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Analysis of silver warehou (*Seriollela punctata*) catch and effort data from the west coast South Island hoki fishery (SWA 1)

Adam Langley
MAF Fisheries Greta Point
P.O. Box 297
Wellington

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MAF Fisheries, N.Z. Ministry of Agriculture and Fisheries

This series documents the scientific basis for stock assessments and fisheries management advice in New Zealand. It addresses the issues of the day in the current legislative context and in the time frames required. The documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

ANALYSIS OF SILVER WAREHOU (*Seriollela punctata*) CATCH AND EFFORT DATA FROM THE WEST COAST SOUTH ISLAND HOKI FISHERY (SWA 1).

Adam Langley

1. INTRODUCTION

Silver warehou are currently managed as four fishstocks. SWA 1 includes those fish around the North Island and off the west coast of the South Island (WCSI). Although some targeted fishing for silver warehou does occur in this area most of the catch is taken as a bycatch of other middle depth trawl fisheries. Since 1986, the majority of silver warehou landings have been taken during the winter WCSI hoki fishery. Total catches and TACCs for SWA 1 from 1983 to 1991 are presented in Table 1.

Silver warehou spawn on the WCSI during winter (Livingston 1988). Seasonal random trawl surveys have detected an increase in abundance during winter indicating that silver warehou migrate to the WCSI to spawn. The stock boundaries of silver warehou, however, are unclear and the distribution of the non-spawning population is not known.

A recent 15% increase in the SWA 1 TACC, under an "adaptive management" strategy, requires that a monitoring programme be developed for the stock. This paper presents the results of an analysis of commercial catch and effort data and discusses the potential of this method as a tool for monitoring future abundance. Catch sampling data collected from the fishery are also presented.

2. CPUE ANALYSIS

The Middle Depth Working Group considered commercial catch and effort data to be potentially useful in developing annual indices of stock abundance (Francis and Hurst 1991). The analysis of CPUE data was restricted to silver warehou taken as a bycatch of the hoki fishery. Since 1986, effort in this fishery has been relatively constant at a high level, providing a good time series of data. The fishery is conducted during winter, when silver warehou are most abundant on the WCSI. Therefore, the CPUE data from the WCSI hoki fishery are probably more representative of the total stock biomass.

2.1 METHODS

Data

Data used in the CPUE analysis came from the catch effort system of the fishery statistics database administered by the Information Technology Directorate. The data were drawn from the following tables:

* vessel-details - vessel descriptors.

* master-header - trip information from 1983 to 1989.

* foreign-header, foreign catch - tow by tow information and catch by foreign vessels

from 1983 to 1989.

* trawl-header, trawl-detail - tow by tow information from 1989 to 1991.

* trawl-processed - daily catch summary from 1989 to 1991.

All tows targeting hoki on the WCSI during the 1986-91 seasons were initially considered in the analysis.

The reliability of the commercial catch data was assessed by examining the annual reported hoki and silver warehou catches (estimated and processed) for each vessel operating in the fishery. Comparison was also made between the reported catch by season and the estimated catch by season determined from catch data observed by the Scientific Observer Programme. To estimate total seasonal catches, the hoki spawning season was divided into area and week strata. The strata ratio of silver warehou catch to hoki catch from observed vessels was prorated to the total reported hoki catch for that stratum and the total silver warehou catch determined by summing across strata.

The audit of catch data indicated that silver warehou was under-reported across the entire fleet, although the extent of misreporting varied with the nationality of the vessel. Catch and effort data collected from the Japanese charter fleet (surimi and head and gut vessels) were considered to be the most complete and more consistent with observed catch data. Further analysis of CPUE was restricted to this subset of the data which is summarised in Table 2.

Stratification of Data

Silver warehou and hoki have different depth distributions on the WCSI. Silver warehou are most abundant within the 200-600 m depth range and generally comprise a higher percentage of the catch in the shallower depths of hoki fishing.

The WCSI hoki fishery is centred on the Hokitika Canyon where the fleet is constrained to deeper water by a 25 n. mile exclusion zone. A significant fishery also operates in the shallower grounds to the north of the Hokitika Canyon. The distribution of fishing effort between these areas varies annually and influences the total seasonal catch of silver warehou. To produce comparable annual indices of abundance for silver warehou it was therefore necessary to stratify the seasonal catch and effort data.

Appropriate strata were determined by examining trends in the total Japanese CPUE for silver warehou across season, latitude, and depth. No trends in catch rate were apparent through the season but significant trends in CPUE occur with depth and latitude. The WCSI hoki fishery was subsequently stratified into two area (within Latitude 41°S and Latitude 42°S) and four depth strata (300-400 m, 401-500 m, 501-600 m, 601-700 m). Catch rates appear relatively homogenous within an individual stratum, and these strata contain the bulk of the silver warehou catch taken through all years.

Indices of abundance

Two indices of abundance were determined: catch per tow and catch per hour. Individual tows were assigned to a given stratum by the start position and recorded bottom depth of that tow. Total annual catch (estimated greenweight) and effort were summed by strata to provide gross indices of CPUE. The resulting strata indices are considered to be independent estimates of silver warehou abundance.

2.2 RESULTS AND DISCUSSION

Annual indices of silver warehou CPUE by strata are presented in Figures 1 and 2. The catch per hour and the catch per tow indices appear correlated across each stratum, although there is more contrast in the catch per hour indices. An independent analysis of hoki CPUE data indicates that catch per hour is a more appropriate index of abundance, as the average tow length has increased in recent years (Vignaux in press).

The highest catch rates were consistently achieved from tows in the area north of the Hokitika Canyon, in depths of 300-600 m. In these strata, catch rates by the Japanese fleet peaked in 1988, declined in 1989, and have subsequently increased. This trend is reflected in the total landings from SWA 1 (Table 1).

Further analysis of the catch and effort data from these major strata indicate that silver warehou CPUE is related to hoki catch and effort (see Fig. 3). The fishery concentrates effort to maintain high hoki catch rates. Consequently, when hoki catch rates are high, total effort will also be high for a given stratum. Annual fluctuations in hoki catch effort by strata indicate variability in the distribution of hoki. The irregularity in silver warehou CPUE data suggest that the seasonal distribution of silver warehou could also be variable.

The CPUE indices do not provide an indication of current trends in stock abundance. Over recent years, strata indices have fluctuated and no consistent trend is apparent across all strata. Further stratification of the data is unlikely to reveal any trends in CPUE. The distribution of silver warehou is generally "patchy", with fish aggregating to spawn and feed. The bycatch of silver warehou in a target hoki fishery could, therefore, be expected to be variable. The stratified design also assumes the areal distribution of silver warehou to be constant which, as indicated above, may not be appropriate.

The annual indices are highly sensitive to the number of tows in a given stratum. The size of each stratum was originally defined to include a relatively large number of tows, but annual variation in fishing effort may "under-sample" a given stratum (Table 3). For example, the large increase in CPUE index for one stratum (Lat 41, depth 601-700 m) in 1991 is attributable to only two tows, both with a very high catch rate. Such discrepancies should be ignored when examining long-term trends in CPUE.

No attempt was made to combine strata indices to produce a single annual index. Combining indices, by an appropriate weighting, would reduce the strength of stratification, producing an index approaching the total seasonal CPUE. Fully stratified data are more likely to reveal an actual change in abundance. If, in the future, such trends are apparent, it would be more appropriate to use a multiple linear regression technique to determine single annual indices.

3. CATCH SAMPLING DATA

Coverage of the hoki fleet by Scientific Observers has enabled the collection of length and biological data from the commercial catch. Sampling effort has concentrated on collecting length and age data for hoki, however, data has also been collected from major bycatch species. Sufficient silver warehou length data were collected from the fishery to estimate length frequencies of the commercial catch for the 1988, 1990, and 1991 seasons (Fig. 4). The low sampling intensity, however, prevents the scaling of length data to determine catch-at-length and imposes high variances on the estimated seasonal length frequencies.

The length structure of the commercial catch appears typical of other silver warehou spawning populations (Gavrilov 1974). Males recruit into the fishery at a smaller size than females (i.e., at about 43 cm compared with about 46 cm for females) and attain a smaller maximum size. The population appears unimodal with a peak at 50 cm for male and 52 cm for female fish. Without ageing data it is not possible to determine the relative strength of annual recruitment into the fishery.

4. CONCLUSIONS

Silver warehou CPUE data are unlikely to be useful for determining short-term changes in abundance or detecting the impact of small (± 20%) changes in TACC on population size. The CPUE data are more appropriate for the monitoring of gross, long-term changes in stock biomass. Despite a significant increase in catch levels since 1986, no significant change in CPUE is apparent from the data analysed. Data collected from the catch sampling programme showed no significant change in the length frequency structure of the spawning stock since 1988.

5. REFERENCES

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Gavrilov, G.M. 1974: The age and rate of growth in the silver warehou (*Seriollela maculata* Forster). From "Investigations into the biology of fish and productivity of oceanography" Part 5: Vladivostock, 1974. *TINRO report* (in Russian, English translation held at MAF Fisheries Greta Point library).

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Table 1. SWA 1 reported landings (t) and estimated total catches (t) from the WCSI hoki fishery and revised total catches (t) from 1983-84 to 1990-91 ("-" denotes data not available). Source: 1983-84 to 1987-88 (FSU); 1988-89 to 1990-91 (QMS). Estimated catches were determined from Scientific Observer Programme catch data extrapolated to the entire fleet.

	WCSI Hoki Season		Total Fishing Year		
Fishing Year	Reported	Estimated	Reported	Estimated	TACC
1983-84	-	-	541	-	1 000
1984-85	-	-	587	-	1 000
1985-86	-	-	806	-	1 000
1986-87	-	-	1 337	-	1 800
1987-88	2 088	2 200	2 947	3 059	1 815
1988-89	623	954	1 605	1 936	1 821
1989-90	1 213	1 384	2 316	2 487	2 128
1990-91	1 595	2 424	2 121	2 950	2 128

Table 2. Summary of annual silver warehou catch (t) and effort data from the Japanese fleet.

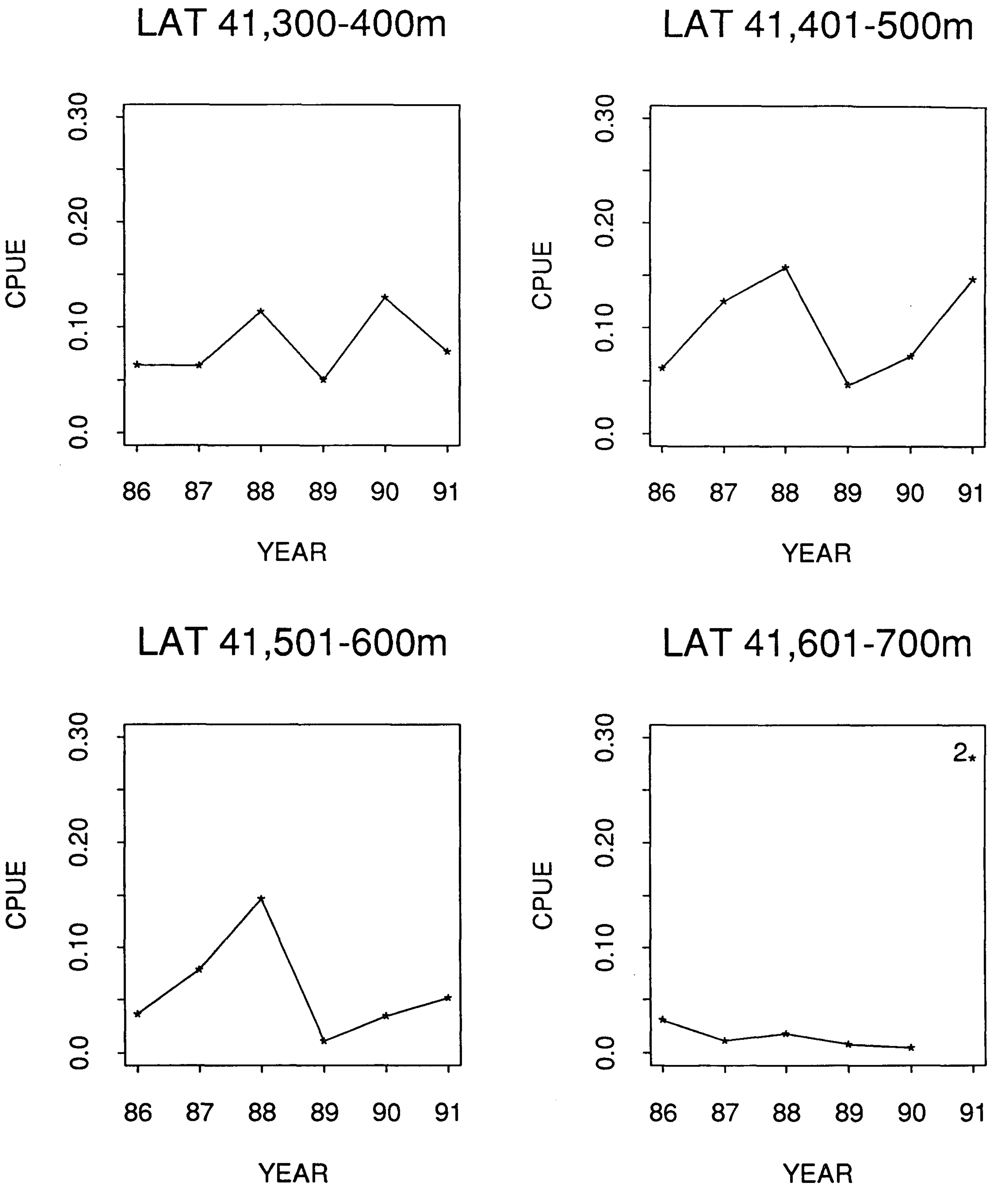
Fishing season	Catch	Number of tows	Total hours fished	Mean catch per tow	Mean catch per hour
1986	296	2 433	8 102	0.122	0.0365
1987	615	3 528	12 812	0.174	0.0480
1988	1 550	4 419	20 661	0.351	0.0750
1989	398	2 587	15 733	0.154	0.0253
1990	875	3 494	18 578	0.250	0.0471
1991	396	2 126	11 042	0.186	0.0359

Table 3. Annual distribution of fishing effort (number of tows) by the Japanese fleet between strata used in CPUE analysis.

WCSI Hoki Season

STRATA	1986	1987	1988	1989	1990	1991
LAT 41, 300-400m	6	155	468	74	118	148
LAT 41, 401-501m	241	406	1007	287	282	302
LAT 41, 501-600m	228	310	392	174	96	70
LAT 41, 601-700m	24	26	42	140	35	2
LAT 42, 300-400m	85	108	323	157	338	139
LAT 42, 401-500m	875	588	637	460	976	484
LAT 42, 501-600m	637	1280	973	684	989	620
LAT 42, 601-700m	337	655	577	611	660	361

Figure 1. Annual indices of silver warehou (SWA 1) CPUE by strata, estimated from Japanese commercial catch and effort data from the WCSI hoki fishery. CPUE is expressed as mean catch (t) of silver warehou per hour fished. [The "2" label (strata LAT 41, 601-700 m) is the number of tows that the 1991 annual index was calculated from.]



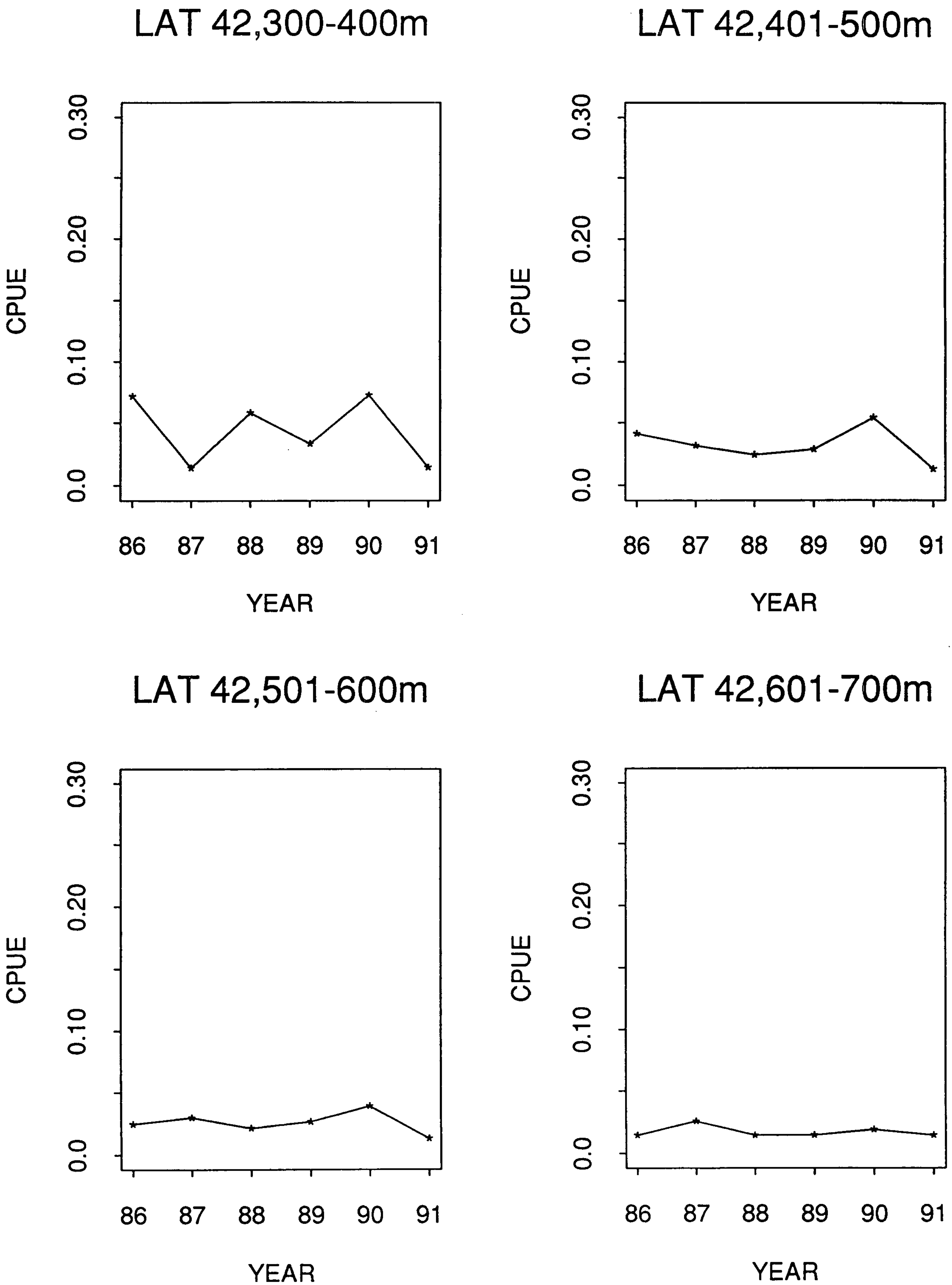
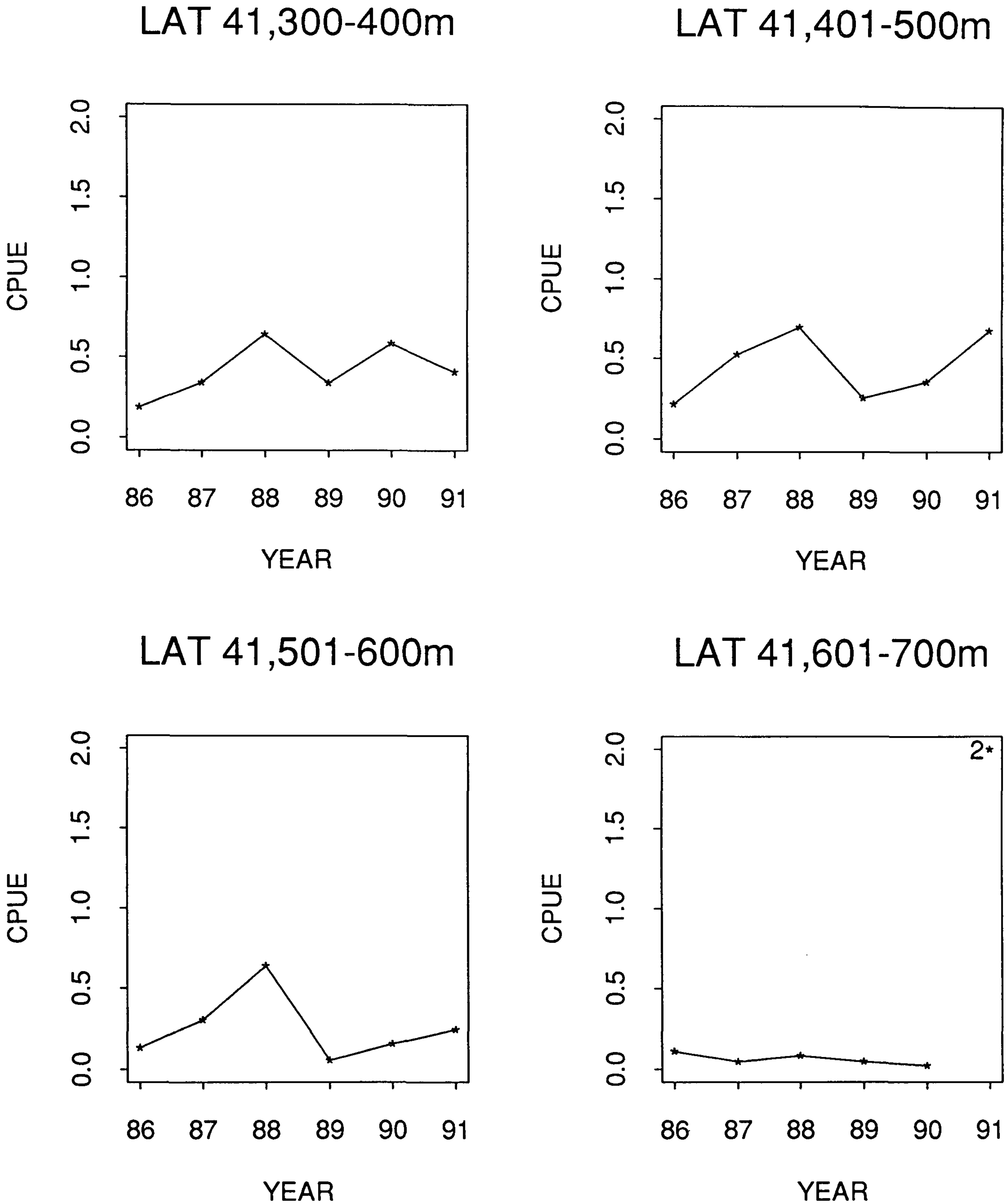
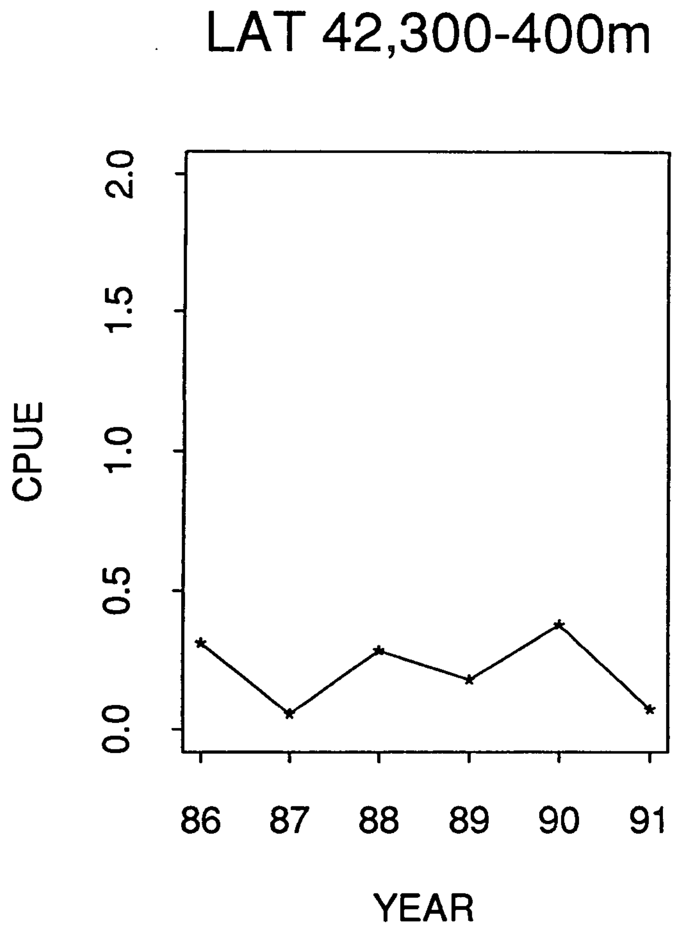
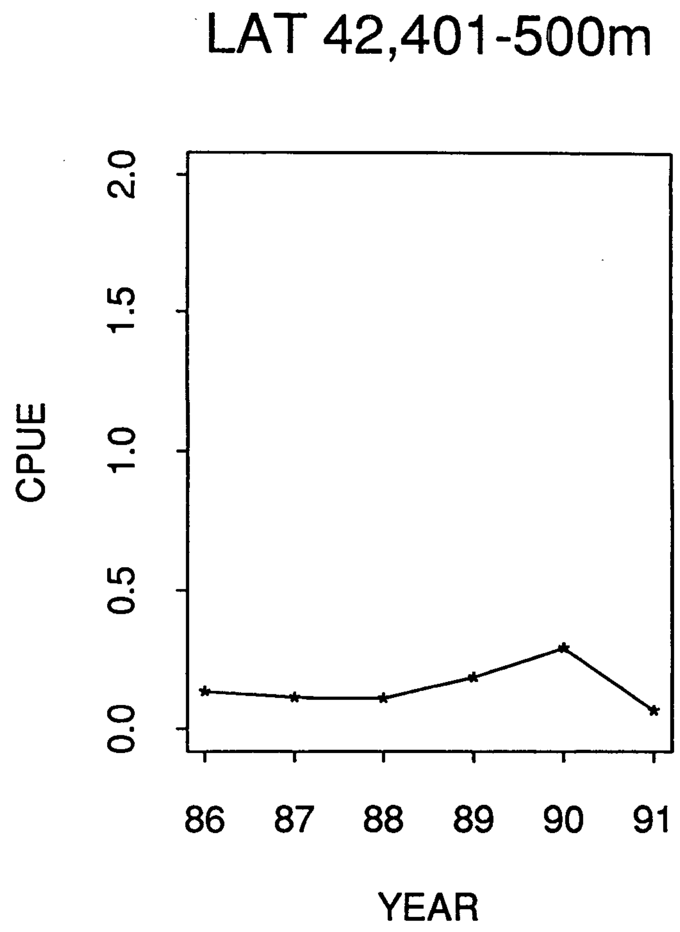
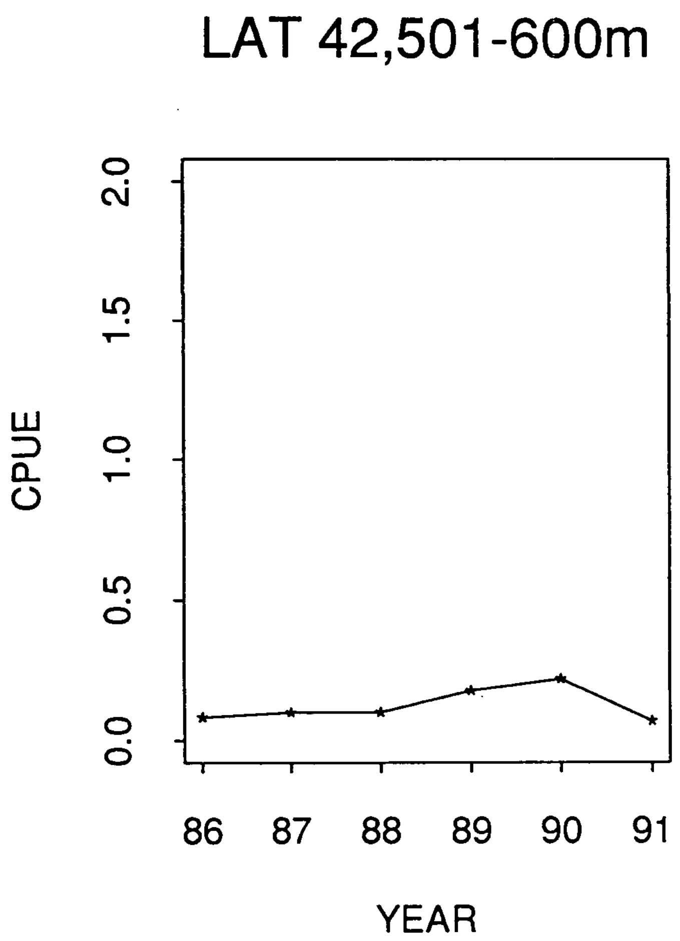

LAT 42,300-400m
LAT 42,401-500m
LAT 42,501-600m
LAT 42,601-700m
CPUE
0.0
0.10
0.20
0.30
86
87
88
89
90
91
YEAR

Figure 2. Annual indices of silver warehou (SWA 1) CPUE by strata, estimated from Japanese commercial catch and effort data from the WCSI hoki fishery. CPUE is expressed as mean catch (t) of silver warehou per tow. [The "2" label (strata LAT 41, 601-700 m) is the number of tows that the 1991 annual index was calculated from.]




LAT 42,300-400m
CPUE
YEAR


LAT 42,401-500m
CPUE
YEAR


LAT 42,501-600m
CPUE
YEAR

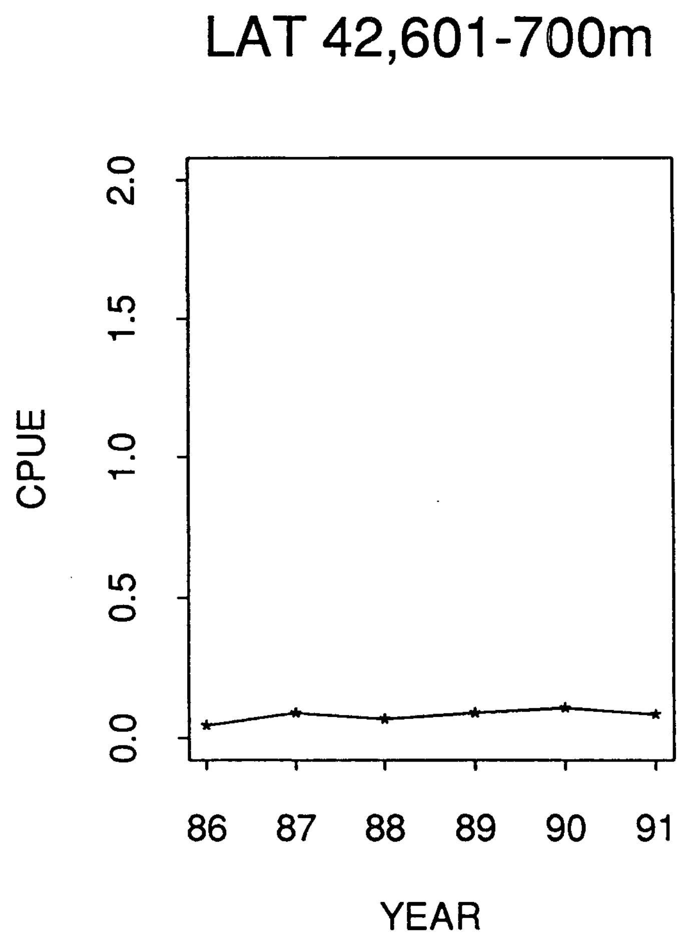
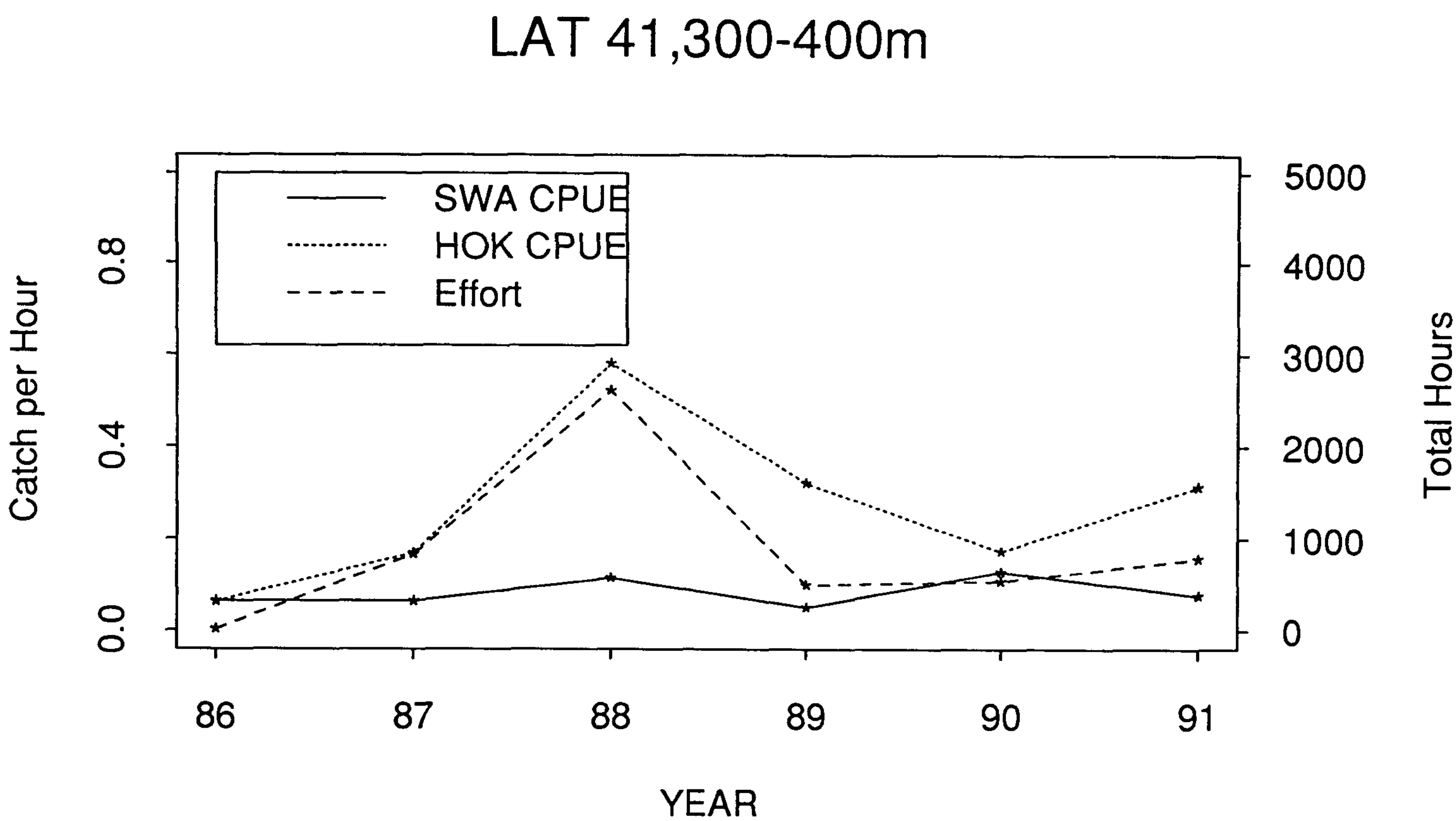
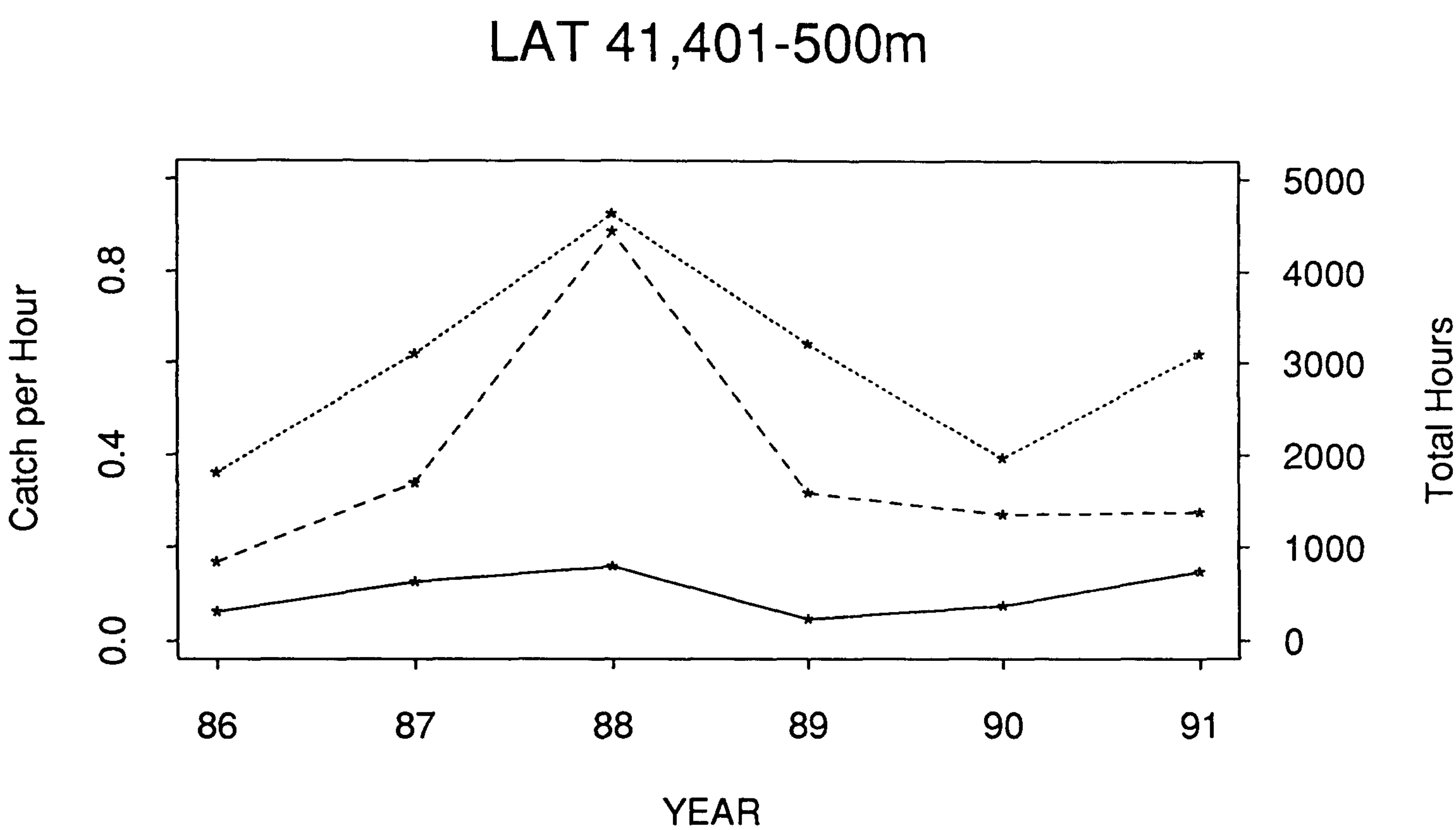
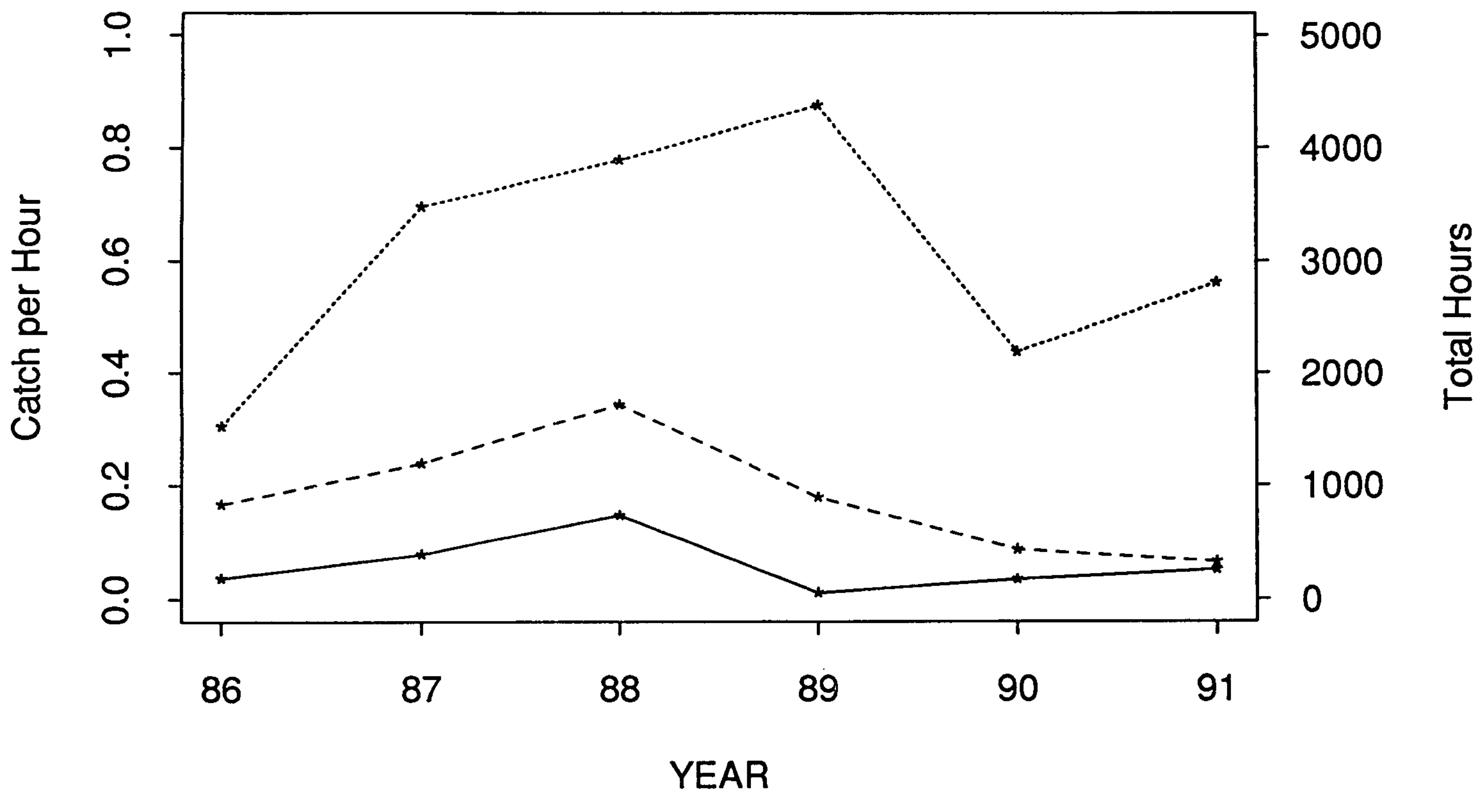

LAT 42,601-700m
CPUE
YEAR

Figure 3. Comparison of annual indices of silver warehou (SWA 1) abundance (tonnes per hour), total effort (hours fished) and hoki catch (tonnes/10) per hour for strata where silver warehou catch rates are consistently high.





LAT 41,501-600m



LAT 42,300-400m

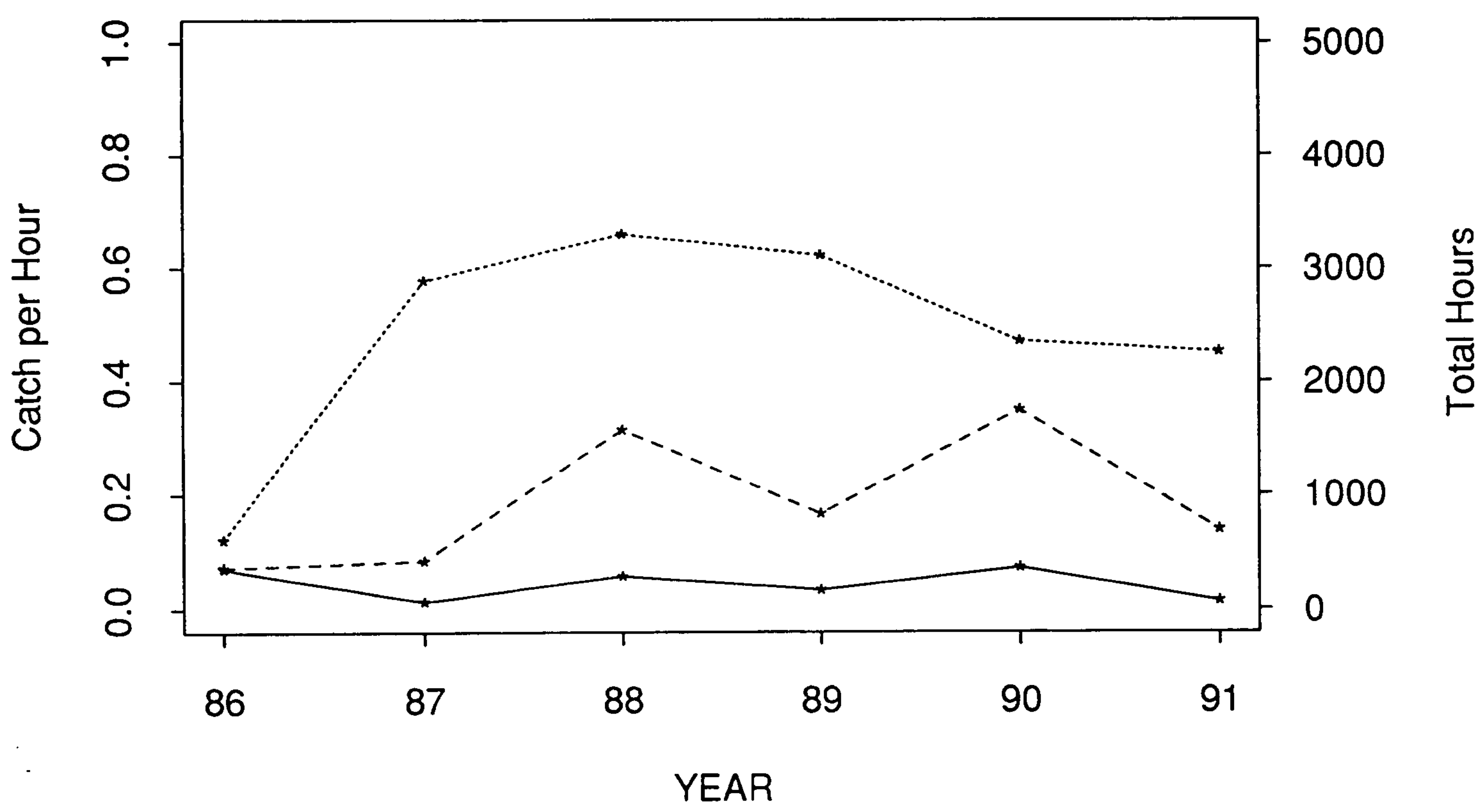


Figure 4. Unscaled length frequency distributions of the silver warehou bycatch from the WCSI hoki fishery 1988, 1990 and 1991 (m = number of male fish measured, f = number of female fish measured, n = number of tows sampled).