アラスカ湾におけるメヌケ類及びアラスカキチジの資源評価(1987年)

Stock assessment of rockfishes and shortspine thornyhead in the Gulf of Alaska in 1987

若林　清・手島和之
Kiyoshi Wakabayashi and Kazuyuki Teshima

1987年　9月
September　1987
水産庁
Fisheries Agency of Japan

この文書を引用する場合は下記による：
若林　清・手島和之．1987．アラスカ湾におけるメヌケ類及びアラスカキチジの資源評価（1987年）．9頁．（第34回INPFC定例年次会議提出文書．1987年10月．カナダ，ヴァンクーバー市）．水産庁，遠洋水産研究所．日本．〒424清水市折戸5－7－1

アラスカ湾におけるメヌケ・キチジ類及び カレイ類の資源評価（1987年）

若林　清・手島　和之
（北海道区水産研究所・遠洋水産研究所）

1. アラスカメヌケ複合種（POP complex）

POP complexは，アラスカメヌケ（Sebastes alutus），ヒレグロメヌケ（S. borealis），アラメヌケ（S. aleutianus），キタノメヌケ（S. polyspinis）及びアゴメヌケ（S. zacentrus）の5種のメヌケ類よりなる。この魚種群は，主に水深約250m以深の大陸斜面上部水域に生息する。1977－1978年の期間では，アラスカメヌケは単一種として，それ以外のメヌケ類はその他のメヌケとして資源管理されていた。しかしながら，船上でメヌケ類漁獲物を正確に仕分けることはむつかしく，アラスカメヌケ以外のメヌケ類がアラスカメヌケとして区分されたり，また，その逆が生じているのが事実である。したがって，メヌケ類の漁獲統計を正確に把握することは困難である。このため，1979年以降アラスカメヌケおよびそれに類似したメヌケ類4種がPOP complexとして管理されるようになった。ところが，1986年には，メヌケ類は再びアラスカメヌケ単一種とそれ以外のメヌケ類の2魚種群に区分された。POP complexを構成する魚種は互いに似たような水深帯に生息しており，それぞれの魚種を選択して魚獲することは極めて困難である。このため，魚種別漁獲統計を作成することは不可能に近い。したがって，本報告では，POP complex，すなわち，斜面生息魚種群（Slope assemblage）として資源評価を行う。

1.1. 漁　獲　量

アラスカ湾におけるアラスカメヌケの漁獲量を表1に示した。漁獲量は，1965年における344.700トンをピークとした後著しく減少し，1976年には48,000トンとなった。200海里体制が確立した1977年には，前年の半分以下の21,600トン，1978年にはさらに急激に減少し7,500トンとなった。1986年の漁獲量はわずかに1,000トンであった。

1.2. 資源の動向

岡田（1985）及びCarlson et al.（1985）は，商業漁業によるアラスカメヌケのCPUEが1976年と1977年にそしてそれ以降急激に低下したことを報告している。このことは，規制の導入と強化さらには漁獲割り当て量が微少になったため，アラスカメヌケの漁獲を目的に費やされた努力量も急激に低下したためと考えられる。現在では，アラスカメヌケは混獲のみで漁獲されている。したがって，漁業から得られたCPUEがアラスカメヌケ資源の動向を反映しないことは明らかであ

る。さらに，上述した理由により，漁獲統計から，アラスカメヌケのみに向けられた努力量を分離することは不可能である。

日・米共同はえなわ資源調査は，1979年以降ほぼ同一の漁船・漁具及び調査計画のもとに実施されている。本調査から得られたデータは底魚類の資源動向の指標，すなわち相対資源尾数(Relative population number, RPN)及び相対資源重量(Relative population wight, RPW)として算出されている（Sasaki and Teshima, 1987）。残念ながら，メヌケ類に関しては，ヒレグロメヌケとアラメヌケを混合したRPNに限られている（表2）。1979年のRPNを100とした1983年から1986年のRPNは95－111の範囲にあり，比較的安定して推移している。

日・米共同はえなわ調査から得られたアラメヌケの平均体長は，1979年の43.5㎝から1984－1986年の45.5－45.9㎝まで，わずかではあるが増加傾向を示している（Yoshimura and Sasaki, 1987）。また，ヒレグロメヌケでは，1979－1982年の57.9－59.9㎝から1983－1986年の60.6から61.9㎝へとわずかではあるが平均体長は増加している。以上のように，POP complex資源の，少なくとも，その一部は悪化の傾向をしめていない。

1.3. 資源量推定値

1984年にアラスカ湾で初めて実施された日・米共同底魚資源調査から得られた魚獲資料を用いて算出したメヌケ・キチジ類の資源量推定値を魚種別，INPFC海区別に表3に示した（Carlson et al., 1985）。推定値は底びき網漁具の効率（Vulnerability）を1.0と仮定し，Alverson and Pereyra（1969）の掃過面積法を用いて得られた。メヌケ類は海底を離れても分布するし，また，海底の荒い水域で分布密度が高くなる傾向を示す。このため，網口高さ約5－6mの底びき網漁具を用いて調査を実施した場合，海底の荒い水域での操業はむつかしく，しかも掃過した水域の魚をすべて漁獲することは不可能である。したがって，これらの実状を考慮すれば，得られた資源量推定値は過少となることが考えられる。

アラスカ湾全水域におけるPOP complexの資源量推定値は総計，552,300トンであった(表3)。その内，アラスカメヌケが61％（334,900トン）を占め，次いでキタノメヌケが14％，アラメヌケとヒレグロメヌケがそれぞれ13％，12％を示した。アゴメヌケは全体の1％以下であった。アラスカメヌケとヒレグロメヌケ資源はアラスカ湾全水域に及んでいたが，キタノメヌケは西部水域に，アゴメヌケは東部水域に偏在していた。また，アラメヌケ資源も西部水域に多かった。

1.4. 平衡漁獲量（EY）

アラスカ湾におけるアラスカメヌケの資源量推定値，334,900トンに対するOY（optimumyield）3,702トンの割合（開発率）は0.011となる。資源量推定値は過少と考えられるから，開発率はより小さいものとなろう。この値は開発の進んだ魚種としてはいかにも低くすぎる。Carlson et al.（1985）は，改良SRAモデル（Balsiger et al., 1985）を用いて資源量の将来予測を行い，資源を近年の水準に安定させるFの値を求めている。それによれば，近年の資源量を152,000トンから508,000トンと推定し，M＝0.05を用いて得られたFの値は資源量の下限推定値に対して

0.05，上限値に対して0.04であった。日・米共同底魚資源調査から得られた1984年のアラスカメヌケの資源量は，Carlson et al.（1985）による推定範囲のほぼ中央値であった。1984年の日・米共同底魚資源調査による推定値は過少に評価されているため，Carlson et al.（1985）を用いて修正すれば，近年のアラスカメヌケの資源量は334,900トンから508,800トンとなり，この下限値に対するFの値は，中央値をとって0.045となる。このF＝0.045は開発率にして0.0429，F＝0.04では0.0383に相当する。日・米共同資源調査結果によれば，アラスカメヌケの推定値はPOP complexの61％を占めているので，この割合とアラスカメヌケの推定値より，POP complexの近年の資源量は549,000－832,800トンと推定される。

上記で求めた資源量推定値に上述開発率を乗ずれば，資源量を低下させない漁獲量，すなわちEYが得られる。POP complexを構成するアラスカメヌケ以外のメヌケ類の生態はアラスカメヌケとよく類似しており，また寿命も同様に長いと推定される。このため，POP complex（すなわちSlope assemblage）に対してアラスカメヌケの開発率を適用すれば，アラスカ湾全水域におけるPOP complexのEYとして23,600－31,900トン（その内，アラスカメヌケのEY：14,400－19,500トン）が得られる。このEYを管理水域別に示すと，資源量に応じて次のようになる。

EY（ton）by INPFC Area

	Western	Central	Eastern
POP complex	5,300－7,200	7,300－9,800	11,000－14,900
Pacific ocean pecrch	2,600－3,500	3,100－4,200	8,700－11,700

資源量推定値の下限値は過少に推定されているので，EYの下限値も過少と考えられる。

2. その他のメヌケ

その他のメヌケは，1977年と1978年ではアラスカメヌケを除くすべてのメヌケ類，1979年から1985年においてはPOP complexに含まれる5種を除くメヌケ類，そして1986年では1977－1978年と同様にアラスカメヌケを除くメヌケ類で構成されている。ここでは，前節で資源評価を行ったPOP complex（Slope assemblage）以外のメヌケ類について資源評価を行う。その他のメヌケに属するメヌケ類は主として200m以浅の浅海域に生息し，Shelf assemblageを構成している。

2.1. 漁　獲　量

漁獲量は，1975年と1976年の約100,000トンをピークに，200海里体制が確立した1977年以降では2,600トン以下の低い水準にある（表4）。

2.2. 資　源　量

その他のメヌケの主要構成種であるナガメヌの資源量推定値は，1984年の日・米共同底魚資源調査結果より，西経144°－170°のアラスカ湾において，25,700トンと推定された（Brown,1985）。

ナガメヌケは手釣りにより中層からも採集される。このため，本種はShelf pelagic assemblageとも呼ばれている（Bracken and Ito, 1985）。POP complexの項でも述べたが，調査に用いた底びき網漁具特性のため，得られた資源量推定値は過少に推定される傾向にある。

ナガメヌケ以外の魚種の日・米共同分析による資源量推定値は得られていない。1984年の日本側のみの漁獲資料による分析結果によると（INPFC海区及び水深帯別のCPUEと調査面積の積として求めた資源重量の相対値，未発表資料），ナガメヌケを除くその他のメヌケ類はナガメヌケの資源重量の相対値の22％であった。したがって，ナガメヌケの資源量推定値，25,700トンと上記の割合とを用いて，ナガメヌケ以外のメヌケ類の資源量は5,600トンと推定される。日本の調査は，これらの魚種が多く分布する浅海域にまで及んでおらず，このため資源量は相対的に過少に推定された傾向にある。

西経144°以東の水域における資源量推定値は現段階では得られていない。西経144°以東の水域には，以西に比較してメヌケ類の種類が豊富であることが知られており，資源量もさらに多いと推定される。

2.3. 平衡漁獲量（EY）

西経144°以西のアラスカ湾におけるその他のメヌケ類の資源量は31,300トンと推定された。この推定値はかなり過少であると考えられる。本魚種群に対する適正な開発率は得られていない。その他のメヌケを構成する魚種はアラスカメヌケと同属で，生理・生態も類似していると考えられる。また，寿命もアラスカメヌケ同様に長いと推定される。これらのことから，アラスカメヌケに対する適正開発率（0.0383－0.0429）を資源量推定値に準用して，その他のメヌケのEYを求めた。その結果，アラスカ湾の西部及び中部水域に対するEYは1,200－1,300トンとなる。資源量推定値は過少に推定されているから，得られたEYも過少である。

3. キ　チ　ジ　類

アラスカキチジ（Sebastolobus alascanus），ヒレナガキチジ（S. altivelis）及びキチジ（S. macrochir）の3種が本魚種群に含まれる。しかし，アラスカ湾では主としてアラスカキチジのみが出現する。

3.1. 漁　獲　量

漁獲量は1979年以降82－1,351トンの低い水準にある（表5）。1985年の漁獲量はわずかに82トンであった。

3.2. 資源量推定値

1984年の日・米共同底魚資源調査結果による資源量推定値は，アラスカ湾全水域について80,600トンであった（表3，Shippen, 1986）。本種が海底の荒い水域により多く分布する傾向を示すこと，また，漁具効率を1と仮定していることなどから，得られた資源量推定値は過少であると考えられる。

3.3. 資源の動向

日・米共同はえなわ資源調査によるアラスカキチジのRPNとRPWは1979－1981年の期間では高い値を示したが，1982年以降では，1979年を100とした値のそれぞれ54－76，55－77の低い水準で推移している（表2）。また，平均体長は，1979年から1986年の期間では，33.9－35.3cmの範囲にあり，特定の経年変化を示していない（表2）。

近年の漁獲量（1979－1985年の平均値）は過少に推定された資源量推定値のわずか0.7％以下の低い水準にある。このことから，近年資源量が低下しているとしても，漁獲による影響のみとは考えられない。

3.4. 平衡漁獲量（EY）

アラスカ湾全水域における資源量推定値は80,700トンであり，近年のOYは3,750トンに設定されている。資源量に対するOYの割合（開発率）は4.6％となり，資源量が過少に推定されていることを考慮すればより小さい値となる。本魚種群に対する適正な開発率は得られていない。Carlson et al.（1985）は，同一の科に属する寿命の長いとされているアラスカメヌケについて，資源を現在の水準に維持する開発率を3.8－4.8％と分析している。OYに対する過大に推定されている開発率はこの範囲にある。キチジ類の寿命もアラスカメヌケ同様に長いと推定されており，また生態も類似している。これらのことを勘案して，キチジ類のOYを現在の3,750トンから変更する必要はないと考える。

References

Alverson, D.L. and W.T. Pereyra. 1969. Demersal fish explorations in the northeastern Pacific Ocean - an evaluation of exploratory fishing methods and analytical approaches to stock size and yield forecasts. J. Fish. Res. Board Can., 26: 1985-2001.

Berger, J., J. Wall, and R. Nelson, Jr. 1986. Summary of U.S. observer samples of foreign and joint venture fisheries in the northeast Pacific Ocean and eastern Bering Sea, 1985. 182pp. (Document submitted to the International North Pacific Fisheries Commission October, 1986). Natl. Mar. Fish. Serv., Northwest and Alaska Fisheries Center.

Bracken, B.E. and D.H. Ito. 1986. Other rockfish. In R.L. Major (editor), Condition of groundfish resources of the Gulf of Alaska region as assessed in 1985, 221-234. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-106.

Bracken, B.E. and V.M. O'Connell. 1986. Other rockfish. In R.L. Major (editor), Condition of groundfish resources of the Gulf of Alaska region as assessed in 1986. 172pp. (Document submitted to the International North Pacific Fisheries Commission, October, 1986). Natl. Mar. Fish. Ser., Northwest and Alaska Fisheries Center.

Brown, E.S. 1986. Preliminary results of the 1984 U.S.- Japan cooperative bottom trawl survey of the central and western Gulf of Alaska. In R.L. Major (editor), Condition of groundfish resources of the Gulf of Alaska region as assessed in 1985, 259 -296. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-106.

Carlson, H.R., D.H. Ito, R.E. Haight, T.L. Rutecki, and J.F. Karinen. 1986. Pacific Ocean perch. In R.L. Major (editor), Condition of groundfish resources of the Gulf of Alaska region as assessed in 1985, 155-209. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-106.

Karinen, J.F. and B.L. Wing. 1986. Pacific Ocean Perch. In R.L. Major (editor), Condition of groundfish resources of the Gulf of Alaska region as assessed in 1986. 172pp. (Document submitted to the International North Pacific Fisheries Commission, October, 1986). Natl. Mar. Fish. Ser., Northwest and Alaska Fisheries Center.

Okada, K. 1985. Stock assessment of pollock, Pacific ocean perch, rockfishes, and flatfishes in the Gulf of Alaska in 1985. (Document submitted to INPFC) 9p. Fish. Agency Japan, Tokyo, Japan.

Sasaki, T. and K. Teshima. 1987. Data report on abundance indices of flatfishes, rockfishes, shortspine thornyhead and grenadiers based on the results from Japan-U.S. joint longline surveys, 1979-1986. 25p. Far Seas Fish. Res. Lab., Shimizu, Japan.

Shippen, H.H. 1986. Thornyhead rockfish. In R.L. Major (editor), condition of groundfish resources of the Gulf of Alaska region as assessed in 1986. 172pp. (Document submitted to the International North Pacific Fisheries Commission, October, 1986). Natl. Mar. Fish. Ser., Northwest and Alaska Fisheries Center.

Yoshimura, T. and S. Sasaki. 1987. Preliminary report on Japan-U.S. joint longline survey by Fukuyoshi maru No.8 in 1986. 11p. Far Seas fish. Res. Lab., Shimizu, Japan.

Table 1. Annual catches of Pacific ocean perch (1,000 t) in the Gulf of Alaska[a].

Year	Japan[b]	USSR	Other nations	Total
1964	10.7	230.0	-	240.7
1965	38.8	306.0	-	344.7
1966	63.0	135.8	-	198.8
1967	54.7	66.5	-	121.2
1968	54.2	45.2	-	99.4
1969	55.5	18.8	-	74.3
1970	44.3	0	-	44.3
1971	44.8	29.7	-	74.5
1972	52.0	24.0	-	76.0
1973	49.8	5.6	-	55.4
1974	35.5	11.0	-	46.5
1975	32.4	10.0	-	42.4
1976	36.4	10.0	1.6	48.0
1977	19.2	1.7	0.6	21.5
1978	3.9	0.6	3.0	7.5
1979	6.5	1.1	1.5	9.1
1980	9.1	1.2	0.5	10.8
1981	8.5	0	1.8	10.3
1982	4.6	0	0.8	5.4
1983	2.9	0	2.4	5.3
1984	2.2	0	2.0	4.2
1985[c]	0			
1986	0			

[a] From Carlson et al. (1985) for data other than Japan, for which FSFRL data file were used. Other rockfishes may be included in catches.
[b] Reported catches of Pacific ocean perch.
[c] From Karinen and Wing (1986) for 1985.

Table 2. Stock size indices and mean length of rockfishes and thornyheads in the Gulf of Alaska based on Japan-U.S. joint longline surveys, 1979-1986[a]

	Rockfishes[b]			Shortspine thornyhead		
Year	RPN[c] (Index)	Average length (cm)		RPN (Index)	RPW[d] (Index)	Average length(cm)
1979	11,535 (100)	59.0[e]	43.5[f]	9,875 (100)	5,696 (100)	34.4
1980	16,481 (143)	58.7	44.4	11,823 (120)	6,726 (118)	34.1
1981	8,441 (73)	57.9	44.9	12,732 (129)	6,793 (119)	33.9
1982	8,560 (74)	59.9	44.9	6,840 (69)	4,254 (75)	35.0
1983	10,972 (95)	61.8	45.6	6,893 (70)	4,148 (73)	34.7
1984	12,802 (111)	60.6	45.9	5,291 (54)	3,115 (55)	34.5
1985	11,120 (96)	61.2	45.8	7,532 (76)	4,362 (77)	34.4
1986	11,576 (100)	61.9	45.5	5,411 (55)	3,401 (60)	35.3

[a] From Sasaki and Teshima (1987) for indices and from Yoshimura and Sasaki (1987) for average length.
[b] Composed mainly of shortraker and rougheye rockfishes.
[c] Relative population number, see Sasaki and Teshima (1987) for details.
[d] Relative population weight, see Sasaki and Teshima (1987) for details.
[e] For shortraker rockfish.
[f] For rougheye rockfish.

Table 3. Biomass estimates of rockfishes and thornyheads (t) by INPFC area in the Gulf of Alaska based on the Japan-U.S. joint trawl survey in 1984[a].

Species	Shumagin	Chirikof	Kodiak	W. Yakutat[b]	Yakutat[c]	South-eastern	Total[d]
Pacific ocean perch	60,300	20,400	51,900	41,500	127,200	33,700	334,900
Shortraker rockfish	8,100	1,800	10,700	100	37,200	9,600	67,500
Rougheye rockfish	13,800	11,700	38,500	1,000	3,700	800	69,400
Northern rockfish	42,300	7,900	25,300	0[e]	0	0	75,600
Sharpchin rockfish	0	0	1,500	0	200	3,300	5,000
POP complex	124,500	41,800	127,900	42,600	168,300	47,400	552,400
Others	----------25,700[f]----------						
Thornyheads	20,000	25,400	29,700	2,400	2,800	300	80,600

[a] Carlson et al. (1985) for POP complex, Brown (1986) for others, and Shippen (1987) for thornyheads.
[b] 144°35'W-147°00'W
[c] 137°00'W-144°35'W
[d] Difference between total and sum of each figures is caused by roundings.
[e] Zero or less than 50.
[f] Dusky rockfish only

Table 4. Annual catches of other rockfish (t) in the Gulf of Alaska[a].

Year	Japan[b]	North America	JV	USSR	Total
1967	148	5	0	179	332
1968	1,077	7	0	880	1,964
1969	1,439	10	0	476	1,925
1970	745	9	0	401	1,155
1971	1,536	26	0	985	2,547
1972	1,987	72	0	884	2,943
1973	7,319	88	0	723	8,130
1974	4,030	90	0	635	4,755
1975	9,596	99	0	401	10,096
1976	9,635	148	0	248	10,031
1977	2,095	143	0	-	2,238
1978	770	95	1	0	866
1979	1,649	225	22	0	1,896
1980	2,454	160	8	0	2,622
1981	2,214	225	0	0	2,439
1982	1,664	255	0	0	1,919
1983	1,416	390	289	0	2,095
1984	432	805	284	0	1,521
1985[c]	1	1,678	45	0	1,725
1986	0				

[a] From Okada (1985) for data of 1967-77 except for USSR, which are estimated based on ratio of Pacific ocean perch and other rockfish in Japanese catch. From data file of the Far Seas Fish. Res. Lab., Shimizu for Japan 1978-85 and from Bracken and Ito (1986) for others 1978-84
[b] Reported catches of other rockfishes than Pacific ocean perch (complex).
[c] From Bracken and O'Connell (1986) and Berger et al. (1986) for 1985.

Table 5. Annual catches of thornyheads (t) in the Gulf of Alaska, 1979-1986[a].

Year	Japan	ROK	Poland	USSR	JV	US	Total
1979	538						538
1980	1,216	132	0	3			1,351
1981	1,120	220	0	0			1,340
1982	659	128	0	0			787
1983	679	37	0	0	13		729
1984	159	5	1	0	19	24	208
1985	4	0	0	0	9	69	82
1986	0						

[a] From Shippen (1986)
ROK: Republic of korea, USSR: Soviet, JV:Joint-venture fishery, US: United States.

Not to be cited by INPFC
Document number

INPFC
Doc. 3184

TRANSLATION

STOCK ASSESSMENT OF ROCKFISHES AND SHORTSPINE THORNYHEAD IN THE GULF OF ALASKA IN 1987

Kiyoshi Wakabayashi and Kazuyuki Teshima

Fisheries Agency of Japan

1987 September

THIS PAPER MAY BE CITED IN THE FOLLOWING MANNER:
Wakabayashi, Kiyoshi and Kazuyuki Teshima. 1987. Stock assessment of rockfishes and shortspine thornyhead in the Gulf of Alaska in 1987. (Document submitted to the Annual Meeting of the International North Pacific Fisheries Commission, Vancouver, Canada, 1987 October.). 9 p. Fisheries Agency of Japan, Tokyo, Japan 100.

1. Pacific Ocean Perch Complex (POP complex)

The POP complex consists of five rockfishes: Pacific ocean perch (*Sebastes alutus*), shortraker rockfish (*S. borealis*), rougheye rockfish (*S. aleutians*), northern rockfish (*S. polyspinis*), and sharpchin rockfish (*S. zacentrus*). This fish group mainly inhabits depths greater than 250 m. During the period of 1977 to 1978, Pacific ocean perch were managed as a single species and rockfishes other than Pacific ocean perch were managed as other rockfishes. However, it was difficult to sort correctly the catches of rockfishes on board the fishing vessel and rockfishes other than Pacific ocean perch were sometimes sorted as Pacific ocean perch and the converse also happened. Thus, it is not easy to grasp correctly the fishery statistics on rockfishes. Therefore, Pacific ocean perch and the similar rockfish species have come to be managed as the POP complex since 1979. However, in 1986 rockfishes were divided into two groups: a single species of Pacific ocean perch and rockfishes other than Pacific ocean perch. The species of the POP complex inhabit similar depths, it is quite difficult to catch selectively each species and it is also impossible to prepare the catch statistics by species. Therefore, the evaluation of the stock was conducted here as a POP complex, i.e. slope assemblage.

Catch

The catch of Pacific ocean perch in the Gulf of Alaska is shown in Table 1. The catch reached a peak of 344,700 t in 1965 and thereafter decreased markedly and amounted to 48,000 t in 1976. In 1977, when the 200 mile zone regime was established, the catch decreased to 21,600 t, less than half of the previous year, and in 1978 decreased drastically further to 7,500 t. The catch in 1985 was only 1,000 t.

Trends in Stock

Okada (1985) and Carlson et al. (1986) reported that CPUEs of Pacific ocean perch by the commercial vessels decreased drastically during the period 1976 through 1977 and thereafter. However, because fishing regulations were introduced and intensified and allocations were minimized, the effort spent fishing for Pacific ocean perch was accordingly decreased drastically. Pacific ocean perch are currently caught only as an incidental catch. Therefore, it is obvious that CPUEs obtained from commercial fisheries do not reflect the trend of stock. For the reasons described above it is also impossible to separate the effort spent for only Pacific ocean perch from the effort data.

Japan-U.S. joint longline surveys have been conducted using almost the same fishing gears and schemes since 1979. Catch data obtained from this survey have been used to calculate RPN (Relative population number) and RPW (Relative population weight) which have been utilized as abundance indices for groundfish resources (Sasaki and Teshima 1987). Unfortunately, the data obtained for the species constituting the POP complex were limited to those for shortraker and rougheye rockfishes combined (Table 2). RPN values during the period 1983 through 1986, obtained using the RPN of 1979 as 100, were 95 to 111, and have been relatively stable during these years.

The average body length of rougheye rockfish obtained from the longline survey increased slightly year by year from 43.5 cm in 1979 to 45.5 to 45.9 cm during the period 1984 through 1986 (Yoshimura and Sasaki 1987). In shortraker rockfish, the average body length increased somewhat from 57.9 - 59.9 cm during the period 1979 through 1982 to 60.6 - 61.8 cm during the period 1983 through 1985. As mentioned above, according to the data obtained by the longline survey, part of POP complex stocks at least do not show any worsening trend.

Estimated Biomass

The estimated biomasses of rockfishes and thornyheads in 1984, based on catch data obtained from the Japan-U.S. trawl survey conducted in the Gulf of Alaska in 1984, are shown in Table 3 by species and by INPFC area (Carlson et al. 1986). The estimated value was obtained by assuming the vulnerability of trawl gear as 1.0 and using the area swept method (Alverson and Pereyra 1969). Rockfishes also inhabit off-bottom waters and they show a high density trend on rough sea bottom. Due to habitats of rockfishes as shown here, it is not possible to catch all fishes in areas, especially on rough sea bottoms, where operations were made by the trawl gear with the net mouth of 5 to 6 m. Therefore, the biomasses obtained are considered to be underestimated.

The estimated biomass of the POP complex throughout the Gulf of Alaska was 552,300 t in total. Of this total, Pacific ocean perch accounted for 61% (334,900 t), followed by northern rockfish (14%), rougheye rockfish, and shortraker rockfish (13% and 12%, respectively). Sharpchin rockfish accounted for less than 1% of the total. Distribution of the biomass of Pacific ocean perch and shortraker rockfish extended throughout the Gulf of Alaska but uneven distributions were observed for northern rockfish (almost all were found in western areas) and sharpchin rockfish (the bulk was observed in eastern areas). The biomass of rougheye rockfish shows higher values for the western areas.

Equilibrium Yield (EY)

The proportion of the optimum yield of 3,702 t to the estimated biomass of 334,900 t of Pacific ocean perch in the Gulf of Alaska was 0.011. Because the biomass is considered to be an underestimate, the exploitation rate could be lower. This value is too low for the species which have been exploited extensively. Carlson et al. (1986)

predicted the future biomass using the improved SRA Model (Balsiger et al. (1985) and obtained the value of F which would stabilize the biomass at the current level; assuming the recent level of the biomass as ranging from 152,000 to 508,000 t and using M = 0.05. The value of F obtained was 0.04 and 0.05 for the upper and lower limits of the range of the biomass estimate, respectively. The biomass estimate of Pacific ocean perch for 1984 obtained from the Japan-U.S. joint trawl survey was almost the middle value of the above estimated range. By applying the result of Carlson et al. (1986) to the biomass estimate from the joint trawl survey, the recent biomass is modified to be in a range from 334,900 to 508,000 t and the value of F for the lower limit value is 0.045 by taking the middle value. This value of F is equivalent to the exploitation rate of 0.0429 and F = 0.04 to 0.0383. According to the Japan-U.S. joint trawl survey, the biomass of Pacific ocean perch accounted for 61% of that of POP complex. The estimated biomass of the POP complex ranges from 549,000 t to 832,000 t using this value and the above biomass of Pacific ocean perch.

The catch which would not lower the biomass, i.e. EY, is obtained by multiplying the estimated biomass and the above exploitation rate. The ecological environment of rockfishes other than Pacific ocean perch in the POP complex is quite similar to that of Pacific ocean perch and it is also considered that their life spans are also long. Therefore, by applying the exploitation rate of Pacific ocean perch to the POP complex (i.e. slope assemblage), EY of POP complex throughout the Gulf of Alaska ranged from 23,600 t to 31,900 t inclusive of the Pacific ocean perch EY range of 1,400 t to 19,500 t. By distributing this EY to each management area by biomass, it ranges from 5,300 t to 7,200 t for the western area (Shumagin Area) (including the EY range from 2,600 t to 3,500 t for Pacific ocean perch), from 7,300 t to 9,800 t for the central area (Chirikof-Kodiak Region), (3,100 to 4,200 t for Pacific ocean perch), and from 11,000 t to 14,900 t for the eastern area (Yakutat-Southeastern Region) (8,700 to 11,700 t for Pacific ocean perch). Because the lower limit value of biomass is underestimated, the lower limit value of EY is also considered to be underestimated.

2. Other Rockfishes

The other rockfishes consisted of all rockfishes other than Pacific ocean perch during the period 1977 and 1978, rockfishes excluding five species included in POP complex during the period 1979 to 1985, and rockfishes other than Pacific ocean perch in 1986, the same as in 1977 and 1978. In this section, stock assessment was made for rockfishes other than the POP complex (slope assemblage) for which the stocks were assessed in the above section. This fish group inhabits mainly the area shallower than 200 m and constitutes the shelf assemblage.

Catch

The catch of the other rockfishes reached a peak of about 10,000 t during the period 1975 and 1976, and was at a low level of less than 2,500 t in 1977 when the 200 mile regime was established and after (Table 4).

Biomass

Biomass of dusky rockfish (*S. ciliatus*), which was a major component of the other rockfishes in the Japan-U.S. joint trawl survey in 1984, was estimated as 25,700 t for the waters between 144° to 170°W in the Gulf of Alaska (Brown 1986). Dusky rockfish also can be sampled with a handline from the mid layer. Bracken and Ito (1986) also regarded this fish as a shelf pelagic species. Because the biomass was the value for the area swept by the trawl net with about 5 to 6 m in the height of net mouth and was obtained by assuming all individuals distributed in the swept area were caught, it is considered to be considerably underestimated.

The estimated biomass of species other than dusky rockfish have not been obtained from the Japan-U.S. joint analysis. Relative population weight, obtained as the product of CPUE by INPFC area and by depth zone and size of the area (analyzed by Japan using catch data from the 1984 joint trawl survey, unpublished data), of the other rockfishes was 22% of that of dusky rockfish. Therefore, if the biomasses of the other rockfishes are estimated by using the biomass of 25,700 t for dusky rockfish and ratio of the biomass, the estimated biomass for the other rockfishes was calculated as 5,600 t. Because the Japanese surveys did not extend to the very shallow area where the abundance of these species was high, it is considered that the biomass is relatively underestimated.

The estimated biomass in waters east of 144°W is not yet available. Since it is known that there is a greater variety of rockfish species in waters east of 144°W compared to that in waters west of 144°W, it is presumed that the biomass for this group in waters east of 144°W is also higher than that in waters west of 144°W.

Equilibrium Yield

Biomasses for this group in the Gulf of Alaska west of 144°W (western and central areas) were estimated as 31,300 t. This value is considered to be considerably underestimated from the true value. No appropriate exploitation rate for the fish group has been obtained. The species constituting the other rockfishes belong to the same genus as Pacific ocean perch and it is considered that their physiology and ecology are similar to those of Pacific ocean perch and it is estimated that their life spans are also long. From these matters, EYs of the other rockfishes were obtained from the estimated biomass using the appropriate exploitation rates (0.0383 to 0.0429) for Pacific ocean perch described in the previous section. EYs of the other rockfishes ranges from 1,200 to to 1,300 t for the western and central areas of the Gulf of Alaska combined. Because the biomass is underestimated, EYs obtained are also underestimates.

3. Thornyheads

This fish group includes the shortspine thornyhead (Sebastolobus alascanus), longspine thornyhead (S. altivelis), and Asiatic thornyhead (S. macrochir). However, practically, only shortspine thornyhead appears in the Gulf of Alaska and, in particular, the Asiatic thornyhead is caught very rarely only in the western area.

Catch

The catch of thornyheads has been at a low level of 267 to to 1,382 t in 1979 and after (Table 5). The catch in 1985 was only 82 t.

Estimated Biomass

The biomass of thornyheads throughout the Gulf of Alaska estimated from the Japan-U.S. joint trawl survey in 1984 was 80,600 t (Table 3; Shippen 1986). Because thornyheads are distributed with higher abundance in rough sea-bottom areas and vulnerability of fishing gears is assumed as 1, the estimated biomass obtained is underestimated.

Trends in Stock

RPN and RPW of shortspine thornyhead obtained from the Japan-U.S. joint longline survey showed higher values during 1979 through 1981, but in 1982 and thereafter those values, expressed as percentage of the 1979 value, have changed, remaining at low levels of 54 - 76% and 55 - 75% respectively (Table 2). The average fork lengths ranged from 33.9 cm to 35.3 cm during the period 1979 through 1986 with no particular yearly trends indicated (Table 2).

The catches of thornyheads in recent years (average value between 1979 and 1985) are at low levels; less than 0.7% of their underestimated biomass. From this fact, even though the biomass is declining, it cannot be considered due only to the influence of fishing.

Equilibrium Yield

The estimated biomass of thornyheads throughout the Gulf of Alaska is established as 80,700 t and OY as 3,750 t. The proportion of OY to the biomass (exploitation rate) is 4.6% but it must be lower because the biomass has been underestimated. No appropriate exploitation rate for thornyheads is available. Carlson et al. (1986) showed that an exploitation rate of 3.8 to 4.8% would maintain the stock of Pacific ocean perch at the current level. The overestimated exploitation rate (4.6%) against OY is included in this range. Thornyheads belong to the same family and are presumed to have a long life span. The ecological environment for thornyheads and Pacific ocean perch is alike. Using an analogy, it is considered that it is not necessary to change OY of thornyheads from the current 3,750 t.

REFERENCES, TABLES 1 TO 5 ARE IN ENGLISH
IN THE JAPANESE DOCUMENT