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## Pacific Halibut Multiregional Economic Impact Assessment (PHMEIA): project report

PREPARED BY: IPHC SECRETARIAT (B. HUTNICZAK; 6 MAY 2022)

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### PURPOSE

The purpose of this document is to provide the Scientific Review Board (SRB) with the Pacific halibut multiregional economic impact assessment (PHMEIA) model project, which has now concluded. PHMEIA was a core product of the IPHC socioeconomic study directly responding to the Commission's "*desire for more comprehensive economic information to support the overall management of the Pacific halibut resource in fulfillment of its mandate*" (economic study terms of reference adopted at FAC095 ([IPHC-2019-FAC095](#)) and endorsed at AM095 in 2019). The update complements the full project report available as an information paper [IPHC-2022-ECON-01](#). The project was concluded at the 98<sup>th</sup> Session of the IPHC Annual Meeting (AM098) ([IPHC-2022-AM098-R](#), par. 70).

### BACKGROUND

The goal of the [IPHC socioeconomic study](#) was to provide stakeholders with an accurate and all-sectors-encompassing assessment of the socioeconomic impact of the Pacific halibut resource that includes the full scope of Pacific halibut's contribution to regional economies of Canada and the United States of America. To that end, the Secretariat developed the Pacific halibut multiregional economic impact assessment (PHMEIA) model that informs stakeholders on the importance of the Pacific halibut resource and fisheries to their respective communities, but also broader regions and nations, and contributes to a wholesome approach to Pacific halibut management that is optimal from both biological and socioeconomic perspective, as mandated by the [Convention](#).

The PHMEIA is a multiregional social accounting matrix (SAM)-based model developed to assess three **economic impact (EI)** components pertaining to Pacific halibut. The **direct EIs** reflect the changes realized by the direct Pacific halibut resource stock users (fishers, charter business owners), as well as the forward-linked Pacific halibut processing sector (i.e., EI related to downstream economic activities). The **indirect EIs** are the result of business-to-business transactions indirectly caused by the direct EIs. The indirect EIs provide an estimate of the changes related to expenditures on goods and services used in the production process of the directly impacted industries. In the context of the PHMEIA, this includes an impact on upstream economic activities associated with supplying intermediate inputs to the direct users of the Pacific halibut resource stock, for example, impact on the vessel repair and maintenance sector or gear suppliers. Finally, the **induced EIs** result from increased personal income caused by the direct and indirect effects. In the context of the PHMEIA, this includes economic activity generated by households spending earnings that rely on the Pacific halibut resource, both directly and indirectly.

The three EI components are assessed by detailing the within-region production structure of the Pacific halibut sectors and accounting for economic interdependencies between sectors and regions by embedding Pacific halibut sectors into the model of the entire economy of Canada and the USA. To accommodate an increasing economic interdependence of regions and nations, the model accounts



for interregional spillovers. These represent economic stimulus in regions other than the one in which the exogenous change is considered. Economic benefits from the primary area of the resource extraction are leaked when inputs are imported, when wages earned by nonresidents are spent outside the place of employment, or when earnings from quota holdings flow to nonresident beneficial owners. At the same time, there is an inflow of economic benefits to the local economies from when products are exported, or services are offered to non-residents.

While the economic impact is most commonly expressed in terms of output, that is the total production linked (also indirectly) to the evaluated sector, the estimates herein focus on the Pacific halibut contribution to households' prosperity (income by place of residence) as the most meaningful metric to the general population.

## MODEL SETUP

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. While the complete path of landed fish includes, besides harvesters and processors, also seafood wholesalers and retailers, and services when it is served in restaurants, it is important to note that there are many seafood substitutes available to buyers. Thus, including economic impacts beyond wholesale in PHMEIA, as opposed to assessing the snapshot contribution to the GDP along its entire value chain, would be misleading when considering that it is unlikely that supply shortage would result in a noticeable change in retail or services level gross revenues (Steinback and Thunberg, 2006). Supplementary snapshot assessment of Pacific halibut contribution to the GDP along the entire value chain, **from the hook-to-plate**, is available in [IPHC-2021-ECON-06-R01](#) (last updated 6 January 2022).

The extended model (referred here as PHMEIA-r) introduces to the SAM also the saltwater charter sector that is disaggregated from the services-providing industry. The estimates assume that the economic impact of Pacific halibut charter fishing is equivalent to estimating the total economic loss resulting from the saltwater charter sector in each region shrinking by share of Pacific halibut effort in total effort. The results for the charter sector, however, should be interpreted cautiously because of the uncertainty on how much of the saltwater angling effort directly depends on Pacific halibut.

The list of industries considered in the PHMEIA and PHMEIA-r models, as well as the primary commodities they produce, is available in **Table 1**. Production by these industries is allocated between 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)
- US West Coast (WOC – including WA, OR, and CA)
- British Columbia (BC)
- Rest of the United States (US-r)
- Rest of Canada (CA-r)



- Rest of the world (ROW)<sup>1</sup>

The adopted methodology is an extension from the multiregional SAM model for Southwest Alaska developed by Seung, Waters, and Taylor (2019) (see [IPHC-2021-ECON-03](#) for details on adopted methodology) and draws on a few decades' worth of experience in developing IO models with applications to fisheries (see [IPHC-2021-ECON-01](#)). Model description can be also found in the [economic study section of the IPHC website](#). The complete model documentation (project report) is available as an information paper ([IPHC-2022-ECON-01](#)).

**Table 1:** Industries and commodities considered in the PHMEIA and PHMEIA-r models.

	Industry	Primary commodity produced
1	Pacific halibut fishing	Pacific halibut
2	Other fish and shellfish fishing	Other fish and shellfish <sup>(1)</sup>
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 manufacturing)	Food (excluding seafood) <sup>(2)</sup>
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	Saltwater charter sector <sup>(3)</sup>	Saltwater fishing trips

Notes: <sup>(1)</sup>In the case of Canada, other fish and shellfish commodity includes, besides wild capture production, also aquaculture output produced by the aquaculture industry that is a part of the ANR industry. Other fish and shellfish processing industry in the USA component, on the other hand, draws more on the ANR commodity that includes aquaculture output. However, this misalignment between model components is not concerning as linking these is based on the trade of aggregated seafood commodity. <sup>(2)</sup>There is a slight misalignment between model components related to the allocation of beverage and tobacco manufacturing products that, in some cases, are considered non-durable goods and lumped with the food commodity. In the case of the USA component, this misalignment is corrected with the use of additional data available from the Annual Survey of Manufactures (ASM) (US Census, 2021). <sup>(3)</sup>Saltwater charter sector extension included in PHMEIA-r model. Model results rely on the estimated share of the sector output that directly depends on Pacific halibut.

Demand for goods and services related to anglers' fishing trips, both guided and unguided, also contributes to the economy. In addition to economic impact related to Pacific halibut sectors, PHMEIA-derived multipliers are used to estimate economic impact related to marine angler expenditures on fishing trips (travel, lodging, other trip-related expenses) and durable goods (rods, tackle, boat purchase, other fishing equipment and accessories, second home, or additional vehicle purchase).

<sup>1</sup> The ROW region in the model is considered exogenous. This implies that the trade relations with the ROW are unaffected by the changes to the Pacific halibut sectors considered in this project. While the full inclusion of the 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.



## THE MODEL

The current PHMEIA incorporates a series of improvements to the economic impact assessment<sup>2</sup> model presented to the SRB019. These are as follows:

- (1) The model uses an updated set of data, and estimates are now available for 2020. At the SRB019, the estimates were available up to 2019. Note that using the updated set of data implies re-estimation of the model for the entire analyzed period (2014-2020) using revised 2014-2019 data. Thus, final estimates for earlier years may have changed. However, no substantial adjustments have been recorded. Extending the model to 2020 illustrates the Covid-19 impact on the Pacific halibut fisheries.
- (2) The model incorporates improved estimates of the flow of earnings related to all Pacific halibut sectors in the model. See [IPHC-2021-ECON-02-R03](#) for the compilation of data on the flows of benefits in the Pacific halibut sectors. These are particularly pronounced in Alaska where substantial flows are identified from harvest location to buyer's headquarters, from the landing area to vessel owner residence and quota holder residence, and from sport fishing location to Charter Halibut Permit owner residence.
- (3) The latest update of the PHMEIA provides refined estimates of community effects. The model informs on the county-level economic impacts in Alaska and highlights areas particularly dependent on Pacific halibut fishing-related economic activities. The current model update makes use of regional COAR (COAR, 2021) data for assessment of the spatial distribution of the processing sector contribution to the economy of each Alaskan county (an improvement from results presented in [IPHC-2021-SRB019-09](#)).
- (4) The extended model (labeled PHMEIA-r) provides estimates for the saltwater charter sector that is disaggregated from the services-providing industry.
- (5) The model incorporates estimates of angler expenditures on fishing trips and durable goods. These are used in conjunction with an estimate of the share of marine angler effort that relies directly on the Pacific halibut stock.
- (6) The model adopts an improved production structure for commercial fishing in British Columbia making use of data on quota lease price (Castlemain, 2019).
- (7) This update on the PHMEIA development is supplemented by an analysis of the formation of the price paid for Pacific halibut products by final consumers (end-users) that is intended to provide a better picture of Pacific halibut contribution to the GDP along the entire value chain, **from the hook-to-plate** ([IPHC-2021-ECON-06-R01](#)).<sup>3</sup>

It is important to note that the model continues to rely heavily on secondary data sources,<sup>4</sup> and as such, the results are conditional on the adopted assumptions for the components for which up-to-date data are not available (details on data inputs are available in [IPHC-2021-ECON-02-R03](#)). That said, the

<sup>2</sup> While this type of assessment is typically termed "economic impact assessment," calculated alongside the impact in terms of output also the impact on employment and wages, and households' prosperity, introduce a broader socioeconomic context.

<sup>3</sup> This analysis will be further refined as a part of collaboration with NOAA Alaska Fisheries Science Center on market profiles for Alaska Groundfish.

<sup>4</sup> That is data collected by other parties, not the IPHC.



Secretariat made the best use of data collection programs of national and regional agencies, academic publications on the topic, and grey literature reporting on fisheries in Canada and the United States of America. The model also uses a set of non-fisheries data inputs described in [IPHC-2021-ECON-07](#).

### PRIMARY DATA COLLECTION

More accurate EI estimates could be achieved by incorporating into the model more extensively 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, or the origin of production inputs). The IPHC is collecting these data directly from stakeholders since the AM096 through the web-based survey available:

- [Here](#), for Pacific halibut commercial harvesters;
- [Here](#), for Pacific halibut processors; and
- [Here](#), for Pacific halibut charter business owners.

However, it should be recognized that the project was challenged by the Covid-19 pandemic that impacted the components directly dependent on the inputs from stakeholders.

### STUDY OBJECTIVES

[Appendix A](#) summarizes the progress against the IPHC economic study objectives, as first defined in [IPHC-2020-IM096-14](#), but now concluded.

### PHMEIA MODEL RESULTS

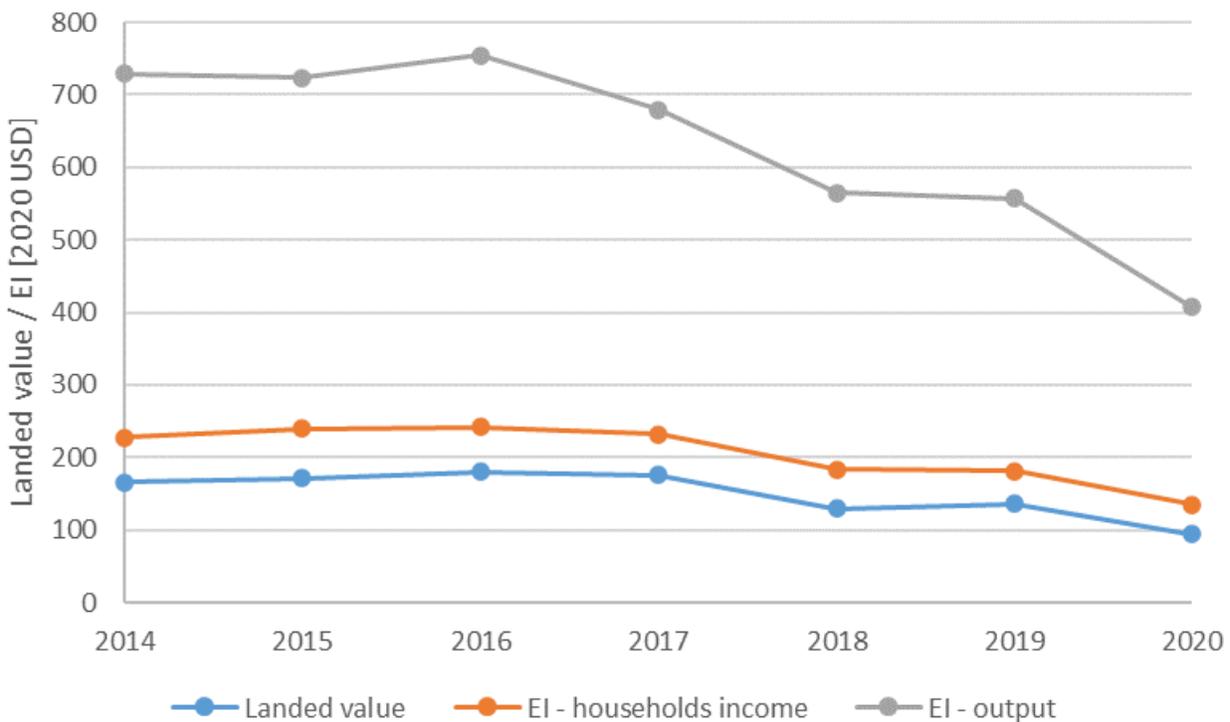
The model results suggested that Pacific halibut commercial fishing's total estimated impact in 2019 amounts to USD 196 mil. (CAD 260 mil.) in households' earnings,<sup>5</sup> including an estimated USD 52.5 mil (CAD 69.7 mil) in direct earnings in the Pacific halibut fishing sectors and USD 12.2 mil. (CAD 16.1 mil.) in the processing sector. This translates to USD 179 mil (CAD 238 mil.) in household income (**Table 2**). Income reflects earnings adjusted for any transfers, including interregional spillovers, i.e. income is related to the place of residence, not the place of work.

Detailed results are provided for 2019 as this represents a more typical year for the economy. The estimates for 2020 suggest that Pacific halibut commercial sectors' contribution to households decreased by 25%, and output related to Pacific halibut commercial fishing decreased by 27%. **Figure 1** depicts EI estimates for Pacific halibut commercial fishing for 2014-2020 in comparison with landed value. To make the values comparable over time, the estimates are adjusted for inflation.<sup>6</sup>

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<sup>5</sup> Earnings include both employee compensation and proprietors' income.

<sup>6</sup> Using the GDP deflator data published by the Organisation for Economic Co-operation and Development (OECD, 2021). The estimates are expressed in 2020 USD.



**Figure 1:** Pacific halibut commercial fishing EI estimates for 2014-2020 in comparison with landed value in mil 2020 USD.

PHMEIA model also informs on the economic impact by county (limited to Alaska), highlighting regions where communities may be particularly vulnerable to changes in the access to the Pacific halibut resource. In 2019, from USD 23.7 mil. (CAD 31.4 mil.) of direct earnings from Pacific halibut commercial sectors in Alaska, 70% was retained in Alaska.<sup>7</sup> These earnings were unevenly distributed between Alaskan counties (**Figure 2**). The most direct earnings per dollar landed are estimated for Ketchikan Gateway, Petersburg and Sitka counties, while the least for Aleutians East, Yakutat and Aleutians West counties. Low earnings per 1 USD of Pacific halibut landed in the county are a result of the outflow of earnings related to vessels' home base, vessels' ownership and quota ownership, processing locations, and processing companies' ownership.

The total contribution of the Pacific halibut charter sector to household income is assessed at USD 42 mil. (CAD 56 mil.) for 2019. Accounting for angler expenditures adds another USD 108 mil. (CAD 143 mil.) to the economic impact of the recreational sector. This translates into 19% less for the charter sector and 45% less for the recreational sector overall in comparison with the commercial sector when looking at impact per USD of landed value (for the commercial sector) and USD spent (for the

<sup>7</sup> Community effects assessment is currently limited to Alaska. The feasibility of a similar assessment for other regions is under investigation. For example, Canadian quotas (L fishery), which are vessel-based, can be allocated based on vessel owner's residency, searchable in the Canadian Register of Vessels available through Transport Canada's Vessel Registration Query System.



recreational sector, including trip costs and expenditures on durable goods). This is not surprising since the commercial sector's production supports not only suppliers to the harvesting sector, but also the forward-linked processing sector (thus, also households employed by these sectors). Recreational sector results, on the other hand, to a large degree are driven by expenditures on goods that are often imported, consequently supporting households elsewhere.

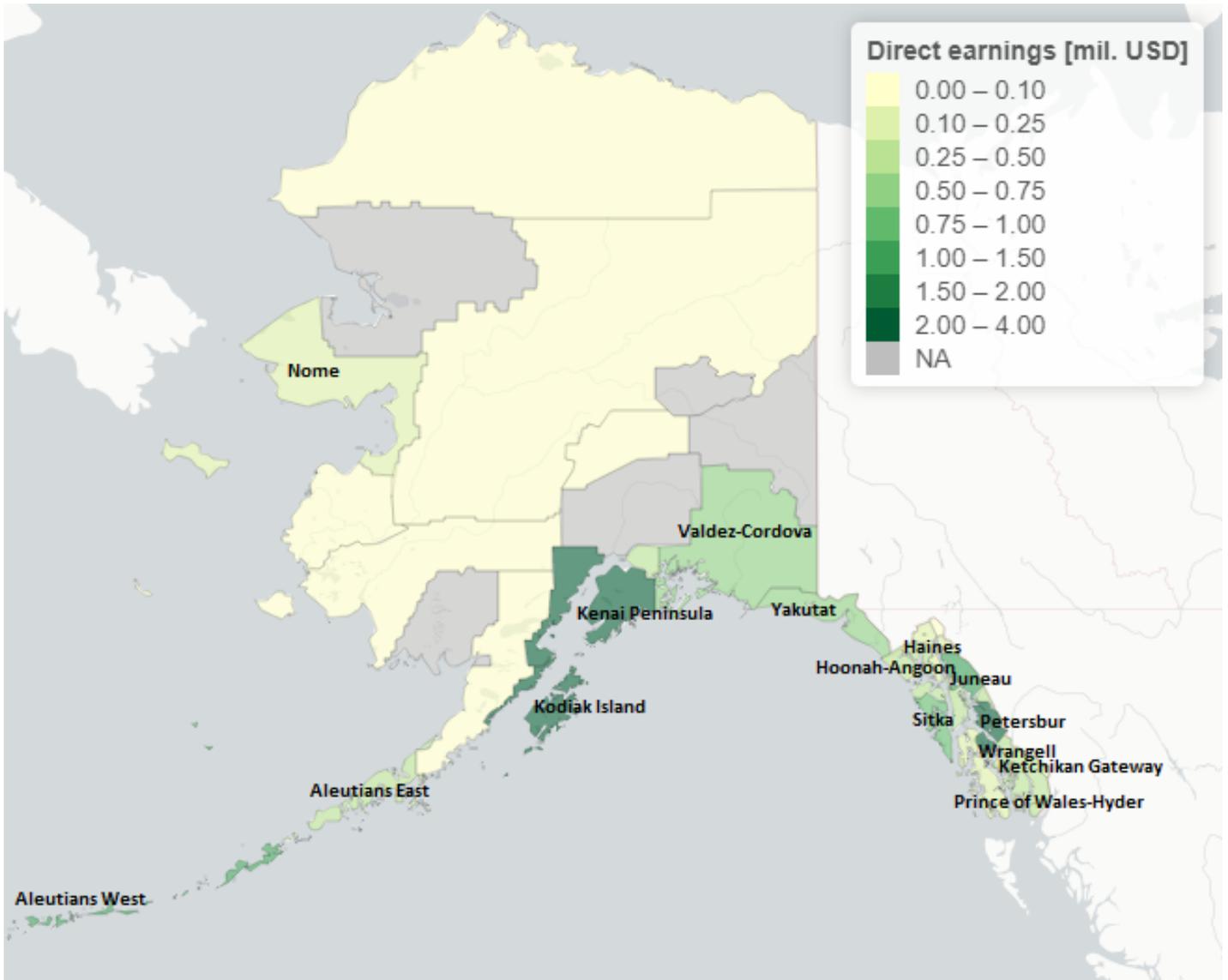
A somewhat different picture emerges when comparing EI per pound of Pacific halibut removal counted against allowed catch by area in the stock assessment. This measure is 63% higher for the charter sector, and more than double for the recreational sector overall when compared with the commercial sector. These differences, however, are less pronounced when focusing only on the EI retained within the harvest region (56% and 139%, respectively).

It should also be noted, however, that this analysis should not be used as an argument in sectoral allocations discussions because, as a snapshot analysis, it does not reflect the implications of shifting supply-demand balance. Participation in sport fishing do not typically scale in a linear fashion with changes to harvest limits.

**Table 2: Economic impact on households**

<b>Economic impact</b>	<b>Unit</b>	<b>Commercial</b>	<b>Charter<sup>(1)</sup></b>	<b>Recreational</b>
EI on households	Total in mil. USD/CAD	179.1/237.6	42.2/55.9	146.9/194.9
EI locally (excludes spillovers)	Total in mil. USD/CAD	114.1/151.4	27.6/36.6	79.0/104.9
EI on households	USD/CAD per 1 USD/CAD of landed value/ 1 USD/CAD spent	1.34	1.08	0.74 <sup>(2)</sup>
EI locally (excludes spillovers)	USD/CAD per 1 USD/CAD of landed value/ 1 USD/CAD spent	0.85	0.71	0.40 <sup>(2)</sup>
EI on households	USD/CAD per 1 lb of removals	7.4/9/8	12.0/15.9 <sup>(3)</sup>	20.9/27.7
EI locally (excludes spillovers)	USD/CAD per 1 lb of removals	4.7/6.2	7.3/9.7 <sup>(3)</sup>	11.2/14.9

Notes: <sup>(1)</sup>This includes only the economic impact generated through businesses offering charter trips, i.e., it excludes the impact of angler expenditures other than charter fees. <sup>(2)</sup>In A considerable share of angler expenditures originates from import, which drives the estimate down. <sup>(3)</sup>Charter sector impact per 1 lb of removals was based on EI on households for Alaska where removals estimates are clearly divided between guided and unguided sectors.

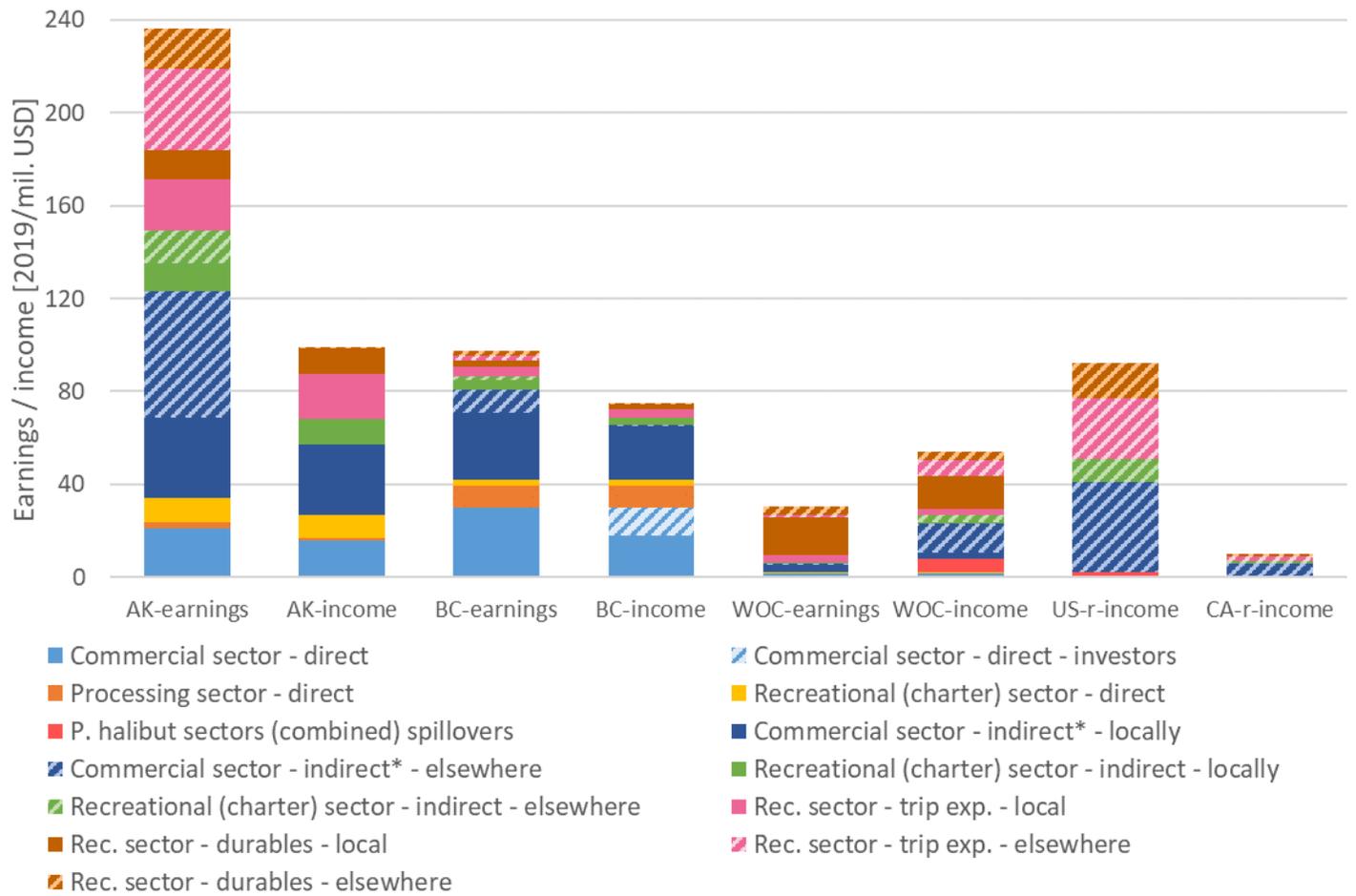


Notes: Alaska retains 70% of direct earnings within the state.

**Figure 2:** County-level estimates of direct earnings in the Pacific halibut commercial sectors in Alaska in 2019.

**Figure 3** depicts the impact of Pacific halibut commercial and recreational fishing on household earnings and income, highlighting the importance of considering cross-regional effects. Earnings estimates (bars with ‘-earnings’ suffix) summarize economic impact by place of work (i.e., where the fishing activity occurs). Income estimates (bars with ‘-income’ suffix) reflect earnings after adjustments for cross-regional flows, i.e., provide estimates by the place of residence of workers, business owners, or owners of production factors (i.e., quota or permit owners).

Results in terms of output, depicted in a similar fashion, are available in [Appendix B](#).



Notes: Legend description available in Box 1. Figure omits the impact on ROW (marginal). \*Commercial indirect effects include processing.

**Figure 3:** Pacific halibut impact on household earnings and income (2019).



**Box 1: Figure 3 legend description**

- a) **Commercial sector – direct:** includes earnings and income directly attributable to the Pacific halibut commercial fishing sector within the indicated region.
- b) **Commercial sector - direct – investors:** indicates the share of the income described in **Commercial sector – direct** that is retained in the region, but flows from the fishing sector to investors. This component captures the value of the leased quota paid to non-fishing stakeholders.
- c) **Processing sector – direct:** includes earnings and income directly attributable to the Pacific halibut processing sector within the indicated region.
- d) **Recreational (charter) sector – direct:** includes earnings and income directly attributable to businesses offering Pacific halibut sport fishing within the indicated region.
- e) **P. halibut sectors (combined) spillovers:** include income attributable to Pacific halibut sectors (commercial fishing, processing, sport fishing) that leaks from the region where the activity occurs as a result of cross-regional flows.
- f) **Commercial sector - indirect\*\* - locally:** includes combined indirect and induced impact on earnings and income resulting from changes in business-to-business transactions and personal income caused by Pacific halibut commercial and processing sector. This component includes only EI resulting from fishing activity in the specified region occurring locally (i.e., in the same region).
- g) **Commercial sector - indirect\*\* - elsewhere:** as above, but includes impact on earnings resulting from fishing activity in the specified region occurring elsewhere ('-earnings' bars), and impact on income resulting from fishing activity elsewhere realized in the specified region ('-income' bars).
- h) **Recreational (charter) sector - indirect – locally:** includes combined indirect and induced impact on earnings and income resulting from changes in business-to-business transactions and personal income caused by the Pacific halibut charter sector. This component includes only EI resulting from fishing activity in the specified region occurring locally (i.e., in the same region).
- i) **Recreational (charter) sector - indirect – elsewhere:** as above, but includes impact on earnings resulting from fishing activity in the specified region occurring elsewhere ('-earnings bars), and impact on income resulting from fishing activity elsewhere realized in the specified region ('-region' bars).
- j) **Rec. sector - trip exp. – local:** includes an estimate of the economic contribution of Pacific halibut-dependent angler trip expenditures on earnings and income that is realized locally, i.e., within the region where the fishing activity is occurring.
- k) **Rec. sector - trip exp. – elsewhere:** includes an estimate of the economic contribution of Pacific halibut-dependent angler trip expenditures to earnings elsewhere ('-earnings' bars) or income within the indicated region realized as a result of fishing activity elsewhere ('-income' bars).
- l) **Rec. sector - durables – local:** includes an estimate of the economic contribution of Pacific halibut-dependent angler expenditures on durable goods on earnings and income that is realized locally, i.e., within the region where the fishing activity is occurring.
- m) **Rec. sector - durables – elsewhere:** includes an estimate of the economic contribution of Pacific halibut-dependent angler expenditures on durable goods to earnings elsewhere ('-earnings' bars) or income within the indicated region realized as a result of fishing activity elsewhere ('-income' bars).

**ECONOMIC IMPACT VISUALIZATION TOOL**

The section on PHMEIA and PHMEIA-r results focuses on the economic impact on households. However, the EI can be expressed with various other policy-relevant metrics. In addition to household welfare impacts, PHMEIA provides estimates in terms of output, compensation of employees, contribution to the gross domestic product (GDP), and employment opportunities. Regulators and stakeholders may be also interested in assessment of various combinations of regional allocations of mortality limits, impact on a subset of sectors, or looking for estimates of localized impacts disproportionately hurting a subset of communities. The full set of PHMEIA and PHMEIA-r results can



be viewed through our [economic impact visualization tool](#).<sup>8</sup> The use of this interactive web-based application can be guided by the PHMEIA app manual ([IPHC-2021-ECON-04-R02](#)).

### **ECONOMIC IMPACT 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 the native population in the community and reliance on wildlife as 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), suggests 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 relies 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 the Pacific 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.

The subsistence component of the study is a subject of a collaborative project with NOAA Alaska Fisheries Science Center: Fish, Food, and Fun - Exploring the Nexus of Subsistence, Personal Use, and Recreational Fisheries in Alaska (SPURF project).

### **FINAL REMARKS**

The PHMEIA model fosters stakeholders' better understanding of a broad scope of regional impacts of the Pacific halibut resource. Leveraging multiple sources of socioeconomic data, it provides essential input for designing policies with desired effects depending on regulators' priorities. By tracing the socioeconomic impacts cross-regionally, the model accommodates the transboundary nature of the Pacific halibut and supports joint management of a shared resource, such as the case of collective management by the IPHC. Moreover, the study informs on the vulnerability of communities to changes in the state of the Pacific halibut stock throughout its range, highlighting regions particularly dependent on economic activities that rely on Pacific halibut. A good understanding of the localized effects is pivotal to policymakers who are often concerned about community impacts, particularly in terms of

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<sup>8</sup> The tool is available at: [http://iphcecon.westus2.cloudapp.azure.com:3838/ModelApp\\_azure/](http://iphcecon.westus2.cloudapp.azure.com:3838/ModelApp_azure/) (full link for printed version).



impact on employment opportunities and households' welfare. Fisheries policies have a long history of disproportionately hurting smaller communities, often because potential adverse effects were not sufficiently assessed (Carothers, Lew, and Sepez 2010; Szymkowiak, Kasperski, and Lew 2019).

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. On average, in 2019, one USD/CAD of Pacific halibut commercial landings was linked to over four USD/CAD-worth economic activity in Canada and the United States and contributed USD/CAD 1.3 to households. In the recreational sector, one USD/CAD spent by recreational anglers was linked to USD/CAD 2.3 circulating in the economy and USD/CAD 0.7 impact on households. The total economic activity linked to Pacific halibut sectors is estimated at USD 1,014 mil. (CAD 1,346 mil), and contribution to households at USD 326 mil. (CAD 432 mil.), highlighting how important Pacific halibut is to regional economies. The estimates of county-level earnings in Alaska were unevenly distributed, but most importantly to resource managers and policymakers, the model suggests that the local earnings were often not aligned with how much was landed within the county.

Understanding the complex interactions within the fisheries sectors is now more important than ever considering how globalized it is becoming. Local products compete on the market with a large variety of imported seafood. High exposure to international markets makes seafood accessibility fragile to perturbations, as shown by the covid-19 outbreak (OECD, 2020). Pacific halibut contribution to households' income dropped by a quarter throughout the pandemic. While signs of strong recovery were present in 2021 (Fry, 2021), the study calls attention to Pacific halibut sectors' exposure to external factors beyond stock condition. Fisheries are also at the forefront of exposure to the accelerating impacts of climate change. A rapid increase in 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.

Integrating economic approaches with stock assessment and management strategy evaluation (MSE) can assist fisheries in bridging the gap between the current and the optimal economic performance without compromising the stock biological sustainability. Economic performance metrics presented alongside already developed biological/ecological performance metrics bring the human dimension to the research products, and could add to the IPHC's portfolio of tools for assessing policy-oriented issues (as requested by the Commission, [IPHC-2021-AM097-R](#), AM097-Req.02). Moreover, the study can also inform on socioeconomic drivers (human behavior, human organization) that affect the dynamics of fisheries, and thus contribute to improved accuracy of the stock assessment and the MSE (Lynch, Methot and Link, 2018). As such, it can contribute to research integration at the IPHC (as presented in [IPHC-2021-IM097-12](#)) and provide a complementary resource for the development of harvest control rules.

Lastly, 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.

## RECOMMENDATION/S

That the SRB:

- 1) **NOTE** paper IPHC-2022-SRB020-09 which provides the status of the Pacific halibut multiregional economic impact assessment (PHMEIA), now concluded.

## LITERATURE

Aslaksen, I. *et al.* (2008) 'Interdependency of subsistence and market economies in the Arctic', in *The Economy of the North*. Statistics Norway. Available at: [http://www.ssb.no/english/subjects/00/00/30/sa84\\_en/kap5.pdf](http://www.ssb.no/english/subjects/00/00/30/sa84_en/kap5.pdf).

Carothers, C., Lew, D. K. and Sepez, J. (2010) 'Fishing rights and small communities: Alaska halibut IFQ transfer patterns', *Ocean and Coastal Management*, 53(9), pp. 518–523. doi: 10.1016/j.ocecoaman.2010.04.014.

Castlemain (2019) *Analysis of commercial fishing licence, quota, and vessel values: Prepared for Fisheries and Oceans Canada, Pacific region*.

Cheung, W. W. L. and Frölicher, T. L. (2020) 'Marine heatwaves exacerbate climate change impacts for fisheries in the northeast Pacific', *Scientific Reports*, 10(1), pp. 1–10. doi: 10.1038/s41598-020-63650-z.

COAR (2021) *Commercial Fishing Reporting, Commercial Operator's Annual Reports*. Available at: <https://www.adfg.alaska.gov/index.cfm?adfg=fishlicense.coar>.

Fry, C. (2021) 'Seawatch: Halibut prices soaring', *Homer News*. Available at: <https://www.homernews.com/business/seawatch-halibut-prices-soaring/>.

Haener, M. K. *et al.* (2001) 'Can Stated Preference Methods be used to Value Attributes of Subsistence Hunting by Aboriginal Peoples? A Case Study in Northern Saskatchewan', *American Journal of Agricultural Economics*, 83(5), pp. 1334–1340. doi: <https://doi.org/10.1111/0002-9092.00287>.

Krieg, T. M., Holen, D. L. and Koster, D. (2009) *Subsistence harvests and uses of wild resources in Igiugig, Kokhanok, Koliganek, Levelock, and New Stuyahok, Alaska, 2005*.

Lynch, P. D., Methot, R. D. and Link, J. S. (2018) 'Implementing a Next Generation Stock Assessment Enterprise: Policymakers' Summary', *NOAA Technical Memorandum NMFS-F/SPO-183*.

OECD (2020) 'Fisheries, aquaculture and COVID-19: Issues and Policy Responses', *Tackling Coronavirus (Covid-19)*.

OECD (2021) *Main Economic Indicators - complete database, Main Economic Indicators (database)*. Available at: <https://doi.org/10.1787/data-00052-en>.



- Seung, C. K., Waters, E. and Taylor, M. L. (2019) 'Developing a Multi-Regional Social Accounting Matrix (MRSAM) for Southwest Alaska Fisheries', *NOAA Technical Memorandum NMFS-AFSC*, 399.
- Steinback, S. R. and Thunberg, E. M. (2006) 'Northeast Region Commercial Fishing Input-Output Model', *NOAA Technical Memorandum NMFS-NE*, 188.
- Szymkowiak, M. and Kasperski, S. (2020) 'Sustaining an Alaska Coastal Community: Integrating Place Based Well-Being Indicators and Fisheries Participation', *Coastal Management*, pp. 1–25. doi: 10.1080/08920753.2021.1846165.
- Szymkowiak, M., Kasperski, S. and Lew, D. K. (2019) 'Identifying community risk factors for quota share loss', *Ocean and Coastal Management*, 178, p. 104851. doi: 10.1016/j.ocecoaman.2019.104851.
- US Census (2021) *Annual Survey of Manufactures, United States Census Bureau*. Available at: <https://www.census.gov/programs-surveys/asm.html>.
- Wolfe, R. J. (2000) *Subsistence in Alaska : A Year 2000 Update*.
- Wolfe, R. J. (2002) *Subsistence halibut harvest assessment methodologies. Report prepared for the National Marine Fisheries Service, Sustainable Fisheries Division*. San Marcos, CA.
- Wolfe, R. J. and Walker, R. J. (1987) 'Subsistence Economies in Alaska: Productivity, Geography and Development Impacts', *Arctic Anthropology*, 24(2), pp. 56–81.
- Zeller, D., Booth, S. and Pauly, D. (2006) 'Fisheries Contributions to the Gross Domestic Product: Underestimating Small-scale Fisheries in the Pacific', *Marine Resource Economics*, 21(4).



**Appendix A**  
**The study objectives – summary of progress and notes on outputs**

<b>Objective</b>	<b>Status*</b>	<b>Output</b>
<b>Item 1: Survey of previous studies and existing information</b>	---	---
<b>Item 1.a:</b> Literature review	<b>COMPLETED</b>	See <a href="#">IPHC-2021-ECON-01</a> (last revised on 2/9/2021) and project report ( <a href="#">IPHC-2022-ECON-01</a> )
<b>Item 1.b:</b> Description of ongoing regular data collection programs	<b>COMPLETED</b>	See <a href="#">IPHC-2021-ECON-02-R03</a> (last revised on 12/31/2021) and project report ( <a href="#">IPHC-2022-ECON-01</a> )
<b>Item 1.c:</b> Collection of primary data – commercial sector survey	<b>IN PROGRESS</b>	Developed in response to the identified data gaps: <a href="#">Commercial Vessel Expenditures Survey</a> <a href="#">Processor Expenditures Survey</a> Survey results available via <a href="#">IPHC economic survey results app</a>
<b>Item 1.d:</b> Collection of primary data – charter sector survey	<b>IN PROGRESS</b>	Developed in response to the identified data gaps: <a href="#">Charter Sector Expenditures Survey</a> Survey results available via <a href="#">IPHC economic survey results app</a>
<b>Item 2: Comprehensive qualitative structural description of the current economics of the Pacific halibut resource</b>	---	---
<b>Item 2.a:</b> Description of the economics of the Pacific halibut commercial sector	<b>COMPLETED</b>	See <a href="#">Economic Research section of the IPHC website</a> and project report ( <a href="#">IPHC-2022-ECON-01</a> )
<b>Item 2.b:</b> Description of the economics of the Pacific halibut recreational sector	<b>COMPLETED</b>	See <a href="#">Economic Research section of the IPHC website</a> and project report ( <a href="#">IPHC-2022-ECON-01</a> )
<b>Item 2.c:</b> Description of the economics of other Pacific halibut sectors (bycatch, subsistence, ceremonial, research, non-directed)	<b>IN PROGRESS</b>	See section on subsistence and ceremonial fishing in project report ( <a href="#">IPHC-2022-ECON-01</a> ) The economic impact of bycatch (U32) was considered in the size limits paper ( <a href="#">IPHC-2021-AM097-09</a> ) Note also additional work proposed in the <i>IPHC's 5-year program of integrated research and monitoring (2022-26)</i> ( <a href="#">IPHC-2021-IM097-12</a> )



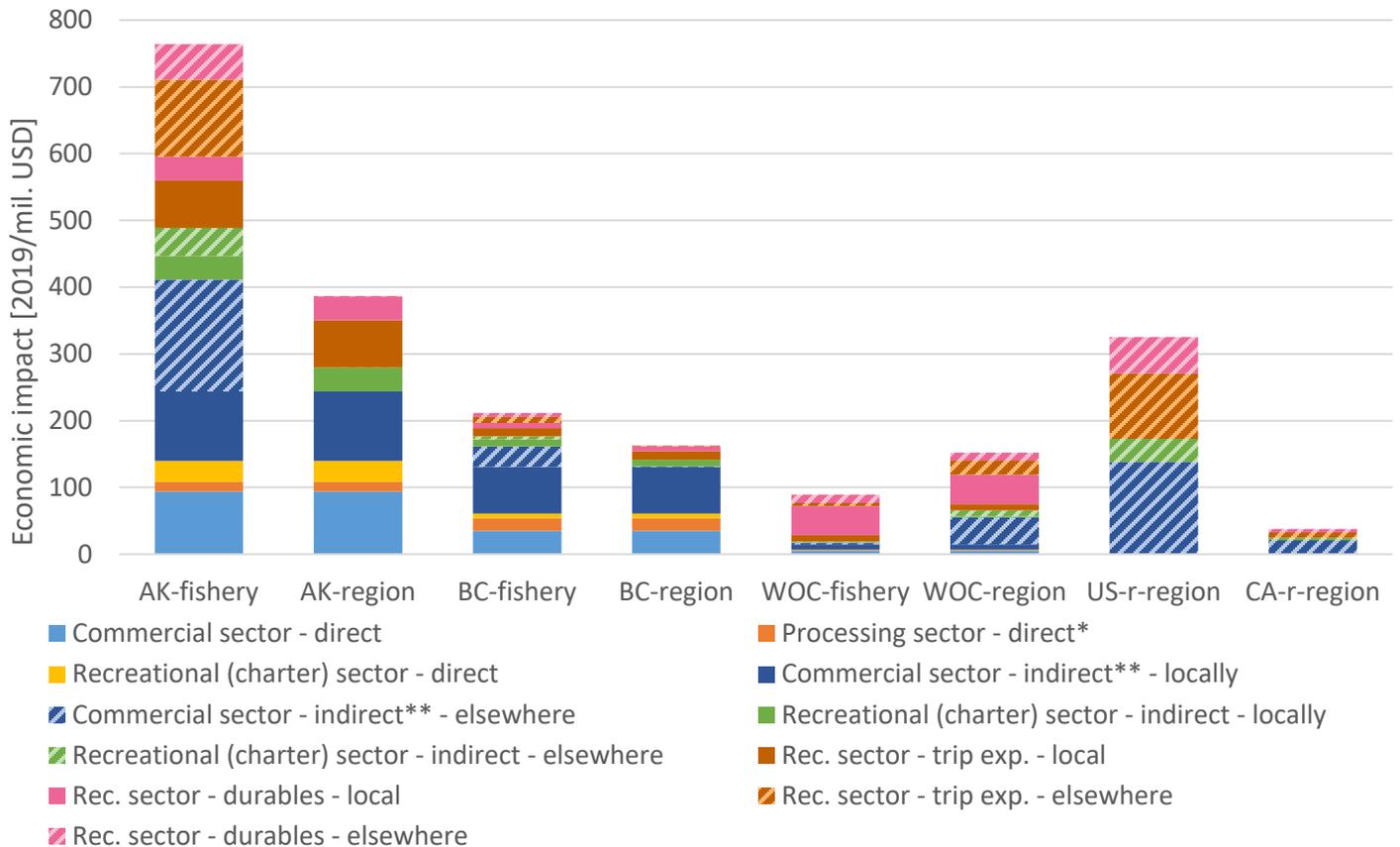
<b>Item 3: Quantitative analysis of the economic impact of the directed Pacific halibut fishery</b>	---	---
<b>Item 3.a:</b> Methodology – a model of the economy	<b>COMPLETED</b>	See details in project report ( <a href="#">IPHC-2022-ECON-01</a> )
<b>Item 3.b:</b> Methodology – inclusion of the commercial sector in the SAM	<b>COMPLETED</b> <sup>(1)</sup>	See project report ( <a href="#">IPHC-2022-ECON-01</a> ) and <a href="#">Economic Research section of the IPHC website</a>
<b>Item 3.c:</b> Methodology – inclusion of the recreational sector in the SAM	<b>COMPLETED</b> <sup>(1)</sup>	See project report ( <a href="#">IPHC-2022-ECON-01</a> ) and <a href="#">Economic Research section of the IPHC website</a>
<b>Item 3.d:</b> Methodology – economic value of the subsistence use	<b>IN PROGRESS</b>	Subject of collaboration with NOAA Alaska Fisheries Science Center (Fish, Food, and Fun: Exploring the Nexus of Subsistence, Personal Use, and Recreational Fisheries (SPURFs) in Alaska)
<b>Item 4: Account of the geography of the economic impact of the Pacific halibut sectors</b>	---	---
<b>Item 4.a:</b> Visualization of region-specific economic impacts	<b>COMPLETED</b> <sup>(1)</sup>	See online <a href="#">economic impact visualization tool</a>
<b>Item 5: Analysis of the community impacts of the Pacific halibut fishery throughout its range, including all user groups</b>	---	---
<b>Item 5.a:</b> Community impacts assessment of the Pacific halibut fishery	<b>COMPLETED</b> <sup>(1)</sup>	See project report ( <a href="#">IPHC-2022-ECON-01</a> ) See <a href="#">economic impact visualization tool</a> ( <i>Community impacts in AK</i> tab) Further improvement of spatial granularity of the estimates was proposed in the <i>IPHC's 5-year program of integrated research and monitoring (2022-26)</i>
<b>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</b>	---	---
<b>Item 6.a:</b> Putting results into perspective	<b>COMPLETED</b> <sup>(1)</sup>	See project report ( <a href="#">IPHC-2022-ECON-01</a> )

\* All items marked as COMPLETED are subject to updates based on the direction of the project and the evolution of the situation in the Pacific halibut fisheries. <sup>(1)</sup>Subject to changes based on the data collected through the IPHC economic survey and publication or revision of relevant secondary data.



## Appendix B Pacific halibut economic impact in terms of output

**Figure 4** depicts the economic impact of Pacific halibut commercial and recreational fishing in terms of output. The figure distinguishes between the impact by fishery (i.e., by region where the fishing activity occurs, bars with '-fishery' suffix) and impact by region (i.e., by region where the impact is realized; bars with '-region' suffix).



*Notes:* The figure omits the impact on the ROW (marginal). \*Adjusted to the wholesale mark-up and does not include fish buying cost; \*\*Commercial indirect impact includes processing.

**Figure 4:** Pacific halibut economic impact in terms of output (2019).

The figure specifies the following components:

- a. **Commercial sector – direct:** includes direct output of the Pacific halibut commercial fishing sector, which is equivalent to the landing value or value of sales by Pacific halibut directed commercial fisheries. This component is equal in the 'by fishery' and 'by region' EI estimate.
- b. **Processing sector – direct:** includes direct output of the Pacific halibut processing sector (wholesale value) adjusted to include only the wholesale mark-up. This means that the estimate does not include the fish buying cost, avoiding this way double counting the landing value of the Pacific halibut commercial sector in the EI estimate. This component is equal in the 'by fishery' and 'by region' EI estimate.



- c. **Recreational (charter) sector – direct:** includes value of direct sales by businesses offering services in the form of guided Pacific halibut recreational (sport) fishing (charter boats, fly-in loges, package deals, etc.). The estimate intends to capture the share of output by the sport fishing sector that depends on the Pacific halibut resource availability, i.e., it is adjusted for mixed target species offers. This component is equal in the 'by fishery' and 'by region' EI estimate.
- d. **Commercial sector - indirect\*\* - locally:** includes combined indirect and induced impact resulting from changes in business-to-business transactions and personal income caused by Pacific halibut commercial and processing sector. This component includes only EI resulting from fishing activity in the specified region occurring locally (i.e., in the same region). This component is equal in the 'by fishery' and 'by region' EI estimate.
- e. **Commercial sector - indirect\*\* - elsewhere:** as above, but includes EI resulting from fishing activity in the specified region occurring elsewhere (i.e., in the regions other than the fishing area specified; '-fishery' bars), and EI resulting from fishing activity elsewhere occurring in the specified region ('-region' bars).
- f. **Recreational (charter) sector - indirect – locally:** includes combined indirect and induced impact resulting from changes in business-to-business transactions and personal income caused by the Pacific halibut charter sector. This component includes only EI resulting from fishing activity in the specified region occurring locally (i.e., in the same region). This component is equal in the 'by fishery' and 'by region' EI estimate.
- g. **Recreational (charter) sector - indirect – elsewhere:** as above, but includes EI resulting from fishing activity in the specified region occurring elsewhere (i.e., in the regions other than the fishing area specified; '-fishery' bars), and EI resulting from fishing activity elsewhere occurring in the specified region ('-region' bars).
- h. **Rec. sector - trip exp. – local:** includes an estimate of the economic contribution of marine angler trip expenditures (travel, lodging, other trip-related expenses) that is realized locally, i.e., within the region where the fishing activity is occurring, and can be attributed to Pacific halibut fishing opportunities. This component is equal in the 'by fishery' and 'by region' EI estimate.
- i. **Rec. sector - trip exp. – elsewhere:** includes an estimate of the economic impact of marine angler trip expenditures (share attributed to Pacific halibut) that is realized elsewhere ('-fishery' bars) or realized within the indicated region as a result of fishing activity elsewhere ('-region' bars).
- j. **Rec. sector - durables – local:** includes an estimate of the economic contribution of marine angler expenditures on durable goods (rods, tackle, boat purchase, other fishing equipment and accessories, second home, or additional vehicle purchase) that is occurring locally, i.e., within the region where the fishing activity is occurring, and can be attributed to Pacific halibut fishing opportunities. This component is equal in the 'by fishery' and 'by region' EI estimate.
- k. **Rec. sector - durables – elsewhere:** includes an estimate of the economic impact of marine angler expenditures on durable goods (share attributed to Pacific halibut) that is realized elsewhere ('-fishery' bars) or realized within the indicated region as a result of fishing activity elsewhere ('-region' bars).