NOAA Technical Memorandum NMFS-NWFSC-57

Species Allocation of *Sebastes* and *Sebastolobus* sp. Caught by Foreign Countries

from 1965 through 1976
off Washington, Oregon, and
California, USA

December 2003

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

NOAA Technical Memorandum NMFS Series

The Northwest Fisheries Science Center of the National Marine Fisheries Service, NOAA, uses the NOAA Technical Memorandum NMFS series to issue informal scientific and technical publications when complete formal review and editorial processing are not appropriate or feasible due to time constraints. Documents published in this series may be referenced in the scientific and technical literature.

The NMFS-NWFSC Technical Memorandum series of the Northwest Fisheries Science Center continues the NMFS-F/NWC series established in 1970 by the Northwest & Alaska Fisheries Science Center, which has since been split into the Northwest Fisheries Science Center and the Alaska Fisheries Science Center. The NMFS-AFSC Technical Memorandum series is now being used by the Alaska Fisheries Science Center.

Reference throughout this document to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

This document should be cited as follows:

Rogers, J.B. 2003. Species allocation of *Sebastes* and *Sebastolobus* sp. caught by foreign countries from 1965 through 1976 off Washington, Oregon, and California, USA. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-57, 117 p.

NOAA Technical Memorandum NMFS-NWFSC-57

Species Allocation of *Sebastes* and *Sebastolobus* sp. Caught by Foreign Countries

from 1965 through 1976
off Washington, Oregon, and
California, USA

Jean Beyer Rogers

Northwest Fisheries Science Center
Fisheries Resource Analysis and Monitoring Division
2032 SE OSU Drive
Newport, Oregon 97365

December 2003

U.S. DEPARTMENT OF COMMERCE
Donald L. Evans, Secretary

National Oceanic and Atmospheric Administration
Vice Admiral Conrad C. Lautenbacher, Jr. USN (Ret), Administrator

National Marine Fisheries Service
William T. Hogarth, Assistant Administrator for Fisheries

Most NOAA Technical Memorandums NMFS-NWFSC are available online at the Northwest Fisheries Science Center web site (http://www.nwfsc.noaa.gov)

Copies are also available from:
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
phone orders (1-800-553-6847)
e-mail orders (orders@ntis.fedworld.gov)

TABLE OF CONTENTS

List of Figures v

List of Tables vii

Executive Summary xi

Acknowledgments xiii

Introduction 1

Methods and Results 7

Step 1. Catch by Area, Year, and Category 7
Step 2. Defining Rockfish Fishing Strategies/Assemblages 16
Step 3. Catch Allocation to Fishing Strategies/Assemblages 18
Step 4. Derive and Apply Species Compositions to Assemblage Catch 27
Comparison with Previous Estimates 35

Discussion 41

Citations 45

Appendix A: Catch by INPFC Area, Calendar Year, and Reporting Category 55

Appendix B: Defining Rockfish Fishing Strategies/assemblages 65

Appendix C: Catch Allocation to Fishing Strategies/assemblages 71

Appendix D: Derive and Apply Species Compositions to Assemblage Catch 91

Appendix E: Comparison with Previous Estimates 111

LIST OF FIGURES

Figure 1. Map of INPFC areas off Washington, Oregon and California, United States 4

Figure 2. Foreign catch off Washington, Oregon, and California by INPFC area 12

Figure 3. Foreign catch off Washington, Oregon, and California by country 12

Figure 4. Proportion of total foreign rockfish catch (t) off Washington, Oregon, and California in 1966-1976 by species 29

Figure 5. Change in dominance of top seven species in the 1966-1976 Washington, Oregon, and California foreign catch by INPFC area. 29

Figure 6. Catch estimates from this paper (NEW) versus recent stock assessments (OLD) for species with highest percentage change 36

Figure A-1. Comparison of possible borders between Soviet "Washington" and "British Columbia" reporting areas 64

Figure A-2. Japanese block reporting areas 64

Figure B-1. Comparison of ordination scores and cluster designations for the four most-frequently occurring clusters 70

Figure C-1. Soviet Union survey changes in Pacific hake strategies over time and INPFC area . . . 89

Figure C-2. Comparison of Soviet Union assemblage-designated catches by INPFC area and year based on three methods 90

Figure D-1. Comparison of percents by weight (y axes) for species dominating the four most frequently occurring Soviet Union research assemblages by INPFC area and year (x axes) 109

Figure D-2. Comparison of the catches of four species in the Soviet Union surveys by year and bottom depth 110

LIST OF TABLES

Table 1. Common and scientific names for species mentioned in this document 2

Table 2. Summary of decisions made in deriving foreign catch estimates for 1966-76 off the coasts of Washington, Oregon, and California (WOC) by INPFC area and calendar year 9

Table 3. Step one results: Catch (t) by INPFC area and year for each country and reporting category 10

Table 4. Decisions and assumptions made in allocating foreign rockfish catch to species 19

Table 5. Step three results: Allocation of catch to assemblages (Assem.) by year and INPFC . 20

Table 6. Consequences (t) of changing species identification in the Soviet Union survey data (Survey[a]) and using Method 1 versus Method 2 to allocate catch (Method[b]) 28

Table 7. Step four results: Allocation to species of foreign rockfish catch (t) off the Washington, Oregon, and California in 1966-1976 by INPFC area and year 30

Table 8. Foreign catch (t) estimates from this paper (New) versus recent stock assessments (Old) for comparable years and areas. 37

Table A-1. Comparison of available estimates of Soviet rockfish catch (t) off Washington, Oregon, and California during 1965-76 56

Table A-2. Comparison of Soviet catch (t) estimates in 1966-68 in the literature versus calculations 58

Table A-3. Calculation of Soviet catch (t) in U.S. Vancouver INPFC area 59

Table A-4. Japanese catch (t) estimates reported by fishing year off Washington, Oregon, and California during 1965-76 60

Table A-5. Comparison of estimates of Japanese catch (t) reported by calendar year off Washington, Oregon, and California during 1965-76 61

Table A-6. Calculation of Japanese catch (t) in U.S. portion of Vancouver INPFC area 62

Table A-7. Comparison of available estimates of foreign catch (t) for other countries off Washington, Oregon, and California during 1965-76 63

Table B-1. Comparison of available species composition information on shelf and slope rockfish assemblage catches during 1966-76 66

Table B-2. Comparison of sources with information on incidental rockfish catch from targeting Pacific hake during or soon after 1966-76 67

Table B-3. Missing weights and replacement data for Soviet Union survey data from 1966-76 of the U.S. West Coast (south of lat. $48^{0}30'$N) 68

Table B-4. Comparison of clusters of tows from the 1966-76 Soviet surveys 69

Table C-1. Regulations and agreements affecting foreign fisheries off the U.S. West Coast in 1966-77 72

Table C-2. Available vessel sighting information for the Soviet Union fishery operating off the coasts of Washington, Oregon, and California in 1966 73

Table C-3. Available vessel sighting information for the Soviet Union fishery operating off the coasts of Washington and Oregon in 1967 75

Table C-4. Available vessel sighting information for the Soviet Union fishery operating off the coast of California in 1967 77

Table C-5. Available vessel sighting information for the Soviet Union fishery operating off the coasts of Washington, Oregon, and California in 1968 78

Table C-6. Allocation of Soviet Union rockfish catch (t) (above line) to rockfish assemblages using method employing information from commercial fisheries (Method 1) 80

Table C-7. Distribution of Soviet Union survey tows by year and INPFC area for the four most frequent assemblages in all years and areas combined 81

Table C-8. Comparison of Soviet Union catch ratios in surveys versus commercial catches 82

Table C-9. Allocation of Soviet Union rockfish catch (t) (above line) to rockfish assemblages using method employing information from Soviet Union surveys (Method 2) (below line) . 83

Table C-10. Allocation of Japanese rockfish catch (t) (above line) to assemblages (below line) . . . 85

Table C-11. Comparison of available fishery species compositions during 1965-76 86

Table C-12. Allocation of Polish rockfish catch (t) to assemblages 87

Table C-13. Allocation of Bulgarian and East German rockfish 1976 catch (t) to assemblages . . . 88

Table D-1. Estimates of Conception INPFC area landings (t) by species percentages 92

Table D-2. Estimates of Monterey INPFC area landings by species 93

Table D-3. Estimates of Eureka INPFC area landings by species 94

Table D-4. Oregon landings estimates for the Columbia INPFC area 95

Table D-5. Columbia area landings made in Washington and Oregon 96

Table D-6. U.S. Vancouver INPFC area landings estimates based on landings in PFMC area 3B + 3CS (Tagart 1985) 97

Table D-7. Species compositions based on observed catches in 1977-83 (incidental hake) and domestic landings (slope and shelf) 98

Table D-8. Species compositions for incidental hake and slope based on Soviet Union survey assemblages 99

Table D-9. Species compositions for north shelf and south shelf based on Soviet Union survey assemblages 101

Table D-10. Soviet Union catch (t) allocated to species by INPFC area and year 103

Table D-11. Japanese catch (t) allocation to individual species by year and INPFC area 106

Table D-12. Allocation of catch (t) for Poland, East Germany, and Bulgaria using the average of Method 1 and Method 2 108

Table E-1. U.S. Vancouver INPFC area P.o.p. assessment foreign catch (t) derivations versus new estimates (t) 112

Table E-2. Columbia INPFC area comparison of P.o.p. assessment calculations with new estimates (t) 113

Table E-3. U.S. Vancouver INPFC area yellowtail and canary assessment calculations versus new values (t) 114

Table E-4. Columbia INPFC area (COL) yellowtail and canary assessment calculations versus new estimates (t) 116

Table E-5. Differences between new estimates (t) for Pacific ocean perch (P.o.p.), yellowtail, and canary and those used previously in the stock assessments 117

EXECUTIVE SUMMARY

Estimates of foreign *Sebastes* and *Sebastolobus* catch (rockfish) occurring off the West Coast of the United States (U.S.) in 1965-76 may affect stock status determination for several species of fish. Although this catch was substantial, only four rockfish stock assessments during this 1965-76 period have included foreign catch estimates for those years. Species with estimates are Pacific ocean perch (*Sebastes alutus*), yellowtail rockfish (*S. flavidus*), canary rockfish (*S. pinniger*), and darkblotched rockfish (*S. crameri*). Those estimates were also only for the Columbia and U.S. Vancouver International Pacific International North Pacific Fisheries Commission (INPFC) Statistical Areas.

Stock assessment authors (cited throughout this document) used different techniques for each of these four species to estimate foreign catch by year and INPFC area. The authors had to allocate catch to species because the foreign countries reported rockfish catch only as "rockfish," "Pacific ocean perch," or "other rockfish," with limited information on actual species composition. Allocation to INPFC area was also necessary because the Soviet Union generally reported by U.S. state boundary, and none of the countries separated United States versus Canadian catch in the Vancouver INPFC area. Japanese catches additionally had to be allocated to calendar year because they were reported by fishing year. Use of different techniques to allocate foreign catch to individual species, year, and INPFC area resulted in overlapping allocation of catch in many years.

This document provides a consistent method of allocating foreign catch to all *Sebastes* and *Sebastolobus* species by year and INPFC area. All available pertinent literature and data for the period from 1965-76 were compiled and analyzed. Allocation involved four steps: 1) select and derive estimates by species category, year, and INPFC area; 2) define fishing strategies (and resulting species catch assemblages) used by the foreign fleet; 3) assign catch to fishing strategy/catch assemblage by year and INPFC area; and 4) apply rockfish species compositions to each assemblage-year-INPFC-area catch. Accomplishment of the four allocation steps involved many decisions, most of which were specific to each country.

Soviet Union catch was both the largest component of total foreign catch and most difficult to allocate. Literature found in step one had a wide range of 1966-68 catch estimates and two methods of allocating to INPFC area. There was also conflicting information on both the northern boundary of Washington-reported catch and species placement in catch categories (this catch may or may not include all of Washington plus some British Columbia, Canada). Catch in 1966-68 was chosen by deriving independent estimates using vessel sightings and catch per vessel day. INPFC estimates were chosen based on vessel sighting allocations. U.S. catch in the Vancouver INPFC area before 1975 was estimated by subtracting Columbia-to-Conception INPFC areas catch from Washington-to-California reported catch. This assumed the northern boundary of Soviet catch reported as "Washington" was the U.S.-Canadian border. After 1974, foreign trawl fishing was not allowed in the U.S. portion of Vancouver INPFC, so catch in that area was assumed zero. Catch categories could not be resolved, so all catch categories were combined. Categories could not then be used as a proxy for catch assemblage in step three. Two alternative methods for steps three and four were developed and the results averaged. One method relied on over-flight and nearby-vessel observations of catch, regulations, on-board observer data (after 1976), and U.S. commercial catch species compositions. The other method assumed that the commercial fleet fished similarly to the 1966-76 Soviet Union surveys. Survey boats often fished with (and scouted for) the fleet in those years. Survey data was analyzed to provide assemblage catch ratios and assemblage species compositions.

Japan had the next largest catch but allocation was easier. Japan consistently reported by INPFC area and "Pacific ocean perch" versus "Other" catch categories, although use of the categories may have changed in response to regulations after 1972. They also appeared to use fishing strategies similar to those used by the United States commercial trawl fleet. Allocation decisions involved allocation from fishing year to calendar year, from Vancouver INPFC area to U.S. and Canada, and use of catch categories. Although calendar-year catch estimates by INPFC area were available from some sources, information by 1^0 longitude by 0.5^0 latitude block was available only for fishing year (1 November - 31 October). In order to use that block data to estimate U.S. catch in Vancouver INPFC area, fishing year catch was assumed to occur in the later year (the year of the 31 October date), an assumption consistent with many literature sources. Catch categories were assumed to represent Slope (Pacific ocean perch) versus Shelf (Other) assemblages, except after 1972 when one-half Other was allocated to Slope. Shelf and Slope species compositions in the U.S. landings data were then applied to the catch categories.

Poland, Bulgaria, East Germany, and Republic of Korea did not fish off the U.S. West Coast until the end of the time period and had minimal catch. All countries except Republic of Korea fished with trawl gear and appeared to employ strategies similar to the Soviet Union. Soviet Union catch allocation methodology was therefore used for those countries. Republic of Korea rockfish catch was mainly from longline and was assumed to be all Pacific ocean perch.

The estimates in this document decreased foreign catch estimates for Pacific ocean perch and canary rockfish, and increased catch for the remaining assessed species. Estimated foreign catch for 1965-76 was highest (>10000 t) for Pacific ocean perch (*Sebastes alutus*), shortbelly rockfish (*S. jordani*), widow rockfish (*S. entomelas*), bocaccio (*S. paucispinis*), splitnose rockfish (*S. diploproa*), darkblotched rockfish (*S. crameri*), and yellowtail rockfish (*S. flavidus*). Change in the total catch (foreign plus domestic) for 1965-76 was greatest for Pacific ocean perch (decreased), shortspine thornyhead (*Sebastolobus alascanus*) (increased), and widow rockfish (increased).

ACKNOWLEDGMENTS

Jack Tagart (Washington Department of Fish and Wildlife), Donald Gunderson (University of Washington), Richard Methot (National Marine Fisheries Service), Bill Barss (Oregon Department of Fish and Wildlife), S. J. Westrheim, Jim Ianelli (National Marine Fisheries Service, Alaska Fisheries Science Center), Jim Bottom (National Marine Fisheries Service, Northwest Fisheries Science Center), Cid Hughes (contractor for MES, Inc.), and Kathleen Jewett (National Marine Fisheries Service) improved the document through their helpful comments on earlier drafts. Bernie Goiney (National Marine Fisheries Service, Alaska Fisheries Science Center), Will Daspit (Pacific States Marine Fisheries Commission), Patricia A. Cook (National Marine Fisheries Service), and the Oregon State University Hatfield Marine Science Center library staff were extremely helpful in locating and providing requested documents and data. Donald Gunderson and Brad Pattie (Washington Department of Fish and Wildlife) located additional documents which added to the completeness of the document. Donald Gunderson, Jack Tagart, Jim Golden, and Dan Ito (National Marine Fisheries Service, Alaska Fisheries Science Center) also kindly searched their files and memories to provide information on previous methods of foreign catch allocation. Joe Pennisi (Royal Seafood), Richard Parrish (National Marine Fisheries Service, Pacific Fisheries Environmental Laboratory), Bert Larkins, S. J. Westheim, Gordon White, and Brad Pattie took time to tell me their personal observations on the early foreign fisheries. Jim Ianelli and Ric Brodeur (National Marine Fisheries Service, Northwest Fisheries Science Center) provided access to the Soviet Union survey data. Cid Hughes (contractor for MES, Inc.) helped edit and format the document for publication. Tonya Ramsey (National Marine Fisheries Service, Northwest Fisheries Science Center) supplied the INPFC area map.

INTRODUCTION

Accurate assessment of fish stock status is dependent upon accurate knowledge of historical catch. A stock is overfished if present spawning biomass is less than 25% of unfished spawning biomass (PFMC 2000). The unfished level and percentage decline can change if the amount of historical catch is altered (Rogers et al. 2000). Increasing historical catch estimates typically leads to higher stock assessment estimates of unfished biomass and may result in greater estimated declines in spawning biomass.

Substantial historical foreign catch occurred off the United States (U.S.) coasts of Washington, Oregon, and California (WOC) during 1966-76. Before October 1966, the U.S. had jurisdiction only within 3 nautical miles (nmi) of the coast (USBCF 1967). During the remainder of the period, U.S. jurisdiction was extended to 12 nmi (USBCF 1967). In the earliest years, the foreign fleets fished outside those boundaries with few restrictions. Agreements were made regarding closed areas and targeting (USBCF 1967, 1968; TSC 1969, 1971), but catch quotas were not instituted until 1973 (TSC 1973). In March of 1977, the Magnuson Fisheries Conservation and Management Act extended the jurisdiction to 200 nmi (INPFCa 1977).

Rockfish (both *Sebastes* and *Sebastolobus* in those years) were a major component of the foreign catch during 1966-76, but catches were not specified to species. Soviet fishermen did not separate rockfish catch until 1973 (Parks and Dark 1972, Parks 1974, Fraidenburg et al. 1977, INPFCa 1975), and then into two categories with unclear specifications (Larkins 1975, VNIRO 1978). Japan sorted into "Pacific ocean perch" (POP) versus "Other Rockfish" (Other) in all years. POP is a market term that included unknown amounts of species other than Pacific ocean perch (P.o.p.) (INPFCa 1974, Westrheim et al. 1972) (See Table 1 for scientific names of species referred to in this document).

Foreign catch before 1977 has been included in only four WOC rockfish stock assessments, with estimates for only Columbia INPFC area and the U.S. portion of the Vancouver International North Pacific Fisheries Commission Statistical Area (INPFC area) (Figure 1). Those assessments are Pacific ocean perch (Ianelli et al. 2000) and canary (STAT 1999) in the Columbia and U.S. Vancouver INPFC areas, darkblotched coast-wide (Rogers et al. 2000), and yellowtail in the Eureka, Columbia, and S. Vancouver INPFC areas (lat. 49^0-$47^0$30'N) (Tagart et al. 2000).

The four assessments differed in method of allocation of foreign catch to INPFC area, year, and species. Pacific ocean perch, yellowtail, and canary estimates were adopted from earlier assessments of the species. Pacific ocean perch relied on estimates from Westrheim et al. (1972), Gunderson et al. (1977), and Fraidenburg et al. (1978). Allocations to the U.S. portion of the Vancouver INPFC area were from Ianelli et al. (1992). Yellowtail relied on Tagart (1988), while canary used estimates from Golden and Demory (1984), with allocations to the U.S. portion of the Vancouver INPFC area from Sampson and Stewart (1994). Darkblotched estimates were 10% of Pacific ocean perch estimates (Rogers et al. 2000).

It is important that allocation of foreign catch to individual rockfish be completed in a consistent manner. This would ensure that all foreign catch is allocated, yet the same catch is not allocated to more than one species. The darkblotched assessment review panel (STAR 2000) recommended development of a commonly agreed upon methodology. They also suggested utilizing rockfish species compositions from recently available Soviet survey data from 1965-76.

Table 1. Common and scientific names for species mentioned in this document. Although presently *Sebastes* are rockfish and *Sebastolobus* are thornyheads, we referred to both as rockfish, as was done in 1965-77. For those Genus, only the first part of the common name is used in the document. Assemblage designations for rockfish are according to PFMC (2000).[a]

Common Name		Genus	Species	Assemblage
black	rockfish	*Sebastes*	*melanops*	nearshore
blue	rockfish	*Sebastes*	*mystinus*	nearshore
brown	rockfish	*Sebastes*	*auriculatus*	nearshore
olive	rockfish	*Sebastes*	*serranoides*	nearshore
quillback	rockfish	*Sebastes*	*maliger*	nearshore
copper	rockfish	*Sebastes*	*caurinus*	nearshore (north) shelf (south)
bocaccio	rockfish	*Sebastes*	*paucispinis*	shelf
canary	rockfish	*Sebastes*	*pinniger*	shelf
chameleon	rockfish	*Sebastes*	*phillipsi*	shelf
chilipepper	rockfish	*Sebastes*	*goodei*	shelf[b] (south)
cowcod	rockfish	*Sebastes*	*levis*	shelf (north)
flag	rockfish	*Sebastes*	*rubrivinctus*	shelf
greenblotched	rockfish	*Sebastes*	*rosenblatti*	shelf
greenspotted	rockfish	*Sebastes*	*chlorostictus*	shelf
greenstriped	rockfish	*Sebastes*	*elongatus*	shelf
halfbanded	rockfish	*Sebastes*	*semicinctus*	shelf
pink	rockfish	*Sebastes*	*eos*	shelf
pinkrose	rockfish	*Sebastes*	*simulator*	shelf
pygmy	rockfish	*Sebastes*	*wilsoni*	shelf
redbanded	rockfish	*Sebastes*	*babcocki*	shelf
redstripe	rockfish	*Sebastes*	*proriger*	shelf
rosethorn	rockfish	*Sebastes*	*helvomaculatus*	shelf
rosy	rockfish	*Sebastes*	*rosaceus*	shelf
shortbelly	rockfish	*Sebastes*	*jordani*	shelf
silvergray	rockfish	*Sebastes*	*brevispinis*	shelf (north)
speckled	rockfish	*Sebastes*	*ovalis*	shelf
starry	rockfish	*Sebastes*	*constellatus*	shelf
stripetail	rockfish	*Sebastes*	*saxicola*	shelf
tiger	rockfish	*Sebastes*	*nigrocinctus*	shelf
vermilion	rockfish	*Sebastes*	*miniatus*	shelf
yelloweye	rockfish	*Sebastes*	*ruberrimus*	shelf
yellowtail	rockfish	*Sebastes*	*flavidus*	shelf[b]
widow	rockfish	*Sebastes*	*entomelas*	shelf[b]

Table 1. Common and scientific names for species mentioned in this document. Although presently *Sebastes* are rockfish and *Sebastolobus* are thornyheads, we referred to both as rockfish, as was done in 1965-77. For those Genus, only the first part of the common name is used in the document. Assemblage designations for rockfish are according to PFMC (2000).[a] Continued.

Common Name		Genus	Species	Assemblage
bank	rockfish	*Sebastes*	*rufus*	shelf (south) slope (north)
aurora	rockfish	*Sebastes*	*aurora*	slope
blackgill	rockfish	*Sebastes*	*melanostomus*	slope
darkblotched	rockfish	*Sebastes*	*crameri*	slope
Pacific ocean perch (P.o.p.)	rockfish	*Sebastes*	*alutus*	slope[b] (north)
rougheye	rockfish	*Sebastes*	*aleutianus*	slope
sharpchin	rockfish	*Sebastes*	*zacentrus*	slope
shortraker	rockfish	*Sebastes*	*borealis*	slope
splitnose	rockfish	*Sebastes*	*diploproa*	slope
yellowmouth	rockfish	*Sebastes*	*reedi*	slope
dusky	rockfish	*Sebastes*	*ciliatus*	unknown
harlequin	rockfish	*Sebastes*	*variegatus*	unknown
northern	rockfish	*Sebastes*	*polyspinis*	unknown
longspine	thornyhead	*Sebastolobus*	*altivelis*	deepwater
shortspine	thornyhead	*Sebastolobus*	*alascanus*	deepwater
Dover sole		*Microstomus*	*pacificus*	deepwater
sablefish		*Anoplopoma*	*fimbria*	deepwater
Pacific hake		*Merluccius*	*productus*	midwater

[a] A "north" assemblage is in Eureka, Columbia, and U.S. Vancouver INPFC areas, "south" is Monterey and Conception INPFC areas.

[b] The species may also be caught in midwater as bycatch from targeting Pacific hake.

Figure 1. Map of INPFC areas off Washington, Oregon and California, United States. Areas referred to in this document are often shortened to: Washington, Oregon, and California = WOC; Washington and Oregon = WO; Washington = W; Oregon = O; California = C; Conception INPFC = CON; Monterey INPFC = MON; Eureka INPFC = EUR; Columbia INPFC = COL; U.S. Vancouver = UVAN (no British Columbia); entire Vancouver = VAN (includes part of British Columbia).

Allocation could be made based on knowledge of fishing strategies and the resulting species in the catch (assemblages). Rockfish species separate based on bottom depth, depth in the water column, and latitude (Eschmeyer et al. 1983). Different target species therefore lead to different fishing strategies, which in turn lead to different species in the catch, including both targeted and not targeted (incidental) species (Rogers 1994).

The specific objective of this document was to use information on fishing strategies and assemblages to allocate all WOC foreign rockfish catch in 1965-76 to species by year and INPFC area. Catch allocation involved: 1) selection and estimation of WOC rockfish foreign catch for 1965-76 by INPFC area, year, and reporting category; 2) definition of fishing strategies/catch assemblages; 3) partition of catch by fishing strategy/ catch assemblage; and 4) application of assemblage species proportions to assemblage catch in each area and year. After completing the allocation, it was compared to those done previously in stock assessments. Additionally, it was discovered that there was no foreign catch in these areas in 1965, so the data in this document covers 1966-76.

INPFC areas referred to in this document are often shortened in tables and figures as follows: Washington, Oregon, and California = WOC; Washington and Oregon = WO; Washington = W; Oregon = O; California = C; Conception INPFC = CON; Monterey INPFC = MON; Eureka INPFC = EUR; Columbia INPFC = COL; U.S. Vancouver = UVAN; entire Vancouver = VAN.

METHODS AND RESULTS

Combined methods and results were presented separately for each allocation step and the final comparison with past estimates. A summary is provided at the beginning of each step, referring to tables and figures with final results, as well as decisions involved and their potential consequences. Decisions and calculations required were often complex and specific to each country, so each summary is followed by detailed information. This detailed information refers to tables and figures placed in separate appendices for each step. Those appendix tables include intermediate worksheets leading to the final results and data summaries for difficult-to-obtain literature.

Step 1. Catch by Area, Year, and Category

Summary

In step one, catch was allocated by INPFC area, calendar year, and reporting category. Catch estimates during 1966-76 were available in the literature for the Soviet Union (1966-76), Japan (1966-76), Poland (1973-76), Republic of Korea (1975-76), Bulgaria (1976), and East Germany (1976). International North Pacific Fisheries Commission Proceedings and documents were the primary source of information. Other sources included United States Bureau of Commercial Fisheries, Reports of the Technical Sub-Committee of the International Trawl Fishery Committee Regulations (re-named Technical Sub-Committee of the International Groundfish Committee in 1972), and International North Pacific Fisheries Commission Statistical Yearbooks.

Utilizing available catch estimates involved several decisions (Table 2). Original catch reports from foreign countries were not always available, and sources citing them did not always agree. Sources also disagreed on how to allocate reported catches to INPFC area and calendar year. Estimates for the U.S. Vancouver INPFC area were not available in literature, so they had to be calculated from combined U.S. and Canadian Vancouver INPFC area catch. Details of the calculations varied by country, but for all countries except the Republic of Korea, U.S. Vancouver INPFC area catch in 1975-76 was assumed to be zero. Foreign trawling was prohibited in that area in those years (TSC 1976).

Resulting catch used for allocation to fishing strategy/species assemblage is in Table 3. Most rockfish catch occurred in 1966-68 in Columbia and Monterey INPFC areas (Figure 2). The Soviet Union caught most of the fish (Figure 3).

Details

Soviet Union

Soviet Union catch decisions greatly influenced total foreign catch (Table 2). Catch reports written by the Soviet Union were available only for 1974-76 (Soviet Union unpubl. data, VNIRO 1978) (Table A-1). In those years, they used market categories “Rockfishes” (Rockfish) versus “Other Rockfishes” (Other). Original reports were not available for 1973, but sources

reported sorting into Other versus POP (Fraidenburg et al. 1977, Parks 1975). Sources cited in Table A-1 assigned various names to pre-1973 unsorted rockfish and the 1974-76 "Rockfishes" category. Rockfish is the term used for those catches, regardless of names used in the citations. Catch estimates were matched when necessary.

The Soviet Union reported catch by INPFC area only for 1973 (Parks 1975), 1975, and 1976 (VNIRO 1978). Except for 1966-68, differences among catch estimates in Table A-1 in Appendix A were based on method of INPFC area allocation.

1966-68 Catches—Catch estimates for 1966 were available from only a few sources and had a wide range (Table A-1). WOC estimates were either 40,000-50,000 t (Forrester et al. 1978, Canada 1969) or about 10,000 t (TSC 1967, INPFCa 1969, FAJ 1973, USBCF 1968). USBCF (1968) stated the 10,000 t came only from Washington and Oregon. There were also inconsistencies in the citations. INPFCa (1969) reported 10,000 t, yet cited Canada (1969), which actually had a 50,000 t estimate. Forrester et al. (1978) stated Soviet "catches in the Columbia-to-Charlotte INPFC areas rose to 45,000 t in 1967," yet their 1966 estimate for those areas totaled 74,000 t.

Most sources consistently reported WOC estimates of 37,611 t in 1967 and 16,251 t in 1968 (Table A-1). The exceptions were the much lower 10,000 t in 1967 and 5,000 t in 1968 (Canada 1969, FAJ 1973).

To examine further the 1966-68 discrepancies, catch is estimated using information on effort and catch rates (Table A-2). (Summaries of citations utilized are in Tables C2-C5.) Effort was vessel days by vessel size category. Monthly average numbers of vessels sighted off WO in 1966-67 were taken from Hitz (1970). Monthly average number of vessels off California in 1966 and WO in 1968 were estimated from information in USBCF (1966, 1968). Effort directed specifically towards rockfish in 1966 was estimated from information in INPFCa (1966), USBCF (1966, 1967), Jewel et al. (1966) and Pattie (1966). The Soviet Union targeted both slope rockfish and Pacific hake in May and part of August 1966 (USBCF 1966). Sources varied on the amount of rockfish targeting in 1967 (INPFCa 1967, USBCF 1967). The maximum estimate is used: 1 January to 13 April 1967 (INPFCa 1967). In 1968, all effort during that period was considered rockfish-directed (USBCF 1968). Four estimated catch rates (t rockfish per trawl vessel day) were applied to the effort estimates (Table A-2). For all estimates, it is assumed the fleet fished every day. The estimated ranges were generally comparable to the range of estimates in literature.

Table 2. Summary of decisions made in deriving foreign catch estimates for 1966-76 off the coasts of Washington, Oregon, and California (WOC) by INPFC area and calendar year. Potential bias is the maximum amount the catch resulting from the decision is over or under the alternatives. Decisions are listed in order in which they were done and amount of bias may depend upon the earlier decisions. For U.S. Vancouver (UVAN) allocations, the bias is based on comparing allocating all or none of the Vancouver catch to the U.S. portion.

Country	Decision	Potential Bias	
		over (t)	under (t)
Soviet	1966-1968 catch estimates	69862	9000
	VAN-CON INPFC using vessel sighting and U.S. by subtracting for 1967-1972,1974	17127	54974
	1966 to INPFC based on vessel sightings	0	0
	No UVAN catch in 1975 and 1976	0	522
Japan	Fishing year to Calendar Year	800	977
	UVAN assuming POP catch distributes evenly in blocks E & F	2503	4091
	UVAN assuming Other Catch distributes evenly by effort in blocks E & F	1079	1722
	No UVAN catch in 1975 and 1976		7390
Poland	1973 WOC catch was an error		8
	UVAN in 1974 based on subtraction from WOC	26	6
	No UVAN catch in 1975 and 1976		16927
	Use INPFC estimates not WOC estimates in 1975		104
	"other species" do not include rockfish in 1976		260
R. of Korea	Select catch estimates		42
	No UVAN catch in 1975		34
	UVAN in 1976 based on subtraction from WOC	29	44
Bulgaria	No UVAN catch in 1976		38
E. Germany	No UVAN catch in 1976		42

Table 3. Step one results: Catch (t) by INPFC area and year for each country and reporting category. Catches in bold assumed to be all Pacific ocean perch.

Area	Country	Category	66	67	68	69	70	71	72	73	74	75	76
UVAN	Soviets	POP/rock*	7319	4172	1959	543	629	813	865	377	174	0	0
	Japan	POP		2478	1445	9	57	193	171	213	452	0	0
	Poland	POP									**26**		
	R. of Korea	POP											**29**
	Soviets	other								233	43		
	Japan	other			198	3	35	53	57	134	1330	0	0
	Total		7319	6650	3603	554	720	1059	1093	957	2024	0	29
COL	Soviets	POP/rock	27532	15637	4844	1699	1990	1649	957	539	1301	784	607
	Japan	POP		3850	4274	0	38	276	880	0	0	0	0
	Poland	POP									**94**	39	
	Bulgaria	POP											89
	E. Germany	POP											95
	R. of Korea	POP											**84**
	Soviets	other								2532	57	9	19
	Japan	other			460	0	31	29	558	1480	0	195	190
	Poland	other/rock										780	247
	Bulgaria	other											3
	E. Germany	other											3
	Total		27532	19487	9578	1699	2059	1954	2395	4551	1452	1807	1337

* "/" indicates "or"

Table 3. Step one results: Catch (t) by INPFC area and year for each country and reporting category. Catches in bold assumed to be all Pacific ocean perch. Continued.

Area	Country	Category	66	67	68	69	70	71	72	73	74	75	76
EUR	Soviets	POP/rock	0	36	4549	21	2	0	258	83	373	201	263
	Japan	POP		59	181	0	2	0	80	433	0	0	0
	Bulgaria	POP											41
	East Germany	POP											44
	R. of Korea	POP											**70**
	Soviets	other	0	0	0	0	0	0	0	708	7	3	9
	Japan	other			147	0	0	0	12	1409	119	15	1
	Poland	other/rock										577	157
	Bulgaria	other											1
	East Germany	other											2
	Total		0	95	4877	21	4	0	350	2633	499	796	588
MON	Soviets	POP/rock	6150	17766	4899	360	0	0	129	19	569	15	35
	Japan	POP		0	1	29	23	0	0	139	0	0	0
	Bulgaria	POP											7
	R. of Korea	POP											22
	Soviets	other	0	0	0	0	0	0	0	2234	12	1002	1461
	Japan	other			4	0	0	0	0	1015	5322	868	685
	Poland	other/rock										1138	23
	Bulgaria	other											229
	East Germany	other											246
	Total		6150	17766	4904	389	23	0	129	3407	5903	3023	2708
CON	Japan	POP		0	0	0	0	0	0	0	12	0	0
	R. of Korea	POP											3
	Japan	other				0	0	0	0	484	57	0	0
	Total		0	0	0	0	0	0	0	484	69	0	3

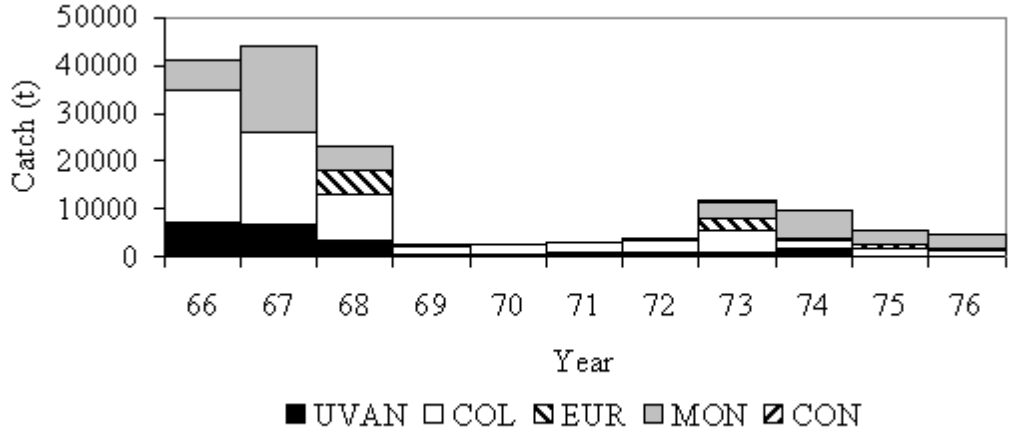

Figure 2. Foreign catch off Washington, Oregon, and California by INPFC area.

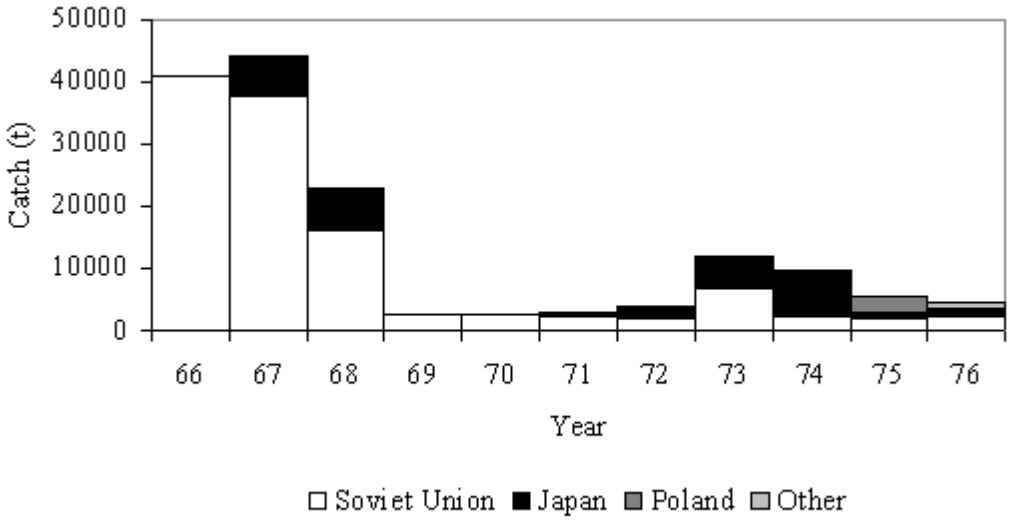

Figure 3. Foreign catch off Washington, Oregon, and California by country.

Two rockfish catch rates (high and low) were derived by applying a range of vessel-size catch ratios to April 1966 vessel and catch estimates. In April 1966, U.S. Bureau of Commercial Fisheries estimated the Soviet fleet of 22 medium and 7 large vessels caught less than 450-855 t per day (USBCF 1966). Large vessels were variously estimated to catch 2.6 (Ketchen 1980), 3.2 (Bailey et al 1982), 2-6 (Polutov et al. 1966), 5-6 (USBCF 1967), or up to 6-7 (USBCF 1968) times that of a medium vessel in the same time period. A low catch rate of 30 t per large vessel day was based on the assumption that in the April 1966 fleet, 2.6 medium vessels equaled 1 large vessel (15 large vessels = 22 medium vessels and 7 large vessels) and the fleet caught 450 t per day. A high catch rate of 85 t per large vessel day was based on the assumption that in the April 1966 fleet, 7 medium vessels equaled 1 large vessel (10 large vessels = 22 medium vessels and 7 large vessels) and the fleet caught 855 t per day. For 1967 and 1968, those catch rates were reduced by 67% and 35% respectively, using reductions in domestic P.o.p. catch rates (Westrheim et al. 1972).

The fleet would therefore have the equivalent of 10-15 large vessels

$$(7 + [22/7] \text{ to } 7 + [22/2.6]),$$

with large vessel catch per day of less than 30-85 t (<450/15 to 855/10).

The other two catch rates were for Soviet fleets fishing off Canada and Alaska. One was 1966-68 information provided by Ketchen (1980) for British Columbia, Canada. He estimated that all vessels made four tows per day, and provided rockfish catch per tow by calendar quarter, year, and vessel size. The other was average Soviet catch per month and vessel size off Alaska in 1964 (one year after the fleet arrived) (Polutov et al. 1966). Those estimates are used only for 1967, one year after the fleet began fishing WOC.

After considering all information, higher estimates were selected for all three years. The high estimates for 1967 and 1968 were chosen because they were found in the majority of literature. The calculations indicate 1968 may be overestimated (Table A-2), but they did not include incidental rockfish caught while targeting Pacific hake. For 1966, 41,000 t was used, rather than the 10,000 t or 50,000 t alternatives. The selected estimate was intermediate in the calculations, while the minimum calculation was twice 10,000 t (Table A-2). The 41,000 t also came from Forrester et al. (1978), who was one of the sources of selected 1967 and 1968 estimates.

Allocation to INPFC area—When the Soviet Union did not report by INPFC area, they used state or province boundaries. In 1966-72, they reported by larger statistical areas (Parks and Dark 1972, Parks 1974). In most, if not all of those years, they reported by WO versus California. The area to the north was British Columbia (BC). In 1974, they reported catch by U.S. state boundary (Soviet Union unpubl. data, Parks 1976).

The boundary between their WO- and BC-reported catches is unclear (Figure A-1). In describing Soviet Union reporting areas for 1967-70, Parks and Dark (1972) presented a 1971 map with the boundary at $48^{0}30'$N. A table of 1967-73 Soviet Union catch "as reported by the Soviet Union to the U.S." also placed the boundary at $48^{0}30'$N (INPFCa 1975). That table cited Larkins (1975), but actually used only his 1973 estimate (Table A-1). Larkins (1975) presented a combined table for all nations, with the boundary specified as $47^{0}30'$N. Ketchen (1977, 1980) stated the boundary changed from year to year, but inconsistently described the changes. Ketchen (1977) placed it at $48^{0}30'$N in 1968, 1971, and 1972, between PFMC Areas 3C and 3B (Figure A-1) in 1969 and 1970, and $47^{0}30'$N in 1974 and 1975. Ketchen (1980) said the 1968-69 boundary was $47^{0}30'$N (which he equated with the bottom of PFMC Area 3B). Tables in Ketchen (1980) placed the 1968-72 boundary between PFMC Areas 3C and 3B.

One way of allocating Soviet Union catches to INPFC area was to place WO catch in the Columbia INPFC area and part or all of BC catch in the Vancouver INPFC area. This would be accurate if the Soviet Union used $47^{0}30'$N as the boundary between WO and BC (Figure A-1). Forrester et al. (1983) placed WO in the Columbia INPFC area for 1971, 1972, and 1974, and stated BC was Vancouver and Charlotte INPFC areas combined (Table A-1).

An alternative method was based on U.S. and Canadian vessel sighting reports (Parks and Dark 1972, U.S. 1973, Parks 1974, Parks 1975, Parks 1976). This was available for 1967-72 and 1974. Catch per INPFC area and month was calculated by multiplying quarterly catch as reported by the Soviet Union by proportions of fishing vessels sighted in each INPFC area within the reporting area (Parks and Dark 1972). Assuming correct information on Soviet Union reporting area boundaries, this method would adjust for any yearly boundary changes. Columbia INPFC area catch was always less than WO catch, while Vancouver INPFC area catch was often more than BC catch (Table A-1).

The vessel-sighting method of allocation to INPFC area was selected. It provided the only allocations for Conception-to-Eureka INPFC areas. In addition, the 1967 and 1968 catch calculations in Table A-2 indicate the boundary between WO and BC was above $47^{0}30'$N. The calculations for WO included vessels sighted in the U.S. Vancouver INPFC area, yet only the 1968 high estimate exceeded the selected literature estimates for WO. If the Soviet Union had included only Columbia INPFC area catch in WO, the catch estimates would logically have been greater than their reports.

The U.S. portion of the Vancouver INPFC area was calculated for 1967-72 and 1974 by subtracting Conception-to-Columbia INPFC areas catch from WOC catch estimates (Table A-3). For 1973, the 1972 and 1974 average percent U.S. was used. This method assumed the vessel sighting allocations to INPFC area were accurate and the Soviet Union boundary between WO and BC was the U.S.-Canadian border (Figure A-1). U.S. Vancouver INPFC area catch was estimated at 25-99% (59% average) of the total Vancouver INPFC area catch, and 50% of the Washington catch.

The method of allocating to INPFC area and calculating the U.S. Vancouver portion could have led to either over or under-estimation of total catch in 1967-74 (Table 2). If the Soviet Union reported WO catch using a $48^{0}30'$N cutoff and the vessel sighting method was correct, some U.S. Vancouver INPFC area catch in 1967-72 and 1974 may have occurred in Canada (Figure A-1). If the reporting border was $47^{0}30'$N, catch was underestimated.

Since 1966 catch was available only for WOC combined, vessel sightings were used to allocate it to INPFC area. December catch was solely from Monterey (USBCF 1967). The low estimate and Ketchen's estimate in Table A-2 indicated 15% of the 1966 catch occurred in December. Monterey INPFC area catch was therefore estimated at 6150 t (15% of 41,000 t WOC catch). Maps of vessel locations off the coasts of Oregon and Washington were not substantially different in 1966 and 1967 (Hitz 1970), so remaining 1966 catch was placed in the U.S. Vancouver and Columbia INPFC areas using 1967 percentages, 21% and 79% respectively.

Japan

Catch reports written by Japan were available for almost all years and market categories (Takahashi 1968, FAJ 1969-70, Yamaguchi 1971-76, Sasaki 1977) (Table A-4). All sources consistently reported catch by two market categories: Other and POP.

Japanese catch decisions had less effect than Soviet Union decisions on total foreign rockfish catch (Table 2). Japan almost always reported by INPFC area rather than state boundaries. POP catch and trawl hours in 1^0 longitude by 0.5^0 latitude blocks were also available, aiding allocation to the U.S. portion of the Vancouver INPFC area. Yearly information, however, was presented in terms of fishing year (1 November to 31 October) rather than calendar year.

Allocation to calendar year—Sources had two ways of allocating catch from fishing year to calendar year. One was to assign all catch to the later year (1 November 1966 - 31 October 1967 = 1967). This was done by Fraidenburg et al. (1977) and Canada (1969). Calendar year estimates were also derived by summing catch by month (Table A-5). Although only monthly reports for 1966-1968 (INPFCb 1967-69) could be located, yearly estimates from Forrester et al. (1978, 1983) and Larkins (1975) equaled the summed months for those years.

Although the summed monthly estimates were more accurate representations of calendar year, all fishing year catch was assigned to the later year. This was done to utilize the 1^0 longitude by 0.5^0 latitude block data, which were available only by fishing year. This choice may have under- or over-estimated the catch depending upon allocation of 1968 Other rockfish catch to INPFC area (Table 2).

Allocation to INPFC area—To allocate catch to the U.S. Vancouver INPFC area, catch and effort were assumed to be distributed evenly within the 1^0 longitude by 0.5^0 latitude reporting blocks. Based on area calculations, the U.S. Vancouver INPFC area included 63% of the long. 125-126^0W by lat. 48^0-48.5^0N block, 77% of the 126^0-127^0W by 47.5^0-48^0N block, 4% of the 126^0-127^0W by 48^0-48.5^0N block, and all 47.5^0-48^0N blocks less than 126^0W (Figure A-2). The U.S. Vancouver INPFC area catch of POP was calculated by applying those percentages to each block's catch and then totaling the catches (Table A-5). For Other rockfish, catch by block was not available, so trawling hours were used as a proxy for catch. The proportion of Vancouver INPFC area trawling hours spent in the U.S. zone was applied to Vancouver INPFC area catch estimates (Table A-5). Less than 42% POP and 40% Other was allocated to the U.S. portion.

Other rockfish in 1968 had to be allocated to INPFC area. Catch was only available for WOC rather than INPFC area (Fraidenburg et al. 1977). Trawl effort (hours) in that year was 477 (24.5%) in U.S. Vancouver INPFC area (Table A-6), 1106 (56.8%) in Columbia INPFC area, 355 (18.2%) in Eureka INPFC area and 9 (0.5%) in Monterey INPFC area (INPFCa 1969). Those percentages of trawl effort were applied to the total catch (810 t).

Poland

Catch estimates for Poland were available for 1973-76 (Table A-7). Decisions involved use of 1973 catch, allocation of 1974 catch to INPFC area, choice of catch in 1975, and disposition of "other species" catch in 1976 (Table 2). The 1973 P.o.p. catch (8 t) was not used. It was found in only one source (Murai et al. 1981) and was not included previously in P.o.p. assessments (Fraidenburg et al. 1978). In 1974, U.S. Vancouver catch (26 t) was calculated by subtracting Columbia INPFC area catch (94 t) (Fraidenburg et al. 1978) from WOC catch (120 t) (Murai et al.1981). P.o.p. estimates in Conception-to-Eureka INPFC areas were not available for 1975. They were assumed zero, but may have been 104 t. Total selected catch for 1975 was

2534 t (Table A-7). This was 104 t less than the 2638 t WOC estimate from Murai et al. (1981). For 1976, the lower range from Murai (unpubl. data a) was used. This was compatible with Murai et al. (1981). The upper estimate included "other species," which may or may not contain rockfish.

Bulgaria and East Germany

Only one source had Bulgarian and East German catch estimates (Table A-7). Gunderson (unpubl. data) derived POP and Other rockfish estimates by applying 1976 Soviet Union catch ratios (POP/ Pacific hake and Other rockfish/Pacific hake by INPFC area) to 1976 Bulgarian and East German Pacific hake catch. Those POP estimates for Vancouver and Columbia INPFC areas were utilized as P.o.p. by Fraidenburg et al. (1978). That methodology was used to derive the catch estimates, but ratios were based on Soviet Union catch selected for this document (details are presented in Table C-12).

Republic of Korea

Decisions for Republic of Korea catch were choice of estimates and allocation to the U.S. Vancouver INPFC area in 1976 (Table 2). Republic of Korea estimates by year and INPFC area were available only in handwritten notes (Murai unpubl. data b) (Table A-7), so those estimates were used. Estimates for combined Conception-to-Vancouver INPFC areas differed only slightly from WOC rockfish catch reported by Pruter (unpubl. data), Murai et al. (1981), and NMFS (1977). Republic of Korea rockfish catch in 1976 was from longline (Table A-7), so some may have occurred in the U.S. Vancouver INPFC area. The U.S. portion was calculated by subtracting Columbia and Eureka INPFC area catch from WOC catch (208 – 179 = 29 t).

Step 2. Defining Rockfish Fishing Strategies/Assemblages

Summary

Potential catch assemblages of rockfish species resulting from foreign fishing strategies were defined using three types of information. The first type was assemblage definitions used by U.S. fisheries managers (included in Table 1). The second type was species compositions from known fishing strategies employed in years as close to 1966-76 as possible. The third type was mutivariate analysis of Soviet Union survey catch data collected off WOC in 1966-76.

All three sources agreed that there were rockfish assemblages targeted in deeper versus shallow water and an assemblage caught incidentally while targeting Pacific hake. We will refer those assemblages as Slope (assemblage targeted in deeper water), Shelf (assemblage targeted in shallower water) and Hake Incidental (assemblage caught while targeting Pacific hake). The Soviet Union survey data and present definitions further indicated that species caught while targeting rockfish in shallower water in more southern areas were distinct from those caught while targeting rockfish in shallow water mainly in areas to the north. We refer to those as Southern Shelf (assemblage caught with that strategy) and Northern Shelf (assemblage caught with that strategy). Available species compositions from known strategies did not include data from California, so there was no information on a possible Southern Shelf assemblage. Current definitions also separated near-shore species from shelf species. The foreign fleet did not generally fish nearshore, so we did not define a separate nearshore assemblage. When catch of those species did occur, it was included in the shelf assemblages.

Details

Current Definitions

Strategies targeting rockfish using bottom trawls are presently believed to catch three assemblages: near-shore, shelf, and slope rockfish (Table 1, PFMC 2000). Shortspine and longspine are caught with sablefish and Dover sole using bottom trawls at slope depths. Those species are, however, sometimes caught with slope rockfish (Rogers and Pikitch 1992). Some shelf and slope rockfish species may also be caught in midwater fisheries. Widow are targeted in midwater with yellowtail caught incidentally (Tagart et al. 2000). Pacific hake are also targeted in midwater with incidental catches of widow, yellowtail, Pacific ocean perch (Dorn 1998), and chilipepper (Rogers and Bence 1992).

Known Strategies in Early Years

Assemblages caught in early years were consistent with current definitions (Tables B-1, B-2). Oregon and Washington commercial fisheries market categories in 1966-76 represented slope (POP) and shelf (Other) (Douglas 1998). The only difference from current species placement was that shortspine catch was included in slope rockfish and black in shelf rather than near-shore rockfish (Table B-1). Bottom trawl surveys investigating P.o.p. (a slope species) in 1965 (Westrheim 1967) and 1968-70 (Gunderson 1997) caught species compositions consistent with slope rockfish. The 1965 surveys, however, had shallower average bottom depth and caught higher proportions of shelf rockfish.

Two sources of known midwater Pacific hake targeting indicated about 1% rockfish to Pacific hake with yellowtail and widow the primary incidental rockfish species (Table B-2). One set of data was from the 1966-67 domestic Pacific hake fishery, which operated off northern Oregon and Washington (Nelson 1970). The other was from the foreign fishery in Eureka and Columbia INPFC areas after 1976 when pelagic gear was required (Edwards et al. 1981). Foreign trawling was restricted in U.S. Vancouver INPFC area and most of the Monterey INPFC area after 1975 (INPFCa 1975). In 1977, 10 tows were observed in the Monterey INPFC area, and there was no incidental catch of rockfish (French et al. 1978).

Two other sources provided coast-wide information, one using midwater gear with no specific target and the other targeting Pacific hake without a specific gear (Table B-2). Rockfish species caught in a 1977 midwater survey with a 3.2 cm (1.25 in) codend liner were mainly yellowtail and widow. In the Monterey INPFC area, however, shortbelly dominated (Dark et al. 1980). The Pacific hake joint-venture fishery began in 1978 and was not restricted in terms of gear, except possibly a minimum mesh size of about 5 cm (2 in) (TSC 1969). Fish were caught by U.S. fishermen and delivered at-sea to foreign vessels. The 1978-83 percentage of rockfish to Pacific hake was less than 2% and widow and yellowtail again dominated in the northern areas. Monterey INPFC area incidental rockfish catch was chilipepper and bocaccio, however only a small amount was caught.

Soviet Survey Data

To supplement information on known strategies, Soviet survey data collected during 1966-76 was analyzed. As mentioned, the darkblotched assessment review panel requested this data be examined to help allocate foreign catch to species (STAR 2000). The principal mission of the survey was to investigate fishery resources off U.S. and Mexican coasts for future Soviet exploitation (USBCF 1966). Soviet research vessels also sometimes accompanied the fishing fleet to locate schools of fish (USBCF 1966, 1967). Survey assemblages may therefore give an indication of foreign fleet commercial strategies. The survey was, however, not subject to

commercial fleet regulations (offshore distance, mesh size, closed areas, etc.) (USBCF 1966). The survey used "flare" bottom trawls with codend mesh of 2 cm (0.8 in) and vertical opening of 6-8 m (Ermakov and Stepanenko 1996).

Catch weight of rockfish species and Pacific hake in individual hauls was used to define groups of species which were consistently caught together. Information available was either catch weight, catch number, or both. When both were available, the average weight for each species (Table B-3) was calculated. When only numbers were available, average weight was multiplied by number to estimate species weight. Species that averaged less than 2% of catch weight or were in less than 2% of tows were not included in the multivariate analyses, because rarely occurring species can distort such analyses. All species, however, were used to compare tows after they were grouped together.

Multivariate techniques were group average clustering (Sneath and Sokal 1973) of a Bray-Curtis dissimilarity index (Bray and Curtis 1957) and detrended correspondence analysis (DCA) (Hill 1979). Those techniques have been used to define species assemblages in more recent catch data (Rogers and Pikitch 1992). Many small clusters of tows split off at very high levels of dissimilarity. To achieve a few clusters which could represent assemblages, clusters were selected at different levels (Table B-4). Assemblages were defined using four clusters with the most tows: Slope (cluster A), Hake Incidental (cluster B), South Shelf (cluster C), and North Shelf (cluster F). The South Shelf assemblage was more similar to the Hake Incidental assemblage than to the North Shelf assemblage, so the two shelf groups could not be combined. The names were based on dominant species, tow locations, bottom depth, and distance the gear was above bottom (Table B-4). Those four groups contained 92% of the 4301 tows. DCA ordination analyses were consistent with separation of the species dominating those four assemblages (Figure B-1). The first axis separated Slope versus shelf species. The second axis separated South Shelf versus North Shelf species.

Step 3. Catch Allocation to Fishing Strategies/Assemblages

Summary

Strategies were described and reporting categories considered as a proxy for catch assemblage. Descriptions for each country were based on regulations, overflight surveillance and other observations, and catch ratios of rockfish to Pacific hake. Regulations were primarily available in Technical sub-committee of the International Trawl Fishery Committee (TSC). Original U.S.-Canadian surveillance reports on locations of vessels and observed catches were available only for Washington from small vessels in 1966 (Jewell et al. 1966, Pattie 1966) and overflights in 1967-68 (WSFD unpubl. data). Secondary sources for 1966-68 surveillance were available in USBCF and INPFCa publications and in Hitz (1970). For rockfish-to-Pacific-hake catch ratios, Pacific hake catches were selected and calculated similarly to rockfish catch (see catch section above).

Allocation was not always clear-cut. Ratios of Pacific-hake-to-rockfish in commercial catches and ratios of assemblage catches in Soviet Union surveys were both utilized. Decisions made are summarized in Table 4. Allocations were made using two methods for all countries except Japan. The first method allocated 11% to Hake Incidental, 21% to Shelf, and 68% to Slope for all years and INPFC areas combined. The second method allocated 37% to Hake Incidental, 31% to Shelf assemblages, and 32% to Slope assemblages. Actual percentages were likely intermediate between the two methods presented in Table 5.

Table 4. Decisions and assumptions made in allocating foreign rockfish catch to species.

Soviet Union, Poland, Bulgaria, and East Germany	
Method 1	1) Hake Incidental is 1% of hake catch for all areas and years
	2) Only Hake Incidental and Slope caught in EUR, COL, and UVAN
	3) MON survey ratio of Shelf to Slope (minus shortbelly, half-banded, and pygmy) applies to fleet
	4) Domestic landings are from only Shelf and Slope strategies
	5) Shelf and slope rockfish are not caught together
	6) Same mesh size used in domestic and foreign fleets
	7) Same discarding by domestic and foreign fleets
	8) Same areas and depths fished within each INPFC area
	9) Two time periods (1966-1971, 1972-1976) express trends over time for slope and shelf
	10) Flag in EUR is redbanded
	11) Unspecified rockfish distributes to shelf and slope based on ratios in domestic catch
Method 2	1) Hake Incidental % changes with INPFC and three time periods
	2) Four major Soviet Union surveys assemblages = commercial assemblages
	3) Three time periods (1966-1968, 1969-1970, 1971-1976) express trends over time
	4) Research vessels fished same depths and areas as commercial fleet
	5) Average weight per fish reasonable for missing survey values
	6) No discarding by foreign fleet
	7) Same mesh size used by survey and foreign fleets
	8) Black = yellowtail and blue = widow in survey data before 1970
	9) Flag in EUR-UVAN = redbanded
	10) Chilipepper in COL-UVAN is unidentified
Japan	
Method 3	1) Caught only Shelf and Slope
	2) POP = slope, Other = Shelf except Other in COL and UVAN in 1973-1976 = 1/2 Other and 1/2 POP
	3) Same mesh size used in domestic and foreign fleets
	4) Same discarding by domestic and foreign fleets
	5) Same areas and depths fished within each INPFC area
	6) Two time periods (1966-1971, 1972-1976) express trends over time in species percentages

Table 5. Step three results: Allocation of catch to assemblages (Assem.) by year and INPFC. Method 1 uses Method 1 for Soviet Union, Poland, Bulgaria, and East Germany and Method 3 for Japan. Method 2 uses Method 2 for Soviet Union, Poland, Bulgaria, and East Germany and Method 3 for Japan.

Assem.	Area	66	67	68	69	70	71	72	73	74	75	76
Method 1												
Hake Inc.*	UVAN	269	544	167	445	629	209	403	44	152	0	0
	COL	1011	1062	466	554	1077	1258	676	985	449	489	1020
	EUR	0	1	21	7	1	0	22	84	380	282	241
	MON	0	344	25	87	0	0	11	321	581	1190	571
Shelf	UVAN			198	3	35	53	57	67	665	0	0
	COL			460	0	31	29	558	740	0	98	96
	EUR			147	0	0	0	12	1409	119	15	1
	MON	3340	9461	2651	143	0	0	99	2637	5322	1678	1890
	CON			0	0	0	0	0	484	57	0	0
Slope	UVAN	7050	6105	3237	107	57	796	633	845	1182	0	0
	COL	26520	18425	8652	1145	951	667	1161	2826	909	1220	153
	EUR	0	94	4709	14	3	0	316	1140	0	499	276
	MON	2810	7961	2228	159	23	0	19	448	0	154	230
	CON		0	0	0	0	0	0	0	12	0	0

Table 5. Step three results: Allocation of catch to assemblages (Assem.) by year and INPFC. Method 1 uses Method 1 for Soviet Union, Poland, Bulgaria, and East Germany and Method 3 for Japan. Method 2 uses Method 2 for Soviet Union, Poland, Bulgaria, and East Germany and Method 3 for Japan. Continued.

Assem.	Area	66	67	68	69	70	71	72	73	74	75	76
Method 2												
Hake Inc.*	UVAN	1491	3018	927	543	629	300	577	64	217	0	0
	COL	6871	7215	3168	1672	1990	1141	613	893	407	443	1002
	EUR	0	16	316	9	1	0	6	21	97	72	61
	MON	0	17766	2084	360	0	0	11	302	550	1118	536
Shelf	UVAN	2975	589	726	3	35	325	209	356	665	0	0
	COL	8184	3336	1124	17	31	186	664	1413	294	458	119
	EUR	0	10	2229	9	1	0	132	1777	254	354	220
	MON	4719	0	2164	0	0	0	115	2911	5352	1876	2113
	CON	0	0	0	0	0	0	0	484	57	0	0
Slope	UVAN	2852	3042	1950	9	57	434	306	537	1117	0	0
	COL	12476	8936	5286	10	38	627	1118	2245	657	905	148
	EUR	0	69	2332	4	2	0	212	835	148	370	237
	MON	1431	0	656	29	23	0	3	194	1	29	41
	CON	0	0	0	0	0	0	0	0	12	0	0

* Hake Inc. = Hake Incidental.

Details

Soviet Union

Description of fishing strategies—As mentioned, early research data helped the Soviet Union develop commercially profitable fishing strategies. The commercial fleet began full-scale fishing off the U.S. West Coast in April 1966. It mainly targeted P.o.p. and other rockfish in greater than 100 fathom off Oregon (USBCF 1966, Table C-2). In late April, Soviet Union research vessels working with the fleet discovered large concentrations of Pacific hake (USBCF 1966). In May, the commercial fleet began to target that species (Hitz 1970), and from late May until October it was their primary target (INPFCa 1966). A 1967 Soviet Union report based on 1965-66 survey data recommended trawl fisheries targeting Pacific hake and slope species in 40^0-55^0N (Eureka INPFC area and north) (Novikov and Chernyi 1967). Recommended slope targets included P.o.p. (in the north), splitnose and darkblotched (in the south), sablefish, and Dover sole area-wide. The fleet first moved to California in December 1966, fishing off San Francisco (USBCF 1967). In May and June 1967, research vessels worked with the fleet in that same area (USBCF 1967).

Regulations progressively discouraged rockfish targeting after 1968 (Table C-1). Although Pacific hake was the primary Soviet Union target off WO in 1967 and 1968, slope rockfish were still targeted from January until the middle of April (INPFCa 1967, USBCF 1968, Tables C-3, C-5). During those months Pacific hake schools were completing an annual spawning migration to Southern California. Pacific hake post-spawning schools arrived off central California in early March in 1966-71, on their way to Oregon (Ermakov 1974). The Soviet Union also targeted rockfish off California before 1969. In December 1966, the fleet was in an area off central California where domestic fishermen caught rockfish (USBCF 1967). In 1967, rockfish were targeted off California either alone or with sablefish or Pacific hake (Table C-4). In 1969, the Soviet Union agreed to not target rockfish south of $48^0$10'N. They also agreed to not fish selected rockfish areas in Northern California to Washington with vessels greater than 33 m (110 ft) from 1 December - 14 April. The smallest Soviet Union fishing vessel was 29 m (95 ft) (Hitz 1968). Probably due to those regulations, the ratio of rockfish to Pacific hake dropped substantially after 1968 (Table C-6). Regulations in subsequent years progressively discouraged targeting rockfish in the U.S. Vancouver INPFC area (Table C-1).

Regulations also restricted inshore Soviet Union Pacific hake fishing strategies after 1966 (Table C-1). Although Pacific hake were first discovered in 100-200 fathom in April, in June and July 1966, most Pacific hake targeting was between the Columbia River and Grays Harbor, Washington inside 60 fathom (USBCF 1966, Table C-2). Pacific hake generally move inshore in June and July (Bailey et al. 1982) and form large schools close to shore off southern Washington (Nelson 1970). In October 1966, the U.S. took jurisdiction over the area within 12 nmi of the coast (USBCF 1967). In November, the Soviet Union agreed to fish only outside 12 nmi off WO (USBCF 1966), which generally falls between 30 and 100 fathom (Hitz 1970). In February 1967, they also agreed to not fish selected areas seaward of 12 nmi (USBCF 1968). One area was less than 60 fathom between the Columbia River and Grays Harbor (Nelson 1970). In July through November 1967, however, the Soviet Union still fished for Pacific hake in other areas as shallow as 37-60 fathom (WSFD unpubl. data, Table C-3).

As rockfish targeting was discouraged and inshore fishing was restricted, midwater gear usage may have increased. Catch rates of Pacific hake are generally much higher using midwater than bottom trawls (Hipkins 1967). In the early years, there was evidence that the Soviet Union targeted Pacific hake on-bottom with rockfish. In 1966 off Oregon and Washington, species specific to the shelf assemblage (canary and greenstripe) were noted with Pacific hake catches (Table C-2). Nelson and Larkins (1970) stated that on the shelf, Pacific hake generally form large post-spawning feeding schools in daytime just off-bottom (within 10 fathom of the bottom). Over the slope, the schools are more off-bottom (Nelson and Larkins 1970). Off Monterey

before 1969, Pacific hake and rockfish were targeted together (Tables C- 4, C-5). The high percentage of rockfish to Pacific hake in Monterey and Eureka INPFC areas in 1967 and 1968 (34-333%) and the April-May timing of the Pacific hake catch (Table C-4) indicates the fleet may not have been targeting off-bottom post-spawning schools.

Actual observations of midwater versus bottom trawling were limited. The first midwater trawling (using pairs of medium vessels) was observed by overflight surveillance at the end of June 1966 (USBCF 1966). Single vessels may also have towed in midwater, but this would not be evident from the air. Pair trawling was said to increase in 1967, but in 1968 medium vessels began to be replaced by large vessels. Although pair trawls caught up to 90 t (100 tons) in a tow (USBCF 1966), large vessels had processing plants on board, reducing the need for support vessels. By August of 1968, large stern trawlers working alone were catching up to 36 t of Pacific hake in a single tow. In 1974-76, Canadian observers reported Soviets fished off-bottom (INPFCa 1977). Ermakov and Stepanenko (1996) stated on-bottom trawls were the main fishing gear for foreign fishermen until they were prohibited in 1971. Available information on Soviet Union-U.S. agreements, however, first mentioned that prohibition in 1977 (Table C-1).

Mesh size used by the Soviet fleet appeared to be relatively small for commercial gear but larger than in their survey mesh. In 1966, a vessel catching Pacific hake and some canary off Washington was noted with 5 cm (2 in) codend mesh (Jewell et al. 1966). In 1967, Soviets were noted catching rockfish and Pacific hake with 5-8 cm (2-3 in) codend mesh in the Monterey INPFC area (USBCF 1967). In 1968, sablefish and Pacific hake were caught with 9-10 cm (3.5-4 in) mesh in the Eureka INPFC area (USBCF 1968). In November 1968, the Soviet Union agreed to a minimum mesh size of 6-7 cm (2.4-2.8 in) (Table C-1).

Reporting categories—Soviet Union reporting categories were of limited use in allocating to catch assemblage. As mentioned earlier, catch was not divided until 1973. Subsequent divisions were unclear. The All-Union Research Institute of Marine Fisheries and Oceanography (VNIRO) in Moscow said "Rockfishes" in 1974 was P.o.p., while Other was yellowtail, redstripe, splitnose, darkblotched, widow, and silvergray (Larkins unpubl. data). Larkins questioned this because it seemed unlikely 871 t of P.o.p. was caught off California with only 19 t of other species. Comparing 1973 POP to 1974-76 Rockfish indicates the categories were not equivalent. POP was 17% of the total rockfish catch in the Columbia INPFC area and 10% in the Eureka INPFC area. Rockfish in 1974-76 was 96-99% of the catch in both areas (Table 3). VNIRO later also appeared unsure of the sorting, reporting 1975-76 catch as "Other Rockfish" versus "Rockfish (P.O.P.?)" (VNIRO 1978). (It is not known whether P.o.p. as used by the Soviets was a category or a species). Forrester et al. (1983) and Fraidenburg et al. (1977), however, assigned Rockfish to P.o.p. in 1974-76.

Allocation methods—After considering the above information on fishing strategies, two methods of allocating catch to assemblage were derived. One method was based mainly on commercial strategy information, including Soviet Union targeting from the literature descriptions and rockfish-to-Pacific-hake ratios in known commercial Pacific hake strategies. The other method relied on Soviet Union survey ratios of Pacific hake to rockfish and assemblage catch ratios.

Method 1—For Method 1, Hake Incidental was allocated 1% of Soviet Union Pacific hake catch in each year and INPFC area (Table C-6). The range of known commercial percentages was 0.2-1.7% (Table B-2). Percentages higher than 1% often exceeded total rockfish catch. Any remaining rockfish catch in Eureka-U.S. Vancouver INPFC areas was allocated to Slope.

For the Monterey INPFC area, where it was less clear which rockfish species were targeted, the remainder was allocated to Shelf and Slope using Soviet Union survey data. Survey vessels were noted working with the fleet in the Monterey INPFC area in 1967, the year of

greatest catch. Since Soviet Union commercial mesh size was larger than their survey mesh, the smallest bodied-species (shortbelly, half-banded, and pygmy [Table B-3]) were excluded in computing the ratio. Mesh size of 4.5" (11 cm) does not catch shortbelly (Lenarz 1980). To compute the ratio, Northern and Southern Shelf catch were combined into Shelf. Ratios were calculated for three time periods: 1966-68, 1969-70, and 1971-76. Those periods reduced year-to-year variation from limited samples (Table C-7), yet allowed changes in strategy (rockfish targeting in 1966-68, midwater gear possibly required after 1970). The result was about one-half Shelf and one-half Slope in 1966-67, which appeared reasonable. They were noted fishing in 100-150 fathom (Tables C-2, C-4) and Southern Shelf averaged 95 fathom (Table B-4).

Method 1 rules were:

1. 1% of the Pacific hake catch by year and INPFC area = Hake Incidental;
2. For U.S. Vancouver, Columbia, and Eureka INPFC areas:
   remaining rockfish catch = Slope;
   For Monterey INPFC area:
   remaining rockfish catch is allocated to Slope or Shelf by survey proportions of large-bodied rockfish species during three time periods.

Method 2—While the first method seemed reasonable, it didn't account for several observations in the literature. There were possible changes in Pacific hake targeting over time or by INPFC area. Shelf assemblage catches were noted in catches north of the Monterey INPFC area. Finally, Soviet fleet mesh nets of 5-8 cm (2-3 in) probably caught some smaller-bodied species in the Monterey INPFC area.

To see if Soviet Union survey data could be used to further allocate fleet catch to fishing strategy/assemblage, comparisons were conducted. Rockfish-to-Pacific-hake survey catch ratios were compared to those for the fleet by year and INPFC area (Table C-8). Rockfish catches were similarly distributed across time except that the survey had large catches of rockfish in the Monterey INPFC area in 1974 (mainly shortbelly), while the Soviet Union commercial fleet did not. Pacific hake catches were not similarly distributed. Fleet Pacific hake catch was more evenly distributed over time (Table C-8). The survey had overall higher ratios of rockfish to Pacific hake than the fleet, but Pacific hake survey catch increased in 1975-76, with a higher proportion of tows in Hake Incidental. A higher proportion of Pacific hake catch was also made in Hake Incidental over time, especially in Monterey and Eureka INPFC areas (top of Figure C-1).

Changes also occurred within the survey Hake Incidental assemblage by year and INPFC area. Those changes may be associated with increased fleet targeting of Monterey INPFC area post-spawning schools after 1968 and increased use of midwater gear over time. The percentage of Pacific hake to rockfish in that assemblage generally dropped over time (bottom of Figure C-1). This was especially true in the Monterey INPFC area. Gear depth above bottom tended to rise over time, although information was often missing (bottom of Figure C-1).

Method 2 used information on survey changes within Hake Incidental over time and INPFC area, but not the proportion of survey catch in Hake Incidental. The same three time periods as in Method 1 were used (1966-68, 1969-70, and 1971-76). Soviet Union fleet catch of Pacific hake by period and INPFC area was multiplied by corresponding percentages of rockfish to Pacific hake in survey Hake Incidental tows (Table C-9). Those percentages were greater than or less than 1%, depending upon the area and period. Any remaining catch was allocated to Slope, South Shelf, and North Shelf assemblages, based on their proportions in the survey data.

Method 2 rules were:

1. Pacific hake catch multiplied by percentage rockfish/Pacific hake in survey Hake Incidental assemblage by INPFC area during three time periods = Hake Incidental;
2. Remaining rockfish catch is allocated to Slope, Northern Shelf, and Southern Shelf based on survey ratios by INPFC area during three time periods.

Actual assemblage designation probably falls between the two estimates. Figure C-2 compares catch allocation to assemblage from the two methods as well as using survey proportions by year without adjustment. Although the Soviet Union caught some shelf species in the Columbia and U.S. Vancouver INPFC areas, shelf catch in adjusted survey assemblages was high given the fleet was targeting mainly slope rockfish and Pacific hake. Soviet Union fleet mesh size (5-10 cm) was between the survey 2 cm and 11 cm, which doesn't catch shortbelly, so an intermediate amount of shortbelly was likely. Survey Hake Incidental percentages, which included large amounts of shortbelly, allocated all rockfish catch in 1967 Monterey INPFC area to that assemblage, yet literature indicates rockfish were also targeted alone or with sablefish (Table C-4).

Japan

Description of fishing strategies—Information on Japanese fishing strategies indicates they used trawls to target P.o.p. and Pacific hake with rockfish. They also had a longline fishery for sablefish which caught very small amounts of POP and Other, primarily in the Vancouver INPFC area. Japan began fishing off WOC at the end of 1966 (INPFCb 1967). In 1967, they were observed with trawl catches of Pacific hake with ocean perch; ocean perch; P.o.p.; and long-line catches of sablefish with P.o.p. and lingcod (USBCF 1966). Ocean perch probably was another name for rockfish. In September 1967, they had three fleets licensed for experimental Pacific hake trawling (USBCF 1968). This was apparently on-bottom because their findings mentioned problems with the rugged bottom. One source stated Japan did not initiate Pacific hake fisheries off the U.S. coast until 1971 and stopped in 1975 (Kaczynski 1981). Pacific hake catch, however, was reported in fishing years 1970-76.

Japan did not appear to develop an off-bottom Pacific hake strategy. The percentage of rockfish in the combined Pacific hake and rockfish trawl catch remained high throughout the time period (Table C-10). The percentages were generally comparable to those in Northern and Southern Shelf and Slope Soviet Union survey assemblages (Table B-4). This indicates Japan was either not accessing the large, relatively pure midwater Pacific hake schools, and/or was continuing to primarily target rockfish. Species compositions reported by Japan did not rule out either on-bottom or off-bottom strategies. They were mainly chilipepper and widow, in addition to P.o.p. (although chilipepper in 1974 represented several species) (Table C-11). Both chilipepper and widow can be caught on-bottom or off-bottom. Domestic widow landings in recent years are caught more often with bottom gear than with midwater gear (Williams et al. 2000). Observer reports for the Vancouver INPFC area and northward in 1974-76 indicated Japan fished more on-bottom than the Russians because they were able to fish over more uneven topography (INPFCa 1977).

Japan also did not appear to be as affected by regulations as were the Russians. Japan agreed to reduce trawl effort on rockfish in 1969 and agreed not to target rockfish after 1971 (Table C-1). In spite of that, the percentage of rockfish to Pacific hake did not change substantially after 1970 (Table C-10). Japan also continued to fish within the 12 nmi limit after the U.S. took jurisdiction. In 1967, Japan said they did not recognize that limit (USBCF 1966).

Finally, there was no indication that Japan used as small a mesh as the Soviet Union. Mesh size reported for 1967 (U.S. 1967) and 1974 (FAJ 1974) both agreed that Japanese trawlers used 8-10 cm (3.5-4 in) codend mesh (Table C-11).

Reporting Categories—Sorting of Japanese catches into POP vesrus Other may have changed after 1972 regulations (INPFCa 1974). In 1973-74, POP was regulated in Columbia and Vancouver INPFC areas, with a very small limit (16 t) in the Columbia INPFC area. After 1972, almost all Columbia INPFC area catch was reported as Other. Japan said increased catch in the Other category was because of more interest in species other than P.o.p. and more careful sorting of POP (INPFCa 1974). Species composition for Other in 1973-1974, as reported by Japanese fishing companies, indicates another reason. That category was 17% P.o.p. (Table C-11). To prevent unlimited catch of P.o.p. reported in the Other category, all rockfish combined were regulated in 1975-76. In those years, Japan reported all rockfish catch as Other.

Allocation Method—Based on the above information, all Japanese catch was allocated to either Slope or Shelf using market category information. This assumed no Hake Incidental strategy. Since longline strategy catch was very limited and no species compositions were available, it was included with the trawl catch. In consideration of sorting differences due to regulations, one-half of Other was assigned to POP in northern areas after 1972. This involved reassignment of 1332 t in the U.S. Vancouver INPFC area and 933 t in the Columbia INPFC area (Table 3).

Method 3 rules were:

1. 1973-1976 in Columbia and U.S. Vancouver INPFC areas:
   POP + 0.5 Other = Slope,
   0.5 Other = Shelf;
2. For all other years and INPFC areas:
   POP = Slope,
   Other = Shelf.

Poland

Fishing strategy descriptions—Poland appeared to target both rockfish and Pacific hake. In 1973, observed catches in Vancouver were dogfish, hake, and red snapper (INPFCa 1974). Red snapper was probably P.o.p. In 1974, trawlers were noted around Heceta Bank, Oregon (INPFCa 1975, U.S. 1975). Hake catches were observed (U.S. 1975). In 1975, they agreed to no longer target rockfish (INPFCa 1975, Table C-1). In the first half of 1975, they fished primarily near San Francisco, California. Moderate catches of small hake and large catches of rockfish were reported (U.S. 1975). Targeting Pacific hake off the U.S. West Coast continued throughout the rest of 1975-76 (INPFCa 1976). It is not known whether Poland fished on- or off-bottom for Pacific hake. The percentages of rockfish to Pacific hake were relatively low, but somewhat higher than for the Soviet Union in those years (Table C-12).

Reporting categories—Poland reported catch in 1975-76 with limited species compositions (Table C-11). In 1975, most rockfish catch was not designated to species. In 1976, rockfish catch was mainly splitnose or yellowtail. There was a substantial amount of "other species" catch, which it was assumed did not contain rockfish. It seems unlikely, however, that they could catch only splitnose and yellowtail without also catching other rockfish.

Allocation method— Since there appeared to be similarities between Soviet Union and Poland fishing strategies, the two methods (Method 1 and Method 2) developed for Soviet catch were employed to allocate 1975-76 catch (Table C-12). Polish catch in 1974 was found only in P.o.p. stock assessments (Gunderson et al. 1977). Since it not known if other rockfish were caught, those catches were left as P.o.p. species.

Bulgaria and East Germany

Total rockfish catch was estimated using the method of Gunderson (unpubl. data). This catch was allocated to rockfish assemblages based on the two methods (Method 1 and Method 2) developed for the Soviet Union (Table C-13). This was consistent with the assumption made to derive the total catches: similar fishing strategies for those three countries.

Republic of Korea

Republic of Korea rockfish catch was primarily from longline gear and all catch was specified as POP. Longline gear fishes more selectively than trawl gear, so it was all assumed to be P.o.p. species.

Step 4. Derive and Apply Species Compositions to Assemblage Catch

Summary

Many decisions were required in this step. They are included in Table 4. Two decisions which had a substantial influence were changing some species identification in the Soviet survey data and averaging Method 1 and Method 2 species catches by year and INPFC area (Table 6).

Two sets of species compositions were derived. One set was based on available commercial data and applied to Method 1 assemblage catch for the Soviet Union, Poland, Bulgaria, and East Germany. Those Shelf and Slope compositions were also applied to Japanese assemblage catches because codend mesh size appeared comparable to that in the domestic fleet. The other set was based on Soviet Union species compositions for Hake Incidental, Slope, Southern Shelf, and Northern Shelf. Those were applied to Method 2 assemblage catch.

Averaged catch-by-species was about one-fourth P.o.p. with ten other species constituting most of the catch (Figure 4). Unspecified catch was less than 1% of the total. Dominant species changed by INPFC area (Figure 5). Catch by species by INPFC area and year are in Table 7.

Details

Commercial compositions

Hake Incidental species compositions were selected from both foreign and joint-venture fleet observer data collected during 1977-83 (Table B-2). Compositions from the Soviet Union and Polish fleets were used for Eureka and Columbia INPFC areas. Those data were not available for Monterey and U.S. Vancouver INPFC areas, so joint venture data were utilized. Those compositions by INPFC area were applied to each year in 1966-76. Using foreign compositions for Eureka and Columbia INPFC areas versus joint-venture for all INPFC areas, increased catch for yellowtail and decreased widow catch in Method 1 estimates.

Species compositions in domestic landings before 1977 were used for Shelf and Slope. Compositions by shelf and slope market categories were not available for California. In addition, Washington market sample compositions were not expanded by catch, and may not be representative of the fishery. Therefore all available information was compiled on species catch by INPFC area and year for years before 1977 (Tables D1-D6). Landings were divided into slope

Table 6. Consequences (t) of changing species identification in the Soviet Union survey data (Survey[a]) and using Method 1 versus Method 2 to allocate catch (Method[b]).

Species	Survey	Method
aurora		-23
black	5955	61
blackgill		308
bocaccio		5057
brown		66
canary		-3172
chilipepper	110	3093
cowcod		38
darkblotched		2939
flag	320	25
greenspotted		43
greenstriped		-450
olive		22
P.o.p.		15001
redbanded	-320	-347
redstripe		-1272
rosethorn		-99
rougheye		-103
sharpchin		-333
shortbelly		-14540
shortraker		15
shortspine		2936
silvergrey		-782
speckled		90
splitnose		2635
stripetail		-475
vermillion		28
widow	-8901	-7053
yelloweye		-21
yellowmouth		2496
yellowtail	-5955	-5137
unidentified	-110	-961

[a] Survey = changes in black to yellowtail, widow to blue, flag to redbanded, and chilipepper to unidentifed.
[b] Method = Method 1- ([Method 1+Method 2]/2).

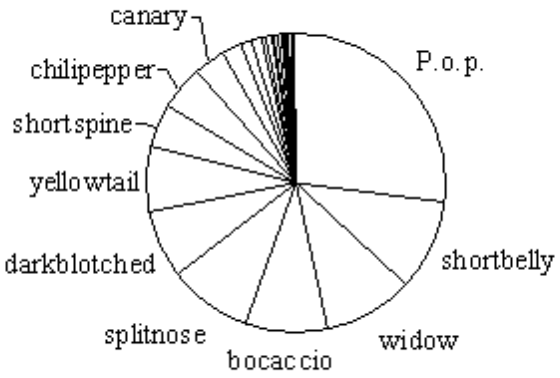

Figure 4. Proportion of total foreign rockfish catch (t) off Washington, Oregon, and California in 1966-1976 by species. (Only the dominant ten species are identified.)

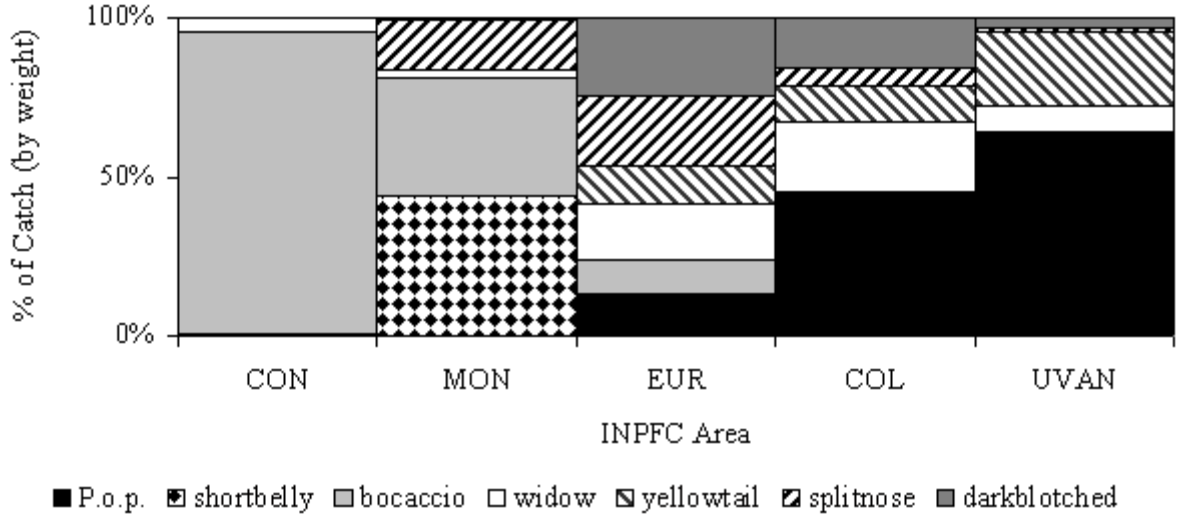

Figure 5. Change in dominance of top seven species in the 1966-1976 Washington, Oregon, and California foreign catch by INPFC area. Total catch is only selected species.

Table 7. Step four results: Allocation to species of foreign rockfish catch (t) off the Washington, Oregon, and California in 1966-1976 by INPFC area and year.

Species	Area	66	67	68	69	70	71	72	73	74	75	76	Total
aurora	COL	1	0	0	0	0	2	2	6	2	2	1	16
	EUR	0	0	0	0	0	0	2	5	2	4	3	16
	MON	0	0	0	0	0	0	0	1	0	0	0	1
bank	MON	0	0	0	0	0	0	0	7	21	5	5	38
	CON	0	0	0	0	0	0	0	16	2	0	0	18
black	UVAN	2	3	1	3	4	3	7	1	3	0	0	27
	COL	3	3	64	2	7	8	58	81	3	14	12	255
	EUR	0	0	26	0	0	0	4	277	25	7	3	342
	MON	11	31	9	0	0	0	0	0	0	0	0	51
blackgill	COL	0	0	0	3	4	4	2	3	2	1	3	22
	EUR	0	0	0	0	0	0	0	1	0	1	0	2
	MON	70	199	56	4	1	0	0	0	0	0	0	330
bocaccio	UVAN	23	20	9	2	3	5	5	4	2	0	0	73
	COL	188	90	30	29	37	17	28	49	11	16	13	508
	EUR	0	1	67	0	0	0	9	313	37	23	14	464
	MON	1101	2856	842	48	0	0	39	1375	3835	1047	1007	12150
	CON	0	0	0	0	0	0	0	299	35	0	0	334
brown	COL	3	4	2	2	4	4	2	3	2	1	3	30
	MON	3	7	2	0	0	0	1	20	59	14	15	121
canary	UVAN	113	90	109	12	28	70	68	68	288	0	0	846
	COL	1445	658	286	50	73	118	318	525	81	141	114	3809
	EUR	0	2	385	3	0	0	12	335	46	35	22	840
	MON	41	101	30	2	0	0	1	37	104	28	27	371
chilipepper	COL	1	1	1	1	1	2	1	1	1	1	1	12
	EUR	0	0	31	0	0	0	7	217	24	18	10	307
	MON	984	1633	639	52	0	0	18	563	1363	715	518	6485
	CON	0	0	0	0	0	0	0	126	15	0	0	141
cowcod	MON	6	18	5	0	0	0	0	6	17	4	3	59
	CON	0	0	0	0	0	0	0	8	1	0	0	9
darkblotched	UVAN	101	93	52	2	2	73	61	78	144	0	0	606
	COL	3654	2550	1280	147	146	205	298	610	190	254	87	9421
	EUR	0	22	927	3	1	0	14	50	9	26	16	1068
	MON	52	41	29	1	0	0	1	30	3	13	15	185
dusky	UVAN	0	1	0	1	1	0	0	0	0	0	0	3
flag	MON	9	18	6	0	0	0	0	1	0	0	0	34

Table 7. Step four results: Allocation to species of foreign rockfish catch (t) off the Washington, Oregon, and California in 1966-1976 by INPFC area and year. Continued.

Species	Area	66	67	68	69	70	71	72	73	74	75	76	Total
greenspotted	MON	9	26	7	0	0	0	0	1	0	0	0	43
	CON	0	0	0	0	0	0	0	3	0	0	0	3
greenstriped	UVAN	17	11	5	0	0	3	3	3	1	0	0	43
	COL	80	40	11	37	44	6	7	19	7	8	4	263
	EUR	0	0	8	0	0	0	4	11	5	11	8	47
	MON	14	92	17	0	0	0	0	2	0	2	1	128
northern	UVAN	0	1	0	1	1	0	1	0	0	0	0	4
olive	COL	2	2	1	1	2	2	1	1	1	1	1	15
	EUR	0	0	0	0	0	0	0	1	3	2	1	7
	MON	1	3	1	0	0	0	0	0	0	0	0	5
pink	MON	1	0	0	0	0	0	0	0	0	0	0	1
P.o.p.	UVAN	4595	4319	2417	64	68	548	421	607	992	0	29	14060
	COL	10966	8038	4222	405	373	354	529	1166	465	496	210	27224
	EUR	0	9	344	1	0	0	17	62	15	35	93	576
	MON	0	11	1	3	0	0	0	11	19	40	40	125
quillback	UVAN	0	0	0	0	0	0	0	0	1	0	0	1
redbanded	UVAN	15	6	3	0	0	1	1	1	4	0	0	31
	COL	124	56	15	6	7	12	11	33	12	16	8	300
	EUR	0	0	32	1	0	0	4	42	7	12	8	106
redstripe	UVAN	115	78	35	3	4	10	8	9	1	0	0	263
	COL	545	236	56	37	48	26	14	28	13	14	20	1037
	EUR	0	1	182	0	0	0	0	1	3	3	1	191
	MON	15	14	9	0	0	0	0	2	4	9	4	57
rosethorn	UVAN	7	4	2	0	0	1	1	1	0	0	0	16
	COL	15	7	2	21	25	0	0	1	1	0	0	72
	EUR	0	0	5	0	0	0	0	0	0	0	0	5
	MON	3	1	2	0	0	0	0	0	0	0	0	6
rougheye	UVAN	13	15	8	0	0	30	51	11	24	0	0	152
	COL	82	70	38	14	17	19	16	50	20	25	11	362
	EUR	0	0	0	0	0	0	1	2	1	2	1	7
	MON	3	0	1	1	0	0	0	0	0	0	0	5
sharpchin	UVAN	31	37	19	0	0	2	1	1	2	0	0	93
	COL	374	195	70	15	16	12	11	29	12	14	8	756
	EUR	0	1	49	0	0	0	0	0	0	0	0	50
	MON	0	0	0	0	0	0	0	1	1	1	1	4

Table 7. Step four results: Allocation to species of foreign rockfish catch (t) off the Washington, Oregon, and California in 1966-1976 by INPFC area and year. Continued.

Species	Area	66	67	68	69	70	71	72	73	74	75	76	Total
shortbelly	COL	1	0	0	0	0	0	0	0	0	0	0	1
	EUR	0	0	5	0	0	0	0	0	0	0	0	5
	MON	1533	8382	1685	163	0	0	53	920	205	823	800	14564
shortraker	UVAN	0	0	0	0	0	3	2	3	0	0	0	8
	COL	2	2	1	1	2	3	2	4	2	2	1	22
	MON	0	0	0	0	0	0	0	0	0	1	0	1
shortspine	UVAN	39	27	12	0	0	3	2	3	3	0	0	89
	COL	565	327	132	45	52	176	316	642	188	259	49	2751
	EUR	0	45	1497	4	1	0	198	757	40	305	178	3025
	MON	270	690	205	16	4	0	7	230	0	61	91	1574
silvergrey	UVAN	97	25	22	0	1	15	9	16	9	0	0	194
	COL	274	119	29	4	6	24	15	71	31	38	10	621
	EUR	0	0	5	0	0	0	2	7	4	7	4	29
	MON	5	0	2	0	0	0	0	0	0	1	0	8
speckled	MON	19	54	15	1	0	0	0	0	0	0	0	89
splitnose	UVAN	197	197	110	2	2	13	10	13	17	0	0	561
	COL	2652	1555	655	66	67	50	50	134	50	63	24	5366
	EUR	0	6	795	1	0	0	23	78	21	53	34	1011
	MON	1815	3267	1218	72	18	0	3	72	8	43	47	6563
	CON	0	0	0	0	0	0	0	0	12	0	0	12
stripetail	UVAN	0	0	0	0	0	19	11	20	0	0	0	50
	COL	49	28	11	24	29	3	3	9	4	5	1	166
	EUR	0	3	85	0	0	0	20	154	30	54	35	381
	MON	7	1	3	0	0	0	1	22	26	20	19	99
vermillion	COL	0	0	0	2	2	1	1	1	1	0	0	8
	MON	2	9	2	1	0	0	0	2	3	6	2	27
	CON	0	0	0	0	0	0	0	7	1	0	0	8
whitebelly	MON	1	4	1	0	0	0	0	0	0	0	0	6
widow	UVAN	449	750	242	51	69	23	40	7	24	0	0	1655
	COL	3221	3150	1451	305	485	678	370	540	243	266	572	11281
	EUR	0	2	263	2	0	0	11	95	149	114	94	730
	MON	96	247	73	19	0	0	2	51	112	118	66	784
	CON	0	0	0	0	0	0	0	14	2	0	0	16
yelloweye	UVAN	0	0	0	0	0	2	2	2	2	0	0	8
	COL	1	1	0	4	5	2	1	4	2	2	1	23
	MON	1	0	0	0	0	0	0	0	0	0	0	1

Table 7. Step four results: Allocation to species of foreign rockfish catch (t) off the Washington, Oregon, and California in 1966-1976 by INPFC area and year. Continued.

Species	Area	66	67	68	69	70	71	72	73	74	75	76	Total
yellowmouth	UVAN	16	20	11	0	0	7	5	8	15	0	0	82
	COL	1344	1130	655	60	54	7	6	12	4	5	3	3280
	EUR	0	0	0	0	0	0	0	1	5	3	3	12
yellowtail	UVAN	1248	892	497	400	521	223	380	94	485	0	0	4740
	COL	1597	1063	522	383	510	211	320	508	103	156	186	5559
	EUR	0	1	168	3	0	0	16	168	66	66	49	537
	MON	38	61	24	1	0	0	0	3	3	8	3	141
unidentified	UVAN	240	61	47	12	14	3	3	3	5	0	0	388
	COL	339	158	45	37	43	7	9	16	4	6	5	669
	EUR	0	0	3	0	0	0	5	55	4	7	4	78
	MON	40	0	19	1	0	0	1	51	118	64	45	339
	CON	0	0	0	0	0	0	0	12	2	0	0	14

and shelf species by INPFC area and two periods, which allowed for lacking or incomplete sampling in many years. Unspecified rockfish could not be divided between shelf and slope based on species, so that catch was divided based on percentages in the known species catch by INPFC area and time period.

Soviet Union survey compositions

Soviet Union survey species compositions were first examined by year and INPFC area to see if there were time periods of distinct change. There was variation due to small sample sizes, but there did not appear to be a change in Hake Incidental and Shelf compositions after the 12 nmi limit was instituted in early 1967 (Figure D-1). What was noticeable was a change in those assemblages between 1969 and 1970 in the Columbia and U.S. Vancouver INPFC areas. Blue and black were dominant species before 1970, while yellowtail and widow occurred only after 1969 (Figures D-1, D-2).

Further investigation indicated widow was misidentified as blue and yellowtail as black before 1970. All four species were caught over similar depths, with most large tows in 50-150 fathom (Figure D-2). Both black and blue are classified as near-shore species, while widow and yellowtail are found at shelf depths (Table 1). Percentages for black in Northern Shelf (29% in Table B-4) and yellowtail in domestic Shelf (35-62% in Table B-1) were similar. Widow and blue had a wider latitudinal range for all survey catches and nearly pure catches of widow and blue also formed similar clusters of tows (Clusters L and K) (Table B-4).

Soviet Union surveys also reported catches of flag and chilipepper in the northern INPFC areas (Table D-9). Redbanded first appeared in Soviet Union data in 1971 in the Columbia and U.S. Vancouver INPFC areas and 1972 in Eureka and Monterey INPFC areas. After those years, both flag and redbanded were in the data in all areas. Chilipepper catches in Columbia and U.S. Vancouver INPFC areas occurred primarily in 1966-68. Chilipepper is fished commercially only off California, although it can occur northward to Canada (Eschmeyer et al. 1983). The species resembles P.o.p., bocaccio, and redstripe, which occur more frequently in the northern areas (Eschmeyer et al. 1983); and Japan in 1973 used “chilipepper” to refer to several species (INPFCa 1974).

Based on those preliminary analyses and species literature review, compositions for Soviet Survey assemblages were derived by INPFC area and the three time periods used for assemblage ratios (1966-69, 1970-71, and 1972-76) (Tables D-8, D-9). Black before 1970 was assumed to be yellowtail and blue before 1970 was assumed to be widow. This substantially increased yellowtail and widow catches in the final estimates, but they were still less than estimated using Method 1 (Table 6). All flag in Eureka-U.S. Vancouver INPFC areas were changed to redbanded, and all chilipepper in Columbia and U.S. Vancouver INPFC areas was assigned to unidentified rockfish.

Averaging Method 1 and Method 2

After species compositions were applied to estimates from Method 1 and Method 2 for catches by Soviet Union, Poland, Bulgaria, and East Germany, the catch for each species was averaged by year and INPFC area. Comparing Method 1 estimates to the average showed substantial differences for P.o.p., shortbelly, widow, and yellowtail (Table 6).

Estimates were averaged with the belief that actual species compositions, as well as assemblage designations, were between the two sets of compositions. The primary difference between compositions was the amount of shortbelly versus chilipepper or bocaccio in the Monterey INPFC area Shelf (versus Southern Shelf) and Hake Incidental (Figure D-3). Domestic mesh size was (11-13 cm) 4.5-5" during 1965-76 (PFMC 1992). As mentioned earlier, this size

mesh would not catch shortbelly (Lenarz 1980). Soviet fleet mesh size was intermediate between domestic and survey sizes, at least for Shelf and Slope. Both sets also had other assumptions that were likely violated (Table 4). Averaging the two estimates could reduce biases from each method.

The commercial percentages had more shortspine versus splitnose in Slope (Figure D-3). This could have been bias from discarding. Domestic fishermen discarded rockfish based on species (splitnose in particular [J. Pennisi[1]]), size, or a combination (shortspine smaller than 33 cm [13 in]) (Rogers et al. 1998). United States fishermen and biologists who observed the foreign fleet during 1966-76 agreed rockfish were not discarded because of either size or species (J. Pennisi [1], G. White [2], B. Larkins [3], and B. Pattie[4]). The higher percentages of domestic fleet shortspine may also have been from fishing deeper than the Soviet Union survey.

Both the domestic fleet and the Soviet Union survey were allowed to fish in areas restricted to the foreign fleet. This may have biased the species compositions. The domestic fleet, however, may have had greater incentive to fish those areas. Logically, Soviet Union researchers would not study or explore areas they could not utilize commercially.

Comparison with Previous Estimates

Summary

Previous foreign catch estimates for 1965-76 have been accepted for many years, so it is important to understand how they differ from estimates produced in this document. The greatest percentage differences in combined domestic and foreign catch for 1965-1976 were for P.o.p., shortspine, and widow (Figure 6). Ratios of new to old domestic plus foreign catches were: 6.9 - widow, 1.9 - shortspine, 1.2 - chilipepper and bocaccio, 1.1 - yellowtail and darkblotched, 0.8 - canary, and 0.52 - P.o.p. Stock assessments for several species, including widow, shortspine, chilipepper, and bocaccio, did not include foreign catch estimates for that period. P.o.p., canary, and yellowtail foreign catch estimates were developed before 1985 and calculation details were not always available or remembered by the authors. Therefore an attempt was made to repeat the methods using available information and citations.

In the new calculations, P.o.p. and canary estimates were reduced, while yellowtail estimates were increased (Table 8). P.o.p. estimates decreased primarily because some of the nominal catches assumed to be pure P.o.p. were allocated to other species. The U.S. portion of the Vancouver area catch was also reduced. Canary was reduced because one-half of Japanese Other in 1973-76 was assigned to POP, the assessment overestimated some nominal catch, and canary was a small component of Hake Incidental. Yellowtail was increased because the Eureka catch was added, yellowtail was a dominant member of both Hake Incidental and Shelf, and the original method tried to not use catch already allocated to P.o.p.

---

[1]J. Pennisi, Royal Seafood, Municipal Wharf, Monterey, CA 93440. Pers. commun., 2001.

[2]G. White, 1150 SW 11th St., Newport, OR 97365. Pers. commun., 2001.

[3]B. Larkins, 14203 Cove Ct., Anacortes, WA. Pers. commun., 2001.

[4]B. Pattie, WDFW, 600 Capitol Way N., Olympia, WA 98501. Pers. commun., 2002.

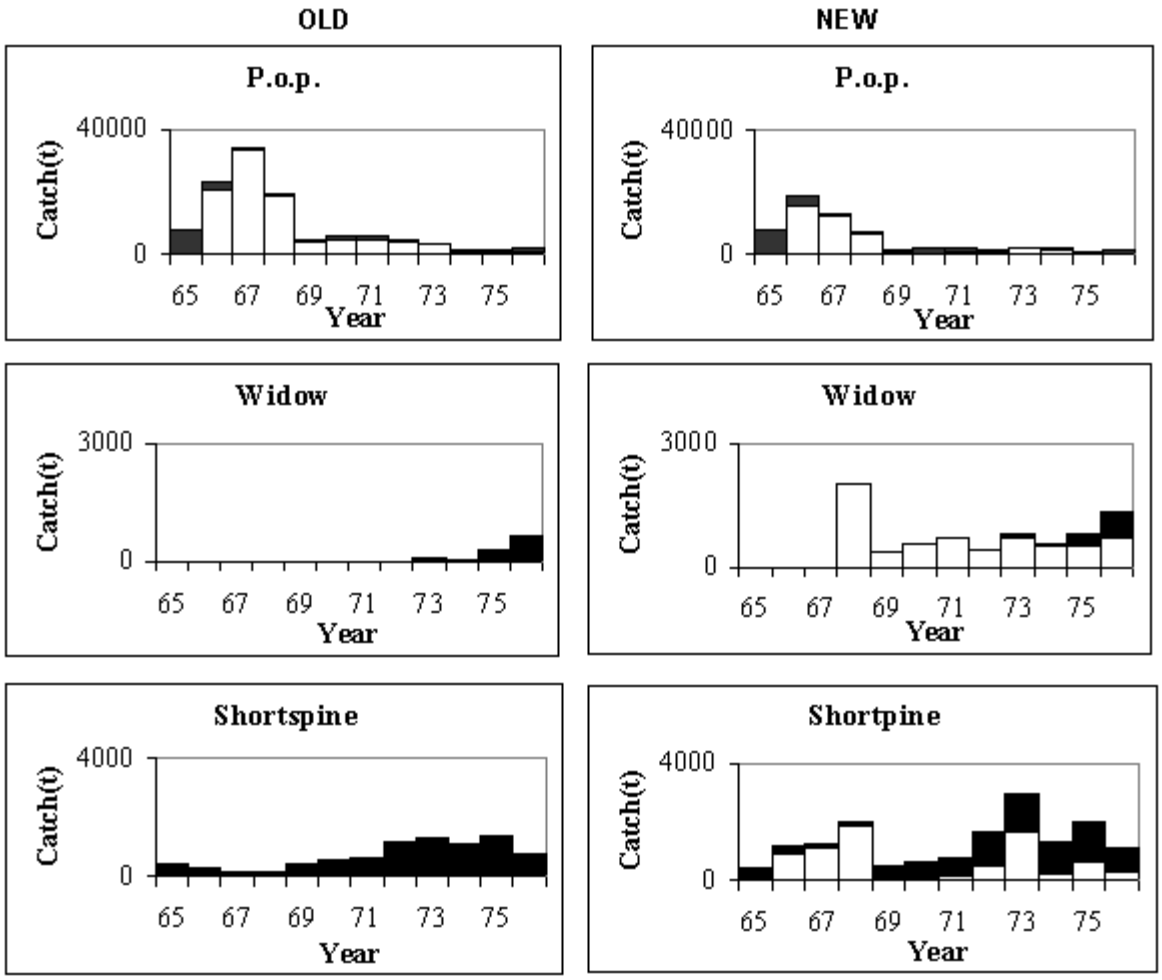

Figure 6. Catch estimates from this paper (NEW) versus recent stock assessments (OLD) for species with highest percentage change. Unshaded bars are foreign catch, shaded are domestic. OLD = 2000 assessments of P.o.p. and widow and 1998 assessment of shortspine.

Table 8. Foreign catch (t) estimates from this paper (New) versus recent stock assessments (Old) for comparable years and areas.

Type	Species	Area	65	66	67	68	69	70	71	72	73	74	75	76
Old														
	P.o.p.[a]	UVAN-COL	375	20500	33204	18783	4361	4435	4792	3995	3148	1060	1201	1146
	Darkblotched[b]	Coast-wide	38	2050	3320	1878	436	444	479	400	315	106	120	115
	Canary[c]	Coast-wide			1947	1685	500	499	389	596	3220	37	318	34
	Yellowtail[d]	EUR-UVAN			416	784	588	189	113	475	1717	640	542	55
	Widow[e]	Coast-wide				0	0	0	0	0	0	0	0	0
	Shortspine[f]	MON-UVAN	0	0	0	0	0	0	0	0	0	0	0	0
	Chilipepper[g]	CON-EUR						0	0	0	0	0	0	0
	Bocaccio[h]	CON-EUR					0	0	0	0	0	0	0	0
New														
	P.o.p.	UVAN-COL	0	15561	12357	6639	469	441	902	950	1773	1457	496	239
	Darkblotched	Coast-wide	0	3807	2706	2288	153	149	278	374	768	346	293	118
	Canary	Coast-wide			851	810	67	101	188	399	965	519	204	163
	Yellowtail	EUR-UVAN			1956	1187	786	1031	434	716	770	654	222	235
	Widow	Coast-wide				2029	377	554	701	423	707	530	498	732
	Shortspine	MON-UVAN	0	874	1089	1846	65	57	179	523	1632	231	625	318
	Chilipepper	CON-EUR						0	0	25	906	1402	733	528
	Bocaccio	CON-EUR					48	0	0	48	1987	3907	1070	1021

[a] Inanelli et al. (2000).
[b] Rogers et al. (2000).
[c] STAT (1999) and Williams et al. (1999)
[d] Tagart et al. (2000).
[e] Williams et al. (2000).
[f] Rogers et al. (1998).
[g] Ralston et al. (1998).
[h] MacCall et al. (1999).

Details

P.o.p.

The most recent P.o.p. stock assessment (Ianelli et al. 2000) used estimates developed by Westrheim et al. (1972), Gunderson et al. (1977), and Fraidenburg et al. (1978), with U.S. portion of the Vancouver INPFC area estimates from Ianelli et al. (1992). The earlier assessments had P.o.p. foreign catch for Vancouver and Columbia INPFC areas. Ianelli et al. (1992) presented combined U.S. Vancouver and Columbia INPFC area foreign catch. After subtracting Columbia INPFC area catch, it was evident the U.S. portion was 75% of the Vancouver INPFC area catch in all years.

Sufficient information was available to closely repeat the estimates of Westrheim et al. (1972), Gunderson et al. (1977), and Fraidenburg et al. (1978) (Appendix E, Tables 1 and 2). They allocated 42-100% of the BC-reported Soviet Union catch to the Vancouver INPFC area. For 1965-1967, Vancouver catch was estimated based on fleet activity and monthly catch rates (Westrheim et al. 1967). For 1968-70, BC catch was allocated to Vancouver versus Charlotte INPFC areas based on observed vessel activity (Westrheim et al. 1967). In 1971, 1972, and 1974, all BC catch was placed in the Vancouver INPFC area (Table E-1). WO Soviet Union catch was allocated to the Columbia INPFC area (Table E-1). Except in 1974, Soviet Union catch reported as Rockfish (or POP) was assumed to be P.o.p. In 1974, Soviet Union Other was allocated to P.o.p. Japanese catch for fishing year was allocated to the later year and POP was assumed to be P.o.p. Polish P.o.p. estimates in 1975-76 were based on species compositions supplied by Poland (Morski unpubl. data, Murai unpubl. data a). Polish 1974 catches could not be found in the literature. Bulgaria and East Germany estimates were based on assuming the same ratios of Pacific-hake-to-rockfish and POP to Other as in 1976 Soviet catch (Gunderson unpubl. data). POP estimates were then allocated to P.o.p. species.

New estimates differed from those in the assessments in several ways (Tables E-1, E-2). Some of those involved choice of market category catches to which species or U.S. proportions are applied (starting catches). Soviet Union catch was allocated to INPFC area based on overflight estimates. This generally increased the Vancouver INPFC area starting catch estimates and decreased the Columbia INPFC area estimates in 1967-72. In 1973-76, the starting catch included all Soviet Union rockfish catch, while the assessment used POP, Other, or Rockfish. Starting catch estimates for Soviet Union 1966 Columbia INPFC area were also substantially higher. The assessments used the lower value (10,000 t) from the range considered. For the Japanese catch, ½ of the other catch was allocated to POP in 1973-76, which made the starting catches higher in both areas in those years. Considering all countries, years, and areas combined, allocating nominal catch to other species caused the greatest reduction in P.o.p. catch (Table E-5). U.S. Vancouver INPFC area percentages were also 33%-75% lower than the 75% used in the assessment.

Canary and Yellowtail

Canary and yellowtail foreign catch for 1967-76 used in recent stock assessments are based on estimates first developed in 1984. STAT (1999) used canary foreign catch estimates from Golden and Demory (1984), with 44.3% Vancouver INPFC area allocation to U.S. portion from Sampson and Stewart (1994). Tagart et al. (2000) used yellowtail foreign catch estimates from Tagart (1988), with U.S. Vancouver INPFC area allocations from Tagart (1993). Tagart (1988) made minor adjustments to one of the estimates produced by Tagart (1984). Tagart (1993) allocated those catches (placed under the whiting fishery) to three areas: Eureka/S. Columbia, N. Columbia, and S. Vancouver. All Columbia INPFC area catch was placed in N. Columbia; all Vancouver INPFC area catch from 1967-74 and 2% Vancouver INPFC area catch from 1975-76 in S. Vancouver. Tagart and Wallace (1996) specified this catch was in the U.S. portion.

Tagart (1984) and Golden and Demory (1984) worked together developing foreign catch estimates for yellowtail and canary (J. Golden[5]). Using information supplied in both assessments, their calculations were nearly replicated (Tables E-3, E-4). Some of the catch they utilized was based on subtracting estimates from different methods of allocation to INPFC area (Soviet Union) or calendar year (Japan). For one of their methods, they subtracted 1967-72 Soviet Union P.o.p. estimates from Gunderson et al. (1977) (Rockfish based on state boundary allocation to INPFC area), from Soviet Union Rockfish from Fraidenburg et al. (1977) (based on overflight allocation to INPFC area). If the amount allocated to P.o.p. was greater than the Rockfish estimates, the left-over catch was set to zero (Tagart 1984). For Japanese Other they selected maximum estimates from Forrester et al. (1978) (allocation to calendar year based on monthly estimates) or Fraidenburg et al. (1977) (allocation based on fishing year to later year). To that catch, they applied domestic landing species compositions minus P.o.p. (Golden and Demory 1984). This was the method later chosen by Tagart (1988) for yellowtail estimates. Golden and Demory (1984) also used those estimates, but averaged the 1967-72 Soviet Union canary catch with another estimate. For that estimate, they applied domestic catch compositions including P.o.p. to all Soviet Union Rockfish in Fraidenburg et al. (1977).

The new yellowtail and canary estimates were overall higher for yellowtail and lower for canary (Tables E-3, E-4, E-5). New Soviet Union starting values were higher for 1965-72 because they included all Soviet Union rockfish catch rather than just Other catch. New Japanese starting values were less in early years because only one method of allocation to calendar year was used. Japanese starting values in 1973-76 were also less because one-half of Other was placed in POP. The percentage of U.S. catch in the Vancouver INPFC area was 2-76% less than in yellowtail assessments and 44% less to 31% more than in canary assessments. The percentage yellowtail in total catch was generally higher than applied previously. That was because much of the Soviet Union catch was allocated to the Hake Incidental. Yellowtail is a dominant member of both the Hake Incidental and Northern Shelf assemblages. The canary percentage was reduced because that species is only a minor component of Hake Incidental. Some of the difference in canary estimates was also due to a skipped year in the assessment.

[5] J. Golden, 3000 NE Mossy Ln, Toledo, OR, 97391.Pers. commun., 2001.

DISCUSSION

Use of historical foreign catch estimates from this document could affect previously made stock status determinations for eight rockfish, five of which are considered overfished (Table 8). The overfished species are P.o.p., canary, widow, darkblotched, and bocaccio. Revised foreign catch estimates for 1965-76 would decrease foreign catch for P.o.p. and canary during that time period by 60% and 50%, respectively. Darkblotched estimates would increase by 20%. Widow and bocaccio assessments have not included any foreign catch estimates (Williams et al. 2000, MacCall et al. 1999). Foreign catch for bocaccio was higher than for widow in modeled years, but was a smaller proportion of total catch. Estimates in this document would also increase catch for species not presently overfished, including yellowtail, shortspine, and chilipepper. Although the first year in many stock assessment models is after 1966 (Table 8), catch in earlier years could affect assumed historical catch or indicate the model should start with an earlier year.

Foreign catch estimates improve on previous estimates because the same catch is not applied to more than one species. Foreign rockfish catch in 1966-76 U.S. Vancouver plus Columbia INPFC areas has been over-allocated for all years except 1966, 1974, and 1976. Catch used in the P.o.p. assessment (Ianelli et al. 2000) admittedly contained unknown quantities of other rockfish species (Gunderson et al. 1977). Some of that catch was also allocated to canary (STAT 1999), yellowtail (Tagart et al. 2000), and darkblotched (Rogers et al. 2000). This was done intentionally for darkblotched (10% of P.o.p. foreign catch) and canary (partially). For canary (partially) and yellowtail, it resulted from comparing foreign catch estimates derived using different methods of allocation to calendar year and INPFC area.

Another improvement in this document is that allocation to the U.S. Vancouver from the Vancouver Area used information from the foreign fisheries and was done consistently for all species. The new allocations used the best available information on foreign catch to allocate Vancouver catch. That information included WOC catch minus Conception-to-Columbia INPFC area catch, catch and effort by small area blocks, and areas closed to fishing by regulations.

Although Soviet Union reporting area boundaries were not clearly defined, some BC catch may have previously been included in the U.S. Vancouver INPFC area. In early P.o.p. assessments, Gunderson et al. (1977) and Fraidenburg et al. (1978) stated the boundary between Soviet-reported WO and BC was $48^{0}30'$N. Given that boundary, their Vancouver catch was all from Canadian waters. In 1992, 75% of this catch was allocated to the U.S. portion (Ianelli et al. 1992). The basis of this percentage could not be easily determined (J. Ianelli [6] and D. Ito[7]). Ito et al. (1987) stated U.S. fishermen caught 75% of their 1972-76 P.o.p. Vancouver INPFC area catch in the U.S. portion, so this may have been the basis of the allocation.

In addition to preventing overestimation, the allocations in this document allow inclusion of almost all foreign catch between the Mexican and Canadian borders. The darkblotched and yellowtail assessments were for areas reaching into California, yet California foreign rockfish catch estimates were not included in those assessments (nor any other assessment). In addition, 1974 Soviet Union catch reported as Rockfish (versus Other) was never included in any assessment. Given uncertainty in 1974 Soviet Union sorting into categories (Larkins 1975), Gunderson et al. (1977) assumed Other was P.o.p. In subsequent years, Rockfish was assumed to be P.o.p. (Fraidenburg et al. 1978). Yellowtail and canary authors (Tagart 1984, Golden and Demory 1984) also allocated catch from Other in 1974, assuming that category contained the same species as in other years and for other countries.

---

[6] J. Ianelli, 7600 Sandpoint Way NE, Seattle, WA 98115. Pers. commun., 2000.

[7] D. Ito, 7600 Sandpoint Way NE, Seattle, WA 98115.Pers. commun., 2000.

As a final improvement, this is the first time all available information on targeting and species compositions has been used to allocate catch to species. Recognizing that some rockfish catch was incidental while targeting Pacific hake, and applying species compositions specific to that assemblage probably resulted in more accurate catch estimates. P.o.p. estimates were based on assuming all unspecified rockfish catch was P.o.p. Yellowtail foreign catch was placed under an at-sea whiting (another name for Pacific hake) strategy in the assessment (Tagart et al. 2000), but yellowtail, canary, and darkblotched assessment authors allocated based only on species compositions in domestic catches. Domestic fishermen in 1965-76 targeted Pacific hake only in a 1966-67 experimental fishery. Yellowtail was a dominant member of both the domestic shelf assemblage and incidental catch from targeting Pacific hake, but canary, darkblotched, and P.o.p. were a small percentage of the incidental catch.

Although the current methods may have led to improved allocations, it must be recognized that catch estimates even prior to allocation were uncertain. Soviet catch estimates were particularly questionable. Fraidenburg et al. (1977) regarded them as minimum estimates only. Surveillance information was sometimes in direct conflict with Soviet-reported areas of catch. The substantial difference in 1966 literature estimates is evidence of uncertainty in the early years. Calculations made in this document based on vessel sightings and catch per vessel day justified selecting the higher 1966 estimate, but even those data were uncertain.

It should also be recognized that while allocations to species were based on the best available knowledge, they required many assumptions and decisions. Several decisions substantially affected catch estimates for P.o.p., shortbelly, widow, yellowtail, blue, and black (Table 5). Some decisions did, however, balance the effects of other decisions. Other uncertainties were not evaluated directly.

Some Soviet Union survey species identification was questioned and changed, but other species may have been incorrectly identified. Many rockfish species appear similar and identification in the 1960's was still evolving. Yellowmouth is often caught with P.o.p. and appears very similar. It was not officially designated as a separate species until 1967 (Westrheim and Tsuyuki 1967). Douglas (1998) and Fraidenburg et al. (1977) reported yellowmouth landings beginning in 1965, probably based on knowledge of the species previous to the official description (W. Barss[8]). Yellowmouth was not specified in the Soviet Union survey data until 1971 and then in only small amounts, so it was probably included as P.o.p. Even U.S. observer data were uncertain. Early observers often lacked experience in rockfish identification, so some errors were expected (French et al. 1977).

Although available species compositions for the 1965-76 foreign rockfish catch were questionable, comparisons with estimates in this document should be noted. Early observer data from the 1967 Japanese fishery was consistent with estimates in this document. P.o.p. was 67% of total catch (U.S. 1967), while estimated 1967 Japanese catch of P.o.p. was 73% of rockfish catch. Species compositions reported by Japan, however, differed from the results. If the 1974 Other market category species composition reported by Japan (Appendix C, Table 11) is applied to 1974 Other Japanese catch (Table 3), bocaccio catch would be reduced and chilipepper, widow, black, yelloweye, and silvergrey increased. Poland reported catch was also almost entirely splitnose and yellowtail catches in 1976, while the new 1976 estimates were 10% yellowtail and 4% splitnose for that year. A final discrepancy was that the new 1973 Soviet Union catch estimate for P.o.p. in the Columbia INPFC area was 849 t, while the Soviet Union reported 539 t as POP.

[8] W. Barss.ODFW, 2040 SE Marine Science Dr., Newport, OR 97365. Pers. commun. 2001.

The analyses in this document did help demonstrate the persistence of rockfish assemblages over time. Species assigned to slope and shelf assemblages were the same as those used presently by managers (PFMC 2000). The exception was that shortspine is now considered part of an assemblage with sablefish, Dover sole, and longspine rather than slope rockfish. Some overlap between those two assemblages is, however, recognized (Rogers 1994). Pacific hake incidental rockfish caught by factory trawlers are now primarily yellowtail, widow, and P.o.p. (Dorn 1998). Yellowtail and widow were dominant in the foreign incidental catch compositions used in this document.

In summary, this document provides a consistent method of allocating foreign catch in 1965-76 to all rockfish species. It eliminates allocation of the same catch from the U.S. Vancouver and Columbia INPFC areas to more than one species. This document also provides an allocation for foreign catch in the Conception-to-Eureka INPFC areas, which have never previously been considered in any stock assessment Compilations of literature in this document eliminate possible prior confusion regarding different methods of allocation to INPFC area and year. All known BC catch was eliminated from U.S. Vancouver estimates. Defining species catch assemblages using 1965-76 data demonstrated the persistence of rockfish assemblages over time. Allocating foreign catch to Pacific hake incidental catch, slope rockfish, and shelf rockfish assemblage species compositions potentially improved upon previous allocations based solely on foreign reporting category or domestic catch. While there are uncertainties both in the total foreign catch and in catch allocation which may never be resolved, all available information was utilized to estimate species catch as accurately as possible.

Recommendations are to use foreign catch estimates in this document in rockfish stock assessments. If stock assessment authors prefer another method of estimating foreign catch, these catches could be considered as an alternative. Modeling should be used to determine the effect of these catches on estimated levels of unfished spawning biomass and percent declines in spawning biomass.

CITATIONS

Bailey, K. M., R. C. Francis, and P. R. Stevens. 1982. The life history and fishery of Pacific whiting, *Merluccius productus*. CalCOFI Rep., Vol XXIII (81-98).

Barss, W. H. and E. L. Niska. 1978. Pacific ocean perch (*Sebastes alutus*) and other rockfish (*Scorpaenidae*) trawl landings in Oregon 1963-1977. Oregon Dept. Fish Wildl. Infor. Rep. 78-6. 5 p.

Berger, J., J. Wall, and R. Nelson, Jr. 1984. Summary of U.S. observer sampling of foreign and joint-venture fisheries in the northeast Pacific Ocean and eastern Bering Sea, 1983. (Document submitted to the annual meeting of the International North Pacific Fisheries Commission, Vancouver, B.C., Canada, October 1984). Northwest and Alaska Fisheries Center, National Marine Fish. Serv., NOAA, 2725 Montlake Blvd. E., Seattle, WA 98112.

Bray, J. R. and J. T. Curtis. 1957. An ordination of the upland forest communities of southern Wisconsin. Ecol. Monogr. 27:325-349.

Canada (Canadian Section of the International North Pacific Fisheries Commission). 1969. Estimated annual catches of Pacific ocean perch by nation, 1959-1968. Unpubl. manuscr., 2 p. (Document 1231 submitted to the International North Pacific Fisheries Commission, October 1969.) (Available from Alaska Fisheries Science Center, Natl. Mar Fish. Serv., NOAA, 7600 Sand Point Way NW, Seattle, WA. 98115-0070.)

Dark, T. A., M. O. Nelson, J. J. Traynor, and E. P. Nunnallee. 1980. The distribution, abundance, and biological characteristics of Pacific whiting, *Merluccius productus*, in the California-British Columbia region during July-September 1977. Mar. Fish. Rev. 42(3-4):17-33.

Dorn, M. W. 1998. Fine-scale fishing strategies of factory trawlers in a midwater trawl fishery for Pacific hake (*Merlucius productus*). Can. J. Fish. Aquat. Sci. 55:180-198.

Douglas, D. A. 1998. Species composition of rockfish in catches by Oregon trawlers, 1963-1993. Oregon Dept. Fish and Wild. Mar. Prog. Data Ser. Rep. 575 p.

Edwards, K. D., T. C. Dark, R. French, R. Nelson, Jr., and J. Wall. 1981. A summary of foreign Pacific whiting catches and trawl positions in the Washington-California region, 1977-1980. NOAA Tech. Memo. NMFS-F/NWC-11, 206 p.

Ermakov, Y. K. 1974. The biology and fishery of Pacific hake, *Merluccius productus*, Ph.D. dissertation, Pac. Sci. Inst. Mar. Fish. Oceanogr. (TINRO), Vladivostok, USSR (as cited in Bailey et al. 1982).

Ermakov, Y. K. and M. A. Stepanenko. 1996. Variations of fish biomass in Vancouver, and Washington-Oregon regions (the Pacific coast of North America) under intensive anthropogenic impact. J. Ichthyology, 36(1):24-29.

Eschmeyer, W. N., E. S. Herald, and H. Hammann. 1983. A field guide to Pacific coast fishes of North America. Houghton Mifflin Company. Boston, Massachusetts, 336 p.

FAJ (Fishery Agency of Japan). 1969. Outline of the Japanese groundfish fishery in the northeastern Pacific ocean, 1968 (from Nov. 1967 to Oct. 1968). Unpubl. manuscr., 14 p. (Document 1189 submitted to the International North Pacific Fisheries Commission.) (Available from Alaska Fisheries Science Center, Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NW, Seattle, WA 98115-0070.)

FAJ (Fishery Agency of Japan). 1970. Outline of the Japanese groundfish fishery in the northeastern Pacific ocean, 1969. Unpubl. manuscr., 13 p. (Document 1303 submitted to the International

North Pacific Fisheries Commission.) (Available from Alaska Fisheries Science Center, Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NW, Seattle, WA 98115-0070.)

FAJ (Fishery Agency of Japan). 1973. Data on the Pacific ocean perch fishery in the northeastern Pacific - IV Development and history of the Japanese trawl fishery through 1972. Unpubl. manuscr., 1 p. (Document submitted to the International North Pacific Fisheries Commission, October 1973.) (Available from Alaska Fisheries Science Center, Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NW, Seattle, WA 98115-0070.)

FAJ (Fishery Agency of Japan). 1974. Vessel and gear specifications of the Japanese fisheries in the North Pacific in 1974. Unpubl. manuscr., 3 p. (Document submitted to the International North Pacific Fisheries Commission., October 1974.) (Available from Alaska Fisheries Science Center, Natl. Ma.r Fish. Serv., NOAA, 7600 Sand Point Way NW, Seattle, WA 98115-0070.)

FAJ (Fishery Agency of Japan). 1975. Species composition of rockfish, other flatfish, and other fishes in northeastern Pacific ocean, 1974. Unpubl. manuscr., 3 p. (Document submitted to the International North Pacific Fisheries Commission, October 1975) (Available from Alaska Fisheries Science Center, Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NW, Seattle, WA 98115-0070.)

Forrester, C. R., R. G. Bakkala, K. Okada, and J. E. Smith. 1983. Groundfish, shrimp, and herring fisheries in the Bering Sea and northeast Pacific – historical catch statistics, 1971-1976. INPFC Bull. 41.

Forrester, C. R., A. J. Beardsley, and Y. Takahashi. 1978. Groundfish, shrimp, and herring fisheries in the Bering Sea and northeast Pacific – historical catch statistics through 1970. INPFC Bull. 37.

Fraidenburg, M. E., J. E. Smith, W. H. Barss, and T. Jow. 1977. Minimum estimates of the all nation removals, North American trawl species composition and cpue for "other rockfish" in the northeastern Pacific ocean. WA Dept. Fish. Tech. Rep. 34, 26 p.

Fraidenburg, M. E., S. J. Westrheim, and R. L. Demory. 1978. The status of Pacific ocean perch (*Sebastes alutus*) stocks off British Columbia, Washington and Oregon in 1977. Unpubl. manuscr., 28 p. (Report to the Tech. Sub-Committee to the Inter. Groundfish. Comm., October 1978.) (Available from Donald Gunderson, School of Aquatic and Fisheries Sci., Box 355020, Seattle, WA 98195.)

French, R., R. Nelson, Jr., J. Wall, and D. Hennick. 1978. Data from the observations of foreign fishing fleets off the coast of California, Oregon, and Washington 1977. Unpubl. manuscr., 39 p. (Document 2067 submitted to the International North Pacific Fisheries Commission by the U.S. National Section, September 1978.) (Available from Alaska Fisheries Science Center, Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NW, Seattle, WA 98115-0070.)

French, R., J. Wall, and V. Wespestad. 1977. The catch of rockfish other than Pacific ocean perch by Japan and USSR in the Gulf of Alaska. Unpubl. manuscr., 24 p. (Document 1998 submitted to the International North Pacific Fisheries Commission by the U.S. National Section, September 1977.) (Available from Alaska Fisheries Science Center, Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NW, Seattle, WA 98115-0070.)

Golden, J. T. and R. L. Demory. 1984. A progress report on the status of canary rockfish (*Sebastes pinniger*) in the INPFC Vancouver, Columbia, and Eureka areas in 1984. Appendix 6 in Pacific Fishery Management Council. Status of the Pacific Coast Groundfish Fishery through 1996 and Recommended Acceptable Biological Catches for 1997. Pacific Fishery Management Council, 2000 SW First Ave., Portland, OR 97201, 29 p.

Gunderson, D. R. 1997. Spatial patterns in the dynamics of slope rockfish stocks and their implications for management. Fish. Bull., U.S. 95:219-230.

Gunderson, D. R. Unpubl. data. Notes on methods and results estimating Bulgaria and East German 1976 P.o.p. and Other Rockfish catch by INPFC area. (Available from Donald Gunderson, School of Aquatic and Fisheries Sci., Box 355020, Seattle, WA 98195.)

Gunderson, D. R., J. E. Smith, J. G. Robinson, and T. Jow. 1975. North American landings of species in the "other rockfish" category, with time series data on cpue. Unpubl. manuscr., 11 p. (Document 1789 submitted to the International North Pacific Fisheries Commission, October 1974.) (Available from Alaska Fisheries Science Center, Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NW, Seattle, WA 98115-0070).

Gunderson, D. R., S. J. Westrheim, R. L. Demory and M. E. Fraidenburg. 1977. The status of Pacific ocean perch (*Sebastes alutus*) stocks off British Columbia, Washington, and Oregon in 1974. Fish. Mar. Serv. Res. Dev. Tech. Rep. 690, 63 p.

Hill, M. O. 1979. DECORANA - A FORTRAN program for detrended correspondence analysis and reciprocal averaging. Ecology and Systematics, Cornell Univ., Ithaca, NY 14850, 52 p.

Hipkins, F. W. 1967. Midwater trawl, telemetry gear prove value on Puget Sound hake. Nat. Fish. 47(10):10B-11B, 15B. As cited in Nelson (1970).

Hitz, C. R. 1968. Catalogue of the Soviet fishing fleet. Nat. Fish. 48(13):9-24.

Hitz, C. R. 1970. Operation of the Soviet trawl fleet off the Washington and Oregon coasts during 1966 and 1967. U.S. Fish Wildl. Serv., Circ. 332:53-76.

Ianelli, J. N., D. H. Ito, and M. Wilkins. 1992. Status and future prospects for the Pacific ocean perch resource in waters off Washington and Oregon as assessed in 1992. Appendix C in Status of the Pacific Coast Groundfish Fishery through 1992 and Recommended Acceptable Biological Catches for 1993. Pacific Fishery Management Council, 2000 SW First Ave., Portland, OR 97201, 45 p.

Ianelli, J. N., M. Wilkins, and S. Harley. 2000. Status and future prospects for the Pacific ocean perch resource in waters off Washington and Oregon as assessed in 2000. Appendix to the Status of the Pacific Coast Groundfish Fishery through 2000 and Recommended Acceptable Biological Catches for 2001, Pacific Fishery Management Council, 2000 SW First Ave., Portland, OR 97201, 54 p.

INPFCa (International North Pacific Fisheries Commission). 1966. Proceedings of the thirteenth annual meeting. Vancouver B.C., INPFC.

INPFCa (International North Pacific Fisheries Commission). 1967. Proceedings of the fourteenth annual meeting. Vancouver B.C., INPFC.

INPFCa (International North Pacific Fisheries Commission). 1968. Proceedings of the fifteenth annual meeting. Vancouver B.C., INPFC.

INPFCa (International North Pacific Fisheries Commission). 1969. Proceedings of the sixteenth annual meeting. Vancouver B.C., INPFC.

INPFCa (International North Pacific Fisheries Commission). 1974. Proceedings of the 21st annual meeting. Vancouver B.C., INPFC.

INPFCa (International North Pacific Fisheries Commission). 1975. Proceedings of the 22nd annual meeting. Vancouver B.C., INPFC.

INPFCa (International North Pacific Fisheries Commission). 1976. Proceedings of the 23rd annual meeting. Vancouver B.C., INPFC.

INPFCa (International North Pacific Fisheries Commission). 1977. Proceedings of the 24th annual meeting. Vancouver B.C., INPFC.

INPFCa (International North Pacific Fisheries Commission). 1979. Proceedings of the 26th annual meeting. Vancouver B.C., INPFC.

INPFCa (International North Pacific Fisheries Commission). 1980. Proceedings of the 27th annual meeting. Vancouver B.C., INPFC.

INPFCa (International North Pacific Fisheries Commission). 1981. Proceedings of the 28th annual meeting. Vancouver B.C., INPFC.

INPFCa (International North Pacific Fisheries Commission). 1982. Proceedings of the 29th annual meeting. Vancouver B.C., INPFC

INPFCb (International North Pacific Fisheries Commission). 1967. Statistical Yearbook 1967. Vancouver B.C.

INPFCb (International North Pacific Fisheries Commission). 1968. Statistical Yearbook 1968. Vancouver B.C.

INPFCb (International North Pacific Fisheries Commission). 1969. Statistical Yearbook 1969. Vancouver B.C.

INPFCb (International North Pacific Fisheries Commission). 1980. Statistical Yearbook 1980. Vancouver B.C.

INPFCb (International North Pacific Fisheries Commission). 1981. Statistical Yearbook 1981. Vancouver B.C.

INPFCb (International North Pacific Fisheries Commission). 1982. Statistical Yearbook 1982. Vancouver B.C.

INPFCb (International North Pacific Fisheries Commission). 1983. Statistical Yearbook 1983. Vancouver B.C.

Ito, D. H., D. K. Kimura, and M. E. Wilkins. 1987. Status and future prospects for the Pacific ocean perch resource in waters off Washington and Oregon as assessed in 1986. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-F/NWC-113, 50 p.

Jewell, E. D., G. DiDonato, and D. E. Day. 1966. Observations of the Russian fishing fleet by Washington State Department of Fisheries biologists while aboard the chartered troller *Hulda I*. Unpubl. manuscr., 23 p. (Available from Brad Pattie, WDFW, 600 Capitol Way N., Olympia, WA 98501.)

Kaczynski, V. 1981. Foreign fleets in the N.E. Pacific hake fisheries: economic efficiency analysis. Inst. Marine Studies, Univer. Wash./ Natl. Mar. Fish. Serv., Cooperative Agreement Project Report. Unpubl. manuscr., 85 p. (Available in HAL database documents held by PacFIN, 7600 Sandpoint Way N.E., Bldg. 4, Seattle, WA 98115.)

Ketchen, K. S. 1977. A summary of foreign and domestic fisheries for groundfish off the west coast of Canada, 1964-1975. Fish. Res. Bd. Can. Man. Rep. Ser. 1423, 35 p.

Ketchen, K. S. 1980. Reconstruction of Pacific ocean perch (*Sebastes alutus*) stock history in Queen Charlotte Sound part I. Estimation of foreign catches, 1965-1976. Can. MS Rep. Fish. Aquat. Sci. 1570, 46 p.

Larkins, H. A. 1975. All-nation removals of groundfish and herring from the Eastern Bering Sea and northeastern Pacific ocean, 1967-1973. Unpubl. manuscr., 11 p. (Document 1753 submitted to

the International North Pacific Fisheries Commission, June 1975.) (Available from Alaska Fisheries Science Center, Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NW, Seattle, WA 98115-0070).

Larkins, H. A. Unpubl. data. March 9, 1976 Memo to NMFS and other biologists. (Available from Donald Gunderson, School of Aquatic and Fisheries Sci., Box 355020, Seattle, WA 98195).

Lenarz, W. 1980. Shortbelly rockfish, *Sebastes jordani*: a large unfished resource in waters off California. Mar. Fish. Rev. 42(3-4):34-40.

Lynde, M. V. H. 1986. The historical annotated landings (HAL) database: documentation of annual harvest of groundfish from the northeast Pacific and eastern Bering Sea from 1956-1980. NOAA Tech. Memo. NMFS-F/NWC 103, 197 p. (Data available from PacFIN, 7600 Sandpoint Way N.E., Bldg. 4, Seattle, WA 98115.)

MacCall, A. D., S. Ralston, D. Pearson, and E. Williams. 1999. Status of bocaccio off California in 1999 and outlook for the next millennium. Appendix to the Status of the Pacific Coast Groundfish Fishery through 1999 and Recommended Acceptable Biological Catches for 2000, Stock Assessment and Fishery Evaluation. Pacific Fishery Management Council, 2000 SW First Ave., Portland, OR 97201, 45 p.

Miller, D. J. and R. N. Lea. 1972. Guide to the coastal marine fishes of California. CDFG, Fish Bull. 157. 249 p.

Morski Instytut Rybacki. Unpubl. data. Tables for Polish Nominal Catches in North East Pacific/ INPFC Columbia and Vancouver subareas for January - December 1975 by species, months, and vessel class, W Gdynia, Poland. April 10, 1976. (Available from Donald Gunderson, School of Aquatic and Fisheries Sci., Box 355020, Seattle, WA. 98195.)

Murai, S. Unpubl. data a. Reported Polish Catches (t) in the Northeastern Pacific ocean - 1976. Summary table evidently based on a 1977 processed report, Polish nominal catch in northeast Pacific/INPFC statistical area for Jan-Dec., 1976 by months, subareas and species/metric tons. W Gdynia, Poland. (Available in HAL database documents held by PacFIN, 7600 Sandpoint Way N.E., Bldg. 4, Seattle, WA. 98115.)

Murai, S. Unpubl. data b. Tables of Republic of Korea catch for P.o.p. in 1975 and 1976 by gear and INPFC area and California, Oregon, and Washington for 1976. (Available in HAL database documents held by PacFIN, 7600 Sandpoint Way N.E., Bldg. 4, Seattle, WA 98115.)

Murai, S., H. A. Gangmark, and R. R. French. 1981. All-nation removals of groundfish, herring, and shrimp from the Eastern Bering Sea and Northeast Pacific Ocean, 1964-1980. NOAA Tech. Memo. NMFS-F/NWC-14. 40 p.

Nelson, M. O. 1970. Pacific hake fishery in Washington and Oregon coastal waters. U.S. Fish Wildl. Serv., Circ. 332:43-52.

Nelson, M. O. and H. A. Larkins. 1970. Distribution and biology of Pacific hake: a synopsis. U.S. Fish Wildl. Serv., Circ. 332:24-33.

Nelson, R., Jr., J. Wall, and J. Berger. 1983. Summary of U.S. observer sampling of foreign and joint-venture fisheries in the northeast Pacific Ocean and eastern Bering Sea, 1982. (Document submitted to the annual meeting of the International North Pacific Fisheries Commission, Anchorage, Alaska, October 1983). Northwest and Alaska Fisheries Center, National Marine Fish. Serv., NOAA, 2725 Montlake Blvd. E., Seattle, WA 98112.

Nitsos, R. J. 1965. Species composition of rockfish (family *Scorpaenidae*) landed by California otter trawl vessels, 1962-1963. Pac. Mar. Fish Comm. Rpt. (17):55-60.

NMFS (National Marine Fisheries Service, Northwest and Alaska Fisheries Center). 1977. Fishery statistics of the Republic of Korea for 1976 in the Eastern Bering Sea and Northeastern Pacific ocean as provided to the U.S. by the Republic of Korea. Unpubl. manuscr., 5 p. (Document submitted to the International North Pacific Fisheries Commission, September 1977.) (Available in HAL database documents, PacFIN, 7600 Sandpoint Way N.E., Bldg. 4, Seattle, WA 98115.)

Novikov, N. P. and E. I. Chernyy. 1967. Soviet fishery prospects in the Eastern Pacific Ocean. [In English and Russian]. Rybnoye Khozyaystvo, Moscow, USSR (3):5-7.

Parks, N. 1974. Allocation of U.S.S.R. trawl catches in 1972 by INPFC statistical areas and month. Unpubl. manuscr., 3 p. (Document submitted to the International North Pacific Fisheries Commission, October 1974). (Available from Alaska Fisheries Science Center, Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NW, Seattle, WA 98115-0070).

Parks, N. 1975. Allocation of U.S.S.R. and Republic of Korea groundfish catches in 1973 by Halibut Conservation Areas in the Bering Sea and INPFC statistical areas in the Northeastern Pacific Ocean. Unpubl. manuscr., 7 p. (Document submitted to the International North Pacific Fisheries Commission, June 1975.) (Available from Alaska Fisheries Science Center, Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NW, Seattle, WA 98115-0070.)

Parks, N. 1976. Allocation of U.S.S.R. and Republic of Korea groundfish catches in 1974 by Halibut Conservation Areas in the Bering Sea and INPFC statistical areas in the Northeastern Pacific Ocean. Unpubl. manuscr., 6 p. (Document submitted to the International North Pacific Fisheries Commission, May 1976). (Available from Alaska Fisheries Science Center, Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NW, Seattle, WA 98115-0070).

Parks, N. B. and T. A. Dark. 1972. Allocation of U.S.S.R. and South Korean trawl catches by INPFC statistical areas by month, 1967-70. Unpubl. manuscr., 12 p. (Document 1515 submitted to the International North Pacific Fisheries Commission, September 1972.) (Available from Alaska Fisheries Science Center, Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NW, Seattle, WA 98115-0070.)

Pattie, B. H. 1966. Further observations of the Russian fishing fleet while aboard the chartered troller Hulda I. Unpubl. manuscr., 2 p. (Available from Brad Pattie, WDFW, 600 Capitol Way N., Olympia, WA 98501.)

PFMC (Pacific Fishery Management Council). 1992. Status of the Pacific coast groundfish fishery through 1992 and recommended acceptable biological catches for 1993. Pacific Fishery Management Council, 2000 SW First Ave., Portland, OR 97201, 82 p.

PFMC (Pacific Fishery Management Council). 2000. Status of the Pacific coast groundfish fishery through 2000 and recommended acceptable biological catches for 2001. Pacific Fishery Management Council, 2000 SW First Ave., Portland, OR 97201, 40 p.

Polutov, L. A,. L. L. Lagunov, P. G. Nikulin, V. D. Verein, and V. G. Dorzdov. 1966. Commercial fishes of Kamchatka. Petrapavlovsk, Kamchatka, U.S.S.R. (as cited in Ketchen 1980).

Pruter, A. Unpubl. data. 1977. Memo to W. H. Neibohm regarding Republic of Korea catch estimates made by B. Larkins. (Available in HAL database documents held by PacFIN, 7600 Sandpoint Way N.E., Bldg. 4, Seattle, WA 98115.)

Ralston, S., D. Pearson, and J. Reynolds. 1998. Status of the chilipepper rockfish stock in 1998. Appendix to the Status of the Pacific Coast Groundfish Fishery through 1998 and Recommended Acceptable Biological Catches for 1999, Stock Assessment and Fishery Evaluation. Pacific Fishery Management Council, 2000 SW First Ave., Portland, OR 97201, 99 p.

Rogers, J. B. 1994. Assemblages of groundfish caught using commercial fishing strategies off the coasts of Oregon and Washington from 1985-1987. PhD Thesis, Oregon State University, Corvallis, OR. 134 p.

Rogers, J. B., and J. R. Bence. 1992. Review of fishery and auxiliary data for chilipepper rockfish in the Eureka/Conception/Monterey INPFC areas. Appendix F in Status of the Pacific Coast Groundfish Fishery through 1992 and Recommended Acceptable Biological Catches for 1993, Stock Assessment and Fishery Evaluation. Pacific Fishery Management Council, 2000 SW First Ave., Portland, OR 97201, 18 p.

Rogers, J. B., and E. K. Pikitch. 1992. Numerical definition of groundfish assemblages caught off the coasts of Oregon and Washington using commercial fishing strategies. Can. J. Fish. Aquat. Sci. 49:2648-2656.

Rogers, J. B., T. Builder, P. Crone, J. Brodziak, R. D. Methot, R. J. Conser, and R. Lauth. 1998. Status of the shortspine thornyhead resource in 1998. Appendix to the Status of the Pacific Coast Groundfish Fishery through 1998 and Recommended Acceptable Biological Catches for 1999, Stock Assessment and Fishery Evaluation. Pacific Fishery Management Council, 2000 SW First Ave., Portland, OR 97201, 64 p.

Rogers, J. B., R. D. Methot, T. L. Builder, and K. Piner. 2000. Status of darkblotched rockfish (*Sebastes crameri*) resource in 2000. Appendix to the Status of the Pacific Coast Groundfish Fishery through 2000 and Recommended Acceptable Biological Catches for 2001, Stock Assessment and Fishery Evaluation. Pacific Fishery Management Council, 2000 SW First Ave., Portland, OR 97201, 71 p.

Sampson, D. B., and E. M. Stewart. 1994. Status of canary rockfish resource off Oregon and Washington in 1994. Appendix G in Pacific Fishery Management Council. Status of the Pacific Coast Groundfish Fishery through 1994 and Recommended Acceptable Biological Catches for 1995. Pacific Fishery Management Council, 2000 SW First Ave., Portland, OR 97201, 62 p.

Sasaki, T. Fishery Agency of Japan. 1977. Outline of the Japanese groundfish fishery in the Northeastern Pacific, 1976. Submitted to the International North Pacific Fisheries Commission.

Sneath, P. H. A., and R. R. Sokal. 1973. Numerical taxonomy. The principles and practice of numerical classification. Freeman, San Francisco. 573 p.

Soviet Union. Unpubl. data. Statistics Form NI for 1974. (Available from Donald Gunderson, School of Aquatic and Fisheries Sci., Box 355020, Seattle, WA 98195.)

STAR (Stock Assessment Review). 2000. Darkblotched rockfish STAR panel meeting report. *In*: Status of the Pacific coast groundfish fishery through 2000 and recommended acceptable biological catches for 2001. Pacific Fishery Management Council, 2000 SW First Ave., Portland, OR 97201, 17 p.

STAT (Stock Assessment Team). 1999. Status of the canary rockfish resource off Oregon and Washington in 1999. Appendix to the Status of the Pacific Coast Groundfish Fishery through 1999 and Recommended Acceptable Biological Catches for 2000. Pacific Fishery Management Council, 2000 SW First Ave., Portland, OR 97201, 111 p.

Takahaski, Y. Fishery Agency of Japan. 1968. Outline of the Japanese groundfish fishery in the northeastern Pacific ocean, 1967. Unpubl. manuscr., 10 p. (Document 1086 submitted to the International North Pacific Fisheries Commission.) (Available from Alaska Fisheries Science Center, Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NW, Seattle, WA 98115-0070.)

Tagart, J. V. 1984. Update of the yellowtail rockfish status of stocks. Appendix 8 in Status of the Pacific Coast Groundfish Fishery and Recommendations for management in 1985. Pacific Fishery Management Council, 2000 SW First Ave., Portland, OR 97201, 37 p.

Tagart, J. V. 1985. Estimated domestic trawl rockfish landings, 1963-1980. Unpubl. manuscr. and data. Wash. Dep. Fish. (Available in HAL database documents held by PacFIN, 7600 Sandpoint Way N.E., Bldg. 4, Seattle, WA 98115.)

Tagart, J. V. 1988. Status of the yellowtail rockfish stocks in the International North Pacific Fishery Commission Vancouver and Columbia areas. U.S. Dept. Commerce, NOAA Tech. Rept. NMFS 48, 57 p.

Tagart, J. V. 1993. Status of the yellowtail rockfish resource in 1993. Appendix E, Status of the Pacific Coast Groundfish Fishery through 1993 and Recommended Acceptable Biological Catches for 1994. Pacific Fishery Management Council, 2000 SW First Ave., Portland, OR 97201, 51 p.

Tagart, J. V. Unpubl.data. (Available from Jack V. Tagart, WDFW, 600 Capitol Way N., Olympia, WA 98501.)

Tagart, J. V., and F. R. Wallace. 1996. Status of the yellowtail rockfish resource in 1996. Appendix D, Volume II to the Status of the Pacific Coast Groundfish Fishery through 1996 and Recommended Acceptable Biological Catches for 1997. Pacific Fishery Management Council, 2000 SW First Ave., Portland, OR 97201, 166 p.

Tagart, J. V., F. R. Wallace, and J. N. Ianelli. 2000. Status of the yellowtail rockfish resource in 2000. *In*: Appendix to the Status of the Pacific Coast Groundfish Fishery through 2000 and Recommended Acceptable Biological Catches for 2001. Pacific Fishery Management Council, 2000 SW First Ave., Portland, OR 97201, 127 p.

TSC (Technical sub-committee of the International Trawl Fishery Committee). 1967. Report of the technical sub-committee (TSC) of the International Trawl Fishery Committee. Minutes of the Eighth Annual Meeting. Nanaimo, B.C.

TSC (Technical sub-committee of the International Trawl Fishery Committee). 1969. Report of the technical sub-committee (TSC) of the International Trawl Fishery Committee. Minutes of the Tenth Annual Meeting. Seattle, WA.

TSC (Technical sub-committee of the International Trawl Fishery Committee). 1971. Report of the technical sub-committee (TSC) of the International Trawl Fishery Committee. Minutes of the Twelfth Annual Meeting. Vancouver, B.C.

TSC (Technical sub-committee of the International Trawl Fishery Committee). 1973. Report of the technical sub-committee (TSC) of the International Trawl Fishery Committee. Minutes of the Fourteenth Annual Meeting. Seattle, WA.

TSC (Technical sub-committee of the International Trawl Fishery Committee). 1976. Report of the technical sub-committee (TSC) of the International Trawl Fishery Committee. Minutes of the Seventeenth Annual Meeting. Newport, OR.

USBCF (United States Bureau of Commercial Fisheries). 1966. Commercial Fisheries Review 28 (4-11).

USBCF (United States Bureau of Commercial Fisheries). 1967. Commercial Fisheries Review 29 (1-12).

USBCF (United States Bureau of Commercial Fisheries). 1968. Commercial Fisheries Review 30 (1-12).

USBCF (United States Bureau of Commercial Fisheries). 1969. Commercial Fisheries Review 31 (1-12).

U.S. (U.S. National Marine Fisheries Service, Northwest Fisheries Center).1967. Cruise reports of U.S. observers aboard Japanese stern trawlers in the Gulf of Alaska during 1967. Unpubl. manuscr., 10 p. (Document 1017 submitted to the International North Pacific Fisheries Commission, October 1967.) (Available from Alaska Fisheries Science Center, Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NW, Seattle, WA 98115-0070.)

U.S. (U.S. National Marine Fisheries Service, Northwest Fisheries Center). 1973. Allocation of U.S.S.R. and South Korean trawl catches in 1971 and 1972, respectively, by INPFC statistical areas and month. Unpubl. Manuscr., 3 p. (Document 1607 submitted to the International North

Pacific Fisheries Commission). (Available from Alaska Fisheries Science Center, Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NW, Seattle, WA 98115-0070).

U.S. (U.S. National Marine Fisheries Service, Northwest Fisheries Center). 1975. Foreign fisheries off Washington, Oregon, and California August 1974 to July 1975. Unpubl. manuscr., 4 p. (Document 1784 submitted to the International North Pacific Fisheries Commission.) (Available from Alaska Fisheries Science Center, Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NW, Seattle, WA 98115-0070.)

VNIRO (All-Union Research Institute of Marine Fisheries and Oceanography). 1978. U.S.S.R. groundfish catches (m.t.) in the northeastern Pacific by INPFC area, 1975-1977. Unpubl. manuscr., 3 p. (Document submitted to the International North Pacific Fisheries Commission, September 1978.) (Available from Alaska Fisheries Science Center, Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NW, Seattle, WA 98115-0070.)

WFSD (Washington State Fisheries Department). Unpubl. data. Foreign fishery surveillance reports, Flights 1-12, July 17, 1967-Oct. 4, 1968, 33 p. (Available from Brad Pattie, WDFW, 600 Capitol Way N., Olympia, WA 98501.)

Westrheim, S. J. 1967. *G. B. Reed* groundfish cruise reports, 1963-1966. Fish. Res. Bd. Can. Tech. Rep. 30. 47 p.

Westrheim, S. J., and H. Tsuyuki. 1967. *Sebastodes reedi*, a new scorpaenid fish in the northeast Pacific Ocean. J. Fish. Res. Bd. Canada 24(9):1945-1954.

Westrheim, S. J., D. R. Gunderson, and J. M. Meehan. 1972. On the status of Pacific ocean perch (*Sebastes alutus*) stocks off British Columbia, Washington, and Oregon in 1970. Fish. Res. Bd. Can. Tech. Rep. 326. 44 p.

Williams, E. H., A. D. MacCall, S. V. Ralston, and D. E. Pearson. 2000. Status of the widow rockfish resource in Y2K. Appendix to the Status of the Pacific Coast Groundfish Fishery through 2000 and Recommended Acceptable Biological Catches for 2001. Pacific Fishery Management Council, 2000 SW First Ave., Portland, OR 97201, 122 p.

Williams, E., S. Ralston, A. D. MacCall, D. Woodbury, and D. E. Pearson. 1999. Stock assessment of the canary rockfish resource in the waters off Southern Oregon and California in 1999. *In*: Appendix to the Status of the Pacific Coast Groundfish Fishery through 1999 and Recommended Acceptable Biological Catches for 2000. Pacific Fishery Management Council, 2000 SW First Ave., Portland, OR 97201, 75 p.

Yamaguchi, H. Fishery Agency of Japan. 1971. Outline of the Japanese groundfish fishery in the northeastern Pacific in 1970 (Nov. 1969-Oct. 1970). Unpubl. manuscr., 17 p. (Document 1407 submitted to the International North Pacific Fisheries Commission, August 1971.) (Available from Alaska Fisheries Science Center, Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NW, Seattle, WA 98115-0070.)

Yamaguchi, H. Fishery Agency of Japan. 1972. Outline of the Japanese groundfish fishery in the northeastern Pacific in 1971 (Nov. 1970-Oct. 1971). Unpubl. manuscr., 9 p. (Document 1492 submitted to the International North Pacific Fisheries Commission, September 1972.) (Available from Alaska Fisheries Science Center, Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NW, Seattle, WA 98115-0070.)

Yamaguchi, H. Fishery Agency of Japan. 1973. Outline of the Japanese groundfish fishery in the northeastern Pacific (Nov. 1971-Oct. 1972). Unpubl. manuscr., 17 p. (Document submitted to the International North Pacific Fisheries Commission, September 1973.) (Available from Alaska Fisheries Science Center, Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NW, Seattle, WA 98115-0070.)

Yamaguchi, H. Fishery Agency of Japan. 1974. Outline of the Japanese groundfish fishery in the northeastern Pacific, 1973. Unpubl. manuscr., 21 p. (Document submitted to the International North Pacific Fisheries Commission, September 1974.) (Available from Alaska Fisheries Science Center, Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NW, Seattle, WA 98115-0070.)

Yamaguchi, H. Fishery Agency of Japan. 1975. Outline of the Japanese groundfish fishery in the northeastern Pacific, 1974. Unpubl. manuscr., 18 p. (Document submitted to the International North Pacific Fisheries Commission, August 1975.) (Available from Alaska Fisheries Science Center, Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NW, Seattle, WA 98115-0070).

Yamaguchi, H. Fishery Agency of Japan. 1976. Outline of the Japanese groundfish fishery in the northeastern Pacific, 1975. Unpubl. manuscr., 24 p. (Document submitted to the International North Pacific Fisheries Commission, September 1976.) (Available from Alaska Fisheries Science Center, Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NW, Seattle, WA 98115-0070).

APPENDIX A: CATCH BY INPFC AREA, CALENDAR YEAR, AND REPORTING CATEGORY

INPFC areas referred to in this document are often shortened in tables and figures as follows: Washington, Oregon, and California = WOC; Washington and Oregon = WO; Washington = W; Oregon = O; California = C; Conception INPFC = CON; Monterey INPFC = MON; Eureka INPFC = EUR; Columbia INPFC = COL; U.S. Vancouver = UVAN; entire Vancouver = VAN.

Table A-1. Comparison of available estimates of Soviet rockfish catch (t) off Washington, Oregon, and California during 1965-76. If sources used other names, catches are placed under categories by matching amounts. Estimates used in this document are in bold. Number preceding symbol (——•) is the total value for the block of cells indicated. For example, under year 1973, the B.C. (Larkins cited) total amount for POP and Other is 1911.

	Year/ Category															
Source	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**		**74**		**75**		**76**	
Area	**Rock[a]**	**Rock**	**Rock**	**Rock**	**Rock**	**Rock**	**Rock**	**Rock**	**POP[b]**	**Other[c]**	**Rock**	**Other**	**Rock**	**Other**	**Rock**	**Other**
Larkins (1975)																
B.C.[d]			6575	7306	1607	186	900	401	1911 ——	•						
WOC			**37611**	**16251**	**2623**	**2621**	**2462**	**2209**	6125 ——	•						
INPFCa (1975) (cited Larkins 1975)																
B.C.			6575	7306	1607	186	900	401	1911 ——	•						
WO			19845	7110	2241	2621	2462	1629	6125 ——	•						
C			17766	9141	382	0	0	580	↓ ——	•						
Forrester et al. (1978)																
B.C.		33000	7000	7000	2000	trace										
WOC		**41000**	38000	16000	3000	3000										
Murai et al. (1981) (cited Larkins 1975, Forrester et al. 1978)																
B.C.	0	33000	6575	7306	1607	186	0	401	1911 ——	•	2536 ——	•	239 ——	•	313 ——	•
WOC	0	41000	37611	16251	2623	2621	2462	2209	6125 ——	•	2536 ——	•	2014 ——	•	2394 ——	•
RTSC (1967)[66]																
B.C.		54885														
WOC		9900														
Canada (1969)																
WOC		50000	10000	5000												
INPFCa (1969) (cited Canadian section of INPFC 1969)																
WOC		10000	10000	5000												
USBCF (1968)																
WO		10000	7500													
C			20-30,000													
Hitz (1970) (cited USBCF 1968)																
WO		10000	7500													

Table A-1. Comparison of available estimates of Soviet rockfish catch (t) off Washington, Oregon, and California during 1965-76. Continued.

Source	Year/ Category															
	65	66	67	68	69	70	71	72	73		74		75		76	
Area	Rock[a]	Rock	Rock	Rock	Rock	Rock	Rock	Rock	POP[b]	Other[c]	Rock	Other	Rock	Other	Rock	Other
Soviet Union (1974)																
B.C.[d]											106	70				
W											**349**	**88**				
O											**1197**	**12**				
C											**871**	**19**				
VNIRO (1978)[75,76]																
VAN													**152**	**87**	**187**	**126**
COL													**784**	**9**	**607**	**19**
EUR													**201**	**3**	**263**	**9**
MON													**15**	**1002**	**35**	**1461**
Forrester et al. (1983)																
VAN							900[e]	401[e]	490	303	106[e]	70[e]	152	87	187	126
COL							2462	1629	539	2532	1546	100	784	9	607	19
EUR							0	581	83	708	871	19	201	3	263	9
MON							↓	↓	19	2233	↓	↓	15	1002	35	1461
CON							↓	↓	0	0	↓	↓	0	0	0	0
Parks and Dark (1972)[67-70], **NMFS (1973)**[71], **Parks (1974)**[72], **Parks (1975)**[73], **Parks (1976)**[74]																
VAN		**10263**	**4602**	**2143**	**814**	**1145**	**878**	**490**	**303**	**280**	**113**					
COL		**15637**	**4844**	**1699**	**1990**	**1649**	**957**	**539**	**2532**	**1301**	**57**					
EUR		**36**	**4549**	**21**	**2**	**0**	**258**	**83**	**708**	**373**	**7**					
MON		**17766**[f]	**4899**	**360**	**0**	**0**	**129**	**19**	**2234**	**569**	**12**					
Fraidenburg et al. (1977) (cited Parks and Dark 1972, NMFS 1973, Parks 1974-1976)																
VAN		10263	4602	2143	814	1145	878		303		113		87			
COL		15637	4844	1699	1990	1649	957		2532		57		9			
EUR		36	4549	21	2	0	258		708		7		3			
MON		17766	4899	360	0	0	129		2234		12		1002			

[a] Rockfishes
[b] Pacific ocean perch, a category name used by Soviet Union
[c] Other rockfishes, a category name used by Soviet Union
[d] British Columbia
[e] VAN + CHARLOTTE
[f] Catch placement based on Soviet reports, surveillance indicates significant fishing in N. and S. California

Table A-2. Comparison of Soviet catch (t) estimates in 1966-68 in the literature versus calculations.

Year	Area	Type (units)	Category	January	February	March	April	May	August	December	Total
1966	WOC	Effort (#)[a]	large vessels				3	7	2	5	
			medium vessels				23	11	16	4	
			days				27	31	15	21	
		Catch (t)	low[b]				9595	10445	3669	4119	27828
			high[c]				14426	22586	5464	9945	52421
			Ketchen[d]				7214	7688	2760	3007	20670
			Literature[e]								10000-50000
1967	WO	Effort (#)	large vessels	1	2	2	2				
			medium vessels	0	3	3	24				
			days	31	28	31	13				
		Catch (t)	low	623	1775	1965	2935				7298
			high	1765	3873	4288	4019				13945
			Ketchen	500	1393	1543	2241				5677
			Polutov[f]	970	2130	2500	3271				8871
			Literature								7,500-19845
1968	WO	Effort (#)	large vessels	3	3	3	4				
			medium vessels	1	1	3	12				
			days	31	28	31	14				
		Catch (t)	low	1023	924	1035	840				3822
			high	2899	2618	2931	2380				10828
			Ketchen	1647	1487	1887	1864				6884
			Literature								<5000-7110

[a] Indicates numbers of vessels sighted fishing rockfish, where 1966 and 1967 were based on Hitz (1970) and 1968 is based on USBCF (1968).
[b] Indicates effort of 2.6 medium vessels equal 1 large vessel, and daily catch of large vessels is 30 t.
[c] Indicates effort of 7 medium vessels equals 1 large vessel, and daily catch of large vessels is 85 t.
[d] Uses catch/tow and tows/day presented in Ketchen (1980).
[e] The range of estimates in Table A-1.
[f] Estimates utilize catch per month estimates in Polutov et al. (1966).

Table A-3. Calculation of Soviet catch (t) in U.S. Vancouver INPFC area. WOC estimates are from Forrester et al. (1978) for 1966, Larkins (1975) for 1967-72, and Soviet Union (Unpubl. data) for 1974. VAN, COL, EUR, and MON estimates are from Parks and Dark (1972) for 1967-70, U.S. (1973) for 1971, and Parks (1974-76) for 1972-74. For 1967-72 and 1974, UVAN is calculated by subtracting the combined COL, EUR, MON, and CON areas (COL-CON) from WOC estimates. For 1966, catch in the MON area is estimated using vessel sighting and catch estimates (see page 12 for more information). The remainder is divided between VAN, COL, and EUR using 1967 proportions. In 1973, the 1972 and 1974 average percentage for combined rockfish in the U.S portion (77%) was applied to VAN estimates.

	Year/Category										
Area	66 Rock	67 Rock	68 Rock	69 Rock	70 Rock	71 Rock	72 Rock	73 POP	73 Other	74 Rock	74 Other
VAN		10263	4602	2143	814	1145	878	490	303	280	113
COL	27531.5	15637	4844	1699	1990	1649	957	539	2532	1301	57
EUR		36	4549	21	2	0	258	83	708	373	7
MON	6150	17766	4899	360	0	0	129	19	2234	569	12
WOC	41000	37611	16251	2623	2621	2462	2209			2417	119
COL-CON		33439	14292	2080	1992	1649	1344			2243	76
UVAN	7319	4172	1959	543	629	813	865	241	233	174	43
% U.S. in VAN		41%	43%	25%	77%	71%	99%	49%	77%	62%	38%
Washington										349	88
% Washington in VAN										50%	49%

Table A-4. Japanese catch (t) estimates reported by fishing year off Washington, Oregon, and California during 1965-76. Estimates used are in bold.

Category	Source Area	Gear	Period								
			Nov. 66-Oct. 67	Nov. 67-Oct. 68	Nov. 68-Oct. 69	Nov. 69-Oct. 70	Nov. 70-Oct. 71	Nov. 71-Oct. 72	Nov. 72-Oct. 73	Nov. 73-Oct. 74	Nov. 74-Oct. 75	Nov. 75-Oct. 76
POP[a]	**FAJ (1968** [66-67], **1969** [67-68], **1970** [68-69])											
	Yamaguchi (1971 [69-70], **1972** [70-71], **1973** [71-72], **1974** [72-73], **1975** [73-74], **1976** [74-75])											
	Sasaki (1977 [75-76])											
	VAN	all	**6678**	**4751**	**1787**	**2186**	**1838**	**1580**	**2989**	**1084**	**352**	**286**
	COL	all	**3850**	**4274**	**0**	**38**	**276**	**880**	**0**	**0**	**0**	**0**
	EUR	all	**59**	**181**	**0**	**2**	**0**	**80**	**433**	**0**	**0**	**0**
	MON	all	**0**	**1**	**29**	**23**	**0**	**0**	**139**	**0**	**0**	**0**
	CON	all	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**12**	**0**	**0**
	VAN	longline			54	35	8	14	0	0	0	
Other[b]	**FAJ (1970** [68-69])											
	Yamaguchi (1971 [69-70], **1972** [70-71], **1973** [71-72], **1974** [72-73], **1975** [73-74], **1976** [74-75])											
	Sasaki (1977 [75-76])											
	VAN	all			**91**	**288**	**267**	**346**	**1166**	**4662**	**1292**	**325**
	COL	all			**0**	**31**	**29**	**558**	**1480**	**0**	**195**	**190**
	EUR	all			**0**	**0**	**0**	**12**	**1409**	**119**	**15**	**1**
	MON	all			**0**	**0**	**0**	**0**	**1015**	**5322**	**868**	**685**
	CON	all			**0**	**0**	**0**	**0**	**484**	**57**	**0**	**0**
	VAN	longline			1	4	44	1	2	3	6	
	COL	longline				3				0	0	

[a] Pacific ocean perch, a category name used by Japan.
[b] Other rockfishes, a category name used by Japan.

Table A-5. Comparison of estimates of Japanese catch (t) reported by calendar year off Washington, Oregon, and California during 1965-76. Estimates used in this document are in bold. Number preceding symbol (⟶) is the total value for the block of cells indicated. For example, 144 is total value for for EUR, MON, and CON for 1968 in the Fraidenburg et al. 1977 citation.

Category	Source	66	67	68	69	70	71	72	73	74	75	76
POP[a]	**Canada (1969)** (cited FAJ 1968, 1969)											
	WOC		3900	4500								
	Forrester et al. (1978 [66-70], **1983** [71-76])											
	VAN	1340	6643	3695	1901	2183	1562	4295	704	692	373	219
	COL	30	4808	3311	16	22	276	880	0	0	0	0
	EUR	7	199	34	2	0	0	191	322	0	0	0
	MON	7	1	0	52	0	0	0	139	0	0	0
	CON	0	0	0	0	0	0	0	0	12	0	0
	Murai et al. (1981) (cited Forrester et al. 1978)											
	WOC	44	5006	3346	70	22	276		463	12		61
Other[b]	**Fraidenburg et al. (1977)** (cited FAJ statistics)											
	VAN			**1777**[c]	91	288	267	346	1166	4665	1298	
	COL			**666**	0	31	29	558	1480	0	195	
	EUR			**144**	0	0	0	12	1409	119	15	
	MON			⟶	0	0	0	0	1015	5322	868	
	CON			⟶	0	0	0	0	484	57	0	
	Forrester et al. (1978)[66-70], **(1983)**[71-76]											
	VAN	0	117	649	175	192	272	490	1069	5243	752	308
	COL	0	441	226	3	28	29	571	1480	0	195	207
	EUR	0	143	1	1	0	0	27	1399	114	15	1
	MON	0	0	0	10	0	0	0	1148	5393	669	690
	CON	0	0	0	0	0	0	0	486	55	0	0
	Murai et al. (1981) (cited Forrester et al. 1978)											
	WOC	0	584	226	13	28	30	585	4524	5559	879	816
Both	**Larkins (1975)** (COL-CON) (cited INPFC documents)											
	WOC		5590	3572	83	50	306	1656				

[a] Pacific ocean perch, a category name used by Japan.
[b] Other rockfishes, a category name used by Japan.
[c] Charlotte + VAN

Table A-6. Calculation of Japanese catch (t) in U.S. portion of Vancouver INPFC area. Block information was from maps in FAJ (1968)[67], (1969) [68], (1970) [69];Yamaguchi (1971)[70], (1972) [71], (1973) [72], (1975) [74], (1976) [75]; and Sasaki (1977) [76]. Block letters refer to designations in Figure A2. VAN = Vancouver INPFC area, UVAN = U.S. portion of the Vancouver INPFC. For the POP market category, the UVAN catch is calculated by applying the percentages to the Block catches. For the Other market category, the hours trawled in the U.S. portion were calculated using the same percentages. The percentage of VAN hours trawled in the U.S. was then applied to the VAN catch to derive the UVAN catch. Data from 1 November - 31 October was assigned to the later (31 October) year.

Category	Units	Year	Block									Totals		
			100% A	100% B	77% C	100% D	63% E	4% F	Total	UVAN (hour)	VAN (hour)	UVAN %	VAN (t)	UVAN (t)
POP	t	67	101	1470	0	0	1388	804	3763			37%	6678	2478
POP	t	68	0	610	0	0	1252	1158	3020			30%	4751	1445
POP	t	69	0	0	0	0	11	41	52			0.5%	1787	9
POP	t	70	0	13	0	0	57	192	262			3%	2186	57
POP	t	71	78	26	1	0	120	307	532			10%	1838	193
POP	t	72	0	65	14	0	143	124	346			11%	1580	171
POP	t	73	0	77	4	0	209	28	318			7%	2989	213
POP	t	74	0	54	0	0	623	137	814			42%	1084	452
Other	hour	68	0	232	0	12	355	244	843	477	1184	40%		
Other	hour	69	0	0	0	0	20	25	45	14	421	3%	91	3
Other	hour	70	18	9	0	0	155	84	266	128	1062	12%	288	35
Other	hour	71	90	43	14	0	155	174	476	248	1254	20%	267	53
Other	hour	72	0	53	11	0	197	137	398	191	1159	16%	346	57
Other	hour	73	0	162	9	0	175	146	492	285	2474	12%	1166	134
Other	hour	74	0	186	0	4	951	582	1723	812	2849	29%	4665	1330

Table A-7. Comparison of available estimates of foreign catch (t) for other countries off Washington, Oregon, and California during 1965-76. Estimates used in this document in bold. Murai et al. (1981) estimates are considered "rockfish" if there is an estimate in one of their two categories and they did not put a dash in the other category.

Country	Source Area	73 POP	74 POP	75 POP	75 Other	75 Rock	76 POP	76 Other	76 Rock
Poland	**Murai et al. (1981)**								
	WOC	**8**	120			2638			427
	Gunderson et al. (1977) [74], **Fraidenburg et al. (1978)** [74-77]								
	VAN		**32**	0					
	COL		**94**	**39**					
	Ketchen (1977)								
	VAN		0	12243					
	Morski Instytut Rybacki (unpubl. data) [75], **Murai (unpubl. data a)** [76]								
	VAN					12243			4614-4684
	COL					819			**247**-425
	EUR					?			**157**-204
	MON					?			**23**-58
	Fraidenburg et al. (1977)								
	VAN				12243				
	COL				**780**				
	EUR				**577**				
	MON				**1138**				
Republic of Korea	**Murai (unpubl. data b)***								
	VAN			**34**			**73**		
	COL			**0**			**84**		
	EUR			**0**			**70**		
	MON			**0**			**22**		
	CON			**0**			**3**		
	WOC						**208**		
	Pruter (unpubl. data)								
	WOC					50			
	Murai et al. (1981)								
	WOC					50			179
	U.S. (1977) Northeastern Pacific minus Canadian coastal area								
	WOC						234		
Bulgaria	**P.o.p. Assessment - Fraidenburg et al. (1978)** [POP VAN,COL], **Gunderson (unpubl. data)**[all]								
	VAN						23	15	
	COL						89	3	
	EUR						41	1	
	MON						7	229	
East Germany	**P.o.p. Assessment - Fraidenburg et al. (1978)** [POP VAN,COL], **Gunderson (unpubl. data)**[all]								
	VAN						25	17	
	COL						95	3	
	EUR						44	2	
	MON						7	246	

* 1975 tows were all trawl. 1976 tows were all longline.
? Data unknown.

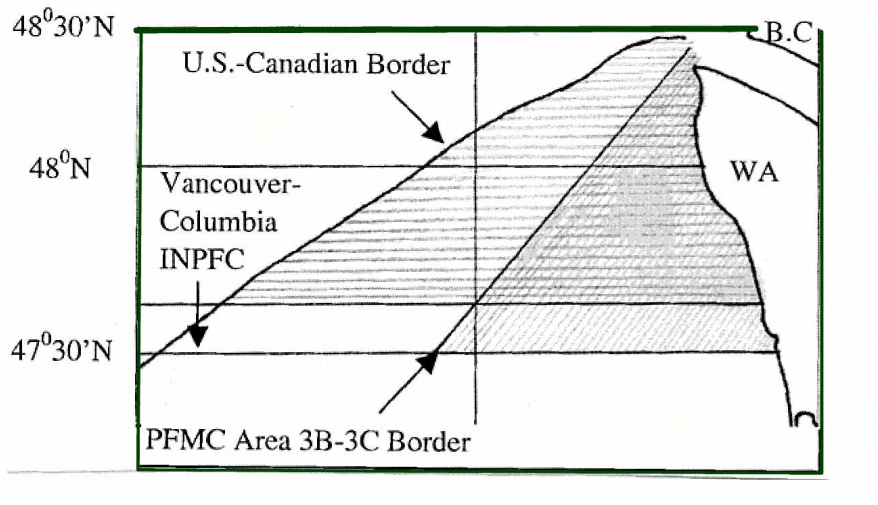

Figure A-1. Comparison of possible borders between Soviet "Washington" and "British Columbia" reporting areas. Shaded area with horizontal lines is the U.S. Vancouver INPFC. Shaded area with diagonal lines is the PFMC Area 3B. Cross-hatched area is the overlap between the two areas.

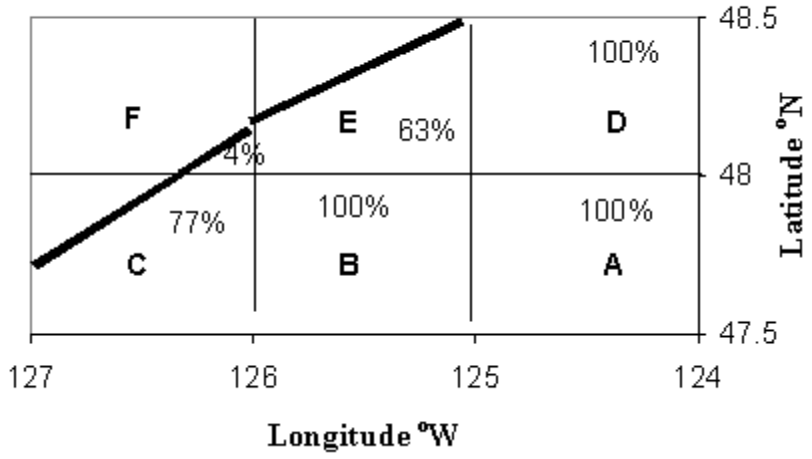

Figure A-2. Japanese block reporting areas. Bold line is the U.S.-Canadian border. Percentages are the estimated area of the block in the U.S. Letters in blocks correspond to columns in Appendix Table A-6.

APPENDIX B: DEFINING ROCKFISH FISHING STRATEGIES/ASSEMBLAGES

Table B-1. Comparison of available species composition information on shelf and slope rockfish assemblage catches during 1966-76. Published data was compiled, except Gunderson (1997), which presented the summary. Line separates species into slope or deepwater (top) versus shelf or nearshore (bottom) species as presently defined (PFMC 2000). Species less than 0.5% in all compositions were not included. Blank spaces indicates no catch of the species.

Description	**Slope**				**Shelf/Nearshore**	
Source	Douglas (1998)	Tagart (unpubl. data)	Westrheim (1967)	Gunderson (1997)	Douglas (1998)	Tagart (unpubl. data)
Type	market	market	survey	survey	market	market
Market category/target	POP	POP	P.o.p.	P.o.p.	Other	Other
Years	66-76	66-76	65	68-70	66-76	66-76
Average depth (fm)	93%>80	147	125	147	79%<80	71
Number Tows/Samples	>222	98	27	76	>404	243
% tows in UVAN	1%	94%	11%	100%	4%	90%
% tows in COL	99%	6%	89%		94%	10%
% tows in EUR	<1%				1%	
Species Composition (%weight)						
P.o.p.	56%	72%	41%	73%	1%	0%
darkblotched	20%	14%	10%	4%	1%	0%
yellowmouth	7%	2%			0%	
splitnose	5%	6%	11%	5%	1%	
shortspine/thornyhead	6%	0%	6%	2%	2%	
sharpchin	0%	0%	6%		0%	
redbanded	1%	1%			1%	0%
rougheye	0%	1%	0%	6%		0%
canary	1%	1%	2%		32%	30%
yellowtail	0%	0%	1%		35%	62%
widow	1%	0%	1%			1%
redstripe	1%	1%	0%		0%	0%
silvergray	0%	0%	5%		1%	2%
bocaccio	1%	0%	2%		3%	1%
stripetail	1%		5%		0%	
greenstriped	0%	0%	2%		1%	
rosethorn	0%	0%	1%		0%	
flag			9%			
black	0%				14%	4%
other/unidentified rock	0%	0%	0.2%	10%	0%	0%

Table B-2. Comparison of sources with information on incidental rockfish catch from targeting Pacific hake during or soon after 1966-76. Species comprising less than 0.5% in all sources are not included.

Description	Nelson (1970)	Edwards et al. (1981) Data in Table D		Dark et al. (1980) Data in Appendix III				rockfish-INPFCa (1979-82), Nelson et al.(1983), Berger et al.(1984) P.hake-INPFCb (1980-83)			
Type	fishery-reported	fishery-observed		fishery-observed				Fishery-estimated catch			
Country	U.S.A	Poland, Soviet		U.S.A				Joint Venture			
Target	P. hake	P. hake		none				P. hake			
Gear	midwater	midwater		midwater				unknown			
Years	67	77-80		77				78-83			
% rockfish/hake	0.7%	1.5%	0.6%	79%	3%	60%	30%	0.2%	6.8%	2.1%	1.9%
Rockfish (t)	6.9	298	1219	8.8	0.11	3.9	3.3	7	634	822	1084
# tows	147	1996	5411	21	14	28	25	? *	?	?	?
Area	UVAN,COL	EUR	COL	MON	EUR	COL	UVAN	MON	EUR	COL	UVAN
Species Composition (% weight)											
black	<1%	0%	1%						0%	0%	1%
bocaccio		3%	2%	2%		1%		16%	10%	2%	1%
brown		0%	1%								
canary		2%	3%		5%	1%		0%	1%	1%	5%
chilipepper		0%	0%	1%				68%	0%	1%	0%
darkblotched		1%	2%					1%	3%	2%	0%
olive		1%	0%								
P.o.p.		5%	5%					7%	5%	1%	5%
redstripe		2%	2%				2%	0%	1%	2%	1%
shortbelly		0%	0%	91%				1%	0%	0%	0%
shortspine		0%	1%								
silvergray		1%	0%								
splitnose		3%	2%	4%							
stripetail			0%						1%		
vermillion		0%	0%					1%			
widow	30%	56%	55%		87%	71%	60%	6%	72%	26%	17%
yellowmouth		3%	1%								
yellowtail	61%	22%	23%	2%	8%	27%	37%	1%	6%	65%	69%
unid. rockfish		0%	1%								
unid. red rock	9%										

* ? indicates that the number of tows is unknown.

Table B-3. Missing weights and replacement data for Soviet Union survey data from 1966-76 of the U.S. West Coast (south of lat. 48°30'N). Total number of tows is 4366. Tows with missing weights have numbers for that species but no weight data. Tows with weight and numbers have information on both. Weight per fish is average for tows with information on both weights and numbers. Units of weight are unknown, but believed to be kilograms.

Species	Number of Tows		Average Tow weight per fish
	missing weight	weight and numbers	
aurora	130	41	0.46
black	417	21	1.86
blackgill	36	21	1.40
blue	296	8	1.24
bocaccio	612	99	2.46
brown	2	3	0.71
canary	578	81	1.93
chilipepper	202	35	0.58
darkblotched	914	207	0.59
dusky	1	0	
flag	733	30	1.40
greenspotted	14	4	0.85
greenstriped	800	74	0.34
halfbanded	19	1	0.02
P.o.p.	863	201	0.66
pink	96	4	0.36
pygmy	18	3	0.06
redbanded	67	61	1.31
redstripe	189	25	0.80
rosethorn	312	11	0.22
rougheye	214	41	1.39
sharpchin	203	29	0.41
shortbelly	143	20	0.15
shortraker	9	5	7.48
shortspine	1020	106	0.30
silvergray	311	55	1.82
splitnose	739	150	0.39
stripetail	196	35	0.32
vermillion	30	1	1.50
widow	241	70	1.23
yelloweye	66	8	3.51
yellowmouth	1	7	1.96
yellowtail	269	78	1.59
Sebastes sp.	117	6	3.90
Pacific hake	1409	896	0.74

Table B-4. Comparison of clusters of tows from the 1966-76 Soviet surveys. Named clusters are those used in this document. % dissimilar = Bray-Curtis index. Catches of species in bold were used in clustering tows. Only species with > 0.5% in any cluster are included.

	Slope	Hake	S.Shelf			N. Shelf							
Cluster	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**
% dissimilar		89.5	93.6	94.2	95.4	95.7	96.1	96.6	97	97.9	98.3	98.8	99.3
tows with rockfish	1360	910	368	110	8	615	55	43	10	26	26	27	1
Tow distribution by INPFC Area													
UVAN	9%	6%	1%	30%	11%	24%	16%	9%	20%	38%	8%	19%	
COL	71%	52%	18%	61%	48%	66%	67%	67%	70%	23%	69%	70%	100%
EUR	8%	16%	6%	5%	11%	7%	5%	16%			8%		
MON	10%	25%	69%	4%	19%	4%	11%	7%	10%	38%	12%	4%	
CON	3%	2%	5%		11%						4%	7%	
Averages in clustered tows													
year	1970	1973	1972	1968	1970	1969	1970	1968	1969	1970	1967	1971	1971
month	7	6	6	7	7	7	6	7	6	6	4	9	10
time of day	1232	1204	1224	1236	1210	1265	1167	1122	742	1429	1214	967	1750
depth (fm)	168	169	95	131	203	73	84	223	105	80	84	77	70
above bottom (fm)	1	71	3	1	6	1	0	1	0	0	2	3	
speed (knots)	3	4	3	3	3	3	3	3	3	3	3	4	3.1
duration (hours)	1.0	1.3	0.9	0.8	1.0	0.9	0.8	0.9	0.8	0.6	0.8	0.7	1.0
rockfish catch	320	64	1836	112	3	461	66	6	16	42	1916	4936	0.02
hake catch	396	3918	371	1	1	164	2	0	1	0	2	0	0
Species Composition (%weight)													
black	0%	4%	0%	0%	0%	29%	0%	2%	13%	1%	0%	0%	0
blackgill	0%	0%	0%	0%	10%	0%	0%	0%	13%	0%	0%	0%	0
blue	0%	12%	0%	0%	1%	6%	0%	0%	0%	0%	99%	0%	0
bocaccio	0%	1%	5%	0%	0%	3%	5%	0%	0%	1%	0%	0%	0
canary	0%	3%	0%	1%	0%	24%	1%	0%	1%	0%	0%	0%	0
chilipepper	0%	0%	8%	1%	7%	0%	0%	0%	6%	0%	0%	0%	0
darkblotched	14%	2%	0%	1%	4%	0%	20%	0%	0%	0%	0%	0%	0
flag	1%	0%	0%	0%	0%	1%	6%	0%	49%	0%	0%	0%	0
greenstriped	0%	0%	0%	1%	0%	1%	27%	0%	0%	2%	0%	0%	0
P.o.p.	42%	2%	0%	35%	0%	6%	0%	1%	0%	0%	0%	0%	100%
redstripe	0%	1%	1%	1%	0%	6%	2%	0%	0%	50%	1%	0%	0
rosethorn	0%	0%	0%	1%	0%	0%	0%	0%	0%	1%	0%	0%	0
rougheye	1%	1%	0%	1%	0%	0%	0%	10%	11%	0%	0%	0%	0
sharpchin	0%	0%	1%	12%	0%	1%	35%	0%	0%	8%	0%	0%	0
shortbelly	0%	37%	79%	0%	1%	0%	0%	0%	0%	15%	0%	0%	0
shortspine	7%	1%	0%	2%	1%	0%	1%	64%	0%	1%	0%	0%	0
silvergray	0%	0%	0%	1%	0%	8%	0%	0%	3%	20%	0%	0%	0
splitnose	27%	1%	2%	41%	8%	0%	0%	0%	2%	1%	0%	0%	0
stripetail	1%	6%	1%	1%	1%	1%	0%	1%	0%	0%	0%	0%	0
vermillion	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%	0
widow	0%	19%	0%	0%	0%	2%	0%	0%	0%	0%	0%	98%	0
yelloweye	0%	0%	0%	0%	0%	0%	0%	0%	3%	0%	0%	0%	0
yellowtail	0%	4%	0%	0%	0%	8%	1%	0%	0%	1%	0%	2%	0
rockfish unid.	3%	2%	0%	1%	65%	3%	1%	20%	0%	0%	0%	0%	0

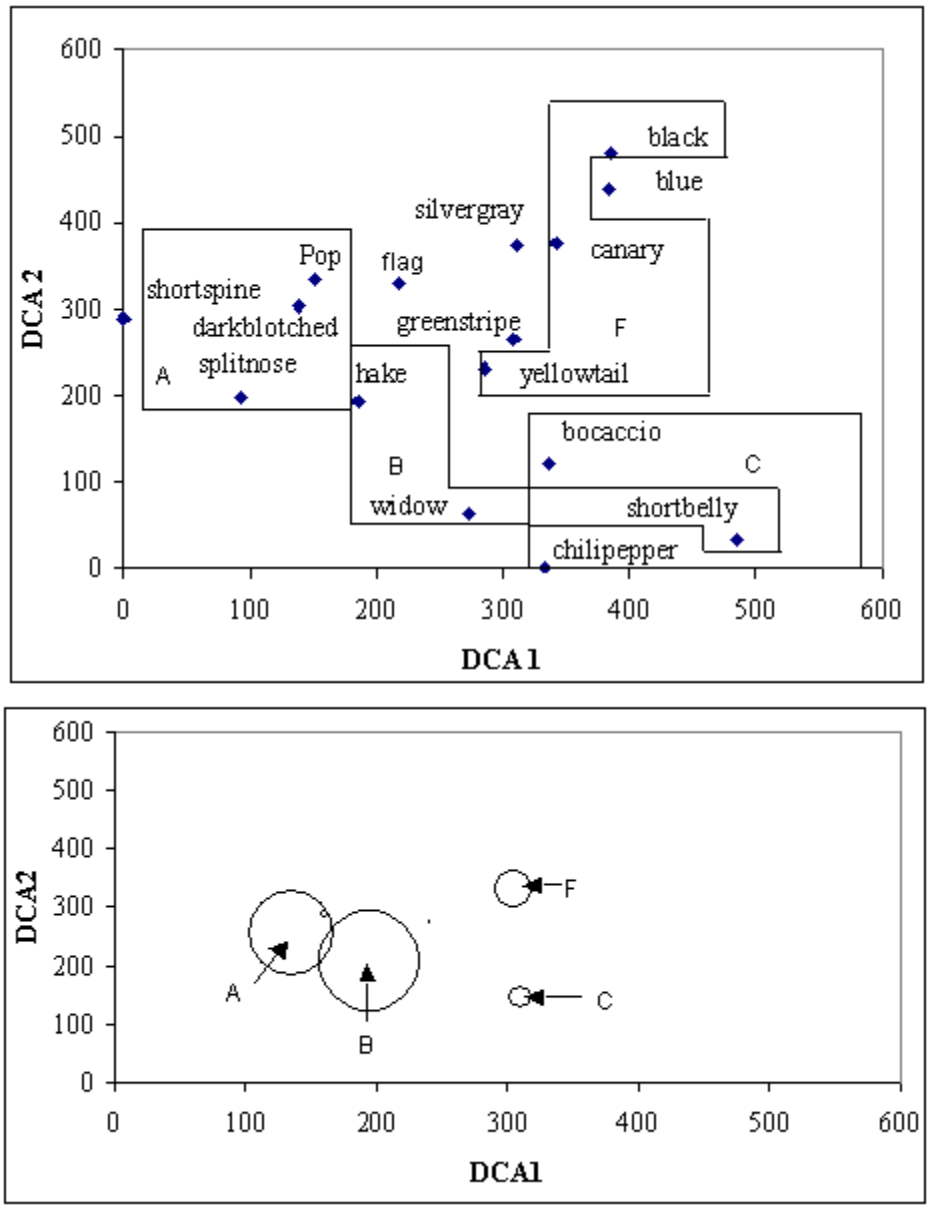

Figure B-1. Comparison of ordination scores and cluster designations for the four most-frequently occurring clusters (designated by letters assigned in Table B-4). Top graph is plot of DCA ordination species scores. Outlines enclose species which average greater than 10% of the tow catch in the four most-frequently occurring clusters. Species enclosed are: A - P.o.p., shortspine, darkblotched, and splitnose; B - hake, widow, and shortbelly; C - bocaccio and chilipepper; and F - black, canary, and yellowtail. Bottom graph plots the average ordination tow scores by cluster, with area of bubble directly related to number of tows. The four clusters with the most tows are designated with letters assigned in Table B-4.

APPENDIX C: CATCH ALLOCATION TO FISHING STRATEGIES/ASSEMBLAGES

Table C-1. Regulations and agreements affecting foreign fisheries off the U.S. West Coast in 1966-77.

Country	Year	Category	Regulation	References
Soviets	Oct. 66	closed areas	within 12 nmi of shore	USBCF 1967
	Feb. 67-Feb. 68	closed or discouraged areas	selected areas seaward of 12 nmi off WO	USBCF 1968
	Nov.68	no specialized fishery for rockfish	south of 48°10'N	TSC 1969
	Nov. 68	mesh size	minimum 2.4-2.8 in hake fisheries	TSC 1969
	Jan. 69-Jan. 71	closed areas for vessels over 110 ft	six rockfish areas off n. California to Washington 12/1-4/15	TSC 1969
	Feb. 71	closed areas	five P.o.p. zones in 100-300 fm December-April	TSC 1971
	Feb. 71	closed to trawl fishery	inside 60 fm between Gray's Harbour and Columbia R.	TSC 1971, INPFCa 1975
	Feb. 71	no vessel concentration, no rockfish fishery	Cape Flattery between June 15 and September 15	TSC 1971
	Feb. 73	no specialized fishery for rockfish	south of 50°30'N	TSC 1973
	Feb. 73	hake limits	150,000 t in Northeast Pacific	TSC 1973, INPFCa 1975
	Feb. 73	no special fishery for flounders and sole	south of 48°10'N	TSC 1973
	75-76	rockfish limits	2500 t in WOC (incidental catch only)	TSC 1976
	75-76	closed areas	Nov. 1-June 30 off Klamath and Columbia R.	TSC 1976, INPFCa 1975
	75-76	pot sanctuaries	two areas closed Nov. 1 - June 30	INPFCa 1975
	75-76	trawling prohibited	47°45'N-48°30'N	TSC 1976, INPFCa 1975
	75-76	trawling prohibited	south of 38°10'N	TSC 1976, INPFCa 1975
Japan	69	rockfish	agreed reduce trawl effort	TSC 1969
	71	rockfish	agreed not target south of 48°30'N	TSC 1971
	73-74	POP limits	800 t in VAN and 16 t in COL	INPFCa 1975
	75	rockfish limits	1350 t in VAN, 250 t in COL and 700 t in EUR-CON	INPFCa 1975
	75-76	trawling prohibited	47°30'N-48°30'N	INPFCa 1975
Poland	75	rockfish	agreed to not target	INPFCa 1975
	75-76	trawling prohibited	47°30'N-48°30'N	INPFCa 1975
	76	trawling prohibited	south of 38°30'N	INPFCa 1976
All other	75-76	trawling prohibited	47°30'N-48°30'N	INPFCa 1975
All foreign	77	gear restrictions	all vessels fishing for hake must use pelagic trawls	INPFCa 1977
	77	rockfish limits	not to exceed 1.3% hake catch	INPFCa 1977
	77	recommended Total Catch	< 1,000 t P.o.p., 18,000 t Other	INPFCa 1977

Table C-2. Available vessel sighting information for the Soviet Union fishery operating off the coasts of Washington, Oregon, and California in 1966. Categories under vessel number are: All (includes support vessels), M = medium fishing vessels (side trawlers), and L = large fishing vessels (stern trawlers).[1]

Source	Date mo	wk	Vessel Num. all	M	L	INPFC	Area Description	Off nmi	Depth fm	Catch species
INPFCa	Apr		23			COL	central OR			P.o.p. target
1966	May	1-2				COL	central OR			P.o.p. target
		3-4	>40			COL	Willappa			hake target
	May-	1-2	<110				mostly WA			mostly hake target
	Oct	3-4								
INPFCa	Jul		111				OR, WA			
1967	Sep	4	75				OR, WA			
	Oct	4	75				OR, WA			
USBCF	Apr	1		25	1-2	COL	OR			P.o.p. target
1966		3								
		4		22	7					
	May	1		22	15	COL	central OR	20-30		POP, some hake
		3	22			COL	Columbia R.	20-30		hake
		3	22			COL	Newport			
		4		24	10	COL	n. Columbia R.		40-50	rockfish (mostly P.o.p.), hake
	Jun	1		>30	4	COL,UVAN	WA			hake
		4		76	8	COL,UVAN	most Willapa			hake
	Jul	1		80	7		WA			hake
		2		78	9		WA			hake
		3		64	9		WA			hake
		4		76	11		WA			hake
	Aug	1		72	13	COL,UVAN	Destruction I.			
		2		77	10	COL,UVAN	WA	<50		hake, P.o.p, rock
		3		58	4	COL,UVAN	OR, WA			hake, P.o.p, rock
		4		56	2	COL	Newport, Willapa			hake, canary, greenstripe
	Sep	1		58	3	COL	n. Columbia R.			
		2		56	6		WA, OR			
		3		58	5	COL	Newport, Grays H.	12-40		hake, P.o.p., canary, yellowtail
		4			12	COL,UVAN	OR, WA			
USBCF	Oct	all				COL	OR			hake, P.o.p., rockfish
1967			70-80			COL	OR			
				8	50		OR, WA			
	Nov	all		31				15-30		mostly hake
				0	0					
				0	0					
			2	2	8		WA, OR			
	Dec	2		9	6	MON	S.F.[b]	sw	100	rockfish grounds
		4		4-5		MON	S.F.	sw	100	rockfish grounds

Table C-2. Available vessel sighting information for the Soviet Union fishery operating off the coasts of Washington, Oregon, and California in 1966. Categories under vessel number are: All (includes support vessels), M = medium fishing vessels (side trawlers), and L = large fishing vessels (stern trawlers).[1] Continued.

Source	Date		Vessel Num.			Area		Off	Depth	Catch
	mo	wk	all	M	L	INPFC	Description	nmi	fm	species
Jewell	Jul	2		1		COL	Grays H.	w		hake, some rock
et al.		2		1		COL	Moclips	w		hake, some canary, lingcod
1966				1	1	COL	Moclips	s		hake
				2						hake
				1						hake, canary
				unl[c]						hake, widow, yellowtail
		2				COL	Copalis Head	w		hake
				1	1					hake
				1	1					hake
		2		unl						ocean perch, hake, canary
				1 pr[d]						hake, yellowtail, canary
				1						ocean perch
				1 pr						hake and perch
		3		16		COL	Moclips - Pt. Grenville			hake with incidental rockfish
Pattie (1966)	Sep	3		1						hake, small amounts canary
Hitz	Jan			0	0		OR, WA			
1970	Feb			0	0		OR, WA			
	Mar			0	0		OR, WA			
	Apr			23	3		OR, WA			
	May			22	14		OR, WA			
	Jun			52	9		OR, WA			
	Jul			76	9		OR, WA			
	Aug			67	7		OR, WA			
	Sep			54	7		OR, WA			
	Oct			45	8		OR, WA			
	Nov			41	8		OR, WA			
	Dec			8	4		OR, WA			

[a] I. = Island, H. = Harbor, R. = River. Off = distance offshore.
[b] S.F. indicates San Francisco.
[c] unloading
[d] one pair

Table C-3. Available vessel sighting information for the Soviet Union fishery operating off the coasts of Washington and Oregon in 1967. Categories under vessel number are: All (includes support vessels), M = medium fishing vessels (side trawlers), and L = large fishing vessels (stern trawlers).*

Source	Date		Vessel Num.			Area		Off	Depth	Catch
	mo	wk	all	M	L	INPFC	Description	nmi	fm	species
INPFCa	Jan-	1	1-			COL	OR			P.o.p. target
(1967)	Apr	2	12							
	Apr	3	39							hake
	May	2	114			COL	mostly OR			hake
	Jun	4	80				OR, WA			hake
	Sep	4	56				OR, WA			hake
USBCF	Jan	all		5	3	COL	Newport			
(1967)	Feb	1	1			COL	mostly OR, 1 WA			hake
		3		4	3					
	Mar	1	10			COL	OR			hake, true cod, some P.o.p.
		4	4			COL	OR			hake, true cod, some P.o.p.
	Apr	1	6			COL	OR			hake, true cod, some P.o.p.
		4	97			COL	Heceta, Stonewall B.			hake, a few rockfish
	May	1		71	4	COL	OR			hake, herring
		2		73	9	COL	OR			hake
		3		64	5	COL	OR			hake
		4		71	9	COL	OR, WA			hake, inc. P.o.p and rockfish
	Jun	1		61	6	COL	mostly WA			
		2	90			COL	mostly WA			hake with a few rockfish
		4	81			COL	WA, OR			hake, P.o.p. and rockfish
	Aug	1	70			COL	OR, WA			hake, inc. rockfish
		4	50			COL	OR, WA			hake, inc. rockfish
	Sep	1		24	8		Heceta, Stonewall B., WA			hake
		2		28	11		Heceta, Stonewall B., WA			hake
		4		22	20		Heceta, Stonewall B., WA			hake
	Oct	all	60			UVAN, COL	OR, WA			hake
USBCF	Nov	1		22	20		OR, WA			
(1968)		2		24	21		OR, WA			
		3		2	20		OR, WA			
		4		13	12		OR, WA			
	Dec	1	<10				OR, WA			
					2	UVAN	Destruction I.	15w		

Table C-3. Available vessel sighting information for the Soviet Union fishery operating off the coasts of Washington and Oregon in 1967. Categories under vessel number are: All (includes support vessels), M = medium fishing vessels (side trawlers), and L = large fishing vessels (stern trawlers).* Continued.

Source	Date mo	wk	Vessel Num. all	M	L	INPFC	Area Description	Off nmi	Depth fm	Catch species
WSFD (1967)	Jul	3	32			COL	Gray's H.-Columbia R.	18-34		red rock, red and black rock, hake
			4			COL,UVAN	Destruction I.	17-18 *sw*		
		4	43	4		COL,UVAN	Destruction I.	20-30 *sw*		hake
	Aug	3	1			COL	Willapa B.		188	
			15			COL,UVAN	Destruction I.	*sw*	72-81	hake
			12	1		COL	C. Elizabeth	12 to 20	37-51	
	Sep	1	5	3		COL	C. Elizabeth-Gray's H.	14-28	50-800	
			5			COL	Columbia R.	24	70	hake
		3		4		COL,UVAN	Grays H.-C. Flattery		70-400	
			1			COL	Columbia R.-Gray's H.	30-57	60	
	Nov	1	11	5		COL,UVAN	C. Johnson-C. Elizabeth	16-45	76-300	hake
			10	1		COL	C. Elizabeth-Gray's H.		50-100	hake, hake and red rock
		4	7			COL	Columbia R.	20-25	80-200	red rock
Hitz (1970)	Jan		0	1						
	Feb		3	2						
	Mar		3	2						
	Apr		24	2						
	May		71	7						
	Jun		60	7						
	Jul		50	6						
	Aug		37	3						
	Sep		28	13						
	Oct		23	24						
	Nov		17	18						
	Dec		2	4						

* I. = Island, H. = Harbor, B. = Bank, C. = Cape, R. = River. Off = distance offshore, Depth = bottom depth. inc = incidental.

Table C-4. Available vessel sighting information for the Soviet Union fishery operating off the coast of California in 1967. Categories under vessel number are: All (includes support vessels), M = medium fishing vessels (side trawlers), and L = large fishing vessels (stern trawlers).*

Source	Date mo	Date week	Vessel Num. all	M	L	INPFC	Area Description	Off nmi	Depth fm	Catch species
USBCF	Jan	1		1		CON	L.A.	120 sw		
(1967)		3		1						
		4		2		MON	Half Moon Bay	15		rockfish
		4		1		MON	Farrallons	19		
	Feb	all		3				14		rockfish grounds
	Mar	all		3		MON	mostly off S.F.			
	Apr	1, 2		0	5	MON	Half Moon Bay	22 sw	100-130	rockfish
		3		1	15	MON	Half Moon Bay	22 sw	100-150	rockfish and hake
		4		6		MON	Half Moon Bay	22 sw		rockfish and hake
		4		7	2	MON	north of S.F.			
	May	2		1		EUR	near Oregon border			
		3, 4		12			further south			rockfish and hake
	Jun	1, 2		14-20		MON	s. of Farrallons			P.o.p., bottom fish, hake
	Aug	1		4		MON	Pt. Reyes	14 nw		
		4		1		MON	Pigeon Pt.	14 w		
	Sep	2		4		MON	off S.F.			
		3		1		MON	n. of Farralons			
	Oct	1		0						
		2		0						
		3		6		EUR	n. CA			
		4		1		MON	Point Reyes	25		
USBCF	Nov	1		0						
(1968)		2	7			EUR	Eel R., Orick	20-28		
		3		0						
		4	7			EUR	Bodega Head, Crescent C.			
	Dec	1		6		EUR	Crescent C.	12		red and black bottomfish
		2		5		MON	S.F.			
		2		2		CON	Santa Barbara			
		3		2			n. CA			
		4		2			n. CA			
TSC (1967)			20			MON	Monterey Bay	25		rockfish and sablefish

* L.A. = Los Angeles, CA, n. CA = northern California, C. = City, S.F. = San Francisco, CA., Off = distance offshore, Depth = bottom depth.

Table C-5. Available vessel sighting information for the Soviet Union fishery operating off the coasts of Washington, Oregon, and California in 1968 (WA and OR are above the line; CA is below). Categories under vessel number are: All (includes support vessels), M = medium fishing vessels (side trawlers), and L = large fishing vessels (stern trawlers).*

Source	Date mo	wk	Vessel Num. all	M	L	INPFC	Area Description	Off nmi	Catch species
INPFCa	Jul		30-35				WA		
(1968)	Sep	2					OR		
	Oct	1				UVAN	n. WA		
USBCF	Jan			1	3				
(1968)	Mar	1			3		OR, WA		P.o.p. and other rockfish
		2			2		OR, WA		
		3			6		OR, WA		
		4		11	1		OR, WA		
	Apr	1		12	3		OR, WA		P.o.p. and other rockfish
		2		12	5		OR, WA		P.o.p. and other rockfish
		3		18	8		OR, WA		hake
		4		18	10		OR, WA		hake
	May	1		22	13		OR, WA		hake
		2		17	6		OR, WA		hake
		3		15	13		OR, WA		hake
		4		15	15		OR, WA		hake
	Jun	4			40		OR, WA		
	Aug		48				OR, mostly WA		hake
	Sep				25		OR, WA		hake
	Oct				22		OR, WA		hake
	Jan			0	0				
	Feb			0	0				
	Mar	3		6-9		MON	above S.F.		
	Apr	1	6			MON	Farallons	16	
		3	13			EUR	n. CA		
	May	1	8-10			CON	Santa Barbara		
		3		7		EUR	Russian R.	18-20	
		4		2					
	Jun	2	5			EUR	Kalamath R.	20-22 w	sablefish, hake, bottomfish
		2	1			MON	Pt. Reyes	18	
	Aug	1			1	MON	Pt. Reyes	17 w	
	Sep	1	0						
		2	0						
		3	0						
		4	0						
	Oct			2		MON	Half Moon Bay	25 w	
				1		EUR	Klamath R.		

Table C-5. Available vessel sighting information for the Soviet Union fishery operating off the coasts of Washington, Oregon, and California in 1968 (WA and OR are above the line; CA is below). Categories under vessel number are: All (includes support vessels), M = medium fishing vessels (side trawlers), and L = large fishing vessels (stern trawlers).* Continued.

Source	Date		Vessel Num.			Area		Off	Catch
	mo	wk	all	M	L	INPFC	Description	nmi	species
CFR	Nov		20			COL	OR		rockfish and hake
(1969)	Dec			1	1		OR, WA		
	Nov	2	4			CON	Santa Barbara		
	Dec		0				CA		
WSFD	Jun	4	26			COL	Oceanside-C. Shoalwater	17-26	
(1968)			6			COL	C. Disappointment	27 w	
	Jul	3				COL	WSW of Pt. Chehalis		
	Aug	3	20			COL,UVAN	C. Flattery-Grays H.	15-40	
	Sep	1	1			UVAN	C. Johnson	30-35	
	Oct	1	5			UVAN	C. Flattery	25	

* n. CA = northern California, C. = Cape, R. = River, H . = Harbor, S.F. = San Francisco, CA., Off = distance offshore, Depth = bottom depth.

Table C-6. Allocation of Soviet Union rockfish catch (t) (above line) to rockfish assemblages using method employing information from commercial fisheries (Method 1) (below line). Rockfish (t) and Pacific hake (t) are from literature or derived. Rockfish in Hake Incidental are assumed to be 1% of Pacific hake catch. Rockfish not allocated to Pacific hake are then allocated to either Slope or Shelf. Slope versus Shelf percentages for MON are based on Soviet Union survey catches of commercial-sized rockfish. Precision shown is less than used in calculations. For 1966, for example, Hake Incidental rockfish in COL is 101,120*0.01 = 1,011.2 t. Rockfish minus Hake Incidental is 27,531.5 - 1,011.2 = 26,520.3, which is assumed 100% Slope assemblage.

Type	Area	66	67	68	69	70	71	72	73	74	75	76
Rockfish	UVAN	7319	4172	1959	543	629	813	865	610	217	0	0
(t)	COL	27532	15637	4844	1699	1990	1649	957	3071	1358	793	626
	EUR	0	36	4549	21	2	0	258	791	380	204	272
	MON	6150	17766	4899	360	0	0	129	2253	581	1017	1496
Pacific hake	UVAN	26880	54424	16708	44465	92914	20929	40314	4447	15212	0	0
(t)	COL	101120	106187	46622	55377	107748	125797	67581	98526	44908	40720	96332
	EUR		106	2051	678	92	0	2249	8390	37977	17639	15514
	MON		34375	2515	8705	0	0	1125	32144	58611	97046	42283
Rockfish in	UVAN	269	544	167	445	629	209	403	44	152	0	0
Hake Incidental	COL	1011	1062	466	554	1077	1258	676	985	449	407	626
Assemblage	EUR	0	1	21	7	1	0	22	84	380	176	155
(1% of hake (t))	MON	0	344	25	87	0	0	11	321	581	970	423
Rockfish not in	UVAN	7050	3628	1792	98	0	604	462	565	65	0	0
Hake Incidental	COL	26520	14575	4378	1145	913	391	281	2086	909	386	0
(t)	EUR	0	35	4528	14	1	0	236	707	0	28	117
	MON	6150	17422	4874	273	0	0	118	1932	0	47	1073
Slope %	UVAN-EUR	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	MON	46%	46%	46%	48%	48%	16%	16%	16%	16%	16%	16%
Shelf %	MON	54%	54%	54%	52%	52%	84%	84%	84%	84%	84%	84%
Slope (t)	UVAN	7050	3628	1792	98	0	604	462	565	65	0	0
	COL	26520	14575	4378	1145	913	391	281	2086	909	386	0
	EUR	0	35	4528	14	1	0	236	707	0	28	117
	MON	2810	7961	2227	130	0	0	19	309	0	7	172
Shelf (t)	MON	3340	9461	2647	143	0	0	99	1622	0	39	901

Table C-7. Distribution of Soviet Union survey tows by year and INPFC area for the four most frequent assemblages in all years and areas combined.

.

Assemblage	Area	66	67	68	69	70	71	72	73	74	75	76
Slope	UVAN	20	35	16	3	3	10	19	9	7	1	1
	COL	156	80	117	91	40	87	78	81	134	30	65
	EUR	27	7	7	5	5		3	13	6	24	6
	MON	1	30	5	23	5		8	16	18	24	5
	CON			8	5	7		2	6	8	3	
Hake	VAN	2	13	15	7	10	6	9	2	26	2	1
	COL	43	76	76	54	44	34	33	60	27	53	343
	EUR	10	2		15	15		7	9	6	73	125
	MON		17	9	39	17		10	9	6	170	127
	CON			3	11	7		3	1	4	1	1
N. Shelf	VAN	14	10	35	32	8	19	14	9	6		
	COL	70	49	93	68	22	33	16	19	7	12	14
	EUR	16	2	1	5			1	7		7	1
	MON	1	1	1	3	5		5			5	2
	CON		1						1			
S. Shelf	VAN			1	2				2			
	COL	12	11	6	15	3	2	7	3	3	2	3
	EUR	4	5		3	1		3	3	2	1	
	MON		25	15	22	22		10	17	92	47	5
	CON			1	4	1		1	10	2		

Table C-8. Comparison of Soviet Union catch ratios in surveys versus commercial catches. Catch (t) distribution is based on dividing catch for a given year and INPFC by the total catch in all years and INPFC areas. Conception INPFC is not included in the comparison because there was no fleet catch.

Data	Type	Area	66	67	68	69	70	71	72	73	74	75	76
Survey	rockfish catch	VAN	2%	2%	3%	1%	2%	1%	1%	0%	0%	0%	0%
	distribution	COL	10%	4%	4%	3%	7%	2%	1%	1%	2%	1%	3%
		EUR	2%	0%	0%	0%	0%		0%	0%	0%	0%	0%
		MDN	0%	3%	1%	4%	1%		1%	2%	28%	3%	1%
	hake catch	VAN	0%	0%	0%	0%	0%	0%	0%	0%	2%	0%	
	distribution	COL	1%	1%	1%	1%	1%	0%	0%	3%	5%	4%	30%
		EUR	0%	0%	0%	0%	0%		0%	0%	0%	7%	9%
		MDN		0%	0%	1%	0%		0%	2%	1%	16%	12%
	(rockfish/	VAN	1743%	266%	273%	412%	142%	1852%	100%	965%	3%	13%	1687%
	hake)*100	COL	179%	68%	64%	116%	207%	144%	55%	9%	8%	4%	2%
		EUR	476%	163%	17%	16%	4%		6%	14%	10%	0%	0%
		MDN	250%	301%	467%	88%	540%		52%	32%	1191%	5%	2%
Fleet	rockfish catch	UVAN	9%	5%	2%	1%	1%	1%	1%	1%	0%		
	distribution	COL	33%	19%	6%	2%	2%	2%	1%	4%	2%	1%	1%
		EUR		0%	5%	0%	0%		0%	1%	0%	0%	0%
		MDN	7%	21%	6%	0%			0%	3%	1%	1%	2%
	hake catch	UVAN	2%	3%	1%	3%	6%	1%	3%	0%	1%		
	distribution	COL	6%	7%	3%	4%	7%	8%	4%	6%	3%	3%	6%
		EUR		0%	0%	0%	0%		0%	1%	2%	1%	1%
		MDN		2%	0%	1%			0%	2%	4%	6%	3%
	(rockfish/	UVAN	27%	8%	12%	1%	1%	4%	2%	14%	1%		
	hake)*100	COL	27%	15%	10%	3%	2%	1%	1%	3%	3%	2%	1%
		EUR		34%	222%	3%	2%		11%	9%	1%	1%	2%
		MDN		52%	195%	4%			11%	7%	1%	1%	4%

Table C-9. Allocation of Soviet Union rockfish catch (t) (above line) to rockfish assemblages using method employing information from Soviet Union surveys (Method 2) (below line). Rockfish in Hake Incidental are assumed to be the percentage of Pacific hake catch in survey Hake Incidental by INPFC and year. Rockfish not allocated to Pacific hake are then allocated to either North Shelf, South Shelf, or Slope based on their relative percentages in Survey catches. Precision shown is less than used in calculations. Using COL 1966 as an example, 101,120 t Pacific hake * 6.7949% = 6871 t rockfish in Hake Incidental. Rockfish not in Hake Incidental is 27,531.5- 6871= 20660.5 t. North Shelf is then 34.5543% of 20660.5 = 7139 t, South Shelf is 5.0582 % of 20660.5 = 1045 t and Slope is 60.3875% of 20660.5 = 12476 t.

Type	Area	66	67	68	69	70	71	72	73	74	75	76
Rockfish	UVAN	7319	4172	1959	543	629	813	865	610	217	0	0
(t)	COL	27532	15637	4844	1699	1990	1649	957	3071	1358	793	626
	EUR	0	36	4549	21	2	0	258	791	380	204	272
	MON	6150	17766	4899	360	0	0	129	2253	581	1017	1496
Pacific hake	UVAN	26880	54424	16708	44465	92914	20929	40314	4447	15212	0	0
(t)	COL	101120	106187	46622	55377	107748	125797	67581	98526	44908	40720	96332
	EUR		106	2051	678	92	0	2249	8390	37977	17639	15514
	MON		34375	2515	8705	0	0	1125	32144	58611	97046	42283
Rockfish in	UVAN	6%	6%	6%	7%	7%	1%	1%	1%	1%	1%	1%
Hake Incidental	COL	7%	7%	7%	3%	3%	1%	1%	1%	1%	1%	1%
% of Hake	EUR	15%	15%	15%	1%	1%	0%	0%	0%	0%	0%	0%
	MON	83%	83%	83%	70%	70%	1%	1%	1%	1%	1%	1%
Rockfish in	UVAN	1491	3018	927	543	629	300	577	64	217	0	0
Hake Incidental	COL	6871	7215	3168	1672	1990	1141	613	893	407	369	626
(t)	EUR	0	16	316	9	1	0	6	21	97	45	39
	MON	0	17766	2084	360	0	0	11	302	550	911	397
Rockfish not in	UVAN	5828	1154	1032	0	0	513	288	546	0	0	0
Hake Incidental	COL	20661	8422	1676	27	0	508	344	2178	951	424	0
(t)	EUR	0	20	4233	12	1	0	252	770	283	159	233
	MON	6150	0	2815	0	0	0	118	1951	31	106	1099

Table C-9. Allocation of Soviet Union rockfish catch (t) (above line) to rockfish assemblages using method employing information from Soviet Union surveys (Method 2) (below line). Rockfish in Hake Incidental are assumed to be the percentage of Pacific hake catch in survey Hake Incidental by INPFC and year. Rockfish not allocated to Pacific hake are then allocated to either North Shelf, South Shelf, or Slope based on their relative percentages in Survey catches. Precision shown is less than used in calculations. Using COL 1966 as an example, 101,120 t Pacific hake * 6.7949% = 6871 t rockfish in Hake Incidental. Rockfish not in Hake Incidental is 27,531.5- 6871= 20660.5 t. North Shelf is then 34.5543% of 20660.5 = 7139 t, South Shelf is 5.0582 % of 20660.5 = 1045 t and Slope is 60.3875% of 20660.5 = 12476 t. Continued.

Type	Area	66	67	68	69	70	71	72	73	74	75	76
N. Shelf%	UVAN	51%	51%	51%	93%	93%	52%	52%	52%	52%	52%	52%
	COL	35%	35%	35%	61%	61%	30%	30%	30%	30%	30%	30%
	EUR	33%	33%	33%	67%	67%	24%	24%	24%	24%	24%	24%
	MON	2%	2%	2%	2%	2%	0%	0%	0%	0%	0%	0%
S. Shelf%	UVAN	0%	0%	0%	1%	1%	1%	1%	1%	1%	1%	1%
	COL	5%	5%	5%	1%	1%	1%	1%	1%	1%	1%	1%
	EUR	16%	16%	16%	3%	3%	23%	23%	23%	23%	23%	23%
	MON	75%	75%	75%	70%	70%	97%	97%	97%	97%	97%	97%
Slope %	UVAN	49%	49%	49%	6%	6%	47%	47%	47%	47%	47%	47%
	COL	60%	60%	60%	38%	38%	69%	69%	69%	69%	69%	69%
	EUR	51%	51%	51%	30%	30%	52%	52%	52%	52%	52%	52%
	MON	23%	23%	23%	28%	28%	3%	3%	3%	3%	3%	3%
N. Shelf	UVAN	2975	589	527	0	0	266	149	283	0	0	0
(t)	COL	7139	2910	579	17	0	150	102	643	281	125	0
	EUR	0	6	1393	8	1	0	61	187	69	39	57
	MON	97	0	45	0	0	0	0	4	0	0	2
S. Shelf	UVAN	1	0	0	0	0	6	3	6	0	0	0
(t)	COL	1045	426	85	0	0	7	5	30	13	6	0
	EUR	0	3	689	0	0	0	59	180	66	37	54
	MON	4622	0	2115	0	0	0	115	1892	30	102	1066
Slope	UVAN	2852	565	505	0	0	242	135	257	0	0	0
(t)	COL	12476	5086	1012	10	0	351	238	1505	657	293	0
	EUR	0	10	2151	4	0	0	132	402	148	83	121
	MON	1431	0	655	0	0	0	3	55	1	3	31

Table C-10. Allocation of Japanese rockfish catch (t) (above line) to assemblages (below line). No catch occurred in 1966. Catch for POP, Other, and Hake COL, MON, and CON are from literature (Forrester et al. 1978, 1983). UVAN is calculated (see Table A-6). Slope = POP and Shelf = Other except in UVAN and COL in 1973-76. In those years, slope = POP+1/2 Other and shelf = 1/2 Other.

Category	Area	67	68	69	70	71	72	73	74	75	76
POP	UVAN	2478	1445	9	57	193	171	213	452	0	0
	COL	3850	4274	0	38	276	880	0	0	0	0
	EUR	59	181	0	2	0	80	433	0	0	0
	MON	0	1	29	23	0	0	139	0	0	0
	CON	0	0	0	0	0	0	0	12	0	0
Other	UVAN		198	3	35	53	57	134	1330	0	0
	COL		460	0	31	29	558	1480	0	195	191
	EUR		147	0	0	0	12	1409	119	15	1
	MON		4	0	0	0	0	1015	5322	868	685
	CON			0	0	0	0	484	57	0	0
Hake	UVAN			0	85	151	18	65	224	0	0
	COL			0	1475	799	307	1379	0	1964	1903
	EUR			0	11	0	0	879	162	79	7
	MON			0	12	0	0	913	8032	1412	1424
	CON			0	0	0	0	205	224	0	0
(Rockfish/	UVAN				107%	163%	1292%	532%	796%		
Hake)*100	COL				5%	38%	468%	107%		10%	10%
	EUR				18%			210%	73%	19%	14%
	MON				192%			126%	66%	61%	48%
	CON							236%	31%		
Slope	UVAN	2478	1445	9	57	193	171	280	1117	0	0
	COL	3850	4274	0	38	276	880	740	0	98	96
	EUR	59	181	0	2	0	80	433	0	0	0
	MON	0	1	29	23	0	0	139	0	0	0
	CON	0	0	0	0	0	0	0	12	0	0
Shelf	UVAN		198	3	35	53	57	67	665	0	0
	COL		460	0	31	29	558	740	0	98	96
	EUR		147	0	0	0	12	1409	119	15	1
	MON		4	0	0	0	0	1015	5322	868	685
	CON		0	0	0	0	0	484	57	0	0

Table C-11. Comparison of available fishery species compositions during 1965-76. Compositions were either from U.S. observers or as reported by foreign countries.*

	Japan			Poland			
Type	observed	reported		reported			
Category		Other		Rockfish			
Year	67	11/72-10/73	11/73-10/74	75	76		
Source	U.S. (1967)	INPFCa (1974)	FAJ (1975) FAJ (1974)	Morksi (unpubl. data)	Murai (unpubl. data a)		
Target	P.o.p., widow, sablefish						
Rockfish (t)	207-261			819	23	157	247
# tows	90						
Area	21% VAN, 71% COL		south of 48°30'N	COL	MON	EUR	COL
codend mesh	9.6 cm (3.8 in)		9-10 cm (3.5-4 in)				
black			8%				
chilipepper		*67%	33%				
bocaccio			2%				
P.o.p	79%		17%	5%			
rougheye		12%					
shortspine			0%				
splitnose					21%	57%	32%
silvergray			3%				
widow		12%	21%	1%			3%
yelloweye			6%				
yellowtail				2%	19%	20%	23%
other rockfish			9%	93%			
other species	21%				60%	23%	42%

* Chilipepper represented several unidentified species.

Table C-12. Allocation of Polish rockfish catch (t) to assemblages. No U.S. Vancouver catch is assumed because trawling was not allowed there. Rockfish catch is from Morski Instytut Rybacki (unpubl.data) [1975], Murai (unpubl. data a) [1976]. Pacific hake catch is from Kaczynski (1981) [1975] and Murai (unpubl. data a) [1976]. Methods of allocation are based on those developed for the Soviet Union.

Type	Data	Year/INPFC					
		75			76		
		MON	EUR	COL	MON	EUR	COL
Catch	P. hake (t)	21992	10584	8168	1070	3564	19002
	rockfish (t)	1138	577	819	23	157	247
	% rockfish/hake	5%	5%	10%	2%	4%	1%
Method 1	% hake incidental	1%	1%	1%	1%	1%	1%
	hake incidental (t)	220	106	82	11	36	190
	Remaining rockfish (t)	918	471	737	12	121	57
	% slope	16%	100%	100%	16%	100%	100%
	% s. shelf	84%	0%	0%	84%	0%	0%
	slope (t)	147	471	737	2	121	57
	s. shelf (t)	771	0	0	10	0	0
Method 2	% hake incidental	0.9%	0.3%	0.9%	0.9%	0.3%	0.9%
	hake incidental (t)	207	27	74	10	9	172
	Remaining rockfish (t)	931	550	745	13	148	75
	% slope	3%	52%	69%	3%	52%	69%
	% n. shelf	0%	24%	30%	0%	24%	30%
	% s. shelf	97%	23%	1%	97%	23%	1%
	slope (t)	26	287	515	0	77	52
	n. shelf (t)	2	134	220	0	36	22
	s. shelf (t)	903	129	10	13	35	1

Table C-13. Allocation of Bulgarian and East German rockfish 1976 catch (t) to assemblages. Pacific hake and rockfish catch estimates are from Gunderson (unpubl. data); steps in allocating Pacific hake to INPFC area and estimating rockfish from Pacific hake are shown. Methods of allocation to assemblage are based on those developed for the Soviet Union.

Source/ Method	Data	Country/ Area							
		Bulgaria				East Germany			
		WOC	MON	EUR	COL	WOC	MON	EUR	COL
Gunderson	P. hake catch (t)	24200				26000			
(unpubl. data)	% by INPFC (Soviet Union)		27%	10%	63%		27%	10%	63%
	P. hake (t)		6639	2436	15125		7133	2617	16250
	% rockfish/hake (Soviet Union)		3.54%	1.75%	0.65%		3.54%	1.75%	0.65%
	rockfish (t)		235	43	98		252	46	106
Method 1	% hake incidental		1%	1%	1%		1%	1%	1%
	hake incidental (t)		66	24	98		71	26	106
	Remaining rockfish (t)		168	18	0		181	20	0
	% slope		16%	100%	100%		16%	100%	100%
	% s. shelf		84%	0%	0%		84%	0%	0%
	slope (t)		27	18	0		29	20	0
	s. shelf (t)		142	0	0		152	0	0
Method 2	% hake incidental		0.9%	0.3%	0.9%		0.9%	0.3%	0.9%
	hake incidental (t)		62	6	98		67	7	106
	Remaining rockfish (t)		173	37	0		185	39	0
	% slope		3%	52%	69%		3%	52%	69%
	% n. shelf		0%	24%	30%		0%	24%	30%
	% s. shelf		97%	23%	1%		97%	23%	1%
	slope (t)		5	19	0		5	20	0
	n. shelf (t)		0	9	0		0	10	0
	s. shelf (t)		167	9	0		180	9	0

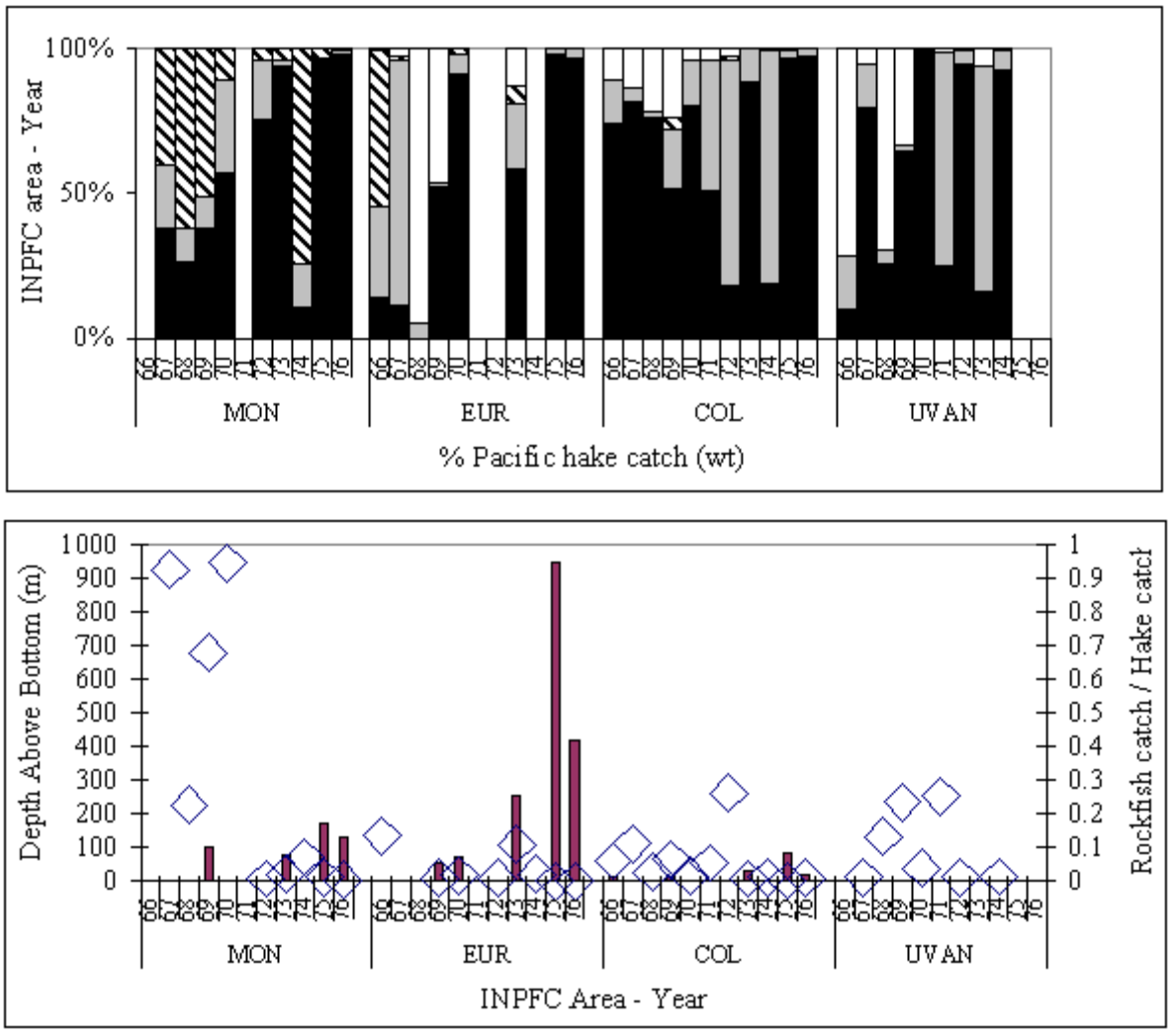

Figure C-1. Soviet Union survey changes in Pacific hake strategies over time and INPFC area. Top graph is percent of Pacific hake catch (weight) by assemblage. Segments of the bars represent Pacific hake target (black), slope (gray), south shelf rockfish (diagonals), and north shelf rockfish (white). Solid white bars indicate no data for that period (example 1971 and 1972). Bars shown are for area-year combinations with at least 20 tows. Bottom graph is for the Pacific hake assemblage only. It is a comparison of the distance the gear is towed above the bottom (solid bars) and the ratio of rockfish-to-Pacific-hake catch weight (diamonds). Information is shown for area-year combinations with at least 5 tows.

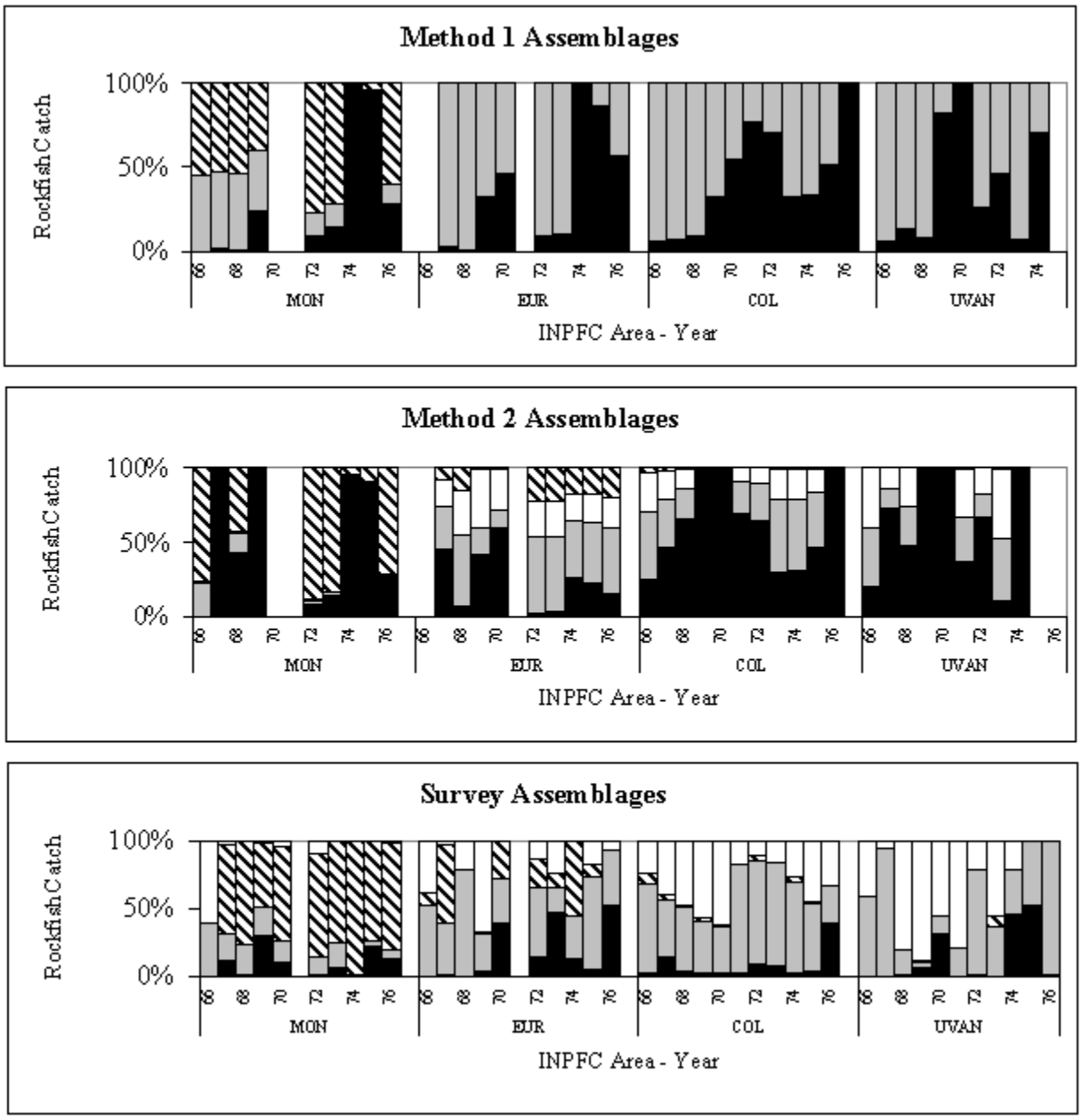

Figure C-2. Comparison of Soviet Union assemblage-designated catches by INPFC area and year based on three methods. Top is method 1, middle is method 2, and bottom are survey multivariate designations. Segmented bars are: black = Hake Incidental, gray = slope, diagonals = South Shelf or Shelf (commercial), white = North Shelf. Solid white bars indicate no data for that period. ("Rockfish Catch" is the percent distribution of rockfish catch into assemblages.)

APPENDIX D: DERIVE AND APPLY SPECIES COMPOSITIONS TO ASSEMBLAGE CATCH

Table D-1. Estimates of Conception INPFC area landings (t) by species percentages. Nitsos (1965) landings are for the ports of Santa Barbara and Morro Bay, CA. Fraidenburg et al. (1977) extrapolated California port samples to the entire Conception landings.

Common Name	Nitsos (1965) Year		Fraidenburg et al. (1977) Year				
	62	63	62	63	73	74	75
bank						9%	1%
bocaccio	60%	69%	56%	67%	66%	56%	62%
brown		1%					
canary		0%					
chilipepper	28%	18%	31%	22%	20%	29%	28%
cowcod	0%	0%	0%	0%	3%	1%	1%
flag	1%	0%					
greenspotted	3%	2%	4%	2%		1%	1%
greenstripe	0%	0%					
speckled	1%	6%					
splitnose	2%	2%	1%	1%		0%	1%
stripetail		0%					
vermillion	1%	0%	2%	0%	4%		1%
whitebelly	0%						
widow	3%	2%	2%	1%	3%	1%	5%
yelloweye	1%						
others			3%	6%	4%	2%	1%
Total landings (t)	757	1063	792	1052	1347	1344	1679

Table D-2. Estimates of Monterey INPFC area landings by species. California landings are from Nitsos (1965) for the ports of Fort Bragg and San Francisco in 1962 and Fort Bragg, San Francisco, and Monterey in 1963. Shortspine, Pacific ocean perch, and splitnose are nominal catches, and the rest are based on expanded port samples (Nitsos 1965). North American trawler landings are from Fraidenburg et al. (1977) (which used Gunderson et al. 1975) except for Pacific ocean perch which are from the HAL data base (Lynde 1986). Nitsos (1965) landings for flag were reported by Fraidenburg et al. (1977) as redbanded.

Common Name	California Year		North American trawlers Year				
	62	63	62	63	73	74	75
bank						1%	
black	2%						
blackgill		1%					
bocaccio	44%	49%	43%	45%	57%	54%	74%
brown						3%	
canary	5%	3%	10%	5%	3%	1%	
chilipepper	35%	27%	32%	26%	26%	17%	13%
cowcod					1%		
darkblotched		2%				4%	
flag		1%					
speckled	3%						
splitnose	7%	8%	5%	10%	2%	2%	
shortspine	2%	3%	5%	3%	10%	11%	11%
stripetail							1%
widow	1%	5%	1%	4%	1%	2%	
yellowtail							
others			5%	6%		3%	1%
Total landings (t)	1011	2217	2024	2210	5152	4382	4687

Table D-3. Estimates of Eureka INPFC area landings by species. California landings are from Nitsos (1965) for the port of Eureka. Shortspine, Pacific ocean perch, and splitnose are nominal catches and, the rest are based on expanded port samples (Nitsos 1965). Oregon landings are from Douglas (1998) based on the only year in which both Oregon market categories (POP and other rock) were sampled for PFMC Area 2A. North American landings are from Gunderson et al. (1975) and Fraidenburg et al. (1977). North American landings for Pacific ocean perch are from the HAL data base (Lynde 1986). They extrapolated California data to the total North American catch.

Common Name	California Year		Eureka Year					Oregon Year
	62	63	62	63	73	74	75	71
black	15%	10%	15%	10%	7%	6%	9%	
bocaccio	9%	10%	9%	10%	11%	9%	4%	5%
canary	31%	37%	31%	37%	12%	11%	2%	30%
chilipepper	1%		1%		5%	6%	5%	
darkblotched	7%	9%	7%	9%		5%	4%	10%
greenstriped								7%
Pacific ocean perch	5%	3%	5%	2%	4%	3%	3%	4%
redbanded/flag	7%	2%	8%	2%	1%	1%	1%	8%
shortspine	17%	18%	17%	18%	55%	44%	55%	16%
splitnose	1%	1%	1%	1%	2%	6%	1%	2%
stripetail							7%	1%
widow							4%	2%
yellowtail	6%	9%	6%	9%	1%	7%	2%	15%
others					3%	2%	3%	
Total landings (t)	730	1142	780	1191	1619	1642	1811	95

Table D-4. Oregon landings estimates for the Columbia INPFC area. Douglas (1998) landings are presented only for years in which each PFMC area within the INPFC area was sampled. Barss and Niska (1978) extrapolated to areas not sampled to produce an INPFC estimate.

Source	Common Name	66	67	68	73	75
Barss and Niska 1978 (PFMC 3A, 2C, 2B) – Oregon Landings						
	black	10%	9%	7%	4%	12%
	bocaccio	1%	1%	1%	2%	4%
	canary	20%	5%	31%	45%	25%
	darkblotched	7%	10%		3%	7%
	Pacific ocean perch	33%	11%	9%	6%	12%
	splitnose	1%	3%	5%		1%
	shortspine			1%	3%	10%
	widow	10%	26%	9%	1%	1%
	yellowtail	15%	23%	33%	32%	27%
	other	2%	11%	5%	4%	2%
	Total landings (t)	3844	2524	1795	1709	1489
Douglas 1998						
	black	10%	9%	7%	4%	12%
	bocaccio	1%	1%	1%	2%	3%
	canary	21%	5%	31%	46%	25%
	darkblotched	7%	10%		4%	7%
	greenstriped					1%
	Pacific ocean perch	33%	11%	10%	6%	13%
	redbanded					1%
	redstripe	1%				
	splitnose	1%	3%	5%	1%	1%
	shortspine			1%	3%	10%
	widow	10%	26%	9%	1%	1%
	yellowmouth		9%	3%		
	yellowtail	15%	23%	31%	32%	27%
	other			1%	1%	
	Total landings (t)	3848	2525	1806	1710	1489

Table D-5. Columbia area landings made in Washington and Oregon (PFMC areas 3A, 2C, and 2B) are based on data from Tagart (1985). Columbia area landings for North Amercian trawlers are calculated by expanding Oregon data to the total North American catch (Fraidenburg et al. 1977). Pacific ocean perch landings are those found in the stock assessment for that species (Fraidenburg et al. 1978).

Source	Common Name	66	67	68	69	70	71	72	73	74	75	76
Tagart (1985) data base (cited Barss and Niska 1978) Oregon landings												
	*PFMC Area 2C not sampled in 1969-1972,1974; Area 2B not sampled in 1976											
					*	*	*	*		*		*
	black	10%	9%	7%	12%	20%	10%	7%	4%	13%	12%	10%
	bocaccio	1%	1%	1%	1%	4%	6%	2%	2%	1%	4%	0%
	canary	20%	5%	30%	25%	29%	33%	27%	45%	33%	25%	5%
	darkblotched	7%	10%	0%	1%	2%	4%	6%	3%	8%	7%	8%
	P.o.p.	33%	11%	9%	7%	9%	10%	6%	6%	8%	12%	19%
	shortspine	0%	0%	1%	4%	6%	4%	3%	3%	1%	10%	1%
	splitnose	1%	3%	5%	1%	2%	1%	1%	0%	2%	1%	0%
	widow	10%	26%	9%	5%	0%	1%	1%	1%	0%	1%	2%
	yellowtail	15%	23%	33%	27%	12%	19%	32%	32%	17%	27%	31%
	unidentified/other	2%	11%	5%	15%	16%	12%	14%	4%	14%	2%	23%
	Total landings (t)	3844	2524	1803	2170	1580	1500	1875	1709	1375	1489	3000
Fraidenburg et al. (1977, 1978) Oregon data expanded to total North American catch												
	black	10%	9%	7%	13%	21%	10%	8%	4%	18%	13%	
	bocaccio	1%	1%	1%	2%	4%	8%	2%	2%	2%	3%	
	canary	21%	5%	30%	29%	30%	34%	29%	38%	35%	24%	
	darkblotched	7%	10%		2%	5%	5%	8%	3%	9%	6%	
	greenstriped							3%			1%	
	P.o.p.	33%	11%	10%	12%	11%	8%	5%	5%	7%	16%	
	redbanded				1%	5%	2%	2%			1%	
	redstripe	1%					1%					
	silvergray						1%					
	splitnose	1%	3%	5%	1%	2%	1%	2%	1%	3%	1%	
	shortspine	0%	1%	1%	5%	6%	5%	3%	4%	2%	8%	
	widow	10%	26%	9%	5%		2%	1%	1%		1%	
	yellowmouth		9%	3%		3%				3%		
	yellowtail	15%	23%	32%	29%	13%	20%	34%	41%	17%	28%	
	other			1%	2%		3%	2%	1%	3%		
	Total landings (t)	3902	2520	1823	2187	1611	1650	2122	1759	1549	1880	

Table D-6. U.S. Vancouver INPFC area landings estimates based on landings in PFMC area 3B + 3CS (Tagart 1985). Prior to 1969, the "POP" market category in Washington was not sampled (included in Tagart (1985) unidentified rockfish). Fraidenburg et al. (1977, 1978) expanded available information to all years for the entire Vancouver INPFC.

PFMC Area 3B	Area 3B + 3 CS									
Species	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**
Tagart (1985) data base (cited Tagart and Kimura 1982)										
—Washington landings in PFMC areas 3B+3CS (U.S. portion of 3C)										
black					0%					
bocaccio	1%	1%	0%	0%	1%	0%		0%		0%
canary	41%	28%	23%	34%	29%	11%	12%	39%	55%	22%
darkblotched			0%	0%	1%	0%	1%	5%	10%	4%
greenstriped										0%
P.o.p.			16%	26%	35%	30%	35%	43%	25%	25%
quillback							1%			
redbanded			0%	0%	0%	0%	1%	1%	0%	0%
redstripe			0%	0%	0%	0%				0%
rosethorn			0%	0%		0%				
rougheye			0%	0%	0%		0%		0%	0%
sharpchin			0%	0%	0%	0%	0%	0%		
shortspine			0%	0%	0%	0%	0%	0%	0%	0%
silvergray	4%	1%	0%	1%	2%	1%	0%	0%	2%	1%
splitnose			1%	1%	2%	0%	1%	0%	1%	0%
widow	0%	1%	0%	0%	2%	1%	1%	0%	0%	2%
yelloweye									0%	0%
yellowmouth			0%	0%	0%	0%	3%	0%		0%
yellowtail	4%	48%	58%	36%	27%	54%	44%	11%	6%	45%
unidentified	50%	21%	0%	0%	0%	0%	0%	0%	0%	0%
Total landings (t)	787	1991	2354	1283	1334	841	631	473	1031	1952
Fraidenburg et al. (1977, 1978) (P.o.p.) Vancouver INPFC										
bocaccio	3%	2%	3%	2%	1%	4%	7%	2%	1%	
canary	38%	34%	33%	30%	39%	21%	40%	52%	53%	
Pacific ocean perch	40%	18%	14%	43%	35%	28%	20%	17%	22%	
redbanded				1%		1%				
shortraker	9%	6%	9%	10%	7%	20%	13%	13%	9%	
widow		1%	1%		1%		1%			
yellowmouth							1%			
yellowtail	9%	39%	40%	15%	16%	26%	16%	15%	12%	
others						1%	2%		2%	
Total landings (t)	2015	3151	4083	4569	3285	2257	1719	1660	1966	

Table D-7. Species compositions based on observed catches in 1977-83 (incidental hake) and domestic landings (slope and shelf). Periods are: e = early (1966-71) and l = late (1972-76). Percentages less than 0.5% were not presented.

Species	Assemblage/Area/Period																					
	Incidental Hake				Slope										Shelf							
	MON	EUR	COL	UVAN	CON		MON		EUR		COL		UVAN		CON		MON		EUR		COL		UVAN	
					e	l	e	l	e	l	e	l	e	l	e	l	e	l	e	l	e	l	e	l
bank																3%								
black			1%	1%													1%		18%	19%	14%	10%		
blackgill							5%																	
bocaccio	16%	3%	2%	1%											65%	62%	57%	71%	14%	21%	2%	3%	1%	
brown			1%												0%			1%						
canary		2%	3%	5%											0%		2%	2%	50%	22%	28%	46%	37%	42%
chilipepper	68%														22%	26%	32%	22%	1%	14%				
cowcod																2%								
darkblotched	1%	1%	2%				1%	9%	27%	5%	18%	24%	2%	12%										
greenspotted															3%	1%	1%							
olive		1%																						
P.o.p.	7%	5%	5%	5%				0%	12%	5%	61%	43%	92%	84%										
redbanded																			6%	2%		1%		1%
redstripe		2%	2%	1%																	1%			
rougheye												1%		1%										
sharpchin											1%		1%											
shortbelly	1%																							
shortspine			1%				17%	78%	57%	83%	1%	28%												
silvergray		1%																					1%	1%
speckled															4%		1%							
splitnose		3%	2%		100%	98%	77%	11%	4%	5%	8%	3%	4%	1%	2%									
stripetail																				7%				
vermillion	1%														1%	1%								
widow	6%	56%	56%	17%											2%	3%	5%	1%		4%	22%	1%	1%	2%
yellowmouth		3%	1%								10%			1%										
yellowtail	1%	22%	23%	69%															11%	9%	32%	38%	60%	54%
unidentified						2%		2%		2%						2%		2%		2%				

Table D-8. Species compositions for incidental hake and slope based on Soviet Union survey assemblages. Periods are: e = early (1966-68), m = mid (1969-70), and l = late (1971-76). Percentages less than 1% are not shown.

Species	Assemblage/Area/Period																							
	Hake Incidental												Slope											
	MON			COL			EUR			VAN			MON			EUR			COL			VAN		
	e	m	l	e	m	l	e	m	l	e	m	l	e	m	l	e	m	l	e	m	l	e	m	l
aurora						1%									2%			2%						
black												2%												
blackgill					4%				1%						1%			1%		1%				
blue																								
bocaccio	1%		5%	6%	1%			3%		1%			2%		1%		13%	1%						
brown																								
canary				6%	14%	11%	3%	5%	10%	4%		5%					1%			1%				
chilipepper			1%		2%	2%							1%		1%		2%							
darkblotched				2%	23%	5%	1%	5%	8%			2%	5%	15%	3%	23%	17%	6%	20%	11%	18%	2%		6%
flag																								
greenspotted																								
greenstriped	1%			1%		1%		4%		1%		1%					1%	1%						1%
halfbanded																								
pink																								
P.o.p.					2%	1%	2%	5%	7%	7%		1%		1%		4%	11%	8%	42%	59%	46%	83%	89%	79%
pygmy									0%															
redbanded					6%	1%		1%	1%							2%	18%	5%	1%	2%	3%	1%	1%	1%
redstripe			1%	8%				4%	2%	4%			2%											
rosethorn								2%									3%							
rougheye		1%						1%	1%			16%		2%	1%			1%			4%			2%
sharpchin				8%	7%			1%	1%							1%	8%			2%			1%	
shorfbelly	94%	91%	69%		3%																			
shortraker																								2%
shortspine				6%	2%	1%		4%	1%	1%			4%	1%	3%	7%	8%	51%	5%	11%	16%	2%	6%	1%
silvergrey				3%				0%	1%								2%							1%
splitnose	2%		3%	6%	6%	1%	1%	2%	2%			1%	79%	82%	85%	62%	14%	20%	25%	6%	9%	3%	1%	4%
stripetail			1%	33%		2%		3%							2%	1%		3%	1%	0%	1%			

Table D-8. Species compositions for incidental hake and slope based on Soviet Union survey assemblages. Periods are: e = early (1966-68), m = mid (1969-70), and l = late (1971-76). Percentages less than 1% are not shown. Continued.

Species	Assemblage/Area/Period																							
	Hake Incidental												Slope											
	MON			COL			EUR			VAN			MON			EUR			COL			VAN		
	e	m	l	e	m	l	e	m	l	e	m	l	e	m	l	e	m	l	e	m	l	e	m	l
vermillion																								
widow		7%	12%	12%	1%	70%	75%	18%	58%	45%	5%	1%							1%				1%	1%
yelloweye																								
yellowmouth																								
yellowtail	1%			9%	30%		15%	38%	6%	35%	90%	69%								1%			1%	2%
unidentified		1%	7%			2%		4%	1%	1%	4%		6%	1%					4%	4%		8%		

Table D-9. Species compositions for north shelf and south shelf based on Soviet Union survey assemblages. Periods are: e = early (1966-68), m = mid (1969-70), and l = late (1971-76). Percentages less than 1% are not shown.

Species	Assemblage/Area/Period																							
	Southern Shelf												Northern Shelf											
	MON			EUR			COL			VAN			MON			EUR			COL			VAN		
	e	m	l	e	m	l	e	m	l	e	m	l	e	m	l	e	m	l	e	m	l	e	m	l
aurora																								
black																		5%			1%			
blackgill								5%																
blue																								
bocaccio	5%	8%	5%	6%	22%	10%	3%	22%	12%	13%	42%		21%	18%	6%	2%		7%	4%	4%	3%	1%	1%	2%
brown																								
canary		1%		19%	2%	2%	6%	6%	18%	87%			5%	4%	8%	34%	62%	26%	36%	14%	37%	5%	19%	26%
chilipepper	19%	16%	6%			18%								6%	29%	4%								
darkblotched				6%	24%	1%	1%	3%	5%		2%	2%												
flag																								
greenspotted																								
greenstriped	1%			1%	2%	10%	1%	15%	12%		1%			2%	2%			1%	2%	1%	2%	1%		1%
halfbanded														0%			9%							
pink					1%									2%	2%									
P.o.p.		4%					1%	1%			4%	48%							4%	8%	1%	8%	1%	23%
pygmy																								
redbanded				1%	1%	1%	3%	6%	6%		50%	2%						1%	1%	1%	1%		1%	
redstripe				27%	1%		28%									11%			10%	4%	3%	5%	9%	6%
rosethorn				1%					1%		1%													
rougheye									17%			2%												
sharpchin				1%			45%	1%	7%							3%				3%	4%			
shortbelly	66%	65%	86%	1%											17%									
shortraker												5%												
shortspine				6%		3%		3%	2%															
silvergrey								2%	1%			1%			1%		1%	7%	7%	2%	20%	6%	8%	10%
splitnose	7%	2%	1%	6%	2%				1%			1%												
stripetail		2%	1%		37%	52%		1%	9%							4%		4%		1%				14%

Table D-9. Species compositions for north shelf and south shelf based on Soviet Union survey assemblages. Periods are: e = early (1966-68), m = mid (1969-70), and l = late (1971-76). Percentages less than 1% are not shown. Continued.

Species	Assemblage/Area/Period																					
	Southern Shelf												Northern Shelf									
	MON			EUR			COL			VAN			MON			EUR			COL			VAN		
	e	m	l	e	m	l	e	m	l	e	m	l	e	m	l	e	m	l	e	m	l	e	m	l
vermillion																								
widow	1%			3%	1%		1%	1%	1%					15%	1%	33%	1%	10%	9%	12%		6%	2%	1%
yelloweye								3%	7%					1%	1%					1%				1%
yellowmouth														0%										
yellowtail				22%	8%	1%	1%	4%					73%	52%	34%	8%	27%	39%	26%	45%	26%	60%	58%	13%
unidentified							11%	28%	2%			39%							1%	2%		8%		

Table D-10. Soviet Union catch (t) allocated to species by INPFC area and year. Catch is rounded to the nearest t.

Species	Area	66	67	68	69	70	71	72	73	74	75	76	Total
aurora	COL	1	0	0	0	0	2	1	5	2	1	1	13
	EUR	0	0	0	0	0	0	2	5	2	1	2	12
	MON	0	0	0	0	0	0	0	1	0	0	0	1
bank	MON	0	0	0	0	0	0	0	3	0	0	2	5
black	UVAN	2	3	1	3	4	3	7	1	3	0	0	27
	COL	3	3	1	2	3	5	3	7	3	2	2	34
	EUR	0	0	0	0	0	0	2	5	2	1	2	12
	MON	11	31	9	0	0	0	0	0	0	0	0	51
blackgill	COL	0	0	0	3	4	4	2	3	2	1	2	21
	EUR	0	0	0	0	0	0	0	1	0	0	0	1
	MON	70	199	56	3	0	0	0	0	0	0	0	328
bocaccio	UVAN	23	20	8	2	3	5	5	4	1	0	0	71
	COL	188	90	23	29	37	16	9	24	11	7	6	440
	EUR	0	1	47	0	0	0	6	19	12	6	8	99
	MON	1101	2856	840	48	0	0	39	655	59	113	389	6100
brown	COL	3	4	2	2	4	4	2	3	2	1	2	29
	MON	3	7	2	0	0	0	1	9	0	0	5	27
canary	UVAN	113	90	36	11	15	48	44	40	9	0	0	406
	COL	1445	658	158	50	64	105	60	183	81	49	41	2894
	EUR	0	2	311	3	0	0	9	29	20	10	12	396
	MON	41	101	30	2	0	0	1	17	1	3	10	206
chilipepper	COL	1	1	1	1	1	2	1	1	1	1	1	12
	EUR	0	0	29	0	0	0	5	17	7	4	5	67
	MON	984	1633	638	52	0	0	18	341	200	340	274	4480
cowcod	MON	6	18	5	0	0	0	0	3	0	0	1	33
darkblotched	UVAN	101	43	23	2	1	49	40	44	7	0	0	310
	COL	3654	1862	517	147	139	139	88	433	190	92	32	7293
	EUR	0	6	878	3	0	0	10	30	9	5	8	949
	MON	52	41	29	1	0	0	1	17	3	5	11	160
dusky	UVAN	0	1	0	1	1	0	0	0	0	0	0	3
flag	MON	9	18	6	0	0	0	0	1	0	0	0	34
greenspotted	MON	9	26	7	0	0	0	0	1	0	0	0	43
greenstriped	UVAN	17	11	5	0	0	3	3	3	1	0	0	43
	COL	80	40	11	37	44	6	4	15	7	3	2	249
	EUR	0	0	8	0	0	0	4	11	5	3	4	35
	MON	14	92	17	0	0	0	0	2	0	1	1	127
northern	UVAN	0	1	0	1	1	0	1	0	0	0	0	4
olive	COL	2	2	1	1	2	2	1	1	1	1	1	15
	EUR	0	0	0	0	0	0	0	1	3	1	1	6
	MON	1	3	1	0	0	0	0	0	0	0	0	5
pink	MON	1	0	0	0	0	0	0	0	0	0	0	1

Table D-10. Soviet Union catch (t) allocated to species by INPFC area and year. Catch is rounded to the nearest t. Continued.

Species	Area	66	67	68	69	70	71	72	73	74	75	76	Total
P.o.p.	UVAN	4595	2044	1090	56	16	387	278	373	32	0	0	8871
	COL	10966	5682	1606	405	350	236	153	849	371	173	38	20829
	EUR	0	2	322	1	0	0	13	38	15	8	12	411
	MON	0	11	1	3	0	0	0	11	19	32	14	91
redbanded	UVAN	15	6	3	0	0	1	1	1	0	0	0	27
	COL	124	56	13	6	7	12	7	28	12	7	3	275
	EUR	0	0	24	1	0	0	4	12	5	3	4	53
redstripe	UVAN	115	78	34	3	4	10	8	9	1	0	0	262
	COL	545	236	53	37	48	26	14	28	13	9	12	1021
	EUR	0	1	182	0	0	0	0	1	3	2	1	190
	MON	15	14	9	0	0	0	0	2	4	7	3	54
rosethorn	UVAN	7	4	2	0	0	1	1	1	0	0	0	16
	COL	15	7	2	21	25	0	0	1	1	0	0	72
	EUR	0	0	5	0	0	0	0	0	0	0	0	5
	MON	3	1	2	0	0	0	0	0	0	0	0	6
rougheye	UVAN	13	7	3	0	0	29	50	9	18	0	0	129
	COL	82	52	18	14	17	17	10	45	20	10	5	290
	EUR	0	0	0	0	0	0	1	2	1	0	1	5
	MON	3	0	1	1	0	0	0	0	0	0	0	5
sharpchin	UVAN	31	18	8	0	0	2	1	1	0	0	0	61
	COL	374	167	39	15	16	11	7	26	12	6	4	677
	EUR	0	1	49	0	0	0	0	0	0	0	0	50
	MON	0	0	0	0	0	0	0	1	1	1	1	4
shortbelly	COL	1	0	0	0	0	0	0	0	0	0	0	1
	EUR	0	0	5	0	0	0	0	0	0	0	0	5
	MON	1533	8382	1685	163	0	0	53	920	205	362	597	13900
shortraker	UVAN	0	0	0	0	0	3	2	3	0	0	0	8
	COL	2	2	1	1	2	3	1	3	2	1	1	19
	MON	0	0	0	0	0	0	0	0	0	1	0	1
shortspine	UVAN	39	25	11	0	0	3	2	2	0	0	0	82
	COL	565	271	70	45	51	97	66	431	188	83	6	1873
	EUR	0	11	1394	4	0	0	132	399	40	34	81	2095
	MON	270	690	205	11	0	0	7	122	0	3	68	1376
silvergrey	UVAN	97	25	19	0	0	14	8	15	0	0	0	178
	COL	274	119	27	4	6	24	15	71	31	15	5	591
	EUR	0	0	5	0	0	0	2	7	4	2	3	23
	MON	5	0	2	0	0	0	0	0	0	1	0	8
speckled	MON	19	54	15	1	0	0	0	0	0	0	0	89
splitnose	UVAN	197	88	47	2	0	10	8	9	1	0	0	362
	COL	2652	1249	315	66	64	42	26	113	50	25	11	4613
	EUR	0	4	788	1	0	0	19	58	21	12	17	920
	MON	1815	3267	1217	50	0	0	3	57	8	15	35	6467

Table D-10. Soviet Union catch (t) allocated to species by INPFC area and year. Catch is rounded to the nearest t. Continued.

Species	Area	66	67	68	69	70	71	72	73	74	75	76	Total
stripetail	UVAN	0	0	0	0	0	19	11	20	0	0	0	50
	COL	49	28	9	24	29	3	2	8	4	2	1	159
	EUR	0	3	85	0	0	0	19	57	22	12	18	216
	MON	7	1	3	0	0	0	1	18	4	7	12	53
vermillion	COL	0	0	0	2	2	1	1	1	1	0	0	8
	MON	2	9	2	1	0	0	0	2	3	5	2	26
whitebelly	MON	1	4	1	0	0	0	0	0	0	0	0	6
widow	UVAN	449	750	240	51	69	22	39	6	14	0	0	1640
	COL	3221	3150	1348	305	478	678	365	534	243	220	354	10896
	EUR	0	2	263	2	0	0	11	41	144	67	60	590
	MON	96	247	73	19	0	0	2	39	50	84	43	653
yelloweye	UVAN	0	0	0	0	0	2	2	2	1	0	0	7
	COL	1	1	0	4	5	2	1	4	2	1	1	22
	MON	1	0	0	0	0	0	0	0	0	0	0	1
yellowmouth	UVAN	16	8	4	0	0	4	3	4	0	0	0	39
	COL	1344	741	223	60	50	6	3	10	4	3	2	2446
	EUR	0	0	0	0	0	0	0	1	5	2	2	10
yellowtail	UVAN	1248	892	378	398	500	195	349	58	127	0	0	4145
	COL	1597	1063	373	383	500	200	110	230	103	76	91	4726
	EUR	0	1	151	3	0	0	15	47	56	27	29	329
	MON	38	61	24	1	0	0	0	3	3	6	3	139
unidentified	UVAN	240	58	45	12	14	2	2	2	0	0	0	375
	COL	339	150	35	37	43	6	3	10	4	3	3	633
	EUR	0	0	3	0	0	0	3	9	1	1	2	19
	MON	40	0	19	1	0	0	1	29	19	32	24	165
Total	Total	40996	37606	16251	2618	2619	2461	2204	6718	2532	2011	2394	118410
	Start*	41000	37611	16251	2623	2621	2462	2209	6725	2536	2014	2394	118446

* Starting catches before allocation to species.

Table D-11. Japanese catch (t) allocation to individual species by year and INPFC area. Catch is rounded to the nearest t.

Species	Area	67	68	69	70	71	72	73	74	75	76	Total
aurora	COL	0	0	0	0	0	1	1	0	0	0	2
bank	MON	0	0	0	0	0	0	4	21	3	3	31
	CON	0	0	0	0	0	0	16	2	0	0	18
black	COL	0	63	0	4	3	55	74	0	10	9	218
	EUR	0	26	0	0	0	2	272	23	3	0	326
blackgill	MON	0	0	1	1	0	0	0	0	0	0	2
bocaccio	UVAN	0	1	0	0	0	0	0	1	0	0	2
	COL	0	7	0	0	1	19	25	0	3	3	58
	EUR	0	20	0	0	0	3	294	25	3	0	345
	MON	0	2	0	0	0	0	720	3776	616	486	5600
	CON	0	0	0	0	0	0	299	35	0	0	334
brown	MON	0	0	0	0	0	0	11	59	10	8	88
canary	UVAN	0	73	1	13	22	24	28	279	0	0	440
	COL	0	128	0	9	13	258	342	0	45	44	839
	EUR	0	74	0	0	0	3	306	26	3	0	412
	MON	0	0	0	0	0	0	20	103	17	13	153
chilipepper	EUR	0	2	0	0	0	2	200	17	2	0	223
	MON	0	1	0	0	0	0	222	1163	190	150	1726
	CON	0	0	0	0	0	0	126	15	0	0	141
cowcod	MON	0	0	0	0	0	0	3	17	3	2	25
	CON	0	0	0	0	0	0	8	1	0	0	9
darkblotched	UVAN	50	29	0	1	24	21	34	137	0	0	296
	COL	688	763	0	7	66	210	177	0	23	23	1957
	EUR	16	49	0	1	0	4	20	0	0	0	90
	MON	0	0	0	0	0	0	13	0	0	0	13
	CON	0	0	0	0	0	0	3	0	0	0	3
greenstriped	COL	0	0	0	0	0	3	4	0	1	1	9
P.o.p.	UVAN	2275	1327	8	52	161	143	234	934	0	0	5134
	COL	2356	2616	0	23	118	376	317	0	42	41	5889
	EUR	7	22	0	0	0	4	24	0	0	0	57
quillback	UVAN	0	0	0	0	0	0	0	1	0	0	1
redbanded	UVAN	0	0	0	0	0	0	0	4	0	0	4
	COL	0	2	0	0	0	4	5	0	1	1	13
	EUR	0	8	0	0	0	0	30	2	0	0	40
redstripe	UVAN	0	1	0	0	0	0	0	0	0	0	1
	COL	0	3	0	0	0	0	0	0	0	0	3
rougheye	UVAN	8	5	0	0	1	1	2	6	0	0	23
	COL	18	20	0	0	2	6	5	0	1	1	53
sharpchin	UVAN	19	11	0	0	0	0	0	2	0	0	32
	COL	28	31	0	0	1	4	3	0	0	0	67
shortraker	COL	0	0	0	0	0	1	1	0	0	0	2

Table D-11. Japanese catch (t) allocation to individual species by year and INPFC area. Catch is rounded to the nearest t. Continued.

Species	Area	67	68	69	70	71	72	73	74	75	76	Total
shortspine	UVAN	2	1	0	0	0	0	1	3	0	0	7
	COL	56	62	0	1	79	250	211	0	28	27	714
	EUR	34	103	0	1	0	66	358	0	0	0	562
	MON	0	0	5	4	0	0	108	0	0	0	117
silvergrey	UVAN	0	3	0	1	1	1	1	9	0	0	16
	COL	0	2	0	0	0	0	0	0	0	0	2
splitnose	UVAN	109	63	0	2	3	2	4	16	0	0	199
	COL	306	340	0	3	8	24	21	0	3	3	708
	EUR	2	7	0	0	0	4	20	0	0	0	33
	MON	0	1	22	18	0	0	15	0	0	0	56
	CON	0	0	0	0	0	0	0	12	0	0	12
stripetail	COL	0	2	0	0	0	1	1	0	0	0	4
	EUR	0	0	0	0	0	1	97	8	1	0	107
	MON	0	0	0	0	0	0	4	22	4	3	33
vermillion	CON	0	0	0	0	0	0	7	1	0	0	8
widow	UVAN	0	2	0	0	1	1	1	10	0	0	15
	COL	0	103	0	7	0	5	6	0	1	1	123
	EUR	0	0	0	0	0	0	54	5	1	0	60
	MON	0	0	0	0	0	0	12	62	10	8	92
	CON	0	0	0	0	0	0	14	2	0	0	16
yelloweye	UVAN	0	0	0	0	0	0	0	1	0	0	1
yellowmouth	UVAN	12	7	0	0	3	2	4	15	0	0	43
	COL	389	432	0	4	1	3	2	0	0	0	831
yellowtail	UVAN	0	119	2	21	28	31	36	358	0	0	595
	COL	0	149	0	10	11	210	278	0	37	36	731
	EUR	0	17	0	0	0	1	121	10	1	0	150
unidentified	UVAN	3	2	0	0	1	1	1	5	0	0	13
	COL	8	10	0	0	1	6	6	0	1	1	33
	EUR	0	0	0	0	0	2	46	3	0	0	51
	MON	0	0	0	0	0	0	22	99	16	13	150
	CON	0	0	0	0	0	0	12	2	0	0	14
Total	Total	6386	6709	39	183	549	1755	5306	7292	1079	877	30175
	Start*	6387	6711	40	185	551	1758	5307	7291	1078	877	30185

* Starting catches before allocation to species.

Table D-12. Allocation of catch (t) for Poland, East Germany, and Bulgaria using the average of Method 1 and Method 2. Catch is rounded to the nearest t. Species with less than 1 t in all categories are not included. Start totals are catch before allocation; differences are from rounding.

Species	Country/Year/Area											
	Poland						Bulgaria			East Germany		
	75			76			76			76		
	MON	EUR	COL	MON	EUR	COL	MON	EUR	COL	MON	EUR	COL
aurora	0	3	1	0	1	0	0	0	0	0	0	0
bank	2		0	0		0	0		0	0		0
black	0	3	2	0	1	1	0	0	0	0	0	0
blackgill	0	1	0	0	0	1	0	0	0	0	0	0
bocaccio	318	14	6	5	4	2	61	1	1	66	1	1
brown	4	0	0	0	0	1	1	0	0	1	0	0
canary	8	22	47	0	6	16	2	2	6	2	2	7
chilipepper	185	12	0	5	3	0	43	1	0	46	1	0
cowcod	1	0	0	0	0	0	0	0	0	0	0	0
darkblotched	8	21	139	0	6	21	2	1	5	2	1	6
greenstriped	1	8	4	0	2	1	0	1	0	0	1	0
olive	0	1	0	0	0	0	0	0	0	0	0	0
P.o.p.	8	27	281	0	7	35	2	2	6	2	2	6
redbanded	0	9	8	0	2	2	0	1	1	0	1	1
redstripe	2	1	5	0	0	4	0	0	2	1	0	2
rougheye	0	2	14	0	0	3	0	0	1	0	0	1
sharpchin	0	0	8	0	0	2	0	0	1	0	0	1
shortbelly	461	0	0	9	0	0	93	0	0	101	0	0
shortraker	0	0	1	0	0	0	0	0	0	0	0	0
shortspine	58	271	148	1	70	14	11	13	1	11	14	1
silvergray	0	5	23	0	1	3	0	0	1	0	0	1
splitnose	28	41	35	0	11	6	6	3	2	6	3	2
stripetail	9	41	3	0	11	0	2	3	0	2	3	0
vermillion	1	0	0	0	0	0	0	0	0	0	0	0
widow	24	46	45	1	15	102	7	9	55	7	10	60
yelloweye	0	0	1	0	0	0	0	0	0	0	0	0
yellowmouth	0	1	2	0	1	1	0	0	0		0	0
yellowtail	2	38	43	0	11	30	0	4	14	0	5	15
unidentified	16	6	2	0	2	1	4	0	0	4	0	0
Total	1136	573	818	21	154	246	234	41	96	251	44	104
Start*	1138	577	819	23	157	247	235	43	98	252	46	106

* Starting catches before allocation to species.

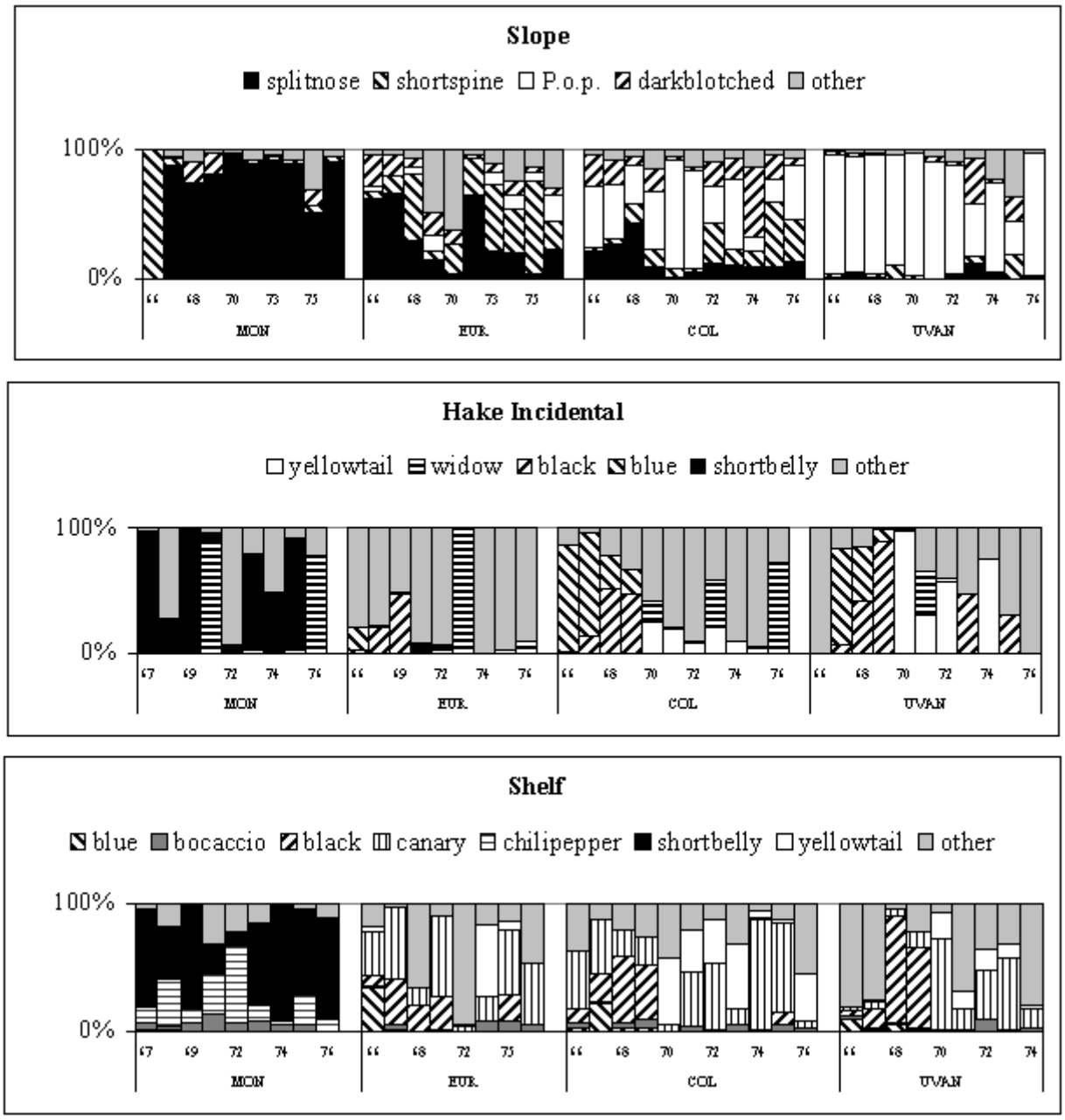

Figure D-1. Comparison of percents by weight (y axes) for species dominating the four most frequently occurring Soviet Union research assemblages by INPFC area and year (x axes). Under shelf, the MON is the S. shelf assemblage and the other areas are the N. shelf assemblage.

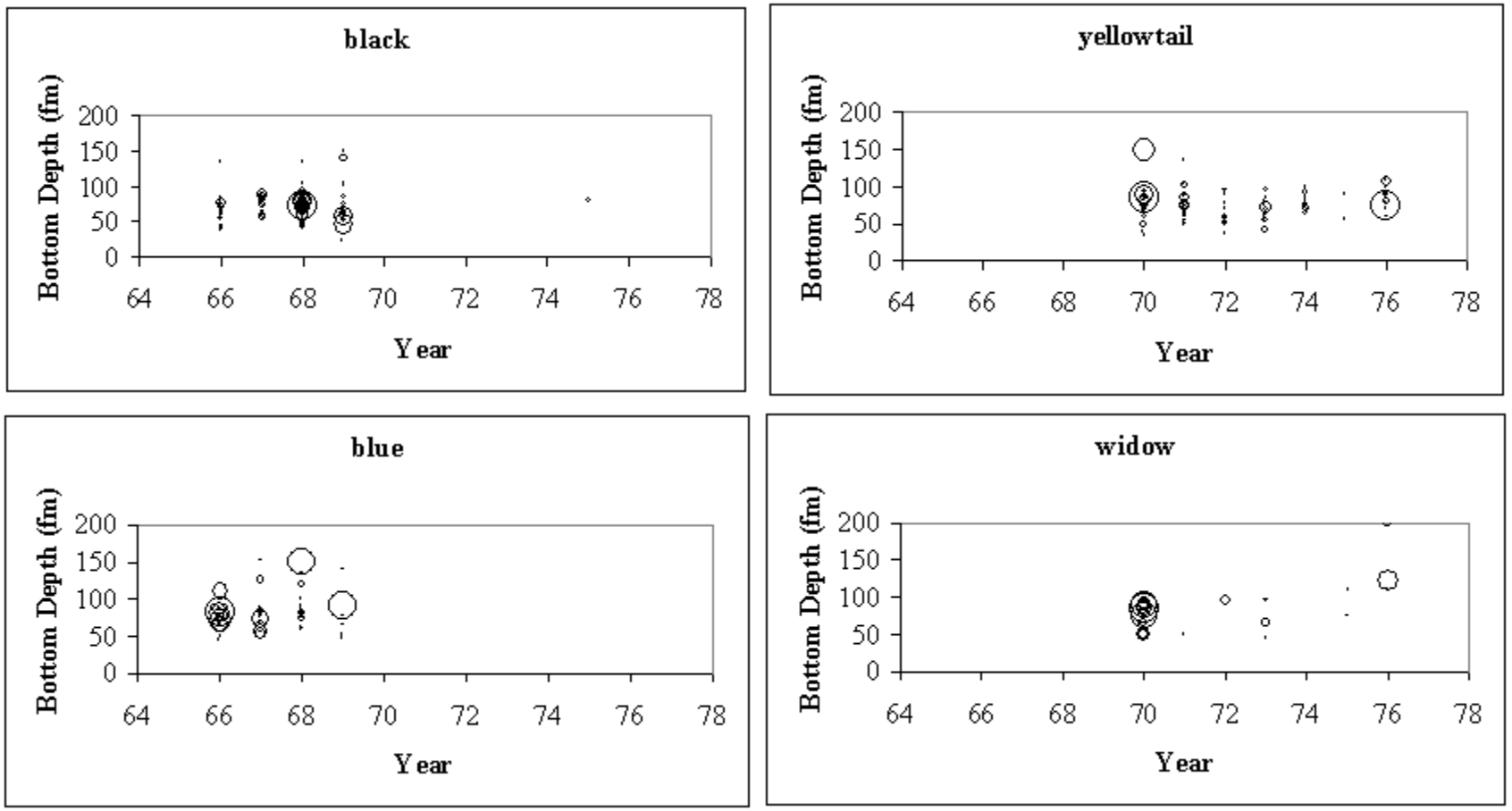

Figure D-2. Comparison of the catches of four species in the Soviet Union surveys by year and bottom depth. Size of the bubble is directly related to the size of the catch.

APPENDIX E: COMPARISON WITH PREVIOUS ESTIMATES

Table E-1. U.S. Vancouver INPFC area P.o.p. assessment foreign catch (t) derivations versus new estimates (t).

Country	Type	Source	Category	Area	65	66	67	68	69	70	71	72	73	74	75	76
Soviets	Citations/	Forrester et al. (1978)	Rockfish	B.C.		33000										
	Calculations	INPFC a (1975)	Rockfish	B.C.			6575	7306	1607	186	900	401				
		Soviet U. (unpubl. data)	Other	B.C.										70		
			from B.C.	VAN		14000	6000	5114	1040	182	900	401		70		
		Forrester et al. (1983)	POP	VAN									490			
		VNIRO (1978)	Rockfish	VAN											152	187
	Assessment	1978 P.o.p.	P.o.p.	VAN	500	14000	6000	5114	1040	182	900	401	490	70	152	187
		1996 P.o.p.	P.o.p.	UVAN	375	10500	4500	3836	780	137	675	301	368	53	114	140
	New		Rockfish	VAN		n/a	10263	4602	2143	814	1145	878	793	393	610	217
			Rockfish	UVAN		7319	4172	1959	543	629	813	865	610	217	0	0
			P.o.p.	UVAN		4595	2044	1090	56	16	387	278	373	32	0	0
Japan	Citations	FAJ (68, 69, 70)	POP	VAN		few	6678	4751	1787	2186	1838	1580	2989	1084	352	286
	Assessment	1978 P.o.p.	P.o.p.	VAN			6678	4751	1787	2186	1838	1580	2989	1084	352	286
		1996 P.o.p.	P.o.p.	UVAN			5009	3563	1340	1640	1379	1185	2242	813	264	215
	New		POP	VAN			6678	4751	1787	2186	1838	1580	2989	1084	352	286
			1/2 Other	VAN									583	2333	646	163
			POP	UVAN			2478	1445	9	57	193	171	213	452	0	0
			1/2 Other	UVAN									67	665	0	0
			P.o.p.	UVAN			2275	1327	8	52	161	143	234	934	0	0
Poland	Assessment	1978 P.o.p.	P.o.p.	VAN										32		
		1996 P.o.p.	P.o.p.	UVAN										24		
	New		P.o.p.	UVAN										26		
Bulgaria	Citations	Gunderson (unpubl. data)	POP	VAN												23
	Assessment	1978 P.o.p.	P.o.p.	VAN												23
		1996 P.o.p.	P.o.p.	UVAN												17
	New		P.o.p.	UVAN												0
E. Germany	Citations	Gunderson (unpubl. data)	POP	VAN												25
	Assessment	1978 P.o.p.	P.o.p.	VAN												25
		1996 P.o.p.	P.o.p.	UVAN												19
	New		P.o.p.	UVAN												0
R. of Korea	New		P.o.p.	UVAN												29

Table E-2. Columbia INPFC area comparison of P.o.p. assessment calculations with new estimates (t).

Country	Type	Source	Category	Area	66	67	68	69	70	71	72	73	74	75	76
Soviets	Citations	INPFCa (1969)	Rockfish	WOC	10000										
		INPFCa (1975)	Rockfish	WO		19845	7110	2241	2621	2462	1629				
		Forrester et al. (1983)	POP	COL								539			
		Soviet U. (unpubl. data)	Other	WO									100		
		VIRNO (1978)	Rockfish	COL										784	607
	Assessment	1978 P.o.p.	P.o.p.	COL	10000	19845	7110	2241	2621	2462	1629	539	100	784	607
	New		Rockfish	COL	27532	15637	4844	1699	1990	1649	957	3071	1358	793	626
			P.o.p.	COL	11116	5750	1623	409	353	273	154	852	372	174	38
Japan	Citations	FAJ (68, 69, 70)	POP	COL	few	3850	4274	0	38	276	880	0	0	0	0
	Assessment	1978 P.o.p.	P.o.p.	COL	few	3850	4274	0	38	276	880	0	0	0	0
	New		POP	COL		3850	4274	0	38	276	880	0	0	0	0
			1/2 Other	COL								740	0	98	95
			POP+1/2	COL		3850	4274	0	38	276	880	740	0	98	95
			P.o.p.	COL		2372	2633	0	23	170	378	318	0	42	41
Poland	Citations	Morski (unpubl. data)	P.o.p.	COL										39	
		Murai (unpubl. data a)	P.o.p.	COL											0
	Assessment	1978 P.o.p.	P.o.p.	COL									94	39	0
	New		Rockfish	COL										819	247
			P.o.p.	COL									94	282	98
Bulgaria	Citations	Gunderson (unpubl. data)	Rockfish	COL											96
	Assessment	1978 P.o.p	P.o.p.												89
	New		P.o.p.	COL											6
E.Germany	Citations	Gunderson (unpubl. data)	Rockfish	COL											103
	Assessment	1978 P.o.p	P.o.p.												95
	New		P.o.p.	COL											6
R.of Korea	New		P.o.p.	COL											84

Table E-3. U.S. Vancouver INPFC area yellowtail and canary assessment calculations versus new values (t). Bold indicates used in assessments. Area is given only when it changes from the above value. B.C. = British Columbia, S. VAN = southern Vancouver INPFC.

Type	Country	Source	Category	Area	67	68	69	70	71	72	73	74	75	76
Citations/	Soviet	Fraidenburg et al. (1977)	Rockfish	VAN	10263	4602	2143	814	1145	878				
Calculations		Gunderson et al. (1977)	P.o.p.		6000	5114	1040	182	900	401				
Yellowtail/		difference	Rock-P.o.p.		**4263**	-512	**1103**	**632**	**245**	**477**				
Canary		Fraidenburg et al. (1977)	Other								**303**	**113**	87	
	Japan	Forrester et al. (1978)	Other		**117**	649	**175**	192						
		Fraidenburg et al. (1977)	Other				91	**288**	**267**	**346**	**1166**	**4665**	1298	
			Other	B.C.		**1777**								
	Poland	Fraidenburg et al. (1977)	Other	VAN									12243	
Assessment	All	1984 yellowtail	not P.o.p.		4380	1777	1278	920	512	823	1469	4778	8085	2889
			yellowtail		525	731	633	238	134	300	342	641	6837	2532
		1988 yellowtail	yellowtail		302	544	587	185	107	268	332	629	6835	2394
		1993 yellowtail	yellowtail	S.VAN	302	544	587	185	107	268	332	629	135	55
Citations/	All	Fraidenburg, Forrester	Other	VAN	117	1777	175	288	267	346	1469	4778		
Calculations		Fraidenburg et al. (1977)	% Canary		64%	42%	39%	53%	59%	28%	50%	63%	68%	
Canary			canary-Other		75	739	68	152	159	98	738	3028		
	Soviet	positive difference	not P.o.p.		4263	0	1103	632	245	477				
		Fraidenburg et al. (1977)	% canary		64%	42%	39%	53%	59%	28%				
			min canary		2720	0	425	335	146	136				
		Fraidenburg et al. (1977)	Rockfish		10263	4602	2143	814	1145	878				
		Fraidenburg et al. (1977)	% canary		38%	34%	33%	30%	39%	21%				
			max canary		3932	1579	709	247	442	181				
			ave canary		3326	789	567	291	294	158				
	All		canary		3401	1529	635	443	452	256	738	3028		
Assessment	All	1984 canary	canary		3474	1660	582	398	426	196	647	2970	33	211
		44.3% U.S.	canary	UVAN	1539	735	258	176	189	87	287	1316	15	93
		1994 canary	canary		1538	735	258	189	87	287	1315	15	93	0

Table E-3. U.S. Vancouver INPFC area yellowtail and canary assessment calculations versus new values (t). Bold indicates used in assessments. Area is given only when it changes from the above value. B.C. = British Columbia, S. VAN = southern Vancouver INPFC. Continued.

Type	Country	Source	Category	Area	67	68	69	70	71	72	73	74	75	76
New	Soviet		Rockfish	VAN	10263	4602	2143	814	1145	878	793	393	610	217
			Rockfish	UVAN	4172	1959	543	629	813	865	610	217	0	0
			yellowtail		892	378	398	500	195	349	58	127	0	0
			canary		90	36	11	15	48	44	40	9	0	0
	Japan		Other	VAN		n/a	91	288	267	346				
			1/2 Other								583	2333	646	162.5
			Other	UVAN		198	3	35	53	57				
			1/2 Other								67	665	0	0
			yellowtail			119	2	21	28	31	36	358	0	0
			canary			73	1	13	22	24	28	279	0	0

Table E-4. Columbia INPFC area (COL) yellowtail and canary assessment calculations versus new estimates (t). Bold indicates used in assessments. New includes 1976 Bulgaria and East Germany catch (29 t yellowtail, 13 t canary). Area listed when it changes (N. = north).

Type	Country	Source	Category	Area	67	68	69	70	71	72	73	74	75	76
Citations/	Soviet	Fraidenburg (1977)	Rockfish	COL	15637	4844	1699	1990	1649	957				
Calculations		Gunderson et al.(1977)	P.o.p.		19845	7110	2241	2621	2462	1629				
Yellowtail/		difference	Rock-P.o.p.		-4208	-2266	-542	-631	-813	-672				
Canary		Fraidenburg et al. (1977)	Other								**2532**	**57**	**9**	
	Japan	Forrester et al. (1978)	Other		**441**	226	**3**	28						
		Fraidenburg et al. (1977)	Other			**666**	0	**31**	**29**	**558**	**1480**	**0**	**195**	
	Poland	Fraidenburg et al. (1977)	Rockfish										**780**	
Assessment	All	1984 yellowtail	not P.o.p.		441	666	3	31	29	558	4012	57	984	274
			yellowtail		114	239	1	4	6	175	1327	9	407	164
		1988 yellowtail	yellowtail		114	240	1	4	6	207	1385	11	407	0
		1993 yellowtail	yellowtail	N.COL	114	240	1	4	6	207	1385	11	407	0
Citations/	All		Other	COL	441	666	3	31	29	558	4012	57	984	
Calculations		Fraidenburg et al. (1977)	%canary		5%	34%	32%	34%	36%	31%	40%	37%	28%	
Canary			other canary		24	223	1	10	11	172	1623	21	276	
	Soviet		with P.o.p.		15637	4844	1699	1990	1649	957				
		Fraidenburg et al. (1977)	% canary		5%	30%	29%	30%	34%	29%				
			max canary		763	1467	486	597	553	280				
			min canary		0	0	0	0	0	0				
			ave canary		382	733	243	298	276	140				
	All		total canary		406	957	244	309	287	312	1623	21	276	
Assessment	All	1984 canary	canary		409	950	242	310	302	309	1905	22	225	34
New	Soviet		Rockfish		15637	4844	1699	1990	1649	957	3071	1358	793	626
			yellowtail		1063	373	383	500	200	110	230	103	76	91
			canary		658	158	50	64	105	60	183	81	49	41
	Japan		Other			460	0	31	29	558				
			1/2 Other								740	0	97.5	95
			yellowtail		0	149	0	10	11	210	278	0	37	36
			canary		0	128	0	9	13	258	342	0	45	44
	Poland		Rockfish										819	247
			yellowtail										43	30
			canary										47	16

Table E-5. Differences between new estimates (t) for Pacific ocean perch (P.o.p.), yellowtail, and canary and those used previously in the stock assessments. Start = catch to which percentages are applied. Yellowtail areas in parentheses are used in the stock assessment.

Assessment	Area	Data	65	66	67	68	69	70	71	72	73	74	75	76	Total
P.o.p.	VAN	start	-500		4263	-512	1103	632	245	477	886	2656	1104	145	10998
	UVAN	start	-375	-3182	-2859	-3995	-1569	-1090	-1048	-450	-1719	471	-378	-391	-16584
		% UVAN			-36%	-39%	-61%	-52%	-41%	-33%	-55%	-40%	-75%	-75%	
		% P.o.p.			-35%	-34%	-28%	-88%	-90%	-41%	-59%	-31%	-26%		
	COL	start		17532	-4208	-2266	-542	-631	-813	-672	3272	1258	887	445	14261
		% P.o.p.		-60%	-58%	-53%	-76%	-81%	-77%	-71%	-69%	-68%	-71%	-78%	
Yellowtail	UVAN (S. VAN)	start			5883		956	182	900	401	-93	-2053			6177
		% UVAN			-59%		-76%	-40%	-39%	-25%	-51%	-68%	-2%	-0.02	
		% yellowtail			15%	-7%	29%	60%	5%	9%	-9%	42%			
	COL (N. COL)	start			15196	4638	1696	1990	1649	957	-201	1301	726	893	28845
		% yellowtail			-19%	-26%	-10%	13%	-8%	-16%	-21%	-12%	-32%	17%	
	EUR (EUR+S. COL)	additional			2	168	3	0	0	16	169	66	67	51	541
Canary	UVAN	start			2883		436	91	450	201	-93	-2053			1915
		% UVAN			-4%		-20%	16%	17%	31%	5%	-12%	-44%	-0.44	
		% canary			-45%	-36%	-30%	-38%	-13%	-56%	-192%	32%			
	COL	start			7378	2216	847	995	825	479	-201	1301	726		14564
		% canary			2%	-12%	-11%	-12%	-10%	1%	-27%	-31%	-20%		
	EUR-CON	additional		41	103	415	5	0	0	13	372	150	63	49	1211

Recent NOAA Technical Memorandums NMFS

published by the
Northwest Fisheries Science Center

NOAA Tech. Memo.
NMFS-NWFSC-

56 **MacCall, A.D., and T.C. Wainwright (editors). 2003.** Assessing extinction risk for West Coast salmon. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-56, 198 p. NTIS PB2003-104642.

55 **Builder Ramsey, T., et al. 2002**. The 1999 Northwest Fisheries Science Center Pacific West Coast upper continental slope trawl survey of groundfish resources off Washington, Oregon, and California. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-55, 143 p. NTIS PB2003-104641.

54 **Krahn, M.M., et al. 2002.** Status review of southern resident killer whales *(Orcinus orca)* under the Endangered Species Act. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-54, 133 p. NTIS PB2003-104520.

53 **Waknitz, F.W., T.J. Tynan, C.E. Nash, R.N. Iwamoto, and L.G. Rutter. 2002**. Review of potential impacts of Atlantic salmon culture on Puget Sound chinook salmon and Hood Canal summer-run chum salmon evolutionarily significant units. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-53, 83 p. NTIS PB2002-108143.

52 **Meador, J.P., T.K. Collier, and J.E. Stein. 2001.** Determination of a tissue and sediment threshold for tributyltin (TBT) to protect prey species of juvenile salmonids listed under the Endangered Species Act. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-52, 21 p. NTIS PB2002-103161.

51 **Emmett, R.L., P.J. Bentley, and G.K. Krutzikowsky. 2001.** Ecology of marine predatory and prey fishes off the Columbia River, 1998 and 1999. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-51, 108 p. NTIS PB2002-101699.

50 **Turk, T.A., et al. 2001.** The 1998 Northwest Fisheries Science Center Pacific West Coast upper continental slope trawl survey of groundfish resources off Washington, Oregon, and California. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-50, 122 p. NTIS PB2002-101700.

49 **Nash, C.E. (editor). 2001.** The net-pen salmon farming industry in the Pacific Northwest. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-49, 125 p. NTIS PB2002-100948.

48 **Meador, J.P., T.K. Collier, and J.E. Stein. 2001.** Use of tissue and sediment based threshold concentrations of polychlorinated biphenyls (PCBs) to protect juvenile salmonids listed under the Endangered Species Act. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-48, 40 p. NTIS number pending.

47 **Johnson, L.L. 2001.** An analysis in support of sediment quality thresholds for polycyclic aromatic hydrocarbons to protect estuarine fish. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-47, 30 p. NTIS number pending.

Most NOAA Technical Memorandums NMFS-NWFSC are available online at the Northwest Fisheries Science Center web site (http://www.nwfsc.noaa.gov).