Selection Criteria and Co-Management Guidelines for Harvest Reserves in Tropical River Fisheries

Biological Monitoring Programme Data Report

UK Department for International Development
Fisheries Management Science Programme
Project R7043

Central Research Institute for Fisheries, Indonesia

Provincial Fisheries Services, Indonesia
MRAG Ltd, UK

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1. Introduction

This report presents the raw data from the Biological Monitoring Programme (BMP), on which the project's Summary Paper (Appendix 8d) is partly based.

The methodology for the BMP was described in the Regional Reserve Survey (RRS) and Monitoring Programme Implementation (MPI) reports (Appendices 2 and 3 respectively). The key results and conclusions from the BMP are included in the Summary Paper and not repeated here.

This report also includes the data and analyses from the 'historical perception' interviews conducted as part of the BMP. As described in Section 2.2, these data proved difficult to analyse and were not included in the main outputs of the project.

2. Results

2.1 Experimental Gill Net Survey

Original Data from each Sample

Summary data on the catches from each sample in the BMP are presented for each study site in Figures 1a-1i. For each site, the series of figures present the following summary information plotted against time:

- water height (at the nearest guage);
- other variables potentially affecting catches on the night of sampling (poaching, fish kills, wind and rain);
- total number of fish caught;
- total weight of fish caught;
- number of different species caught;
- mean weight of fish caught;
- percentage of fish over 30cm in total length (by number); and
- percentage of fish over 30cm in total length (by weight).

For ease of comparison, each of the different plots uses a common scale across all the sites. Comparisons are further aided by Figures 2a-2f, in which the data for all of the study sites are presented together on a single page for each index. In comparing these plots, however, it should be remembered that the hydrological seasons varied between the sites. While the magnitude of the catches are comparable, the timing of the peak catches depends on the flood patterns.

Partial exclusion of Meliau data

Meliau village was the most remote of the four study villages in West Kalimantan province. During the sampling design discussions with the village members there had been some concern about fishing small meshed gill nets in the study reserve site, Danau Balaiaram. Although confirmation could not be obtained from the village (partly due to the difficulties of communication at this remote site), it is suspected that from January 1999 onwards, the experimental gill nets were fished without the small meshed panels at this site. This suspicion is supported by the sudden decline in fish catches and the increase in fish sizes that occured at this time (see Figure 1b). The relative constancy of the data from this time onwards also provide some concern that some or all of the 1999 data may have been fabricated at this site.

For this reason, the Meliau 'wet season' data were included in the main analyses, but the 1999 data were excluded.

Catch Rate Data

As described in the RRS and MPI reports, it was anticipated that the catch rates in the experimental gill nets would vary between seasons due to (1) the relatively mobility of fish and (2) their relative densities. Mobility increases particularly during the flood and drawdown seasons, while density is relatively low in the high water season and relatively high in the low water (dry) season. To aid comparison of the gill net catch rates between sites, mean values were computed within both high water and low water seasons. The actual months included in each season naturally varied between sites due to the different flood patterns they experienced. Seasons were identified based on both the hydrological (water level) data, and on the relative catch patterns observed in the survey data. Seasons were selected to include full sampling months in which a relatively constant catch rate was maintained. Full sampling months were included to give an even balance over the eight sampling sites used in each water-body. The months identified in each season at each site are shown in Table 1.

The average catches and sample standard deviations in each season for each site are given in Table 2.

Fish Size Data

Mean individual fish weights taken in the experimental gill nets are also given in Table 2.

The data on the percentages of fish over 30cm (by numbers and weight) were collected as a simple index of the size of fish caught in the different waterbodies. Not surprisingly, these data are fairly well correlated to the data on mean sizes (see Figures 2d, 2e, and 2f). Part way through the survey, it was also realised that large mean sizes can either be due to low mortality rates (possibly indicating 'good' reserves) or to low recruitment rates (possibly indicating 'bad' reserves). For this reason, it is difficult to interpret these data as either positive or negative in terms of reserve impacts. The percentages of fish over 30cm were therefore not included in the summary paper. With hindsight, the data need not have been collected.

Species Compositions

The summary paper gives the total numbers of different species caught at each of the sampling sites. The mean number of different species caught per gill net per night are also given in the summary paper and in Table 2 of this report. The overall percentages by weight of each different species caught at each site are given in Table 3 of this report. Based on these data, and on the identification of the known species as either 'blackfish' or 'whitefish' (see column 3 of Table 3), Table 4 gives the percentages of the total fish catch at each site in each of these migratory categories. These data particularly demonstrate the relatively low numbers of blackfish at the poison fished Pulau Majang site in West Kalimantan.

2.2 Historical Catch Trend Survey

In the historical catch trend surveys, a randomly selected sample of at least ten fishermen from each study site was interviewed about their perceptions of any changes in fish catches in their local water-bodies over time. Each respondent was first asked to estimate the change in average CPUE over a stated time period within his memory. Separate estimates were requested for different gear types. Secondly, each respondent was asked to state *which* fish species had either become extinct or increased or decreased significantly within the period of

his experience. For the South Sumatra and West Kalimantan study sites, the respondents were also asked to comment on the change in fishing effort levels. Further details on these processes were provided in the RRS and MPI Reports. The surveys were conducted during the MPI fieldwork period.

This survey was undertaken to give some indication of the *trends* in the state of the fishery. Such information was not available from the main gill net survey which was clearly only able to give a 'snap shot' picture of the *current* state of the fishery.

The methods used in this survey attempted to obtain quantitative indices from information sources which necessarily varied between respondents (depending on their different skills and experiences and the length of time of their involvement in the fishery). As shown in the following sections, the results may depend more on these differences between respondents than on the underlying trends in the fisheries.

Perceived Changes in Overall Catch Trends

The results from these analyses are presented in Figures 3a-h. In the figures, the data points show the estimated CPUE in previous years divided by that in the current year. Points above the '1' line thus indicate years in which the catch was better than at the current time. Conversely, points below the '1' line imply that the current catches are now *better* than at those earlier years.

If all fishermen had equal fishing skills, used the same fishing gears and had perfect memories of their catch rates, such a plot should show the trend in fish abundances over time. The wide spread of points within any particular year (see Figures 3a-h), indicates that different fishermen experienced (or remembered at least) a range of different changes over the periods examined. The differences between fishermen may also be due to their use of different fishing gears, since these catch different fish species, whose abundances may be expected to have changed in different ways over time. While it is thus perhaps expecting too much to obtain a clear pattern from such small samples of respondents with mixed experiences, the data nevertheless reveal a relatively consistent result.

Surprisingly (given the results from the gill net survey), all of the respondents from the West Kalimantan sites only reported previous fish abundances to be greater than at the current time (all of the data points in Figures 3c-f are on or over unity). In contrast, the data points from the Jambi sites (Figures 3a,b) and the South Sumatra sites (Figures 3g,h) show a more even scatter around the '1' line, especially in recent years. These data may be interpreted as suggesting that fish stocks at the Kalimantan sites are in decline, while those in the Jambi and South Sumatra sites are more stable (see summary in Table 5).

While these observations may have some basis in fact, two additional factors may also have influenced this result. The figures also show that the respondents from West Kalimantan mostly had longer experience in their fishery, with some reporting data from as far back as 40 years ago. At the South Sumatra sites, the earliest comparison year was with 1989 in Lebak Nilang and with 1986 in Pedamaran, only 9 and 12 years earlier respectively. The Jambi and South Sumatran fishers may thus be less aware of the changes in their fisheries due to the relatively shorter periods of their local employment. It may also be significant that the West Kalimantan surveys were conducted only by CRIFI field staff, without the support of the MRAG collaborators. It is possible that the CRIFI staff introduced the subject or asked the question in West Kalimantan in such a way as to bias the answers in some way.

Perceived Changes in Catches of Individual Species

The aggregate results from these analyses are presented in Figures 4a-d. In broad terms, the individual species data support the observations from the above historical trend analysis. In each of the South Sumatran sites and the West Kalimantan sites (Figures 4a,b,c), between two and four species were recognised by a majority of fishermen (at least 50% of the respondents) as either having declined significantly or become extinct (Table 5). Again, in surprising contrast, the fishers in South Sumatra only agreed on one species (Betutu, *Oxyeleotris marmorata*) that had declined. This result may again be due to the relative inexperience and short memories of the respondents from South Sumatra. From CRIFI's long term sampling of the fishery, it is well known that several other valuable species have also declined over time.

A further point to note in these results is the clear differences in the responses between different fishermen. In cases where 10 of the 11 respondents report a species as 'extinct' (e.g. as for Arawana/kelso in Dano Lamo (Figure 4a), it may be fairly accepted that that species has indeed declined dramatically, if not become biologically extinct locally. Many of the species listed in Figures 4a-d, however, were mentioned by only one or two of the respondents. For other species, some respondents reported them as having increased significantly, while others reported them as having decreased significantly. With further concerns as given above, about how the data were collected in West Kalimantan, it is unclear how much faith can be placed in these results.

Due to the subjective and possibly biased means by which these 'historical' data were collected, and the contradictions they make with the more quantitative gill net data (Section 2.1), these results were not included in the summary paper about the project.

Table 1. Months selected as representative of different seasons at each study site, based on water levels and observations on fish catches.

		Jambi	West Kalimantan Sites				South Sumatra Sites			
Months in sampled seasons		Arang Arang	Meliau	Sekolat	Pulau Majang	Teng-kidap	Lebak Nilang	Teluk Gelam	Teluk Rasau	Teluk Toman
Dry Season 1998	Start	Aug-98					Sep-98	Sep-98	Sep-98	Sep-98
	End	Oct-98					Oct-98	Oct-98	Sep-98	Sep-98
Wet Season	Start	Jan-99	Sep-98	Sep-98	Sep-98	Sep-98	Dec-98		Nov-98	
	End	Apr-99	Dec-98	Dec-98	Dec-98	Dec-98	Apr-99		Mar-99	
Dry Season 1999	Start	Aug-99		Jun-99	Jun-99	Jun-99	Aug-99	Aug-99	Aug-99	Aug-99
	End	Aug-99		Jul-99	Jul-99	Jul-99	Sep-99	Sep-99	Sep-99	Sep-99

NB: Shaded cells indicate no sampling or unreliable data (Meliau, dry season '99)

Table 2. Means and standard deviations of catches per night per multi-mesh gill net from the BMP study sites sampled in each season.

		Jambi	West Kalimantan Sites				South Sumatra Sites			
Dry Season 1998		Arang Arang					Lebak Nilang	Teluk Gelam	Teluk Rasau	Teluk Toman
Total number of fish caught	Mean	243					55	42	225	104
	Std Dev	106					32	32	134	54
Total weight of fish caught	Mean	4717					680	626	4360	2273
	Std Dev	1866					434	357	2659	1145
Number of species caught	Mean	12.7					9.1	4.6	13.3	11.3
	Std Dev	1.9					1.3	1.2	3.4	1.4
Mean individual fish weight	Mean	21.0					13.1	18.5	20.1	22.6
	Std Dev	7.1					5.4	10.8	4.5	6.5

Wet Season		Arang Arang	Meliau	Sekolat	Pulau Majang	Teng-kidap	Lebak Nilang	Teluk Rasau
Total number of fish caught	Mean	105	956	751	62	171	74	101
	Std Dev	35	381	461	19	121	23	75
Total weight of fish caught	Mean	2495	12554	13059	838	2973	814	2268
	Std Dev	584	5859	7476	485	2293	403	1799
Number of species caught	Mean	10.0	23.9	15.1	9.9	19.4	9.1	10.4
	Std Dev	1.0	2.6	3.4	2.2	3.4	1.2	2.5
Mean individual fish weight	Mean	26.4	13.8	17.9	16.1	18.6	11.6	24.2
	Std Dev	11.0	5.4	5.3	15.3	9.3	6.7	10.6

Dry Season 99		Arang Arang	Sekolat	Pulau Majang	Teng-kidap	Lebak Nilang	Teluk Gelam	Teluk Rasau	Teluk Toman
Total number of fish caught	Mean	232	1612	337	119	93	121	57	99
	Std Dev	45.7	761	146	49.5	27.8	92.9	19.6	31.2
Total weight of fish caught	Mean	5644	37413	1719	3259	2201	1380	1175	1404
	Std Dev	3585	16333	1117	3222	1342	885	386	728
Number of species caught	Mean	9.6	13.9	11.7	18.2	9.4	5.8	9.8	12.2
	Std Dev	0.5	3.6	1.4	3.0	1.0	2.0	2.3	2.7
Mean individual fish weight	Mean	23.3	24.8	5.4	32.6	23.1	12.3	22.2	14.0
	Std Dev	11.9	8.1	2.7	42.8	11.8	4.4	8.8	5.8

- Means and standard deviations based on eight samples per month for the seasons of 1-5 months (i.e. n = 8, 16, 24, 36 or 40, see Table 1).
- Vertical lines separate sites from different catchments, which are least comparable due to ecological and meteorological differences.
- Highlighted results indicate reserve site catches that are significantly less than (outlined cells) or greater than (shaded cells) those at the fished site.

Table 3. Overall percentages by weight of each fish species caught at each study site. Column 3 categorises better known fish species as either relatively sedentary blackfish (B) or migratory whitefish (W) according to the personal experience of project staff.

			Jambi	West Kalimantan				South Sumatra			
Spec-ies Code	Scientific Name	Black / White Fish	Arang Arang	Meliau	Sekolat	Pulau Majang	Teng-kidap	Lebak Nilang		Peda-maran	Peda-maran
			Arang Arang	D. Balai-aram	D. Batuk	D. Seriang	D. Seliban	Lebak Nilang	Teluk Gelam	Teluk Rasau	Teluk Toman
???	Unknown local name	?	0.026%	0.114%	1.614%		1.825%	0.039%		0.003%	
AT	Anabas testudineus	?	0.463%							0.037%	
AW	Parambassis wolfii	?			1.301%	1.351%	0.637%	0.110%	0.034%	1.105%	1.861%
BC	Cyclocheilichthys (Oxybarbus) heteronema	?		0.007%		0.015%	0.431%				0.102%
BD	Betta dimidiata	?			0.001%						
BDA	Belodontichthys dinema	?		1.739%	0.076%	0.132%	0.954%				
BH	Botia hymnophysa	?		0.025%	0.046%		0.028%				
BM	Botia macracanthus	W		0.032%			0.001%				
BS	Barbodes schwanefeldii	W		0.108%	0.005%	0.142%	0.534%	0.459%		0.070%	0.446%
CA	Cyclocheilichthys apogon	?	0.237%	1.406%	2.874%	3.452%	0.244%	3.504%	16.065%	11.937%	18.615%
CAG	Kryptopterus apogon	W		5.344%	0.449%	0.432%	0.992%		0.134%	0.024%	0.178%
CB	Clupeichthys bleekeri	W				6.754%	0.008%			0.031%	
CC	Kryptopterus schilbeides	W		0.209%	0.192%	0.352%	0.142%				
CD	Clarias melanoderma	B		0.372%	0.045%		0.023%				
CDS	Channa maruloides	B					0.042%				
CHB	Chaca bankanensis	?		0.161%							
CL	Kryptopterus limpok	W	0.039%	0.571%	0.261%	0.311%	0.209%				0.039%
CLS	Channa lucius	B	0.498%	0.642%	0.061%		1.618%	1.007%		0.356%	
CM	Kryptopterus micronema	W	3.761%	3.559%	0.790%	0.517%	0.687%	3.200%	0.676%	0.582%	6.143%
CMS	Chela maassi	?					0.135%			0.025%	
CMT	Channa micropeltes	B	2.437%	2.097%	1.685%		0.289%			0.056%	
CN	Clarias nieuhofi	B		0.400%			0.037%				
CO	Parachela oxygastroides	?	2.107%	0.113%	0.369%	6.161%	0.030%	1.744%	29.120%	0.062%	4.075%
CP	Channa pleurophthalmus	B	1.467%	4.681%	0.122%	0.015%	1.864%	9.489%		1.106%	2.413%
CR	Cyclocheilichthys repasson	?		0.380%	1.092%	1.579%	1.458%	3.005%	0.061%	0.103%	2.711%
CRS	Clarias spp	B	0.045%	0.082%			0.081%	0.586%		0.105%	
CS	Channa striatus	B	12.063%	1.158%	0.586%	0.152%	0.746%	0.889%		2.783%	4.816%
CTR	Kryptopterus sp	W	0.038%			0.091%	0.016%				
DC	Labiobarbus cuvieri	W	0.648%				0.033%	0.025%			
DF	Labiobarbus festivus	W		0.342%				1.329%		0.069%	1.873%
DM	Datnoides microlepis	?		0.306%							
DO	Labiobarbus ocellatus	W	8.779%	1.036%	6.010%	9.340%	4.278%	14.653%		0.770%	0.813%
HHS	Hemisilurus sp	?		0.035%			0.041%				
HM	Hampala macrolepidota	W		1.022%	0.160%	0.612%	2.344%	1.466%	0.122%	0.155%	0.428%
HN	Hampala ampalong	?		0.000%			0.081%	0.156%		1.927%	8.030%
HP	Hemirhamphodon pogonognathus	?		0.001%	0.005%		0.131%				0.120%
HT	Helostoma temminckii	B	10.845%	2.553%	25.137%	2.206%	12.367%	2.917%	5.155%	27.453%	8.720%
LC	Labeo chrysophekadion	W			0.053%		0.014%				
LCS	Leiocassis cf.stenomus	?		0.007%							
LF	Labiobarbus festivus	W		0.244%	0.003%	0.438%	0.011%				
LH	Leptobarbus hoeveni	?	3.777%				0.797%	5.971%	0.640%	0.705%	0.542%
LM	Leptobarbus melanopterus	?		6.088%		0.205%	0.175%				
LS	Labiobarbus sumatranus	W					0.011%				
LT	Luciosoma trinema	?	0.073%	0.184%	0.180%	0.059%	0.923%				
M	Mastacembelus sp	B			0.037%		0.020%				
MA	Monopterus albus	B		0.008%			0.818%				
ME	Mastacembelus erythrotaenia	B								0.025%	0.102%
MM	Mystus micracanthus	?	0.014%	0.194%	2.458%	0.126%	1.837%				
MMC	Macrochyrichthys macrochyrus	?	0.443%	0.001%		0.152%	0.417%				
MN	Mystus nemurus	W	6.852%	1.407%	12.089%	6.267%	9.737%	14.077%	4.278%	11.456%	8.692%
MP	Mystus nigriceps	?	5.921%	0.528%	8.226%	7.238%	5.325%	3.870%	4.863%	3.083%	5.973%
MR	Macrobrachium rosenbergii	W								0.000%	
MW	Mystus wyckii	?		0.501%	1.747%		1.355%				

NCT	Chitala lopis	W		10.240%	1.579%	0.091%	5.765%				
NN	Notopterus notopterus	?			0.031%			2.191%		0.242%	0.286%
NS	Nandus rebulosus	?					0.011%	0.309%	0.012%	0.020%	0.380%
O	Osteochilus sp	?	0.074%					0.414%		0.062%	
OA	Osteochilus melanopleura	?	0.452%								
OE	Ompok eugeneiatus	W		0.003%	0.020%						
OG	Osphronemus gouramy	B		0.097%		0.010%	0.014%	0.274%		0.042%	
OH	Osteochilus hasselti	B			0.093%		0.240%	1.764%	0.396%	1.079%	2.464%
OHP	Ompok hypophthalmus	W		0.357%	0.493%	2.046%	2.395%				
OI	Osteochilus intermedius	?		1.160%	0.748%	6.893%	1.840%	0.782%	0.275%	0.042%	1.476%
OK	Osteochilus kappenii	?			0.661%		0.291%				
OM	Oxyeleotris marmoratus	B			0.190%		0.008%	0.003%		0.212%	
OP	Osteochilus melanopleura	?		4.471%	2.769%	1.097%	0.783%	0.150%			
OPR	Osteochilus partilineatus	?		0.480%	0.124%	0.116%	0.586%				
OS	Osteochilus schlegelii	?		0.009%	0.082%		0.169%				
OSB	Osteochilus brachynotopterus	?		0.454%		0.032%				0.036%	0.030%
OSM	Osteochilus microcephalus	?		0.004%	0.027%	0.165%	0.214%				
OV	Osteochilus vittatus	?	3.321%				0.008%			0.004%	
P	Pangasius spp	W								0.051%	
PB	Pectenocypris balaena	?	3.675%	0.086%	0.050%		0.011%				
PBL	Puntioplites bulu	?		6.625%	5.500%	3.207%	0.734%	0.327%			
PF	Pristolepis fasciatus	B	1.383%	1.064%	1.203%	1.555%	2.256%	2.653%	0.110%	4.190%	1.191%
PFS	Puntius fasciatus	?							0.018%	0.001%	0.006%
PG	Barbodes gonionotus	?								0.791%	
PH	Polycanthus hasselti	B	3.036%							0.056%	
PHS	Parachela hypophthalmus	?			0.003%						
PM	Pseudeutropius brachypopterus	?		2.789%	2.511%	3.040%	2.246%		12.296%	0.388%	0.030%
PO	Parachela oxygastroides	?	2.080%	3.195%	1.993%	14.204%	3.271%	1.540%	3.364%	1.331%	1.819%
POO	Pseudeutropius moolenburghae	?		0.636%							
PPL	Pangasius polyuranodon	W			0.042%	5.751%	0.203%				
PS	Puntius sumatrana	?								0.000%	
PW	Puntioplites waandersii	?		0.236%	2.741%	3.026%	1.697%	0.007%			
R	Rasbora spp	?	0.199%	0.829%	0.034%	0.642%	0.469%	0.046%		0.003%	0.018%
RA	Rasbora argyrotaenia	?		0.028%	0.025%	0.086%	0.064%				
RB	Rasbora borneensis	?					0.073%				
RM	Rohteichthys microlepis	W		0.011%	0.705%		0.020%				
SE	Siluroides eugenciatus	W	0.861%	1.954%	3.592%	4.924%	4.122%	11.863%	19.322%	5.581%	7.491%
SNK	Snake	?								0.119%	
ST	Luciosoma trinema	?	0.186%								
SV	Sphaerichthys vaillanti	B			0.087%		0.642%				
T	Tetraodon sp	B						0.029%			
TH	Thyssocypris sp	?				0.081%	0.126%				
TL	Trichogaster leeri	W	1.651%	2.160%	1.230%		0.285%	0.024%		0.904%	0.027%
TP	Thynnichthys polylepis	?		0.003%	4.160%	3.534%	5.418%	2.283%	3.035%	18.839%	7.617%
TR	Trichogaster pectoralis	B	11.667%		0.033%		0.293%	0.200%		1.928%	0.434%
TT	Trichogaster trichopterus	B	1.801%		0.124%	0.901%	0.184%	0.363%	0.024%	0.030%	0.024%
TTS	Thynnichthys thynnoides	W		0.450%	0.112%	0.496%	1.024%	5.502%		0.020%	
WL	Wallago leeri	W	9.083%	24.999%	1.365%		10.792%	0.782%			
XC	Xenentodon canciloides	?									0.015%

Table 4. Percentages of the known fish species caught at each study site in the blackfish and whitefish categories.

Reserve	Of the total number of fish caught:				Of the total weight of fish caught:			
	Unknown species	Blackfish	Whitefish	Black / White ratio	Unknown species	Blackfish	Whitefish	Black / White ratio
Arang Arang	48.7%	28.0%	23.4%	1.20	27.5%	43.3%	29.2%	1.48
Meliau	74.0%	7.7%	18.2%	0.42	41.0%	8.4%	50.6%	0.17
Sekolat	69.0%	12.9%	18.1%	0.71	52.2%	21.5%	26.3%	0.82
Pulau Majang	57.3%	3.7%	39.0%	0.10	52.9%	3.2%	43.8%	0.07
Tengkidap	63.8%	13.3%	22.9%	0.58	40.8%	16.6%	42.7%	0.39
Lebak Nilang	45.8%	12.1%	42.1%	0.29	33.7%	19.5%	46.8%	0.42
Teluk Gelam	95.7%	1.6%	2.7%	0.58	73.3%	5.5%	21.2%	0.26
Teluk Rasau	73.0%	19.7%	7.3%	2.71	47.0%	35.8%	17.2%	2.08
Teluk Toman	81.6%	10.2%	8.2%	1.25	62.4%	17.9%	19.7%	0.91

Table 5. Summary of perceptions of respondent fishermen on trends in fishing effort and catches at the main study sites.

Comparison Group	Jambi		West Kalimantan				Lebak Nilang (S. Sumatra)	Pedama-ran (S. Sumatra)
Study Site	Arang Arang	Dano Lamo	Meliau	Sekolat	Pulau Majang	Teng-kidap	Lebak Nilang	Teluk Rasau
Reserve type	PR	FR	PR	PR	None	PR	(None)	FR
Closed season	Dry	All	All	Dry		Dry		All
Banned gears	Some	All	Some	Some		Some		All
Management	Com.	Com. / Govt.	Com.	Com.		Com.	(Govt. / Com.)	Govt.
Perceived trend in fishing effort	?	?	Up	Up	Up	Up	Flat	Up
Perceived trend in catch rates	Down	Down	Down	Down	Down	Down	Flat	Flat
Species reported by at least 50% of respondents as 'extinct'	Ridikangus	Arawana Ridikangus Serandang	Belantau	Ketutung Arawana (siluk)	Kapas-kapas Ketutung	Belantau Ketutung		
Species reported by at least 50% of respondents as 'declined' or 'extinct'	Serandang Toman		Belida Jelawat Arawana (siluk)	Belantau Bubuk	Belantau		Betutu	

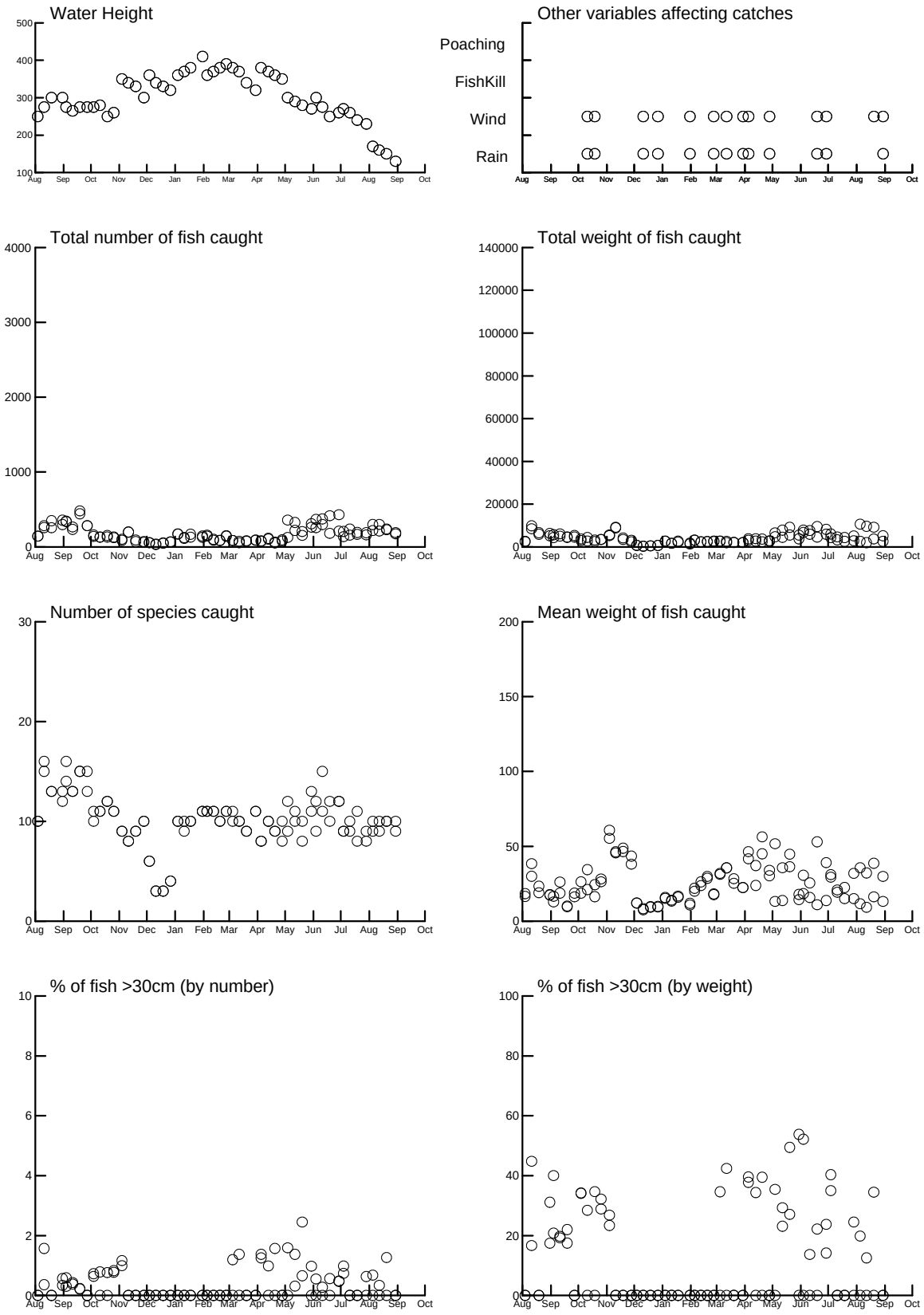

Figure 1a. Fish stock indices from gill net samples, and water heights and other variables potentially affecting catches, plotted against time, for **Arang Arang** reserve, Jambi.

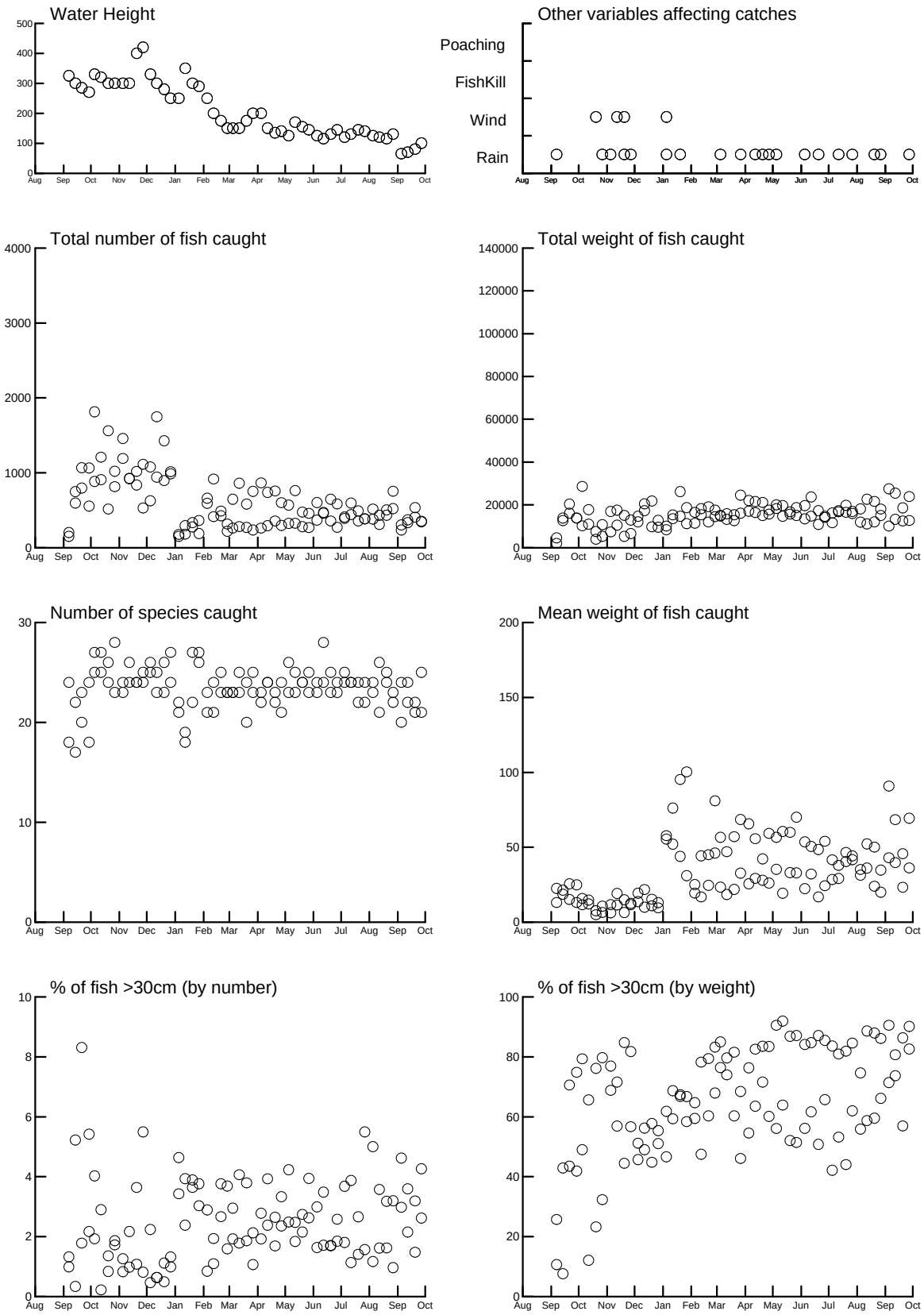

Figure 1b. Fish stock indices from gill net samples, and water heights and other variables potentially affecting catches, plotted against time, for **Danau Belaiaram** reserve, Meliau village, West Kalimantan.

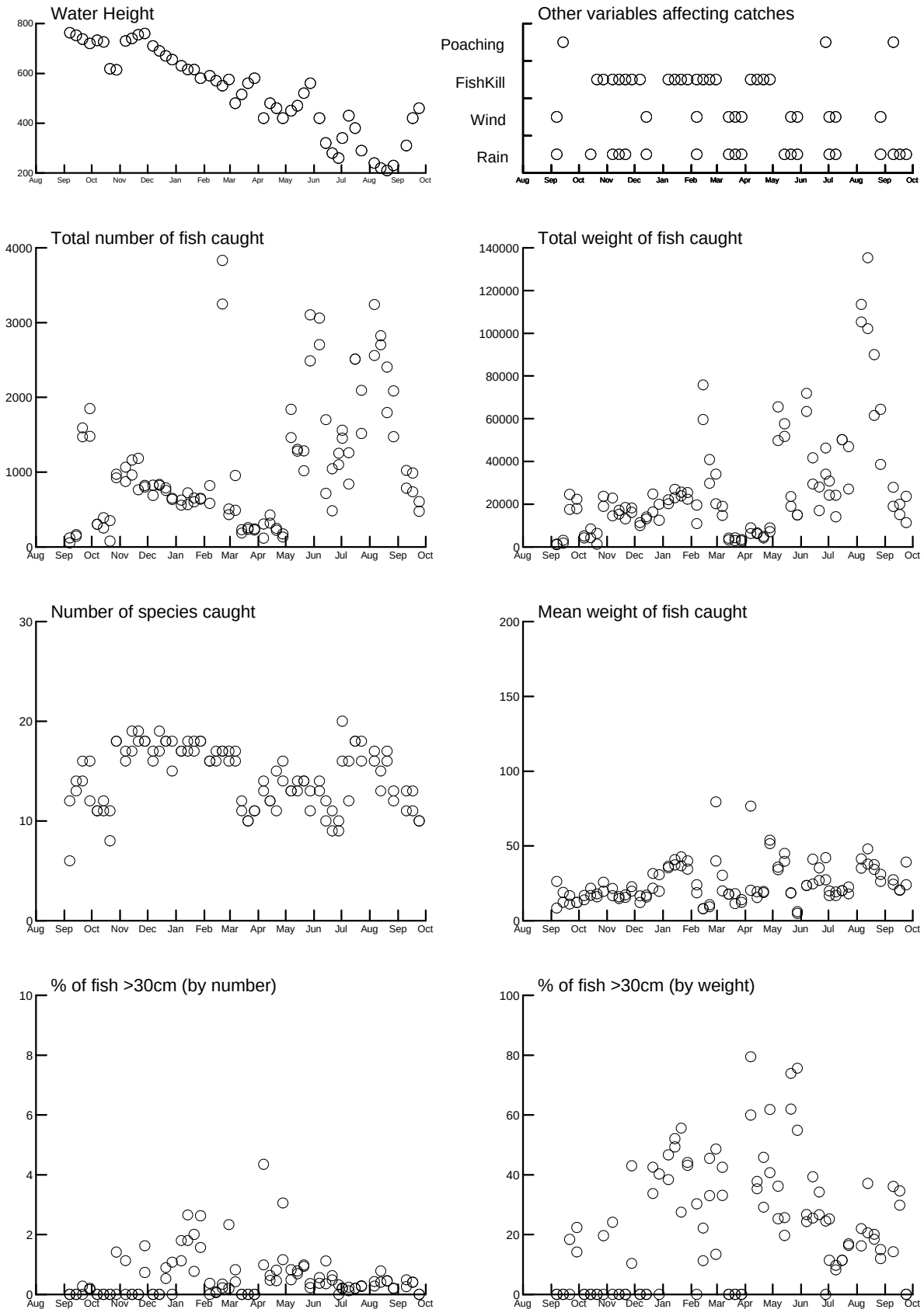

Figure 1c. Fish stock indices from gill net samples, and water heights and other variables potentially affecting catches, plotted against time, for **Danau Batuk** reserve, Sekolat village, West Kalimantan.

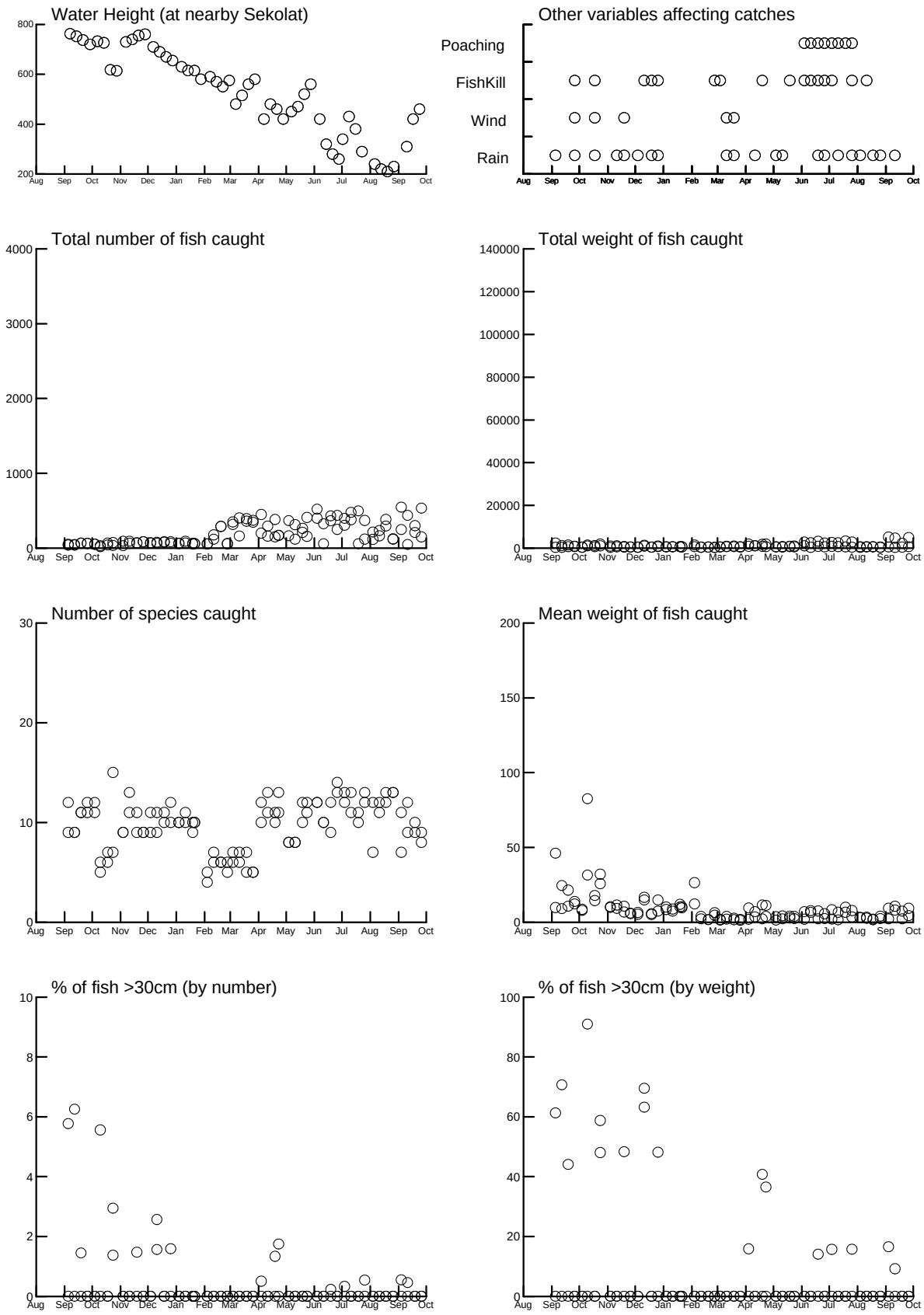

Figure 1d. Fish stock indices from gill net samples, and water heights and other variables potentially affecting catches, plotted against time, for **Danau Seriang** fished lake, Pulau Majang village, West Kalimantan.

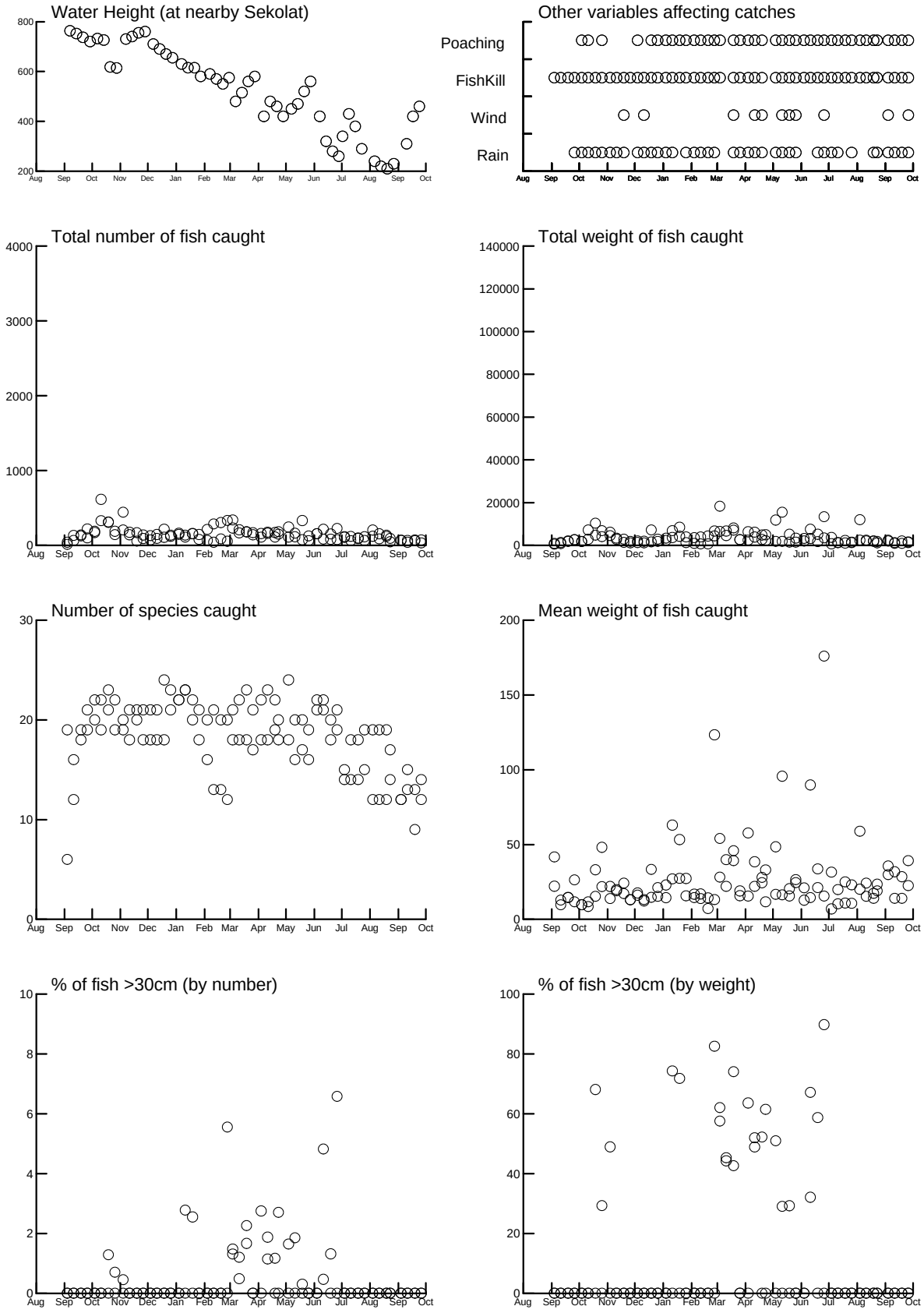

Figure 1e. Fish stock indices from gill net samples, and water heights and other variables potentially affecting catches, plotted against time, for **Danau Seliban** reserve, Tengkidap village, West Kalimantan.

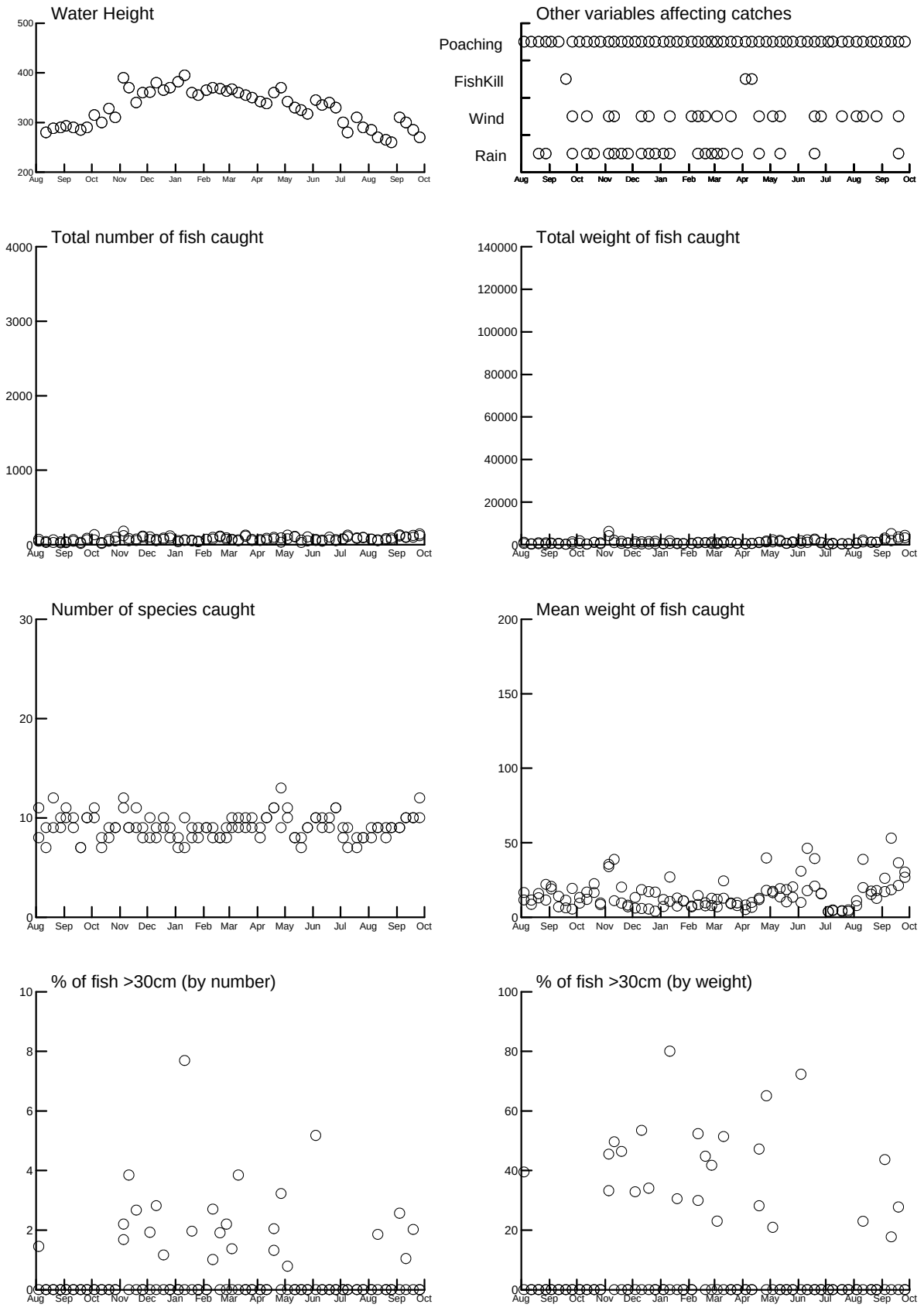

Figure 1f. Fish stock indices from gill net samples, and water heights and other variables potentially affecting catches, plotted against time, for **Lebak Nilang** fished lake, near Benawa village, South Sumatra.

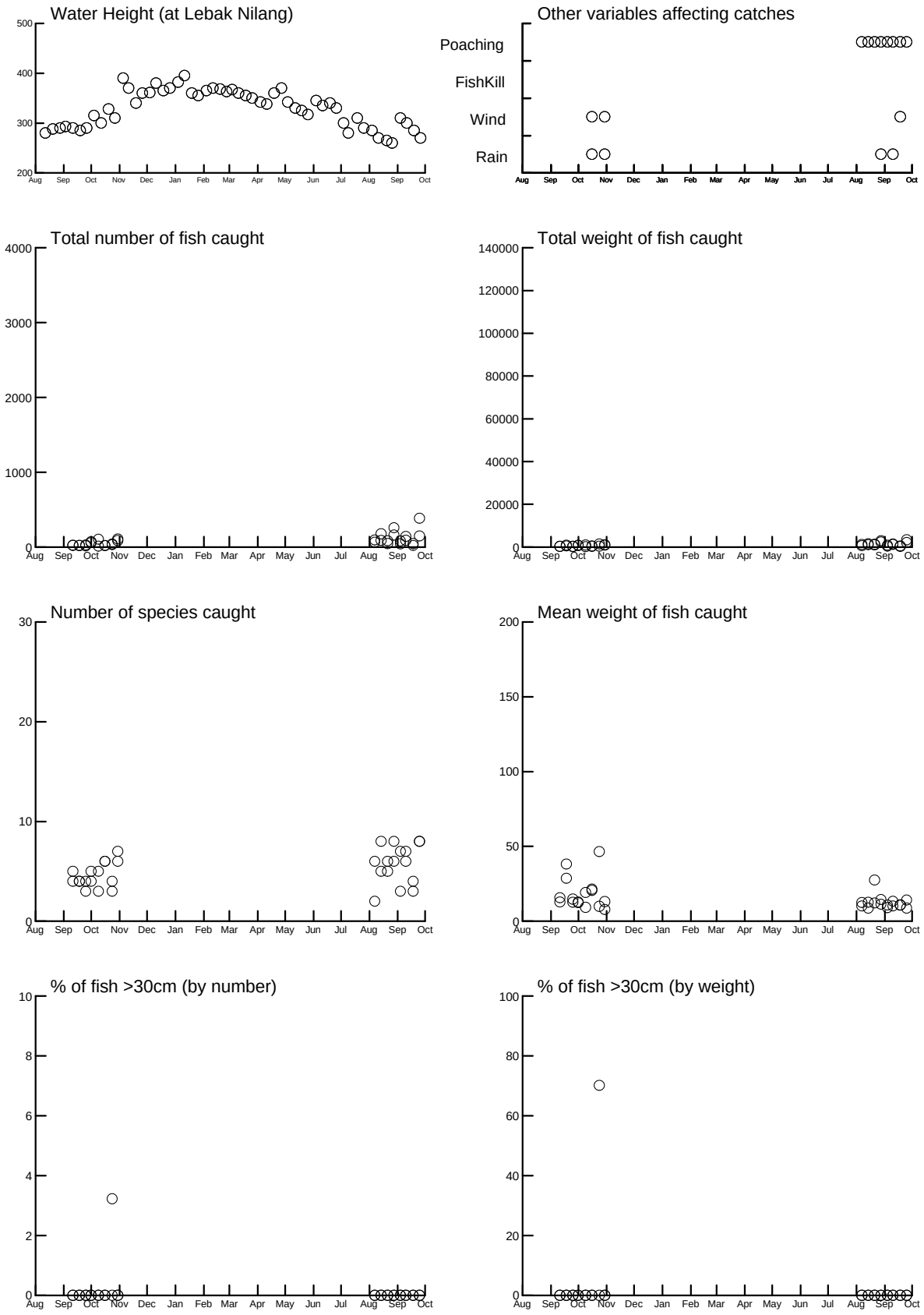

Figure 1g. Fish stock indices from gill net samples, and water heights and other variables potentially affecting catches, plotted against time, for **Teluk Gelam** reserve, South Sumatra.

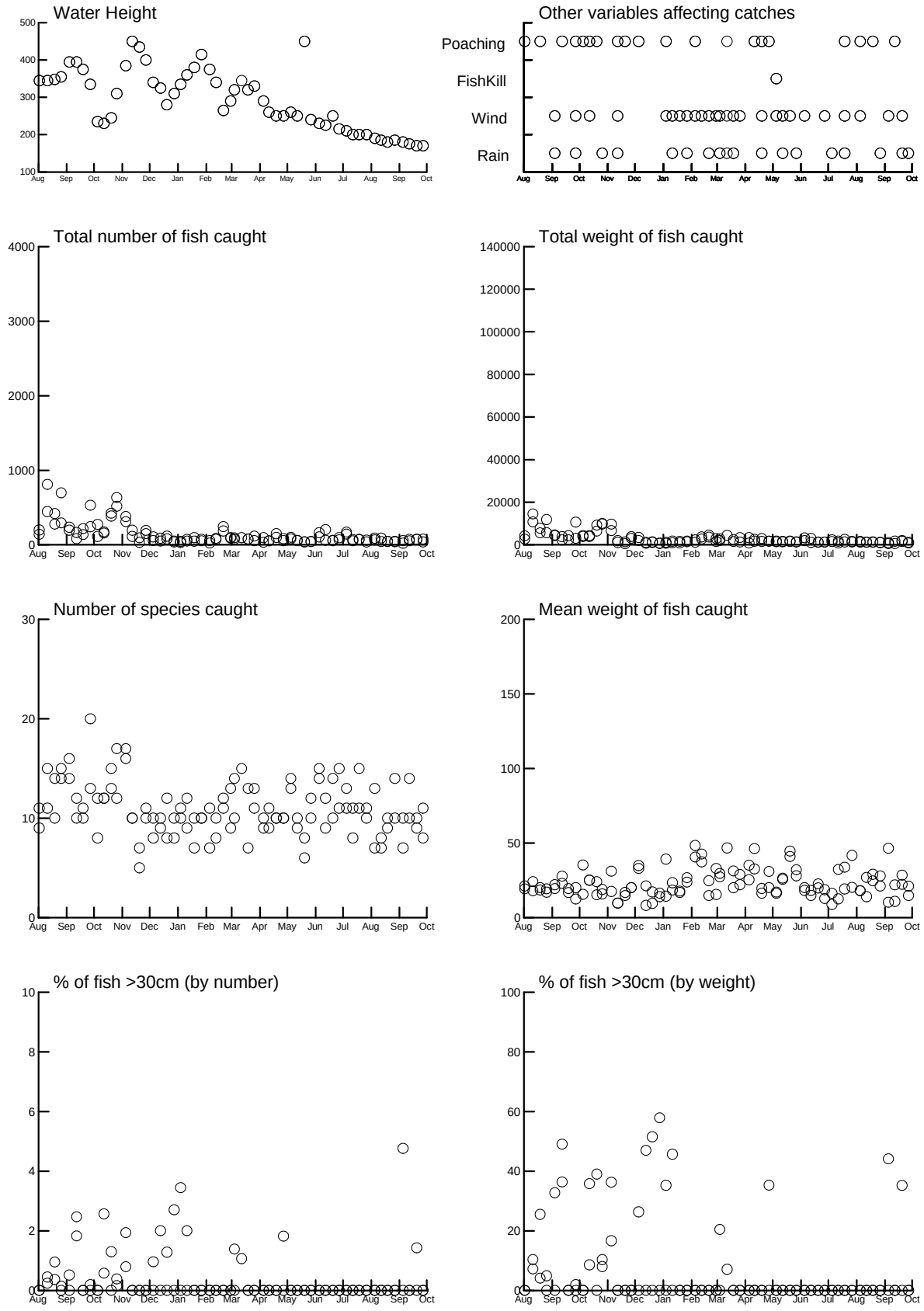

Figure 1h. Fish stock indices from gill net samples, and water heights and other variables potentially affecting catches, plotted against time, for **Teluk Rasau** reserve, near Pedamaran, South Sumatra.

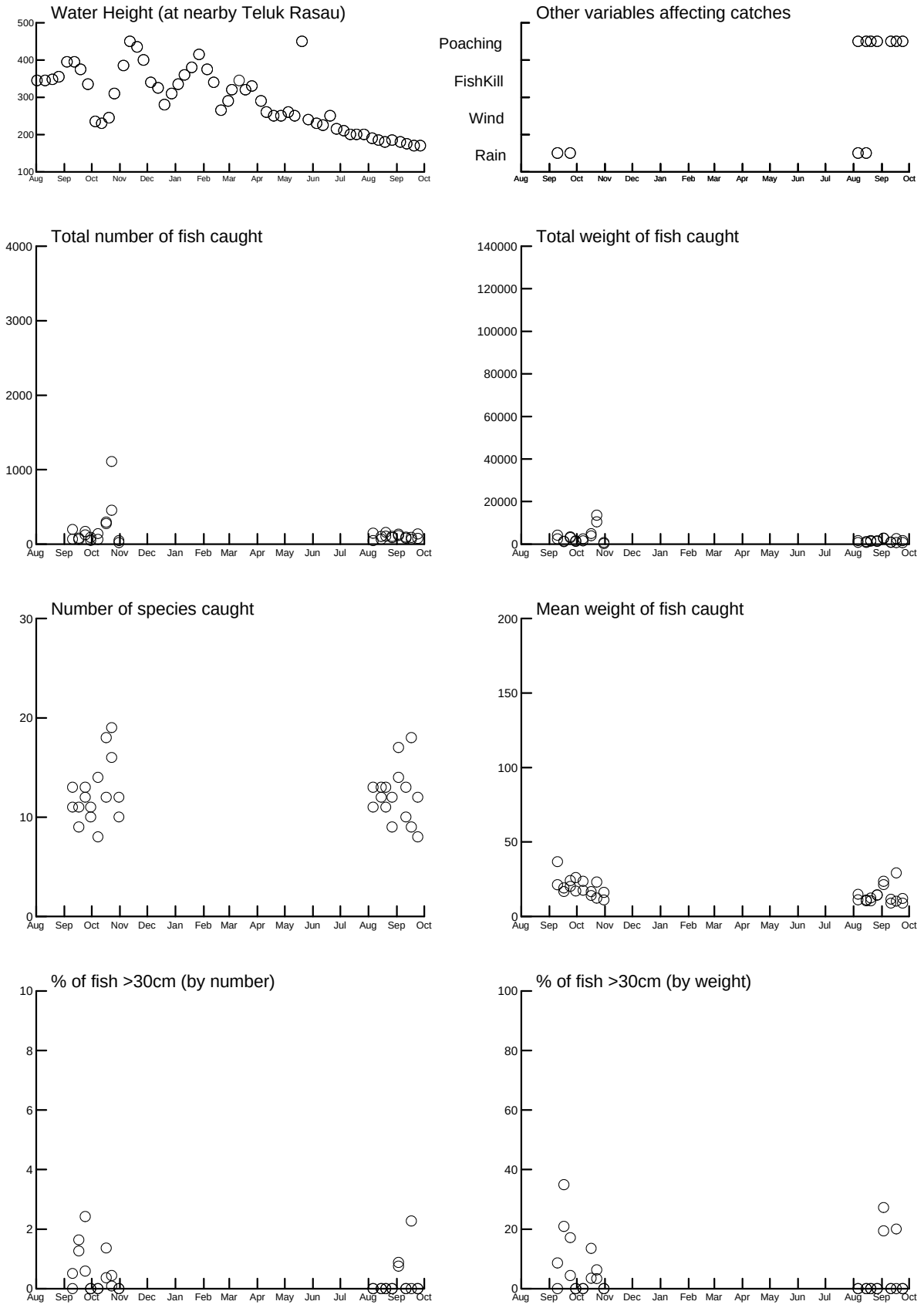

Figure 1i. Fish stock indices from gill net samples, and water heights and other variables potentially affecting catches, plotted against time, for **Teluk Toman** fished lake, near Pedamaran, South Sumatra.

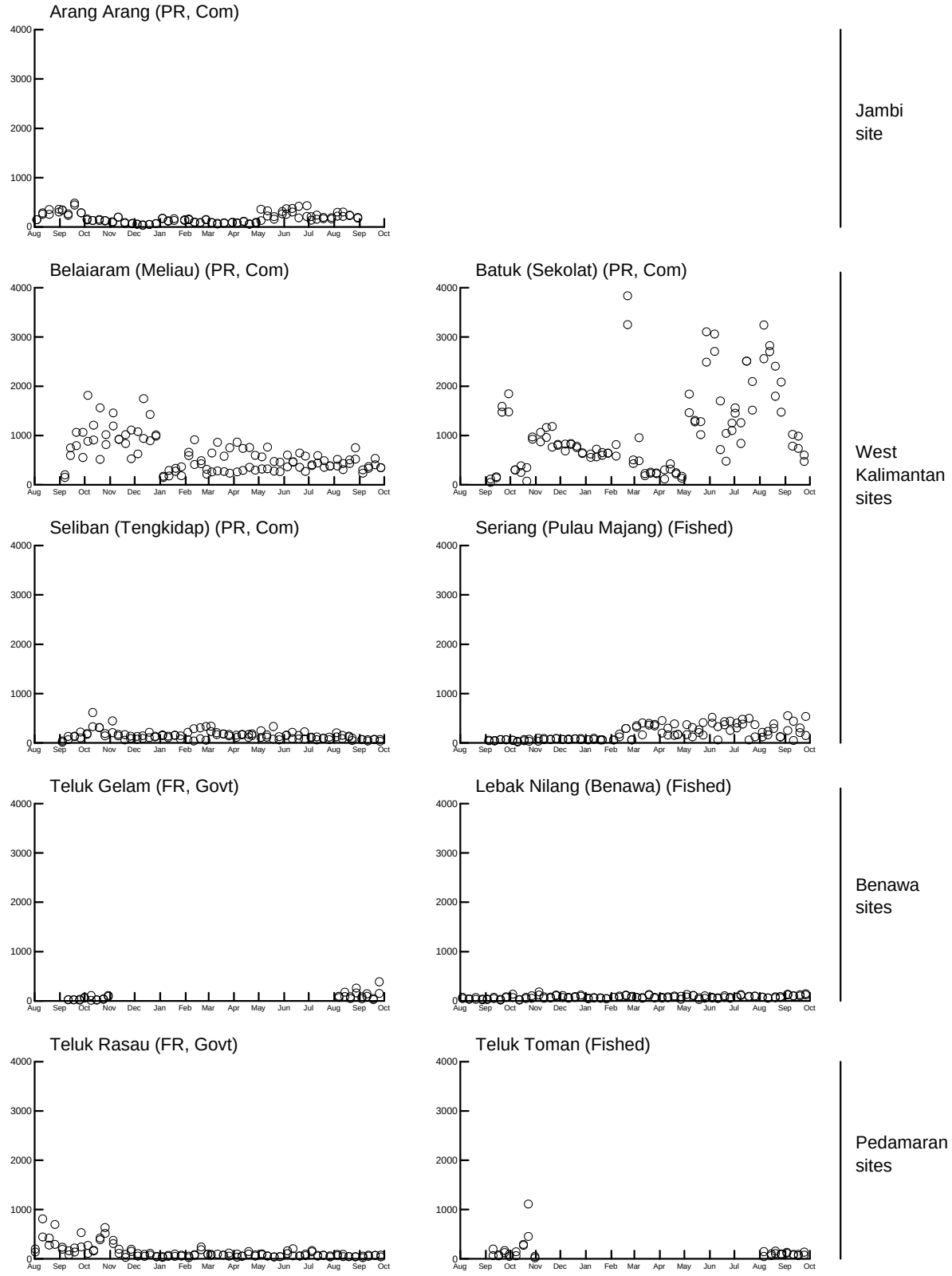

Figure 2a. Comparison of **total numbers of fish caught** per gill net sample, plotted against sample date, for each biological study site. PR = partial reserve, FR = full reserve, com = mainly community-managed, govt = mainly government-managed.

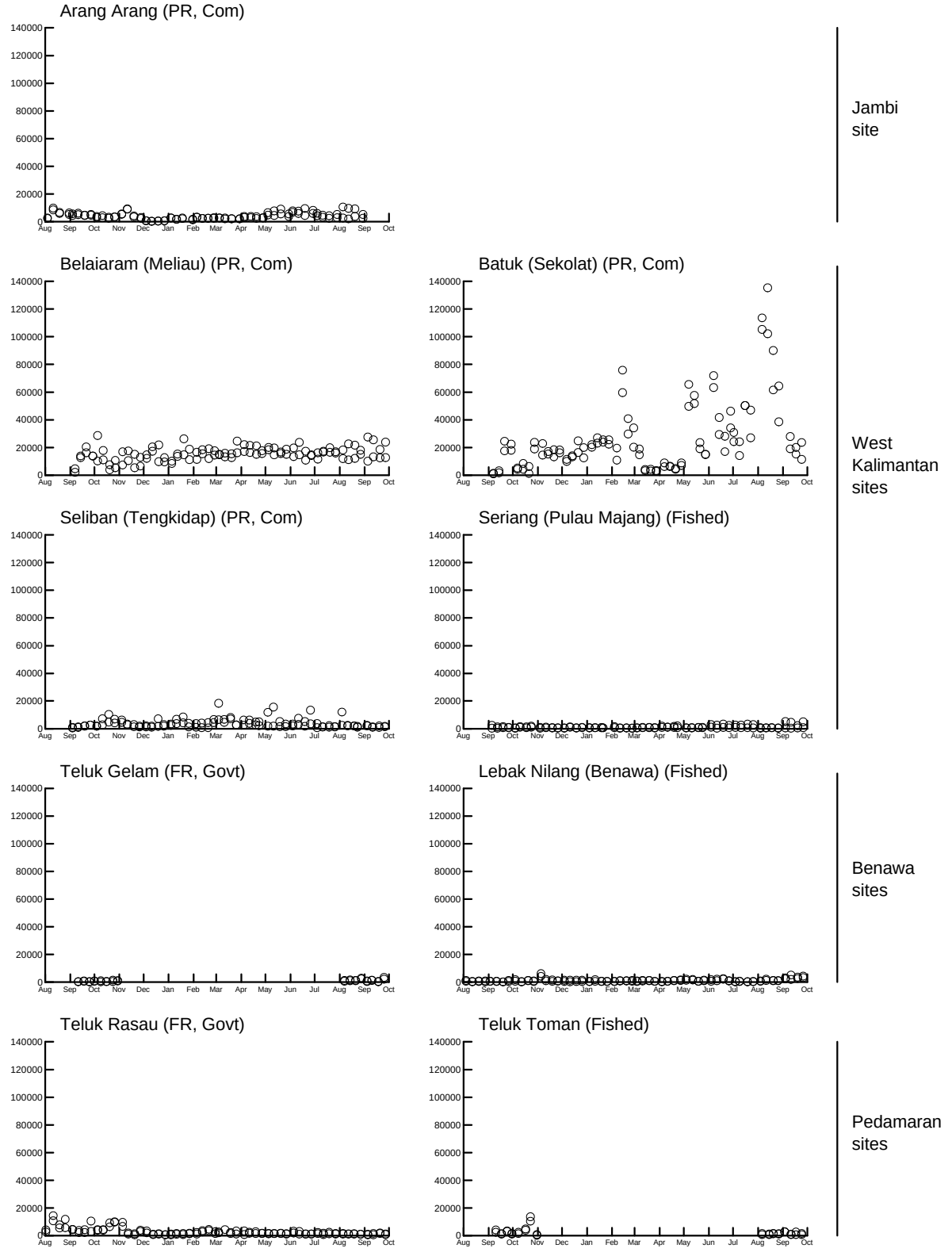

Figure 2b. Comparison of **total weight of fish caught** per gill net sample, plotted against sample date, for each biological study site. PR = partial reserve, FR = full reserve, com = mainly community-managed, govt = mainly government-managed.

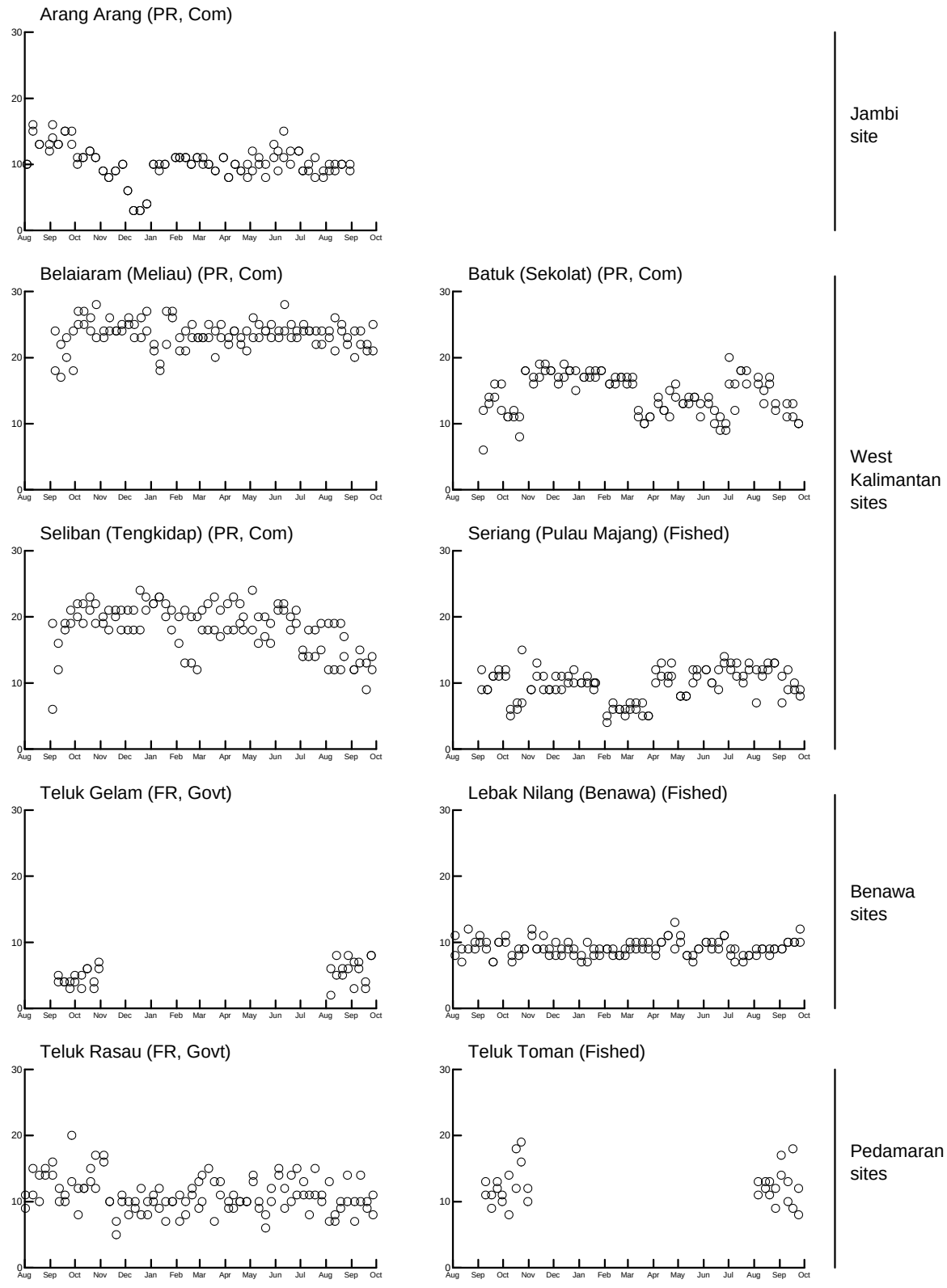

Figure 2c. Comparison of **number of fish species caught** per gill net sample, plotted against sample date, for each biological study site. PR = partial reserve, FR = full reserve, com = mainly community-managed, govt = mainly government-managed.

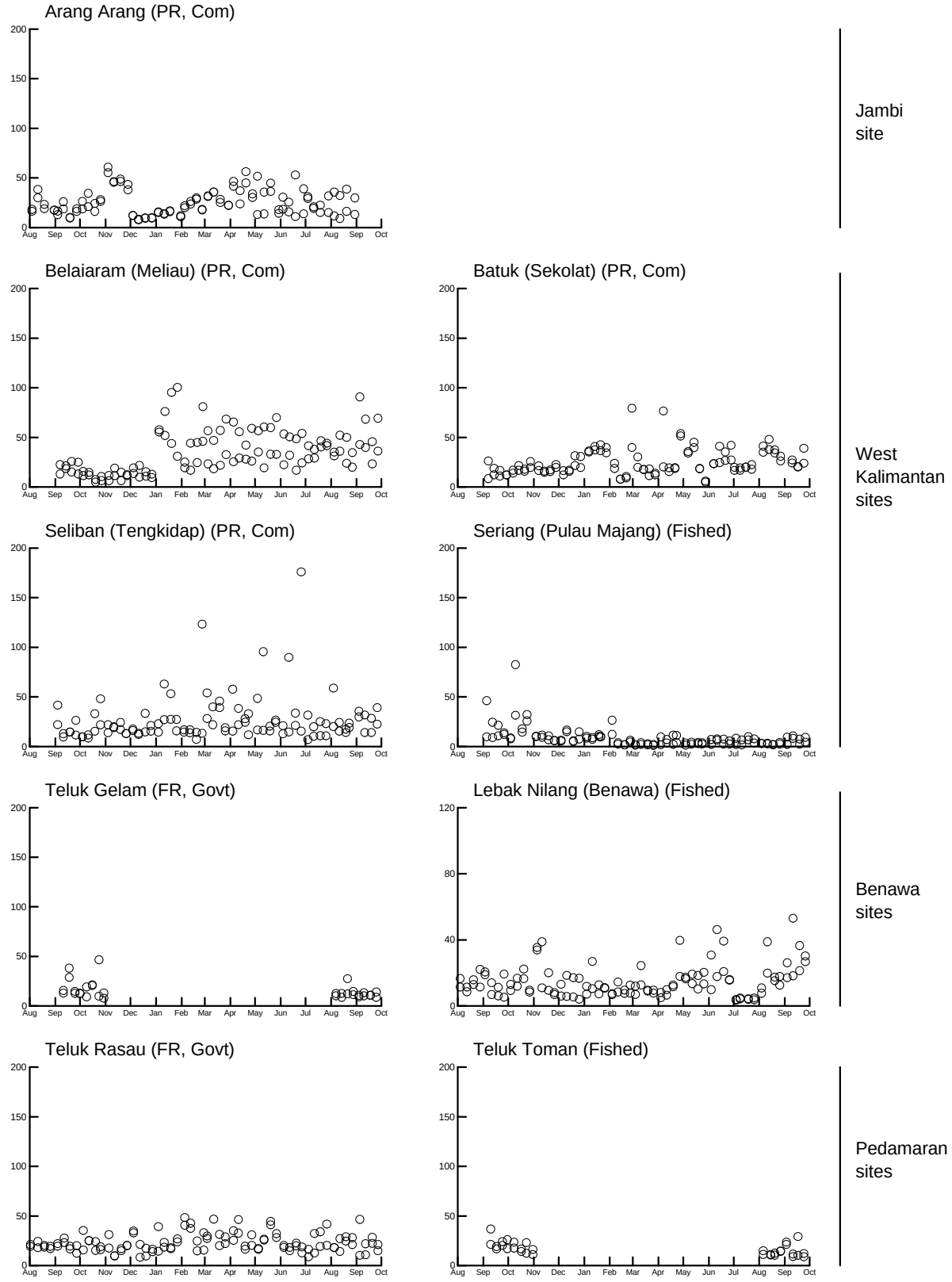

Figure 2d. Comparison of **mean weight of fish caught** per gill net sample, plotted against sample date, for each biological study site. PR = partial reserve, FR = full reserve, com = mainly community-managed, govt = mainly government-managed.

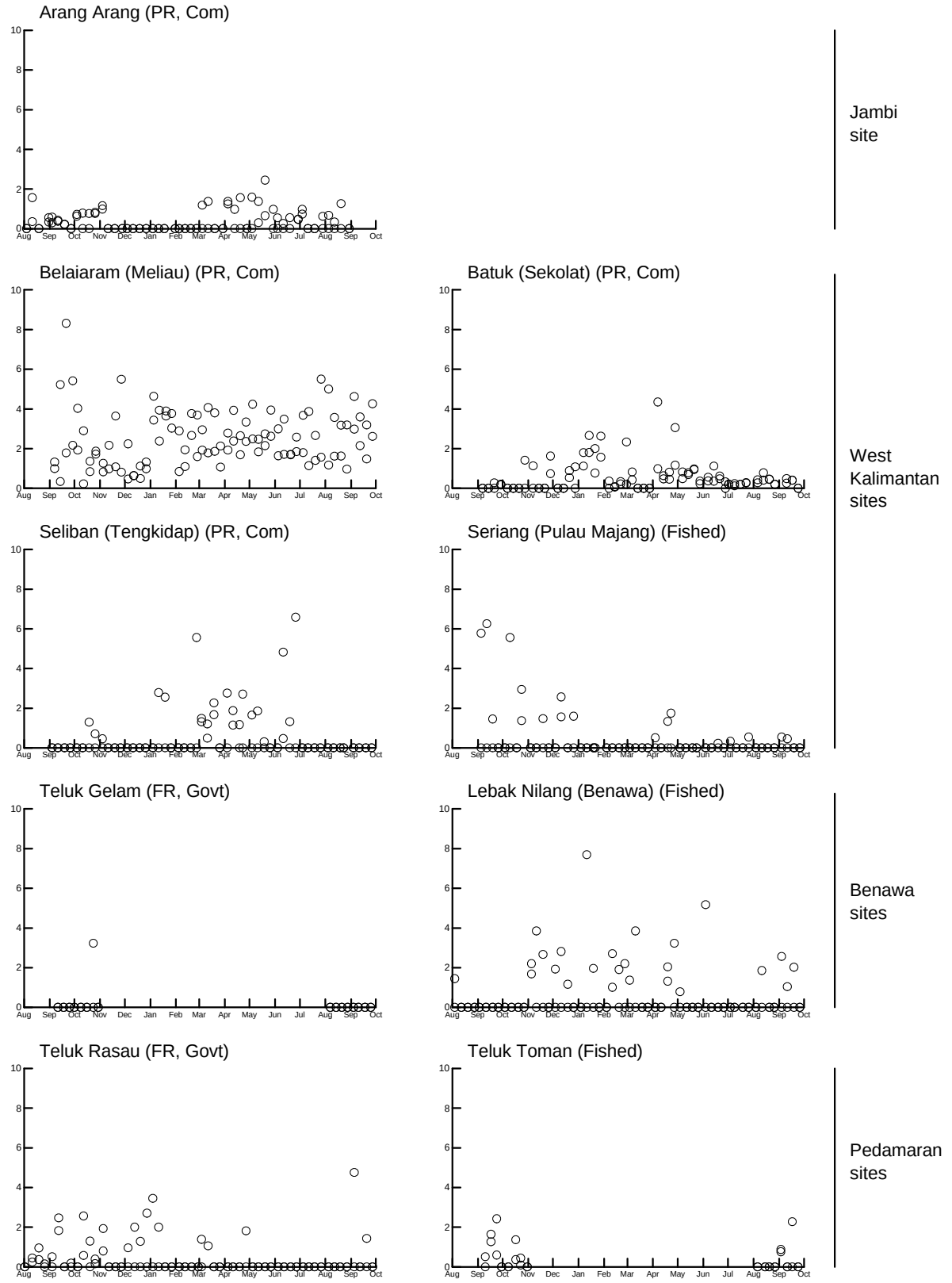

Figure 2e. Comparison of **percentage (by number) of fish > 30cm** in each gill net sample, plotted against sample date, for each biological study site. PR = partial reserve, FR = full reserve, com = mainly community-managed, govt = mainly government-managed.

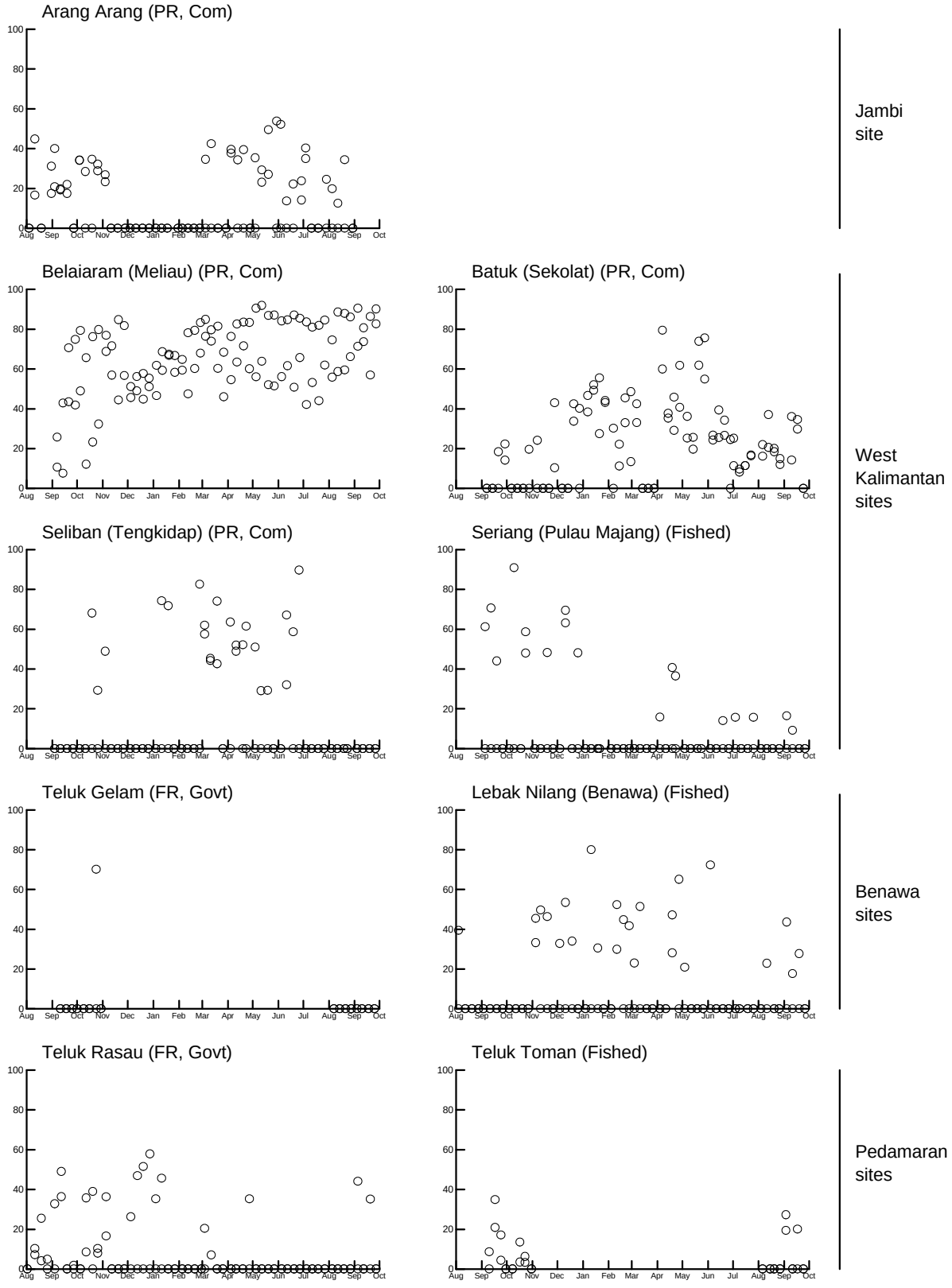

Figure 2f. Comparison of **percentage (by weight) of fish > 30cm** in each gill net sample, plotted against sample date, for each biological study site. PR = partial reserve, FR = full reserve, com = mainly community-managed, govt = mainly government-managed.

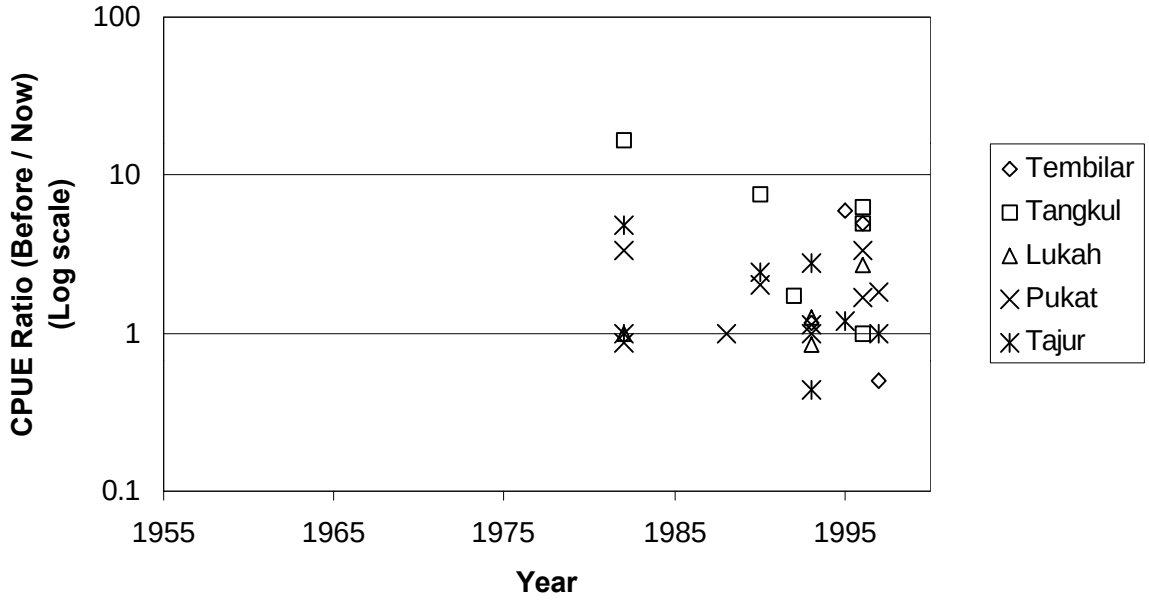

Figure 3a. Respondent's perceptions of historical catch rates (CPUE), relative to current rates, by gear type for Arang Arang village (Lake Arang Arang reserve), Jambi.

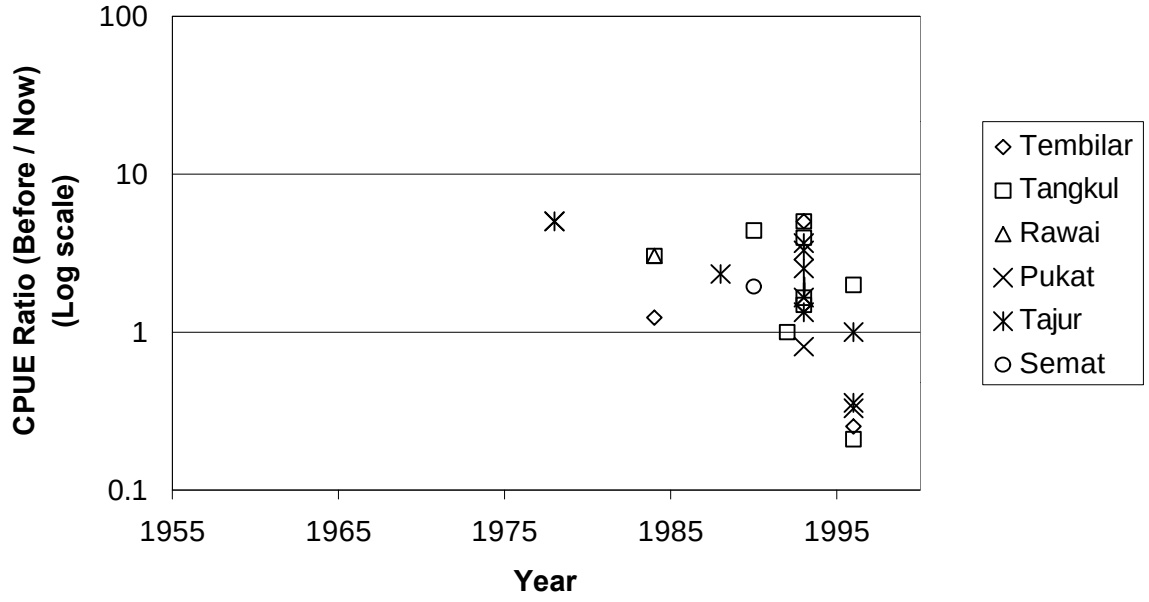

Figure 3b. Respondent's perceptions of historical catch rates (CPUE), relative to current rates, by gear type for Dano Lamo village (River Mahligai reserve), Jambi.

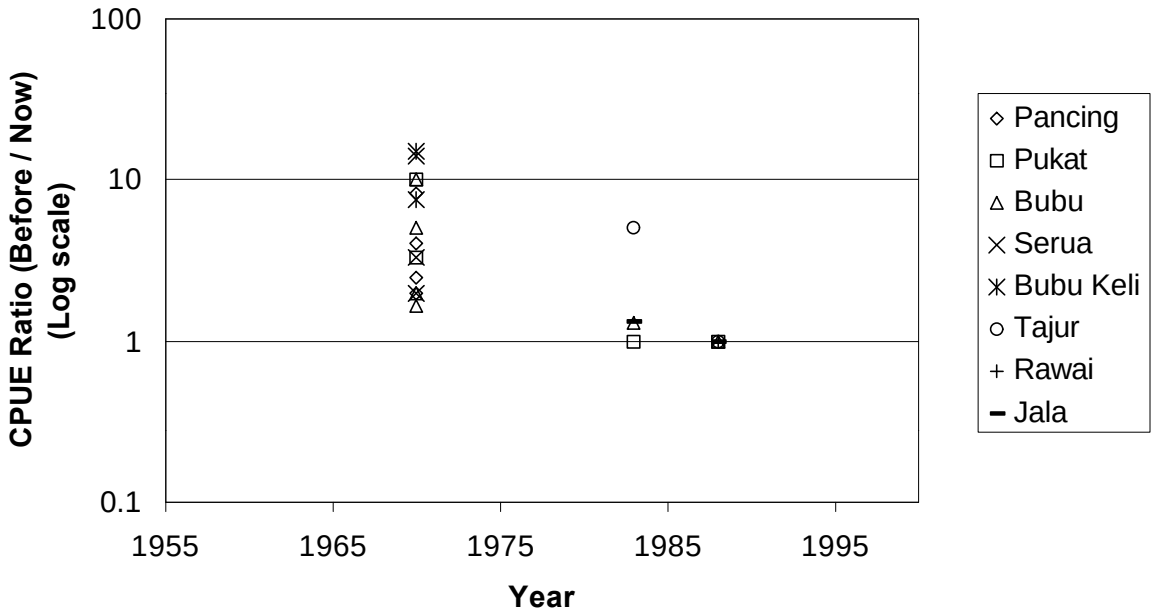

Figure 3c. Respondent's perceptions of historical catch rates (CPUE), relative to current rates, by gear type for Meliau village (Danau Balaiaram reserve), West Kalimantan.

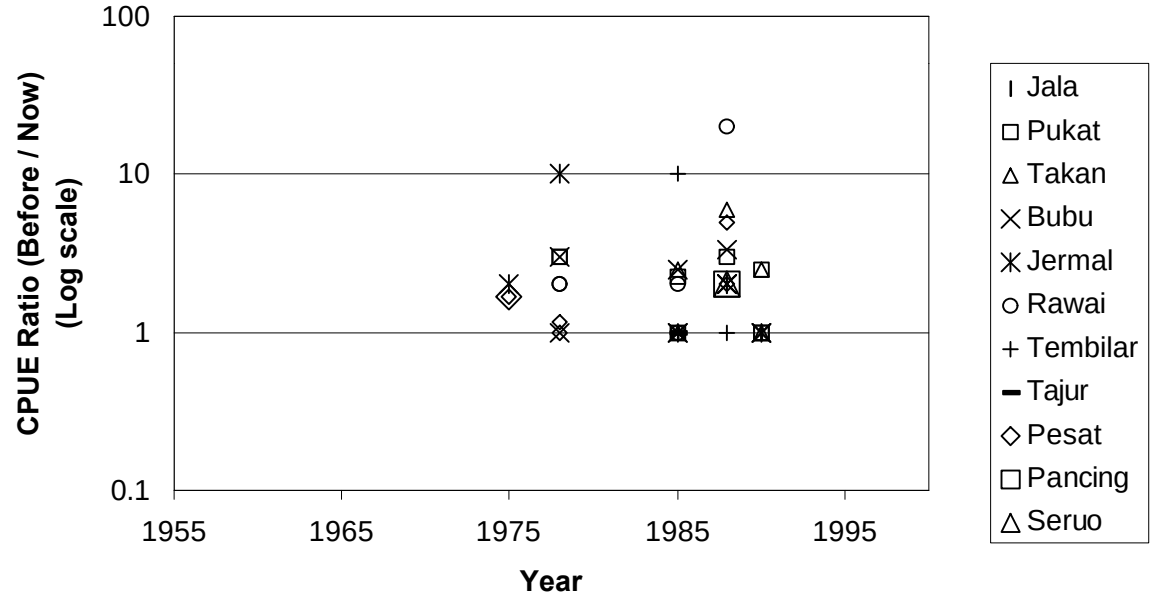

Figure 3d. Respondent's perceptions of historical catch rates (CPUE), relative to current rates, by gear type for Sekolat village (Danau Batuk reserve), West Kalimantan.

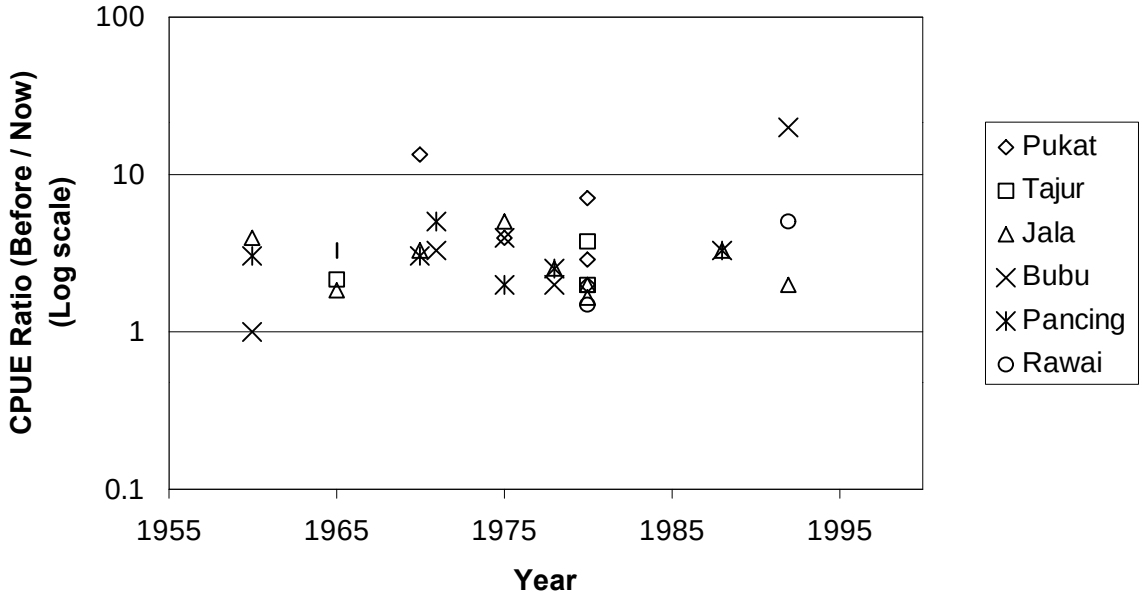

Figure 3e. Respondent's perceptions of historical catch rates (CPUE), relative to current rates, by gear type for Pulau Majang village (Seriang Lake, no reserve), West Kalimantan.

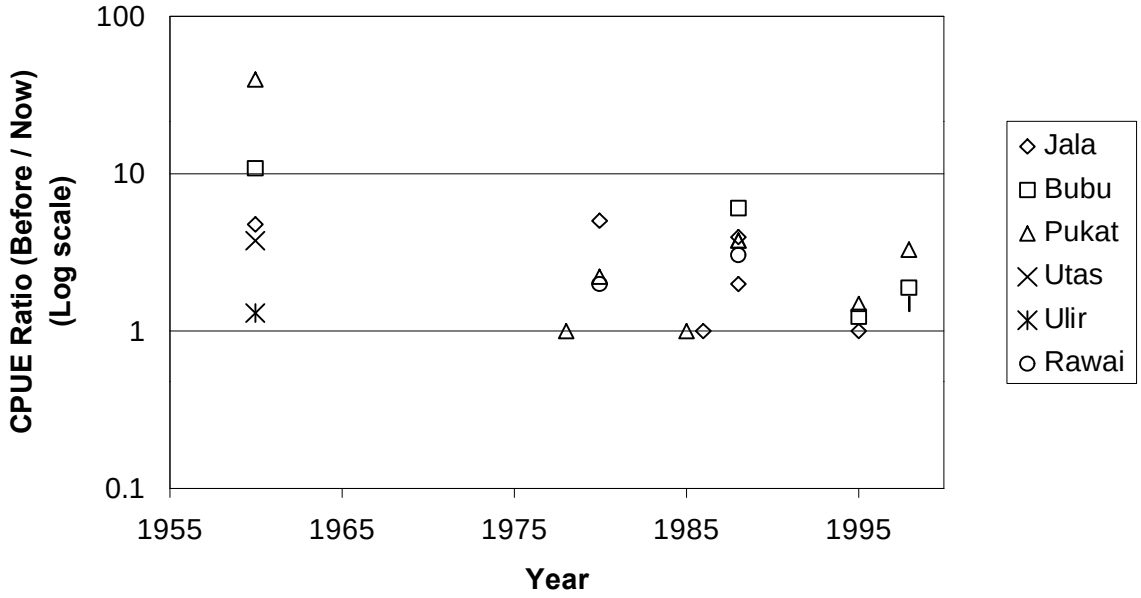

Figure 3f. Respondent's perceptions of historical catch rates (CPUE), relative to current rates, by gear type for Tengkidap village (Danau Seliban reserve), West Kalimantan.

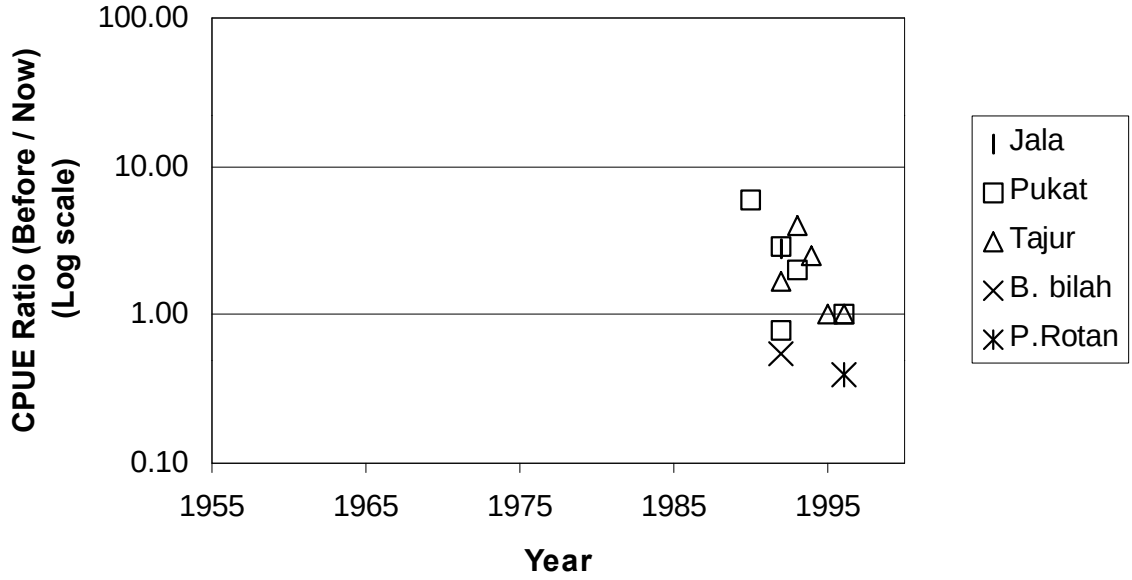

Figure 3g. Respondent's perceptions of historical catch rates (CPUE), relative to current rates, by gear type for Benawa village (Lebak Nilang fished waterbody), South Sumatra.

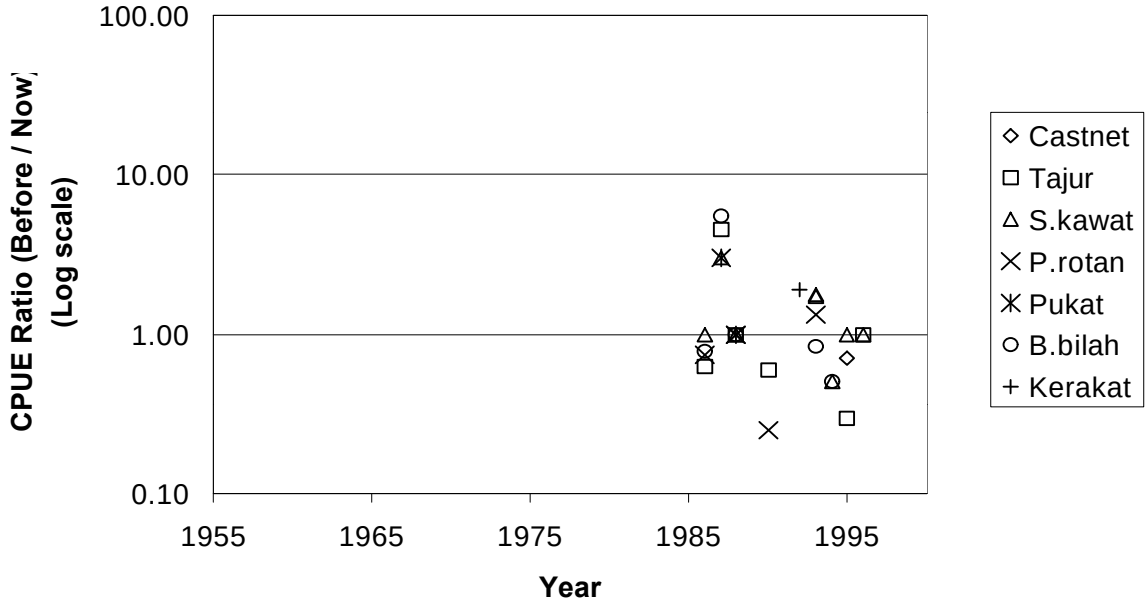

Figure 3h. Respondent's perceptions of historical catch rates (CPUE), relative to current rates, by gear type for Pedamaran / Lempuing villages, (Teluk Rasau reserve), South Sumatra.

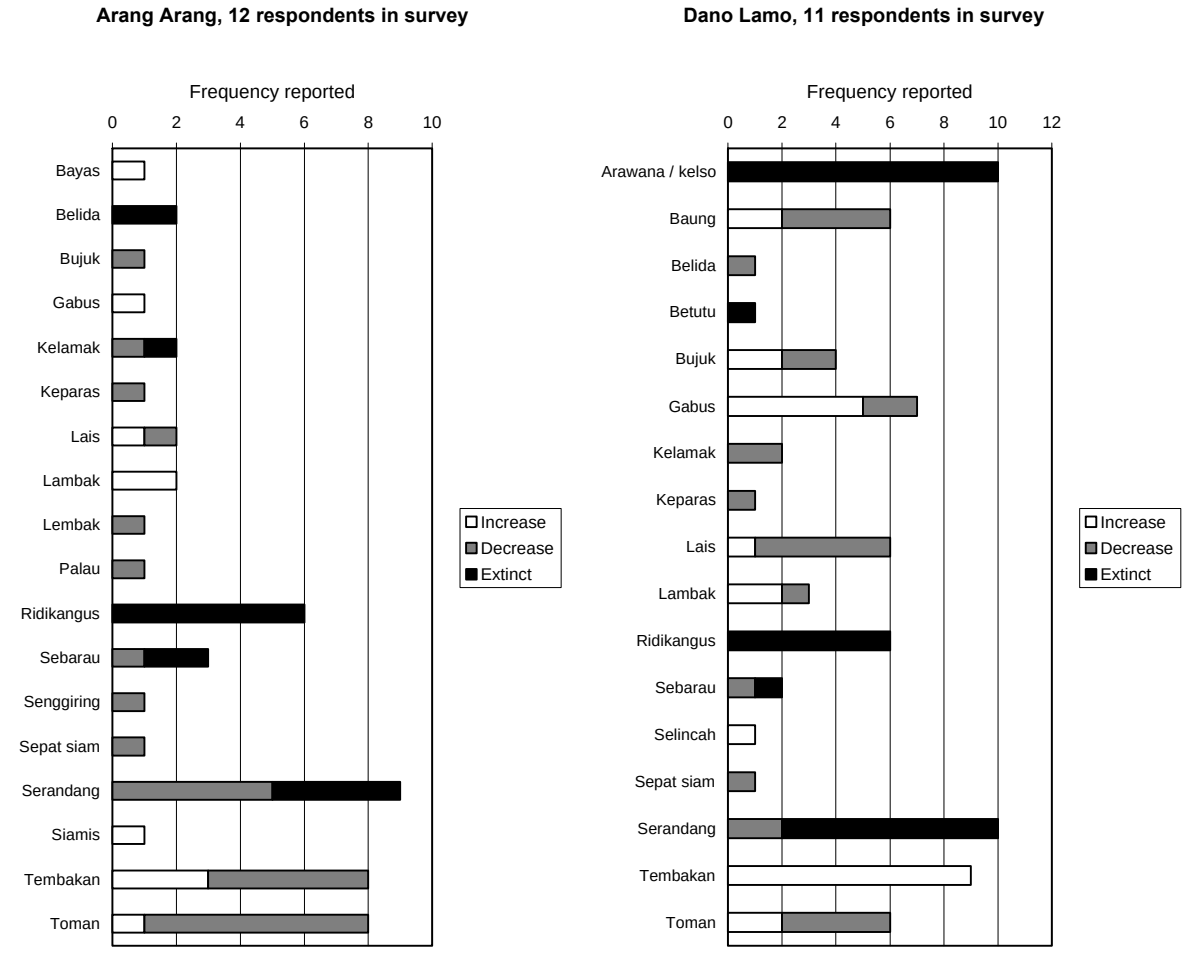

Figure 4a. Number of fishermen reporting each listed fish species as increased, decreased or extinct within their local fishery. The total number of respondents at each site is given at the top of each figure.

Jambi study sites Left: Arang Arang village (Lake Arang Arang reserve)
Right Dano Lamo village (River Mahligai reserve)

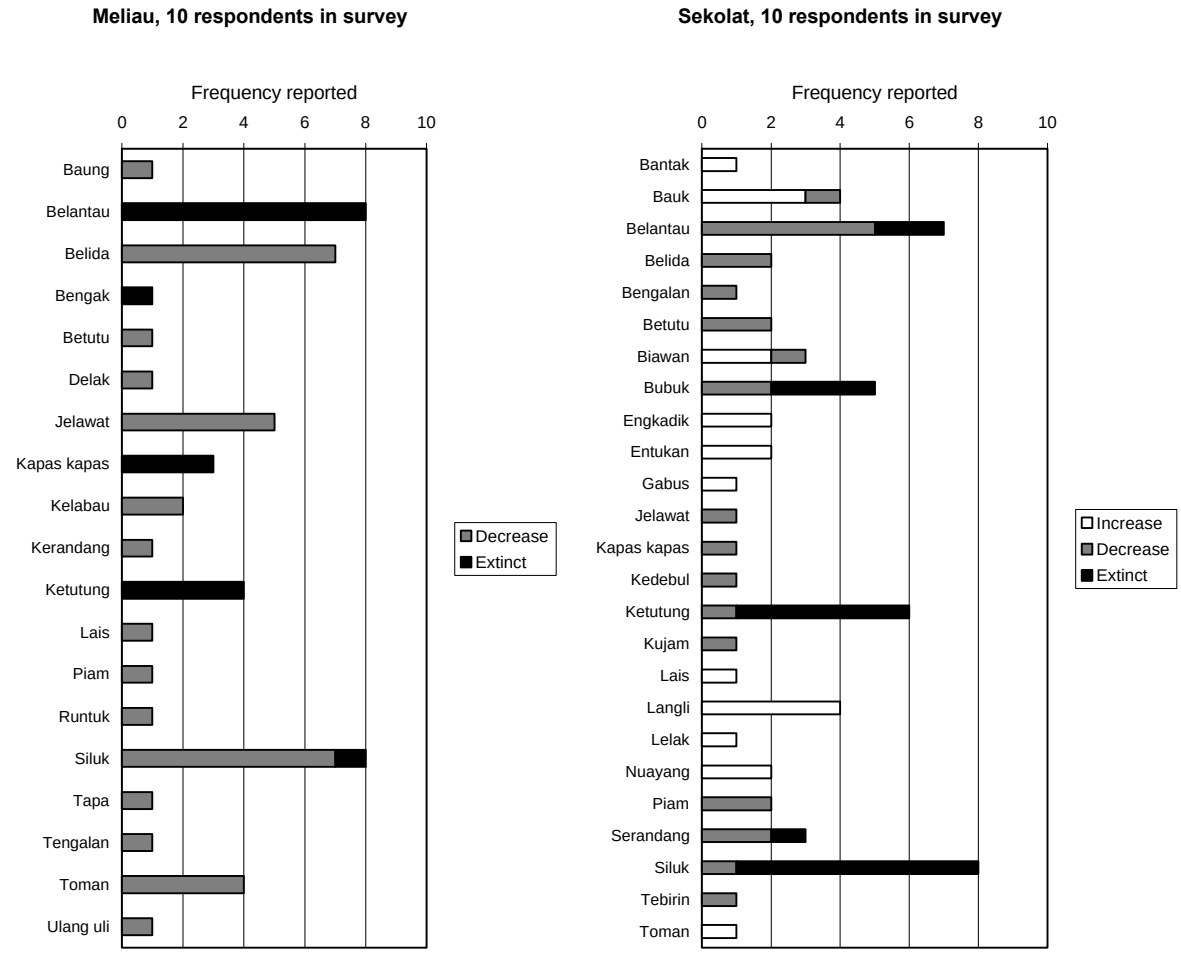

Figure 4b. Number of fishermen reporting each listed fish species as increased, decreased or extinct within their local fishery. The total number of respondents at each site is given at the top of each figure.

West Kalimantan sites: Left: Meliau village (Danau Balaiaram reserve)
Right: Sekolat village (Danau Batuk reserve)

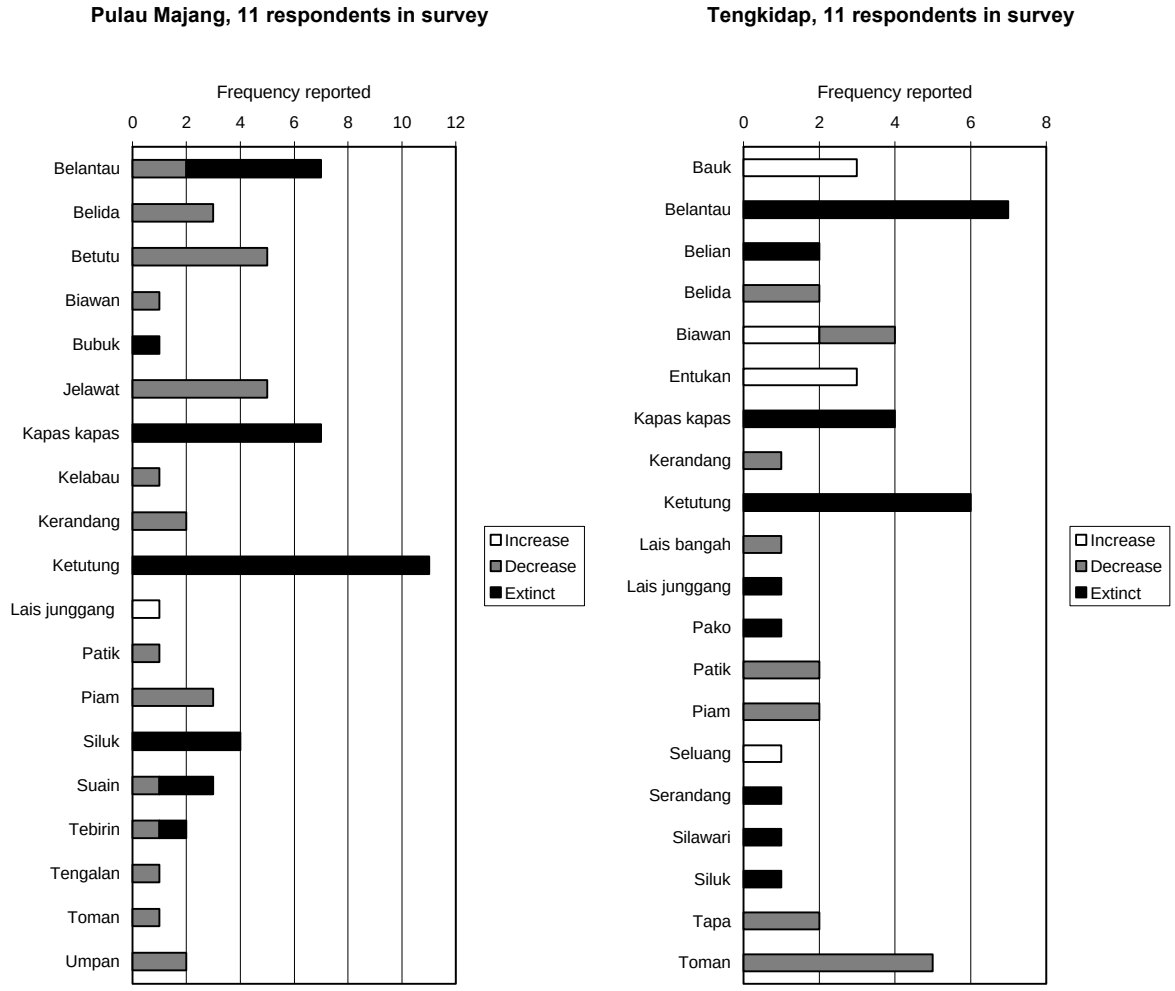

Figure 4c. Number of fishermen reporting each listed fish species as increased, decreased or extinct within their local fishery. The total number of respondents at each site is given at the top of each figure.

West Kalimantan sites: Left: Pulau Majang village (Seriang Lake, no reserve)
Right: Tengkidap village (Danau Seliban reserve)

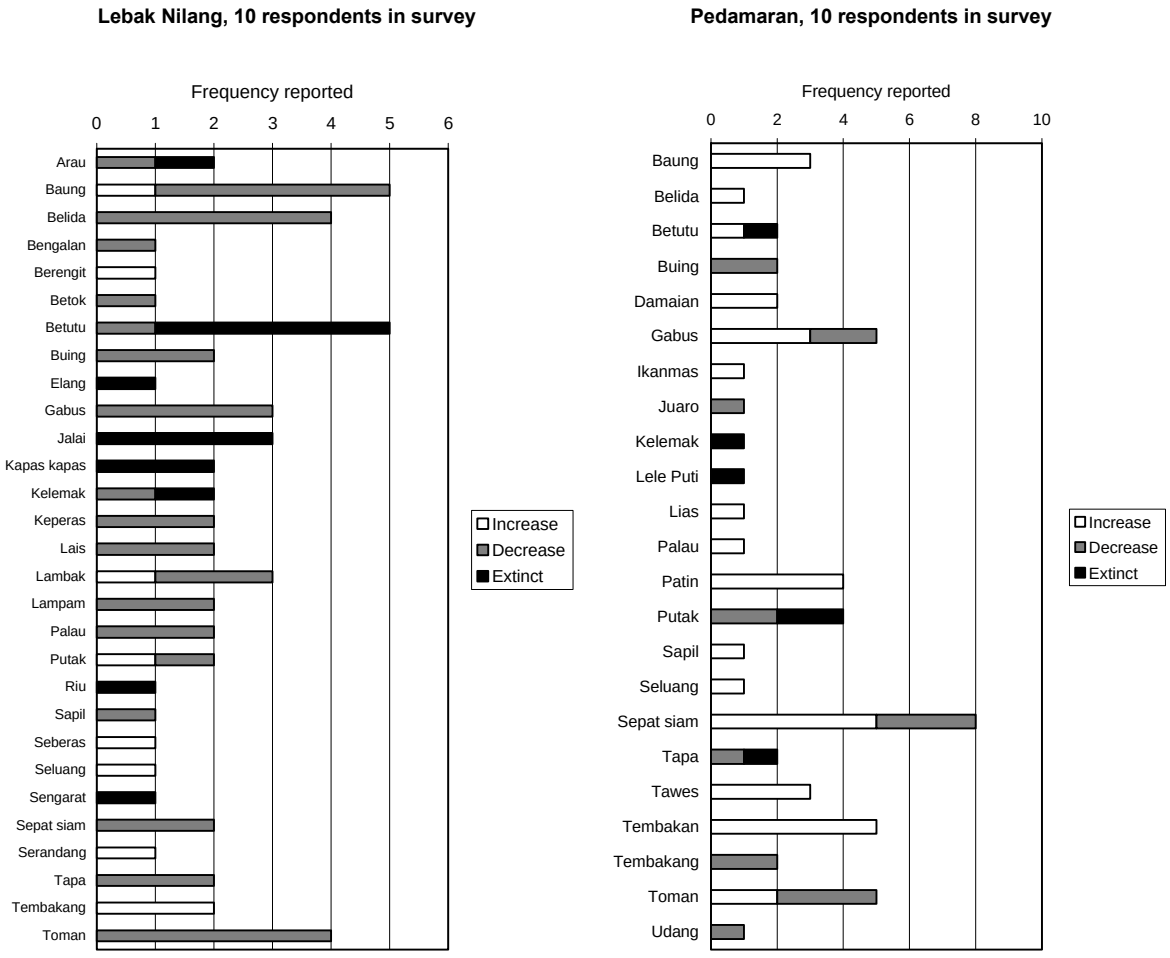

Figure 4d. Number of fishermen reporting each listed fish species as increased, decreased or extinct within their local fishery. The total number of respondents at each site is given at the top of each figure.

South Sumatra sites: Left: Benawa village (Lebak Nilang fished waterbody)
Right: Pedamaran / River Lempuing villages (Teluk Rasau reserve)