FAD RESEARCH PROJECT: FINAL RESULTS FROM COMMUNITY SURVEYS, GENDER ASSESSMENT, AND CATCH AND EFFORT DATA ANALYSIS

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Introduction

The three-year SPC fish aggregating device (FAD) research project ran from mid-2001 to mid-2004, with a six-month extension until the end of 2004. The project was funded through the New Zealand Pacific Initiative for the Environment (PIE), and was implemented in Niue, and Rarotonga and Aitutaki in the Cook Islands.

In the last issue of *Fisheries Newsletter* (#112), the objectives and outputs of the project were presented along with final project activity results, with respect to FAD designs, aggregator designs and FAD costings. This second article summarises the final results of the project in regards to community surveys, gender assessment of fishing activities, and catch and effort data.

Summary of community survey activities

A coastal community survey questionnaire was developed by SPC in 2001 in consultation with the Fisheries Departments in both Niue and the Cook Islands. The first community surveys were completed in Niue in December 2001, and in March 2002 in the Cook Islands. These surveys were carried out with the assistance of Fisheries Department staff in each location. Table 1 summarises the data. This table and the results were reported in *Fisheries Newsletter* #101 with an explanation of the figures.

The second community surveys were conducted in Niue in March 2003, with Mr Jay Jay Talagi from the Fisheries Department assisting with the work. The surveys were conducted in the Cook Islands in May 2003, with the assistance of Ms Tuaine Turua from the

Table 1: Summary of data collected during the first community surveys (December 2001 in Niue and March 2002 in the Cook Islands)

Island	Village	Number of h/holds covered	Number of people covered	People per h/hold	H/holds fishing	Percent of h/holds fishing	Number of canoes	Number of boats	Number of h/holds fishing outside reef	Percent of h/holds fishing outside reef	Number of h/holds fishing FADs	Percent of h/holds fishing FADs
Niue	Alofi North	27	100	3.7	23	85.20%	17	15	15	55.60%	15	55.60%
Niue	Avatele	27	106	3.9	21	77.80%	29	13	19	70.40%	8	29.60%
Niue	Hikutavake	12	37	3.1	7	58.30%	6	0	3	25.00%	2	16.70%
Niue	Lakepa	22	84	3.8	15	68.20%	7	2	6	27.30%	3	13.60%
Niue	Makefu	20	75	3.8	15	75.00%	12	2	8	40.00%	2	10.00%
Niue	Namakulu	7	9	1.3	4	57.10%	2	1	2	28.60%	2	28.60%
Niue	Selected fishermen	4	21	5.3	4	100.00%	4	7	4	100.00%	4	100.00%
Niue	Tuapa	24	75	3.1	23	95.80%	18	6	12	50.00%	10	41.70%
	Vaiea	11	60	5.5	10	90.90%	6	3	7	63.60%	6	54.50%
	Sub-total	**154**	**567**	**3.7**	**122**	**79.20%**	**101**	**49**	**76**	**49.40%**	**52**	**33.80%**
Aitutaki	Amuri	54	214	4	38	70.40%	28	14	10	18.50%	6	11.10%
Aitutaki	Arutanga and Araura	27	120	4.4	14	51.90%	4	11	4	14.80%	3	11.10%
Aitutaki	Nikaupara	34	143	4.2	26	76.50%	7	21	10	29.40%	8	23.50%
Aitutaki	Reureu	27	125	4.6	15	55.60%	7	7	3	11.10%	2	7.40%
Aitutaki	Ureia	24	95	4	17	70.80%	10	10	8	33.30%	6	25.00%
Aitutaki	Vaipae and Vaipeka	80	375	4.7	53	66.30%	22	26	12	15.00%	11	13.80%
	Sub-total	**246**	**1072**	**4.4**	**163**	**66.30%**	**78**	**89**	**47**	**19.10%**	**36**	**14.60%**
Rarotonga	Aroko and Avana	23	76	3.3	14	60.90%	0	2	0	0.00%	0	0.00%
Rarotonga	Matavera	25	93	3.7	10	40.00%	0	4	2	8.00%	2	8.00%
Rarotonga	Pokoinu to Nikao	77	339	4.4	33	42.90%	2	10	6	7.80%	4	5.20%
Rarotonga	Rutaki and Aroa	43	174	4	24	55.80%	2	3	1	2.30%	1	2.30%
Rarotonga	Selected fishermen	19	85	4.5	19	100.00%	5	21	19	100.00%	19	100.00%
Rarotonga	Titikaveka	34	136	4	16	47.10%	8	5	4	11.80%	4	11.80%
	Sub-total	**221**	**903**	**4.1**	**116**	**52.50%**	**17**	**45**	**32**	**14.50%**	**30**	**13.60%**
	Total	**621**	**2542**	**4.1**	**401**	**64.60%**	**196**	**183**	**155**	**25.00%**	**118**	**19.00%**

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Fisheries Department, with several other fisheries staff assisting from time to time in each location. Table 2 summarises the data. This table and the results were reported in *Fisheries Newsletter* #106 with an explanation of the figures.

The third community surveys were conducted in the Cook Islands in June 2004, with the assistance of Mr Ngametua Tangatakino in Rarotonga and Mr Richard Henry in Aitutaki, with several other fisheries staff assisting from time to time in each location. The surveys were conducted in Niue in July 2004, with Mr Jay Jay Talagi from the Fisheries Department assisting in this work. Table 3 summarises the data from the third survey.

Table 2: Summary of data collected during the second community surveys (March 2003 in Niue and May 2003 in the Cook Islands)

Island	Village	Number of h/holds covered	Number of people covered	People per h/hold	H/holds fishing	Percent of h/holds fishing	Number of canoes	Number of boats	Number of h/holds fishing outside reef	Percent of h/holds fishing outside reef	Number of h/holds fishing FADs	Percent of h/holds fishing FADs
Niue	Alofi North	26	76	2.9	15	57.70%	10	7	7	26.90%	7	26.90%
Niue	Avatele	28	89	3.2	21	75.00%	24	12	15	53.60%	11	39.30%
Niue	Hikutavake	14	36	2.6	9	64.30%	8	1	4	28.60%	2	14.30%
Niue	Lakepa	22	76	3.5	18	81.80%	7	3	4	18.20%	2	9.10%
Niue	Makefu	21	63	3	16	76.20%	14	2	7	33.30%	4	19.00%
Niue	Namakulu	8	6	0.8	3	37.50%	2	0	1	12.50%	1	12.50%
Niue	Selected fishermen	4	23	5.8	4	100.00%	9	8	4	100.00%	4	100.00%
Niue	Tuapa	28	59	2.1	13	46.40%	8	2	8	28.60%	7	25.00%
	Vaiea	11	55	5	10	90.90%	5	6	7	63.60%	7	63.60%
	Sub-total	**162**	**483**	**3**	**109**	**67.30%**	**87**	**41**	**57**	**35.20%**	**45**	**27.80%**
Aitutaki	Amuri	54	175	3.2	37	68.50%	22	19	14	25.90%	9	16.70%
Aitutaki	Arutanga and Araura	27	89	3.3	17	63.00%	8	9	4	14.80%	3	11.10%
Aitutaki	Nikaupara	35	140	4	27	77.10%	8	20	9	25.70%	7	20.00%
Aitutaki	Reureu	27	107	4	19	70.40%	2	8	5	18.50%	2	7.40%
Aitutaki	Ureia	24	95	4	21	87.50%	6	12	11	45.80%	7	29.20%
Aitutaki	Vaipae and Vaipeka	80	306	3.8	49	61.30%	15	19	11	13.80%	6	7.50%
	Sub-total	**247**	**912**	**3.7**	**170**	**68.80%**	**61**	**87**	**54**	**21.90%**	**34**	**13.80%**
Rarotonga	Aroko and Avana	24	63	2.6	8	33.30%	0	0	0	0.00%	0	0.00%
Rarotonga	Matavera	25	73	2.9	10	40.00%	0	3	1	4.00%	0	0.00%
Rarotonga	Pokoinu to Nikao	77	317	4.1	31	40.30%	0	4	3	3.90%	2	2.60%
Rarotonga	Rutaki and Aroa	43	156	3.6	24	55.80%	2	2	1	2.30%	1	2.30%
Rarotonga	Selected fishermen	19	96	5.1	19	100.00%	1	22	19	100.00%	18	94.70%
Rarotonga	Titikaveka	33	81	2.5	7	21.20%	0	5	1	3.00%	1	3.00%
	Sub-total	**221**	**786**	**3.6**	**99**	**44.80%**	**3**	**36**	**25**	**11.30%**	**22**	**10.00%**
	Total	**630**	**2181**	**3.5**	**378**	**60.00%**	**151**	**164**	**136**	**21.60%**	**101**	**16.00%**

Table 3: Summary of data collected during the third community surveys (June 2004 in the Cook Islands and July 2004 in Niue)

Island	Village	Number of h/holds covered	Number of people covered	People per h/hold	H/holds fishing	Percent of h/holds fishing	Number of canoes	Number of boats	Number of h/holds fishing outside reef	Percent of h/holds fishing outside reef	Number of h/holds fishing FADs	Percent of h/holds fishing FADs
Niue	Alofi North	27	86	3.2	16	59.30%	8	7	6	37.50%	6	37.50%
Niue	Avatele	28	98	3.5	22	78.60%	24	9	14	63.60%	11	50.00%
Niue	Hikutavake	14	33	2.4	9	64.30%	4	0	4	44.40%	3	33.30%
Niue	Lakepa	22	68	3.1	15	68.20%	3	3	2	13.30%	2	13.30%
Niue	Makefu	21	56	2.7	13	61.90%	6	1	5	38.50%	5	38.50%
Niue	Namakulu	8	8	1	3	37.50%	1	0	1	33.30%	1	33.30%
Niue	Selected fishermen	4	16	4	3	75.00%	3	5	3	100.00%	3	100.00%
Niue	Tuapa	28	49	1.8	12	42.90%	3	1	2	16.70%	2	16.70%
Niue	Vaiea	11	54	4.9	5	45.50%	4	3	3	60.00%	3	60.00%
	Sub-total	**163**	**468**	**2.9**	**98**	**60.10%**	**56**	**29**	**40**	**40.80%**	**36**	**36.70%**
Aitutaki	Amuri	54	167	3.1	33	61.10%	17	11	12	36.40%	6	18.20%
Aitutaki	Arutanga and Araura	27	89	3.3	13	48.10%	4	9	4	30.80%	3	23.10%
Aitutaki	Nikaupara	35	140	4	22	62.90%	10	13	7	31.80%	5	22.70%
Aitutaki	Reureu	27	107	4	16	59.30%	3	7	4	25.00%	3	18.80%
Aitutaki	Ureia	24	95	4	17	70.80%	6	5	7	41.20%	4	23.50%
Aitutaki	Vaipae and Vaipeka	80	342	4.3	46	57.50%	16	21	8	17.40%	5	10.90%
	Sub-total	**247**	**940**	**3.8**	**147**	**59.50%**	**56**	**66**	**42**	**28.60%**	**26**	**17.70%**
Rarotonga	Aroko and Avana	24	72	3	10	41.70%	2	0	0	0.00%	0	0.00%
Rarotonga	Matavera	25	86	3.4	11	44.00%	1	2	2	18.20%	1	9.10%
Rarotonga	Pokoinu to Nikao	77	288	3.7	36	46.80%	1	4	3	8.30%	3	8.30%
Rarotonga	Rutaki and Aroa	43	163	3.8	25	58.10%	1	4	0	0.00%	0	0.00%
Rarotonga	Selected fishermen	19	87	4.6	18	94.70%	4	21	17	94.40%	15	83.30%
Rarotonga	Titikaveka	35	122	3.5	13	37.10%	1	3	1	7.70%	1	7.70%
	Sub-total	**221**	**818**	**3.7**	**113**	**50.70%**	**10**	**34**	**23**	**20.40%**	**20**	**17.70%**
	Total	**633**	**2226**	**3.5**	**358**	**56.60%**	**122**	**129**	**105**	**29.30%**	**82**	**22.90%**

The same survey form was used for all three surveys and, when possible, the same person interviewed from each household. This made the survey process lengthy, as the same households needed to be found. In places such as Rarotonga, both parents were often working, which necessitated that surveys be conducted in the evening or on weekends.

Care is needed when examining the data in Tables 2 and 3, as the number of households covered is different, which alters other figures in the table such as boat and canoe numbers. Table 4 breaks down this figure into the number of households that were interviewed in each survey, and those that were surveyed once, twice or three times.

Table 4: Summary of the households surveyed to identify the number of households that were interviewed once, twice and three times in each location

Island	Village	Number of h/holds covered (first survey)	Number of h/holds covered (second	Number of h/holds covered (third	Number of new h/holds surveyed three times	Number of new h/holds surveyed twice	Number of h/holds surveyed once
Niue	Alofi North	27	26	27	19	5	3
Niue	Avatele	27	28	28	24	1	3
Niue	Hikutavake	12	14	14	9	3	2
Niue	Lakepa	22	22	22	19	2	1
Niue	Makefu	20	21	21	15	2	4
Niue	Namakulu	7	8	8	3	3	2
Niue	Selected fishermen	4	4	4	3	1	0
Niue	Tuapa	24	28	28	12	5	11
Niue	Vaiea	11	11	11	7	4	0
	Sub-total	**154**	**162**	**163**	**111**	**26**	**26**
Aitutaki	Amuri	54	54	54	39	7	8
Aitutaki	Arutanga and Araura	27	27	27	20	3	4
Aitutaki	Nikaupara	34	35	35	29	1	5
Aitutaki	Reureu	27	27	27	25	0	2
Aitutaki	Ureia	24	24	24	22	2	0
Aitutaki	Vaipae and Vaipeka	80	80	80	65	6	9
	Sub-total	**246**	**247**	**247**	**200**	**19**	**28**
Rarotonga	Aroko and Avana	23	24	24	15	2	7
Rarotonga	Matavera	25	25	25	18	5	2
Rarotonga	Pokoinu to Nikao	77	77	77	56	13	8
Rarotonga	Rutaki and Aroa	43	43	43	36	4	3
Rarotonga	Selected fishermen	19	19	19	19	0	0
Rarotonga	Titikaveka	34	33	33	24	5	4
	Sub-total	**221**	**221**	**221**	**168**	**29**	**24**
	Total	**621**	**630**	**631**	**479**	**74**	**78**

Table 5: Comparison of community survey data for households that were surveyed three times on Niue

Island	Village	Number of h/holds surveyed	Number of people covered	People per h/hold	H/holds fishing	Percent of h/holds fishing	Number of canoes	Number of boats	Number of h/holds fishing outside reef	Percent of h/holds fishing outside reef	Number of h/holds fishing FADs	Percent of h/holds fishing FADs
Niue-1	Alofi North	19	71	3.7	16	84.20%	12	9	9	56.30%	9	56.30%
Niue-1	Avatele	24	99	4.1	19	79.20%	25	12	17	89.50%	7	36.80%
Niue-1	Hikutavake	9	30	3.3	6	66.70%	5	0	2	33.30%	1	16.70%
Niue-1	Lakepa	19	77	4.1	13	68.40%	7	2	6	46.20%	3	23.10%
Niue-1	Makefu	15	64	4.3	13	86.70%	10	2	7	53.80%	2	15.40%
Niue-1	Namakulu	3	4	1.3	2	66.70%	1	0	1	50.00%	1	50.00%
Niue-1	Selected fishermen	3	18	6	3	100.00%	4	5	3	100.00%	3	100.00%
Niue-1	Tuapa	12	43	3.6	12	100.00%	10	1	6	50.00%	6	50.00%
Niue-1	Vaiea	7	37	5.3	6	85.70%	4	0	4	66.70%	3	50.00%
		111	**443**	**4**	**90**	**81.10%**	**78**	**31**	**55**	**61.10%**	**35**	**38.90%**
Niue-2	Alofi North	19	74	3.9	15	78.90%	10	7	7	46.70%	7	46.70%
Niue-2	Avatele	24	86	3.6	20	83.30%	23	11	14	70.00%	10	50.00%
Niue-2	Hikutavake	9	28	3.1	6	66.70%	4	0	2	33.30%	1	16.70%
Niue-2	Lakepa	19	71	3.7	16	84.20%	7	3	4	25.00%	2	12.50%
Niue-2	Makefu	15	58	3.9	14	93.30%	9	2	5	35.70%	2	14.30%
Niue-2	Namakulu	3	2	0.7	1	33.30%	2	0	1	100.00%	1	100.00%
Niue-2	Selected fishermen	3	18	6	3	100.00%	9	6	3	100.00%	3	100.00%
Niue-2	Tuapa	12	43	3.6	9	75.00%	7	0	6	66.70%	5	55.60%
Niue-2	Vaiea	7	40	5.7	7	100.00%	4	3	4	57.10%	4	57.10%
		111	**420**	**3.8**	**91**	**82.00%**	**75**	**32**	**46**	**50.50%**	**35**	**38.50%**
Niue-3	Alofi North	19	72	3.8	13	68.40%	7	6	5	38.50%	5	38.50%
Niue-3	Avatele	24	95	4	21	87.50%	24	9	14	66.70%	11	52.40%
Niue-3	Hikutavake	9	28	3.1	7	77.80%	3	0	3	42.90%	3	42.90%
Niue-3	Lakepa	19	68	3.6	15	78.90%	3	3	2	13.30%	2	13.30%
Niue-3	Makefu	15	53	3.5	12	80.00%	6	1	5	41.70%	5	41.70%
Niue-3	Namakulu	3	5	1.7	2	66.70%	1	0	1	50.00%	1	50.00%
Niue-3	Selected fishermen	3	16	5.3	3	100.00%	3	5	3	100.00%	3	100.00%
Niue-3	Tuapa	12	45	3.8	10	83.30%	3	1	2	20.00%	2	20.00%
Niue-3	Vaiea	7	46	6.6	4	57.10%	3	3	2	50.00%	2	50.00%
		111	**428**	**3.9**	**87**	**78.40%**	**53**	**28**	**37**	**42.50%**	**34**	**39.10%**

As can be seen from Table 4, 631 households were covered during the third surveys, (163 on Niue, 247 on Aitutaki and 221 on Rarotonga). As with the second survey, however, many households were not located for the interview. In those cases in which households had simply moved to another area, the households were located and interviewed. It should be noted that during the second survey, additional households were surveyed to increase the number for future surveys.

Tables 5, 6 and 7 compare the data collected by area for the households that were surveyed on all three occasions (111 on Niue, 200 on Aitutaki and 168 on Rarotonga). Tables 8, 9 and 10 compare the data collected by area for households that were surveyed on two occasions (surveys 1 and 2, or 1 and 3, or 2 and 3); this includes 26 on Niue, 19 on Aitutaki and 29 on Rarotonga. This left 78 households that were only surveyed once (26 on Niue, 28 on Aitutaki and 24 on Rarotonga); these data are not used in any of the comparative assessments below.

On Niue (Table 5) the number of households fishing has stayed roughly constant (survey 1: 90, survey 2: 91 and survey 3: 87) for the 111 households that were surveyed three times. However, there was a change in fishing activities by village, as Cyclone Heta caused extensive damage to some reef areas, and people did not want to fish in these

Table 6: Comparison of community survey data for households that were surveyed three times on Aitutaki

Island	Village	Number of h/holds surveyed	Number of people covered	People per h/hold	H/holds fishing	Percent of h/holds fishing	Number of canoes	Number of boats	Number of h/holds fishing outside reef	Percent of h/holds fishing outside reef	Number of h/holds fishing FADs	Percent of h/holds fishing FADs
Aitutaki-1	Amuri	39	169	4.3	25	64.10%	20	10	8	32.00%	5	20.00%
Aitutaki-1	Arutanga	20	97	4.9	11	55.00%	4	9	3	27.30%	3	27.30%
Aitutaki-1	Nikaupara	29	129	4.4	22	75.90%	5	20	9	40.90%	8	36.40%
Aitutaki-1	Reureu	25	117	4.7	14	56.00%	7	6	2	14.30%	1	7.10%
Aitutaki-1	Ureia	22	92	4.2	16	72.70%	9	10	8	50.00%	6	37.50%
Aitutaki-1	Vaipae and Vaipeka	65	310	4.8	44	67.70%	19	21	10	22.70%	9	20.50%
		200	**914**	**4.6**	**132**	**66.00%**	**64**	**76**	**40**	**30.30%**	**32**	**24.20%**
Aitutaki-2	Amuri	39	163	4.2	34	87.20%	21	17	14	41.20%	9	26.50%
Aitutaki-2	Arutanga and Araura	20	85	4.3	17	85.00%	8	9	4	23.50%	3	17.60%
Aitutaki-2	Nikaupura	29	136	4.7	26	89.70%	8	19	9	34.60%	7	26.90%
Aitutaki-2	Reureu	25	107	4.3	19	76.00%	2	8	5	26.30%	2	10.50%
Aitutaki-2	Ureia	22	93	4.2	20	90.90%	6	12	11	55.00%	7	35.00%
Aitutaki-2	Vaipae and Vaipeka	65	300	4.6	49	75.40%	15	19	11	22.40%	6	12.20%
		200	**884**	**4.4**	**165**	**82.50%**	**60**	**84**	**54**	**32.70%**	**34**	**20.60%**
Aitutaki-3	Amuri	39	158	4.1	31	79.50%	15	11	11	35.50%	6	19.40%
Aitutaki-3	Arutanga and Araura	20	84	4.2	12	60.00%	3	9	4	33.30%	3	25.00%
Aitutaki-3	Nikaupura	29	136	4.7	21	72.40%	10	12	6	28.60%	5	23.80%
Aitutaki-3	Reureu	25	107	4.3	16	64.00%	3	7	4	25.00%	3	18.80%
Aitutaki-3	Ureia	22	95	4.3	17	77.30%	6	5	7	41.20%	4	23.50%
Aitutaki-3	Vaipae and Vaipeka	65	328	5	45	69.20%	16	21	8	17.80%	5	11.10%
		200	**908**	**4.5**	**142**	**71.00%**	**53**	**65**	**40**	**28.20%**	**26**	**18.30%**

Table 7: Comparison of community survey data for households that were surveyed three times on Rarotonga

Island	Village	Number of h/holds surveyed	Number of people covered	People per h/hold	H/holds fishing	Percent of h/holds fishing	Number of canoes	Number of boats	Number of h/holds fishing outside reef	Percent of h/holds fishing outside reef	Number of h/holds fishing FADs	Percent of h/holds fishing FADs
Rarotonga-1	Aroko and Avana	15	57	3.8	11	73.30%	0	1	0	0.00%	0	0.00%
Rarotonga-1	Matavera	18	62	3.4	10	55.60%	0	4	2	20.00%	2	20.00%
Rarotonga-1	Pokoinu to Nikao	56	250	4.5	30	53.60%	2	9	6	20.00%	4	13.30%
Rarotonga-1	Rutaki and Aroa	36	161	4.5	23	63.90%	2	2	1	4.30%	1	4.30%
Rarotonga-1	Selected fishermen	19	85	4.5	19	100.00%	5	21	19	100.00%	19	100.00%
Rarotonga-1	Titikaveka	24	104	4.3	12	50.00%	8	4	3	25.00%	3	25.00%
		168	**719**	**4.3**	**105**	**62.50%**	**17**	**41**	**31**	**29.50%**	**29**	**27.60%**
Rarotonga-2	Aroko and Avana	15	60	4	8	53.30%	0	0	0	0.00%	0	0.00%
Rarotonga-2	Matavera	18	66	3.7	10	55.60%	0	3	1	10.00%	0	0.00%
Rarotonga-2	Pokoinu to Nikao	56	303	5.4	28	50.00%	0	4	3	10.70%	2	7.10%
Rarotonga-2	Rutaki and Aroa	36	152	4.2	24	66.70%	2	2	1	4.20%	1	4.20%
Rarotonga-2	Selected fishermen	19	96	5.1	19	100.00%	1	22	19	100.00%	18	94.70%
Rarotonga-2	Titikaveka	24	88	3.7	7	29.20%	1	6	1	14.30%	1	14.30%
		168	**765**	**4.6**	**96**	**57.10%**	**4**	**37**	**25**	**26.00%**	**22**	**22.90%**
Rarotonga-3	Aroko and Avana	15	68	4.5	9	60.00%	2	0	0	0.00%	0	0.00%
Rarotonga-3	Matavera	18	78	4.3	11	61.10%	1	2	2	18.20%	1	9.10%
Rarotonga-3	Pokoinu to Nikao	56	250	4.5	32	57.10%	0	4	3	9.40%	3	9.40%
Rarotonga-3	Rutaki and Aroa	36	159	4.4	24	66.70%	1	4	0	0.00%	0	0.00%
Rarotonga-3	Selected fishermen	19	87	4.6	18	94.70%	4	21	17	94.40%	15	83.30%
Rarotonga-3	Titikaveka	24	100	4.2	9	37.50%	0	3	1	11.10%	1	11.10%
		168	**742**	**4.4**	**103**	**61.30%**	**8**	**34**	**23**	**22.30%**	**20**	**19.40%**

locations. Overall the high percentage of households fishing (roughly 80%) is attributed to the subsistence needs of the community (few job opportunities are available, and cash incomes are limited). In contrast, the number of households fishing outside the reef dropped significantly — 55 (61.1%) in the first survey, 46 (50.5%) in the second survey, and 37 (42.5%) in the third survey. This may be because of the limited market on Niue for fishermen to sell their catch. Additionally, the problems caused by Cyclone Heta and the loss of the crane on the wharf greatly restricted the ability of fishermen to launch and retrieve their vessels; as a result, fishing from boats was restricted, especially during the first four months of 2004.

The number of canoes also decreased significantly in the last survey (78 to 75 to 53), mainly as a result of Cyclone Heta, which washed some away while damaging others. The number of boats also dropped slightly (31 to 32 to 28) over the survey period. The use of FADs has remained fairly constant over the survey period (34 households or around 39%), even though most offshore FADs were lost during the cyclone. Fishermen concentrated on using the inshore FADs, fishing from both canoes and boats.

On Aitutaki (Table 6), the number of households involved in fishing increased from 132 (66%) in the first survey, to 165 (82.5%) in the second survey, and dropped to 142 (71%) in the third survey. This increase from the first to second survey was mainly in subsistence fishing, with collecting on the reef and gillnetting activities increasing. The decline in fishing activities from the second to third survey was more general and included collecting on the reef, gillnetting and fishing outside the reef. Limited markets for selling fish on Aitutaki and a small increase in the incidence of ciguatera, including some parrotfish species, may also have attributed to the decline in fishing activities.

The number of canoes has continued to drop over the survey period (64 to 60 to 53) as people move more towards boats, especially in the lagoon. Overall, boat numbers also dropped (76 to 84 to 65), which can be partly attributed to an overestimate during the first two surveys, in which several people or households were recorded as having a boat, when in fact they used the same boat (either together or at different times). However, there was still a drop in overall boat numbers, as some older boats were in use anymore.

The number of households fishing outside the reef was the same in the first and third surveys (40), while the figure increased in the second survey (to 54 households); this can be partly attributed to the same over estimate of boat numbers, where several households were recorded as separately fishing outside the reef, when in fact they were fishing together. Fishing activities around FADs dropped a little overall (32 to 34 to 26), as either the number of fishermen dropped slightly, or they changed to fishing in the lagoon or close to the reef. Limited markets for fish locally at times, especially tunas, also contributed to the small drop in FAD fishing activities.

On Rarotonga (Table 7), the number of households involved in fishing has fluctuated over the three surveys from 105 (62.5%) in the first survey, dropping to 96 (57.1%) in the second survey, and increasing again to 103 (61.3%) in the third survey. This partially reflects the ability of people to find work; in many cases, households have both parents working. As several households mentioned, they now "fish at the market with 20 dollar bills", rather than with hooks and lines or nets. The increase in the number of households fishing in the third survey is somewhat misleading, and can be attributed to the opening of several *raui* (local marine protected areas), which allowed households that normally don't fish to fish or collect once or twice in an area that has been closed for several years.

Looking more closely at the Rarotonga data, the number of canoes and boats has dropped (17 and 41 in the first survey, 4 and 37 in the second survey, and 8 and 34 in the third survey, respectively). In line with this trend, the number of households fishing outside the reef has dropped from 31 (29.5%) to 25 (26%) to 23 (22.3%), and the number of fishermen going to the FADs has also dropped from 29 (27.6%) to 22 (22.9%) to 20 (19.4%). The main reason for these decreases is the shrinking market for fishermen to sell their fish, and the competition between fishermen for existing markets.

Rarotonga has a developing tuna longline fishery that has only really developed in the last three years. As this fishery developed, a considerable amount of byproduct and non-export quality target species have been marketed locally, with around 100 t sold on the domestic market in 2002 and 200 t in 2003. This has greatly affected small-scale fishermen, who are finding it difficult to compete with longline fishermen. The marketing problem has meant that several fishermen have stopped fishing altogether, and taken employment on shore.

The comparative data presented in tables 8, 9 and 10 are more difficult to interpret, as there is a mix of pairing between surveys one and two, one and three, and surveys two and three. The numbers are also low, so it is dif-

Table 8: Comparison of community survey data for households that were surveyed twice on Niue

Island	Village	Number of h/holds surveyed	Number of people covered	People per h/hold	H/holds fishing	Percent of h/holds fishing	Number of canoes	Number of boats	Number of h/holds fishing outside reef	Percent of h/holds fishing outside reef	Number of h/holds fishing FADs	Percent of h/holds fishing FADs
Niue-1	Alofi North	5	16	3.2	5	100.00%	4	3	4	80.00%	4	80.00%
Niue-1	Hikutavake	1	4	4	1	100.00%	1	0	1	100.00%	1	100.00%
Niue-1	Lakepa	2	6	3	1	50.00%	0	0	0	0.00%	0	0.00%
Niue-1	Makefu	2	5	2.5	2	100.00%	2	0	1	50.00%	0	0.00%
Niue-1	Namakulu	2	2	1	0	0.00%	0	0	0		0	
Niue-1	Selected fishermen	1	3	3	1	100.00%	0	2	1	100.00%	1	100.00%
Niue-1	Tuapa	4	10	2.5	4	100.00%	2	3	1	25.00%	1	25.00%
Niue-1	Vaiea	4	23	5.8	4	100.00%	2	3	3	75.00%	3	75.00%
		21	**69**	**3.3**	**18**	**85.70%**	**11**	**11**	**11**	**61.10%**	**10**	**55.60%**
Niue-2	Alofi North	1	2	2	0	0.00%	0	0	0		0	
Niue-2	Avatele	1	3	3	1	100.00%	1	1	1	100.00%	1	100.00%
Niue-2	Hikutavake	3	8	2.7	3	100.00%	4	1	2	66.70%	1	33.30%
Niue-2	Lakepa	2	5	2.5	2	100.00%	0	0	0	0.00%	0	0.00%
Niue-2	Makefu	1	1	1	1	100.00%	1	0	1	100.00%	1	100.00%
Niue-2	Namakulu	3	4	1.3	2	66.70%	0	0	0	0.00%	0	0.00%
Niue-2	Selected fishermen	1	5	5	1	100.00%	0	2	1	100.00%	1	100.00%
Niue-2	Tuapa	3	8	2.7	3	100.00%	1	2	2	66.70%	2	66.70%
Niue-2	Vaiea	3	15	5	3	100.00%	1	3	3	100.00%	3	100.00%
		18	**51**	**2.8**	**16**	**88.90%**	**8**	**9**	**10**	**62.50%**	**9**	**56.30%**
Niue-3	Alofi North	4	14	3.5	3	75.00%	1	1	1	33.30%	1	33.30%
Niue-3	Avatele	1	3	3	1	100.00%	0	0	0	0.00%	0	0.00%
Niue-3	Hikutavake	2	5	2.5	2	100.00%	1	0	1	50.00%	0	0.00%
Niue-3	Makefu	1	3	3	1	100.00%	0	0	0	0.00%	0	0.00%
Niue-3	Namakulu	1	3	3	1	100.00%	0	0	0	0.00%	0	0.00%
Niue-3	Tuapa	3	4	1.3	2	66.70%	0	0	0	0.00%	0	0.00%
Niue-3	Vaiea	1	8	8	1	100.00%	1	0	1	100.00%	1	100.00%
		13	**40**	**3.1**	**11**	**84.60%**	**3**	**1**	**3**	**27.30%**	**2**	**18.20%**

Table 9: Comparison of the community survey data for households that were surveyed twice on Aitutaki

Island	Village	Number of h/holds surveyed	Number of people covered	People per h/hold	H/holds fishing	Percent of h/holds fishing	Number of canoes	Number of boats	Number of h/holds fishing outside reef	Percent of h/holds fishing outside reef	Number of h/holds fishing FADs	Percent of h/holds fishing FADs
Aitutaki-1	Amuri	7	20	2.9	7	100.00%	7	3	2	28.60%	1	14.30%
Aitutaki-1	Arutanga	3	7	2.3	1	33.30%	0	0	0	0.00%	0	0.00%
Aitutaki-1	Ureia	2	3	1.5	1	50.00%	1	0	0	0.00%	0	0.00%
Aitutaki-1	Vaipeka	6	21	3.5	2	33.30%	0	1	1	50.00%	1	50.00%
		18	**51**	**2.8**	**11**	**61.10%**	**8**	**4**	**3**	**27.30%**	**2**	**18.20%**
Aitutaki-2	Amuri	4	12	3	3	75.00%	1	2	0	0.00%	0	0.00%
Aitutaki-2	Araura	2	4	2	0	0.00%	0	0	0		0	
Aitutaki-2	Nikaupura	1	4	4	1	100.00%	0	1	0	0.00%	0	0.00%
Aitutaki-2	Ureia	2	2	1	1	50.00%	0	0	0	0.00%	0	0.00%
Aitutaki-2	Vaipeka	3	6	2	0	0.00%	0	0	0		0	
		12	**28**	**2.3**	**5**	**41.70%**	**1**	**3**	**0**	**0.00%**	**0**	**0.00%**
Aitutaki-3	Amuri	3	9	3	2	66.70%	2	0	1	50.00%	0	0.00%
Aitutaki-3	Araura	1	5	5	1	100.00%	1	0	0	0.00%	0	0.00%
Aitutaki-3	Nikaupura	1	4	4	1	100.00%	0	1	1	100.00%	0	0.00%
Aitutaki-3	Vaipeka	3	14	4.7	1	33.30%	0	0	0	0.00%	0	0.00%
		8	**32**	**4**	**5**	**62.50%**	**3**	**1**	**2**	**40.00%**	**0**	**0.00%**

ficult to discern any trends in the data. In looking at the different pairings, it would appear that the same basic trends as reported above for tables 5, 6 and 7 hold true for these tables.

The overall objective of this part of the project was to conduct studies over the three-year life of the project with selected coastal communities, especially in areas where reef and/or lagoon marine protected areas (MPAs) have been declared and FADs deployed, to try to measure any benefits accruing to the communities and the usefulness of FADs as a management tool. As stated above, three community surveys were conducted in selected villages at each project area. In assessing the data, the benefits accruing to the surveyed communities from having FADs adjacent to their villages appear to be in two forms: direct and flow-on. The main beneficiaries are the local fishermen with canoes and boats, who receive a direct benefit. The FADs increased the areal fishing areas open to these fishermen, and increased their catches. Canoe fishermen benefited if the FADs were close enough to shore to access these safely, which was the case in Niue. Because there are very few canoes in the Cook Islands, canoe access was not an issue.

Table 10: Comparison of community survey data for households that were surveyed twice on Rarotonga

Island	Village	Number of h/holds surveyed	Number of people covered	People per h/hold	H/holds fishing	Percent of h/holds fishing	Number of canoes	Number of boats	Number of h/holds fishing outside reef	Percent of h/holds fishing outside reef	Number of h/holds fishing FADs	Percent of h/holds fishing FADs
Rarotonga-1	Aroko and Avana	2	4	2	1	50.00%	0	0	0	0.00%	0	0.00%
Rarotonga-1	Matavera	5	17	3.4	0	0.00%	0	0	0		0	
Rarotonga-1	Pokoinu to Nikao	13	56	4.3	2	15.40%	0	1	0	0.00%	0	0.00%
Rarotonga-1	Rutaki and Aroa	4	7	1.8	1	25.00%	0	1	0	0.00%	0	0.00%
Rarotonga-1	Titikaveka	5	17	3.4	2	40.00%	0	0	0	0.00%	0	0.00%
		29	**101**	**3.5**	**6**	**20.70%**	**0**	**2**	**0**	**0.00%**	**0**	**0.00%**
Rarotonga-2	Aroko and Avana	1	1	1	0	0.00%	0	0	0		0	
Rarotonga-2	Matavera	3	7	2.3	0	0.00%	0	0	0		0	
Rarotonga-2	Pokoinu to Nikao	5	14	2.8	3	60.00%	0	0	0	0.00%	0	0.00%
Rarotonga-2	Rutaki and Aroa	3	4	1.3	0	0.00%	0	0	0		0	
		12	**26**	**2.2**	**3**	**25.00%**	**0**	**0**	**0**	**0.00%**	**0**	**0.00%**
Rarotonga-3	Aroko and Avana	1	4	4	1	100.00%	0	0	0	0.00%	0	0.00%
Rarotonga-3	Matavera	2	8	4	0	0.00%	0	0	0		0	
Rarotonga-3	Pokoinu to Nikao	8	38	4.8	4	50.00%	1	0	0	0.00%	0	0.00%
Rarotonga-3	Rutaki and Aroa	1	4	4	1	100.00%	0	0	0	0.00%	0	0.00%
Rarotonga-3	Titikaveka	5	19	3.8	4	80.00%	1	0	0	0.00%	0	0.00%
		17	**73**	**4.3**	**10**	**58.80%**	**2**	**0**	**0**	**0.00%**	**0**	**0.00%**

Boat fishermen were able to fish both offshore and inshore FADs and increase their catches, while reducing their operating costs (as they used less fuel). They were also able to travel along the coast to target FADs off different villages, whereas canoe fishermen were restricted to the FAD adjacent to their village. In most cases, fishermen kept what they needed from the catch, and sold the surplus. The flow-on benefits were in the form of fish being distributed by the fishermen to family, relatives and friends, especially when good catches were taken.

The success of FADs as a management tool was harder to determine. This was mainly due to the fact that in all locations, marine protected areas (MPAs) were already in place and local communities and fishermen had already changed their activities to account for this. It was expected that new MPAs would be implemented during the course of the project, but this did not occur. In fact, in Rarotonga, several MPAs (*raui*) were opened in the final year of the project, which increased the number of households involved in fishing, although this was limited and only for a short time.

Summary of the gender analysis of fishing activities

The following gender analysis is provided based on the sex disaggregated data collected during the community surveys.

Niue

Figure 1 depicts the proportion of fishing effort attributed to each fishing method in Niue, by survey village, based on the results of the community surveys. Reef fishing and reef gleaning each accounted for over 20% of the fishing effort in each of the three surveys. On average, trolling, baitfishing (mainly fishing for bait species, such as *ulihega* – *Decapterus* spp. outside the reef) and bottomfishing each accounted for around 10% of the fishing effort in each survey. The gender split by fishing activity for Niue is presented in Figures 2 (a) and (b).

Reef fishing was a family activity, with most family members involved. The split between male and female participation varied by village in Niue, but on average more males participated (roughly 60% males and 40% females). Reef gleaning, which is

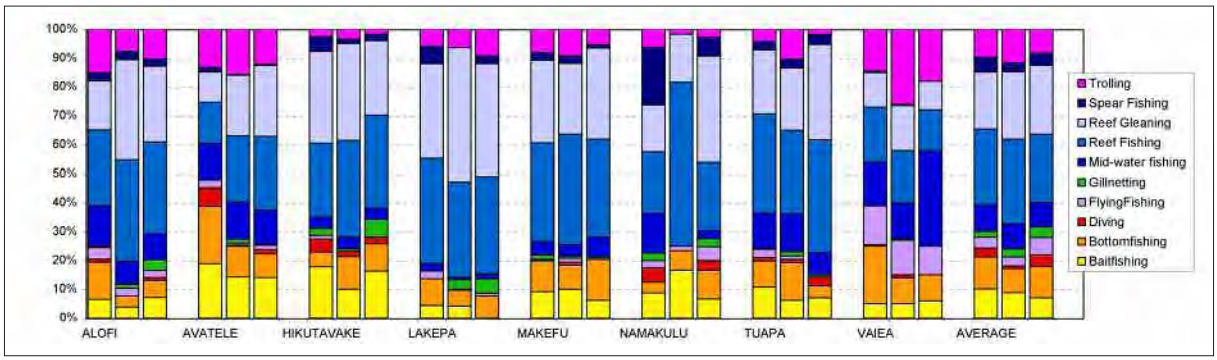

Figure 1: Percentage of fishing effort by method, survey and survey village for Niue

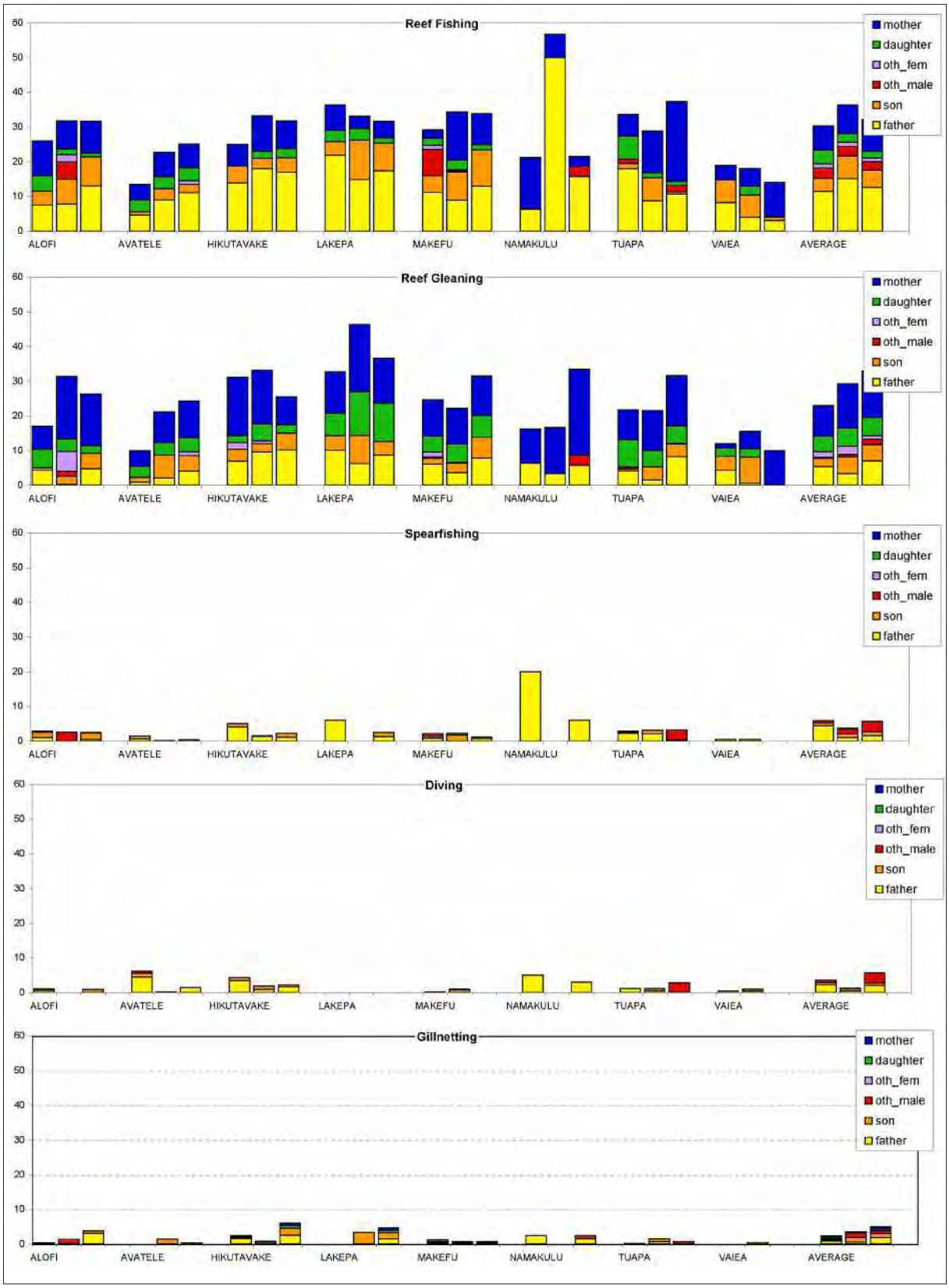

Figure 2 (a): Gender split of fishing effort for reef fishing, reef gleaning, spearfishing, diving and gillnetting by survey and village, with an average per survey for Niue

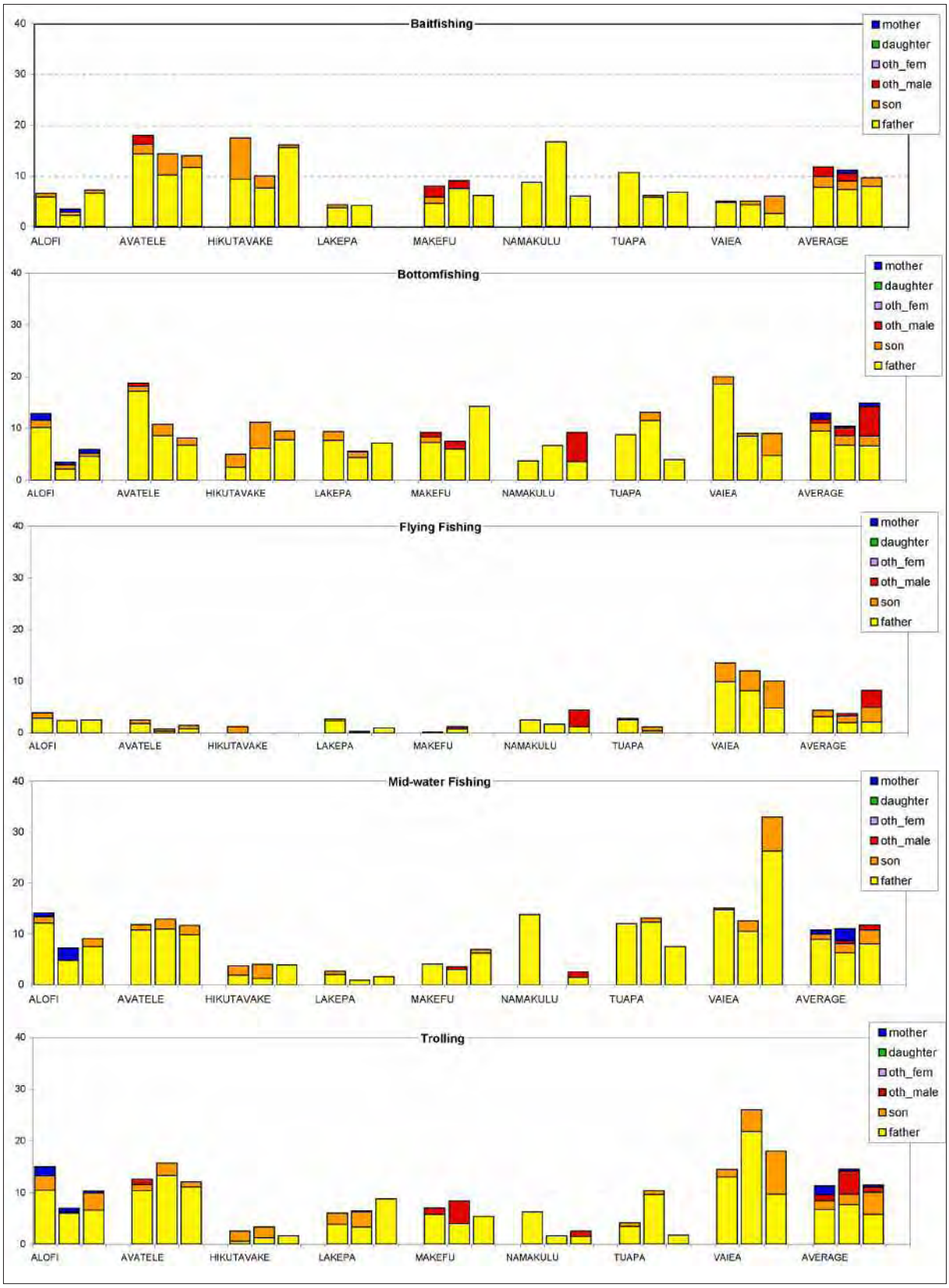

Figure 2 (b): Gender split of fishing effort for baitfishing, bottomfishing, flyingfish fishing, mid-water fishing and trolling by survey and village, with an average per survey for Niue

also a family fishing method, showed the reverse ratio (about 40% males and 60% females). These two fishing methods accounted for around 90% of the total female fishing effort on Niue.

Spearfishing and diving for clams and crayfish were rarely practiced on Niue, and each accounted for less that 5% of fishing effort. These activities were male dominated, with fathers and sons working together. Gillnetting was not frequently practiced on Niue, mainly because there is limited reef area and the windward side of the island can not be fished very often. When gillnetting activities were undertaken, there was more male effort than female, with the total effort was less than 5% of total fishing effort on Niue.

The fishing methods used outside the reef were male dominated, with some fathers taking their sons out to train them in different fishing methods. Baitfishing is a traditional method practiced from canoes to catch *ulihega*; fishermen use traditional gear and green coconut flesh for bait. This method accounted for around 10% of the total fishing effort, with males accounting for 95% of activity. Bottomfishing and flyingfish fishing were fishing methods undertaken by adult males, sometimes with their sons; very few women were involved in these fisheries.

Trolling and mid-water fishing for tunas were also male-dominated fishing methods, although several fishermen were accompanied by their wives on some trips. Each of these methods accounted for 9–19% of the total fishing effort, with 90% of this being undertaken by fathers and sons. In Vaiea village, which is mainly populated by Tuvaluans who do a lot of fishing, trolling and mid-water tuna fishing make up around 30–40% of the total fishing effort from the village; women do very little fishing of any sort.

Overall, fishing activities around Niue are predominantly undertaken by men, especially those activities that require a canoe or boat, and are undertaken outside the reef. Adult males are the main fishermen, followed by male children. Female fishing activity, especially by adult females, was mainly focused on reef gleaning and reef fishing; women's involvement in gillnetting and trolling was minor.

Aitutaki

The percentage of fishing effort attributed to each fishing method, by survey village and based on the results of the community surveys, is presented in Figure 3. In Aitutaki, gillnetting and reef fishing each accounted for around 25% of the fishing effort in each of the three surveys. On average, spearfishing accounted for around 15% of fishing effort, while trolling and reef gleaning each accounted for around 9–10%. The gender split by fishing activity for Aitutaki is presented in Figures 4 (a) and (b).

Gillnetting in Aitutaki lagoon was the most common fishing method recorded during the community surveys. This activity was mainly undertaken from boats in the lagoon and on the reef flats and passages, and primarily involved adult males, followed by male children. Some women participated in the use of gillnets along the coast or reef flats, which was more of a family activity. Overall, the gender split was roughly 80% males and 20% females, in terms of activity or effort. Spearfishing was also a male dominated fishing activity, with many adult males and male children involved. Spearfishing was undertaken both in the lagoon and along the outer edge of the reef. Female participation in this activity was less than 5% of the total effort for this method.

Reef fishing and reef gleaning are both family fishing activities, with many families practicing these methods when they visit lagoon islets by boat on weekend picnics. Of the two, reef fishing is the main method used, with a 65:35 per cent split between males and females. In contrast, reef gleaning activities were dominated by women

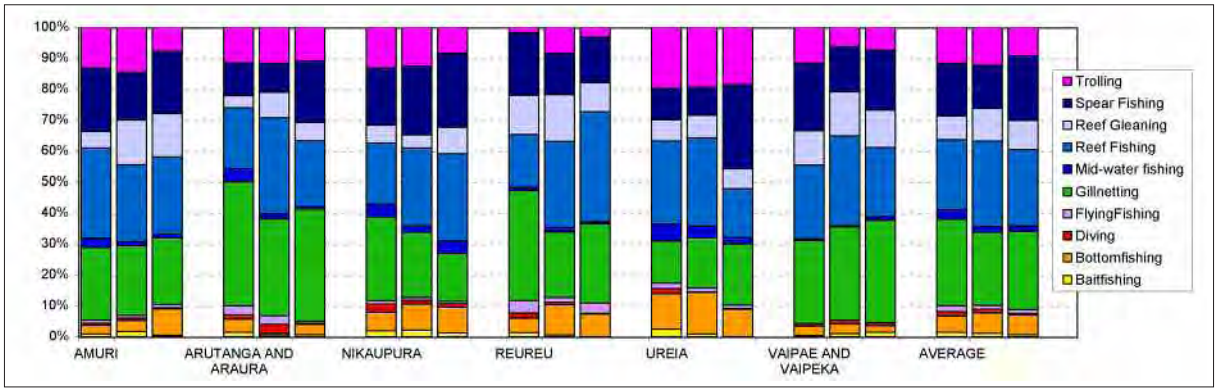

Figure 3: Percentage of fishing effort by method, survey and survey village for Aitutaki

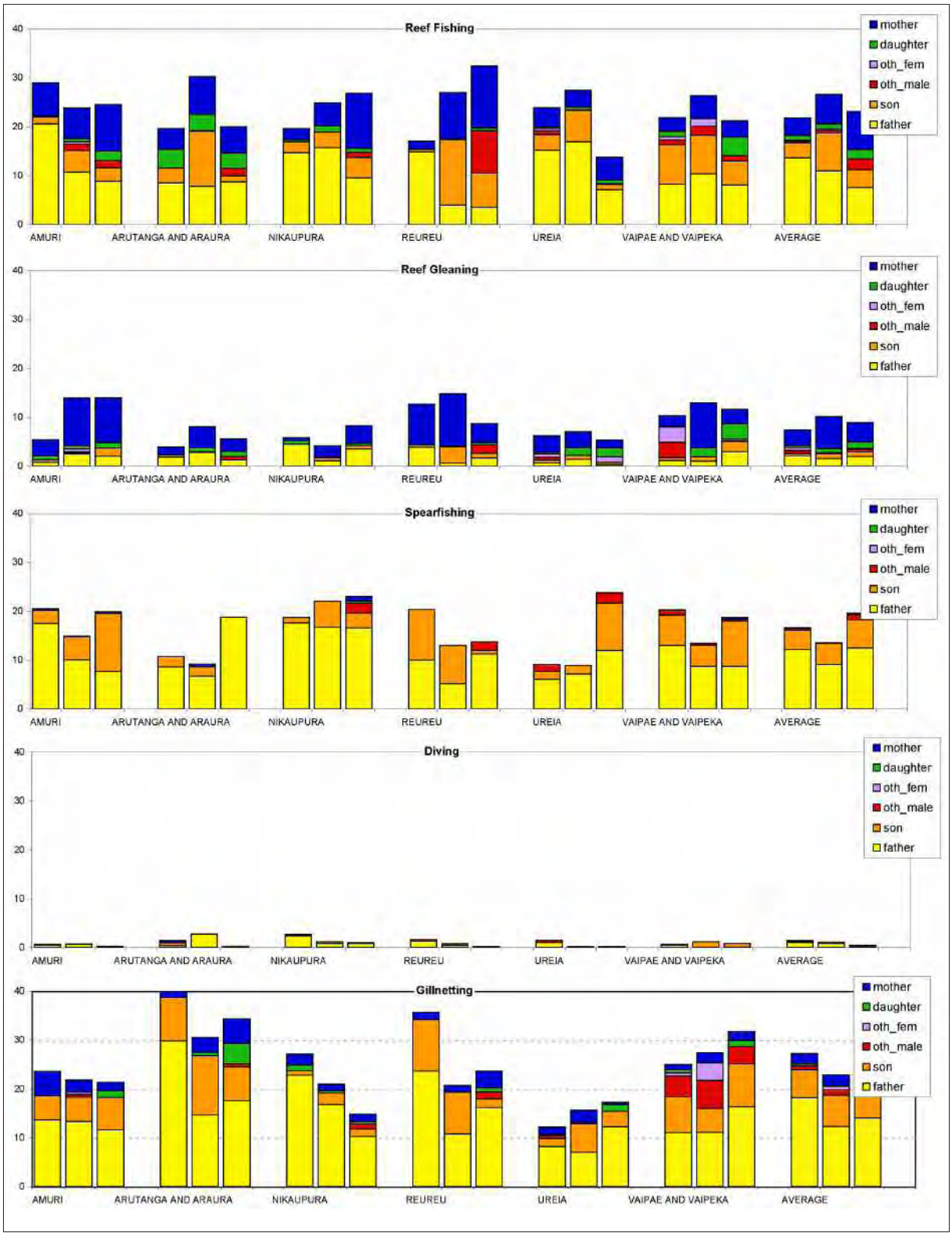

Figure 4 (a): Gender split of fishing effort for reef fishing, reef gleaning, spearfishing, diving and gillnetting by survey and village, with an average per survey for Aitutaki

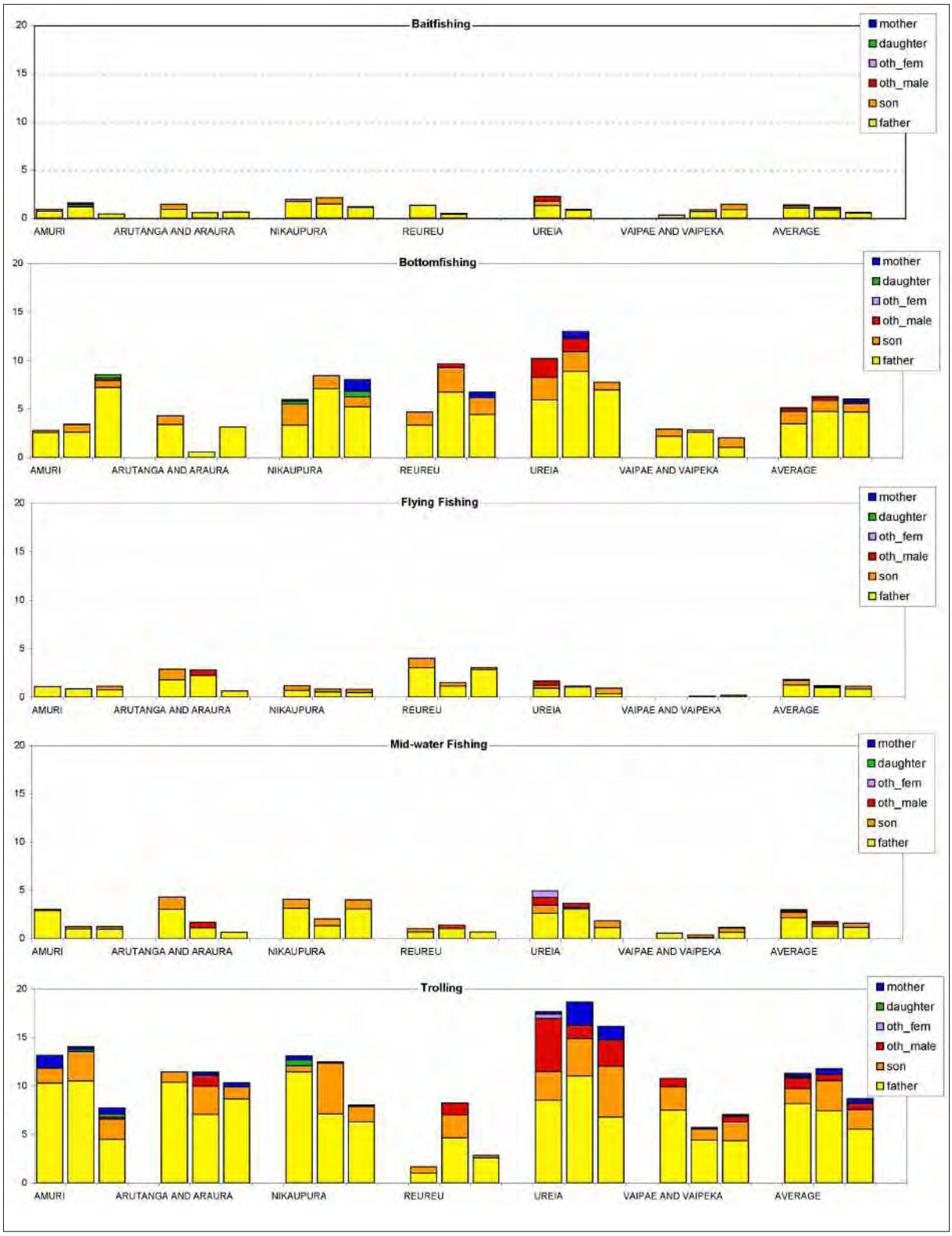

Figure 4 (b): Gender split of fishing effort for baitfishing, bottomfishing, flyingfish fishing, mid-water fishing and trolling by survey and village, with an average per survey for Aitutaki

(35% males and 65% females), but accounted for only ~10% of total fishing effort recorded.

Trolling and bottomfishing are the next two most important methods, accounting for ~ 10% and 6% of the total effort, respectively. Both methods are male dominated, as they are mainly done from boats outside the reef. Female participation in these two methods accounted for about 10% of total activity in each case.

The remaining fishing methods (diving for clams and crayfish, baitfishing, mid-water fishing and flyingfish fishing) are all done infrequently, making up between 1% and 3% of total fishing effort. These methods are male dominated, with fathers and sons working together in many instances.

Overall, the large lagoon and many boats owned by people on Aitutaki (or available to family members) influenced the fishing activities undertaken. Many fishermen with boats concentrated their fishing effort in the lagoon, and only ventured outside the reef when the weather was calm. Gillnetting was the preferred fishing method as the nets can be set while people do other activities, including both fishing (reef fishing and gleaning), swimming and other recreational activities. Aitutaki's lagoon is fairly rich in fish stocks, although the amount of gillnetting is raising concerns, as parrotfish and mullet catches are declining.

Rarotonga

The percentage of fishing effort attributed to each fishing method (by survey village, based on the results of the community surveys), is presented in Figure 5. Reef gleaning accounted for around 25% of the fishing effort recorded in Rarotonga in each of the three surveys. On average, reef fishing and gillnetting each accounted for around 18% of the fishing effort in each survey. The gender split by fishing activity for Rarotonga is presented in Figures 6 (a) and (b).

Reef gleaning was the main fishing method practised by surveyed households. This was in many cases a family activity, with mothers and daughters the main people involved. Some women went to the lagoon when they wanted to eat seafood, eating what they collected and taking nothing home, as the amount of shellfish available on the reefs around Rarotonga was limited. Around 30% of the reef area was closed to fishing under the local raui system, thus restricting the already limited area available for this activity. It should be noted that several *raui* were opened to fishing prior to the third survey being undertaken, increasing the fishing effort to over 50% of the total effort in the Rutaki area (up from the 40% recorded in the previous surveys).

Reef fishing and gillnetting were the next most popular fishing methods practiced. On average these methods each accounted for about 15–18% of the total fishing effort recorded. Both methods were male dominated (fathers and sons) with only minor female fishing effort.

Spearfishing accounted for around 15% of the total fishing effort recorded for Rarotonga. This method was again male dominated, although several women spearfished for octopus in the Rutaki area, which they then sold. Spearfishing occurred outside the reef, mainly for parrotfish.

Trolling represented around 10% of the total fishing effort recorded. It should be noted that around one half of this effort was recorded by the 19 selected fishermen (see Table 7). The reason for creating this group was to have a representation of commercial fishing in the survey, as it was noted during the first survey that very few fishermen were in the areas surveyed. This method was male dominated, with fathers being the main group followed by sons and other males. Female participation accounted for less than 2% of the activity recorded for this method.

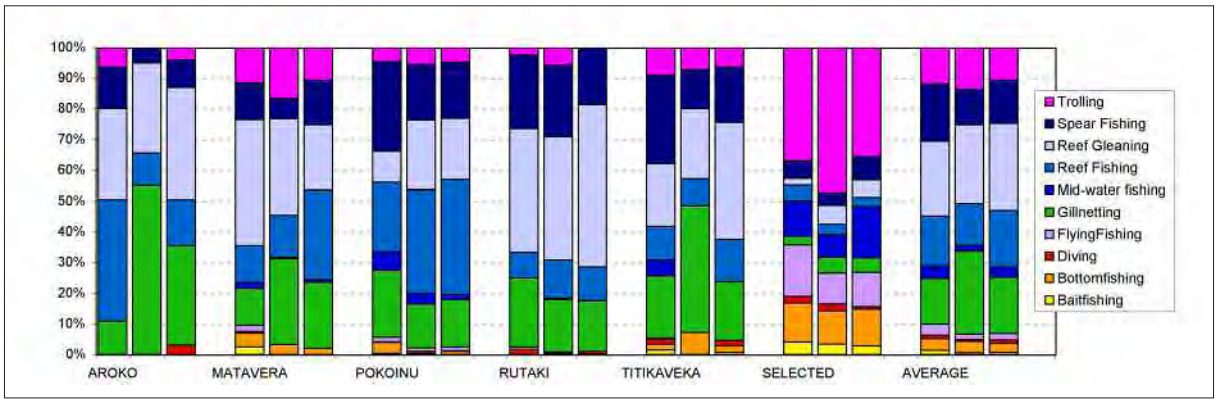

Figure 5: Percentage of fishing effort by method, survey and survey village for Rarotonga

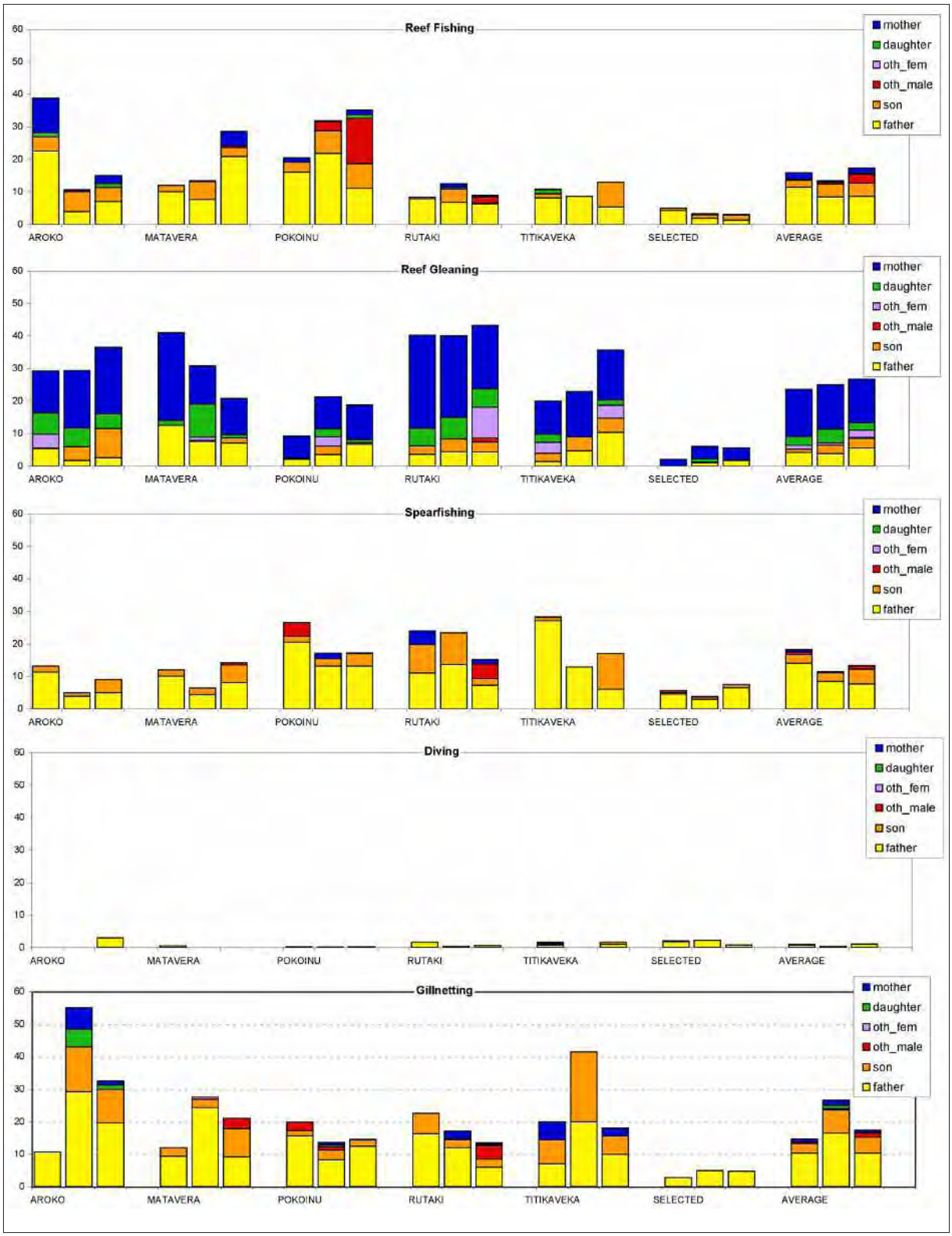

Figure 6 (a): Gender split of fishing effort for reef fishing, reef gleaning, spearfishing, diving and gillnetting by survey and village, with an average per survey for Rarotonga

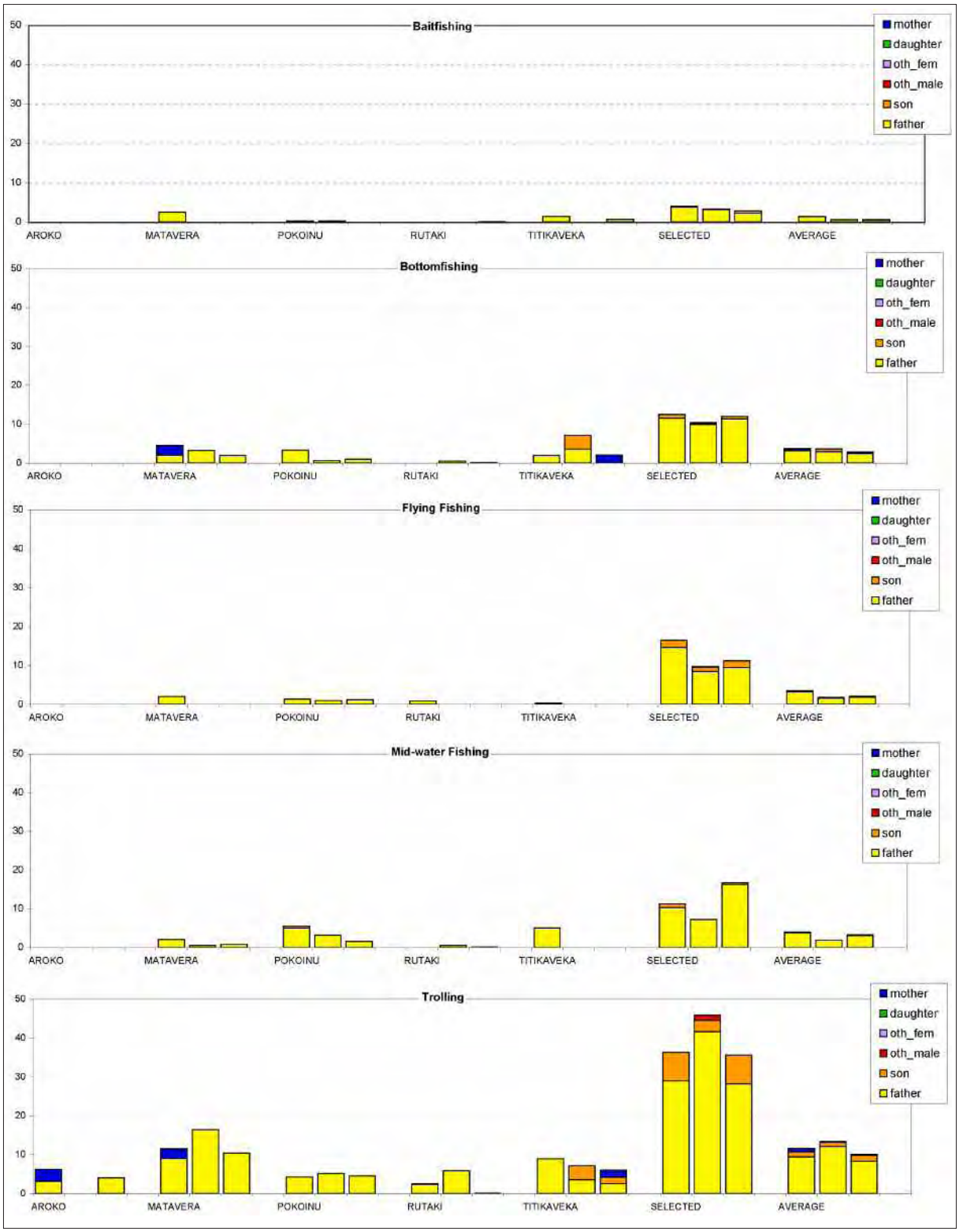

Figure 6 (b): Gender split of fishing effort for baitfishing, bottomfishing, flyingfish fishing, mid-water fishing and trolling by survey and village, with an average per survey for Rarotonga

In looking at the remaining five fishing methods (diving, bait-fishing, bottomfishing, flying-fish fishing, and mid-water fishing), each accounted for less than 5% of total participation, and some figures were inflated due to the responses of the selected fishing group (19 selected fisherman group), who focused on bottomfishing, flyingfish fishing and mid-water fishing, as well as trolling. If this group was removed, then the effort recorded for each of these methods would be less than 3%, with several being less than 1%. All of these methods were male dominated, although there was a small amount of female participation (category mothers) in bottomfishing, where wives accompanied their husbands for this activity in times of good weather.

Overall, the fishing around Rarotonga, apart from reef gleaning, is male dominated. This could be partly due to the fact that there is limited reef area open to fishing (in part because of the raui system of marine protected areas), and no real lagoon areas to fish. Rarotonga is the capital, administrative centre and main tourist centre for the Cook Islands, and as such has many employment opportunities; consequently, many people have jobs. The tourist hotels employ many women, who consequently have less time to engage in fishing activities. In addition, ciguatera is a major problem in some areas, and affected the amount of fishing pressure in areas where it is known to occur.

Results of catch and effort data collection and analysis

A major component of the project was the collection of catch and effort data. A catch and effort logsheet was developed in September 2001 in consultation with the Fisheries Departments of both countries. The logsheets were then made into a logbook using carbonised paper, with three copies of each record (one each for SPC, the Fisheries Department and the fisherman), with 30 records per book.

Logbook returns have been slow since the introduction of the system, although this improved over the course of the project, with over 3000 records received by the end of June 2004 (Table 11). Based on the catch and effort data provided, the fishermen from Rarotonga and Niue seem to be the best data providers. Four Rarotongan and five Niuean fishermen in particular have provided excellent data, and they encouraged others to do the same.

In mid-2003, other methods of encouraging fishermen to complete the logbooks were explored. During meetings with fishermen on Rarotonga and Aitutaki, six T-shirts and caps were given as an incentive to the fishermen who were providing the most consistent data (four on Rarotonga and two on Aitutaki). This created some interest, and a local businessman donated a rod and reel to be given to the fisherman on Rarotonga who provided the most consistent data over the next 12 months as an incentive for fishermen to complete their logbooks. The project then expanded on this and sought sponsorship from Gourock in New Zealand to provide some fishing gear as prizes for a fishing competition for data providers in Rarotonga and another in Niue. Gourock provided a selection of fishing gear in late 2004 for the fishing competition in each location. The fishing competitions (Rarotonga and Niue) were held in early 2005.

Table 11: Summary of logbook returns by location and year to 30 June 2004

Year	Niue	Aitutaki	Rarotonga	Total
2001	8	1		9
2002	425	274	443	1142
2003	693	34	731	1458
2004	267	0	165	432
Total	1393	309	1339	3041

In looking at the catch and effort data, Table 12 provides a summary of the trolling catch for all locations by year, with Table 13 providing a summary of the catch by other mid-water fishing techniques. A preliminary analysis of the catch and effort data on hand at the end of June 2004 was also conducted and provided to the Fisheries Department in each country to disseminate to local fishermen.

As seen from Table 12, the trolling catch off Niue was split roughly 50/50 between open water trolling and trolling around FADs. However, in 2003, the catch split was 60% from trolling FADs and 40% for open water trolling. In 2004, with the loss of four offshore FADs on 5 January due to Cyclone Heta, fishermen changed their fishing practice, and mainly trolled in open water. It should also be noted that there is a marked season for trolling for wahoo (*Acanthocybium solandri*) along the coast (Fig. 7), and this accounted for the main part of the open water trolling effort and catch.

Little is known about the trolling catch from Aitutaki, due to the lack of data and the lack of cooperation by fishermen. The data from Rarotonga clearly shows the reliance of fishermen on FADs, however, with roughly 66% of the trolling catch taken from FADs. There is also a marked wahoo trolling season off Rarotonga (Fig. 7), and this

species accounted for most of the open water trolling catch.

In looking at the seasonality of the catch (Fig. 7), the main wahoo catch was taken by open water trolling along the coast off both Niue and Rarotonga from August to October each year. In contrast, the trolling catch around FADs extended throughout the year, although reported catches during the months of August and September were low, possibly as a result of fishermen concentrating on wahoo fishing along the coast.

The main species caught around the FADs off Rarotonga were yellowfin tuna (*Thunnus albacares*) and skipjack tuna (*Katsuwonus pelamis*), which made up around 71% and 17%, respectively. Wahoo and mahi mahi (*Coryphaena hippurus*) were also common in the catch, making up around 5% each of the FAD trolling catch. The catch off the Niue FADs was more evenly

Table 12: Summary of trolling catch by location for the different areas fished

Island/ year	Total effort (h)	Inshore FADs		Offshore FADs		Open water		Total	
		No.	Kg	No.	Kg	No.	Kg	No.	Kg
Niue									
2001	28	3	30	2	14	23	307	28	351
2002	1,749	258	2,181	1,958	6,986	1,042	10,731	3,258	19,898
2003	2,638	184	1,651	3,822	12,365	859	8,196	4,865	22,212
2004	767	61	641	95	644	833	6,480	989	7,765
Sub-total	**5,182**	**506**	**4,503**	**5,877**	**20,009**	**2,757**	**25,714**	**9,140**	**50,226**
Aitutaki									
2002	1,057	222	1,126	876	4,878	404	3,505	1,502	9,509
2003	85	0	0	121	721	54	316	175	1,037
Sub-total	**1,142**	**222**	**1,126**	**997**	**5,599**	**458**	**3,821**	**1,677**	**10,546**
Rarotonga									
2002	2,433	99	433	2,819	10,809	436	4,007	3,354	15,249
2003	4,459	399	1,761	4,526	18,807	1,260	9,916	6,185	30,484
2004	650	7	52	360	2,259	218	1,686	585	3,997
Sub-total	**7,541**	**505**	**2,246**	**7,705**	**31,875**	**1,914**	**15,609**	**10,124**	**49,730**
Total	**13,865**	**1,233**	**7,875**	**14,579**	**57,483**	**5,129**	**45,144**	**20,941**	**110,502**

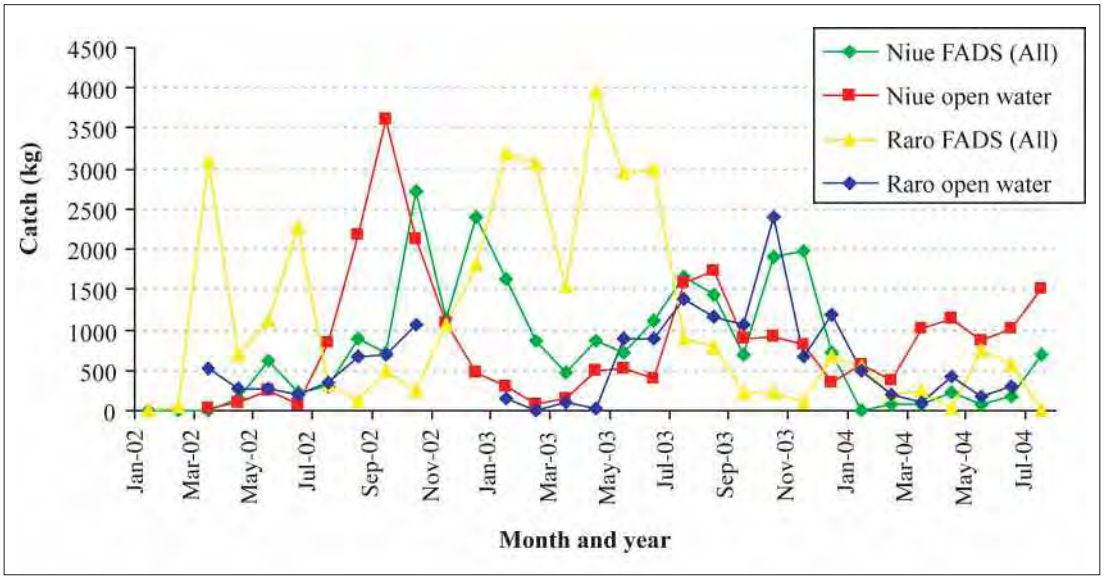

Figure 7: Trolling catch (all species) for Niue and Rarotonga by month

spread amongst the same four species. Most common was yellowfin tuna (31%), followed by skipjack tuna (30%), with wahoo and mahi mahi each making up around 16% of the catch.

Overall, the trolling effort in both locations moved between the FADs (for the four species mentioned above) and open water trolling (primarily for wahoo in season). This indicates that FADs play an important role in the fishing activities that occur in both locations. The FADs provide a known fishing location that can be targeted in the early morning and late afternoon, which are the two main feeding times for tunas, when fish concentrate or aggregate around the FADs. Fishermen cut their running costs by going to FADs and not searching for tuna schools off the coast. The data indicate that the two types or areas of trolling complement each other and increase the number of areas available to fishermen, while also increasing their chance of having a good catch.

Limited fishing effort was devoted to mid-water fishing techniques of using vertical longlines, single-hook drift lines, or mid-water handlines (drop-stone and palu-ahi). Yellowfin tuna was the main fish caught by these methods off both Niue and Rarotonga (71% and 76%, respectively). Mahi mahi was the next most common fish, making up around 17% of the mid-water catch from FADs off Niue, and around 18% off Rarotonga. Wahoo and skipjack tuna caught by these methods made up only a small percentage of the catch in both locations.

The catches from mid-water fishing techniques around FADs are relatively small at present, although the methods becoming more popular. Use of these methods decreased the amount of fuel used, thus cutting operational costs. It is anticipated that more fishermen will use these methods in the future as fuel prices in the Pacific increase.

Cost benefit analysis of the project FADs

One of the main objectives of this FAD research project was to conduct a cost-benefit analysis of the catch and effort data to estimate the benefits or otherwise to the use of FADs. The analysis is based on the catch and effort data collected from small-scale commercial or part-time fishermen's logbook returns. In both Niue (Table 14) and Rarotonga (Table 15), a price has been applied to the catch by species, with the value being an estimated average based on the actual fish prices fishermen received during 2003 and 2004 in each location for these species.

This analysis is based only on the actual data collected. In reality, it is estimated that the catch and effort data collected in both Niue and Rarotonga represents just 20–40% of the commercial and part-time fishing effort in each location. Therefore, the data presented in Tables 14 and 15 represent about one-third of the total catch in each location, meaning that these figures could conservatively be multiplied by three to equal the total catch from small-scale commercial and part-time fishing in each location (note the resultant figure would still not account for recreational fishing).

The two main components to the commercial and part-time fishing activities conducted in Niue and Rarotonga are fishing around FADs and fishing in open water. Trolling is the primary open water fishing method, although some bottom-fishing and catching of flying-fish occurs at night. The Niue catch (Table 14) from FADs was 27,468 kg of fish over the course of the project life, with a value of

Table 13: Summary of catch by other mid-water fishing techniques by location

Island/ year	Total effort (h)	Vertical longline		Drop-stone		Palu-ahi		Single hook line		Total	
		No.	Kg	No.	Kg	No.	Kg	No.	Kg	No.	Kg
Niue											
2002	152	36	486	75	246	0	0	10	149	121	881
2003	286	136	1,253	88	476	0	0	0	0	224	1,729
2004	52	23	340	0	0	0	0	6	23	29	363
Sub-total	**490**	**202**	**2,079**	**163**	**722**	**0**	**0**	**16**	**172**	**374**	**2,973**
Aitutaki											
2002	55	6	104	12	49	0	0	1	38	19	191
Sub-total	**55**	**6**	**104**	**12**	**49**	**0**	**0**	**1**	**38**	**19**	**191**
Rarotonga											
2002	389	56	928	164	866	24	266	5	67	249	2,127
2003	386	61	745	113	743	41	323	1	12	216	1,823
2004	128	72	822	38	272	2	40	1	5	113	1,139
Sub-total	**902**	**189**	**2,495**	**315**	**1,881**	**67**	**629**	**7**	**84**	**578**	**5,089**
Total	**1,446**	**397**	**4,678**	**490**	**2,652**	**67**	**629**	**24**	**294**	**971**	**8,253**

Table 14: Catch weight and value of catch for Niue, based on the following value by species in New Zealand dollars (NZD): yellowfin tuna, 6.00/kg; skipjack tuna, 4.00/kg; wahoo, 7.00/kg; and others, 6.00/kg

Year and method	Yellowfin tuna		Skipjack tuna		Wahoo		Other		Total	
	Kg	Value	Kg	Value	Kg	Value	Kg	Value	Kg	Value
FAD fishing methods										
2001 – trolling	0	0	0	0	10	70	20	120	30	190
2002 – trolling	2,120	12,720	2,173	8,692	2,057	14,399	2,817	16,902	9,167	52,713
2003 – trolling	4,992	29,952	5,244	20,976	1,410	9,870	2,367	14,202	14,013	75,000
2004 – trolling	497	2,982	31	124	434	3,038	323	1,938	1,285	8,082
Sub-total	**7,609**	**45,654**	**7,448**	**29,792**	**3,911**	**27,377**	**5,527**	**33,162**	**24,495**	**135,985**
2002 – all mid-water	655	3,930	0	0	31	217	195	1,170	881	5,317
2003 – all mid-water	1,147	6,882	26	104	176	1,232	403	2,418	1,752	10,636
2004 – all mid-water	296	1,776	0	0	10	70	34	204	340	2,050
Sub-total	**2,098**	**12,588**	**26**	**104**	**217**	**1,519**	**632**	**3,792**	**2,973**	**18,003**
Total for FAD fishing	**9,707**	**58,242**	**6,474**	**29,896**	**4,128**	**28,896**	**6,159**	**36,954**	**27,468**	**153,988**
Open-water trolling										
2001 – trolling	0	0	0	0	292	2,044	15	90	307	2,134
2002 – trolling	411	2,466	633	2,532	8,799	61,593	888	5,328	10,731	71,919
2003 – trolling	1,044	6,264	286	1,144	5,381	37,667	1,495	8,970	8,196	54,045
2004 – trolling	1,451	8,706	747	2,988	3,875	27,125	407	2,442	6,480	41,261
Total	**2,906**	**17,436**	**1,666**	**6,664**	**18,347**	**128,429**	**2,805**	**16,830**	**25,714**	**169,359**

Table 15: Catch weight and value of catch for Rarotonga, based on the following value by species in New Zealand dollars (NZD): yellowfin tuna, 6.00/kg; skipjack tuna, 5.00/kg; wahoo, 7.00/kg; and others, 6.00/kg

Year and method	Yellowfin tuna		Skipjack tuna		Wahoo		Other		Total	
	Kg	Value	Kg	Value	Kg	Value	Kg	Value	Kg	Value
FAD fishing methods										
2002 – trolling	7,065	42,390	2,516	12,580	285	1,995	1,376	8,256	11,242	65,221
2003 – trolling	15,376	92,256	3,181	15,905	879	6,153	1,132	6,792	20,568	121,106
2004 – trolling	1,783	10,698	318	1,590	31	217	179	1,074	2,311	13,579
Sub-total	**24,224**	**145,344**	**6,015**	**30,075**	**1,195**	**8,365**	**2,687**	**16,122**	**34,121**	**199,906**
2002 – all mid-water	1,540	9,240	2	10	0	0	585	3,510	2,127	12,760
2003 – all mid-water	1,213	7,278	20	100	16	112	552	3,312	1,801	10,802
2004 – all mid-water	1,084	6,504	0	0	0	0	55	330	1,139	6,834
Sub-total	**3,837**	**23,022**	**22**	**110**	**16**	**112**	**1,192**	**7,152**	**5,067**	**30,396**
Total for FAD fishing	**28,061**	**168,366**	**6,037**	**30,185**	**1,211**	**8,477**	**3,879**	**23,274**	**39,188**	**230,302**
Open-water trolling										
2002 – trolling	1,024	6,144	185	925	1,797	12,579	1,001	6,006	4,007	25,654
2003 – trolling	3,229	19,374	1,220	6,100	4,764	33,348	703	4,218	9,916	63,040
2004 – trolling	565	3,390	284	1,420	509	3,563	328	1,968	1,686	10,341
Total	**4,818**	**28,908**	**1,689**	**8,445**	**7,070**	**49,490**	**2,032**	**12,192**	**15,609**	**99,035**

NZD 153,988. The open water trolling catch for Niue equalled 25,714 kg of fish, with a value of NZD 169,359. It should be noted that some of the open water catch could actually be catch associated with FADs, as fishermen troll past each of the inshore FADs during their open water trolling, and may have caught fish close to the FADs but recorded them as open water catch.

The Rarotonga catch (Table 15) from the FADs was much higher than in Niue: 39,188 kg with a value of NZD 230,302. In contrast, the catch from open water trolling was much lower than in Niue: 15,609 kg, with a value of NZD 99,035.

Table 16 presents a summary of the funding spent on FAD materials, including materials used for the different aggregators being trialled, and the freight costs for getting the materials to each project location. Funding for the

materials was provided primarily by this project, although some complimentary funding was provided by Taiwan/ROC to support project activities. The value of the recorded catch is also provided in Table 16, although as previously stated, this represents an estimated one-third of the actual catch.

The cost of all materials provided to Niue equalled NZD 91,007. This included the cost of the eight original FADs and the three replacement FADs (one deployed in 2003 and two in 2004). In addition, there are materials available in Niue to construct three additional FADs. Unfortunately four of the five project FADs were lost in January 2004, due to Cyclone Heta, which greatly changed the fishing activities of local fishermen. This resulted in fishermen doing more open water trolling, as only one offshore FAD remained in early 2004, which was not very productive.

In Rarotonga, the value of the FAD materials provided came to NZD 90,480. About one-third of these materials were used off Aitutaki, although these fishermen did not provide enough logbook data to allow a meaningful analysis. Therefore, the analysis is based on catch data from Rarotonga alone, although costs include the full cost of all FAD materials. Four FADs were deployed initially off Rarotonga, with one replacement FAD deployed in 2003. In addition, three FADs were initially deployed off Aitutaki, with one replacement in 2003. Enough materials are available in Rarotonga to deploy another three FADs.

In both Niue and Rarotonga, the value of the catch far exceeded the cost of the materials, especially given the fact that there are still materials on hand to deploy three replacement FADs at each location. This will allow the continuation of the FAD programme and provide ongoing FADs for fishermen to fish around, thus increasing the value of the catch taken from them with no additional costs in FAD materials. Therefore, the figures presented in Table 16 reflect only the initial benefits to fishermen from the FADs, as the catches will be ongoing as long as the FADs stay on station. In addition, the value of the catch in Table 16 is estimated to be around one-third of the actual catch (NZD 491,964 for fishing around FADs off Niue and NZD 690,906 for fishing around FADs off Rarotonga); the full cost of the FAD materials is already accounted for.

In examining the overall catch, FADs are a major contributor to the success of small-scale fishing operations in both locations. The social good that these provide for local communities is also very important, as there are many subsistence and recreational fishermen that use the FADs to catch fish for their families or for sport or pleasure. Fish taken by commercial or part-time fishermen are available for sale; the limited market on Niue restricts the amount of fishing and the catch taken at some times of the year, however. Based on the data collected by the project, there is no question that the benefits to local small-scale fishermen and local communities far outweighs the cost of the FAD materials. Ongoing FAD programmes should be continued by governments as a way to support local communities and the small-scale fishing sector.

New FAD technical manual

The final output of the FAD research project was to produce a technical manual covering the new and recommended designs for FADs based on the project results. This output has been completed: the "Manual on fish aggregating devices (FADs): lower-cost moorings and programme management" was produced in English in June 2005. The French version of this manual was completed in July 2005. For more information, please contact the Fisheries Development Section at: Capture@spc.int

Table 16: Value of the FAD materials and the catch taken from FADs and open water in both locations — all values in New Zealand dollars (NZD)

Item	Niue	Rarotonga
FAD materials and freight — New Zealand funded	80,075	82,280
FAD materials and freight — Taiwan/ROC funded	10,007	8,200
Total value of materials and freight	**91,007**	**90,480**
Value of the FAD trolling catch	135,985	199,906
Value of the FAD mid-water catch	18,003	30,396
Total value of the FAD catch	**153,988**	**230,302**
Value of the open water trolling catch	**169,359**	**99,035**

Summary

Community surveys were conducted three times each in Niue, Aitutaki and Rarotonga, at one-year intervals. Over 600 households were interviewed between the three locations, with 479 households (111 on Niue, 200 on Aitutaki and 168 on Rarotonga) being interviewed on all three occasions. A further 74 households were interviewed on two occasions. Benefits accruing to the surveyed communities from having FADs adjacent to their villages appear to be in two forms, direct and flow-on. The main beneficiaries are local fishermen with canoes and boats, who benefit directly. The FADs increased their fishing areas, and increased catches. Canoe fishermen benefited if a FAD was close enough to shore for them to access it safely, which was the case in Niue.

Boat fishermen were able to fish both offshore and inshore FADs and increase their catches, while reducing their operating costs (by using less fuel). They were also able to travel along the coast to fish the FADs located off different villages, whereas canoe fishermen were restricted to the FAD adjacent to their village. In most cases, fishermen would keep what they needed from the catch and sell the surplus. The flow-on benefits were in the form of fish being distributed by the fishermen to family, relatives and friends, especially when catches were good.

Analysis of the sex disaggregated data collected during the community surveys revealed that women in all three locations were mainly involved in reef fishing and reef gleaning. Males conducted the majority of fishing activities, however, especially in terms of fishing outside the reef in canoes or boats. The split of fishing effort varied between the three locations, with gillnetting a main method used in Aitutaki (which has a large lagoon). Baitfishing from canoes was a traditional fishing method that many men were involved in off Niue.

A catch and effort data collection system was implemented in March/April 2002 in each project location. Fishermen were asked to complete a logbook that covered their fishing activities by method used. Some fishermen in Niue and Rarotonga provided excellent data from the outset, but it was difficult to get a lot of fishermen to do this consistently. Over 3000 logsheets were completed, and these showed a marked season for wahoo trolling in open water along the reef (August to October), while catches from FADs were spread more evenly throughout the year. Trolling was the main fishing method, with mid-water fishing methods used around the FADs from time to time.

To conduct a cost benefit analysis in regard to the use of FADs, a dollar value was assigned to the catch by species, based on the average price fishermen received in 2003 and 2004. The Niue catch from FADs was 27,468 kg of fish over the project, with a value of NZD 153,988. The open water trolling catch for Niue equalled 25,714 kg with a value of NZD 169,359. The Rarotonga catch from FADs (39,188 kg) was much higher than Niue's, and had a value of NZD 230,302. In contrast, the catch from open water trolling in Rarotonga was much lower than in Niue (15,609 kg, with a value of NZD 99,035). The reported catch figures are estimated to be around one-third of the actual catch; this would increase the value of the FAD-related catch to around NZD 491,964 in Niue and NZD 690,906 in Rarotonga.

The cost of all FAD materials provided to Niue equalled NZD 91,007. This includes the cost of eight original FADs, the three replacement FADs that were deployed, and the materials still available in Niue (sufficient for three additional FADs). The cost of the materials for Rarotonga FADs equalled NZD 90,480. In the case of Rarotonga, four FADs were deployed initially, with one replacement FAD deployed in 2003. In addition, three FADs were initially deployed off Aitutaki with one replacement in 2003. Materials are available in Rarotonga to deploy three additional FADs.

The value of the catch far exceeded the cost of the materials in both Niue and Rarotonga,, especially as there are still materials on hand for three replacement FADs at each location. In terms of the overall catch, FADs are a major contributor to the success of small-scale fishing operations in both locations. These also provide important social benefits for local communities, as there many subsistence and recreational fishermen use the FADs to catch fish for their families or for sport or pleasure. Fish taken by commercial or part-time fishermen are available for sale, although the market in Niue is limited, which restricts the amount of fishing and the catch taken at some times of year. Based on the data collected by the project, it is clear that the benefits to local small-scale fishermen and local communities far exceeds the cost of the FAD materials. Ongoing FAD programmes should be continued by government as a way to support local communities and the small-scale fishing sector.

The FAD research project has been widely publicised, with results published in SPC's *Fisheries Newsletter* on a quarterly basis. Two major articles appeared in the *Fisheries Newsletter* (#105 and #106) that presented the results as of the end of the project's second year. *Fisheries Newsletter* #112 provided the final results of the project in regard to FAD mooring designs, aggregators and costs. The production of a technical manual with recommended FAD designs was completed in English in June 2005, and in French in July 2005.