communities, often because potential adverse effects were not sufficiently assessed.

RECOMMENDATIONS

That the Commission:

1) **NOTE** paper IPHC-2021-AM097-14 which provides the Commission with an update on the IPHC economic study, including progress on the development of the economic impact assessment model, state of the collection of primary economic data from Pacific halibut dependent sectors and plan for the year ahead;
2) **NOTE** that the accuracy of economic impact assessment of the Pacific halibut resource depends on broader stakeholders' active participation in developing the necessary data for analysis;
3) **NOTE** that the accuracy of the assessment of community impacts depends on cooperation between Contracting Parties and the IPHC on economic data exchange.

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