RESTRICTED

International Commission for the Northwest Atlantic Fisheries

Serial No. 3386
(D.c.9)

Summ.Doc. 74/47
(Revised)

ANNUAL MEETING - JUNE 1974

An example of the by-catch problem on directed fisheries for 1975

by

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The effect of by-catch on management of mixed species fisheries were examined in Res. Doc. 73/99/ It was stressed that the individual catch of a species in fisheries directed toward other species in addition to directed fishing can produce a fishing mortality in excess of that desired. Thus, the catch from a directed fishery must be less than the TAC if that species is caught incidental to other fisheries. The estimation of quantities that should be taken in directed fisheries to prevent exceeding the TAC's was the subject of Res. Doc. 73/99 and is briefly updated here with 1972 by-catch statistics. The 1972 nominal catches for finfish only were analyzed in the same manner as previously developed by the Assessments Subcommittee (Redbook, 1973). Table 1 indicates those directed fisheries summed over countries that produce the greatest incidental catches of other species. The silver hake directed fishery, for example, produces only 67,762 tons of silver hake from a total catch of 150,162 tons for this fishery. A directed fishery for herring, on the other hand, produces 116,834 tons of herring out of a total catch of 131,945 tons. A total of 232,913 tons (as shown by the column total) of herring were taken, however, mainly as a result of by-catches of herring from the directed fisheries on mackerel, silver hake and red hake.

Table 2 gives the by-catch ratios calculated as ratios of by-catch to main species sought within each directed fishery. The totals by species sought fisheries indicate the relative amount of by-catch generated by each directed fishery. The data in Table 2 were used in a linear programming technique for examining the effect of directed fishing on the total catches taken for each species under certain constraints of TAC levels and minimum catches taken by the US fisheries. The results of two examples are shown in Tables 3 and 4. Proposed 1975 TAC levels were chosen as constraints in Table 3 to provent the TAC level from being exceeded under the by-catch situation as shown in Tables 1 and 2. Of course, the 1972 by-catches may not pertain to 1975 and the results would be altered by any change in the by-catches that have taken place since 1972. Constraints were chosen for unregulated species (e.g. other pelagics) by calculating the proportion of their catch to the catch of a similar regulated species (e.g. mackerel) and applying this to the TAC for the latter. TAC constraints that add to 974,000 tons thus produce a total catch of 875,000 tons of fish from a directed catch of 547,000 tons (Table 3). This is the macimum total catch that can be taken without exceeding the TAC constraints and the macimum directed catch that can be taken under the 1972 pattern of incidental catches.

Table 4 adds the additional constraints of providing the coastal state with at least a partial potential for pursuing directed fisheries.

The total catch is thereby reduced by 20,000 tons although the directed catch in only reduced by 4,000 tons. Both procedures indicate no directed fishery for haddock, red hake or other groundfish and a very low directed catch of 3,000 tons for other fish.

This procedure indicates the problem of species regulation when significant by-catch occurs in directed fisheries.

In some cases, even with no directed catch, the total catch on the species may exceed the allowable total catch by a substantial level; for red hake, for example.

The incidental catches must be reduced or the catches of directed fisheries must be less than the total catch desired.

Table 1 Catch of major species by directed finfish fisheries in 1972 in Subarea 5 and Statistical Area 6

Species sought	Catch by species: cod	haddock	redfish	silver hake	red hake	pollock	yellowtail	other flounder	other groundfish	herring	mackerel & other pelagics	other fish	total
cod	18420	2361	76	21	1	798	253	807	1081	5	2	222	24047
haddock	230	620	8	1	0	66	31	31	40	0	1	0	1028
redfish	430	122	15005	62	142	407	4	9	389	2	744	984	18300
silver hake	672	92	212	67762	25772	946	2418	1944	5074	6652	22197	16421	150162
red hake	1144	9	33	22560	39066	85	2405	1314	4985	8752	5009	11630	96992
pollock	292	118	102	30	0	6330	1	1	22	0	0	3	6899
witch	3	0	4	0	0	0	0	2	0	0	0	0	9
yellowtail	1580	399	0	30	11	14	25001	1346	74	0	16	9	28480
other flounder	2310	581	13	68	12	67	2401	5126	338	0	7	18	10941
other groundfish	4495	2180	828	1212	983	3881	1286	1063	12099	172	1481	2921	32601
herring	327	21	37	1200	327	93	47	3	305	116834	10023	2728	131945
Mackerel & other pelagics	494	49	2029	20617	8421	180	905	177	3957	99532	343029	43025	522425
other fish	102	4	29	1327	314	4	8	3	323	964	3212	29916	36206
Total	30499	6556	18376	114890	75059	12871	34760	11826	28687	232913	385721	107877	1060035

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Table 2. Ratios of by-catch to main species sought within major finfish fisheries for Subarea 5 and Statistical Area 6 based on 1972 fishing patterns summed over countries and considering each species as independently distributed over fisheries.

Species sought	Species caught: cod	haddock	redfish	silver hake	red hake	pollock	yellowtail	other flounder	other groundfish	herring	mackerel & other pelagics	other fish	total
cod	1.00	.128	.004	.001	0	.043	.014	.044	.068	0	0	.012	1.314
haddock	.371	1.00	.013	.001	0	.106	.050	.050	.079	0	0	0	1.670
redfish	.029	.008	1.00	.004	.009	.027	0	0	.033	0	.050	.066	1.226
silver hake	.010	.001	.003	1.00	.380	.014	.036	.029	.099	.098	.327	.242	2.239
red hake	.029	0	.001	.58	1.00	.002	.062	.034	.161	.224	.128	.298	2.519
pollock	.046	.019	.016	.005	0	1.00	0	0	.004	0	0	0	1.090
yellowtail	.063	.016	0	.001	0	0	1.00	.054	.046	0	0	0	1.180
other flounder	.451	.113	.003	.013	.002	.013	.469	1.00	.463	0	.001	.004	2.532
other groundfish	.352	.171	.065	.095	.077	.304	.101	.083	1.00	.013	.115	.229	1.605
herring	.003	0	0	.010	.003	0	0	0	.003	1.00	.086	.023	1.128
mackerel & other pelagics	.001	0	.006	.060	.025	0	.003	.001	.012	.293	1.00	.126	1.527
other fish	.003	0	.001	.044	.010	0	0	0	.011	.032	.107	1.00	1.208
Assumed TAC(1975)	45	0(6) [1]	25	175	65	27	16(21) [1]	25	55.46	175	292	62.5	

[1] Number in brackets is expected catch.

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Table 3. Linear programming simulation of 1975 catches maximizing total catch (1000 tons)

Species sought	Total allowable catch constraint[1]	Directed catch	Total catch
Cod	45.0	22.5	35.0
Haddock	6.0	0	6.0
Redfish	25.0	23.0	25.0
Silver hake	175.0	114.0	130.0
Red hake	65.0	0	50.0
Pollock	27.0	23.5	27.0
Yellowtail	21.0	6.0	21.0
Other flounder	25.0	20.0	25.0
Other groundfish	55.5	0	26.5
Herring	175.0	92.0	175.0
Mackerel & other pelagics	292.0	246.0	292.0
Other fish	62.5	0	62.5
Total	974	547.0	875.0

[1]) Catch less than or equal to

Table 4. Linear programming simulation of 1975 catches maximizing total catch considering nation allocation and preserving portion to the US directed fishery (catches in 1000 tons).

Species sought	Total allowable catch constraint[1]	Directed catch	Total catch
Cod	45	22	35
Haddock	6	0	6
Redfish	25	23	25
Silver hake	175	100	116
Red hake	65	0	45
Pollock	27	24	27
Yellowtail	21	7	21
Other flounder	25	21	25
Other groundfish	55.5	0	25
Herring	175	92	175
Mackerel & other pelagics	292	251	292
Other fish	62.5	3	62.5
Total	974	543	854.5

[1]) Catch less than or equal to

Additional constraints (directed catch greater than or equal to) for coastal state fisheries.

Species sought	Directed catch
Cod	8
Haddock	0
Redfish	19
Silver hake	3
Other flounder	25
Other groundfish	9
Herring	21
Other pelagics	9
Other fish	3