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## PHMEIA APP MANUAL

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### PURPOSE

This document provides a description and tutorial of the IPHC's web-based economic impact visualization tool ([http://iphcecon.westus2.cloudapp.azure.com:3838/ModelApp\\_azure/](http://iphcecon.westus2.cloudapp.azure.com:3838/ModelApp_azure/), version from 11 January 2022) presenting the results of the Pacific halibut multiregional economic impact assessment (PHMEIA).

### BACKGROUND

The economic impact of the Pacific halibut resource can be expressed with various metrics, or derived for just a subset of sectors. Regulators and stakeholders may also be interested in assessing various combinations of regional allocations of mortality limits (i.e., supply-side restrictions). To address this, the Pacific halibut multiregional economic impact assessment (PHMEIA) is complemented by an interactive web-based application allowing users to estimate and visualize the full set of economic impact results, including joint effects based on custom changes simultaneously applied to all IPHC-managed Pacific halibut producing areas. The tool is available at:

[http://iphcecon.westus2.cloudapp.azure.com:3838/ModelApp\\_azure/](http://iphcecon.westus2.cloudapp.azure.com:3838/ModelApp_azure/).

The tool comprises three components:

- (1) Estimates of the economic impact (EI) of the Pacific halibut commercial fishing sector at the regional level (map and table) – ***EI of the commercial sector – map*** tab (tab 1) and ***EI of the commercial sector – table*** tab (tab 2)
- (2) Estimates of the economic impact of Pacific halibut recreational fishing contrasted with the estimates for the commercial sector – ***EI of recreational fishing*** tab (tab 3)
- (3) Visualization of community impacts in Alaska (county-level results) – ***Community impacts in AK*** tab (tab 4)
- (4) Plots combining the economic impact of all assessed Pacific halibut sectors – ***Total Pacific halibut EI – plot*** tab (tab 5)

Components can be selected by choosing the appropriate tab on the left-hand side panel. The panel on the left also includes control widgets allowing the user to customize estimates. The box below input controls summarizes the selected inputs.

Model details on the PHMEIA can be found on the IPHC website, in the [Economic Research](#) section. Details on the model development are also available in [IPHC-2022-AM098-INF04](#).

### ***Economic impact of the Pacific halibut commercial fishing***

The map (tab 1) and the table (tab 2) display the EI estimates as deviations from the status quo in the selected year (select box 1 in the sidebar) in the selected currency (select box 2 in the sidebar).

The EI is calculated based on the input supplied in terms of Pacific halibut output value (in mil. USD/CAD) by region (see **Box 1** for definitions of regions) using sidebar sliders (**Figure 1**).

The default values are set to status quo outputs in each region in the selected year; thus, by definition, the initially displayed EI is NULL. The displayed results should be interpreted as “*what would be the economic impact if the output in AK/BC/WOC increased/decreased by XX mil. USD/CAD in the given year.*” Decreasing the output to ZERO in each region gives the total contribution of the Pacific halibut commercial fishing to the economy of each region.

#### **Box 1: PHMEIA model regions**

The PHMEIA model accounts for interregional spillovers, which accommodate an increasing economic interdependence of regions and nations. The economic impact of Pacific halibut is not necessarily limited to where it is fished or processed. Economic benefits from the primary area of the resource extraction are leaked when inputs to production 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. 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)
- 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) – exogenous in the model

By accounting for the economic linkages among these six regions, the study shows the importance of the multiregional approach 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.



**Figure 1:** PHMEIA model input sliders.

While the table tab (tab 2) includes the full set of results for the given combinations of fishery outputs, the map in tab 1 displays the selected type of EI and its components (see **Figure 2** for control widgets). First, the user selects the type of impact to display. These are defined as follows:

- **Output:** Output is a measure of the total value of goods produced.
- **Wages:** Compensation of employees, includes employer social contributions (e.g., contributions for employee pension)
- **Earnings:** Earnings are a sum of compensation of employees and profit-type income from self-employment (proprietor income).
- **Taxes:** Taxes measure net taxes on production, i.e., taxes less subsidies.
- **Value added/GDP:** Value added is a measure of the wealth created by industry activity. It is the sum of compensation of employees, taxes on production and imports less subsidies, and gross operating surplus, which includes proprietor income. Value added and the value of the intermediate inputs gives the output.
- **Employment:** The employment measure represents the number of jobs supported by economic activity. Estimates of employment are given in the number of employees.
- **Households income:** Households income is a measure of the impact on earnings by households by place of residence. This estimate accounts for the flow of earnings between regions related to out-of-state employment, flows related to beneficial ownership of Pacific halibut fishing rights in Alaska (i.e., quota holdings), and corporate interests of the processing sector. Impact on household income is derived directly from the matrix building the PHMEIA (i.e., social accounting matrix) and cannot be decomposed into direct, indirect, and induced EIs (see next paragraph).

Second, the user may select EI components that will be displayed:

- **Direct EIs** reflect the changes realized by the direct Pacific halibut resource stock users, i.e., Pacific halibut fishers.

- **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.
- **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.

Unless fully substituted by imports, changes in the fisheries output are also associated with production adjustments by **forward-linked industries** relying on the supply of fish. Selecting *Include forward-linked (FL) Pacific halibut processing* includes in the assessment of the EI also the Pacific halibut processing sector. However, note that direct output of the Pacific halibut processing sector (i.e., wholesale value) is adjusted to include only the wholesale mark-up when selecting EI in terms of output (option 1) in the *Type of impact to display* select box. This means that the output 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.

The image shows two screenshots of a web interface. The left screenshot shows a dropdown menu titled 'Type of impact to display' with 'Output' selected. The menu is open, showing a list of options: Output, Wages, Earnings, Taxes, Value added / GDP, Employment [Number of employees], and Household income. The right screenshot shows the same dropdown menu with 'Output' selected and closed. Below the dropdown, there are four checkboxes: 'Direct economic impact (Pacific halibut fishery)' (checked), 'Indirect economic impact' (unchecked), 'Induced economic impact' (unchecked), and 'Include forward-linked (FL) Pacific halibut processing' (unchecked).

**Figure 2:** Control widgets allowing the user to select the type of EI and its components.

It is important to note that the results represent a static snapshot of EIs based on the observed prices and other economic conditions. A dynamic approach to estimating the economic impact of Pacific halibut resource is an extension suggested in the *IPHC 5-year program of integrated research and monitoring (2021-2026)* ([IPHC-2021-IM097-12](#)).

The full set of results for the selected combination of fishery outputs can be downloaded by clicking the **Download** button at the bottom of the table tab (tab 2).

### Example 1

The example section suggests a series of steps that modifies the app output. Text in blue represent selections in the control widgets. What follows is the interpretation of the displayed results. Example 1 focuses on displaying the desired set of EI measured by region.

1. Select tab → [EI of the commercial sector – map](#)

2. Select year → [2019](#)
3. Select currency → [USD](#)
4. Change the position of the slider Pacific halibut output – commercial fishing, Alaska [mil. USD] → [98](#) (this represents a hypothetical change in the output by the commercial fishing sector in Alaska from USD 94.1 mil. to USD 98 mil., i.e., an increase of the production by USD 3.9 mil. or 4% (you can use keyboard arrows for precise selection of the output).

The box below the sliders summarizes the user-defined adjustments and compares them with the selected year's status quo. The default display following the adjustment of the Pacific halibut output is the direct EI in terms of output, i.e., change in the landing value by region (here adopted only for Alaska). Note that the changes on the map displaying in light-to-dark green indicate increases with respect to the status quo, while decreases will display in the orange-to-red palette. No change is represented by yellow color.

5. Select → [Indirect economic impact](#) and → [Induced economic impact](#) ([Direct economic impact](#) ([Pacific halibut fishery](#)) remains selected)

The map will now display the sum of the full set of the EI components (direct, indirect, and induced EI). Note that selecting indirect and/or induced components of the EI, the economic impact is realized not only in Alaska but also in other regions because of the spillover effects.

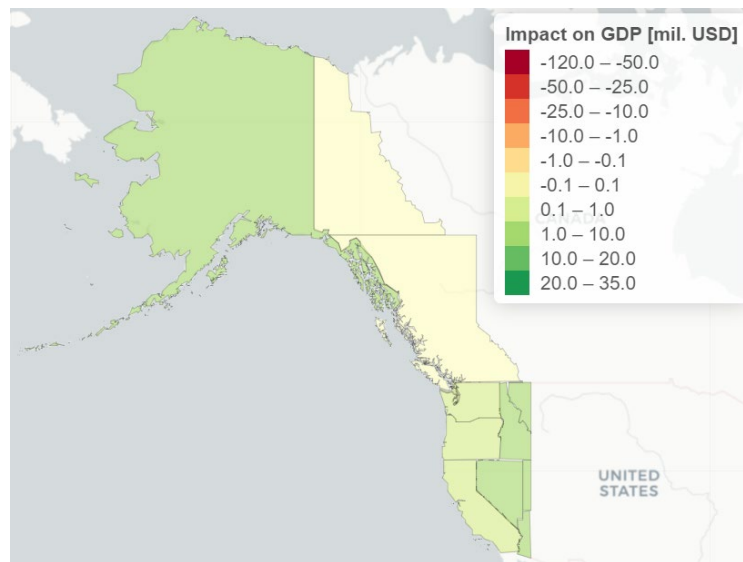
6. Change the type of impact to display to → [Value added/GDP](#)

Now, the map will display the contribution of the Pacific halibut commercial fishing in Alaska to each region. Other types of EI that can be displayed include wages, employment, and household income.

7. Select → [Include forward-linked \(FL\) Pacific halibut processing](#)

Selecting this option extends the scope of the displayed EIs to the forward-linked Pacific halibut processing sector. The measure including forward-linked processing assumes that the change in the fishing sector has a proportional impact on the processing sector that relies on the supply of fish.

The model suggests that an increase of Pacific halibut output in Alaska by 4% in 2019 would contribute to the GDP of Alaska about USD 3.1 mil., but there would also be a substantial contribution to the economy of the US West Coast (USD 0.9 mil.) and the rest of the United States (USD 2.7 mil.). See the final output from the described example in **Figure 3**.

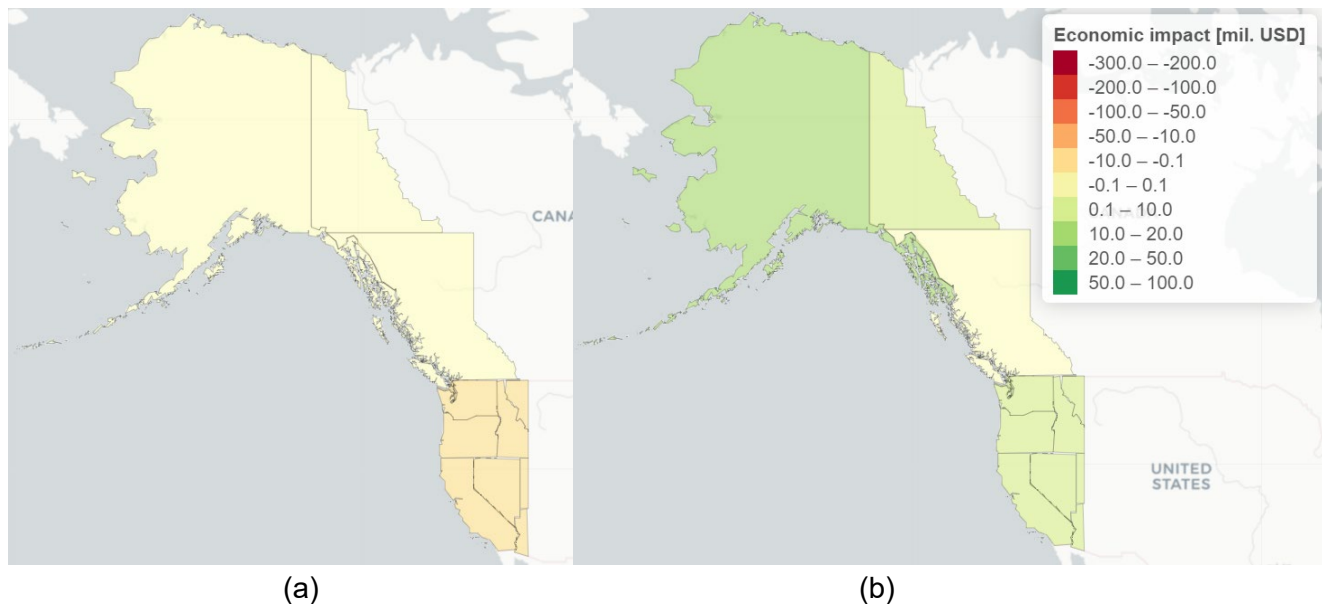


**Figure 3:** Impact on GDP of 4% increase on Pacific halibut output in Alaska based on 2019 economic conditions.

*Example 2*

1. Select tab → [EI of the commercial sector – map](#)
2. Select year → [2019](#)
3. Select currency → [USD](#)
4. Select → [Indirect economic impact](#) and → [Induced economic impact \(Direct economic impact \(Pacific halibut fishery\) remains selected\)](#)
5. Change the position of the slider Pacific halibut output - commercial fishing, West Coast [mil. USD] → [4](#) (20% decrease)
6. Change the position of the slider Pacific halibut output – commercial fishing, Alaska [mil. USD] → [103](#) (9% increase)

Notice that a decrease in Pacific halibut output on the USA West Coast (step 5) has a negative impact on the region and causes ca. USD 2.8 mil. loss. However, an additional increase in output in Alaska (step 6) results in positive net EI on the USA West Coast (ca. USD 0.7 mil). See the comparison in **Figure 4**.



**Figure 4:** EI of (a) 20 % decrease of Pacific halibut output in WC and (b) 20 % decrease of Pacific halibut output in WC and 9% increase in Alaska. Both figures based on 2019 economic conditions.

### **Economic impact of recreational fishing**

Tab **EI of recreational fishing** displays results for the recreational sector in comparison with estimates for the commercial sector. The user can select year [2018, 2019, or 2020] and currency [USD or CAD]. The estimates focus on the economic impact on households.

Charter estimates include only the economic impact generated through businesses offering charter trips, i.e., it excludes the impact of angler expenditures other than charter fees, while recreational fishing EI estimates include also the EI associated with 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). Estimates for the recreational sector are based on the assumption that the economic impact of Pacific halibut recreational fishing is equivalent to estimating the total economic loss resulting from the saltwater charter sector shrinking by the share of Pacific halibut charter effort in the total effort in each region, and decrease in expenditures on fishing trips and durable goods proportional to share of recreational effort dependent on Pacific halibut.

Six measures are specified:

- (1) EI on households - total in mil. USD: Total economic impact on households in all regions. The estimate includes spillover effects to other regions and EI associated with the forward-linked Pacific halibut processing sector for the commercial sector.
- (2) EI locally (excludes spillovers) - total in mil. USD: EI from (1) that is retained locally, i.e., in the region where the harvest/angling was occurring.
- (3) EI on households - USD per 1 USD landed value/USD spent: EI from (1) divided by the total landed value (for the commercial sector) or dollars spent by anglers (for the recreational sector, including trip costs and expenditures on durable goods).

- (4) EI locally (excludes spillovers) - USD per 1 USD landed value/USD spent: EI from (2) divided by the total landed value (for the commercial sector) or dollars spent by anglers (for the recreational sector, including trip costs and expenditures on durable goods).
- (5) EI on households - USD per 1 lb of removals: EI from (1) divided by the volume of removals by the sector (retained harvest plus discards). This measure intends to provide an estimate of an impact per lb of Pacific halibut removal counted against the harvest limits in the stock assessment.
- (6) EI locally (excludes spillovers) - USD per 1 lb of removals: EI from (2) divided by the volume of removals by the sector (retained harvest plus discards).

Estimates are based on constant prices. Adoption of demand-adjusted prices is proposed in the IPHC 5-year program of integrated research and monitoring (2021-2026) ([IPHC-2021-IM097-12](#)). The results for the recreational sector should be interpreted cautiously because of the uncertainty on how much of the saltwater angling effort directly depends on Pacific halibut. See details in [IPHC-2022-AM098-INF04](#).

### ***Community impacts in Alaska***

Besides providing economic impact estimates for broadly-defined regions (as defined in **Box 1**), the PHMEIA model results inform the county-level impacts of the Pacific halibut commercial fishing in Alaska, highlighting areas particularly dependent on Pacific halibut fishing-related economic activities.

The map in tab 4 displays estimates of **direct household earnings [in mil. USD] by county dependent on Pacific halibut commercial fishing**. This includes earnings in the Pacific halibut commercial sector (Pacific halibut commercial fishing and Pacific halibut processing) retained in each county after adjusting for the cross-country flows related to employment and profits. Earnings from wages in the Pacific halibut fishing sector were assigned to counties based on the registered homeport of the vessel, while in the Pacific halibut processing sector, based on the processing location. Proprietor income in the Pacific halibut fishing was assigned to counties based on the residence of the permit owner and residence of the vessel owner (assuming 50-50 split, if different), and in the Pacific halibut processing, based on the location of the processor final point of contact.

The displayed earnings are in absolute values for the selected Pacific halibut output in Alaska (in mil USD, slider in the left-hand side panel; this includes Pacific halibut harvested in IPHC regulatory areas 2C, 3A, 3B, and 4A-E, even if landed outside Alaska) given economic conditions in the selected year (select box on the left-hand side panel). Greyed areas indicate counties that did not have a sufficient number of observations to preserve the confidentiality of the Pacific halibut direct users.

When selecting *Adjust outputs by IPHC regulatory area*, instead of selecting output in terms of value, the user can select harvest volume by IPHC regulatory area based on which the results are calculated.



Community effects assessment is currently limited to Alaska. The feasibility of a similar assessment for other regions (British Columbia, USA West Coast) is under investigation.

### *Example 3*

Example 3 focuses on the displaying impact of commercial fishing in Alaska on Alaskan households by county. Note that the impact outside Alaska is omitted here.

1. Select tab → [Community impacts in AK](#)
2. Select year → [2019](#)
3. Change the position of the slider Pacific halibut output – commercial fishing, Alaska [mil. USD] → [98](#) (same as in Example 1)

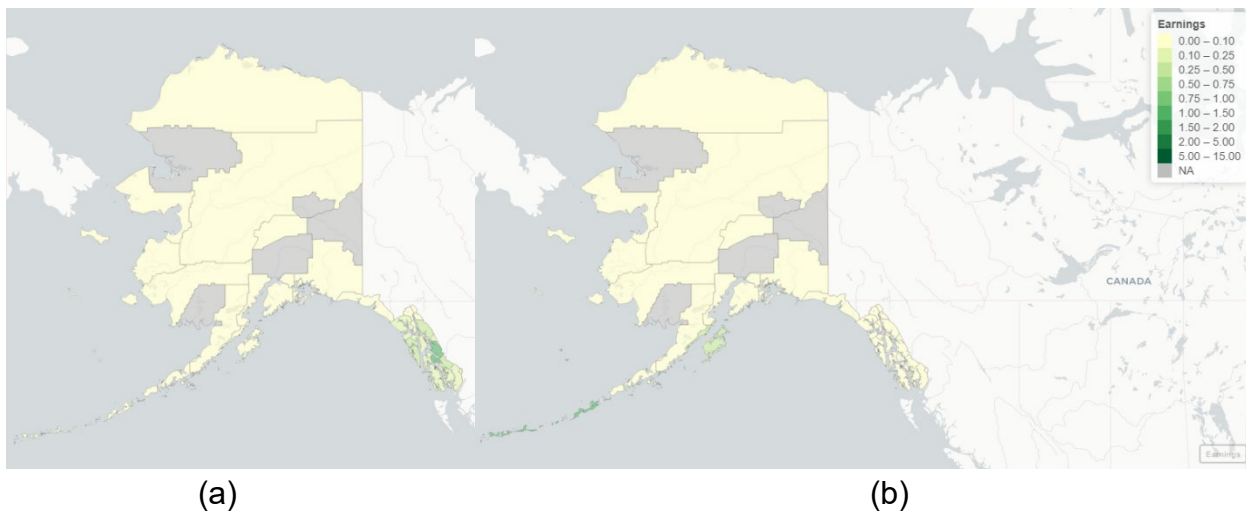
Following the adjustment of the Pacific halibut output, the map displays the impact on direct earnings by county. This includes impact on wages and profits in both Pacific halibut commercial fishing and Pacific halibut processing sector. Note that the community impacts are displayed in absolute terms, as opposed to deviation from the status quo (Example 1).

4. Select → [Adjust outputs by IPHC regulatory areas](#)

Selecting this option allows the user to display direct earnings calculated based on output in terms of volume (in 1000 lbs, net weight) by IPHC regulatory area. Under each numeric box, the comment section will indicate how the selected value compares with the status quo for the area.

Note that selecting the same number in different numeric boxes will have a different outcome (**Figure 5**). For example, [2000](#) under 2C (representing 2 mil. lbs) results in USD 3.5 mil in direct earnings, with the majority in Petersburg county, while [2000](#) under 4B results in USD 2.7 mil. in earnings, predominately affecting Aleutians West county.

Information for some counties cannot be displayed because of the confidentiality restrictions (counties in grey). However, the direct earnings for these counties are included in the total for all regions displayed as text below the numeric input boxes. Note that the sum of earnings will also include earnings that flow out of Alaska to other regions (predominantly US West Coast).



**Figure 5:** Community impacts in terms of direct earnings based on (a) 2 mil. lbs output in 2C and (b) 2 mil. lbs output in 4B.

### **Total Pacific halibut economic impact**

Figures in tab **Total Pacific halibut EI – plot** (tab 5) depict the complete set of results for both Pacific halibut commercial and recreational fishing.

The first figure 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).

The second figure depicts the impact of Pacific halibut commercial and recreational fishing on household earnings and income, highlighting the importance of considering cross-regional effects when assessing these. 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).

Clicking ‘*Show description of the variables*’ under each figure will display a detailed description of all EI components depicted in the figures.