Appendix A DESCRIPTION OF PROJECTION MODELS

Proposed Harvest Specifications and Management Measures for the 2013-2014 Pacific Coast Groundfish Fishery and Amendment 21-2 to the Pacific Coast Groundfish Fishery Management Plan Final Environmental Impact Statement

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This Appendix describes the projection models used for each fishery to estimate the total catch of selected non-overfished species (generally target species) and overfished species.

A.1 Commercial Landings Distribution Model

The purpose of the commercial fishery landings distribution model (LDM) is to inform the Council's management processes by projecting where (PacFIN PCID) landings are likely to occur under a set of alternative scenarios (e.g., alternative ACLs or management measures). The projected landings ports can then be mapped onto Port Area aggregations to allow comparison of the geographic distribution of ex-vessel revenues under the alternatives. Since all the alternatives are modeled consistently, projections from the LDM facilitate comparison of the alternatives in an apples-to-apples fashion.

A list of Port Areas and underlying PCIDs is shown in Table 1. Although used primarily to inform the groundfish management processes, the LDM methodology can be applied to analyze any west coast fishery. In the case of groundfish, exvessel revenue results from the LDM, aggregated by Port Area, are fed directly into the IO Pac input-output model and vessel net revenue projection model, where they are used to calculate and compare economic impacts under the different alternatives.

A.1.1 Data Elements

The core of the LDM is a recent-year commercial fishing landings data report from the Pacific Coast Fisheries Information Network (PacFIN) data system. The standardized PacFIN daily vessel landing is used for this purpose. The PacFIN website briefly describes the vdrfd table thus:

> **Vdrfd table**: The relationship between vessels, tickets, date-of-landing, permit(s), fish-ticket category, and post-distribution species id code. (Produced by prod/refresh_vdrfd.sql.)

For analyzing the 2013-2014 groundfish management specifications, a vdrfd table for 2011 was used.

Key data elements of the LDM provided by the PacFIN data report include:

- Inventories of all species (SPIDs including nominal and market categories after application of species composition factors), round weights and ex-vessel values landed during the year by port ((PCID).
- Assignment of each landing to a fisheries management sector.
- Distribution of species landings and revenues by vessel (DRVID).
- Distribution of species landings and revenues among first receivers (Processor ID).

This historical information forms one of baselines against which changes under the management alternatives can be measured.

A.1.2 Model

Groundfish landings records in the vessel landings table are categorized by fisheries sector. This categorization is based on Council area, port, species and the gear used. The fisheries sector categories align with the GMT fishery sector projection models listed below. The GMT models project landings in each of five sectors under the management alternative as part of their overall analysis of harvest specifications and management measures. The next step is to compute the base year percentage of landings for each fishery sector by each combination of Area, Vessel ID, SPID and PCID. The "area" used for this calculation varies according to the resolution of the corresponding fishery sector projection model, as noted below. The percentages are then applied to the results from the GMT fishery sector projection models to estimate the geographic distribution of landings across ports (PCIDs) in each fishery.

To project the geographic distribution of landings under the alternatives, results from the commercial fisheries sector landings projection models are applied to the landings percentages calculated from the vdrfd report as noted above. Unless indicated otherwise (by the GMT model results or the proposed management measures), landings under the alternatives are assumed to occur in the same ports in proportion to landings observed in the base year vdrfd table. Only landings of the main economic groundfish species that are modeled for each fisheries sector are of concern in the LDM. Landings of nongroundfish species, incidentally-caught groundfish species and overfished species such as canary rockfish, bocaccio and cowcod are generally ignored, as these are not managed by the Council or do not generate significant revenues in groundfish fisheries.

The level of detail carried over from the GMT models to the LDM varies considerably by fisheries sector (Figure A-1). The most detailed results are produced by the IFQ catch projection model which generates a table of projected landings by species category for each groundfish permit ID.

Less detailed results and mappings are used to link the LDM with the remaining fishery sector models. For example, the Non-nearshore fisheries model projects landings of sablefish (and incidentally-caught overfished species) in aggregate for the LE and OA fixed gear fisheries north of 36° N. latitude. So, unless otherwise constrained or indicated under the alternatives, a port (PCID) that received, e.g., 8 percent of the north of 36° LE fixed gear sablefish landings in 2011 is expected to receive 8 percent of projected north of 36° LE fixed gear sablefish landings under each alternative each year of the biennial cycle. The same rationale is applied to distribute OA-DTL fixed gear sablefish landings.

Linkage between the LDM and the Nearshore fisheries model is similar, except the additional area detail in the nearshore model is incorporated to distribute projected landings of nearshore groundfish species by area to the ports (PCIDs) associated with each catch area and in proportion to the distribution of landings observed in the base year vdrfd data table.

The main features the GMT model inputs and additional procedures used for integrating this information in the LDM are described below:

- **IFQ catch projection model:** Projected groundfish target species landings by each vessel/permit participating in the LE trawl fishery. The list of target species projected includes Sablefish, Longspine thornyhead, Shortspine thornyhead, Dover sole, Arrowtooth flounder, Petrale sole, English sole, Other flatfish, and Pacific whiting. Incidental landings of nontarget overfished species are also projected by the model, however these projections are not generally incorporated for economic analysis.
- **Non-nearshore fisheries model:** Projected maximum aggregate landings of sablefish and incidentally caught overfished species north of 36° by vessels participating in the fixed-gear LE and OA-DTL fisheries. Only sablefish landings are used in the economic analysis. Note: To date sablefish landings south of 36° have not been explicitly modeled by the GMT. Instead the sablefish OYs/ACLs under each alternative are compared with landings observed in the base year, and then those ratios are applied to project landings under the alternatives.
- **Nearshore fisheries model:** Projected aggregate landings by area (Oregon, California north of 40°10 and California south of 40°10) of nearshore target species (black rockfish, blue rockfish, cabezon, kelp greenling, lingcod, and other minor nearshore rockfish) by vessels participating in the fixed gear OA fishery. Landings of canary and yelloweye rockfish are also projected however these are not used in the economic analysis of this sector.

- **At-sea whiting fisheries model:** Projected alternative allocations of Pacific whiting to the at-sea CP and mothership fisheries, constrained by anticipated relevant overfished species allocations and observed bycatch rates, if applicable.
- **Tribal fisheries model:** Projected total whiting (shoreside and at sea) and nonwhiting groundfish target species landings by the tribal groundfish fisheries.

A.1.2.1 IFQ fishery

Information in the final end-of-year run for the relevant year from the IFQ catch projection model is used to adjust records in the vdrfd table for IFQ fishery participants. This step produces a calibrated landings report that can be readily linked with IFQ catch projections generated for each groundfish management option or alternative. Projected landings by vessels (permits) are assumed to distribute to ports (PCIDs) based on where those vessels (permits) landed in the base year vdrfd table.

A.1.2.2 Non-Nearshore fisheries

Total sablefish landings projected under each option or alternative for the fixed gear LE and OA-DTL fisheries north of 36° by the non-nearshore fisheries model are distributed to participating vessels and ports (PCIDs) in proportion to where sablefish landings occurred in the base year vdrfd table. For areas south of 36° a different procedure is used. The ratio of sablefish landings in the base year to the corresponding sablefish ACL is calculated. This ratio is then applied to the ACL projected under each option or alternative to estimate total sablefish landings south of 36° under each scenario. Estimated total landings are then distributed to associated landing ports south of 36° in proportion to where sablefish landings occurred in the base year vdrfd table.

A.1.2.3 Nearshore fisheries

For the fixed gear OA fishery, total projected nearshore target species landings under each option or alternative projected by the nearshore fishery model are distributed to participating vessels and ports in the proportions observed in the base year vdrfd table. Nearshore target species distributed in this manner include black rockfish, blue rockfish, cabezon, kelp greenling, lingcod, and other minor nearshore rockfish. The most recent three nearshore fishery catch areas: Oregon, California north of 40°10 and California south of 40°10Whiting fisheries

Total projected landings and deliveries by the two nontribal at-sea whiting fisheries (CP and motherships) under each option or alternative are distributed among vessels that participated in the whiting fishery in proportion to their participation in the base year. Pacific whiting harvest is regulated separately from the nonwhiting groundfish specifications process, but a range of possible Pacific whiting harvests is sometimes analyzed in the groundfish DEIS for purposes of comparison.

A.1.2.4 Tribal groundfish fisheries

Total projected landings and deliveries under each option or alternative by the tribal groundfish fisheries, including shoreside and at sea whiting, are distributed among vessels and ports that participated in those fisheries in proportion to their participation in the base year.

A.1.3 Assumptions and Caveats

Major simplifying assumptions are highlighted here, including:

- Average exvessel prices observed in the base year will carry over to the projection period(s).
- There is no cross hauling of raw product. That is the amount landed in each port area is also processed there.
- Average annual ex-vessel prices are assumed to apply in each port no matter when during the year landings occur.

One concern with this approach is that the more future ex-vessel prices deviate from the range of prices observed in the base year, the more projected revenue impacts may be inaccurate. However if better information is available on future exvessel price trends, it is possible to incorporate this type of information into the revenue projections.

Landings and revenue impacts projected for groundfish by the LDM are used in the IO Pac model to estimate community income impacts under the alternatives. To the degree that processing activities, the vessel's home port, or the residences of owners and workers are located in the port of landing, then a larger portion of the impacts generated by these landings will to accrue in the community associated with the port. However to the extent that processing activities, the vessel's home port, or the residences of workers and owners are located elsewhere, the pattern of landings may overstate the value of these activities to the local economy. Where landings are made in one port but a vessel's home port or crew reside elsewhere, or where first receivers transfer landings elsewhere for processing, at least a portion of projected income impacts may be attributed to the wrong port.

A.1.4 Results

Results from the LDM are used as inputs to estimate community income impacts and vessel sector net revenues ("profits") under the alternatives. Projected revenues by species, fishing sector and port are fed into the IO Pac model to generate community personal income impacts under each alternative. IO Pac is in input-output economic model constructed using landings data, vessel cost estimates, and secondary economic data to estimate income and employment impacts resulting from a change in the distribution of commercial fishery landings. Projected landings and revenue for groundfish species by each groundfish fishery sector coupled with vessel cost estimates from IO Pac are also used to estimate net revenues accruing to vessel owners participating in west coast groundfish fisheries. Estimates from these two models are used to compare and contrast economic impacts under the groundfish management alternatives.

Tables 2 and 3 compare results generated using the LDM to analyze management measures and harvest specifications for the 2007-2008 and 2009-2010 groundfish management cycles with actual landings recorded during those periods.

Table A-1. List of Port Groups and PCIDs in the Landings Distribution Model.

State	Port Group Area	County	PCID	Port Name
Washington	**Puget Sound**	Whatcom	BLN	Blaine
		Whatcom	BLL	Bellingham Bay

State	Port Group Area	County	PCID	Port Name
		San Juan	FRI	Friday Harbor
		Skagit	ANA	Anacortes
		Skagit	LAC	La Conner
		Snohomish	ONP	Other North Puget Sound Ports
		Snohomish	EVR	Everett
		King	SEA	Seattle
		Pierce	TAC	Tacoma
		Thurston	OLY	Olympia
		Mason	SHL	Shelton
	North Washington Coast	Jefferson	TNS	Port Townsend
		Clallam	SEQ	Sequim
		Clallam	PAG	Port Angeles
		Clallam	NEA	Neah Bay
		Clallam	LAP	La Push
	South & Central WA Coast	Grays Harbor	CPL	Copalis Beach
		Grays Harbor	GRH	Grays Harbor
		Grays Harbor	WPT	Westport
		Pacific	WLB	Willapa Bay
		Pacific	LWC	Ilwaco/Chinook
		Klickitat	OCR	Other Columbia River Ports
Oregon	**Columbia River**	Multnomah	CRV	Psuedo Port Code for Columbia River
	Astoria-Tillamook	Clatsop	AST	Astoria
		Clatsop	GSS	Gearhart - Seaside
		Clatsop	CNB	Cannon Beach
		Tillamook	NHL	Nehalem Bay
		Tillamook	TLL	Tillamook / Garibaldi
		Tillamook	NTR	Netarts Bay
		Tillamook	PCC	Pacific City
	Newport	Lincoln	SRV	Salmon River
		Lincoln	SLZ	Siletz Bay
		Lincoln	DPO	Depoe Bay
		Lincoln	NEW	Newport
		Lincoln	WLD	Waldport
		Lincoln	YAC	Yachats
	Coos Bay	Lane	FLR	Florence
		Douglas	WIN	Winchester Bay
		Coos	COS	Coos Bay
		Coos	BDN	Bandon
	Brookings	Curry	ORF	Port Orford
		Curry	GLD	Gold Beach
		Curry	BRK	Brookings
California	**Crescent City**	Del Norte	CRS	Crescent City
		Del Norte	ODN	Other Del Norte County Ports
	Eureka	Humboldt	ERK	Eureka (Includes Fields Landing)
		Humboldt	FLN	Fields Landing
		Humboldt	TRN	Trinidad
		Humboldt	OHB	Other Humboldt County Ports
	Fort Bragg	Mendocino	BRG	Fort Bragg

State	Port Group Area	County	PCID	Port Name
		Mendocino	ALB	Albion
		Mendocino	ARE	Arena
		Mendocino	OMD	Other Mendocino County Ports
	San Francisco (incl. Bodega Bay)	Sonoma	BDG	Bodega Bay
		Marin	BOL	Bolinas
		Marin	TML	Tomales Bay
		Marin	RYS	Point Reyes
		Marin	OSM	Other Son. and Mar. Co. Outer Coast Ports
		Marin	SLT	Sausalito
		Alameda	OAK	Oakland
		Alameda	ALM	Alameda
		Alameda	BKL	Berkely
		Contra Costa	RCH	Richmond
		San Francisco	SF	San Francisco
		San Mateo	PRN	Princeton
		San Francisco	SFA	San Francisco Area
		San Francisco	OSF	Other S.F. Bay and S.M. Co. Ports
	Monterey	Santa Cruz	CRZ	Santa Cruz
		Monterey	MOS	Moss Landing
		Monterey	MNT	Monterey
		Monterey	OCM	Other S.C. and Mon. Co. Ports
	Morro Bay	San Luis Obispo	MRO	Morro Bay
		San Luis Obispo	AVL	Avila
		San Luis Obispo	OSL	Other S.L..O. Co. Ports
	Santa Barbara	Santa Barbara	SB	Santa Barbara
		Santa Barbara	SBA	Santa Barbara Area
		Ventura	HNM	Port Hueneme
		Ventura	OXN	Oxnard
		Ventura	VEN	Ventura
		Ventura	OBV	Other S.B. and Ven. Co. Ports
	Los Angeles	Los Angeles	TRM	Terminal Island
		Los Angeles	SPA	San Pedro Area
		Los Angeles	SP	San Pedro
		Los Angeles	WLM	Willmington
		Los Angeles	LGB	Longbeach
		Orange	NWB	Newport Beach
		Orange	DNA	Dana Point
		Orange	OLA	Other LA and Orange Co. Ports
	San Diego	San Diego	SD	San Diego
		San Diego	OCN	Oceanside
		San Diego	SDA	San Diego Area
		San Diego	OSD	Other S.D. Co. Ports

Table A-2. Projections under the LDM compared with actual landings: 2007-2008.

				2007-2008 Spex		PacFIN Actual landings				Projections / Actual (% difference)			
		2005 (Base Year)		Final Council Preferred Alt.		2007		2008		2007		2008	
Groundfish Sector	**Port Area**	mt	$ million	**mt**	**$ million**	mt	$ million	mt	$ million	mt	$ million	mt	$ million
Non-whiting Trawl	Puget Sound	2,080.1	2.1	**2,118.3**	**1.9**	893.0	1.0	823.1	1.0	137.2%	98.2%	157.4%	94.7%
	North Washington Coast	552.8	0.5	**514.4**	**0.4**	74.5	0.1	30.5	0.0	590.6%	474.0%	1587.7%	849.6%
	South and Central Washington Coast	483.0	0.5	**458.7**	**0.4**	1,190.2	1.4	1,330.8	1.5	-61.5%	-69.9%	-65.5%	-70.9%
	Astoria-Tillamook	5,641.9	6.5	**6,578.3**	**6.9**	6,391.8	6.7	7,934.1	8.8	2.9%	3.9%	-17.1%	-21.2%
	Newport	1,653.5	2.2	**1,971.3**	**2.4**	2,245.7	3.2	3,136.2	4.6	-12.2%	-24.7%	-37.1%	-48.9%
	Coos Bay	2,230.6	2.6	**2,697.4**	**2.9**	3,080.5	3.8	3,547.6	4.6	-12.4%	-21.9%	-24.0%	-36.7%
	Brookings	679.7	0.8	**910.7**	**1.0**	1,052.0	1.4	1,277.6	1.9	-13.4%	-28.1%	-28.7%	-46.1%
	Crescent City	621.6	0.8	**709.3**	**0.8**	672.8	0.9	752.5	1.0	5.4%	-9.1%	-5.7%	-15.8%
	Eureka	1,860.1	2.2	**2,158.2**	**2.4**	2,880.8	3.6	2,921.2	4.0	-25.1%	-33.1%	-26.1%	-38.9%
	Fort Bragg	1,545.4	1.7	**2,179.8**	**2.3**	1,276.1	1.9	1,508.5	2.3	70.8%	22.5%	44.5%	1.8%
	San Francisco-Bodega Bay	579.7	0.8	**561.6**	**0.8**	1,120.2	1.8	1,057.8	1.8	-49.9%	-58.9%	-46.9%	-57.4%
	Monterey	602.7	0.8	**725.6**	**0.9**	240.6	0.5	286.1	0.5	201.5%	101.4%	153.6%	84.9%
	Morro Bay	410.0	0.5	**460.0**	**0.5**	26.5	0.1	165.5	0.3	1635.9%	767.0%	178.0%	50.3%
	Santa Barbara					0.0	0.0	0.4	0.0			-100.0%	-100.0%
Limited Entry Fixed Gear	Puget Sound	670.7	2.0	**570.0**	**1.6**	554.0	1.9	326.9	1.5	2.9%	-18.3%	74.3%	2.2%
	North Washington Coast	172.3	0.6	**134.6**	**0.5**	180.8	0.8	257.5	0.8	-25.6%	-45.2%	-47.7%	-42.0%
	South and Central Washington Coast	289.5	1.1	**222.9**	**0.9**	231.4	1.0	334.8	1.6	-3.6%	-12.4%	-33.4%	-46.8%
	Astoria-Tillamook	204.1	0.8	**156.2**	**0.6**	135.2	0.6	140.9	0.8	15.6%	1.7%	10.9%	-20.2%
	Newport	378.3	1.5	**287.5**	**1.2**	320.4	1.6	372.6	2.1	-10.3%	-28.2%	-22.8%	-44.9%
	Coos Bay	271.8	1.2	**206.1**	**0.9**	187.0	1.0	183.4	1.1	10.2%	-7.5%	12.4%	-17.0%
	Brookings	148.1	0.6	**115.3**	**0.5**	142.7	0.6	162.2	0.8	-19.2%	-29.7%	-28.9%	-45.1%
	Crescent City	83.1	0.2	**66.4**	**0.2**	61.4	0.2	64.6	0.3	8.1%	-17.6%	2.7%	-40.7%
	Eureka	87.8	0.3	**68.5**	**0.2**	104.4	0.4	123.0	0.5	-34.4%	-38.7%	-44.3%	-51.0%
	Fort Bragg	64.4	0.2	**49.9**	**0.2**	93.9	0.4	108.6	0.5	-46.9%	-54.0%	-54.1%	-65.2%
	San Francisco-Bodega Bay	43.8	0.2	**34.6**	**0.2**	40.4	0.1	43.0	0.2	-14.3%	11.2%	-19.6%	-8.5%
	Monterey	146.3	0.4	**122.7**	**0.4**	145.2	0.5	143.6	0.5	-15.5%	-29.5%	-14.5%	-26.4%
	Morro Bay					1.6	0.0	30.7	0.1	-100.0%	-100.0%	-100.0%	-100.0%
	Santa Barbara	65.2	0.3	**60.7**	**0.2**	44.9	0.3	31.9	0.2	35.1%	-16.7%	90.2%	-0.2%
	Los Angeles	119.7	0.7	**111.7**	**0.7**	127.5	0.8	114.6	0.8	-12.3%	-17.1%	-2.5%	-13.2%
	San Diego	53.9	0.3	**49.2**	**0.3**	60.0	0.4	105.2	0.8	-18.0%	-29.9%	-53.2%	-63.8%
Open Access	Puget Sound	10.9	0.0	**10.1**	**0.0**	1.4	0.0	0.1	0.0	612.9%	174.5%	8500.6%	1409.6%
	North Washington Coast	38.8	0.1	**30.5**	**0.1**	29.5	0.1	29.8	0.1	3.3%	-28.7%	2.2%	4.9%
	South and Central Washington Coast	137.2	0.5	**103.9**	**0.4**	46.6	0.2	68.4	0.3	122.9%	124.6%	52.0%	31.5%
	Astoria-Tillamook	84.2	0.3	**71.5**	**0.2**	55.9	0.2	52.0	0.2	27.9%	0.4%	37.6%	-4.0%
	Newport	24.5	0.1	**21.1**	**0.1**	29.5	0.1	44.8	0.2	-28.7%	-57.8%	-53.0%	-74.8%
	Coos Bay	104.9	0.3	**82.5**	**0.3**	40.3	0.2	81.1	0.4	104.5%	57.8%	1.7%	-37.3%
	Brookings	273.1	1.2	**236.8**	**1.1**	193.3	1.0	227.4	1.2	22.5%	11.4%	4.1%	-13.2%
	Crescent City	88.5	0.4	**87.7**	**0.4**	100.0	0.5	107.1	0.5	-12.3%	-29.1%	-18.1%	-32.6%
	Eureka	88.1	0.2	**70.5**	**0.2**	45.5	0.2	72.4	0.3	54.9%	24.2%	-2.6%	-31.3%
	Fort Bragg	298.8	1.0	**233.0**	**0.8**	108.4	0.5	111.7	0.6	115.0%	72.6%	108.7%	35.8%
	San Francisco-Bodega Bay	49.6	0.3	**47.0**	**0.3**	50.4	0.3	43.2	0.3	-6.7%	-18.9%	8.8%	-27.3%
	Monterey	187.8	0.5	**164.0**	**0.5**	73.5	0.4	112.6	0.5	123.0%	16.1%	45.6%	-12.5%
	Morro Bay	83.7	1.0	**83.1**	**1.0**	188.6	1.4	161.4	1.4	-56.0%	-30.7%	-48.5%	-30.9%
	Santa Barbara	26.8	0.1	**26.8**	**0.1**	20.9	0.2	36.4	0.3	27.8%	-38.9%	-26.6%	-49.8%
	Los Angeles	32.6	0.1	**32.1**	**0.1**	23.6	0.1	25.4	0.1	36.0%	-15.6%	26.6%	-21.8%
	San Diego	34.5	0.2	**31.8**	**0.2**	14.0	0.1	15.4	0.1	126.8%	94.9%	105.9%	124.8%
	TOTAL	**23,304.2**	**39.2**	**25,632.3**	**37.8**	**24,596.9**	**42.6**	**28,504.5**	**51.8**	**4.2%**	**-11.2%**	**-10.1%**	**-26.9%**

Table A-3. Projections under the LDM compared with actual landings: 2009-2010.

		2007 (Base Year)		2009-2010 Spex Final Council Preferred Alt.		PacFIN Actual landings 2009		PacFIN Actual landings 2010		Projections / Actual (% difference) 2009		Projections / Actual (% difference) 2010	
Groundfish Sector	**Port Area**	mt	$ million	**mt**	**$ million**	mt	$ million	mt	$ million	mt	$ million	mt	$ million
Non-whiting Trawl	Puget Sound	852.5	0.9	**1,013.9**	**1.0**	1,300.2	1.1	1,265.9	1.0	-22.0%	-8.6%	-19.9%	4.5%
	North Washington Coast	109.9	0.1	**113.9**	**0.1**	53.5	0.1	10.7	0.0	112.8%	76.3%	967.9%	961.5%
	South and Central Washington Coast	460.0	0.5	**494.8**	**0.6**	1,352.6	1.1	866.2	0.5	-63.4%	-52.0%	-42.9%	0.4%
	Astoria	5,797.1	6.6	**6,674.5**	**7.4**	8,415.3	8.0	7,332.0	6.9	-20.7%	-8.3%	-9.0%	6.7%
	Tillamook	9.0	0.0	**9.0**	**0.0**	27.6	0.0	9.5	0.0	-67.5%	-65.1%	-5.8%	-14.4%
	Newport	1,922.7	2.5	**2,166.9**	**2.9**	3,773.7	5.1	2,722.9	3.7	-42.6%	-43.6%	-20.4%	-21.5%
	Coos Bay	3,534.8	4.0	**3,911.9**	**4.6**	3,625.7	4.2	3,617.5	4.1	7.9%	9.5%	8.1%	11.7%
	Brookings	961.6	1.1	**1,047.5**	**1.3**	1,198.6	1.6	1,321.3	1.8	-12.6%	-21.2%	-20.7%	-29.1%
	Crescent City	695.5	0.8	**743.1**	**0.9**	986.7	1.3	259.3	0.4	-24.7%	-32.9%	186.6%	129.4%
	Eureka	3,034.8	3.5	**3,285.5**	**3.8**	2,667.5	3.5	2,444.5	3.3	23.2%	9.6%	34.4%	15.8%
	Fort Bragg	1,783.5	1.9	**2,055.2**	**2.3**	1,684.3	2.6	1,574.8	2.2	22.0%	-14.0%	30.5%	0.5%
	Bodega Bay	28.5	0.0	**29.6**	**0.0**	52.6	0.1	30.2	0.1	-43.7%	-52.8%	-1.8%	-27.9%
	San Francisco	1,038.6	1.4	**1,131.9**	**1.5**	661.6	1.0	636.5	0.9	71.1%	53.0%	77.8%	71.9%
	Monterey	526.3	0.5	**578.7**	**0.6**	292.7	0.5	340.0	0.5	97.7%	21.9%	70.2%	14.5%
	Morro Bay	26.1	0.0	**28.7**	**0.0**	99.9	0.2	0.0	0.0	-71.3%	-79.5%	100.0%	100.0%
	Santa Barbara					0.0	0.0	0.0	0.0				
Limited Entry Fixed Gear	Puget Sound	528.8	1.8	**629.7**	**2.3**	289.3	1.6	141.3	0.9	117.6%	41.4%	345.6%	155.7%
	North Washington Coast	168.4	0.8	**216.1**	**1.0**	221.9	1.0	142.0	0.8	-2.6%	7.1%	52.2%	30.9%
	South and Central Washington Coast	178.9	0.8	**232.2**	**1.0**	313.5	1.5	505.5	3.1	-25.9%	-33.6%	-54.1%	-67.2%
	Astoria	134.0	0.6	**174.3**	**0.8**	148.5	0.8	22.3	0.1	17.3%	-1.8%	680.3%	475.9%
	Tillamook	0.1	0.0	**0.1**	**0.0**	0.0	0.0	0.0	0.0	100.0%	100.0%	100.0%	100.0%
	Newport	317.6	1.6	**419.2**	**2.1**	529.9	3.1	475.5	3.2	-20.9%	-32.5%	-11.8%	-33.9%
	Coos Bay	185.2	1.0	**244.1**	**1.3**	195.8	1.2	337.3	2.3	24.7%	6.5%	-27.6%	-42.2%
	Brookings	142.2	0.6	**180.4**	**0.8**	264.1	1.4	267.3	1.5	-31.7%	-43.1%	-32.5%	-46.5%
	Crescent City	63.7	0.2	**79.1**	**0.3**	108.4	0.5	50.6	0.2	-27.1%	-50.0%	56.3%	18.9%
	Eureka	100.8	0.4	**131.3**	**0.5**	101.8	0.4	134.4	0.7	28.9%	15.1%	-2.3%	-27.4%
	Fort Bragg	94.6	0.4	**122.9**	**0.5**	151.8	0.9	195.4	1.2	-19.1%	-39.2%	-37.1%	-54.4%
	Bodega Bay	4.4	0.0	**4.4**	**0.0**	9.5	0.1	11.9	0.1	-53.8%	-69.3%	-63.0%	-78.9%
	San Francisco	37.1	0.1	**48.7**	**0.2**	59.9	0.3	49.5	0.3	-18.7%	-34.0%	-1.6%	-49.3%
	Monterey	145.4	0.5	**177.2**	**0.6**	108.2	0.4	145.4	0.6	63.8%	50.9%	21.9%	10.5%
	Morro Bay	8.6	0.0	**10.7**	**0.1**	200.1	0.7	193.2	0.7	-94.6%	-92.1%	-94.5%	-92.4%
	Santa Barbara	45.0	0.3	**97.6**	**0.5**	35.7	0.3	69.5	0.5	173.6%	79.3%	40.5%	-0.1%
	Los Angeles	124.7	0.8	**353.7**	**2.0**	119.2	0.9	124.7	0.9	196.6%	127.6%	183.7%	117.1%
	San Diego	59.9	0.4	**177.1**	**1.1**	82.3	0.6	86.6	0.7	115.2%	67.4%	104.5%	55.8%
Nearshore Open Access	Puget Sound	0.0	0.0	**0.0**	**0.0**	0.0	0.0	0.0	0.0				
	North Washington Coast	2.9	0.0	**2.9**	**0.0**	0.2	0.0	0.8	0.0	1506.1%	1903.4%	254.5%	-8.5%
	South and Central Washington Coast	1.4	0.0	**1.4**	**0.0**	0.0	0.0	1.0	0.0	5350.4%	605.5%	35.9%	-69.8%
	Astoria	1.4	0.0	**1.4**	**0.0**	0.2	0.0	0.3	0.0	752.9%	96.7%	397.2%	-1.6%
	Tillamook	36.9	0.2	**36.9**	**0.2**	32.0	0.1	24.0	0.1	15.3%	11.5%	53.5%	48.7%
	Newport	12.4	0.1	**12.4**	**0.1**	10.2	0.0	12.9	0.0	20.8%	36.4%	-4.4%	15.9%
	Coos Bay	7.9	0.0	**7.9**	**0.0**	3.9	0.0	5.3	0.0	103.3%	53.8%	48.1%	-10.3%
	Brookings	108.1	0.5	**108.1**	**0.5**	161.4	0.9	114.7	0.7	-33.0%	-46.1%	-5.8%	-30.5%
	Crescent City	72.6	0.3	**72.6**	**0.3**	77.5	0.3	47.9	0.2	-6.3%	-7.1%	51.6%	50.9%
	Eureka	15.4	0.0	**15.4**	**0.0**	14.3	0.1	4.0	0.0	8.0%	-10.4%	284.4%	178.1%
	Fort Bragg	9.1	0.1	**9.1**	**0.1**	14.9	0.2	14.4	0.2	-39.0%	-62.6%	-37.2%	-60.9%
	Bodega Bay	1.0	0.0	**1.0**	**0.0**	2.4	0.0	2.8	0.0	-56.9%	-80.2%	-64.0%	-83.5%
	San Francisco	5.2	0.0	**5.2**	**0.0**	20.2	0.1	9.9	0.1	-74.4%	-73.2%	-47.8%	-69.7%
	Monterey	6.3	0.1	**6.3**	**0.1**	16.3	0.2	13.2	0.1	-61.1%	-69.2%	-52.3%	-62.8%
	Morro Bay	23.8	0.2	**23.8**	**0.2**	67.4	0.9	74.9	0.9	-64.7%	-72.9%	-68.2%	-73.4%
	Santa Barbara	0.6	0.0	**0.6**	**0.0**	14.9	0.2	17.2	0.2	-95.9%	-98.3%	-96.4%	-98.5%
	Los Angeles	0.3	0.0	**0.3**	**0.0**	4.9	0.0	5.8	0.0	-93.7%	-95.7%	-94.7%	-94.8%
	San Diego	0.6	0.0	**0.6**	**0.0**	3.8	0.0	1.4	0.0	-85.0%	-80.6%	-58.7%	-65.2%
Non-Nearshore Open Access	Puget Sound	3.2	0.0	**3.7**	**0.0**	0.0	0.0	0.8	0.0	100.0%	100.0%	100.0%	100.0%
	North Washington Coast	27.8	0.1	**35.9**	**0.2**	23.1	0.1	16.9	0.1	55.3%	79.2%	112.7%	80.3%
	South and Central Washington Coast	35.4	0.2	**46.7**	**0.2**	41.5	0.2	56.5	0.3	12.6%	-1.1%	-17.3%	-41.5%
	Astoria	18.6	0.1	**24.2**	**0.1**	17.1	0.1	8.5	0.0	41.7%	18.6%	184.1%	120.6%
	Tillamook	3.3	0.0	**6.6**	**0.0**	2.7	0.0	3.5	0.0	141.8%	112.2%	87.4%	45.6%
	Newport	12.0	0.0	**15.7**	**0.1**	34.3	0.2	24.6	0.2	-54.1%	-67.6%	-36.0%	-59.6%
	Coos Bay	37.4	0.2	**49.2**	**0.2**	82.7	0.4	46.0	0.3	-40.5%	-50.3%	7.0%	-20.4%
	Brookings	80.4	0.5	**104.5**	**0.6**	114.9	0.6	75.0	0.4	-9.0%	-3.1%	39.3%	33.2%
	Crescent City	25.7	0.2	**23.6**	**0.2**	4.2	0.0	0.7	0.0	461.4%	865.8%	3518.6%	6051.4%
	Eureka	33.5	0.1	**43.3**	**0.2**	59.2	0.3	59.6	0.3	-27.0%	-38.3%	-27.4%	-45.8%
	Fort Bragg	101.0	0.4	**132.1**	**0.5**	88.4	0.4	73.4	0.4	49.5%	20.5%	80.1%	38.1%
	Bodega Bay	3.9	0.0	**4.5**	**0.0**	14.9	0.1	29.5	0.2	-69.9%	-36.5%	-84.8%	-75.9%
	San Francisco	35.3	0.2	**39.6**	**0.2**	27.0	0.1	23.1	0.2	46.5%	63.2%	71.8%	54.4%
	Monterey	65.9	0.3	**79.6**	**0.4**	58.0	0.3	69.0	0.3	37.3%	40.8%	15.4%	29.8%
	Morro Bay	160.3	1.1	**199.4**	**1.3**	449.6	1.7	461.9	1.9	-55.7%	-24.0%	-56.8%	-33.0%
	Santa Barbara	24.4	0.2	**25.8**	**0.2**	63.7	0.3	168.9	0.7	-59.4%	-11.7%	-84.7%	-67.7%
	Los Angeles	34.0	0.1	**105.5**	**0.3**	10.2	0.1	8.2	0.1	933.6%	368.5%	1186.0%	477.8%
	San Diego	12.8	0.1	**31.0**	**0.3**	13.7	0.0	29.9	0.1	126.3%	536.9%	3.7%	259.5%
	TOTAL	**24,140.5**	**39.9**	**27,860.4**	**48.6**	**30,682.0**	**54.4**	**26,890.1**	**51.4**	**-9.2%**	**-10.7%**	**3.6%**	**-5.5%**

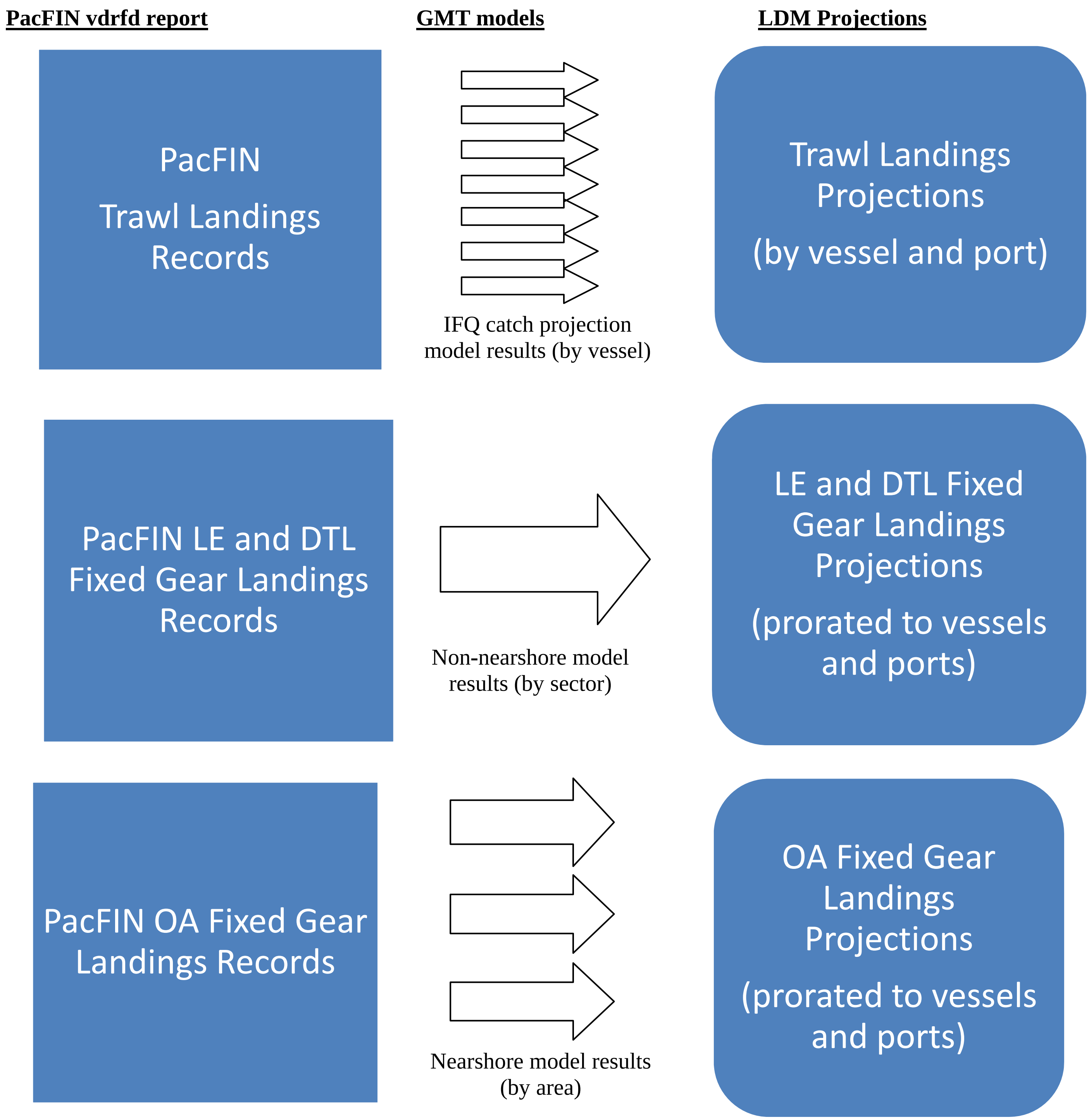


Figure A-1. Linkages between base year data, GMT landings projections, and the LDM.

Note: Results from the at-sea whiting fisheries and tribal fisheries models are incorporated in similar fashion.

A.2 Shorebased IFQ

A.2.1 Analytical description

The purposes of this analysis are to compare the relative predicted total catches and relative constraining influences among the proposed alternatives, in order to explore the range of alternatives, and assist in making the choice of a final preferred alternative in the biennial groundfish harvest specifications for 2013 and 2014. This was accomplished through the development of a new IFQ catch projection model, through the collaboration of staff from the NMFS Northwest Region (Dr. Sean Matson) and the Northwest Fishery Science Center (Dr. Jim Hastie and Dr. Ian Taylor). The model was coded in the R programming language, and executed in R version 2.1.3.0.

A.2.2 Model summary

The purpose of the model is to predict annual total annual catch of target and rebuilding species in the IFQ fishery, under different proposed allocations structures, and to produce landings estimates of each target species for input into economic models, for use in the 2013-14 biennial harvest specifications EIS. Data inputs consist of vessel-species-trip level catch data, vessel account information (total annual quota pounds (QP) by species and vessel account) and fleet allocations by species from the NMFS, IFQ Vessel Accounts system. Total catch is defined here as landings plus discards, and total bycatch is defined the same way, for rebuilding species and Pacific halibut. The model functions at the vessel-species level, and vessel predictions were summed to produce fleet estimates of catch for each IFQ species category. Figure A-2 illustrates the flow of information through the model.

The model predicts catch in three ways: it predicts catch of target species according to annual vessel QP for those species, and expected attainment of target species QP, either as observed in catch data, or the observed attainment rates can be modified by a user-defined formula, for each species, which is applied to every vessel. The model also predicts catch of target species according to the amount of bycatch of rebuilding species (the combination of observed, vessel-specific bycatch ratios and vessel QP of each rebuilding species). It predicts catch of rebuilding species (and Pacific halibut) by applying observed bycatch ratios to final predicted target catch. Observed species and vessel-specific retention rates are applied to final predicted catch, to produce landings estimates.

Catch of target species was deterministically modeled as related to vessel and species-specific attainment of QP. The relationship between variability in observed vessel QP and observed total catch is shown for each IFQ species in Table A-4. The proportion of variation among vessels in catch of each species category, which is explained by variation in QP, is expressed as R^2. Values of this parameter range from 99.9 percent for Pacific whiting, to 95.8 percent for sablefish, north of 36° N. lat., to 52 percent for minor slope rockfish, south of 40°10’ N. lat., to 34.9 percent for arrowtooth flounder, to 0.9 percent for minor shelf rockfish, south of 40°10’ N. lat. These R^2 values give an indication of the reliability of estimates of total catch by species.

Catch of non-target species was modeled as a function of vessel QP and vessel-specific bycatch rates. Thus, catch projections for rebuilding species depend upon the combination of vessel-specific QP for rebuilding species, bycatch ratios of those species, and vessel-specific aggregates of target species attainment rates.

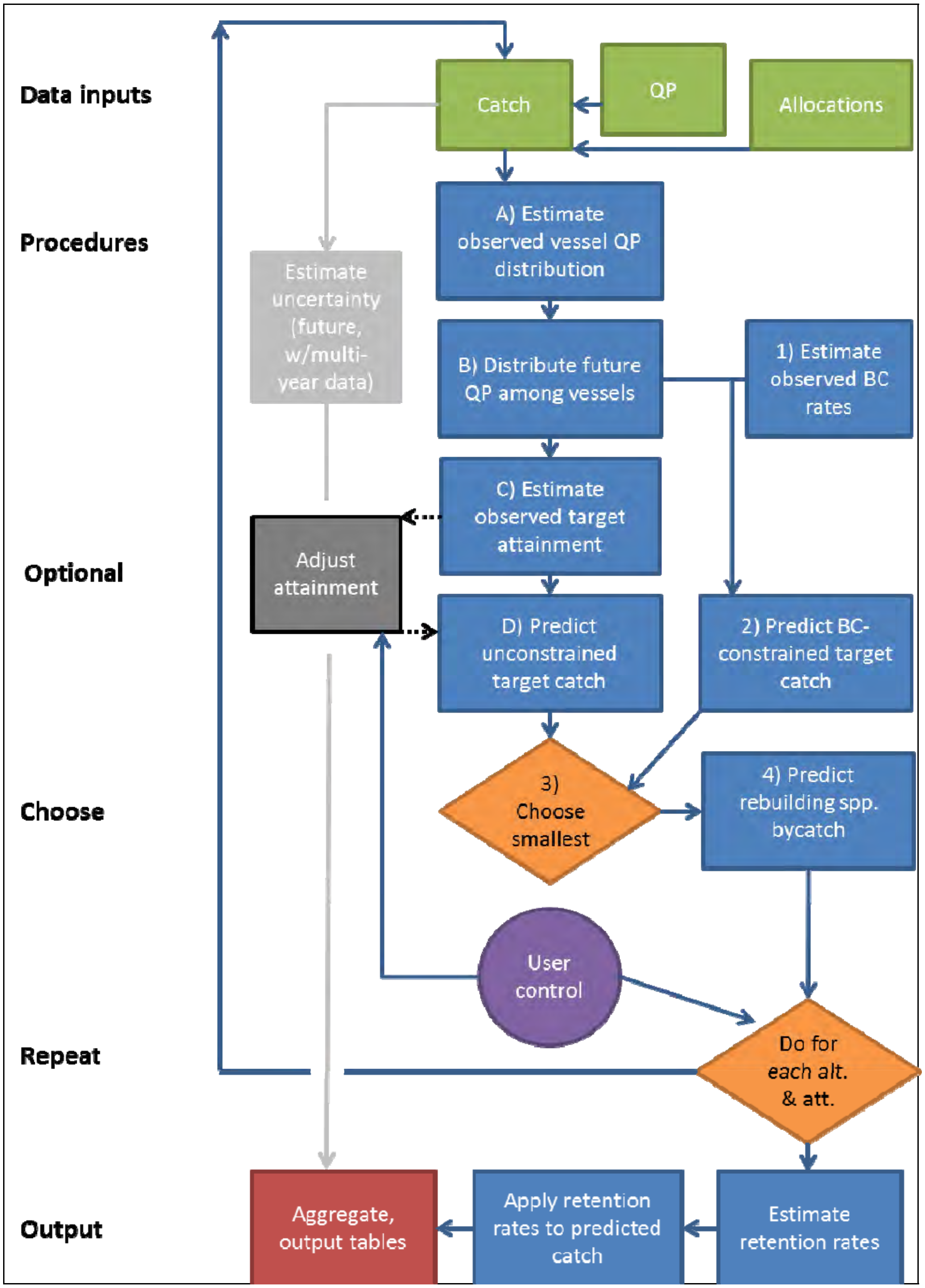


Figure A-2. Diagram illustrating information flow in the IFQ catch projection model, used in the 2013-14 West Coast groundfish harvest specifications.

Table A-4. Estimates of the proportion of variation in observed vessel catch of IFQ species in 2011, explained by variation in vessel QP, for each species category.

IFQ species category	R^2	lo CI	hi CI	p	sig.	n
Pacific whiting	0.999	0.999	0.999	0.000	*	91
Chilipepper rockfish south of 40°10' N.	0.966	0.933	0.999	0.000	*	11
Sablefish north of 36° N.	0.958	0.942	0.974	0.000	*	100
Sablefish south of 36° N.	0.832	0.685	0.979	0.000	*	12
Petrale sole	0.781	0.696	0.866	0.000	*	75
Widow rockfish	0.769	0.669	0.869	0.000	*	58
Longspine thornyheads north of 34°27' N.	0.760	0.669	0.851	0.000	*	76
Shortspine thornyheads north of 34°27' N.	0.642	0.528	0.756	0.000	*	92
Shortspine thornyheads south of 34°27' N.	0.575	-0.607	1.757	0.452		3
Pacific ocean perch north of 40°10' N.	0.546	0.392	0.700	0.000	*	68
Minor slope rockfish south of 40°10' N.	0.520	0.267	0.773	0.000	*	24
Starry flounder	0.460	0.136	0.784	0.005		15
Dover sole	0.444	0.298	0.590	0.000	*	95
Yellowtail rockfish north of 40°10' N.	0.369	0.162	0.576	0.000	*	48
Arrowtooth flounder	0.349	0.196	0.502	0.000	*	93
Pacific cod	0.322	0.096	0.548	0.000	*	40
Lingcod	0.314	0.154	0.474	0.000	*	84
Pacific halibut (IBQ) north of 40°10' N.	0.293	0.125	0.461	0.000	*	75
Darkblotched rockfish	0.289	0.131	0.447	0.000	*	85
Minor slope rockfish north of 40°10' N.	0.176	0.025	0.327	0.000	*	76
English sole	0.148	-0.006	0.302	0.002	*	65
Bocaccio rockfish south of 40°10' N.	0.147	-0.189	0.483	0.275		10
Other flatfish	0.100	-0.019	0.219	0.003	*	84
Minor shelf rockfish north of 40°10' N.	0.071	-0.046	0.188	0.034	*	64
Canary rockfish	0.054	-0.059	0.167	0.090		54
Splitnose rockfish south of 40°10' N.	0.038	-0.124	0.200	0.470		16
Cowcod south of 40°10' N.	0.037	-0.274	0.348	0.807		4
Yelloweye rockfish	0.012	-0.092	0.116	0.735		12
Minor shelf rockfish south of 40°10' N.	0.009	-0.084	0.102	0.086		11

A.2.3 “Unconstrained” target catch prediction

The model predicts total catch of IFQ target species by vessel, by applying the proportion of each vessel’s total annual quota pounds (QP = total allowable catch by species for one particular vessel) which it caught in 2011, to that vessel’s estimated future QP, under a proposed fleet allocation structure. A vessel’s future QP for a particular species category is estimated as the same proportion of the future year’s fleet allocation of that species category, as existed in the observed year. This routine relies upon end-of-year, total QP weights from IFQ vessel accounts. We refer to this as the “unconstrained target catch prediction”, since it is not constrained by bycatch of rebuilding species.

In making predictions of catch, the model either assumes the same attainment level of each vessel’s QP in 2011, or the user adjusts attainment levels for each species category, for a given set of proposed fleet allocations. Vessel total annual QP can be scaled up according to a user-defined function, and parameter value(s). In this case, annual vessel attainment (through November 30) for each species was multiplied by 1.0909, in order to add the equivalent of an additional average month of catch for each vessel. A limit of 100 percent of vessel QP for each species was applied to attainment. This attainment adjustment resulted in a similar monthly catch pattern to 2010. This model was not intended for inseason analysis; however the adjustable attainment mechanism enabled imputation of December catch, in order to meet the deadline for the DEIS.

A.2.4 “Constrained” target catch prediction and bycatch estimation

The model then makes a second type of prediction of target species catch (“constrained target catch prediction”), which is limited by the combination of each vessel’s bycatch limits of each rebuilding species (QP), and its bycatch ratios of each rebuilding species, according to the following formula, in order to predict the “constrained” sum target catch:

predicted constrained sum target catch = QP of rebuilding species “X” / bycatch ratio of species “X”

Bycatch ratios are estimated for each species, for each vessel from observed (2011) data as the ratio of each rebuilding species catch, to the observed sum of target species catch.

The two predictions of the sum of target species catch for each vessel are then compared, and the smaller is accepted (either “unconstrained” or “constrained”), reported, and labeled at “target” or “rebuild” in the model output.

Observed bycatch ratios are applied to the final sum of predicted vessel target catch, to produce total bycatch predictions for rebuilding species. The accepted prediction of sum target catch is distributed among target species categories according to the catch composition produced in the unconstrained prediction of target species catch.

A.2.5 Landings estimation

Finally, vessel and species-specific retention rates from 2011 catch data were applied to the predictions of total catch in order to provide landings estimates for revenue modeling by the economic analytical team.

A.2.6 Assumptions and limitations

Although these predictions of catch constitute the best available information at the time of the analysis, several assumptions needed to be made for this exercise. First, due to the timeline for production of the DEIS, catch and vessel account data were truncated at November 30, 2011 to produce vessel landings estimates in time for further analysis by economists, etc. This model was intended to function with one full year of catch data as an input, and so December catch had to be imputed. However, any lack of accuracy of the imputed December catch data does not compromise the usefulness of the model output for the purpose of making relative comparisons of the predictions among alternatives.

Since this is the first year of the IFQ groundfish fishery, and no historic data regarding attainment of allocations exist for the fishery under this management regime, which is vastly different than that of trip limits, it was assumed that the fishery would progress through December of 2011 with vessels fishing at their average monthly vessel and species-specific attainment rate of QP, from January through November of 2011. Imputing December catch in this way also produced a monthly catch time series for DTS species (Dover sole, sablefish, and thornyheads), similar to that of 2010. In the NMFS mid-year IFQ catch report (Matson, 2011), it was shown that Dungeness crab fishery participation was strongly and negatively related to IFQ fishing participation from January through June of 2011 (R^2=0.83). The crab fishery often opens during December, however it was uncertain when this would happen during December of 2011, and thus how much effort could potentially be diverted away from IFQ.

It was also assumed for the purposes of the analysis that all quota pounds (QP) transactions had finished for the year, although additional trading could occur until December 15, 2011. A means for modeling commerce of vessel QP does not yet exist in the current model, although it may be added in the next biennial cycle.

It is inherently assumed in the model predictions of catch that bycatch rates and target species attainment rates will be the same as estimated for 2011. Given that IFQ management for this fishery has existed for less than one year, these rates could change as ratios of QP for different species on each vessel change, new fishing strategies are perfected, risk pools are formed, and different ratios of trawl gear and fixed gear are used.

A.2.7 Bias in catch projections

Catch projections from this analysis are likely to be biased low for 2013 and 2014, and since catch of bycatch species is estimated as a function of vessel catch of all target species, they are affected as well. There are two apparent reasons for this. One stems from the data used for input, and another from the method this first version of the model uses for projecting target catch.

As described earlier, the catch data used for input was incomplete, December catch was imputed, and actual December catch was higher than expected; also incomplete distributions QP to vessel accounts were used, and with no historical annual catch history available in this new fishery, it was impossible to impute the final amounts of QP, thus the QP distributions were biased low.

The second source of low bias in projected catch was also discussed earlier, but it should be noted that it affects projections for bycatch species as well as target species. This source is that the estimation method likely relies too heavily on vessel attainment proportions of their QP for some species. Stated simply, using arrowtooth flounder as an example, it does not seem likely that catch of arrowtooth will drop as drastically as predicted, just because the allocation has dropped drastically, given that this species is vastly underexploited; it's fleet-level attainment rate was only approximately 20 percent in 2011. The amount of variance in vessel catch in this species explained by QP is approximately 35 percent, the rest is likely explained my other predictors such as market influences, processor limits, etc. However, the current version of the model assumes that catch of arrowtooth drops proportionately with the amount of QP available to each vessel.

Since the catch of arrowtooth is relatively large (2 percent of the entire IFQ fishery catch by weight, and 13 percent of the nonwhiting IFQ fishery catch), and since bycatch ratios of rebuilding species are estimated relative to total target species catch, for each vessel, bias in projections of arrowtooth flounder should carry through to those of rebuilding species as well, for vessels which catch arrowtooth. Catch projections for rebuilding species were lower for the alternatives other than No Action, as were arrowtooth flounder, English sole, sablefish north of 36° N. lat., while petrale sole allocations were higher than No Action in all other alternatives (however, the size of the petrale sole allocation is only approximately 5 percent of the sum of the arrowtooth flounder, English sole, and sablefish allocations, for No Action - not enough to counterbalance effects of the other species on projected amounts of total vessel target species catch). It should be noted that vessel catch of sablefish north of 36° N. lat. is strongly related to vessel QP of this species (R^2=0.958).

At least two possible solutions to this problem exist for implementation in the model used for the next harvest specifications and management measures cycle. One is to mediate the proportion of total vessel QP caught for each target species that the model uses to project future target catch by the proportion of the variance in vessel-species catch which is explained by variance in vessel QP for each species (R^2value). For those species whose catch is strongly correlated with the amount of QP available (the amount of QP available results from changes to fleet allocations) projected catch would continue to covary strongly with QP as well. However, for species such as arrowtooth flounder, which weakly covaries with QP, the projected change in catch in response to change in QP would be correspondingly weak (according to R^2 or similar estimate of explicable variance due to QP). Bounds could be placed on projected catch of certain species, corresponding to historical maximums and minimums as well.

Another factor that is often absent from projection models, this one included, is the possibility of change in fisher behavior. The model does not factor the possibility for increased risk in fisher behavior in pursuit of more target catch, and higher resulting bycatch rates of rebuilding species, which could potentially be associated with higher allocations of rebuilding species, and increased confidence after one year of the new IFQ fishery. This situation could be remedied by estimating uncertainty associated with a range of increase or decrease in bycatch rate. This uncertainty could be informed by actual data, when more than one year of catch data exists, such as by the next biennial cycle.

For now, one can look to actual catch data for 2011, as an additional source of inference about absolute amounts of species allocations of bycatch species that are likely to be needed for the next biennium, with the caveat that 2011 was only the first year of the fishery, and one might expect more confidence surrounding bycatch, coinciding with more cooperation and organization among fishermen in the coming seasons, which could enable more full use of bycatch allocations, in pursuit of target species attainment.

A.3 Non-Nearshore

The non-nearshore model projects bycatch impacts for limited entry and open access fixed gear vessels that are fishing seaward of the nontrawl RCA. The main focus is on bycatch of the rebuilding rockfish, canary and yelloweye in particular, as described in Appendix D. WCGOP observations on discards and landed catch 2002-2009 provide the primary data input for estimating bycatch with PacFIN fish ticket data also providing information on the distribution of catch among gear types. Data from 2009 were the most recent data available at the time of the analysis.

As also described in Appendix C, sablefish is the primary target for vessels fishing in these sectors. The sablefish ACL north of 36° N. latitude is apportioned according to the formal intersector allocations shown in Figure A-3. Management measures are intended to keep the total mortality—i.e. discard mortality and landings—within the allocation for each sector. Because of the economic importance of sablefish, the bycatch impact analysis assumes that the annual sablefish allocation will be fully attained by the fixed gear fleets seaward of the RCA. WCGOP bycatch observations are therefore expressed as a ratio to the expected landings of sablefish.

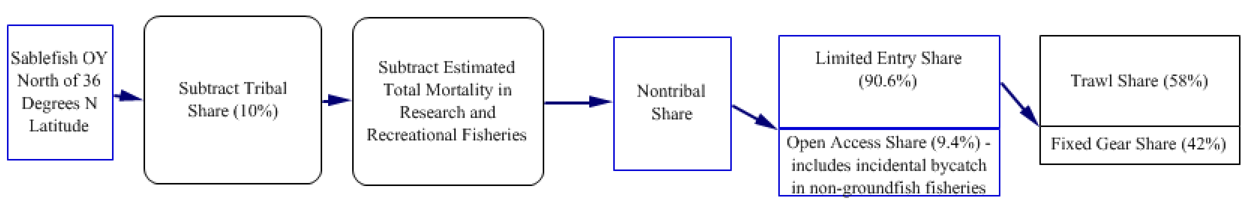


Figure A-3. The formal intersector allocations of sablefish north of 36° N. latitude.

The structure of the projection model has not been changed from that used during the 2009-10 and 2011-12 analyses. Observations were added from 2009 and the model now combines data from the fixed gear sablefish fishery north and south of 40°10' N. latitude from the years 2002-2009. Data from each year is weighted equally. There are tradeoffs with data accuracy and precision involved with stratifying observations to finer levels across attributes (i.e. time, area, depth, and gear type). Aggregating data across years allows reporting of retained and discarded catch of groundfish species by gear type at a finer latitudinal and depth scale than would otherwise be possible. Differences in the encounter rate of yelloweye and canary rockfish between depths and areas are the major focus of the model and so these stratifications have taken priority. The data is stratified by gear because of the differences in the rate of encounter between pot and longline gear types.

Data summarizing observed retained and discarded catch from fishing efforts north of 40°10' N. latitude are stratified across three alternative depth ranges that are used to evaluate the potential impact of extending the seaward boundary of the nontrawl RCA on bycatch levels. As described in Appendix D, the seaward RCA boundary is the key bycatch management measures in these non-nearshore sectors. Although the range of depths recorded for an individual fixed gear set by observers is commonly much smaller than for observed trawl tows, there is some uncertainty in the assignment of catch and discard from many sets to a specific 25 fm interval. For this exercise, the average of the beginning and ending depths of each set was used to represent the depth at which all fish on the set were caught.

The area stratification used in this model was developed first for use in the 2009-10 biennial management cycle. This stratification was arrived at through consideration of canary and yelloweye bycatch north of 40°10' N. latitude by depth and area and provides the Council with the option of employing differential seaward RCA boundaries within these areas. Four subareas were identified bounded by: Cape Mendocino at 40°10' N. latitude, the boundary of the Columbia and Eureka INPFC areas (43°10' N. latitude), Cascade Head (45.064°10' N. latitude), Point Chehalis (46.888°10' N. latitude), and the U.S.-Canada border. Several alternative boundaries were evaluated. Analysts determined that the four listed above provided the greatest contrast and reliability between areas of high and low yelloweye bycatch. Since rockfish bycatch in the pot gear fleet is very small and there are very limited numbers of pot gear observations in some areas, results for this group are summarized with respect to depth only (without subareas). The seaward boundary of the nontrawl RCA south of 40°10' N. latitude has always been 150 fm and so no data is available shallower than that depth.

To produce estimates of catch by area, the model must assume a distribution of sablefish catch between the areas north and south of 40°10' N. latitude and between longline and pot gear types for both the open access and limited entry sectors. The assumed distribution is based on fish ticket landings for the years 2002-2009 (Table A-5). The 2002-2009 average of WCGOP observed landings are then used to project the distribution of the longline catch north of 40°10' N. latitude among the four management subareas (Table A-6). The model then applies WCGOP observed discard rates to these projected catch distributions using the appropriate area, depth, and gear stratification to produce annual estimates of discard for the rebuilding rockfish encountered by the non-nearshore fixed gear sectors. Discard rates were calculated by dividing the total observed discard weight for each species by the weight of retained sablefish and are reported in Table A-7 through Table A-10. Data is available for all species encountered in the non-nearshore sectors, however, this projection model focuses on the rebuilding rockfish stocks and the potential need to adjust the seaward boundary of the RCA to lower their catch. The total mortality of other groundfish species discarded and landed by these sectors is reviewed and accounted for annually and will be addressed if catch reaches levels where a sector allocation or other catch limit is at risk of being exceeded. If necessary, the structure and data in this model could be used to project bycatch of species for which discard becomes a concern in the non-nearshore sectors. The analysis of impact associated with alternative RCA specifications based on this methodology is discussed in Appendix C.

Table A-5. Distribution of fish ticket landings among longline (hkl) and pot gear types in the limited entry and open access non-nearshore fixed gear sectors, 2002-2009.

	LIMITED ENTRY						OPEN ACCESS				
	36° - 40°10'		North of 40°10'		TOTAL (LE)		36° - 40°10'		North of		TOTAL (OA)
	hkl	pot	hkl	pot			hkl	pot	hkl	pot	
2002	154	16	783	345	1,298	2002	125	82	138	16	361
2003	201	24	1,013	587	1,825	2003	126	148	246	29	549
2004	214	58	1,264	575	2,111	2004	90	156	191	10	447
2005	212	-	1,319	623	2,154	2005	111	262	419	101	893
2006	186	50	1,389	564	2,189	2006	78	247	280	182	787
2007	190	45	1,117	391	1,742	2007	31	209	185	32	458
2008	226	39	1,146	398	1,809	2008	66	206	273	24	570
2009	377	63	1,481	441	2,363	2009	279	319	305	37	940
Total	1,758	295	9,513	3,924	15,490	Total	906	1,629	2,038	432	5,005
% of LE total	11%	2%	61%	25%	100%	% of OA total	18%	33%	41%	9%	100%

Table A-6. Distribution of observed longline sablefish landings among the four management subareas north of 40°10' N. latitude, 2002-2009.

	Longline				
	North of 40°10' N	**40°10' - Col./Eur. line 43°**	**Col./Eur. line 43° - Cascade Head 45.064°**	**Cascade Head 45.064° - Pt. Chehalis 46.888°**	**North of Pt. Chehalis 46.888°**
Observed sablefish landings (mt)	2,058	296	537	324	900
% of total		**14%**	**26%**	**16%**	**44%**
min (02-09)		*6%*	*17%*	*4%*	*24%*
max (02-09)		*24%*	*37%*	*45%*	*55%*
mean (02-09)		*14%*	*26%*	*18%*	*42%*
stdev (02-09)		*6%*	*7%*	*13%*	*11%*

Table A-7. Rates of species discard (2002-2009 average) for the rebuilding rockfish species relative to retained sablefish, used to project bycatch impacts for longline gear south of 40°10' N. latitude and for pot gear types north and south of north of 40°10' N. latitude.

	36° - 40°10' N. lat.		North of 40°10' N. Lat Pot		
	Longline	Pot	100 fm	125 fm	150fm
Bycatch ratios (total catch lbs / retained sablefish lbs)					
Rebuilding species					
Bocaccio	0.0000	0.0000	0.0000	0.0000	0.0000
Canary rockfish	0.0000	0.0000	0.0000	0.0000	0.0000
Darkblotched rockfish	0.0000	0.0000	0.0000	0.0000	0.0000
Pacific ocean perch	0.0014	0.0010	0.0007	0.0007	0.0007
Yelloweye rockfish	0.0002	0.0000	0.0000	0.0000	0.0000

Table A-8. Rates of species discard (2002-2009 average) observed on fixed gear sablefish sets deeper than 100 fm for rebuilding rockfish species, relative to retained sablefish, used to project bycatch impacts for longline gear north of 40°10' N. latitude by management subareas.

	North of 40°10' N	40°10' - Col./Eur. line 43°	Col./Eur. line 43° - Cascade Head 45.064°	Cascade Head 45.064° - Pt. Chehalis 46.888°	North of Pt. Chehalis 46.888°
Bycatch ratios (total catch lbs / retained sablefish lbs)					
Rebuilding species					
Bocaccio	0.0001	0.0004	0.0000	0.0000	0.0001
Canary rockfish	0.0016	0.0001	0.0002	0.0021	0.0027
Darkblotched rockfish	0.0000	0.0000	0.0000	0.0000	0.0000
Pacific ocean perch	0.0025	0.0094	0.0028	0.0009	0.0005
Yelloweye rockfish	0.0000	0.0000	0.0000	0.0001	0.0000

Table A-9. Rates of species discard (2002-2009 average) observed on fixed gear sablefish sets deeper than 125 fm for rebuilding rockfish species, relative to retained sablefish, used to project bycatch impacts for longline gear north of 40°10' N. latitude by management subareas.

	North of 40°10' N	40°10' - Col./Eur. line 43°	Col./Eur. line 43° - Cascade Head 45.064°	Cascade Head 45.064° - Pt. Chehalis 46.888°	North of Pt. Chehalis 46.888°
Bycatch ratios (total catch lbs / retained sablefish lbs)					
Rebuilding species					
Bocaccio	0.0001	0.0004	0.0000	0.0000	0.0000
Canary rockfish	0.0012	0.0000	0.0001	0.0001	0.0025
Darkblotched rockfish	0.0000	0.0000	0.0000	0.0000	0.0000
Pacific ocean perch	0.0030	0.0098	0.0035	0.0019	0.0005
Yelloweye rockfish	0.0000	0.0000	0.0000	0.0001	0.0000

Table A-10. Rates of species discard (2002-2009 average) observed on fixed gear sablefish sets deeper than 150 fm for rebuilding rockfish species, relative to retained sablefish, used to project bycatch impacts for longline gear north of 40°10' N. latitude by management subareas.

	North of 40°10' N	40°10' - Col./Eur. line 43°	Col./Eur. line 43° - Cascade Head 45.064°	Cascade Head 45.064° - Pt. Chehalis 46.888°	North of Pt. Chehalis 46.888°
Bycatch ratios (total catch lbs / retained sablefish lbs)					
Rebuilding species					
Bocaccio	0.0000	0.0001	0.0000	0.0000	0.0000
Canary rockfish	0.0012	0.0000	0.0001	0.0000	0.0025
Darkblotched rockfish	0.0000	0.0000	0.0000	0.0000	0.0000
Pacific ocean perch	0.0039	0.0111	0.0055	0.0025	0.0006
Yelloweye rockfish	0.0000	0.0000	0.0000	0.0000	0.0000

A.4 Coastwide Sablefish Trip Limits

The following section discusses catch projection and trip limit analyses for the four fixed gear, daily trip limit (DTL) fisheries, including both limited entry (LE) and open access (OA), north and south of 36° N. lat. for 2011. Hereafter, they will be referred to as follows: LE North, LE South, OA North, and OA South.

Proposed trip limits for 2013 and 2014 in the fixed gear, sablefish, DTL fisheries were produced through iteration using GMT catch projection models (models described briefly below, and in detail in the 2011-2012 SPEX EIS).

Proposed trip limits in the Preferred Alternatives for 2013 and 2014 were reduced or increased to bring projected catch to within new management targets, resulting from changes to the sablefish ACLs for the areas north and south of 36° N. lat. Landings projections were approximately 91 percent of the landings target, in order to produce trip limits which are likely to result in full attainment of harvest guidelines, while providing sufficient catch buffer, appropriate for the uncertainty in accuracy of estimated landings data, and normal uncertainty associated with statistical model projections. This strategy was supported by the Council in establishing sablefish DTL trip limits for 2012, in the November, 2011 Council meeting.

For 2013, in the LE North fishery, proposed trip limits for 2013 were reduced to approximately 85 percent of No Action levels; for the OA North fishery, proposed trip limits were reduced to 68 percent of No Action. In the area south of 36° N. lat., harvest guidelines were higher than No Action (due to a slightly higher sablefish ACL for 2013 and 2014 in this area). For LE South, proposed trip limits were 104 percent of no action; for OA South, 108 percent. Trip limits for 2014 were slightly higher than for 2013 (2 to 5 percent higher) across all four sablefish DTL fisheries, due to higher ACLs in 2014.

A.4.1 Analytical description

The purposes of this analysis are to compare predicted landings between the No Action Alternative and the Preferred Alternative, under their resultant regional allocations, and fishery harvest guidelines, for the four fixed gear, sablefish daily trip limit (DTL) fisheries, including limited entry (LE) and open access (OA), both north and south of 36° N. lat.

The ACLs, regional allocations, and fishery landing targets (LTs) only vary between the No Action Alternative, versus the Preferred Alternative and all other alternatives, within each year. Levels of these three harvest control points vary only between years (2013-2014), and between No Action and all other alternatives. Within this analysis, "harvest guidelines" is defined as numerical management harvest objectives which are not quotas. These are either cited in regulation or calculated from other higher level numerical management objectives appearing in regulation. These harvest guidelines were reduced to account for discard mortality, the method and rationale for which is described below, to produce "landings targets", which were used in projection modeling to predict landings, and determine necessary trip limits.

A.4.2 Model description

The catch projection models used in this analysis are linear regression models that relate trip limits to monthly or bimonthly landings, separately for each fishery. Detailed descriptions of the models can be found in Appendix A. of the 2011-2012 harvest specifications EIS.

Limited entry models were specified as described in the 2011-2012 EIS. Minor differences in model specification were made in the open access models for 2013-2014. Sablefish ex-vessel revenue and fuel prices were removed as predictor variables in the open access North and South models. Although these variables present a meaningful picture in retrospect, when their historical values are known, they do not provide valuable information for making projections of future catch, since fuel prices and sablefish prices in the future are not known, are subject to substantial variability, and either assumptions or projections must be made about these would-be predictor variables themselves. Error in assumptions regarding future values of these variables introduces bias and significantly affects accuracy of projections; using them inflates apparent accuracy and precision, producing unrealistically high multiple-R^2 values and low standard errors for the regressions. Trip limits, on the other hand, are known (are set by the Council process), and their use for projecting catch into the future presents a realistic picture of uncertainty. Data from years 2004-2006, when there was extremely small variation in trip limits, and provided little information content for the model, were removed from the OA South model, and resulted in increased model fit.

A.4.3 Model input data

Landings and catch data were acquired from PacFIN using the query "slct_ves_sabl_arid_DTL_no_EFP.sql". As described in the GMT inseason statements from the April, June, September, and November 2011 Council meetings, data from this query were found this year to have two substantial problems, both of which were corrected before use in the analysis for these harvest specifications. First, historical landings of sablefish with fixed gear, in the LE North, DTL fishery were substantially underestimated from 2004 through 2011, as the software in the PacFIN database which estimates division of fixed gear sablefish landings between the sablefish primary fishery and DTL fisheries was malfunctioning. The software has since been modified to make the most accurate division of catch between the two fisheries which is currently possible, and the GMT and Council are working on a long-range solution that would provide direct catch accounting, which would replace the currently necessary computational estimation procedure. Second, gear-switching provisions under IFQ lead to misattribution of IFQ landings of sablefish using fixed gear, to the various sablefish DTL fisheries. This has also been corrected, and screening procedures have been put in place both in PacFIN and with the states to flag and remove IFQ fish tickets from the "slct_ves_sabl_arid_DTL_no_EFP.sql" query for the sablefish DTL projection models.

A.4.4 Accounting for discards and discard mortality

Landings targets which appear in this section have been reduced from harvest guidelines that would appear in regulation, where applicable, in order to account for discard mortality. The harvest guideline (a specified numerical harvest objective that is not a quota) was multiplied by 15.9 percent (discard rate estimate), and by 20 percent (discard mortality rate estimate), and then that product (estimated dead discarded sablefish) was subtracted from the harvest guideline, resulting in a "landings target", which projected landings should be beneath, in order to keep total catch within the harvest guideline. The estimated discard rate used by GMT was taken from the 2010 West Coast Groundfish Observer Program (WCGOP) Total Mortality Report. In the 2009-10 management cycle, the discard rate estimate was the same, and was derived from data in the 2007 WCGOP Total Mortality Report, which was the most recent available data at that time. That discard mortality rate estimate was taken from information in Davis (2001, LTtp://onlinelibrary.wiley.com/doi/10.1111/j.1095-8649.2001.tb00495.x/abstract), Shirrippa and Colbert (2005, LTtp://www.pcouncil.org/wp-content/uploads/Sable05_complete.pdf), and Shirrippa (2007, LTtp://www.pcouncil.org/wp-content/uploads/Sable07v3_0.pdf). Shirrippa (2005) used experimental data and sea surface temperature to predict varying release mortality by gear. The GMT considered that Davis (2001) demonstrated high sensitivity to temperature and deck time, along with high variability of predicted discard mortality in Shirrippa (2005) informed by sea surface temperature data, and adopted an estimate of 20 percent. This value was also adopted by Taylor 2011 in the current sablefish stock assessment.

A.4.5 Results

A.4.5.1 No Action Alternative

Under No Action, the following Rockfish Conservation Area boundaries for use of fixed gear, from 2012 regulations, would remain in place for 2013 and 2014 (Table A-11).

Table A-11. Rockfish Conservation Area (RCA) boundaries for fixed gear, under the No Action Alternative.

Area	Jan-Feb	Mar-Apr	May-Jun	Jul-Aug	Sep-Oct	Nov-Dec
North of 46° 16'	shore - 100 fm					
45° 03’ 83” - 46° 16’	30 - 100 fm					
43° - 45° 03’ 83”	30 - 125 fm (125 line reduced to 100 fm during directed halibut season)					
42° - 43°	20 - 100 fm					
40° 10’ - 42°	20 fm depth contour - 100 fm					
34° 27’ - 40° 10’	30 fm - 150 fm line					
South of 34° 27’ (w/islands)	• m - 150 fm line					

Projected impacts (No action)
Projected landings under the No Action Alternative are presented in Table A-12. The GMT and the Council considered, while constructing and adopting them, respectively, the uncertainty in the landings data seen during 2011 (in terms of correctly separating sablefish primary fishery landings from DTL landings, and separating new IFQ fixed gear landings from DTL landings) along with the normal uncertainty associated with projection models, the No Action trip limit structures for 2012 for each fishery presented here. The No Action Alternative resulted in projected attainments in the range of 91 percent to 93 percent, aiming to enable harvest of a high proportion of the HG, yet accommodating previously described uncertainty.

Table A-12. Model-projected impacts of trip limits under the No Action Alternative, for the fixed-gear, sablefish, DTL fisheries. Landings targets and projected impacts are in metric tons (mt) of landed catch.

Fishery	Area	LT	No act. projection	% of LT
LE N.	North of 36° N. lat.	265	242	91%
OA N.	North of 36° N. lat.	419	381	91%
LE S.	South of 36° N. lat.	380	353	93%
OA S.	South of 36° N. lat.	309	284	92%

These trip limits can be adjusted inseason as needed to influence higher or lower catch as 2013 progresses. We strove to present trip limits with a predictable and temporally even structure (which was appreciated by the GAP, in their statement, in the November 2011 Council meeting), and to avoid starting the year with highly variable trip limits, such as resulted from the “rolling over” of 2010 trip limits into 2011, due to unforeseeable delays in implementation (Table A-13).

Table A-13. Trip limits for sablefish DTL fisheries under No Action.

Area	Fishery	Jan-Feb	Mar-Apr	May-Jun	July-Aug	Sept-Oct	Nov-Dec
North of 36° N. lat. (U.S./Canada Border to 36° N. lat.)	LE N.	1,300 lb. per week, not to exceed 5,000 lb. per 2 mo.					
	OA N.	300 lb. per day, or 1 landing per week of up to 900 lb., not to exceed 1,800 lb. per 2 mo.					
South of 36° N. lat.	LE S.	1,800 lb. per week					
	OA S.	300 lb. per day, or 1 landing per week of up to 1,350 lb., not to exceed 2,700 lb. per 2 mo.					

A.4.5.2 Preferred and remaining alternatives

Preferred Alternative for 2013

Projected landings under the Preferred Alternative are presented in Table A-14. As with the No Action Alternative, we considered the uncertainty in the landings data seen during 2011 (in terms of correctly separating sablefish primary fishery landings from DTL landings, and separating new IFQ fixed gear landings from DTL landings), along with the normal uncertainty associated with projection models, when constructing the trip limit structures for 2013 for each fishery presented here. The Preferred Alternative results in projected attainments of 91 percent, aiming to enable harvest of a high proportion of the LT, yet accommodating previously described uncertainty. These trip limits can be adjusted inseason as needed to influence higher or lower landings as 2013 progresses. We strove to present trip limits with a predictable and temporally even structure, using the same rationale as for No Action. Landings targets for each fishery are equal for the PPA and all alternatives other than No Action, within each year.

Table A-14. 2013 Model-projected impacts of trip limits under the Preferred Alternative, No Action Alternative, and comparison between them, in the fixed-gear, sablefish, DTL fisheries for 2013. Landings targets and projected impacts are in metric tons (mt) of landed catch.

Fishery	Area	LT	PPA projection	% of LT
LE N.	North of 36° N. lat.	197	179	91%
OA N.	North of 36° N. lat.	291	266	91%
LE S.	South of 36° N. lat.	446	405	91%
OA S.	South of 36° N. lat.	362	330	91%

Projected landings under the PPA were lower than No Action for the LE North and OA North fisheries (74 percent and 70 percent of No Action, respectively), and higher than No Action for the LE South and OA South (115 percent and 116 percent, respectively), covarying with changes to the area-specific sablefish ACLs in 2013; see Table A-15 and Figure A-4.

Table A-15. 2013 Model-projected impacts of trip limits under the Preferred Alternative (equal to alternatives other than No Action), No Action Alternative, and comparison between them, in the fixed-gear, sablefish, DTL fisheries for 2013. Landings targets and projected impacts are in metric tons (mt).

Fishery	Area	PPA projection	No act. projection	% of No act.
LE N.	North of 36° N. lat.	179	242	74%
OA N.	North of 36° N. lat.	266	381	70%
LE S.	South of 36° N. lat.	405	353	115%
OA S.	South of 36° N. lat.	330	284	116%

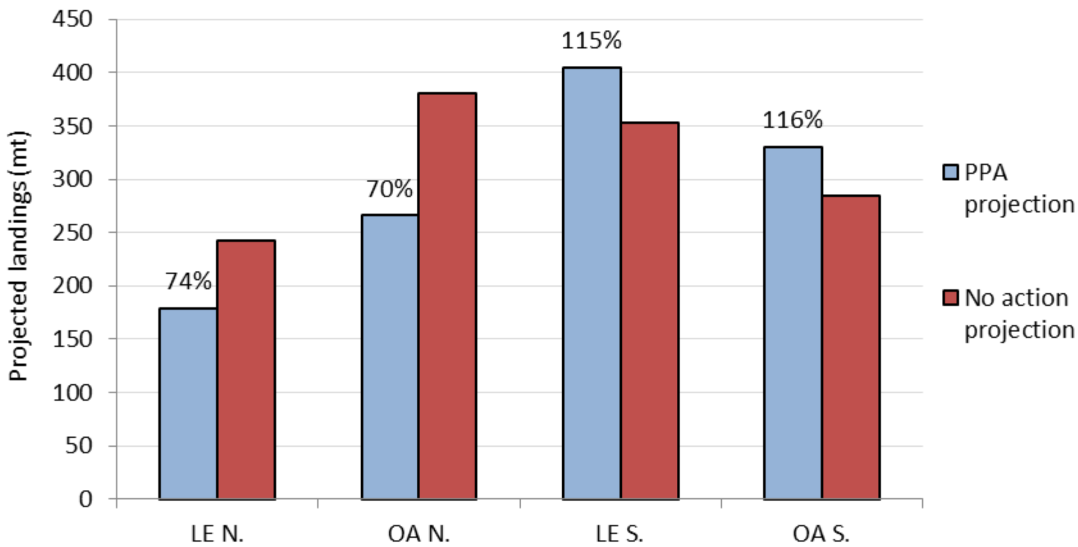


Figure A-4. Projected landings for 2013 under the PPA and No Action, for the four fixed gear, sablefish, DTL fisheries. Column labels show PPA projection as a percentage of No Action.

The proposed trip limits which informed the above landings projections were reduced accordingly in the North, compared with No Action, and increased in the South, compared with No Action (Table A-16), to keep catch within the LTs. For the LE North, weekly trip limits needed to be reduced by 200 pounds per week, and bimonthly limits by 800 pounds, to maintain a similar rate of attainment as in the No Action Alternative. For the OA North, a reduction of 290 pounds per week and 580 pounds per two months was necessary.

For the area south of 36° N. lat., an increase to trip limits of 80 pounds per week was possible in the LE South fishery, while an increase of 110 pounds per week and 220 pounds per bimonthly period was possible in the OA South fishery.

Table A-16. 2013 Proposed trip limits for 2013 in sablefish DTL fisheries under the PPA, and alternatives other than No Action.

Area	Fishery	Jan-Feb	Mar-Apr	May-Jun	July-Aug	Sept-Oct	Nov-Dec
North of 36° N. lat. (U.S./Canada Border	LE N.	1,100 lb. per week, not to exceed 4,200 lb. per 2 mo.					

to 36° N. lat.)	OA N.	300 lb. per day, or 1 landing per week of up to 610 lb., not to exceed 1,220 lb. per 2 mo.
South of 36° N. lat.	LE S.	1,880 lb. per week
	OA S.	300 lb. per day, or 1 landing per week of up to 1,460 lb., not to exceed 2,920 lb. per 2 mo.

Preferred Alternative for 2014

Projected landings under the Preferred Alternative for 2014 are presented in Table A-17. As with the No Action Alternative, we considered uncertainty in the landings data seen during 2011 (in terms of correctly separating sablefish primary fishery landings from DTL landings, and separating new IFQ fixed gear landings from DTL landings), along with the normal uncertainty associated with projection models, when constructing the trip limit structures for 2014 for each fishery presented here. The Preferred Alternative for 2014 results in projected attainments of 91 percent, aiming to enable harvest of a high proportion of the LT, yet accommodating previously described uncertainty. These trip limits can be adjusted inseason as needed to influence higher or lower landings as 2014 progresses. We strove to present trip limits with a predictable and temporally even structure, using the same rationale as for No Action. Landings targets for each fishery are equal for the PPA and all alternatives other than No Action, within each year.

Table A-17. Model-projected impacts of trip limits under the Preferred Alternative, No Action Alternative, and comparison between them, in the fixed-gear, sablefish, DTL fisheries for 2014. Landings targets and projected impacts are in metric tons (mt) of landed catch.

Fishery	Area	LT PPA	PPA projection	% of LT
LE N.	North of 36° N. lat.	214	194	91%
OA N.	North of 36° N. lat.	319	290	91%
LE S.	South of 36° N. lat.	483	441	91%
OA S.	South of 36° N. lat.	393	359	91%

Projected landings under the PPA were lower than No Action for the LE North and OA North fisheries (80 percent and 76 percent of No Action, respectively), and higher than No Action for the LE South and OA South (125 percent and 126 percent, respectively), covarying with changes to the area-specific sablefish ACLs in 2014; see Table A-18 and Figure A-5.

Table A-18. Model-projected impacts of trip limits under the Preferred Alternative, No Action Alternative, and comparison between them, in the fixed-gear, sablefish, DTL fisheries for 2014. Landings targets and projected impacts are in metric tons (mt) of landed catch.

Fishery	Area	PPA projection	No act. projection	% of No act.
LE N.	North of 36° N. lat.	194	242	80%
OA N.	North of 36° N. lat.	290	381	76%
LE S.	South of 36° N. lat.	441	353	125%
OA S.	South of 36° N. lat.	359	284	126%

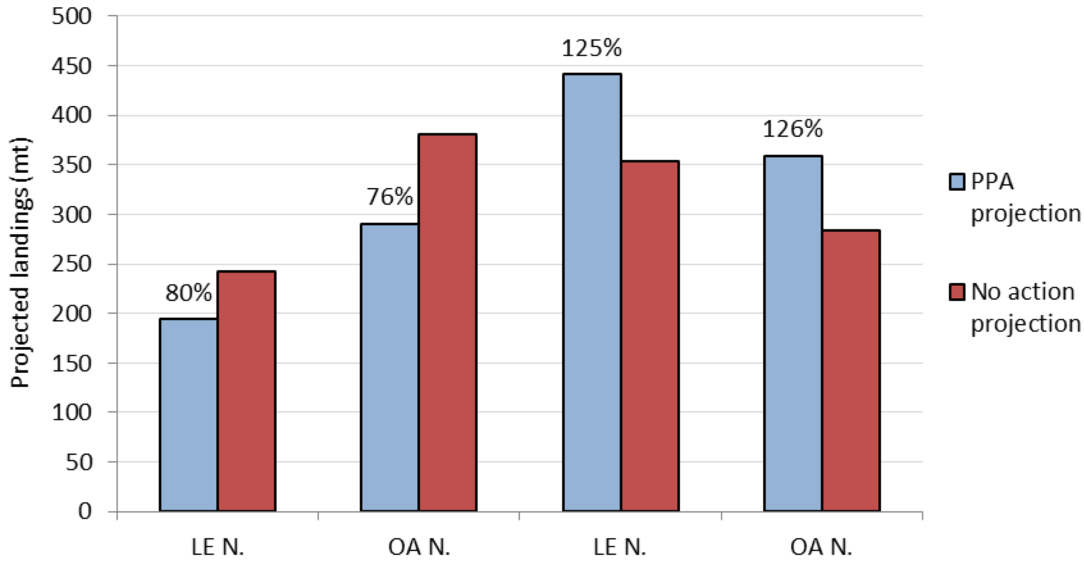


Figure A-5. Projected landings for 2014 under the PPA and No Action, for the four fixed gear, sablefish, DTL fisheries. Column labels show PPA projection as a percentage of No Action.

Table A-19. Proposed trip limits for 2014, in sablefish DTL fisheries under the PPA, and alternatives other than No Action.

Area	Fishery	Jan-Feb	Mar-Apr	May-Jun	July-Aug	Sept-Oct	Nov-Dec
North of 36° N. lat. (U.S./Canada Border to 36° N. lat.)	LE N	1,100 lb. per week, not to exceed 4,400 lb. per 2 mo.					
	OA N	300 lb. per day, or 1 landing per week of up to 675 lb., not to exceed 1,350 lb. per 2 mo.					
South of 36° N. lat.	LE S	1,930 lb. per week					
	OA S	300 lb. per day, or 1 landing per week of up to 1,525 lb., not to exceed 3,050 lb. per 2 mo.					

The proposed trip limits which informed the above landings projections were reduced accordingly in the North, compared with No Action, and increased in the South, compared with No Action (Table A-19), to keep catch within the LTs. For the LE North, weekly trip limits needed to be reduced by 200 pounds per week, and bimonthly limits by 600 pounds, to maintain a similar rate of attainment as in the No Action Alternative. For the OA North, a reduction of 225 pounds per week and 450 pounds per two months was necessary.

For the area south of 36° N. lat., an increase to trip limits of 130 pounds per week was possible in the LE South fishery, while an increase of 175 pounds per week and 350 pounds per bimonthly period was possible in the OA South fishery.

A.5 Non-Nearshore: Blackgill Rockfish South of 40°10 N. Latitude Trip Limits

The following analytical treatment of the 2005-2010 PacFIN data aims to define bi-monthly period limits for the limited entry and fixed gear nontrawl fleets. Given the yearly harvest guideline is known, the two main unknowns in these calculations are how many vessels will participate each bi-monthly period and how much of the period limit they will attain. If one assumes each vessel fully attains the limit each period, the corresponding limit given a certain number of vessels per period is expressed as an exponentially declining function (Figure A-6). The two methods used to calculate period limits explore different attainment and vessel participation assumptions to define a range of period limits with differing levels of risk.

A.5.1 Method 1: Used to calculate the most conservative estimates of bi-monthly period limits.

Assumptions

Vessel attainment: All latent removal by every participating vessel in each fishery is realized, therefore any limit is fully realized by all vessels in every bi-monthly period.

Vessel participation: The mean and standard deviation of vessel numbers by each year and bi-monthly period are used to define a normal distribution of expected number of vessels per bi-monthly period (Figure A-7 and Figure A-8).

Calculations

The bi-monthly limit is then calculated as:

$$P = \left(\frac{HG}{6}\right) \Big/ V$$

where P = period limit; HG = yearly harvest guideline; v = number of vessels. Five different vessel participation assumptions (values for V) were explored, where the mean is the least conservative and the 99 percent is the most conservative (Table A-20).

A.5.2 Method 2: Used to calculate less conservative estimates of bi-monthly period limits.

Assumptions

- Vessel attainment: Instead of assuming each vessel participating will attain the full limit, a threshold value is used to determine which vessels will and will not attain the full limit. Vessels with average catch over a given time period that exceeds the threshold are assumed to catch the period limit; vessels with average catch below the threshold are assumed to catch their average value in any given period:

$$C_{v,b,y,P_y,T} = \begin{Bmatrix} P_y & \text{if } \hat{C}_{v,b,y} > T \\ \hat{C}_v & \text{if } \hat{C}_{v,b,y} \leq T \end{Bmatrix}$$

  where C_v = catch per vessel within bi-monthly period b across years y; $\hat{C}_{v,b,y}$= average catch of vessel v within bi-monthly period b across years y; T = threshold value.
- Vessel participation: For a given set of years, any vessel that caught blackgill in any bi-monthly period will contribute an average catch to that period's total catch.

Calculation

- The bi-monthly period limit ($P_{HG,y}$) is subsequently solved to allow vessel catches over all periods to obtain the yearly harvest guideline for a given T and series of years:

$$HG = \sum_{b=1}^{6} C_{v,b,y,P_{HG,y},T}$$

A.5.3 Applications

Method 1
Table A-3 provides application of method 1 to each fleet and area. Figure A-8 shows how alternative allocation scenarios of the nontrawl harvest guideline between the limited entry and fixed gear fleets will change the limited entry period limit.

Method 2
Table A-21 provides the catch per vessel by periods and years used to calculate threshold values. Table A-22 gives the period limits as calculated for several threshold values and data assumptions.

Each method can be updated at each in-season consideration using the remaining amount of the harvest guideline and any updated information on number of vessels, allowing for adjustable period limits to avoid harvest guideline overages. It can also be updated easily to accommodate different limited entry:open access allocations.

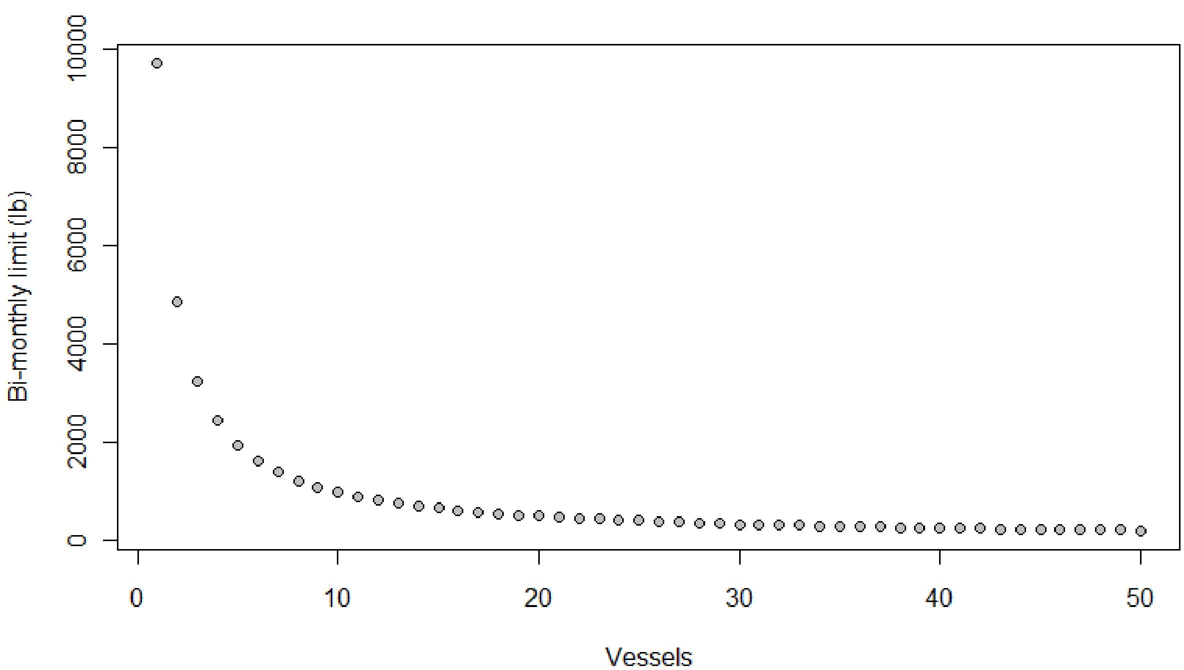


Figure A-6. Relationship between number of vessels and the bi-monthly limit (in lb) of blackgill rockfish (assuming no discards) in the limited entry fishery for the 2013 harvest guideline assuming 60% allocation to the limited entry fishery.

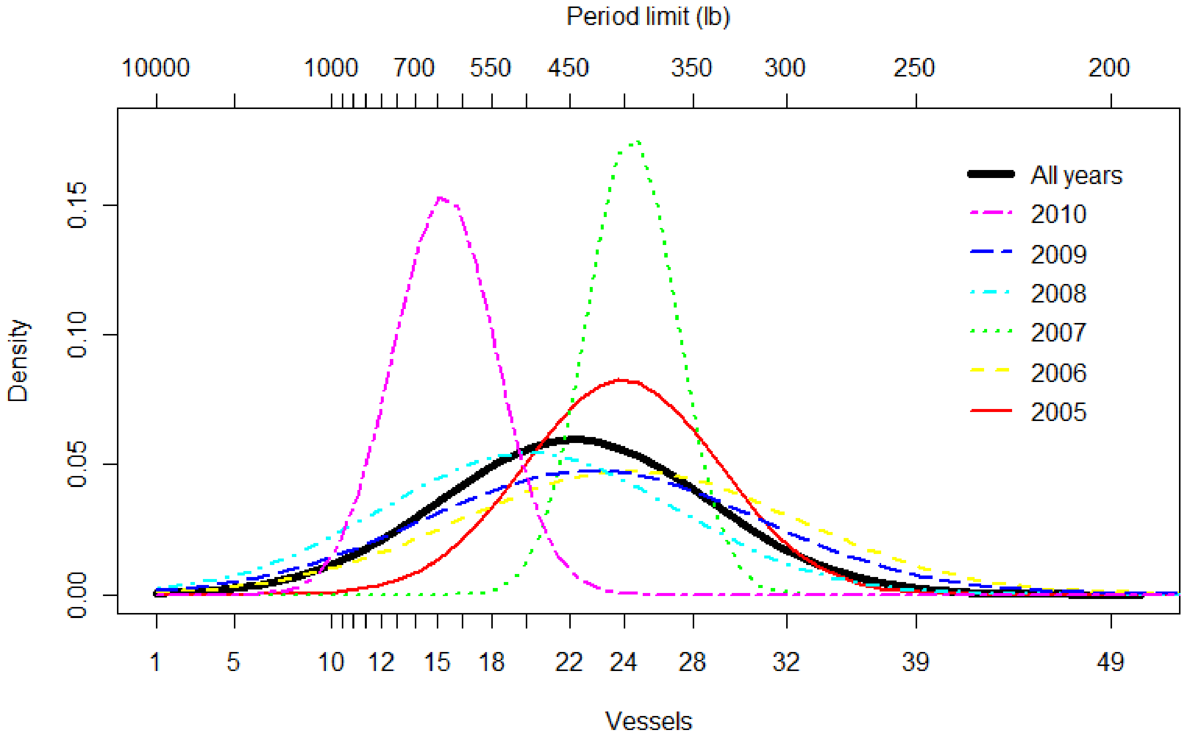


Figure A-7. Normal probability density function distribution for bi-monthly trips that caught blackgill rockfish in each year and all years combined for the limited entry fishery south of 40.10. Secondary x-axis identifies the bi-monthly blackgill rockfish trip limits associated with the number of vessels that would reach the 2013 blackgill harvest guideline (26.4 mt).

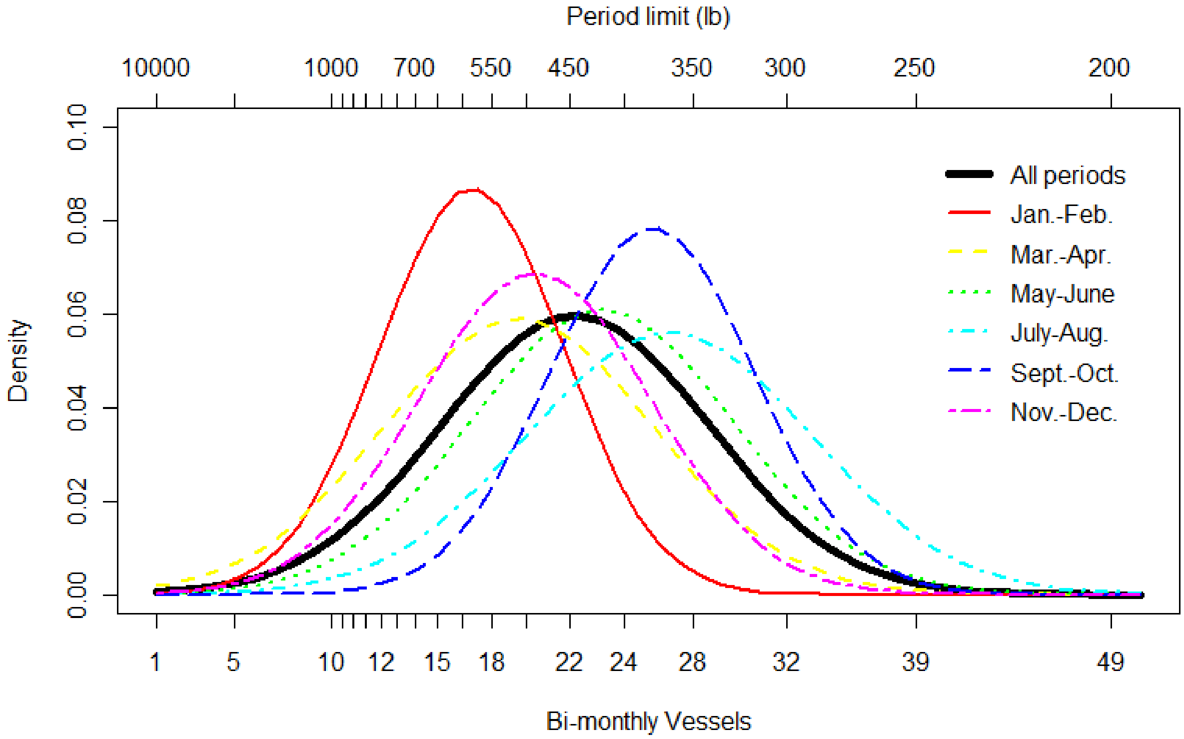


Figure A-8. Normal probability density function distribution for bi-monthly trips that caught blackgill rockfish in each bi-monthly period across all years and all combined bi-monthly periods for the limited entry fishery south of 40.10. Secondary x-axis identifies the bi-monthly blackgill rockfish trip limits associated with the number of trips that would reach the blackgill harvest guideline for the 2013.

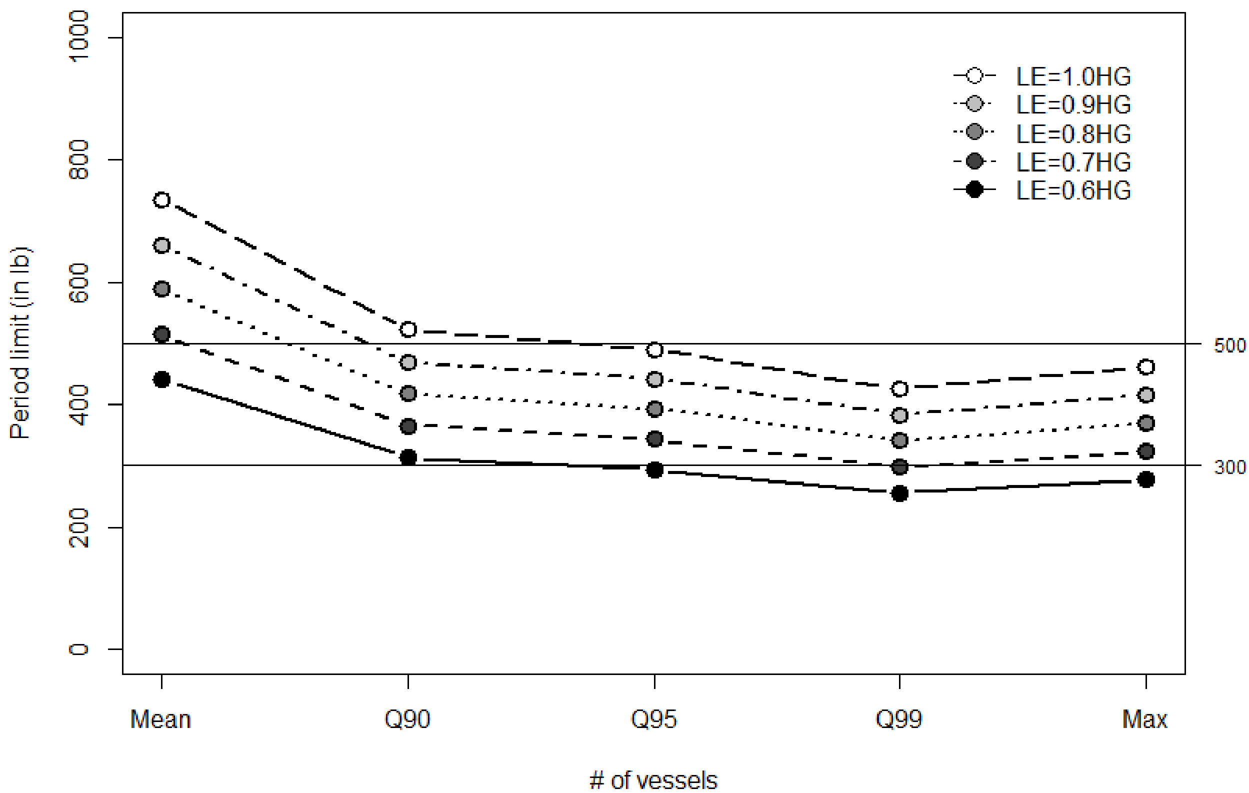


Figure A-9. Bi-monthly period limits (in pounds) of blackgill rockfish under different estimates of vessels in the limited entry (LE) fishery for different scenarios of harvest guideline (HG) allocation to the limited entry fishery. Horizontal lines are two possible period limits. Points at or below lines would result in yearly catches at or below the HG.

Table A-20. Number of vessels and the associated bi-monthly period limits for several measures along the normal probability density distribution summarized for years, bi-monthly periods, and all years/periods combined for all nontrawl gears and areas.

A) Limited Entry

	# Vessels					Bi-monthly limit (lb)				
Time	Mean	Q=90%	Q=95%	Q=99%	Maximum	Mean	Q=90%	Q=95%	Q=99%	Maximum
Year										
2005	25	31	33	36	28	388	313	294	269	346
2006	25	36	39	45	35	388	269	249	216	277
2007	25	28	29	30	27	388	346	334	323	359
2008	20	29	32	37	29	485	334	303	262	334
2009	23	34	37	43	32	422	285	262	226	303
2010	16	19	20	22	18	606	511	485	441	539
Bi-monthly period										
Jan-Feb	17	23	25	28	22	571	422	388	346	441
Mar-Apr	19	28	31	35	28	511	346	313	277	346
May-June	24	32	34	39	32	404	303	285	249	303
July-Aug	27	36	39	44	35	359	269	249	220	277
Sept-Oct	26	33	35	38	32	373	294	277	255	303
Nov-Dec	20	28	30	34	27	485	346	323	285	359
All years, periods	22	31	33	38	35	441	313	294	255	277

B) Open Access N 38°

	# Vessels					Bi-monthly limit (lb)				
Time	Mean	Q=90%	Q=95%	Q=99%	Maximum	Mean	Q=90%	Q=95%	Q=99%	Maximum
Year										
2005	1	2	3	3	2	100	50	33	33	50
2006	1	2	3	3	2	100	50	33	33	50
2007	2	5	6	7	6	50	20	17	14	17
2008	1	2	2	3	2	100	50	50	33	50
2009	1	2	2	2	1	100	50	50	50	100
2010	3	5	6	7	6	33	20	17	14	17
Bi-monthly period										
Jan-Feb	1	2	3	3	2	100	50	33	33	50
Mar-Apr	1	2	2	2	1	100	50	50	50	100
May-June	2	3	3	3	2	50	33	33	33	50
July-Aug	2	5	6	7	6	50	20	17	14	17
Sept-Oct	3	5	6	7	6	33	20	17	14	17
Nov-Dec	1	2	2	2	1	100	50	50	50	100
All years, periods	2	3	4	5	6	50	33	25	20	17

B) Open Access S 38°

	# Vessels					Bi-monthly limit (lb)				
Time	Mean	Q=90%	Q=95%	Q=99%	Maximum	Mean	Q=90%	Q=95%	Q=99%	Maximum
Year										
2005	14	17	18	20	17	455	375	354	318	375
2006	17	23	24	27	22	375	277	265	236	289
2007	14	19	21	24	19	455	335	303	265	335
2008	12	20	22	26	21	531	318	289	245	303
2009	20	27	29	33	26	318	236	220	193	245
2010	18	28	31	36	26	354	227	205	177	245
Bi-monthly period										
Jan-Feb	11	14	15	17	14	579	455	424	375	455
Mar-Apr	14	18	19	21	17	455	354	335	303	375
May-June	18	26	29	33	26	354	245	220	193	245
July-Aug	18	26	29	33	26	354	245	220	193	245
Sept-Oct	18	26	28	32	26	354	245	227	199	245
Nov-Dec	15	23	25	29	21	424	277	255	220	303
All years, periods	16	23	25	29	26	398	277	255	220	245

Table A-21. Blackgill pounds per vessel by year and bi-monthly period for the A) Limited Entry, B) Open Access North of 38○, and C) Open Access South of 38○ fixed gear fisheries.

A) Limited Entry

Year	Bi-monthly period					
	Jan.-Feb.	Mar.-Apr.	May-June	July-Aug.	Sept.-Oct.	Nov.-Dec.
2005	294	277	86	197	118	131
2006	220	465	81	152	539	389
2007	79	166	113	179	140	173
2008	67	103	675	121	143	562
2009	1151	596	455	460	441	256
2010	216	530	428	373	730	743

B) Open Access N 38°

Year	Bi-monthly period					
	Jan.-Feb.	Mar.-Apr.	May-June	July-Aug.	Sept.-Oct.	Nov.-Dec.
2005	26	0	13	161	10	2
2006	0	2	16	8	13	14
2007	12	4	12	0	30	30
2008	0	0	0	0	14	10
2009	0	0	32	1	6	0
2010	1	3	12	11	32	8

C) Open Access S 38°

Year	Bi-monthly period					
	Jan.-Feb.	Mar.-Apr.	May-June	July-Aug.	Sept.-Oct.	Nov.-Dec.
2005	559	257	191	296	876	448
2006	237	427	308	268	306	175
2007	180	874	559	517	63	60
2008	233	323	190	198	46	80
2009	315	156	265	673	181	222
2010	164	361	523	497	678	896

Table A-22. Bi-monthly period limits that correspond to various catch thresholds and years used to calculate vessel average catch for nontrawl fleets.

		Average catch years	
Fleet	Catch threshold	2005-2010	2008-2010
Limited Entry	**238**	**768**	1137
	300	865	1218
	448	1019	**1586**
	500	1115	1710
	750	1232	1967
	1000	1315	2226
	Maximum	1586	2675
Open access S 38°	208	582	394
	249	676	**399**
	254	688	402
	282	**739**	402
	500	1002	416
	750	1344	359
	1000	2117	300
	Maximum	2880	422

A.6 Nearshore

A.6.1 Modeling Open Access Impacts

Impacts associated with the directed open access daily-trip-limit fishery targeting sablefish are modeled using the primary sablefish model described above. Nearshore commercial fisheries in waters off Oregon and California are modeled separately from offshore efforts targeting sablefish.

A.6.2 Modeling Nearshore Commercial Impacts

The nearshore commercial model incorporates fleet-wide discard estimates by depth from West Coast Groundfish Observer Program (WCGOP) data, landings data from PacFIN, and depth-specific discard mortality rates derived by the Groundfish Management Team (GMT) (refer to 2009/2010 Harvest Specifications and Management Measures FEIS for full description of model). The WCGOP began pilot coverage of vessels targeting nearshore rockfish and associated species, such as cabezon and kelp greenling, in January 2003 for the California nearshore fishery and in May 2004 for the Oregon nearshore/rockfish fisheries. Data from these vessels from January 2003 – December 2009 were averaged for analyses. Data from 2009 were the most recently available data at the time of the analysis. Although the number of observed trips has increased since the WCGOP began monitoring the fleet, coverage levels are still lower than for other fleets and thus greater uncertainty in estimating discard relationships exists (Table A-23).

Table A-23. Summary of WCGOP observer coverage (2003-2009)

Area/Depth	# Trips	# Sets	# Vessels
North of 42° N lat.			
0-10 fm	484	632	85
10-20 fm	540	713	81
> 20 fm	48	53	27
42° to 40° 10' N lat.			
0-10 fm	160	215	23
10-20 fm	216	256	21
> 20 fm	37	41	10
South of 40° 10' N lat.			
0-10 fm	335	542	83
10-20 fm	241	317	65
> 20 fm	40	63	20

In 2010-11, the nearshore model structure was modified to include finer area stratifications and used modified landings data to project overfished species impacts. These modifications would facilitate management, provide greater protection to stocks while minimizing adverse impacts to communities, and provide the best estimate of fishery needs. No changes are proposed to the model for 2013-14.

The nearshore model is stratified into three areas based on available WCGOP data: (1) north of 42° N lat; (2) between 42° and 40°10' N lat; and (3) south of 40°10' N lat. These finer area stratifications facilitate overfished species impact projections on a smaller scale, reduce adverse actions to lower bycatch areas, and allowed incorporation of state specific management measures.

Instead of using a single previous year landings data to project overfished species impacts, average landings were used as the best estimate of fishery needs. As a starting point, average landings from the last four years (2007-2010) were used for both Oregon and California; the year with the lowest landings was excluded for projections. Landings data were adjusted from this starting point based on new information (i.e., change in ACL) or based on increased availability in overfished species (i.e., higher nearshore allocation of yelloweye). Opportunities were maximized for this fishery where available while staying within available overfished species impacts.

Table A-25, Table A-26, Table A-27summarize the ratios of observed discarded and retained catch for each of the three depth intervals (0-10 fm, 11-20 fm, and 21-50 fm) used to model impacts in nearshore commercial fisheries.

A.6.3 Allocation of Overfished Species (Canary and Yelloweye Rockfish) Between States

In 2011-12, a de-facto allocation for canary (OR = 26.7 percent; CA = 73.3 percent) and yelloweye rockfish (OR = 72.7 percent; CA = 27.3 percent) was used which resulted from specific landings that were meant to keep both fisheries at harvest levels similar to previous years.

For 2013-14, the GMT maintained the 2011-12 status quo allocations for modeling impacts. In addition, two alternative relationships were examined to demonstrate the tradeoffs of varying overfished species allocations. Equal catch sharing (50:50) and reverse status quo were chosen to bracket the upper and lower ranges of landings and management measures (Table A-24).

Table A-24. Comparison of canary and yelloweye rockfish allocations for Oregon and California under three catch sharing alternatives.

		Status Quo	Equal Sharing	Reverse Status Quo
OR	Canary	26.7%	50%	73.3%
	Yelloweye	72.7%	50%	27.3%
CA	Canary	73.3%	50%	26.7%
	Yelloweye	27.3%	50%	72.7%

Table A-25. Average Bycatch and discard rates (2003-2009) from the commercial nearshore projection model north of 42° N. latitude.

NORTH of 42° N. lat.	Observed discard (mt) 0-10 fm	Observed discard (mt) 11-20 fm	Observed discard (mt) > 20 fm	Observed retained (mt) 0-10 fm	Observed retained (mt) 11-20 fm	Observed retained (mt) > 20 fm	% of observed landings by depth 0-10 fm	% of observed landings by depth 11-20 fm	% of observed landings by depth > 20 fm	Discard mortality rate 0-10 fm	Discard mortality rate 11-20 fm	Discard mortality rate > 20 fm
Rebuilding species												
Bocaccio	0.000	0.000	0.000	0.000	0.000	0.000				30%	54%	100%
Canary rockfish	0.149	0.548	0.059	0.000	0.001	0.000				32%	54%	100%
Darkblotched rockfish	0.000	0.000	0.000	0.000	0.082	0.000						
Widow rockfish	0.000	0.000	0.000	0.000	0.005	0.005				32%	54%	100%
Yelloweye rockfish	0.061	0.471	0.063	0.000	0.001	0.000				32%	56%	100%
Other species												
Black rockfish	1.305	1.231	0.043	24.369	23.738	0.821	49.8%	48.5%	1.7%	23%	42%	90%
Blue rockfish	0.619	1.336	0.079	0.955	1.390	0.135	38.5%	56.0%	5.4%	29%	49%	100%
Cabezon	0.481	0.833	0.006	3.444	8.347	0.368	28.3%	68.7%	3.0%	7%	7%	7%
Kelp greenling	0.626	0.656	0.024	3.876	3.679	0.149	50.3%	47.7%	1.9%	7%	7%	7%
Lingcod	3.636	5.325	0.414	3.596	7.475	0.616	30.8%	64.0%	5.3%	7%	7%	7%
Other minor nearshore rockfish	0.089	0.200	0.013	1.777	4.243	0.367	27.8%	66.4%	5.7%	24%	48%	100%

Table A-26. Average bycatch and discard rates (2003-2009) from the commercial nearshore projection model north of 42° N. latitude to 40°10' N. latitude.

42° to 40°10' N. lat.	Observed discard (mt)			Observed retained (mt)			% of observed landings by depth			Discard mortality rate		
	0-10 fm	11-20 fm	> 20 fm	0-10 fm	11-20 fm	> 20 fm	0-10 fm	11-20 fm	> 20 fm	0-10 fm	11-20 fm	> 20 fm
Rebuilding species												
Bocaccio	0.000	0.000	0.000	0.000	0.001	0.000				30%	54%	100%
Canary rockfish	0.069	0.486	0.142	0.000	0.000	0.000				32%	54%	100%
Darkblotched rockfish	0.000	0.000	0.000	0.000	0.000	0.000						
Widow rockfish	0.000	0.026	0.005	0.002	0.062	0.003				32%	54%	100%
Yelloweye rockfish	0.013	0.131	0.223	0.000	0.000	0.000				32%	56%	100%
Other species												
Black rockfish	0.124	0.089	0.002	15.420	16.375	1.216	44.5%	52.3%	3.2%	23%	42%	90%
Blue rockfish	0.186	0.440	0.045	1.356	5.082	0.884	18.1%	70.7%	11.2%	29%	49%	100%
Cabezon	0.186	0.179	0.040	0.583	0.455	0.172	46.6%	39.7%	13.8%	7%	7%	7%
Kelp greenling	0.199	0.180	0.016	0.130	0.201	0.003	37.7%	61.4%	0.9%	7%	7%	7%
Lingcod	0.614	1.132	0.120	1.199	1.840	0.876	30.4%	47.9%	21.7%	7%	7%	7%
Other minor nearshore rockfish	0.002	0.009	0.010	0.494	1.046	1.057	18.9%	41.5%	39.7%	24%	48%	100%

Table A-27. Average bycatch and discard rates (2003-2009) from the commercial nearshore projection model south of 40°10' N. latitude.

SOUTH of 40°10' N. lat.	Observed discard (mt)			Observed retained (mt)			% of observed landings by depth			Discard mortality rate		
	0-10 fm	11-20 fm	> 20 fm	0-10 fm	11-20 fm	> 20 fm	0-10 fm	11-20 fm	> 20 fm	0-10 fm	11-20 fm	> 20 fm
Rebuilding species												
Bocaccio	0.000	0.001	0.001	0.000	0.000	0.051				30%	54%	100%
Canary rockfish	0.012	0.271	0.085	0.000	0.000	0.000				32%	54%	100%
Cowcod	0.000	0.000	0.000	0.000	0.000	0.000						
Darkblotched rockfish	0.000	0.000	0.000	0.000	0.000	0.000						
Widow rockfish	0.000	0.000	0.000	0.000	0.001	0.000				32%	54%	100%
Yelloweye rockfish	0.000	0.010	0.006	0.000	0.000	0.000				32%	56%	100%
Other species												
Black rockfish	0.100	0.102	0.008	0.385	0.402	0.044	46.3%	48.4%	5.3%	23%	42%	90%
Blue rockfish	0.231	0.368	0.169	0.410	0.314	0.054	52.7%	40.4%	6.9%	29%	49%	100%
Cabezon	2.110	0.269	0.038	4.591	0.191	0.070	94.6%	3.9%	1.4%	7%	7%	7%
Deeper nearshore rockfish	0.157	0.193	0.036	1.751	3.501	0.455	30.7%	61.3%	8.0%	23%	48%	100%
Kelp greenling	0.602	0.155	0.062	0.344	0.026	0.00635	91.5%	6.8%	1.7%	7%	7%	7%
Lingcod	1.555	1.343	0.118	1.809	1.390	0.129	54.4%	41.8%	3.9%	7%	7%	7%
Shallow nearshore rockfish	0.739	0.530	0.096	3.464	1.210	0.339	69.1%	24.1%	6.8%	25%	49%	100%

A.7 Washington Recreational

The Washington Ocean Sampling Program (OSP) generates catch and effort estimates for the recreational boat-based groundfish fishery, which are provided to Pacific States Marine Fisheries Commission (PSMFC) and incorporated directly into RecFIN. The OSP provides catch in total numbers of fish, and also collects biological information on average fish size, which is provided to RecFIN to enable conversion of numbers of fish to total weight of catch. Boat egress from the Washington coast is essentially limited to four major ports, which enables a sampling approach to strategically address fishing effort from these ports. Effort estimates are generated from exit-entrance counts of boats leaving coastal ports while catch per effort is generated from angler intercepts at the conclusion of their fishing trip. The goal of the program is to provide information to RecFIN on a monthly basis with a one-month delay to allow for inseason estimates. For example, estimates for the month of May would be provided at the end of June. Some specifics of the program are:

Exit/entrance count - boats are counted either leaving the port (4:30 AM - end of the day) or entering the port (approximately 8:00 AM through end of the day) to give a total count of sport boats for the day.

Interview - boats are encountered systematically as they return to port; anglers are interviewed for target species, number of anglers, area fished, released catch data and depth of fishing (non-fishing trips are recorded as such and included in the effort expansion). The OSP collects information on released catch but does not collect information on the condition of the released fish. Therefore, released catches must be post-stratified as live or dead based upon an assumed discard mortality rate. Onboard observers are deployed on charter vessels throughout the salmon season primarily to observe hatchery salmon mark rates but also to collect rockfish discard information on these trips.

Examination of catch - catch is counted and speciated by the sampler. Salmon are electronically checked for coded wire tags and biodata is collected from other species.

Sampling Rates - vary by port and boat type. Generally, at boat counts less than 30, the goal is 100 percent coverage. The sampling rate goal decreases as boat counts increase (e.g., at an exit count of 100, sample rate goal is 30 percent; over 300, sample rate goal is 20 percent). Overall sampling rates average approximately 50 percent coastwide through March-October season.

Sampling Schedules - due to differences in effort patterns, weekdays/weekend days are stratified. Usually, both weekend days and a random 3 of 5 weekdays are sampled.

Personnel - OSP sampling staff include two permanent biologists coordinating data collection, one permanent technician generating in-season estimates of groundfish catch, approximately twenty-two port samplers, three on-board observers and one data keypuncher.

Volume of data - Between 20,000 and 30,000 boat interviews completed per season coastwide.

Data Expansion:
Algorithm for expanding sampled days:

$$\frac{\text{Exit Count}}{\text{Total boats sampled}} * P_s \text{ sampled} = P_t$$

where P_s = any parameter (anglers, fish retained, fish released) within a stratum,
and P_t = total of any parameter with stratum for the sample day

Algorithm for expanding for non-sampled days:

$$\text{Total Weekday Catch} = \frac{\Sigma(P_t)\text{ on sampled weekdays}}{\text{number weekdays sampled}} * \text{no. of weekdays in stratum}$$

$$\text{Total Weekend Catch} = \frac{\Sigma(P_t)\text{ on sampled weekend days}}{\text{number weekend days sampled}} * \text{no. weekend days in stratum}$$

Total weekend catch + total weekday catch = total catch in stratum

Notes on Data Expansion:
Salmon and halibut catch estimates are stratified by week; catch estimates for all other species are stratified by month. All expansions are stratified by boat type (charter or private), port, area and target species trip type (e.g., salmon, halibut, groundfish, albacore)

Washington Recreational Fishery Impact Modeling

A.7.1 Pre-Season Catch Projections

Projected impacts for Washington's recreational fishery are essentially based upon the previous season's harvest estimated by the Ocean Sampling Program (OSP) and incorporated in RecFIN. This is especially true if recreational regulations remain consistent.

Washington's management measures have relied on the use of depth closures in waters deeper than 20 or 30 fathoms since 2005 and therefore historical catch estimates will be representative of projected mortalities. Depth restrictions for Washington's recreational fisheries are primarily designed to reduce encounters with yelloweye and canary rockfish but are especially restrictive to keep yelloweye rockfish impacts below the Washington recreational fishery harvest target. Because the ACL alternative and resulting Washington recreational harvest target for yelloweye rockfish that is being considered for 2013-2014 is only slightly higher than the yelloweye harvest target adopted for 2011-2012 no changes to depth restrictions or other management measures are being proposed for this management cycle and as such the most recent catch and effort estimates from 2011 is the basis for projected catch for 2013-2014.

A.7.2 Inseason Catch Projections for 2013-2014

Inseason catch projections are based upon the most recent OSP estimates and incorporated in RecFIN (with a one-month time lag) with subsequent months extrapolated from the pre-season catch projections. Beginning in 2009, depth dependant mortalities have been applied uniformly to all discarded fish coast wide through RecFIN. It should be noted that the precision of recreational groundfish catch estimates based upon previous seasons will continue to be influenced by factors such as the length and success of salmon and halibut seasons, weather and unforeseen factors.

A.8 Oregon Recreational

A.8.1 Harvest and discard mortality calculations

Groundfish impacts by recreational anglers in Oregon are estimated and tracked inseason by the Oregon Department of Fish and Wildlife (ODFW). Impacts consisting of weights of harvested fish and released fish that are presumed to die (discard mortality) are estimated for ocean boat anglers using Oregon Recreational Boat Survey (ORBS) data and are estimated for shore and estuary anglers using Shore and Estuary Bank Survey (SEBS) data from 1998-2002 (discontinued after 2002). Impacts are monitored inseason for black rockfish (RF), blue RF, yelloweye RF, canary RF, other nearshore RF species complex (quillback , China , grass , brown , and copper RF), greenlings species complex (rock and kelp greenling), cabezon, and lingcod.

Methods: Ocean boat fishery
Harvest and discard mortality estimates (mt) are calculated by month and are typically completed within thirty days of the end of the month. Harvest estimate calculations, number of harvested fish multiplied by the average weight of harvested fish, remain the same as in previous cycles.

Discard mortality estimate calculations, number of discarded fish multiplied by average weight of discarded fish multiplied by discard mortality rate, remain the same as well. However, a new method for calculating discard mortality rates is now being used due recent availability of released fish by depth data obtained by ORBS. Starting in March 2009, anglers were asked the depth they fished. Previous discard mortality rate estimates used depth of release data from observed charter trips. The new method is advantageous because: (a) greater sample sizes (e.g., > 1000 vs 51 yelloweye rockfish), (b) incorporates private boat data, (c) accounts for monthly variations in catches (fixed rates previously used for all months), (d) same methodology used by the Recreational Fisheries Information Network (RecFIN) and (e) estimates should be closer to what is actually occurring. The new ORBS depth data is also very useful for economic modeling because percentages of effort by depth bin can be calculated and potential decreases in angler trips due to proposed depth restrictions can be modeled. Mean weights of discarded fish continue to be calculated from observed charter trips (updated with newest data) since accurate weights of discarded fish cannot be obtained from angler reported releases.

Only a fraction (typically > 20 percent) of anglers are interviewed; therefore, a total discard mortality rate is applied to expanded total discards. Since discard mortality rates vary by depth bin (Table A-28), the total discard mortality rate is the sum of the products, by depth bin, of the proportion of fish released (from ORBS data) multiplied by the discard mortality rate (from GMT depth dependent discard mortality matrix; Table A-28). An example of a total discard mortality rate is shown in Table A-29.

Table A-28. GMT discard mortality rates for select rockfish species by depth bin. The discard mortality rates of cabezon, lingcod, and greenling species are 7%, regardless of depth, to account for hooking mortality (as these fish do not suffer barotrauma).

	Mortality rate				
Species	< 10 fm	11-20 fm	21-30 fm	31-40 fm	> 40 fm
Black RF	11%	20%	29%	63%	63%
Blue RF	18%	30%	43%	100%	100%
Brown RF	12%	22%	33%	100%	100%
China RF	13%	24%	37%	100%	100%
Copper RF	19%	33%	48%	100%	100%
Quillback RF	21%	35%	52%	100%	100%
Canary RF	21%	37%	53%	100%	100%
Yelloweye RF	22%	39%	56%	100%	100%

Table A-29. Sample calculation of the new method for calculating total discard mortality using data of fish release by depth (obtained from angler interviews). Total discard mortality rate is multiplied by released fish to determine total discard mortality (mt).

Depth bin (fm)	Fish	Proportion		Mortality rate		Product	
0-10	6	0.133	x	0.22	=	0.029	
11-20	24	0.533	x	0.39	=	0.208	
21-30	12	0.267	x	0.56	=	0.149	
> 30	3	0.067	x	1.00	=	0.067	
					∑ =	0.453	= Total mortality rate

Methods: Shore and estuary

Landings and discard impacts for shore and estuary caught species were modeled on a season total basis using the 1998-2002 averages from the discontinued Oregon SEBS program. This fishery is managed for a year-round season, as it does not impact yelloweye or canary rockfish. The metric tons were adjusted for changes in length limits applied to cabezon and greenling since that period. Cabezon and greenling that were landed from 1998-2002 that would be sub-legal under current regulations are now considered discards. A mortality rate of 7 percent was applied to all species discarded in the shore and estuary fishery to account for hooking mortality, as the waters are not deep enough to cause mortality from barotrauma.

A.8.2 Groundfish fishery projection model

Introduction:

Depth restriction is the main management method used by ODFW in the recreational groundfish fishery to reduce overfished species impacts, particularly yelloweye rockfish. Further depth restrictions may be implemented inseason if anglers are projected to attain overfished species caps before the end of the season with existing preseason depth restrictions. Exceeding overfished species caps can result in complete closure of the recreational groundfish fishery (and possibly the Pacific halibut fishery), regardless of remaining quota of harvestable species. Implementing shallower depth restrictions reduces overfished species impacts by reducing catches (catch rates increase with depth) and decreasing discard mortality (mortality rate increases with depth). Depth restrictions can also affect impacts of harvestable groundfish species (e.g., impacts to groundfish more commonly caught in shallower waters may increase if anglers are restricted to shallower waters).

Old and new model descriptions:
The old depth restriction impact model was developed before angler reported catch rate and effort by bin data existed and consequently used scaling rules based on observed charter data to project impacts by depth restriction and month (Table A-30). Projected impacts by depth restriction were calculated by multiplying three year mean impacts during status quo depth restrictions by the scaling rule of the proposed depth restriction.

Table A-30. Scaling rules by depth restriction and month used in the old model to project discard mortality of yelloweye rockfish in the groundfish fishery. Values were multiplied by three year means of observed impacts during status quo months (1.00 denotes status quo depth restriction) to project impacts given proposed depth restrictions.

	Depth restriction (fm)				
Month	Any	40	30	25	20
Jan	1.00	0.71	0.71	0.61	0.29
Feb	1.00	0.71	0.71	0.61	0.29
Mar	1.00	0.71	0.71	0.61	0.29
Apr	1.40	1.00	1.00	0.86	0.41
May	1.40	1.00	1.00	0.86	0.41
Jun	1.40	1.00	1.00	0.86	0.41
Jul	1.40	1.00	1.00	0.86	0.41
Aug	1.40	1.00	1.00	0.86	0.41
Sep	1.40	1.00	1.00	0.86	0.41
Oct	1.00	0.71	0.71	0.61	0.29
Nov	1.00	0.71	0.71	0.61	0.29
Dec	1.00	0.71	0.71	0.61	0.29

The old model relied, due to lack of better data, on the unlikely assumption that observed charter data was representative of the entire fleet (charter and private anglers). The old model also relied on fixed discard mortality rates, which has been shown to be incorrect (Table A-31).

Table A-31. Total discard mortality rate of yelloweye rockfish in the groundfish fishery for the new calculation method (2009 and 2010) versus the old method (fixed for all years).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	0.39	0.38	0.79	0.48	0.46	0.42	0.41	0.38	0.39	0.35	0.00	0.35
2009	0.77	0.52	0.88	0.42	0.42	0.54	0.41	0.35	0.39	0.54	0.39	0.75
Old	0.66	0.66	0.66	0.51	0.51	0.51	0.51	0.51	0.51	0.66	0.66	0.66

The new depth restriction projection model no longer requires these flawed assumptions since it uses newly acquired data of angler reported catch rate and effort by depth bin to provide better estimates of where anglers fish, how angler behavior may be affected by depth restrictions, and what actual discard mortalities are.

The new depth restriction impact model, outlined in Table A-32, utilizes the new data of angler reported catch rate and effort by depth bin. To increase sample sizes for catch rates and proportions of anglers by depth bin, data from months with similar status quo depth restrictions is pooled (Jan-Mar; Apr-Sept; Oct-Dec). Pooling also occurs across years to further increase sample sizes. Catch rates and proportions of anglers by depth bin vary among pooling periods but are the same within a period, average groundfish anglers is a three year mean for the month, and the rest of the variables are fixed for all months (fish weight, discard mortality rate by depth bin, and weight conversion). Table A-32 models discard mortality, and can be changed to model harvest by replacing discard mortality rates to 1.00 for all depth bins (catch rate is also change to harvested per angler instead of released per angler).

Table A-32. Example of data and calculations used in the new depth restriction projection model for the groundfish fishery and an example of the difference in estimates between a 40 fm depth restriction and a 30 fm depth restriction. This example projects discard mortality and a harvest projection can be made by changing the discard mortality rates to 1.00 for all depth bins (and changing catch rates from discarded per angler to harvest per angler).

Depth bin (fm)	Catch per angler		Proportion of anglers		avg. anglers		Mean fish weight (kg)		Discard mort. rate		Kg to mt conv.		Impact by bin
40 fm depth restriction													
<10 fm	0.013	x	0.381	x	12185	x	1.289	x	0.22	x	0.001	=	0.016
10-20	0.041	x	0.489	x	12185	x	1.289	x	0.39	x	0.001	=	0.123
20-25	0.129	x	0.063	x	12185	x	1.289	x	0.56	x	0.001	=	0.071
25-30	0.126	x	0.018	x	12185	x	1.289	x	0.56	x	0.001	=	0.020
30-40	0.027	x	0.050	x	12185	x	1.289	x	1.00	x	0.001	=	0.021
													∑ = 0.252 = Expected impact
30 fm depth restriction													
<10 fm	0.013	x	0.400	x	12185	x	1.289	x	0.22	x	0.001	=	0.017
10-20	0.041	x	0.515	x	12185	x	1.289	x	0.39	x	0.001	=	0.129
20-25	0.129	x	0.066	x	12185	x	1.289	x	0.56	x	0.001	=	0.075
25-30	0.126	x	0.019	x	12185	x	1.289	x	0.56	x	0.001	=	0.021
													∑ = 0.242 = Expected impact

Table A-32 also shows how differences in projected impacts by depth restriction are calculated. All variables remain the same except for the proportion of anglers by depth bin. No declines in angler trips are assumed because we know little of changes in angler behavior in response to regulatory changes and it is better to have models that overestimate impacts for catch accounting and conservation purposes. In this example, the proportion of anglers that fished the 30-40 fm depth bin (dark grey box) are proportionally redistributed among the available depth bins given a 30 fm depth restriction (light grey boxes). This was done instead of a shift to the next deepest depth bin available because deep water trips are typically specialty trips for large lingcod (anecdotal evidence) and it is assumed that these displaced anglers would return to “typical bottomfish trips”.

An advantage to the new model is that variables can easily be adjusted provided due evidence. For example, if we develop a method to better predict angler effort.

A summary table of projected outputs by depth restrictions by month is automatically updated given new data and is used for management purposes (Table A-33). Two versions exist of the model for projecting impacts by depth restriction in the groundfish fishery. The preseason version uses data prior to the projection year and the inseason version uses data from the projection year when it becomes available. The data pooling rules are the source of change for the inseason version.

Table A-33. Summary table of projected canary rockfish impacts (mt) by month and depth restriction from the groundfish fishery.

Groundfish fishery projected impacts

Depth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<20 fm	0.040	0.052	0.075	0.200	0.336	0.605	0.537	0.568	0.255	0.082	0.012	0.021
<25 fm	0.045	0.059	0.085	0.239	0.401	0.722	0.640	0.677	0.304	0.090	0.013	0.023
<30 fm	0.045	0.059	0.085	0.253	0.425	0.765	0.679	0.718	0.322	0.099	0.014	0.025
<40 fm	0.046	0.059	0.085	0.259	0.434	0.782	0.693	0.733	0.329	0.166	0.023	0.042
>40 fm	0.091	0.118	0.171	n/a	n/a	n/a	n/a	n/a	n/a	0.273	0.038	0.069

Average weights used in models

Average weights of released yelloweye rockfish and canary were assumed to increase with depth in the old calculation method and the old groundfish depth projection model; however, the same weights are used in the new versions because there does not appear to be a relationship between depth and weight of either species (Figure A-10; from catch data from observed charter trips). Fixed mean weights were consequently used for yelloweye rockfish (1.29 kg) and canary rockfish (0.69 kg) in the new method for calculating discard mortality and in the new groundfish depth projection model. Data of weights of fish caught beyond 40 fm is lacking and should be addressed in the future to determine if the same average weights are applicable to deep water (> 40 fm).

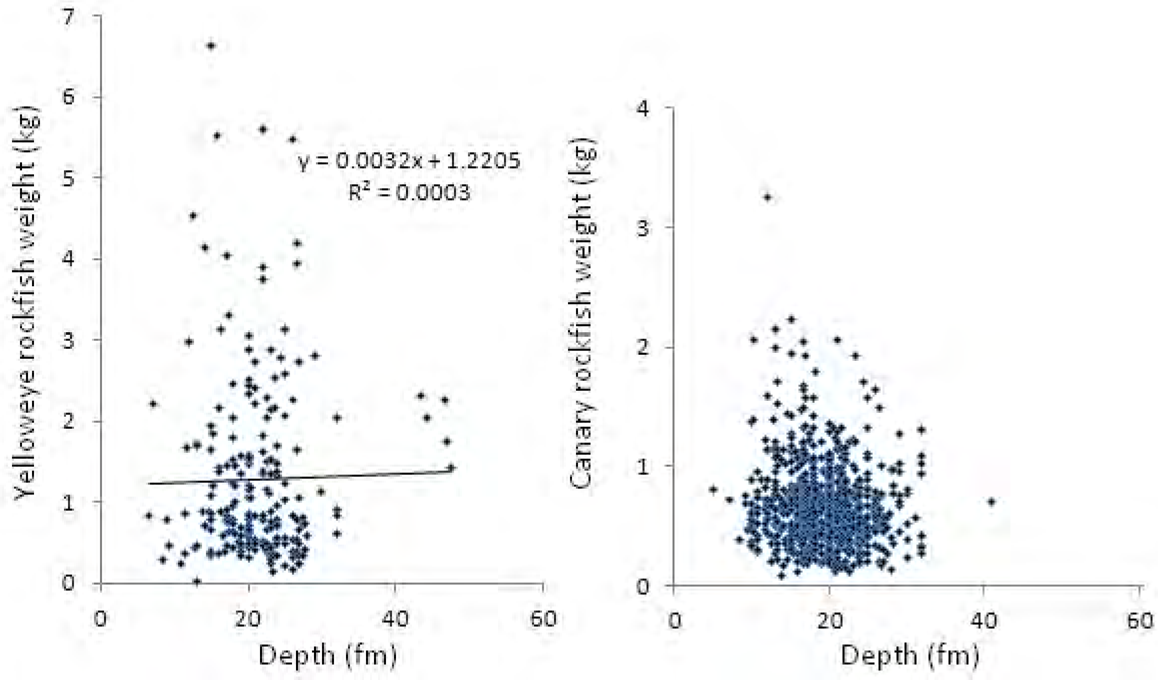


Figure A-10. Relationship between depth and weight of released yelloweye rockfish and canary rockfish from observed charter trips, 2006-2010.

Incorporation of variance into the groundfish projection model

Point estimates of depth restriction models are valuable for setting preseason depth restrictions by month. However, greater than expected impacts of yelloweye rockfish often lead to greater inseason depth restrictions. Incorporation of variance into the yelloweye rockfish projection model allows for development of prediction intervals that are useful for management decisions because it gives managers a better understanding of potential ranges of impacts.

Yelloweye rockfish encounters are extremely variable (Figure A-11) and difficult to predict. For example, June 2011 discards (~950 fish; outlier dot) were more than twice expected.

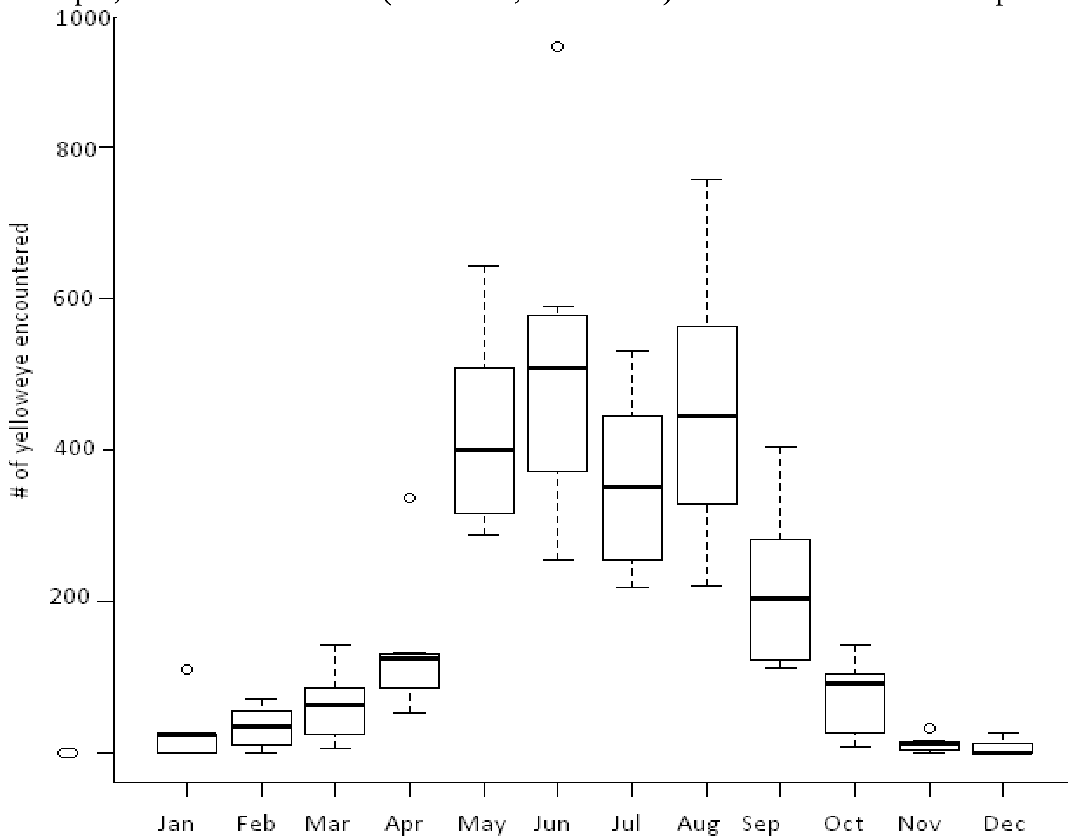
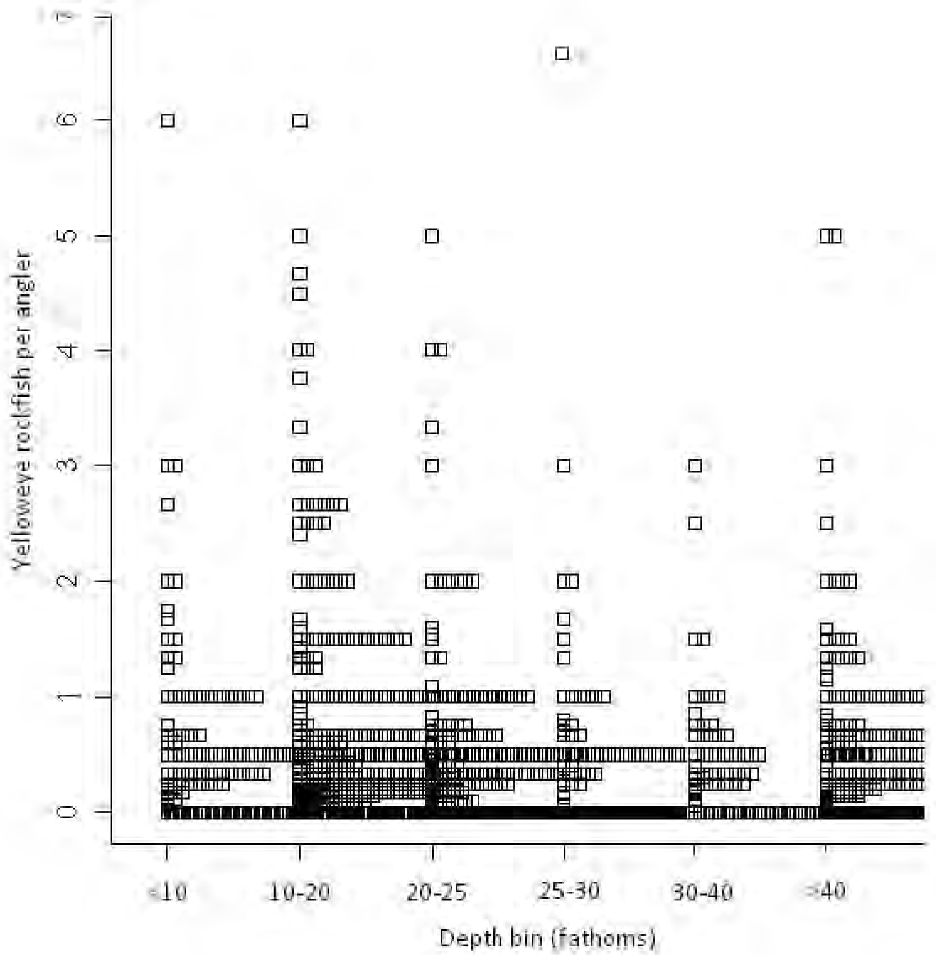


Figure A-11. Number of yelloweye rockfish encountered (discarded and harvested illegally) by month from recreational anglers in Oregon, 2004-2011.

Variation in yelloweye rockfish discards is attributed to variance in effort (total and by depth bin) and catch rates because the other variables are fixed (e.g., average fish weight, discard mortality rates). Catch rates (discarded per angler) and angler trips are also highly variable (Figure A-12 and Figure A-13).



Yelloweye rockfish per angler
0
1
2
3
4
5
6
7
<10
10-20
20-25
25-30
30-40
>40
Depth bin (fathoms)

Figure A-12. Yelloweye rockfish catch rates (discards per angler) by depth bin.

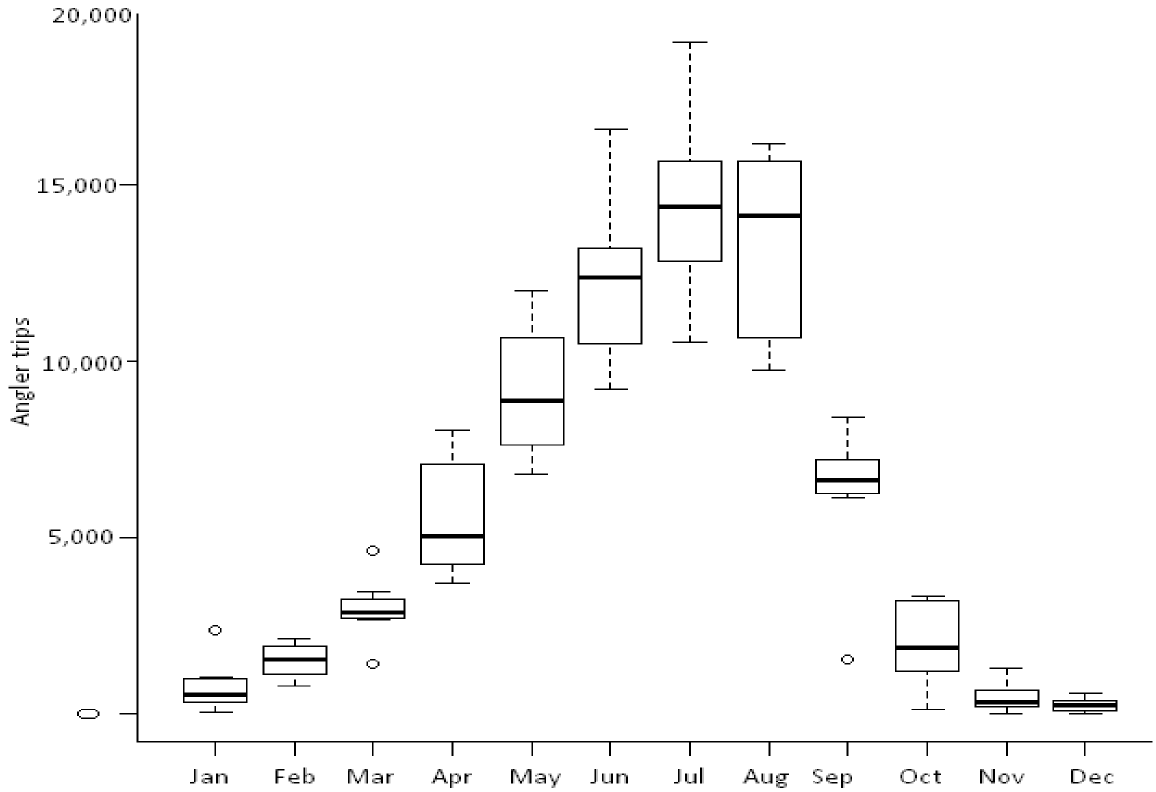


Figure A-13. Groundfish angler trips by month, 2004-2011.

Due to all the variation in variables used in modeling, a standard error based prediction interval would likely provide too wide of bands for management purposes (i.e., upper bounds above harvest guide line for all depth restrictions and a negative lower bounds, especially if a small alpha value is used). Further, carryover of variances to develop prediction intervals would require complex calculations that may be beyond the skill sets of fishery managers.

For simplicity and to simulate more probable yelloweye rockfish impacts, pseudo prediction intervals were developed using upper and lower ranges of catch rates and angler effort. Combined record high catch rates and effort would represent a worst case scenario, whereas combined record low catch rates and effort would represent a best case scenario. Although possible, it is unlikely that record catch rates and effort would coincide (either high or low); therefore, actual impacts would not be expected outside of the pseudo prediction interval bands. Expected impacts, with pseudo prediction intervals, for a year round 30 fm depth restriction are shown in Figure A-14.

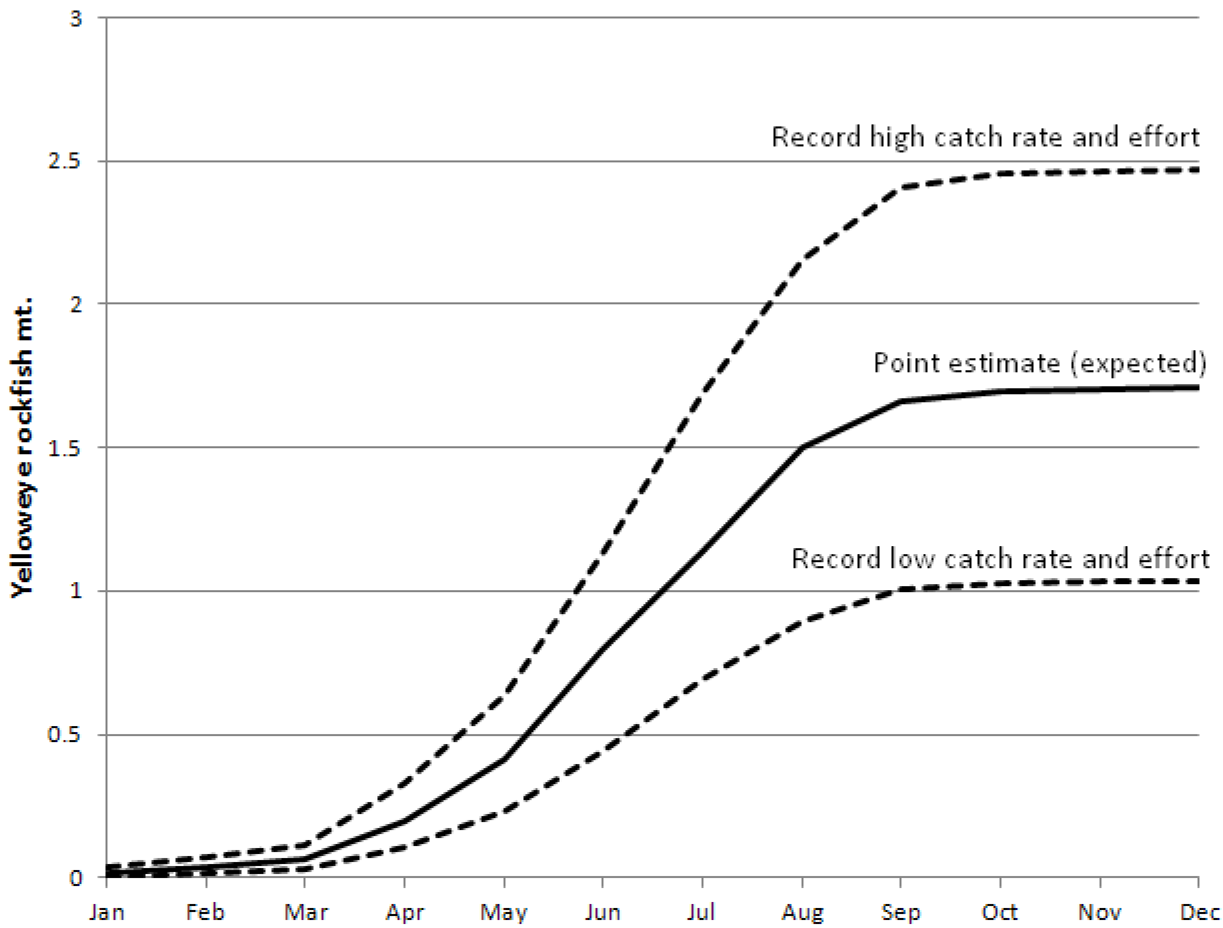


Figure A-14. Expected cumulative yelloweye impacts (average catch rates and effort) for a year round 30 fm depth restriction and pseudo (not standard error derived) prediction intervals (record high and low catch rates and effort).

A.8.3 Projected species impacts from the groundfish projection model

Five depth restriction alternatives were modeled for yelloweye rockfish (RF), canary RF, black RF, blue RF, greenlings (kelp greenling and rock greenling combined), cabezon, and other nearshore rockfish (brown, copper, China, grass, and quillback RF combined). The modeled depth restrictions were: < 20 fm, < 25 fm, <30 fm, < 40 fm, and > 40 fm (all-depths). Variables used in calculations were calculated by depth bin: 0-10 fm, 10-20 fm, 20-25 fm, 25-30 fm, 30-40 fm, and > 40 fm. Depth bins are similar to those used by the GMT due to similar discard mortality rates, but some GMT depth bins are split to allow projections of depth restrictions that could be less restrictive for management purposes. For example, a 20 fm depth restriction severely hinders groundfish fishing for Garibaldi, but a 25 fm restriction does not. Harvested and released impacts were calculated for species with federal landing caps (as required) and harvested impacts only for species with state landings caps. Tables of projected harvest and release impacts were created for each depth restriction alternative. Year totals for constant depth restrictions are summed, and combinations of depth restrictions during different months can be calculated by summing the corresponding month/depth values.

Black rockfish

Annual black rockfish harvest impacts are projected to be less than 310 mt for all depth restriction alternatives (Table A-34). Greater harvests are expected with shallower depth restrictions because effort in deep bins, with lesser catch rates, would be shifted to shallower bins, with greater catch rates. Black rockfish release mortality impacts are projected to be less than 4.2 mt for all depth restriction alternatives and are projected to increase as depth restrictions become shallower (Table A-35).

Table A-34. Projected black rockfish harvests impacts (mt) by month and by depth restriction.

Depth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
<20 fm	4.67	6.04	8.74	22.02	36.96	66.53	59.02	62.42	28.05	9.00	1.26	2.26	306.97
<25 fm	4.61	5.98	8.64	21.72	36.47	65.65	58.24	61.59	27.67	8.71	1.22	2.19	302.70
<30 fm	4.61	5.98	8.64	21.56	36.19	65.16	57.80	61.13	27.47	8.56	1.20	2.15	300.46
<40 fm	4.51	5.85	8.45	21.38	35.89	64.61	57.32	60.62	27.24	8.12	1.14	2.04	297.19
40+ fm	4.08	5.29	7.65	n/a	n/a	n/a	n/a	n/a	n/a	7.01	0.98	1.76	n/a

Table A-35. Projected black rockfish discard mortality (mt) by month and by depth restriction.

Depth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
<20 fm	0.05	0.07	0.10	0.30	0.50	0.90	0.80	0.84	0.38	0.13	0.02	0.03	4.11
<25 fm	0.05	0.07	0.10	0.29	0.48	0.87	0.77	0.82	0.37	0.12	0.02	0.03	3.98
<30 fm	0.05	0.07	0.10	0.28	0.48	0.86	0.76	0.81	0.36	0.12	0.02	0.03	3.93
<40 fm	0.05	0.07	0.10	0.28	0.47	0.85	0.76	0.80	0.36	0.11	0.02	0.03	3.89
>40 fm	0.05	0.06	0.09	n/a	n/a	n/a	n/a	n/a	n/a	0.09	0.01	0.02	n/a

Blue rockfish

Blue rockfish harvests are projected to be less than 40.0 mt for all depth restriction alternatives (Table A-36). Greater harvests are expected with intermediate depth restrictions (25-30 fm) because effort in deep bins, with lesser catch rates, would be shifted to intermediate depth bins, with greatest catch rates.

Table A-36. Projected blue rockfish harvest impacts (mt) by month and by depth restriction.

Depth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
<20 fm	0.63	0.82	1.19	0.84	1.41	2.53	2.25	2.37	1.07	1.06	0.15	0.27	14.59
<25 fm	0.66	0.85	1.23	0.89	1.49	2.68	2.38	2.52	1.13	1.15	0.16	0.29	15.43
<30 fm	0.66	0.85	1.23	0.89	1.50	2.70	2.39	2.53	1.14	1.17	0.16	0.29	15.51
<40 fm	0.65	0.84	1.22	0.89	1.49	2.68	2.38	2.52	1.13	1.11	0.16	0.28	15.33
>40 fm	0.59	0.76	1.10	n/a	n/a	n/a	n/a	n/a	n/a	0.97	0.14	0.24	n/a

Other nearshore rockfish species complex (brown, quillback, China, grass, and copper RF)

Other nearshore rockfish harvest impacts are analyzed by individual species, but are summed in this report because of the aggregate state landing cap for these species. Harvest estimates are projected to be less than 12.0 mt for all depth restriction alternatives (Table A-37). Unlike for black rockfish and blue rockfish, lesser harvest impacts are expected with shallower depth restrictions because effort in deep bins, with greatest catch rates, would be shifted to shallower bins, with lesser catch rates.

Table A-37. Projected other nearshore rockfish harvest impacts (mt) by month and depth restriction.

Depth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
<20 fm	0.14	0.18	0.26	0.63	1.07	1.92	1.70	1.80	0.81	0.36	0.05	0.09	9.00
<25 fm	0.15	0.20	0.28	0.82	1.37	2.47	2.19	2.32	1.04	0.40	0.06	0.10	11.40
<30 fm	0.15	0.20	0.28	0.86	1.44	2.59	2.30	2.43	1.09	0.41	0.06	0.10	11.92
<40 fm	0.15	0.19	0.28	0.86	1.45	2.61	2.31	2.45	1.10	0.39	0.06	0.10	11.94
>40 fm	0.14	0.18	0.26	n/a	n/a	n/a	n/a	n/a	n/a	0.34	0.05	0.08	n/a

Greenling species complex (rock greenling and kelp greenling)

Greenlings harvests are analyzed by individual species, but are summed in this report because of the aggregate landing cap for these species. Harvest estimates are projected to be less than 6.5 mt for all depth restriction alternatives (Table A-38). Greater harvest impacts are expected with shallower depth restrictions because effort in deep bins, with lesser catch rates, would be shifted to shallower bins, with greater catch rates.

Table A-38. Projected greenlings harvest impacts (mt) by month and depth restriction.

Depth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
<20 fm	0.11	0.14	0.21	0.45	0.76	1.37	1.21	1.28	0.58	0.17	0.02	0.04	6.34
<25 fm	0.11	0.14	0.21	0.45	0.76	1.37	1.21	1.28	0.58	0.16	0.02	0.04	6.33
<30 fm	0.11	0.14	0.21	0.45	0.75	1.36	1.20	1.27	0.57	0.16	0.02	0.04	6.29
<40 fm	0.11	0.14	0.20	0.45	0.75	1.35	1.19	1.26	0.57	0.15	0.02	0.04	6.22
>40 fm	0.10	0.13	0.19	n/a	n/a	n/a	n/a	n/a	n/a	0.13	0.02	0.03	n/a

Cabezon

Cabezon impacts are only projected through August because harvest rate is not available in latter months due to early attainment of the cabezon quota in years since depth data become available (2009). Impacts for all depth restrictions are projected to be less than 24.0 mt harvested and 1.2 mt released (Table A-39 and Table A-40). Cabezon catch rates are greater in shallow depth bins; therefore, cabezon impacts are expected to be greater for shallow depth bins.

Table A-39. Projected cabezon harvest impacts (mt) by month and depth restriction.

Depth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
<20 fm	0.38	0.49	0.71	1.97	3.31	5.96	5.28	5.59	na	na	na	na	23.68
<25 fm	0.41	0.52	0.76	1.92	3.22	5.80	5.15	5.44	na	na	na	na	23.23
<30 fm	0.41	0.52	0.76	1.90	3.19	5.75	5.10	5.39	na	na	na	na	23.02
<40 fm	0.40	0.52	0.75	1.89	3.17	5.71	5.06	5.36	na	na	na	na	22.86
>40 fm	0.39	0.51	0.73	n/a	n/a	n/a	n/a	n/a	n/a	na	na	na	n/a

Table A-40. Projected cabezon discard mortality (mt) by month and depth restriction.

Depth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
<20 fm	0.06	0.08	0.11	0.08	0.13	0.24	0.21	0.22	n/a	n/a	n/a	n/a	1.12
<25 fm	0.06	0.07	0.11	0.08	0.13	0.23	0.21	0.22	n/a	n/a	n/a	n/a	1.11
<30 fm	0.06	0.07	0.11	0.08	0.13	0.23	0.20	0.22	n/a	n/a	n/a	n/a	1.10
<40 fm	0.06	0.07	0.11	0.08	0.13	0.23	0.20	0.22	n/a	n/a	n/a	n/a	1.09
>40 fm	0.05	0.07	0.10	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Yelloweye rockfish
Yelloweye rockfish harvest has been prohibited since 2004; therefore, the majority of impacts are now due to discard mortality. Yelloweye rockfish impacts are projected to be less than 1.8 mt for all depth restriction scenarios (Table A-41). Shallower depth restrictions are expected to reduce yelloweye rockfish impacts due to lesser catch rates and discard mortality rates in shallow water depth bins.

Table A-41. Expected yelloweye rockfish discard mortality by month and depth restriction in the bottomfish fishery.

Depth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
<20 fm	0.015	0.019	0.027	0.077	0.130	0.233	0.207	0.219	0.098	0.016	0.002	0.004	1.046
<25 fm	0.016	0.020	0.029	0.113	0.189	0.340	0.302	0.319	0.144	0.025	0.003	0.006	1.507
<30 fm	0.016	0.020	0.029	0.123	0.206	0.372	0.330	0.349	0.157	0.030	0.004	0.008	1.643
<40 fm	0.021	0.028	0.040	0.126	0.212	0.382	0.339	0.358	0.161	0.068	0.010	0.017	1.762
>40 fm	0.051	0.066	0.095	n/a	n/a	n/a	n/a	n/a	n/a	0.140	0.020	0.035	n/a

Canary rockfish
Canary rockfish release impacts are projected to be less than 3.7 mt for all depth restriction alternatives (Table A-42). Shallower depth restrictions are expected to reduce catch rockfish release impacts due to lesser catch rates and mortality rates in shallow water depth bins.

Table A-42. Expected canary rockfish discard mortality (mt) by month and depth restriction in the bottomfish fishery.

Depth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
<20 fm	0.040	0.052	0.075	0.200	0.336	0.605	0.537	0.568	0.255	0.082	0.012	0.021	2.782
<25 fm	0.045	0.059	0.085	0.239	0.401	0.722	0.640	0.677	0.304	0.090	0.013	0.023	3.297
<30 fm	0.045	0.059	0.085	0.253	0.425	0.765	0.679	0.718	0.322	0.099	0.014	0.025	3.488
<40 fm	0.046	0.059	0.085	0.259	0.434	0.782	0.693	0.733	0.329	0.166	0.023	0.042	3.652
>40 fm	0.091	0.118	0.171	n/a	n/a	n/a	n/a	n/a	n/a	0.273	0.038	0.069	n/a

A.8.4 Pacific halibut fishery projection model

Yelloweye rockfish and canary rockfish are typically the only groundfish species with impact limits caught in the Pacific halibut fishery; therefore, Pacific halibut fishery projection models exist only for these species.

Old and new projection models
The old model was ratio based and projected 0.00557 mt of yelloweye rockfish and 0.003065 mt of canary rockfish per 1,000 lbs of Oregon Pacific halibut quota. However, a ratio based projection method appears inappropriate because there does not appear to be a relationships between Oregon Pacific halibut

quota and yelloweye rockfish catches (Figure A-15; $R^2 < 0.01$) nor canary rockfish catches (Figure A-16; $R^2 < 0.01$) (given in fish due to change in discard mortality calculations). Yelloweye rockfish and canary rockfish may be unrelated to Pacific halibut quota because of different habitat preferences of the fish (i.e., rocky reefs for rockfish and gravel/sand for Pacific halibut).

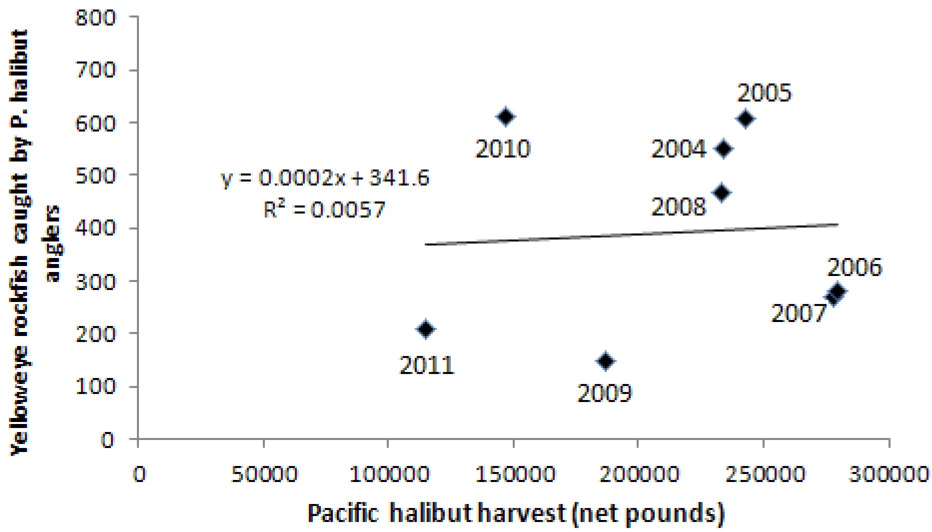


Figure A-15. Relationship between yelloweye rockfish catches (discards) and Oregon Pacific halibut quota.

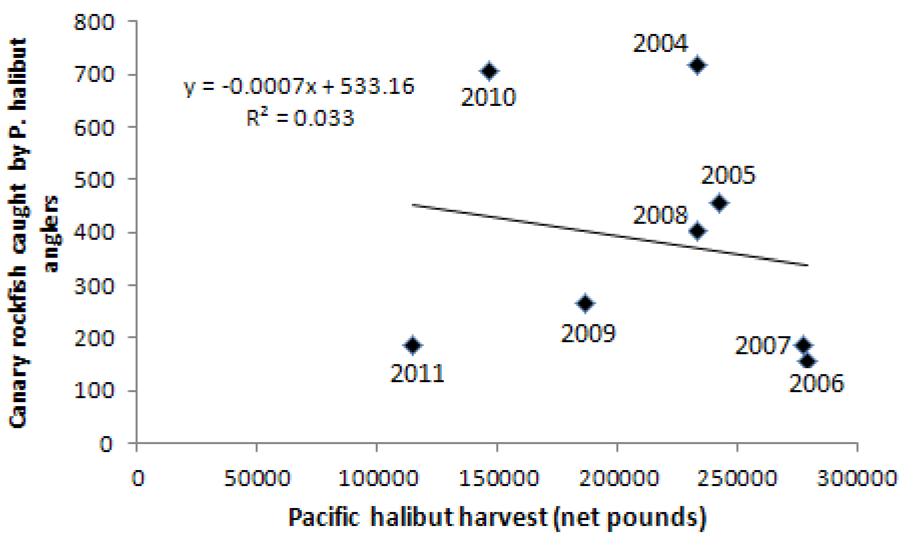


Figure A-16. Relationship between canary rockfish catches (discards) and Oregon Pacific halibut quota.

Instead of using a ratio based approach, the new Pacific halibut model simply uses mean impacts, regardless of quota (0.49 mt for yelloweye rockfish and 0.69 mt for canary rockfish).

Incorporation of variance into the Pacific halibut projection model

Prediction intervals (not confidence intervals) for a one year prediction of canary rockfish and yelloweye rockfish were made for α=0.1 and 0.2 values using the following formula.

$$\bar{X} \pm K \cdot s \qquad K = t_{1-\alpha/k,n-1}\sqrt{\frac{1}{n}+\frac{1}{m}}$$

k = number of sampling periods interested in
m = number of samples per sampling period
n = number of background samples
1-α/2k = level of confidence

The yelloweye rockfish prediction intervals were 0.49 ± 0.68 (α=0.1) and ± 0.405 (α=0.2). The canary rockfish prediction intervals were 0.69 ± 0.44 (α=0.1) and ± 0.26 (α=0.2). These wide ranges make it difficult to project future impacts of these species from the Pacific halibut fishery.

A.8.5 Bag limit models

Bag limits have been used by ODFW to manage the recreational groundfish fishery since 1976. The rockfish, greenling, and cabezon (RGC) aggregate bag limit encompasses the most commonly harvested groundfish species. The RGC bag limit since 2004 has ranged from five to ten fish. This variation was used to determine if RGC bag limits can be used to alter angler catch rates and impacts of RGC target species or incidentally caught overfished species. Only black rockfish and blue rockfish catch rates appear to be affected by differences in RGC bag limits; therefore, RGC bag limits only appear to be effective at manipulating impacts (mt landed) of those species. Catch rates of other species included in the RGC bag limit, including overfished species, are not expected to be affected by RGC bag limit adjustments (catch rates unrelated to RGC bag limits). Of RGC species, cabezon are least affected by bag limits. Even year-round one cabezon sub-bag limits are not expected to result in significant cabezon harvest reductions.

Introduction:
Bag limits are a commonly used fisheries management method for controlling harvests. Only anglers with catches within the scope of bag limit changes are affected. For example, a bag limit reduction from six fish to four fish will not affect the catches of those anglers that caught zero to four fish. Bag limits reductions would be expected to reduce releases of overfished species (harvest prohibited) because anglers may catch bag limits in less time, resulting in decreased fishing effort. However, bag limit reductions may not reduce prohibited species impacts if releases of these species are more dependent on where anglers fish than how long they fish.

Analysis of adjustments to the rockfish, greenling, and cabezon (RGC) aggregate bag limit:
Analysis of bag limit adjustments used data from angler interviews from the Oregon Recreational Boat Survey (ORBS) since 2004 (first year yelloweye rockfish and canary rockfish harvest was prohibited). The RGC bag limit has been five through eight and ten (Table A-43). RGC bag limit analysis was performed for black rockfish (RF), blue RF, greenlings (rock greenling and kelp greenling combined), cabezon, other nearshore RF (brown RF, grass RF, China RF, quillback RF, and copper RF combined), yelloweye RF, and canary RF.

Table A-43. RGC bag limits by month and by year, 2004-2011.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004	10	10	10	10	10	10	10	10	10	10	10	10
2005	8	8	8	8	8	8	8,5	5	5	5	5	5
2006	6	6	6	6	6	6	6	6	6	6	6	6
2007	6	6	6	6	6	6	6	6	6	6	6	6
2008	6	6	6	6	6	6	6,5	5	5	5	5	5
2009	6	6	6	6	7	7	7	7	7	7	7	7
2010	7	7	7	7	7	7	7	7	7	7	7	7
2011	7	7	7	7	7	7	7	7	7	7	7	7

Black RF

A percentage of anglers caught RGC bag limits that were comprised only of black RF for all RGC bag limits (5, 6, 7, 8, 10; Table 5-2); therefore, adjustments to RGC bag limits can be used to alter black RF harvests. Differences between black RF harvests under different RGC bag limits were made by (a) multiplying the percent of anglers that caught zero fish by zero, the percent that caught one by one, the percent that caught two by two, and so on until 10 for each RGC bag limit, (b) summing those products for each RGC bag limit, and (c) comparing the total values for each RGC bag limit. Angler catch rates that exceed bag limits were removed due to probable data errors (e.g., 57 black RF per angler under a five RGC limit). Projections of black RF catches under two, three, four and nine RGC bag limits were also made by shifting the percentage of anglers that caught the bag limit under a greater RGC bag limit to the bag limit of a lower RGC bag limit. For example, a projection of a nine RGC bag limit was made from the 10 RGC bag limit by deleting the 7.5 percent of angers that caught 10 fish and by adding that 7.5 percent to the percentage that caught nine fish. Projections of two, three, and four RGC bag limits were made from when the RGC bag limit was six rather than five due to much greater sample size (78,729 anglers vs. 10,343 anglers). A multiplier table was then created to compare black RF harvests under different RGC bag limits (Table A-44). To determine differences between harvests for a given month under different RGC bag limits, multiply the harvest impact estimate by the multiplier.

Table A-44. Percent of bottomfish anglers that caught 0-10 black RF (fish/ang) under 5, 6, 7, 8, and 10 RGC bag limits (bold values) and projected percent of anglers that would have caught 0-10 black RF under 2, 3, 4, and 9 RGC bag limits. Projected angler percentages of 2-4 bag limits were based off data from when the bag limit was 6 instead of 4 due to a greater sampler size.

	Bag limit								
fish/ang	2	3	4	**5**	**6**	**7**	**8**	9	**10**
0	11.7	11.7	11.7	12.8	11.7	12.0	10.8	13.1	13.1
1	12.7	12.7	12.7	17.9	12.7	15.0	11.5	9.2	9.2
2	75.6	11.2	11.2	15.5	11.2	14.5	9.9	7.9	7.9
3	0.0	64.4	12.3	15.8	12.3	12.8	9.9	7.5	7.5
4	0.0	0.0	52.1	21.4	14.6	11.0	11.2	8.7	8.7
5	0.0	0.0	0.0	16.7	21.1	12.6	12.3	7.2	7.2
6	0.0	0.0	0.0	0.0	16.4	12.8	12.3	7.7	7.7
7	0.0	0.0	0.0	0.0	0.0	9.3	13.8	9.1	9.1
8	0.0	0.0	0.0	0.0	0.0	0.0	8.2	10.6	10.6
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.0	11.5

10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5
total	100	100	100	100	100	100	100	100	100

Table A-45 calculation of a bag limit of 4 (based off 6) example: The percentage of anglers that would have caught 1-3 fish is the same for bag limits of 4 and 6 (would not have been affected by a bag limit of 4). Those that caught 5 or 6 fish (with a bag of 6) would have had their catches reduced to 4 fish with a bag limit of 4, so the expected percentage of anglers catching the limit with a 4 fish bag limit is the sum of the anglers that caught 4-6 fish with a bag limit of 6 (14.6 + 21.1 + 14.6 = 52.1).

Table A-45. Multiplier table to compare differences in black RF harvests (mt) under different RGC bag limits.

	Bag from:								
Bag to:	2	3	4	5	6	7	8	9	10
2	1.000	0.718	0.585	0.618	0.490	0.495	0.406	0.339	0.333
3	1.393	1.000	0.814	0.860	0.683	0.690	0.566	0.472	0.464
4	1.711	1.228	1.000	1.057	0.839	0.847	0.695	0.579	0.570
5	1.619	1.163	0.946	1.000	0.794	0.802	0.658	0.548	0.540
6	2.040	1.465	1.192	1.260	1.000	1.010	0.829	0.691	0.680
7	2.019	1.450	1.180	1.247	0.990	1.000	0.820	0.684	0.673
8	2.462	1.768	1.439	1.520	1.207	1.219	1.000	0.834	0.821
9	2.953	2.120	1.726	1.824	1.448	1.463	1.200	1.000	0.985
10	2.999	2.153	1.753	1.852	1.470	1.486	1.218	1.016	1.000

Blue RF

The same bag limit analysis was used for blue RF and black RF. As for black RF, RGC bag limits can be used to adjust blue rockfish impacts, although to a much lesser degree because a lesser percentage of anglers are catching RGC bag limits that consist only of blue RF (<1%;Table A-46) than black RF (7.5 percent-16.7 percent). Accordingly, the blue RF multiplier table shows lesser impacts due to RGC bag limit changes than for black RF (Table A-47).

Table A-46. Percent of anglers that caught 0-10 blue RF (BRF/ang) under 5, 6, 7, 8, and 10 RGC bag limits (bold values) and projected percent of anglers that would have caught 0-10 blue RF under 2, 3, 4, and 9 RGC bag limits.

	Bag limit								
Fish/ang.	2	3	4	**5**	**6**	**7**	**8**	9	**10**
0	96.37	96.37	96.37	95.00	96.34	90.92	95.36	93.24	93.24
1	3.12	3.12	3.12	4.24	3.12	7.63	4.05	5.82	5.82
2	0.35	0.35	0.35	0.40	0.35	0.94	0.39	0.60	0.60
3	0.16	0.09	0.09	0.17	0.09	0.25	0.06	0.22	0.22
4	0.00	0.08	0.05	0.16	0.05	0.12	0.10	0.05	0.05
5	0.00	0.00	0.02	0.02	0.03	0.04	0.01	0.01	0.01
6	0.00	0.00	0.00	0.00	0.02	0.07	0.01	0.04	0.04
7	0.00	0.00	0.00	0.00	0.00	0.04	0.01	0.03	0.03
8	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01

9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
total	100	100	100	100	100	100	100	100	100

Table A-47. Multiplier table to compare differences in blue RF harvests (mt) under different RGC bag limits.

	Bag from:								
Bag to:	2	3	4	5	6	7	8	9	10
2	1.00	0.92	0.89	0.65	0.88	0.56	0.25	0.50	0.50
3	1.08	1.00	0.97	0.71	0.96	0.61	0.27	0.55	0.55
4	1.12	1.03	1.00	0.73	0.98	0.63	0.28	0.56	0.56
5	1.53	1.41	1.37	1.00	1.35	0.86	0.39	0.77	0.77
6	1.13	1.05	1.02	0.74	1.00	0.64	0.29	0.57	0.57
7	1.78	1.64	1.59	1.16	1.57	1.00	0.45	0.90	0.89
8	3.94	3.64	3.53	2.57	3.48	2.22	1.00	1.99	1.98
9	1.99	1.83	1.78	1.30	1.75	1.12	0.50	1.00	1.00
10	1.99	1.83	1.78	1.30	1.75	1.12	0.50	1.00	1.00

Other nearshore RF (China, quillback, copper, brown, and grass RF combined)

Other nearshore RF bag limit analysis was the same as used for black RF. Unlike for black RF and blue RF, RGC bag limits do not appear to affect other nearshore RF catch rates since (a) 0 percent of anglers caught RGC bag limits that comprised only of other nearshore RF, (b) the percentage of anglers that caught 0, 1, 2, and 3 other nearshore RF were similar for all RGC bag limits, and (c) greater than 99 percent of anglers caught fewer than 2 other nearshore RF for all RGC bag limits (Table A-48).

Table A-48. Percent of anglers that caught 0-10 other nearshore RF (fish/ang) under 5, 6, 7, 8, and 10 RGC bag limits (bold values) and projected percent of anglers that would have caught 0-10 other nearshore RF under 2, 3, 4, and 9 RGC bag limits.

	Bag limit								
Fish/ang.	2	3	4	**5**	**6**	**7**	**8**	9	**10**
0	92.75	92.75	92.75	95.63	92.75	92.79	95.82	95.01	95.01
1	6.45	6.45	6.45	4.02	6.45	6.61	3.97	4.82	4.82
2	0.80	0.61	0.61	0.28	0.61	0.41	0.18	0.09	0.09
3	0.00	0.18	0.12	0.07	0.12	0.13	0.03	0.07	0.07
4	0.00	0.00	0.06	0.00	0.05	0.04	0.00	0.01	0.01
5	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
total	100	100	100	100	100	100	100	100	100

Greenlings (kelp greenling and rock greenling)

RGC bag limits would be expected to have little to no impact on greenlings catch rates since (a) fewer than 0.01 percent of anglers harvested RGC bag limits that were comprised only of greenlings, (b) the percentage of anglers that caught 0, 1, 2, and 3 greenlings were similar for all RGC bag limits, and (c) greater than 99 percent of anglers caught fewer than 2 greenlings for all RGC bag limits (Table A-49).

Table A-49. Percent of anglers that caught 0-10 greenlings (fish/ang) under 5, 6, 7, 8, and 10 RGC bag limits (bold values) and projected percent of anglers that would have caught 0-10 greenlings under 2, 3, 4, and 9 RGC bag limits.

	Bag limit								
Fish/ang.	2	3	4	**5**	**6**	**7**	**8**	9	**10**
0	96.4	96.4	96.4	95.0	96.3	90.9	95.4	93.2	93.2
1	3.1	3.1	3.1	4.2	3.1	7.6	4.0	5.8	5.8
2	0.4	0.4	0.4	0.4	0.4	0.9	0.4	0.6	0.6
3	0.2	0.1	0.1	0.2	0.1	0.3	0.1	0.2	0.2
4	0.0	0.1	0.1	0.2	0.1	0.1	0.1	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
total	100	100	100	100	100	100	100	100	100

Overfished rockfish: Yelloweye RF and canary RF

Since harvest of yelloweye and canary RF is prohibited, anglers can continue to catch and release these species until they stop fishing (due to RGC attainment or other). Lesser overfished species releases would be expected with reduced RGC bag limits because of reduced fishing effort per angler (less time to catch limit). However, there is a curvilinear relationship between RGC bag limit and percentages of anglers releasing 1-4 yelloweye or canary RF (peaks at RGC bag limit of 7; Figure A-17 and Figure A-18). The curvilinear relationship may be due to the rebuilding of the stocks; greater catches have occurred in recent years (7 and 6 RGC bag limits) than earlier years (8 and 10 RGC bag limits). It is also possible that encounters of overfished stocks may be more related to where an angler fishes than how long they fish.

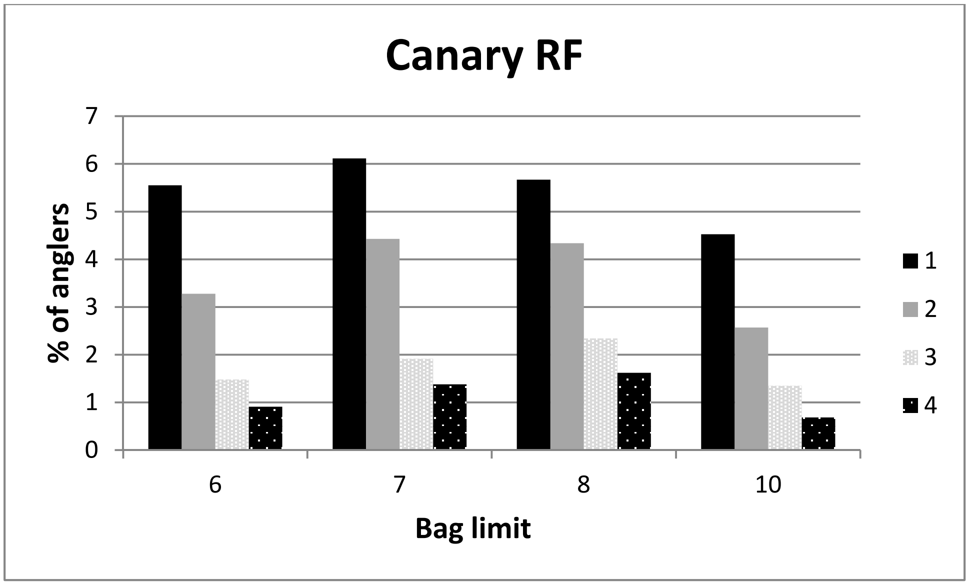


Figure A-17. Percentage of anglers that caught 1-4 canary rockfish under 6-10 RGC bag limits.

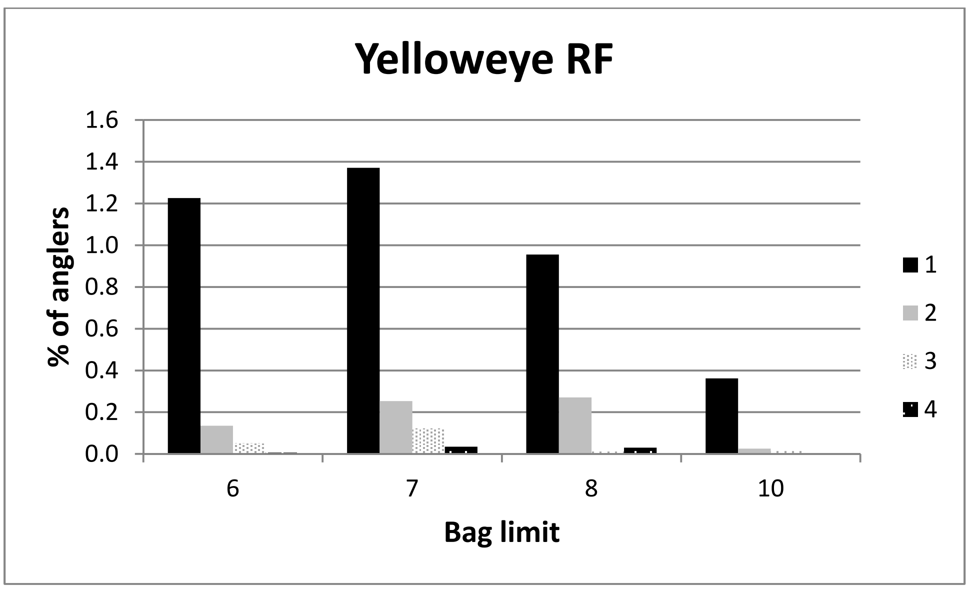


Figure A-18. Percentage of anglers that caught 1-4 yelloweye rockfish under 6-10 RGC bag limits.

Cabezon:

Inseason closure of cabezon retention has occurred before October in all years since 2004 (due to attainment of quota), and closures have occurred during July in 2010 and 2011.

Only 3.3 percent of anglers that kept cabezon kept more than one when permitted (cabezon harvest could equal RGC bag); therefore, cabezon catch rates or harvest impacts would not be expected to be significantly altered by reductions in the RGC bag limit or even one cabezon sub-bag limits (only one can be cabezon)(Table A-50). As evidence, the earliest inseason closure of cabezon occurred in the only year (2011) with a one cabezon sub-bag limit. Accordingly, year-round retention of cabezon may not be able to occur with per angler bag or sub-bag limits. A one cabezon per boat bag limit could result in year-round harvest opportunities, but would disproportionally impact vessels with multiple anglers (e.g., charters).

Table A-50. Expected cabezon harvests (mt) with a one cabezon per boat limit, one cabezon per angler limit, and a seven cabezon per angler limit.

	Bag limit		
Month	1 / boat	1 / angler	7 (RGC)
Jan	0.24	0.41	0.43
Feb	0.31	0.52	0.54
Mar	0.43	0.73	0.77
Apr	1.01	1.53	1.63
May	1.76	2.66	2.84
Jun	2.31	3.49	3.73
Jul	2.97	4.50	4.81
Aug	2.23	3.38	3.61
Sep	1.23	1.87	2.00
Oct	n/a	n/a	n/a
Nov	n/a	n/a	n/a
Dec	n/a	n/a	n/a
Total	12.49	19.09	20.37

Notes: Used 2008-2011 data. Impacts for a seven cabezon bag limit were calculated for each month by multiplying average catch rate by average cabezon weight (kg) by average angler trips by .001 (kg to mt conversion). One cabezon per angler impacts were calculated with the same formula, but reducing all catch rates greater than one to one. Impacts for a one cabezon per boat limit were calculated with the same formula, but reducing catch rates greater than one per boat to one. Estimates were not made for Oct-Dec because cabezon retention was prohibited for those months in all years (cabezon releases averaged less than 0.2 mt for October and less than 0.1 mt for Nov and Dec).

A.8.6 Multivariate forecasting: yelloweye rockfish (excluding management regulations)

Yelloweye rockfish have been the most constraining groundfish species because annual catch limits of this species have generally been obtained before catch limits of other non-overfished groundfish species or species complexes. Therefore, the objective of most management measures is to reduce yelloweye rockfish impacts, to allow greater utilization of other groundfish stocks. The ability to accurately predict yelloweye catches could increase the effectiveness of management measures. Unfortunately, yelloweye rockfish catches are rare (Figure A-19), highly variable (Figure A-20), and do not appear to be strongly related to economic indicators (e.g., gas prices, stock market, unemployment), weather (e.g., wind, waves, or ocean condition (wind and waves interaction together), or strength of other fisheries (e.g., tuna, halibut, and salmon harvests) (Figure A-21). Weak relationships between the mentioned indicators and yelloweye impacts would lead to poor goodness of fit with multivariate analysis (e.g., regression), and would lead to wide prediction intervals with little value for management purposes. Until more accurate predictions of yelloweye rockfish impacts can be made, inseason management of groundfish fisheries will have to remain reactionary.

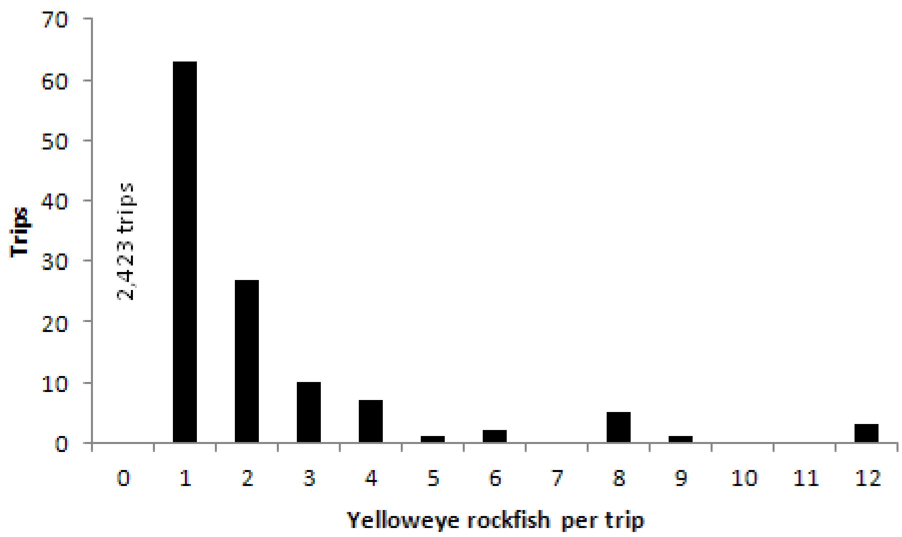


Figure A-19. Yelloweye rockfish per angler trip for June 2011.

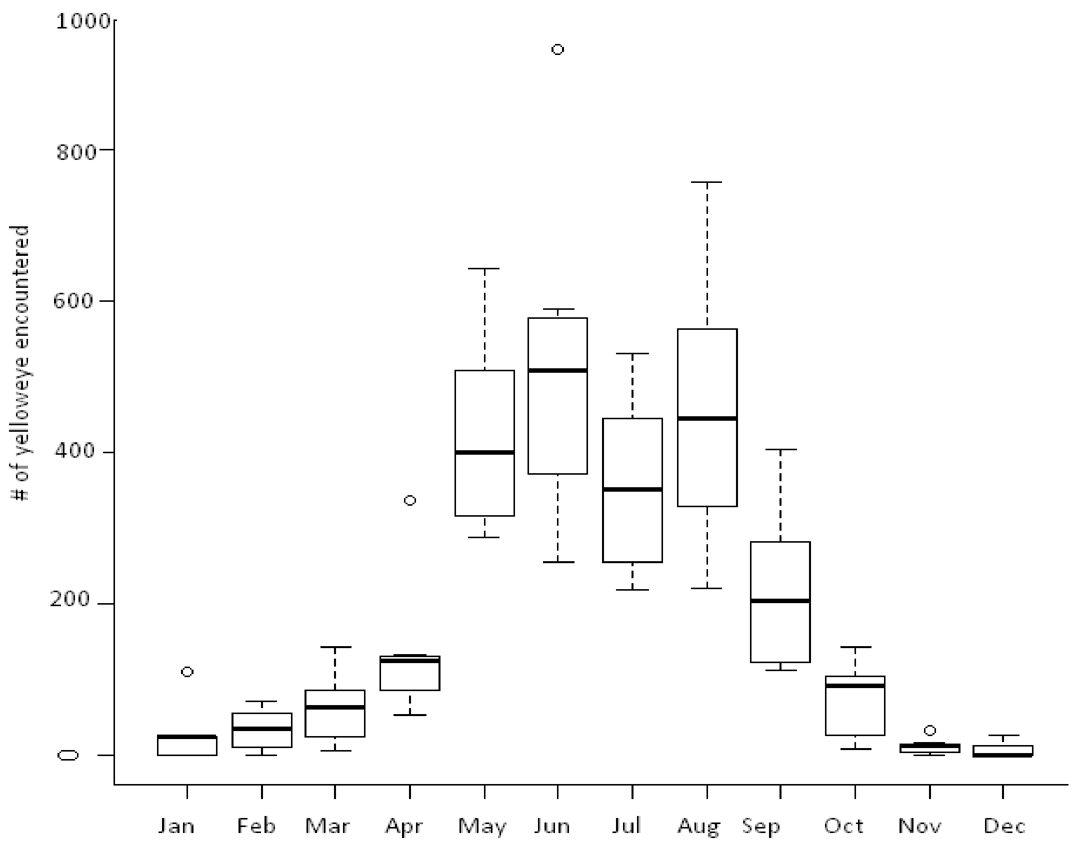


Figure A-20. Yelloweye rockfish encounters (landed + released) by month for the bottomfish fishery, 2004-2011.

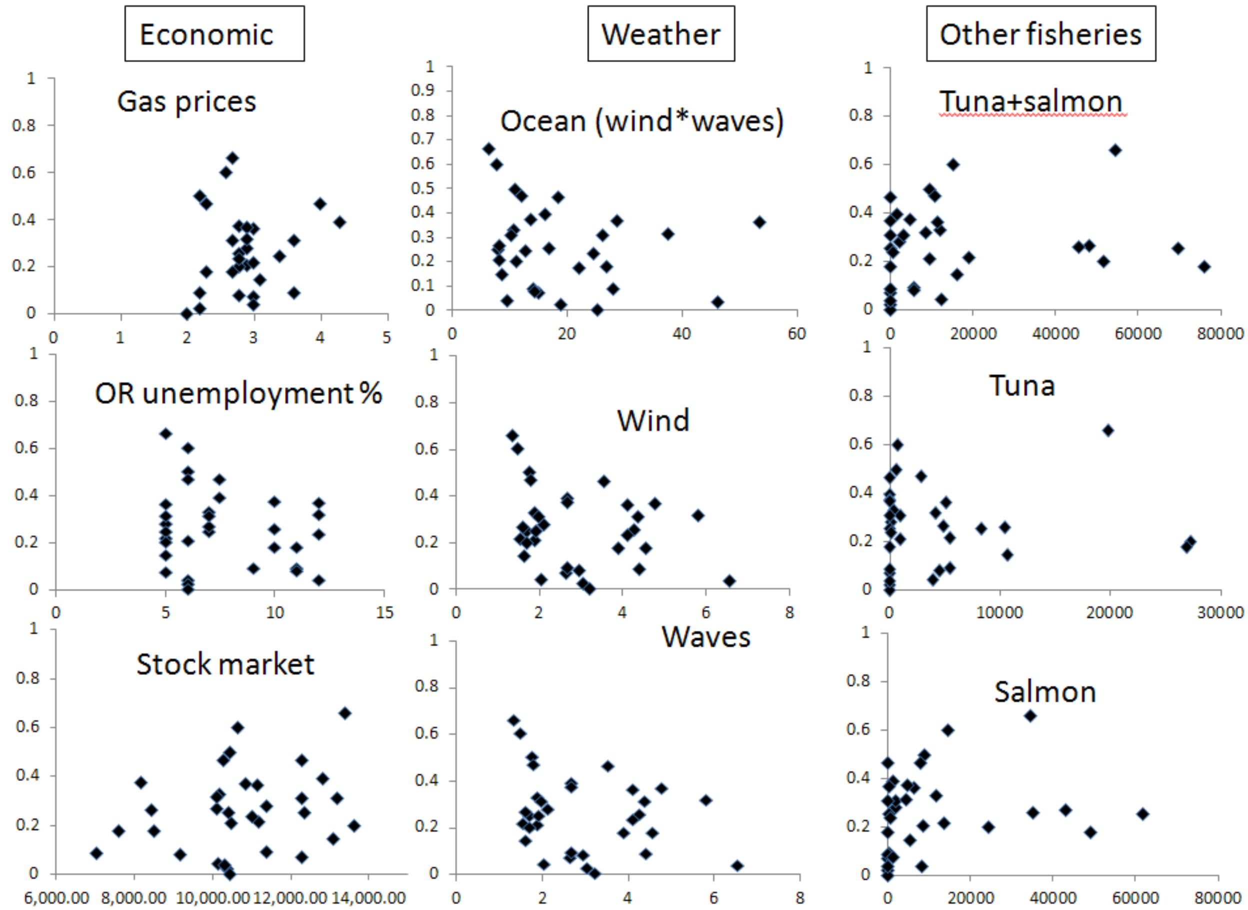


Figure A-21. Relationship between yelloweye impacts and economic indicators, weather, and strength of other fisheries for months with < 40 fm depth restrictions (months with majority of impacts), 2004-2010. y axis = mt of yelloweye rockfish; x axis units: gas = $, unemployment = %; stock market = DOW points; ocean = kts X swell feet; wind = kts; waves = swell feet; other fisheries = fish landed).

A.8.7 Model performance

The ability to accurately predict groundfish species impacts (harvests and discards) under different management restrictions is essential to reduce the possibility of inseason closures of fisheries. In Oregon, the ability to predict groundfish species impacts given different depth restrictions in the groundfish fishery is of greatest importance because other management restrictions do not appear capable of significantly manipulating impacts (e.g., bag limits unless set unrealistically low) or have not been examined (e.g., additional area closures). Of particular concern is the ability to accurately predict yelloweye rockfish impacts since they are the most limiting species to groundfish management in Oregon (only species in which quotas are typically obtained and because impacts cannot be reduced by prohibiting harvest because retention is always prohibited). Although the same models are used to predict impacts of all groundfish species with impact caps, only the ability of models to predict yelloweye rockfish impacts is examined, due to their relative importance, by comparing actual versus expected impacts.

Effects of new data source for determining discard mortality rates

Acquiring data of anger catches and efforts by depth has given ODFW a much greater understanding of where anglers fish, how angler behavior may be affected by depth restrictions, and what actual discard mortalities are than when only observed charter data on fish releases was available (see section 1). This newly acquired information shows that discard mortalities rates fluctuate and that the assumption of fixed discard mortalities used in previous calculations of discard mortalities was consequently inaccurate. Since the same fixed discard mortalities were used in both the old projection model and old discard mortality rate calculations, this created a greater chance of more aligned estimates and projections (although more inaccurate) than with the new projection model, which has to account for the variable discard mortality rates of the new calculation method.

Old model performance 2007-2009: actual versus expected impacts for discard mortality from groundfish fishery

Prior to 2010, the new and old projection models cannot be compared because data necessary for the new model (catch rate and effort by depth) did not exist (first obtained in 2009 but need a full year of data for the model). Therefore, it was only possible to compare actual versus expected values for the old model. Only three years were compared (2007-2009) because this model is no longer used and because three years of comparisons were sufficient enough to prove that the old model had poor predictive abilities.

The close to expected year end totals for yelloweye rockfish discard mortalities from the groundfish fishery for 2009 (-11.7 percent error) and 2008 (-6.1 percent error) are misleading because substantial monthly positive and negative errors cancelled each other out (typically > ± 20 percent; Table A-51). The -38.6 percent error in 2007 is more representative of the true predictive ability of the old model.

The old model was also fairly poor at predicting total discard mortality from the Pacific halibut fishery and harvest from all fisheries (Table A-51). The old model appeared to be fairly accurate at predicting total impacts (discard mortality plus harvest) in 2007 (3.4 percent error) and 2008 (2.0 percent error), but this was misleading because substantial errors of the different fisheries canceled each other out.

Table A-51. Comparison of actual versus expected yelloweye rockfish discard mortalities from the groundfish fishery by month and year for the old model (2007-2009). Actual and expected values are in metric tons; depth = depth restriction; negative error = projection < actual.

	2009					2008					2007				
Month	Depth	Expected	Actual	Actual-Expected	% error	Depth	Expected	Actual	Actual-Expected	% error	Depth	Expected	Actual	Actual-Expected	% error
Jan	All	0.010	0.119	0.109	-91.6	All	0.046	0.045	-0.001	2.0	All	0.041	0.0469	0.006	-12.6
Feb	All	0.019	0.075	0.056	-75.1	All	0.077	0.076	-0.002	2.0	All	0.035	0.0523	0.017	-33.1
Mar	All	0.085	0.100	0.015	-15.3	All	0.162	0.159	-0.003	2.0	All	0.172	0.2562	0.084	-32.9
Apr	40	0.064	0.087	0.023	-26.1	40	0.360	0.312	-0.048	15.3	40	0.041	0.0696	0.029	-41.1
May	40	0.148	0.176	0.028	-16.1	40	0.537	0.466	-0.071	15.3	40	0.147	0.2496	0.103	-41.1
Jun	40	0.220	0.376	0.156	-41.4	40	0.454	0.393	-0.060	15.3	40	0.085	0.1438	0.059	-40.9
Jul	40	0.205	0.175	-0.030	17.0	20	0.107	0.159	0.051	-32.4	40	0.117	0.1986	0.082	-41.1
Aug	40	0.370	0.259	-0.111	42.7	20	0.121	0.179	0.058	-32.4	40	0.388	0.6598	0.272	-41.2
Sep	40	0.177	0.077	-0.100	129.9	40	0.047	0.090	0.043	-47.9	40	0.184	0.3127	0.129	-41.2
Oct	All	0.084	0.168	0.084	-50.2	40	0.095	0.211	0.116	-54.9	All	0.114	0.1696	0.056	-32.8
Nov	All	0.026	0.011	-0.015	139.4	40	0.028	0.061	0.034	-54.9	All	0.019	0.0289	0.010	-34.2
Dec	All	0.054	0.032	-0.022	68.8	40	0.012	0.027	0.015	-54.9	All	0.009	0.0126	0.004	-28.7
Total		1.461	1.655	0.194	-11.7		2.046	2.178	0.132	-6.1		1.352	2.201	0.849	-38.6

Table A-52. Comparison of actual versus expected yearly yelloweye rockfish discard mortalities, harvests, and total impacts (2007-2009). Negative error = projection < actual.

	Discard mort. GF fishery			Discard mort. P. halibut fishery			Harvest (all fisheries)			Total impacts (all)		
Year	expected	actual	% error	expected	actual	% error	expected	actual	% error	expected	actual	% error
2009	1.461	1.656	-11.8	0.974	0.312	212.2	0.055	0.075	-26.7	2.490	2.043	21.9
2008	2.046	2.178	-6.1	1.200	1.010	18.8	0.068	0.062	9.7	3.314	3.250	2.0
2007	1.352	2.201	-38.6	1.548	0.590	162.3	0.053	0.064	-17.2	2.953	2.855	3.4

New model performance 2010-2011: actual versus expected impacts for discard mortality from groundfish fishery

The old projection model became obsolete when it was discovered that assumption of fixed discard mortality rates was incorrect for the groundfish fishery; therefore, there is no need to compare the predictive ability of the old and new models for the discard mortality from the groundfish fishery.

Instead, projected discard mortality from the groundfish fishery is compared with two variations of the new model. The preseason version of the new model uses only data prior to the projection year and the inseason version uses monthly data from the projection year when it becomes available. The inseason version was expected to have better predictive abilities because it could incorporate trends from the projection year that would be expected to continue for the entire year (e.g., greater than expected catch rates from Jan-May would be expected to result in greater than expected catch rates for the rest of the year).

As expected, the inseason version was better at predicting total year discard mortality than the preseason version for 2010 (-12.6 percent and -21.4 percent error, respectively) and 2011 (-6.8 percent and -11.2 percent error, respectively) (Table A-53). Percent error for the inseason version was greatest during months with relatively low impacts (typically > 20 percent and often nearly 100 percent or greater; Jan-Mar and Sep-Dec). Discard mortality is very difficult to accurately project during these months because efforts are much less than during summer months (small sample size issue) and catch rates are highly variable. Of greater concern is the ability to accurately predict discard mortality during summer months (Jun-Aug) when the majority of impacts occur. Percent error with the inseason version was less than 20 percent for each of these months during 2010 and during July of 2011. The relatively large percent error during June 2011 (-63.3 percent) was due more than double record yelloweye rockfish discards (released fish) for the month (due to record catch rates and record effort). Inclusion of the record June 2011 catch rate data into model caused the inseason projections for July-Sept to increase, but actual catch rates returned to normal, resulting in projections greater than what actually occured for the period.

Table A-53. Actual versus expected yelloweye rockfish discard mortalities from the groundfish fishery for the preason (PRE; using data before projection year) and inseason (IN; using data for the projection year when available) versions of the new projection method. Negative error = projection < actual.

		2011								2010							
		Expected (mt)		Actual (mt)	Actual - expected		% error			Expected (mt)		Actual (mt)	Actual - expected		% error		
Month	Depth	PRE	IN		PRE	IN	PRE	IN	Depth	PRE	IN		PRE	IN	PRE	IN
Jan	All	0.027	0.027	0.023	-0.004	-0.004	19.1	19.1	All	0.022	0.022	0.012	-0.010	-0.010	76.3	76.3
Feb	All	0.047	0.047	0.029	-0.018	-0.018	64.2	64.2	All	0.026	0.026	0.035	0.009	0.009	-24.7	-24.7
Mar	All	0.071	0.071	0.026	-0.045	-0.045	174.1	174.1	All	0.056	0.056	0.063	0.007	0.007	-10.7	-10.7
Apr	40	0.104	0.102	0.052	-0.052	-0.050	99.4	95.6	40	0.082	0.086	0.033	-0.049	-0.053	151.8	164.1
May	40	0.177	0.174	0.165	-0.012	-0.009	7.2	5.4	40	0.148	0.155	0.313	0.165	0.158	-52.8	-50.5
Jun	40	0.205	0.201	0.547	0.342	0.346	-62.6	-63.3	40	0.172	0.180	0.181	0.009	0.001	-5.1	-0.6
Jul	20	0.172	0.236	0.210	0.038	-0.026	-18.1	12.4	40	0.280	0.224	0.241	-0.039	0.017	16.2	-7.0
Aug	20	0.147	0.203	0.151	0.004	-0.052	-2.9	34.1	20	0.099	0.157	0.132	0.033	-0.025	-24.9	19.1
Sep	20	0.072	0.099	0.055	-0.017	-0.044	29.9	78.7	20	0.044	0.069	0.062	0.018	-0.007	-28.9	11.5
Oct	All	0.061	0.048	0.136	0.075	0.088	-55.2	-64.7	20	0.021	0.023	0.004	-0.017	-0.019	420.8	470.4
Nov	All	0.014	0.012	0.001	-0.013	-0.011	834.8	701.3	20	0.006	0.006	0.000	-0.006	-0.006	no impacts	
Dec	All	0.01	0.008	NA	NA	NA	NA	NA	20	0.003	0.003	0.005	0.002	0.002	-39.1	-39.1
Total		1.097	1.220	1.396	0.299	0.176	-21.4	-12.6		0.959	1.007	1.080	0.121	0.073	-11.2	-6.8

Model comparison for predicting discard mortality in Pacific halibut fishery

Near 100 percent discard mortalities of yelloweye rockfish caught in the Pacific halibut fishery make it possible to compare the old and new models for projecting discard mortality in the fishery. Both methods are much simpler than the groundfish discard mortality models: the old method is ratio based and projects 0.00557 mt of yelloweye rockfish per 1,000 lbs of Pacific halibut quota for Oregon fisheries and the new method assumes 0.455 mt total, regardless of the Oregon quota (see section 4).

The new model resulted in a smaller mean percent error than the old model (-15 percent and 95 percent, respectively) and consequently appears to be the better projection model (Table A-54). Inconsistencies in percent errors with the old model means that a simple ratio approach would not fit the data well or have accurate predictive abilities.

Table A-54. Actual versus expected yelloweye rockfish discard mortality from the Pacific halibut fishery. Negative error = projection < actual.

		Expected		Actual - Expected		% error	
Year	Actual	New	Old	New	Old	New	Old
2011	0.531	0.466	1.044	0.065	-0.513	-12	97
2010	0.770	0.466	0.886	0.304	-0.116	-39	15
2009	0.312	0.466	1.036	-0.154	-0.724	49	232
2008	1.010	0.466	1.200	0.544	-0.190	-54	19
2007	0.590	0.466	1.264	0.124	-0.674	-21	114
				Mean error =		-15	95

A.8.8 Model output use in management

Model outputs are used to keep projected impacts within catch limits while minimizing potential reductions in angler trips. An example of a potential 3.5 mt canary rockfish harvest guideline (HG) is used to outline the steps in the process.

The first step in the process is to create regulatory and season framework options to keep projected impacts within catch limits. Model outputs of projected impacts from the Pacific halibut fishery and from the groundfish fishery, by depth restriction, are used to keep total projected impacts within 3.5 mt HG (Table A-55). Status quo regulations are projected to result in impacts (4.68 mt) greater than the HG (Option SQ; Table A-56). Projected impacts can be kept within the HG by either limiting the groundfish fishery to 20 fm for the entire year and keeping the Pacific halibut fishery open (3.47 mt; Option 1; Table A-56) or by limiting the groundfish fishery to 30 fm for the entire year and closing the Pacific halibut fishery (3.49 mt; Option 2; Table A-56).

Table A-55. Projected canary rockfish impacts (mt) by month and depth restriction from the groundfish fishery and from the Pacific halibut fishery.

Groundfish fishery projected impacts

Depth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<20 fm	0.040	0.052	0.075	0.200	0.336	0.605	0.537	0.568	0.255	0.082	0.012	0.021
<25 fm	0.045	0.059	0.085	0.239	0.401	0.722	0.640	0.677	0.304	0.090	0.013	0.023
<30 fm	0.045	0.059	0.085	0.253	0.425	0.765	0.679	0.718	0.322	0.099	0.014	0.025
<40 fm	0.046	0.059	0.085	0.259	0.434	0.782	0.693	0.733	0.329	0.166	0.023	0.042
>40 fm	0.091	0.118	0.171	n/a	n/a	n/a	n/a	n/a	n/a	0.273	0.038	0.069

(Pacific halibut projection = 0.690 mt)

Table A-56. Regulatory options of potential depth restrictions by month for the groundfish fishery and presence/absence (present unless specified) to keep projected impacts (mt) of canary rockfish (CAN) within a 3.5 mt HG.

Option	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	CAN
SQ	all-depth			40 fm						all-depth			4.68
1	20 fm												3.47
2	30 fm --No Pacific halibut												3.49

The next step is to determine which option results in the fewest potential decrease in angler trips. Potentially eliminated groundfish trips are calculated by multiplying the percent of sampled trips that occured seaward of a proposed depth restriction during months with status quo depth restrictions by expanded total trips for the month (the new angler effort by depth data is vital for this calculation). All Pacific halibut trips are deducted if this fishery is closed. These estimates are upper range projections because anglers would have had the option of fishing shallower permissible depths or could have fished for other species. If all displaced anglers would have found substitute fishing opportunities, then the lower range of the projected decrease in angler trips would be zero. Socioeconomic survey data on potential changes in angler behavior due to proposed restrictions would be beneficial for point estimate projections.

Option 1 would be preferred instead of Option 2 because of fewer potential reductions in angler trips (Table A-57). Potential decreases in angler trips with Option 1 are 8,493 (9 percent) and 26,567 (28.3 percent) for Option 2. This example only has two regulatory options to simply outline how calculations and decisions are made. Five to ten options are typically analyzed and are discussed with members of the public before a decision on regulations is made.

Table A-57. Comparison of potential decreases in angler trips by fishery and port for Options 1 and 2 of Table 7-2.

	Decline in trips with Option 1									Status quo trips					
	Bottomfish			Pacific halibut			Combined			Bottomfish		Pacific halibut			
Port	Charter	Private	Total	Charter	Private	Total	Charter	Private	Total	Charter	Private	Charter	Private	Total	% decrease
Astoria	12	9	21	0	0	0	12	9	21	37	243	159	148	587	3.5
Garibaldi	1789	2525	4314	0	0	0	1789	2525	4314	3548	3812	574	2457	10392	41.5
Pacific City	5	24	29	0	0	0	5	24	29	337	2753	6	705	3801	0.8
Depoe Bay	970	129	1099	0	0	0	970	129	1099	9208	1713	1211	552	12684	8.7
Newport	546	135	680	0	0	0	546	135	680	10984	5089	1781	9505	27359	2.5
Florence	0	0	0	0	0	0	0	0	0	0	0	0	241	241	0.0
Winchester	5	7	13	0	0	0	5	7	13	5	31	0	265	302	4.2
Charleston	365	917	1282	0	0	0	365	917	1282	3221	5794	325	969	10309	12.4
Bandon	141	229	370	0	0	0	141	229	370	932	1094	79	423	2527	14.6
Port Orford	7	62	70	0	0	0	7	62	70	30	430	147	104	711	9.8
Gold Beach	145	190	335	0	0	0	145	190	335	731	2372	9	106	3218	10.4
Brookings	191	89	281	0	0	0	191	89	281	3146	15472	19	3127	21764	1.3
Total	4178	4315	8493	0	0	0	4178	4315	8493	32181	38804	4310	18602	93896	9.0

	Decline in trips with Option 2									Status quo trips					
	Bottomfish			Pacific halibut			Combined			Bottomfish		Pacific halibut			
Port	Charter	Private	Total	Charter	Private	Total	Charter	Private	Total	Charter	Private	Charter	Private	Total	% decrease
Astoria	12	9	21	159	148	307	171	156	328	37	243	159	148	587	55.8
Garibaldi	407	1863	2269	574	2457	3031	981	4320	5300	3548	3812	574	2457	10392	51.0
Pacific City	0	0	0	6	705	711	6	705	711	337	2753	6	705	3801	18.7
Depoe Bay	279	49	329	1211	552	1763	1490	601	2091	9208	1713	1211	552	12684	16.5
Newport	380	97	477	1781	9505	11286	2161	9602	11763	10984	5089	1781	9505	27359	43.0
Florence	0	0	0	0	241	241	0	241	241	0	0	0	241	241	100.0
Winchester	5	7	13	0	265	265	5	273	278	5	31	0	265	302	92.2
Charleston	49	362	411	325	969	1294	374	1332	1705	3221	5794	325	969	10309	16.5
Bandon	0	7	7	79	423	502	79	430	509	932	1094	79	423	2527	20.1
Port Orford	0	0	0	147	104	251	147	104	251	30	430	147	104	711	35.3
Gold Beach	95	0	95	9	106	115	104	106	209	731	2372	9	106	3218	6.5
Brookings	15	19	34	19	3127	3146	34	3146	3180	3146	15472	19	3127	21764	14.6
Total	1242	2413	3655	4310	18602	22912	5552	21015	26567	32181	38804	4310	18602	93896	28.3

Potential decreases in angler trips (Table A-57) are used in conjunction with economic survey data to determine potential decreases in saltwater angler expenditures (i.e., gas, lodging, food, charter tickets, tackle, bait, licenses, etc.) by county in Oregon (Table A-58).

Option 1 is projected to reduce annual saltwater angler expenditures by $5.160 million, and more than half of this loss would be expected from Tillamook County (Table A-58). Option 2 is projected to reduce annual saltwater angler expenditures by $14.265 million (nearly three times that of Option 1).

Table A-58. Expected decreases in saltwater angler expenditures (all costs related to fishing trip) by county for Options 1 and 2 (Table 7-2).

	Status quo		Option 1		Option 2	
County	$ (millions)	Trips	Δ trips	Δ $	Δ trips	Δ $
Clatsop	5.766	5,545	-21	-0.022	-328	-0.341
Tillamook	21.235	24,026	-4,343	-3.838	-6,011	-5.313
Lincoln	21.466	51,353	-1,779	-0.744	-13,854	-5.791
Lane	2.628	814	0	0	-241	-0.778
Douglas	6.998	6,386	-13	-0.014	-278	-0.305
Coos	8.365	17,722	-1,652	-0.78	-2,215	-1.046
Curry	5.183	27,273	-685	-0.13	-3,640	-0.692
Total	71.641	133,119	-8,493	-5.528	-26,567	-14.265

Notes: $= angler expenditures (i.e., gas, lodging, tackle, etc.); trips = angler trips for all target species (e.g., tuna, salmon, bottomfish, halibut); Δ trips = projected decline in angler trips for Options 1 and 2; Δ $ = projected decrease in angler expenditures from Options 1 and 2 . Clatsop= Astoria; Tillamook= Garibaldi and Pacific City; Lincoln= Depoe Bay and Newport; Lane= Florence; Douglas= Winchester Bay; Coos= Charleston and Bandon; Curry= Port Orford, Gold Beach, and Brookings.

A.9 California Recreational Catch and Effort Model

Recreational fisheries management for multi-species assemblages in California presents many challenges. In recent years, declining stocks of several rockfish species have dictated recreational groundfish management seasons and depths in California. Increasingly complex restrictions have been necessary to keep total catch of depleted species within the reduced limits that are necessary to rebuild the stocks while providing fishing opportunity.

Prior to 2000, the recreational daily bag limit for rockfish was 15 fish per angler with no closed months or depths. Beginning in 2000, the daily bag limit was reduced to 10 fish. Regulations have changed each year since 2000, making analyses of the effects of particular regulations difficult. In addition, regulations have become more region-specific, adding to the difficulty of modeling projected catches.

A.9.1 Methodology Used to Project Recreational Catches for 2013-14

The recreational catch model incorporates a number of parameters and assumptions, all of which are either risk-neutral or risk-adverse. The basic analytical approach used for 2013-14 is the same as for 2011–12. The 2008-2010 data from the California Recreational Fishery Survey (CRFS) program serves as a baseline. The model output predicts expected catch under any combination of season and depth fishing restrictions for each of the regions

A.9.2 Changes to the RecFISH Model for 2013-2014

The CRFS estimates from 2008 to 2010 were inputted into the RecFISH model to determine the proposed season structure and species projected impacts. The proportion of catch by depth applied to the depth dependent mortality rates to derive Management Area Specific discard mortality rates were updated and applied to the 2008-2010 CRFS estimates. In addition, the proportion of catch by time and by depth in the historical catch were revised as described below, to better reflect the seasonality of effort North of Point Arena and the proportion of catch by depth North of 40° 10' min N. Latitude respectively.

A.9.3 Model Assumptions

The following assumptions were made for projecting impacts in the California recreational fishery.

- Effort Shift Inshore: The model includes a 27.6 percent increase in expected landings when fishing is restricted to less than 30 fm and a 39.3 percent increase in expected landings when fishing is restricted to less than 20 fm. The increase, or effort shift, is applied to account for increased effort in a smaller fishing area.
- Discard Mortality: Depth-dependent mortality rates for discarded rockfish are applied to the discarded fish (B2 & B3) in 10-fm increments. When projecting the 2013-14 season catch, discard catch estimates are multiplied by the proportion of catch in a given 10-fm depth increment times the depth-dependent mortality rate for the corresponding depth for each species.

A.9.4 Methodology Used to Calculate Annual Unrestricted Catch

- Pull (A+B1+B2+B3) Catch for each year from RecFIN[1]: Specify species and select the parameters month and district under Define Table Layout.
- Pull historical catch by depth (1999-2000, most recent years unregulated by depth) from the RecFIN boatdepth3 CDFG private access website. Add PC and PR fish caught together for each separate region and species, maintaining combined depth totals for each depth strata. Calculate average percentage of total fish caught within each 10 fm depth stratum (= "Depth Profile") by dividing 10 fm depth strata totals by combined total sum of all strata for the region. Assign proxies as needed for data-poor areas, using adjacent regions, similar species, etc.
- Pull historical catch through time (1993-1999, the most recent years unregulated by monthly closure) from RecFIN[2] : Calculate average percent catch by wave over combined years 1993-1999 by dividing individual wave totals by sum of all waves for each region. Assign proxies as needed for data-poor areas using the other region (North or South) as the proxy.
- For each management region and species, calculate total regulated catch based on months that each set of regulations was in effect. For example, if fishing was only open from 0-60 fm for March-December, sum total catch for those months only. Each management region should have catch data for all species grouped by the different sets of management regulations (MR sets) in effect for the year so that the identical calculations can easily be performed on identically restricted species.
- Expanding to All Depths. For each MR set: If there was no depth restriction, use the unmodified total regulated catch as the expected catch for all depths for that period of the year. If a depth restriction was in place, use total regulated catch to expand out each species in each MR set to all depths. From the Depth Profile, divide total regulated catch by sum of proportion of catch by the depth where fishing was open. This is the total expected catch for all depths. For example, if fishing for a MR set was open less than 20 fm, divide the total catch by the percentage of the catch less than 20 fm using the appropriate Depth Profile (historical unregulated catch data) for each species and region.
- Effort Shift. If the depth restriction is confined to 20 or 30 fm, we assume a shift in effort in shallower depth occurred for these months. To account for this effect, apply an effort shift factor to the constrained depth zone. For example, if a 0-20 fm restriction was in

[1] http://www.psmfc.org/recfin/forms/est2004.html
[2] http://www.psmfc.org/recfin/forms/est.html

effect multiply the total expected catch for all depths by 1.393 to calculate final total expected catch for those months. Similarly, use a factor of 1.276 if fishing was restricted within 30 fm. No effort shift is applied for depth restrictions greater than 30 fm.

- Accounting for Closed Months. After expanding to all depths and removing effort shift (if needed), sum all final expected catch values across all MR sets for the year for each management region and species. Divide this sum by the percent catch for the year that these regulated months represent (from the percent catch by wave for the year). In other words, divide the calculated catch for all open months by the percentage of the catch for the year these months historically represent. This results in the expected annual unregulated catch, expanded out from the regulated catch, for each region and species.
- Input expected annual unregulated catch for each region-species into the Catch by Year Table in the RecFISH Model database. The weighting of the different years' data to be used by the model in projecting catch can be selected at the model-user interface.

A.9.5 Description of the Catch Projection Model (RecFISH)

To improve the accuracy of catch estimates north of Point Arena for all rockfish including yelloweye rockfish, the following method was applied when modeling the effect of depth restrictions on rockfish species.

- For expanding baseline input catch data from regulated seasons to all depths, unregulated depth distribution of catch data from other areas can be used to supplement the existing historical data; these data must be from unregulated years to be able to expand to all depths. In the Northern Management Area, data from 1999-2003 were used (years unregulated by depth), recent unregulated Oregon catch by depth (1999-2003), and 1999-2000 data from the North-Central area that is north of Point Arena (for bathymetric and fishing effort similarities to the North). For the North-Central area, additional data from dockside party charter catch by depth data from 1999-2000 were used.

A.9.6 Inputs and Key Parameters for the Model

Weighting of Base Years: Base year data 2008-2010 were given nearly equal weighting by applying a 0.99 decay function. This is the same approach used in 2011-12.

Base Year Catch: CRFS catch estimates were summed for angler retained fish ("A" fish), angler-reported dead fish ("B1" fish), and a proportion of CRFS reported discarded fish derived ("B2" fish) using depth-based mortality estimates. Base year catch estimates are assumed to be for an unrestricted fishery that is open year-round at all depths. Therefore, for each year, a back calculation method was used to obtain an estimate for what catch would have been had the fishery been open for all months and at all depths. This back calculation uses month and depth catch proportions derived from historical catch estimates from seasons unregulated by month and depth.

Historical Catch By Month: Estimates of historical catch (in percent) by two-month period were calculated for each region based on Marine Recreational Fisheries Statistics Survey (MRFSS) data (weight of A+B1) from 1993-99, which was a time period when seasons and depths were unconstrained. Proxies were considered on a species by species basis for regions where there was a lack of catch data for that area. Monthly estimates of percent catch then were divided equally (50:50) for each pair of months.

Historical Catch by Depth: Estimates of percent catch by depth were calculated for each region based on MRFSS depth sample data (numbers caught A+B1 for CPFV and A+B1+B2 for PR) from 1999-2000, which was a time period when depths were unconstrained. Proxies were considered on a species by species basis for regions where there was a lack of catch data for that area.

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A.9.7 Determining the Proportion of Angler Reported Unavailable Dead Catch for Yelloweye and Canary Rockfish that was Composed of Discarded Dead Fish:

CRFS uses several different catch types in generating catch estimates which include A, B1, B2 etc. The B1 category includes disposition such as retained (filleted fish, fish given away, used for bait or otherwise unavailable) and fish discarded dead. Unfortunately, since CRFS began in 2004, the disposition of the B1 has not been recorded for the majority of private and rental trips which are sampled in the PR1 mode. Therefore, it is not possible to separate the discarded dead fish from the retained unavailable fish in B1 without use of a proxy for the proportion of fish discarded dead. Attempts have been made to apply the available data to the B1 fish, but few data exist for species such as yelloweye and canary rockfish, which are not allowed to be retained.

To estimate the proportion of yelloweye and canary rockfish B1 catch that is discarded dead, a "compliance factor" (CF) was determined for each management area for all groundfish species using CRFS data from 2008 to 2010. The CF was calculated by dividing B2 catch by total catch (A+B1+B2); this represents the proportion of fish reported discarded live by anglers. The CF is used as a proxy for the proportion of B1 that is discarded dead, and so it is multiplied by the B1 catch to estimate the total fish discarded dead. This amount is added to the known B2 catch to calculate total discards. This value is then multiplied by depth dependant mortality rate to obtain the discard mortality. Total mortality is the sum of retained catch (A+B1, less the proportion of B1 designated discarded dead) plus discard mortality. Because CFs are conservative, the proportions of B1 that are considered unavailable dead (filleted, used for bait, given away) are be biased high; this could result in an overestimate of total mortality.

A.10 California Recreational: Bocaccio Size Limit

Length data from the California Recreational Fisheries Survey (CRFS) from 2005 to 2010 were used to analyze the projected impacts to bocaccio as a result of removing the recreational size limit; both raw sample and estimate data were used.

The following steps were taken to calculate the increase in projected impacts expected as a result from removing the recreational size limit. The total weight of all sampled released fish (CRFS type "3" and "3d" catch types) was calculated along with the total weight of all sampled released fish under 10 inches. This was done to determine the proportion of fish under ten inches out of the total sampled fish. This proportion was then multiplied by the estimated weight of released fish ("B2" fish) to get the estimated weight of all fish under 10 inches. The estimated weight of fish under ten inches was then divided by the total weight of encountered fish (A+B1+B2) to determine what percentage of fish under ten inches is accounted for in the total encounters. That percentage was then applied to CDFG's RecFISH catch projection model results for bocaccio to determine the expected increase in projected impacts as a result of removing the size limit.

A.11 California Recreational: Greenling Bag Limit

RecFIN raw sample data were extracted and downloaded from the public web page for two time periods: 1995-2001 and 2009-2010. The years 1995-2001 were used as a base comparison time period because during those years there was a greenling ten-fish bag limit. These data were extracted from the Marine Recreational Fisheries Statistical Survey (MRFSS). The years 2009-2010 were chosen as a recent period because a greenling two-fish bag limit was in place and landings were very equal to or above the annual

TAC allocation for those years. The 2009-2010 RecFIN estimate data for greenlings were also extracted from the California Recreational Fisheries Survey (CRFS)

For each time period, three types of data were extracted: type 1, type 2, and type 3 so that summaries captured the header data and the A (kept) + B1 (unavailable dead) + B2 (released alive) fish. Only data from northern California (north of Point Conception) data were used; all modes and fishing areas within this area were included. Data were extracted and downloaded as comma delimited text files and converted into Access tables capturing the following fields:

- Type 1 records (header information)
- Type 2 records (B fish) – fish returned
- Type 3 records (A fish) – fish that were kept and available for inspection

Using Access, two tables were created for each time period: one table for the type 2 fish and one for the type 3 fish with four identification/update fields added to each table.

- A "Type" field was added to identify all "A" fish (type 3 records) or "B" fish (type 2 records) based upon the extracted record type (3 or 2)
- A "Trip type" field was identified and was updated with a "Y" for any record where:
  - greenlings (kelp, rock, genus, or family) were in the SP_CODE field
  - greenlings were identified in the PRIM1 or PRIM2 fields
    1. PRIM1 were fish identified by the angler as the primary target for the trip
    2. PRIM2 were the secondary target
- A "Trip type 2" field that was identified and was updated for all records that met any of the following criteria (using the Trip type 2 sub-codes as follows):
  - 1 = records where PRIM1 or PRIM2 were greenling
  - 2 = records where the SP_CODE (species code) was a greenling
  - 3a = records where the MODE_f was 2 or 5 (beach/bank) and PRIM1 or PRIM2 was cabezon, lingcod, rockfish genus, or monkeyface prickleback
  - 3b = records where the MODE_f was 2 or 5 and the SP_CODE was greenling, cabezon, lingcod, rockfish genus, or monkeyface prickleback
  - 3c = records where the MODE_f was 5 and the SP_CODE was any shallow nearshore rockfish
  - 4a = records where the MODE_f was 6, 7, or 8 and PRIM1 or PRIM2 was any shallow nearshore rockfish, cabezon, or monkeyface prickleback
  - 4b = records where the MODE_f was 6, 7, or 8 and the SP_CODE was any shallow nearshore rockfish, cabezon, or monkeyface prickleback
- A "GL" field that was identified and was updated for any record that had greenlings in the SP_CODE field
- All records that had a "Trip type 2" identifier as per any of the above were then used to update all "Trip type" records to a "Y" status – meaning that any bag/trip that was updated to a "Y" status (as per above) was identified and categorized as one that either had greenling as part of the bag or had the potential to have had a greenling
- Therefore, all records with a "Y" in the "GL" field were identified as greenling bags and any record with a "Trip type" identified as a "Y", but had a null value for the "GL" field were identified as a zero greenling bag
- Once a record was identified accordingly, all the records belonging to that bag (based on the same bag ID_CODE number) were updated so that each bag (in its entirety) had a uniform "Trip type" code identifier

Using both the updated main A fish and B fish tables, greenling COUNT tables were created that summed the number of greenlings per bag (based on the ID_CODE (using the Group By query function)) and the number of anglers per bag (using the CNTRBTRS (number of contributors – or anglers) field).

- Aggregate bags (bags with more than one angler) were factored in by dividing the number of greenlings per bag by the number of anglers resulting in many bags with a fractional amount of greenling(s) per bag
- Many bags had a zero or null value in the CNTRBTRS field and to correct for this a temporary table was created for A fish and B fish where the ID_CODE records were grouped and the CNTRBTRS was also grouped (where CNTRBTRS was >0 or not null). The temporary table and main tables were then linked and the main tables were then updated for those records missing a CNTRBTRS value. This yielded a more robust anglers/bag set of data which were used to update the 0 or null values in the A and B fish greenling COUNT tables. Type 1 records were not used because many records in those database tables also had 0 or null values in the CNTRBTRS field.

Bins were then set-up that summed the number of bags (based on the grouped ID_CODE) for all potential greenling trips where greenlings were not part of the bag (zero bag trips) and those where greenlings made up part of the bag. After the bin counts were completed, the estimated take at the two-fish, five-fish, and 10-fish levels were calculated for the base period using the following:

- A summed total (count) for each bin was calculated using this summary method:
  0 bags – no greenlings per bag
  0.01 – 1 greenling per bag
  1.01 – 2 greenlings per bag
  2.01 – 3 greenlings per bag
  Etc.
- A percent for each bin was calculated from the overall total number of bags (excluding those categorized as zero bags) with a cumulative running total noted at the two-fish bag level, the five-fish bag level, and at the 10-fish bag level
- For this base period, the percent difference between the two-fish, five-fish, and 10-fish amounts were noted
- Using the same method for the two-year recent period (2009-2010), the percent for the two two-fish bin was calculated, which included all bags that were in excess of the two-fish bin as part of the two-fish percentage.
- A 20 percent buffer was applied (i.e. the calculated percentage was increased by 20 percent) and the higher percentage was multiplied by the 50 mt new TAC allocation amount to estimate the status quo amount.
- To the two-fish percentage the difference between the two-fish and five-fish percentages was added from the base period to get a hypothetical five-fish bin percentage
- The five-fish percentage was multiplied by 50 mt amount to calculate that estimated harvest amount
- To the five-fish percentage the difference between the five-fish and 10-fish percentage was added from the base years and multiplied by 50 mt to estimate the harvest amount with a 10-fish bin

Assumptions used in the Model

- Since this model estimates (predicts) the amount of fish that potentially would be taken, all A fish (those retained in the bag), and B1 and B2 (fish returned dead or alive or eaten or given away, etc.) were included
- Only data from north of Point Conception were used because few greenling are taken south
- It is assumed that the number of bags per bin reflects a proportional amount of greenlings that would be taken

- Zero bags were identified using the above criteria to ascertain the number of bags (trips) where greenlings could have reasonably been taken as part of the fishing trip taking into consideration the mode and associated species for the mode
- The associated species used in the categorization criteria focused on those species commonly caught or potentially could be caught with greenlings from the same fishing area, method of catch, and habitat
- A 20 percent buffer was factored in to account for possible future (2012-2013) catch increases as the most conservative estimate possible
- For the base period, the differences between bin percentages were calculated using only bins with fish (the zero bins were excluded) because this yielded slightly higher percentage differences and was a more conservative approach