NIWA

Taihoro Nukurangi

Landed paua shell lengths in PAU 2, PAU 3, PAU 4, PAU 5 (A, B, & D), and PAU 7 in 1999–2000 and 2000–2001

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Final Research Report for
Ministry of Fisheries Research Project PAU 1999/01
Objectives 1 & 4

National Institute of Water and Atmospheric Research

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Final Research Report

Report Title: Landed Paua Shell Lengths in PAU 2, PAU 3, PAU 4, PAU 5 (A, B, & D), and PAU 7 in 1999–2000 and 2000–2001, with an assessment of the optimum number of sites per stratum to sample.

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2. **Contractor:** Ministry of Fisheries

3. **Project Title:** Stock assessment of paua

4. **Project Code:** PAU1999/01

5. **Project Leader:** J. R. Naylor

6. **Duration of Project:**
   Start date: 1 October 2000
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7. Executive Summary

Shed measuring was conducted in PAU 2, 3, 4, 5A, 5B, 5D, and 7. A total of 31 798 paua were measured during the 1999–2000 fishing year and 38 400 were measured from the 2000–2001 fishing year. The length frequency distributions are typical of commercial paua fisheries and appear consistent over time. Analysis of length frequency data from PAU 7 and PAU 5B indicate that a minimum of 30 samples (diver-days) are required to give an expected mean weighted c.v. of 0.2.

8. Objectives

Objective 1:

Re-establish the catch sampling program in fish sheds and estimate the size frequency distribution of the commercial catch of paua from the 1999–2000 fishing year and use this data to investigate the optimum number of sites required to give an expected mean weighted c.v. of 0.2

Objective 4:

Continue the catch sampling program in fish sheds and estimate the size frequency distribution of the commercial catch of paua from the 2000–2001 fishing year.

To design and implement an ongoing catch sampling program in fish sheds and estimate the size frequency distribution of the commercial catch of paua in PAU 2, PAU 3, PAU 4, PAU 5A, PAU 5B, PAU 5D, and PAU 7 in the 1999–2000 and 2000–2001 fishing years. Using these data, investigate the number of sites that should be sampled to give an expected mean weighted c.v. of 0.2, as per Ministry of Fisheries target c.v.

9. Methods

9.1 Shed sampling

Sampling was done in processing sheds at Masterton (PAU 2), Blenheim and Ward (PAU 3 and PAU 7), Chatham Islands (PAU 4), Christchurch (PAU 5A, 5D), Dunedin (PAU 5A, 5D), Bluff (PAU 5A, 5B, 5D) and Oban (PAU 5B).

Sampling was carried out between October and March each year. Diver-days were the basic unit of sampling and were haphazardly selected for sampling on an *ad hoc* basis. True random sampling is not possible because of the unpredictability of fishing and the availability of samples. Samples are selected without reference to the identity of the diver or the location of fishing.

For each diver-day sampled, a bag of unsorted shucked shells was set aside and labelled to record the diver, the date and location of the catch, and the total weight of paua landed by the diver on the day. Approximately 100 randomly selected shells from each bag were measured to the nearest millimetre. Lengths were grouped into 2 mm size classes for presentation. Paua longer than 170 mm were pooled into a single size class.

Length-frequency data was scaled up to the size of the sampled catch by dividing the sample size by the proportion of the catch sampled. Where the total landed weight was recorded, the weight of the 100 animals sampled was estimated according to the length-weight relationship of Schiel & Breen (1991) where:

$$\text{weight (g)} = (2.6 \times 10^{-5}) \times \text{length (mm)}^{3.32}$$

Alternatively the proportion sampled was estimated on site (e.g., 1 sack measured from a total landing of 5 sacks = 20%).

9.2 Required sample size

An analysis was done in order to obtain an estimate of the minimum number of diver-days required to sample that would result in a representative sample of the landed catch. In this sense we define 'representative' as that sample size required to produce a c.v. of less than 0.2.

An estimate of the required number of samples for shed sampling was determined by a simple simulation study, using empirical data collected by shed measuring in previous years. A simple simulation using resampled diver-day data was used to determine the expected mean weighted c.v. for the length frequencies resulting from differing numbers of diver-day samples.

The simulations were based on a large sample assembled from previous years sampling — we assume that this sample will encompass at least as much variation as within-year samples. We repeated these simulations for two QMAs with divergent length-frequency distributions — PAU 7 in which there are few large paua and consistent distributions among years, and PAU 5B, which has more large paua and large differences between diver-days in the mean size of paua landed.

Diver-days were sampled with replacement from the PAU 5B and PUS 7 datasets (N=73 and 116 respectively). The number of resampled diver-days ranged from between 10 and 80. For resampled diver-day, the mean weighted c.v. was calculated by first determining the mean length frequency and mean c.v.s for each length, and then calculating the mean weighted c.v. Expected mean weighted c.v.s were than determined by calculating the mean over all simulations for that number of diver-days. In addition, the upper 90% bounds for the expected mean weighted c.v. were calculated as the upper 90% bound on the simulated mean weighted c.v.s for each diver-day.

We assume that all variance within the samples was associated with the number of diver-days and the c.v. was determined by length. Further, we note that the simulations give equal weight to each diver-day, and assume that each diver-day sample is a complete representation of that diver-day.

10. Results

10.1 Shed sampling

The number of samples recorded for each QMA in the 1999–2000 and 2000–2001 fishing years is shown in Tables 1 and 2 respectively. The number of diver-days where the logbook zone was recorded is also shown in Tables 1 and 2. Initial difficulties in obtaining samples from PAU 5A (Fiordland) were addressed by sampling greater than 100 shells per sample, so while less than 40 diver days were sampled, a total of 3621 shells were measured from this area. In PAU 7, 72 diver-days were sampled to allow the effects of larger sample sizes on the c.v.s to be examined.

Table 1: Summary of data recorded per fishing zone for the 1999–2000 fishing year

Area code	Diver days	Diver days with zone information	Diver days with % sampled	Number of shells measured	Scaled N
PAU 2	35	28	32	4 285	49 930
PAU 3	46	44	45	6 865	57 695
PAU 4	23	21	21	2 333	33 325
PAU 5A	29	2	17	3 621	89 419
PAU 5B	31	28	6	3 215	6 176
PAU 5D	33	14	8	3 590	20 400
PAU 7	72	63	71	7 889	44 443
Total	268	200	200	31 798	301 388

The number of samples recorded for each QMA in the 2000–2001 fishing year is shown in Table 2.

Table 2: Summary of data recorded per fishing zone for the 2000–2001 fishing year

Area code	Diver days	Diver days with zone information	Diver days with % sampled	Number of shells measured	Scaled N
PAU 2	40	11	40	5 261	67 831
PAU 3	42	2	42	7 857	32 821
PAU 4	41	32	36	4 409	68 623
PAU 5A	35	3	34	4 434	139 225
PAU 5B	32	19	32	4 145	33 792
PAU 5D	44	4	44	5 613	48 458
PAU 7	40	28	40	6 681	17 365
Total	274	99	268	38 400	408 115

Length frequency distributions for the 1999–2000 fishing year, for PAU 2, 3, 4, and 7; and for PAU 5A, 5B, and 5D are shown in Figures 1 and 2 respectively. For the 2000–2001 fishing year these are shown in Figures 3 and 4 respectively.

10.2 Required number of samples

The results of the simulation study are shown in Figure 5. In PAU 7, based upon empirical data from 72 diver-days, the target mean weighted c.v. of 0.2 was achieved with a sample size of 21 diver-days. The upper 90% bound was 23 samples (Figure 5a). In PAU 5B, based upon empirical data from 30 diver-days, the target mean weighted c.v. of 0.2 was achieved with a sample size of 32 diver-days. The upper 90% bound was 39 samples (Figure 5b).

11. Conclusions

The length structure of the commercial catch appears to be consistent between years in all areas. The length structure of the catch in PAU 7 appears consistent since the 1989–1990 fishing year (Andrew et al. 2000). The mode of the length frequencies for all QMAs except PAU 7 is between 125 and 135 mm. In PAU 7 the mode of the distributions was near the MLS for the fishery.

The minimum number of samples required to achieve a c.v. of 0.2 or less varied from 21 samples in PAU 7 to 32 samples in PAU 5B. In view of this variability we recommend that a minimum of 30 diver-days be sampled from each QMA in any one year. We recognise that this will mean that some fisheries, such as PAU 7, will be over-sampled but given the relatively cheap cost of shed sampling this will provide a generalisable minimum across all paua fisheries. The target of 30 diver days was met or exceeded in sampling done for the 1999–2000 and 2000–01 fishing years in all but one QMA, in PAU 4 in 1999–00.

12. Publications

None.

13. Data Storage

Data are physically stored in a secure area on site at NIWA, Greta Point Wellington. The data are also stored electronically on the Ministry of Fisheries Market Data base and managed by NIWA (Fisher and Mackay 2000).

14. References

Andrew, N.L., Breen, P.A., Naylor, J.R., Kendrick, T.H. and Gerring, P.K. 2000. Stock assessment of paua (*Haliotis iris*) in PAU 7 in 1998–99. New Zealand Fisheries Assessment Report 2000/49. November 2000.

Fisher, D.O. and Mackay, K.A. 2000. Database documentation: Market. NIWA internal Report 93.

Schiel, D.R. & Breen, P.A. 1991. Population structure, ageing, and fishing mortality of the New Zealand abalone *Haliotis iris. Fishery Bulletin 89*: 681–691.

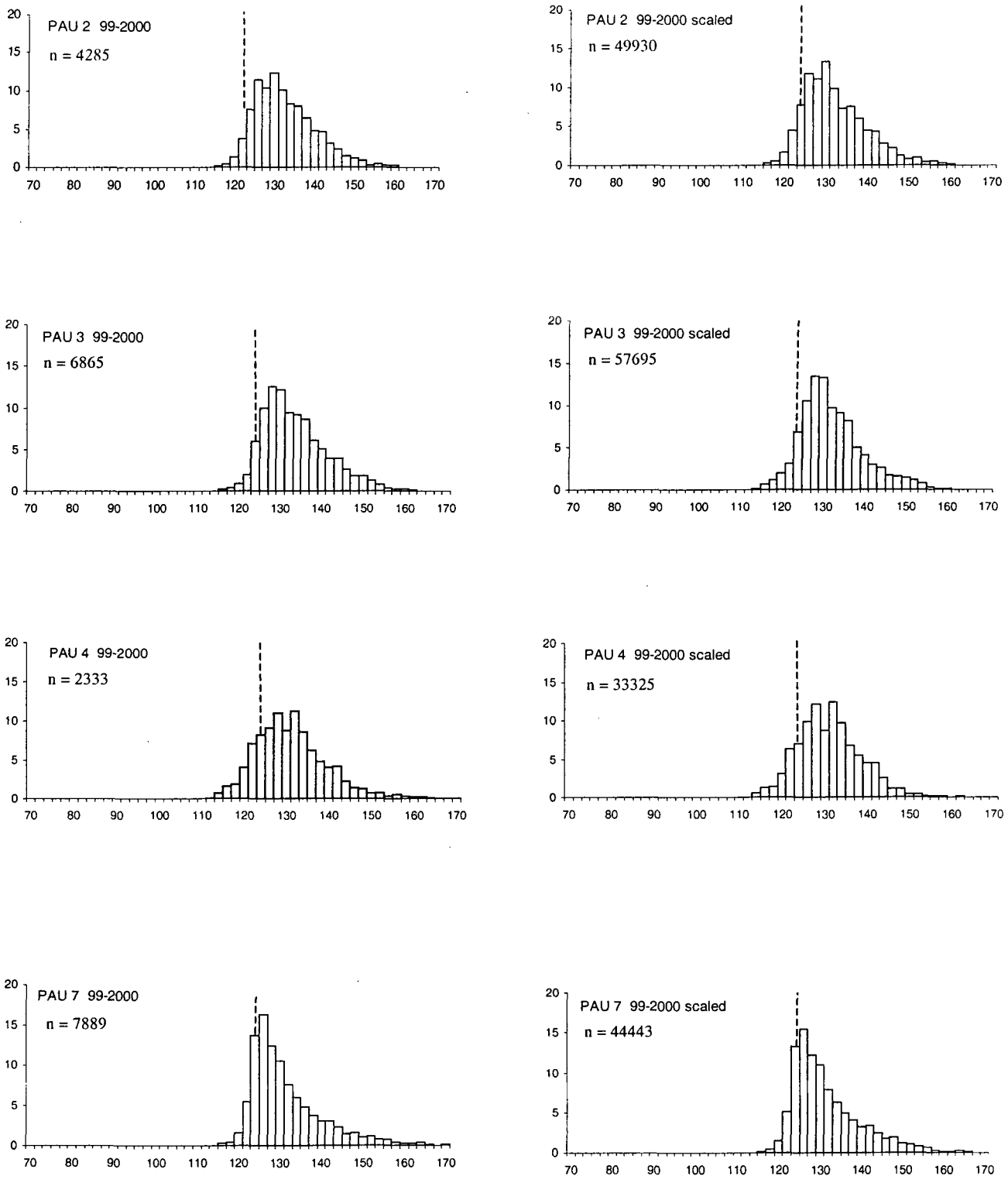

Figure 1: Length frequency distributions of *H. iris* from shed sampling in PAU 2, 3, 4 and 7. Minimum legal size of 125 mm is also indicated.

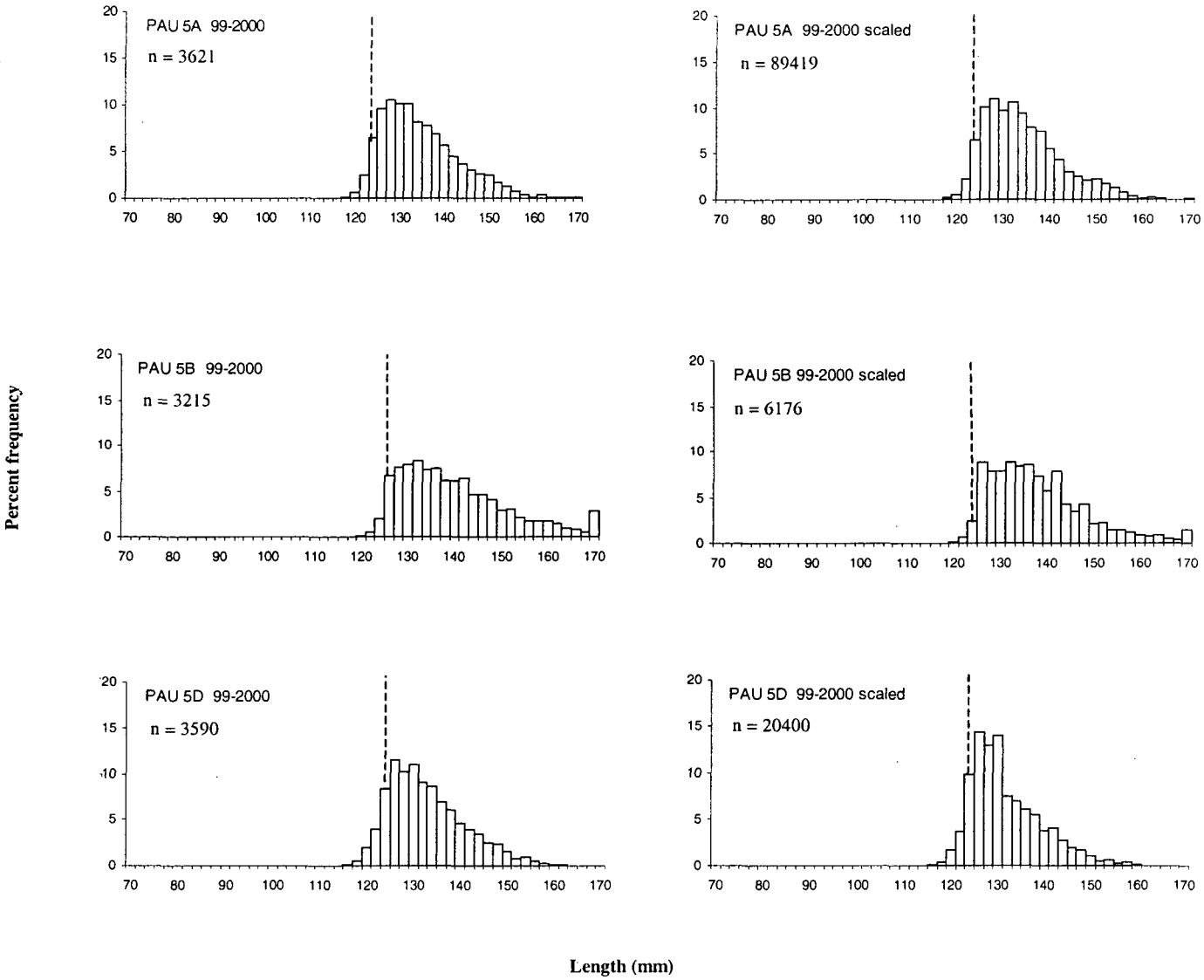

Figure 2: Length frequency distributions of *H. iris* from shed sampling in PAU 5A, 5B and 5D. Minimum legal size of 125 mm is also indicated

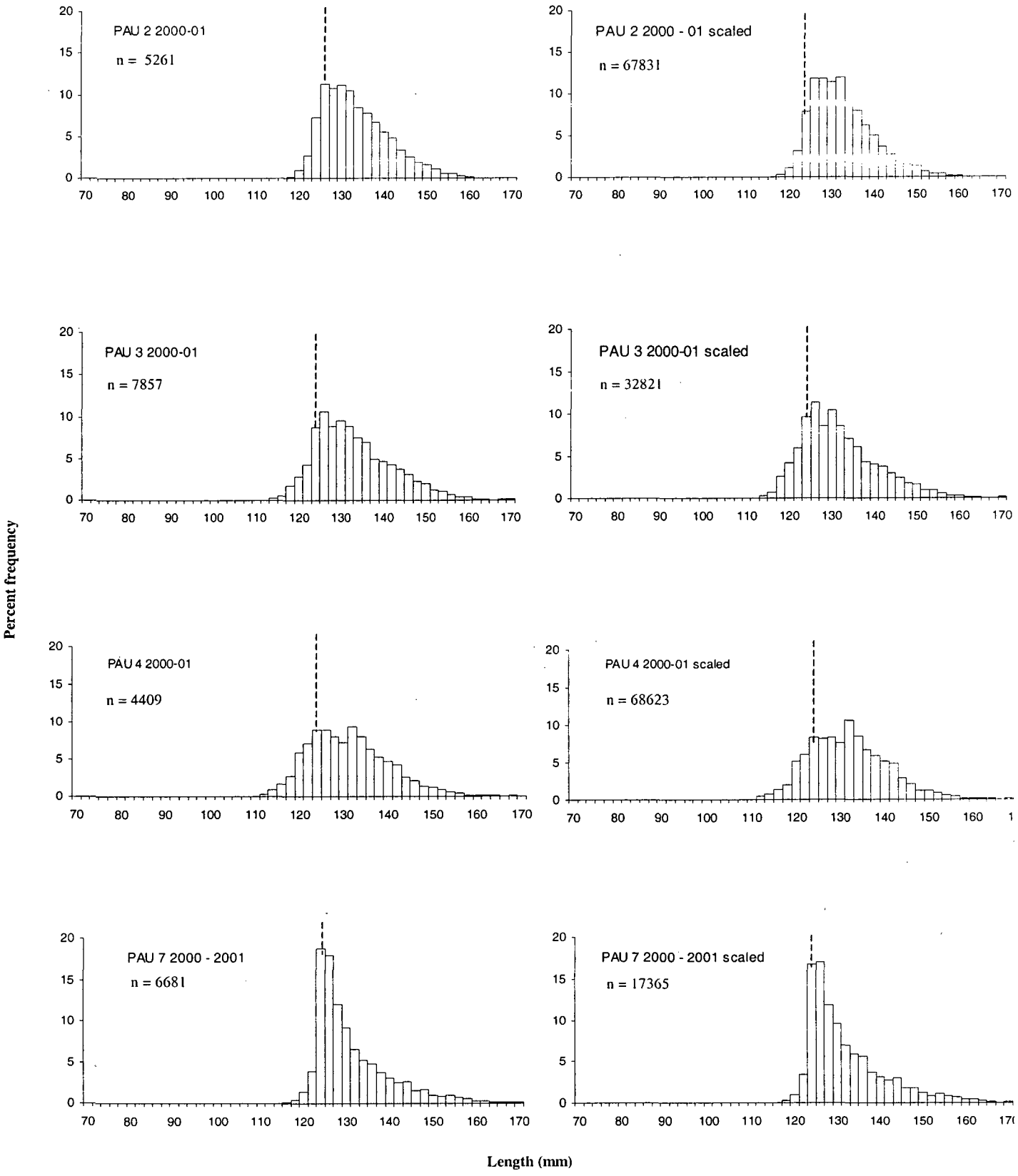

Figure 3: Length frequency distributions of *H. iris* from shed sampling (2000 – 2001) in PAU 2, 3, 4 and 7. Minimum legal size of 125 mm is also indicated

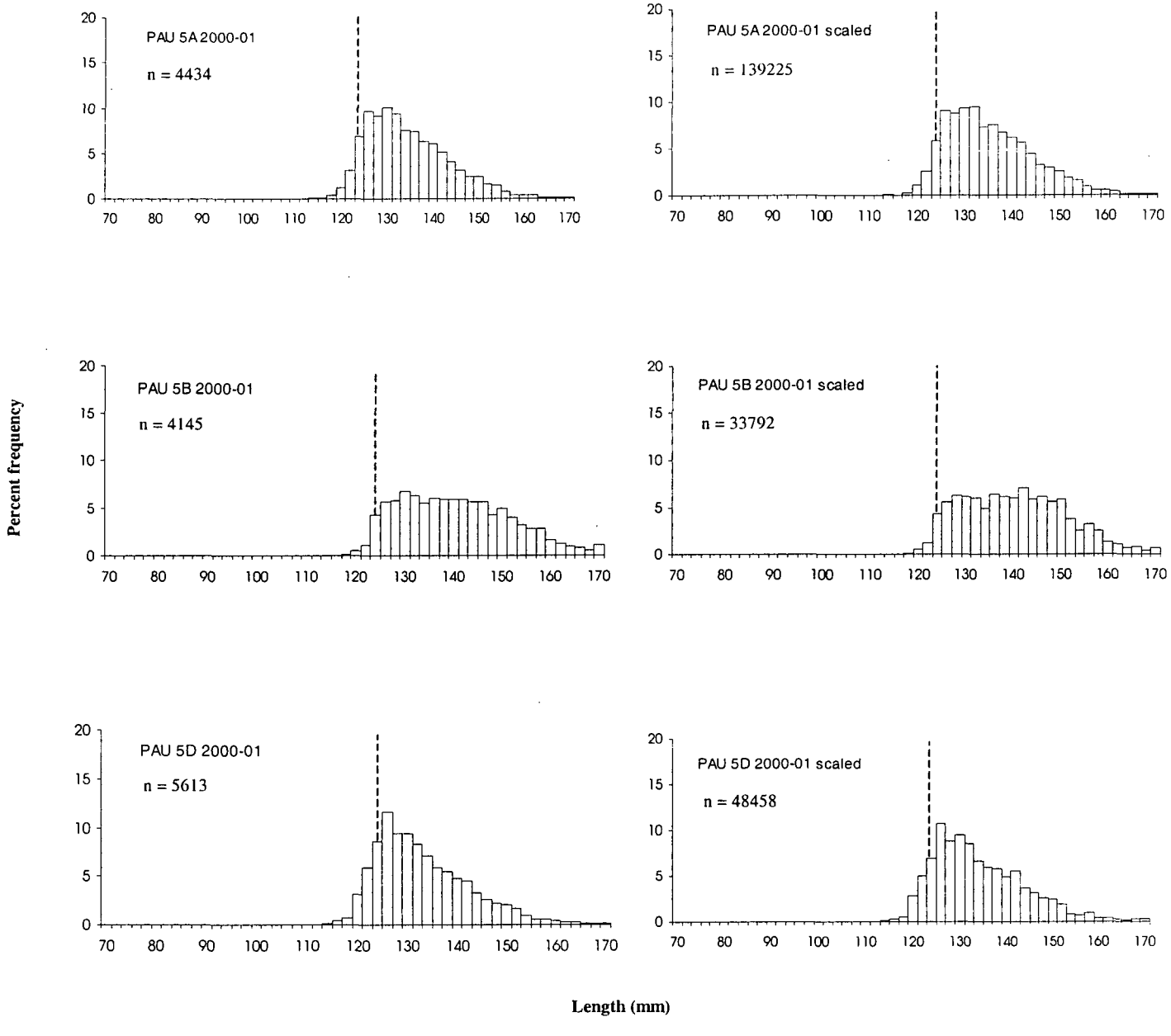

Figure 4: Length frequency distributions of *H. iris* from shed sampling (2000 – 2001) in PAU 5A, B and D. Minimum legal size of 125 mm is also indicated

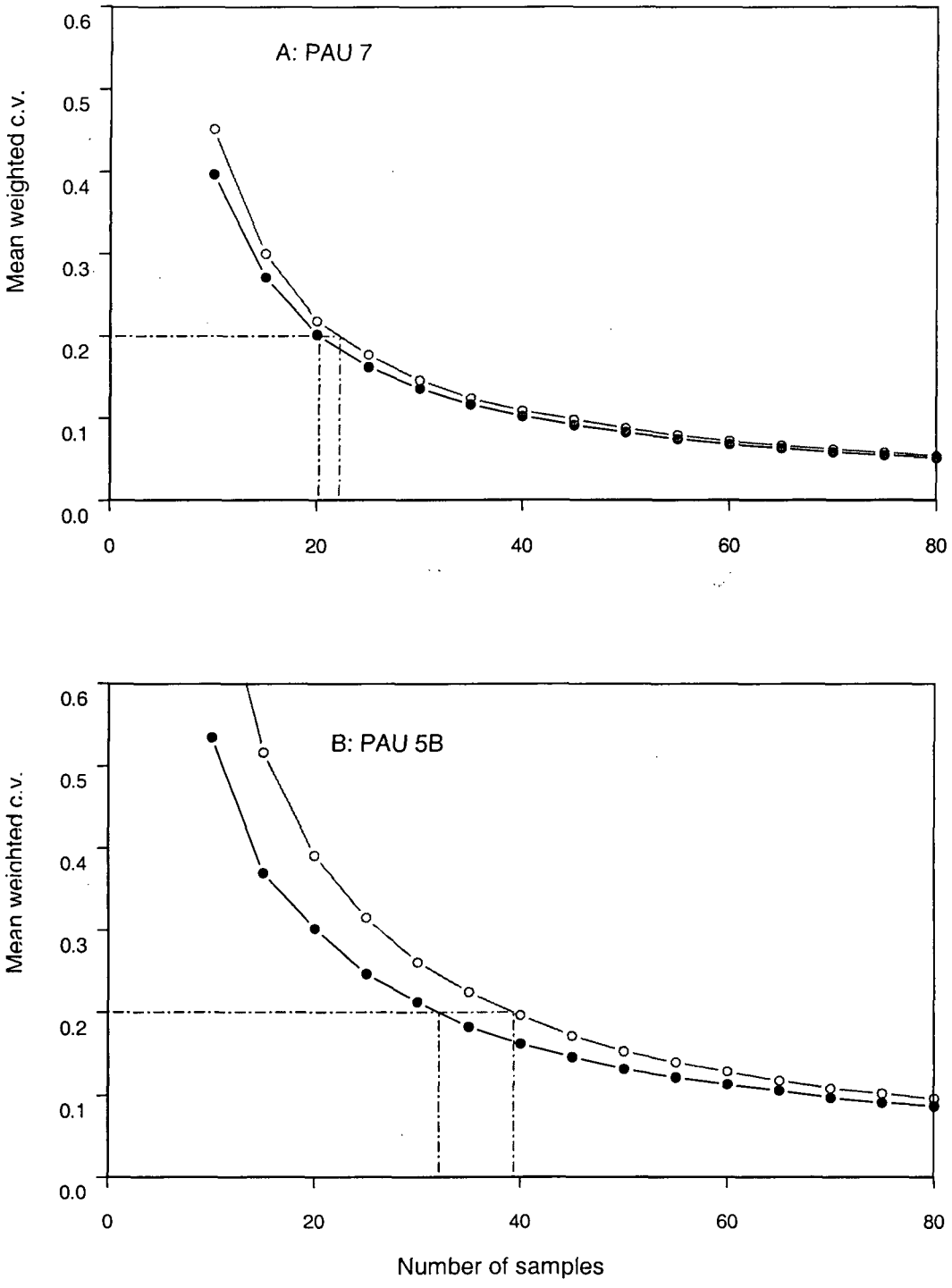

Figure 5. Expected mean weighted c.v. (dark circles) by sample size and the upper 90% bounds (open circles) for A; PAU 7 and B; PAU 5B.