FIRDC 88/25 Parasites as Indicators of Orange Roughy Biology

Final Report to the Fishing Industry Research and Development Council

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ABSTRACT

The parasite fauna of 451 orange roughy collected from spawning aggregations in 1989 was compared to that of 548 orange roughy collected in the same areas outside spawning season. No significant differences were found, suggesting that spawning aggregations are composed mainly of fish recruited locally and not of those that have migrated from another area. As in a previous study (Lester et al, 1988), fish from different areas tended to have different parasite faunas. These differences were more marked in medium sized fish (30 – 37cm std. l.), than in large fish (38 – 45cm) suggesting that large fish are less sedentary than medium sized fish. Evidence is presented that some large fish from southern Tasmania move north to join the St Helen's winter aggregation.

INTRODUCTION

Large catches of orange roughy, *Hoplostethus atlanticus*, have been taken when the fish aggregate. This project aimed to determine whether fish in aggregations were drawn from fish in the immediate area or whether they had migrated in from other areas.

An earlier study (Lester, Sewell, Barnes and Evans, 1988) has shown that orange roughy from different areas can be descriminated by their parasite faunas. We therefore looked at the parasite faunas to see if parasite faunas of roughy in spawning aggregations are different from fish caught in the same area outside the spawning season.

METHODS

Samples of approximately 20 small (20 to 29cm standard length), 20 medium (30 to 37cm) and 20 large (38 to 45cm) orange roughy were sought from winter aggregations (June to August inclusive), and from the same areas in the summer (December to February inclusive). The viscera from each fish was frozen with a label giving the length and haul number. Frozen viscera were thawed and examined for parasites. Other details are as in Lester et al, 1988.

In three areas we had good samples of fish taken from aggregations in the spawning season, and fish from the same area outside the spawning season. These were areas 4, 5 and 7. We also examined samples from a further 10 sites (Figure 1).

Parasites counted for the analysis were *Anisakis* type 1, *Anisakis* type 2, *Anisakis* type 3, degenerate *Anisakis* and *Callitetrarhynchus* sp..

Fish length was expressed as standard length (StdL). Comparisons with earlier data which used length to caudal fork (LCF) were facilitated using the formula LCF = (SL x 1.10) + 0.195 (Sewell and Lester, 1988).

Data were analysed using simple statistics and by multivariate analysis. Numbers of parasites were transformed using $\text{Log}_e(x+1)$ and adjusted to a standardized length using regression (Lester et al, 1988).

The larval nematode *Terranova* sp. used by Lester et al, 1988 was not used in the study, because its abundance and small size made it difficult to count. Tests showed

that the different dissectors made different estimates of its abundance in the same fish.

Samples taken in 1988 from Tasmania in 1988 (areas 4, 5, 7 and 14; 561 fish) had to be discarded because the proportion of viscera collected had varied with the collector.

RESULTS

Small fish had relatively low numbers of parasites (Table 2). There was little discrimination of season or area (Fig. 2). Area 4 winter and area 4 summer were close to each other and to area 5 summer and winter which also show a high degree of overlap. The other areas sampled are all grouped on the left of the figure, indicating no significant difference in the parasite faunas except for area 7 both samples of which are pulled to the right. The third axis pulled area 7 further away from areas 4 and 5 that remained close together.

The medium fish had more parasites than the small fish (Table 3), and differences in parasite fauna between areas were more easily detected (Fig. 3). Nevertheless, areas 4 and 5, winter and summer samples showed strong overlap and were not significantly different from each other at the 95% level of confidence. The winter and summer samples taken from area 7 also carried parasite faunas that were not significantly different. These results suggest that the same subpopulations of fish were sampled in both seasons. The third axis did little to change the situation.

In the large fish, discrimination is less marked (Fig. 4). The paired samples 4 winter and 4 summer, 5 winter and 5 summer, and 7 summer and 7 winter overlap with each other indicating that the parasite faunas in fish from the same areas at different. These results suggest that the same areas at different seasons are not significantly different. The third axis involvement did little to discriminate the areas further. An unexpected finding, however, is that area 7 fish in aggregations (7 winter) show some similarities to area 19 Pedra Branka and areas 4 and 5 (west Tasmania).

As a final step in the analysis, the data were grouped into years to compare areas and to compare them to data collected in an earlier study (Lester et al, 1988). Again, the parasite fauna of the small fish poorly discriminated areas (Fig. 5). There was no statistical difference between samples for the two studies.

The fauna of medium fish gave a much better correlation with area (Fig. 6). The earlier area 7 fell close to our area 7 samples, and the same occurred for areas 4 and 5, showing that the characteristic faunas had not changed in the 3 to 5 years between the two studies. These areas fell to the side of areas 3, 12, 13 and 17, which stretch up the mainland coast from King Island to Robe. Between areas 7 and 4/5 lie the Maatsuyker and Pedra Branka samples 18 and 19, and southwest Tasmania (sample 14). Thus the graph reveals a remarkable correlation between the parasite fauna and the physical positions of the sampling areas. The only area that does not conform is area 16 (Kangaroo Island). Its similarity to St Helen's fish (area 7) presumably reflects a similarity in the host fauna in those two widely spaced localities.

The clear geographical relationships evident in the medium fish are somewhat obscured in the large fish (Fig. 7). Nevertheless the paired samples from areas 4, 5 and 7 fall close to each other within the limits of our data. The only pair not closely associated is that from area 6 which in the present sample is from the Cascade Plateau and in the earlier sample consisted of a mixture of Cascade Plateau and Tasman Rise fish.

DISCUSSION

Lester et al. (1988) showed that the parasite faunas of orange roughy from different areas differed, suggesting a sedentary life style on the part of the fish. In general we support that finding and show that the parasite fauna of several areas has remained stable over a four year period. In their paper, area differences were more marked in medium and large fish than in small fish. This is apparently because medium and large fish had more parasites; hence each fish carried more information about its past environment and thus provided more data to discriminate areas. Here we show that the fauna of large fish is less area related that that of medium fish, and conclude that large roughy move about more than medium roughy.

In our comparison of aggregated versus non-aggregated fish we found that the parasite faunas of the two groups were generally indistinguishable, suggesting that aggregations are drawn largely from fish in the immediate locality. However, in one area, area 7, aggregations contained a component of large fish that showed similarities to areas further south. This is consistent with some large fish having moved up the east coast of Tasmania. An indication that this may occur was present

parasites in Australian and New Zealand samples of orange roughy *Hoplostethus atlanticus*, 1983 to 86.' *Tech. Rep. Dep. Sea Fish., Tasm.* 26:1 – 38.

Smith, P.J. (1986) `Genetic similarity between samples of the orange roughy *Hoplostethus atlanticus* from the Tasman Sea, South – west Pacific Ocean and North – east Atlantic Ocean.' *Mar. Biol.* 91: 173 – 180.

in Lester et al. (1988) as they found that fish from area 7 were distinct from other areas at the 99% level of confidence for the medium fish but only at 95% level for the large fish. Their multivariate analysis was not subdivided by season.

Allozyme studies by Smith (1986) and Elliot and Ward (1991) suggest that orange roughy around Australia all belong to the same gene pool. We have shown that medium fish are relatively sedentary and few move to spawning aggregations in other areas. The necessary mixing to explain the observed genetic similarities could arise in two ways: either the pelagic period of the eggs and larvae is sufficiently long to enable the products from different spawning locations to mix; or some large fish, which we have shown move more than the medium fish, move between spawning aggregations, and it is these very large and (possibly very old fish) that confuse any genetic differences that start to emerge. As there is no evidence at the moment for the first hypothesis, and as we have given evidence for the second, perhaps the second should be favoured until more data is available.

As our findings show that roughy are relatively sedentary the current management strategy of management by area of known spawning aggregation appears to be the most appropriate at the moment.

ACKNOWLEDGEMENTS

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REFERENCES

Elliott, N.G. and R.D. Ward (1991) ` Australian Orange Roughy Fishery – One or More Stocks?' Abstracts AMSA Conference, Brisbane 1991.

Lester, R.J.G., Sewell, K.B., Barnes, A. and Evans, K. (1988) `Stock discrimination of orange roughy, *Hoplostethus atlanticus*, by parasite analysis.' *Mar. Biol.* 99: 137 – 143.

Sewell, K.B. and Lester, R.J.G. (1988) ` The numbers of selected

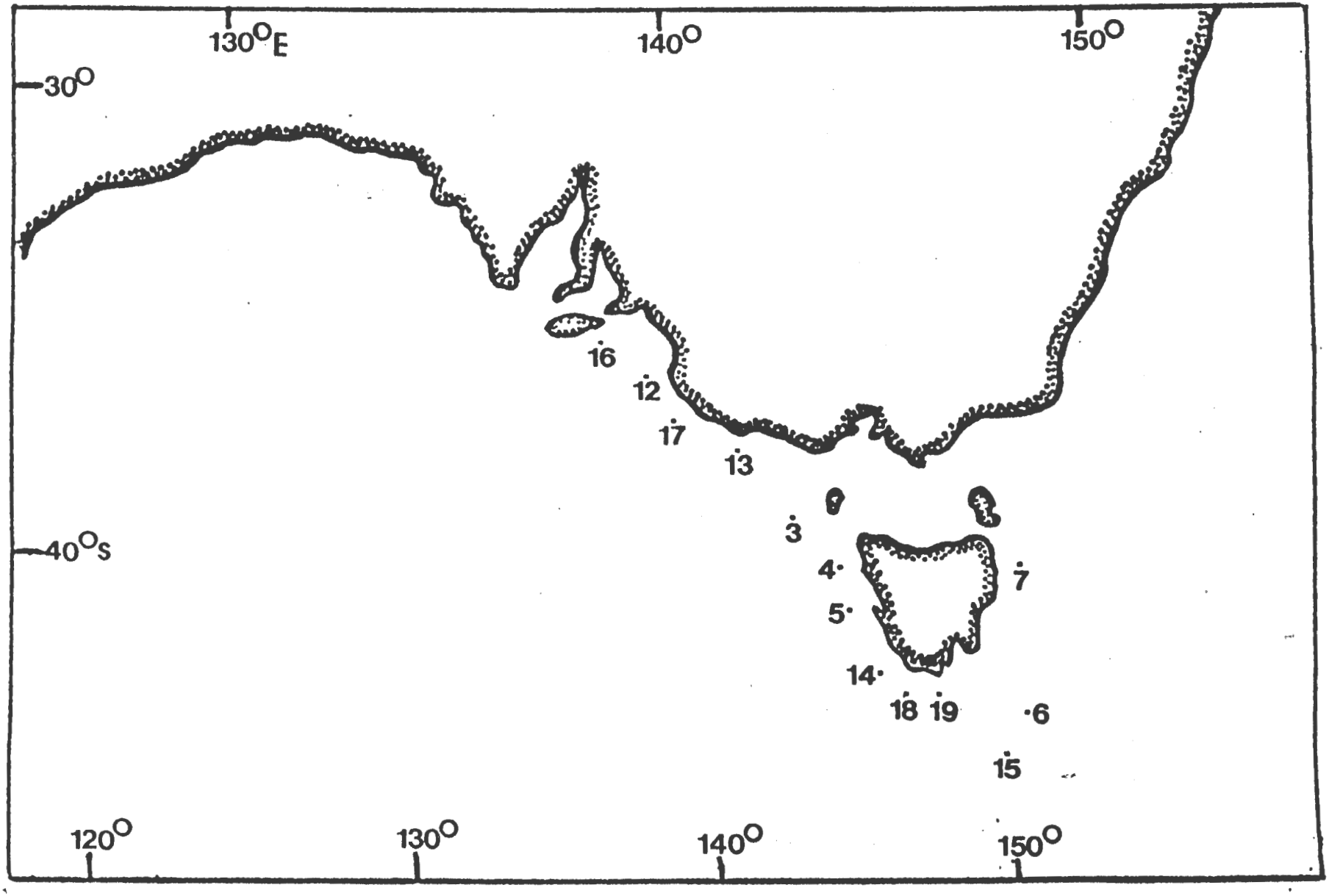

Figure 1. Origins of samples of Orange Roughy from southern Australia in 1988, 1989 and 1990.

TABLE 1. Numbers of Orange Roughy taken from 13 areas in southern Australia in 1989 and 1990 for parasite analysis.

AREA	Size Classes (cm) 20-29		30-37		38-45		>45	
	'89	'90	'89	'90	'89	'90	'89	'90
4 NW Tas.	43	0	49	0	53	0	0	0
5 W Tas.	50	0	54	0	13	0	0	0
6 Cascade P.	0	8	0	2	1	33	7	10
7 St Helens	68	0	157	36	107	27	1	1
12 Robe	18	0	12	0	9	0	0	0
13 Portland	0	0	0	0	0	0	0	0
14 SW Tas.	9	0	42	0	16	0	0	0
15 Tas. Rise	0	20	0	0	0	0	0	0
16 Kang. Is.	0	0	0	0	0	0	0	0
17 SW Vic.	0	0	0	0	0	0	0	0
18 Maats.	0	0	0	49	0	44	0	0
19 Pedra B.	0	2	0	97	0	71	0	0
Total	188	30	363	184	189	175	8	11

TABLE 2. Average numbers of selected parasites in orange roughy from three areas both during the spawning season and outside the spawning season (untransformed data).

Parasite	Area 4		Area 5		Area 7	
	Sp	Non	Sp	Non	Sp	Non
Small fish						
Anisakis 1	2.1	2.1	2.1	5.4	2.7	4.4
Anisakis 2	0.6	0.4	0.4	0.3	0.7	1.38
Anisakis 3	0	0.1	0	0.2	0.2	0.88
Degen Anis	0.04	0.06	0	0	0.2	0.7
Callit	0.08	0	0.05	0	0.03	0.04
Total fish	25	29	19	41	66	50
Medium fish						
Anisakis 1	16.4	19.7	27.4	13.1	10.8	20.4
Anisakis 2	1.1	1.6	0.65	1.1	2.0	3.8
Anisakis 3	0.86	1.4	3.5	0.9	2.5	3.8
Degen Anis	0.92	1.9	0.8	1.1	2.3	3.5
Callit	0	0.1	0	0.1	0.1	0.1
Total fish	155	108	49	52	17	58
Large fish						
Anis 1	37.8	33.8	22.3	37.4	40.0	25.6
Anis 2	1.5	2.5	0.67	2.0	3.8	4.5
Anis 3	2.4	3.1	0	3.1	5.0	4.5
Degen Anis	5.9	7.6	0	7.7	10.0	10.0
Callit	0.1	0.1	0	0.2	0.3	0.3
Total fish	30	58	3	25	87	127

Figures 2-4. Results of multivariate analysis on small, medium and large fish from southern Australia using five parasites in 1989/90. Confidence rings of 95% are given for areas 4, 5 and 7. . = non-spawning samples; o = spawning samples. Fig. 2 small; Fig. 3 medium; Fig. 4 large.

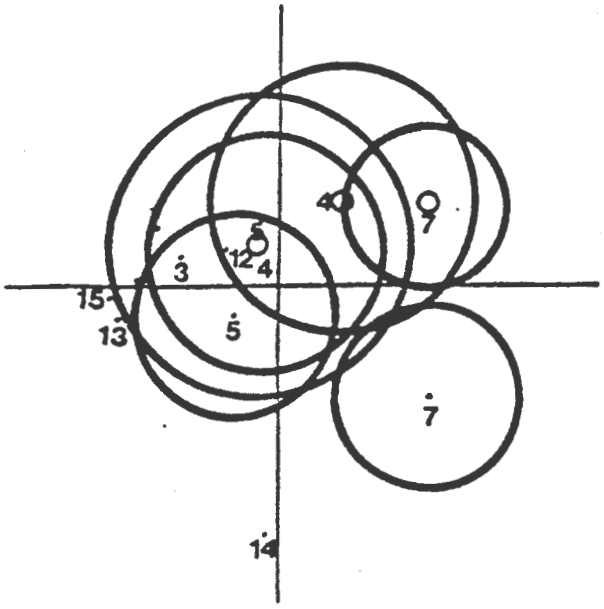

Fig. 2 small

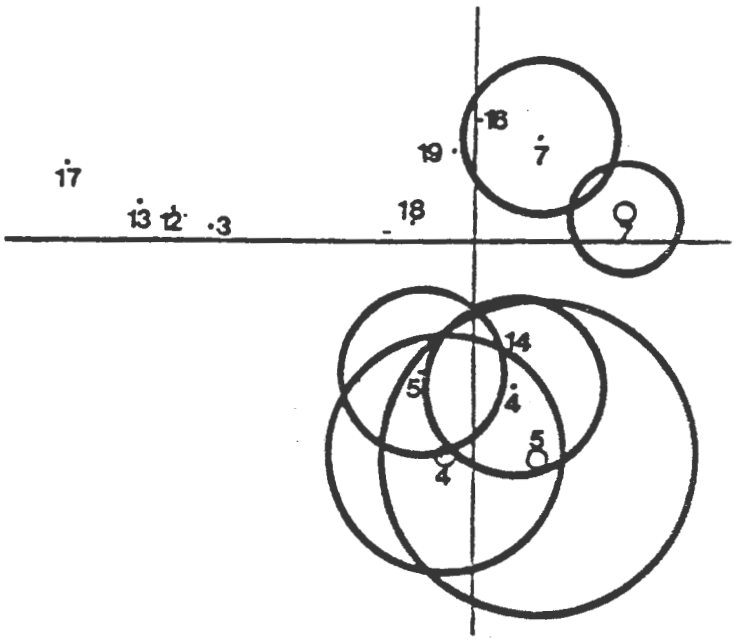

Fig. 3 medium

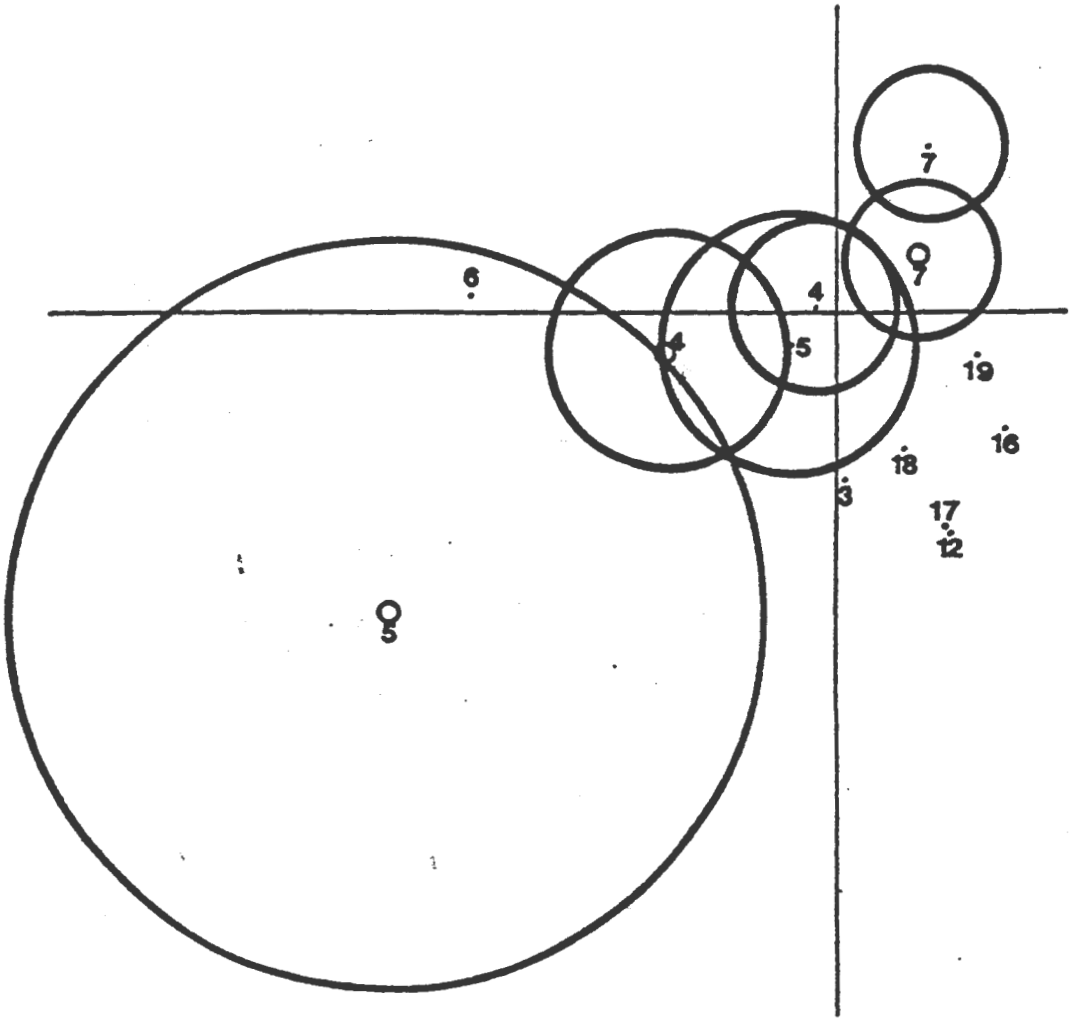

Fig. 4 large

Figures 5-7. Results of multivariate analysis on small, medium and large fish from the previous and present studies, all seasons combined. Confidence rings of 95% are given for areas 4, 5 and 7.
. = 1989/90; o = 1983/85.
Fig. 5 small; Fig. 6 medium; Fig. 7 large.

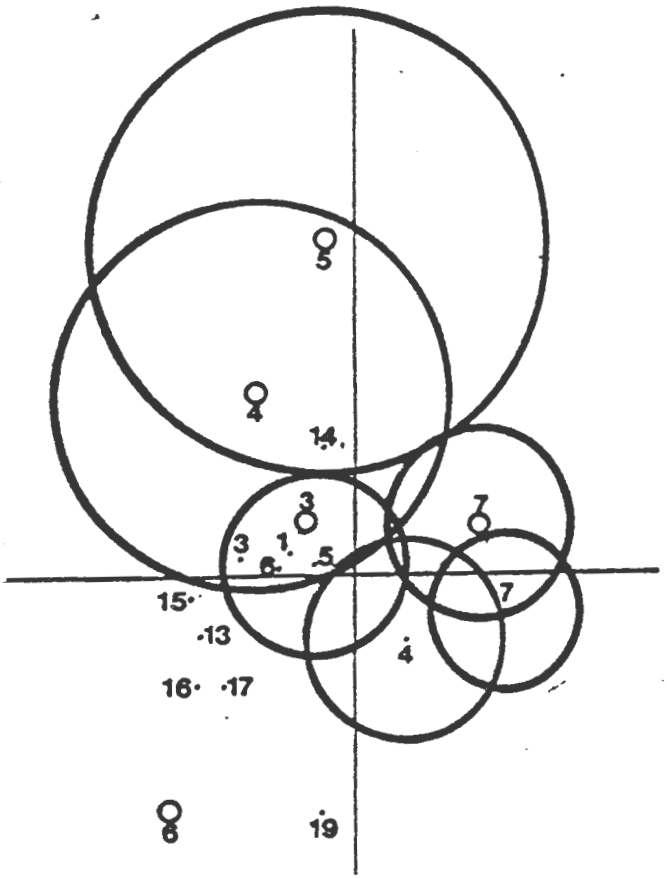

Fig. 5 small

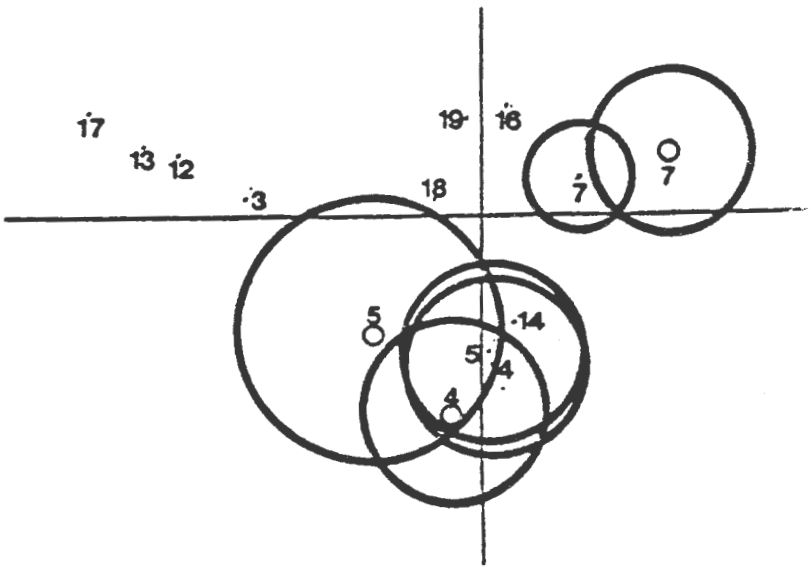

Fig. 6 medium

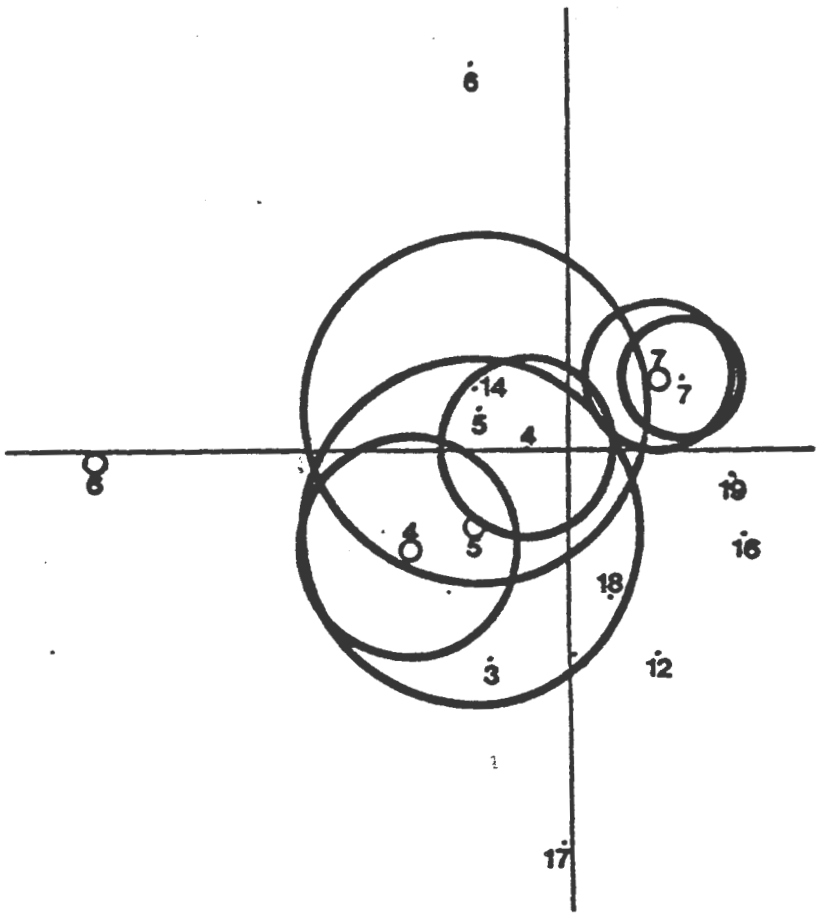

Fig. 7 large