

Uniformity and Regional Variation in Marine Fish Catches from Prehistoric New Zealand



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THE DISCRIMINATION OF UNIFORMITY AND VARIATION in archaeological evidence is very much dependant upon the scale of analysis. Maori culture represents, at the same time, a variation on consistencies of East Polynesian ancestry and a complex of regional variations on underlying uniformity—not to mention local deviations from regional generalities. Cultural variation at the regional level in New Zealand, the scale at which this paper is pitched, was first discussed by Skinner (1921)—who took an age-area approach after reading Clark Wissler's paper delivered at the 1919 (Honolulu) Pacific Science Congress—and later was accorded formal status in Golson's (1959) adaptation of Willey and Phillips' (1958) schema to Maori material culture. It has been elaborated subsequently across a range of additional interests, including subsistence and settlement patterns (Anderson and McGlone 1992; Green 1975; Leach 1984), houses (Anderson 1986*a*), and dialects (Harlow 1979), among other topics. The underpinning proposition is that, beyond a core of common features, there were some differences in cultural traits or activities at a regional level that could be attributed to the influence, over time and mediated by perception and behavior, of geographically variable environmental factors—notably distance, climate, and biology. Recognition of this is important for the light it casts upon processes of development and change in Maori prehistory (or in that of other Polynesian societies, e.g., Kirch 1990).

The hypothesis is argued most cogently with respect to subsistence activities, and foremost among those activities throughout New Zealand's prehistory was sea-fishing. My intention in this paper is to use osteological evidence of marine fishing to define and account for certain uniformities in the prehistoric fishing strategy and to outline and discuss regional variations in the catch patterns.

Sea-fishing was a prominent feature of Maori subsistence, its importance marked, *inter alia*, by the frequency with which shell middens, generally rich in fish remains, occur about the New Zealand coasts. In southern New Zealand there were 947 middens recorded (by the New Zealand Historic Places Trust) in 1989 (Anderson 1989*a*), about one per km of coastline. In Muriwhenua (northern

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Northland), 1267 middens were recorded (Leach 1989*b*), which is about three to five per km of coastline. Undoubtedly, these are minimum figures, but they still suggest heavy coastal exploitation given the low population densities (0.02 people per km² in the southern district and 1.41 people per km² in Northland by A.D. 1800 [from data in Lewthwaite 1950]) and the brevity of prehistory (about 700 years [Anderson 1991]).

Yet neither what might have been distinctive of Maori sea-fishing as a whole in the early European era nor regional variety in catches is evident in the standard ethnographic works (Best 1929; Hamilton 1908) and other relevant reviews (e.g., Beattie 1994; Firth 1972). The emphasis of these is upon fishing techniques, with merely incidental reference to taxa and none to the characteristics of catches. In Best's seminal work (1929), for example, only kehe (marblefish), kahawai, manga (barracouta), and hapuku (groper) receive more than passing mention.¹

Analysis of archaeological collections of Maori fishing gear would provide one approach to the ethnology and prehistory of fishing, but at present there is no sufficiently comprehensive and quantitative description of the material. There are many idiosyncratic descriptions of localized fish hook collections, but no agreement on typology nor any systematic attempt to distinguish stylistic from functional attributes (cf. Allen 1996). Some very broad features of fish hook distribution are suggested by current evidence, such as a southern emphasis on lure hooks (Hjarno 1967) and a northern dominance of bait hooks (Crosby 1966), but these are impressions that require much better documentation before technological arguments can be brought to bear. Consequently, the discussion here is confined primarily to the archaeological evidence of fish remains.

I refer in this material to quantitative data based on counts of fish bone as "catch" data (these are all expressed as Minimum Number of Individuals [MNI] because NISP [Number of Identified Specimens] is not used routinely in New Zealand fish bone research). Of course, there are many ways (such as prehistoric processing, differential survival, archaeological recovery, analytical processing, etc.) in which the composition of actual catches in prehistory might have become distorted in the final product of archaeological evidence, so the term cannot be taken to imply precise representation of catches.

I present a new set of data on catch patterns, compare it with an existing set, and discuss three questions about the relative variation disclosed. Can a common Maori fishing strategy be defined? How did catch patterns vary between regions and do the present data agree with expectations? And, to what extent is temporal variation involved in the regional differences? I then comment briefly on matters of methodology and the broader economic context in which prehistoric marine fishing existed.

COMPOSITION OF CATCH DATA SAMPLES

Systematic attempts to identify large numbers of fish bones from archaeological collections began in the 1960s in New Zealand, but data from sufficient sites to make worthwhile any attempt to look at catch patterns on a regional basis have accumulated more recently. The first survey (Anderson 1986*b*) collated data for southern New Zealand and showed that there were some differences in the catch between the eastern and southern coasts of the South Island that might be ascribed

to relative difficulty of fishing conditions. There were subsequent analyses of South Island (Anderson 1989a; Leach 1989a) and northern North Island data (Anderson 1989b; Leach 1989b; Nichol 1988). The first New Zealand-wide study was by Leach and Boocock (1993), who provided a first approximation of overall characteristics and regional differences in fish catches. This paper builds on that study.

Leach and Boocock (1993) report two sets of results: those arising from their analysis of existing fish bone collections and additional results they regard as reliable that were obtained by others. Reliability is necessarily a subjective quality, but identifications by archaeologists with substantial experience working with fish bone and access to large comparative collections, especially the collections at the University of Otago and the Museum of New Zealand, comprise this category. It is called "MNI 1" in the Leach and Boocock (1993) compendium and consists of collections from 26 sites. The second or "MNI 2" data set consists of collections from 63 sites identified in the museum project. There is some overlap of these sets of results so, taking the latter as preferred, there is an MNI 2 database of MNI = 12,091 identifications and a larger database (MNI = 17,624) of MNI 1 collections. All of the analysis of regional and temporal patterning in Leach and Boocock (1993) is with respect to sample MNI 2 exclusively.

For present purposes, I have modified both samples as follows: removed Chathams sites data (MNI = 10,189), because my present topic is mainland New Zealand; deleted MNI 1 results for Harataonga East, which are on NISP mistaken for MNI; and replaced the older set of identifications from Houhora with those established by Nichol (1988). Further, because the identification of cartilaginous fish taxa (class Chondrichthyes) from archaeological remains is still very difficult and selective, I have reduced all the results to those for bony fishes (class Osteichthyes) of marine provenance (here including *Anguilla* sp.). Lastly, I have left out all collections with MNI of less than five. This is because there are many reports of a few individuals of fish where the identifications may be acceptable, but the material was collected in circumstances where the representativeness of the results, compared with those from systematic sampling or large samples, is distinctly questionable (e.g., a few casually collected fish bones from extensive middens).

The effect of these changes is to reduce the Leach and Boocock (1993) MNI 1 sample to 14 sites (total MNI = 5147) and the MNI 2 sample to 50 sites (total MNI = 11,899). These are called samples FBA (Table 1) and FBB (Table 2), respectively.

Following the same restriction to marine Osteichthyes and samples of MNI of five or more, sets of reliably identified results from additional sites were collected. Some of these are sites that were missed in the Leach and Boocock (1993) survey, whereas others are collections identified since that survey was compiled in 1989. This database comprises 41 sites (total MNI = 8555) and is referred to as sample FBC. It is divided into four regional groups: NNI (northern North Island), SNI (southern North Island), NSI (northern South Island), and SSI (southern South Island), with boundaries as in Leach and Boocock (1993: Figures 3 and 4). The results are shown in Tables 3–6 and the sites and regions in Figure 1.

In discussing the various results below, I have combined samples FBA and FBC to create sample FBD (55 sites, total MNI = 13,702), shown in Table 7. This comprises all the material compiled by me together with that reported in Leach and Boocock (1993), but not used in their analyses (i.e., modified MNI 1). In these

TABLE 1. THE MODIFIED LEACH AND BOOCOCK (1993) SAMPLE (FBA) OF RELIABLY IDENTIFIED COLLECTIONS.

TAXA	REGION				TOTAL MNI	TOTAL %
	NNI	SNI	NSI	SSI		
Eel		27	1		28	0.54
Conger Eel		3	7		10	0.19
Red Cod		45	41	1413	1499	29.13
Ling		1	12	144	157	3.05
John Dory	2				2	0.03
Scorpion Fish			3		3	0.05
Sea Perch	1	1		1	3	0.05
Red Gurnard	2	9	4		15	0.29
Groper		6	4	44	54	1.04
Trevally	4	2	1		7	0.13
Jack Mackerel		1			1	0.01
Mackerels		11	4		15	0.29
Kahawai	18	31	2		51	0.99
Snapper	287	10	235		532	10.34
Marblefish	1	1			2	0.03
Tarakihi	10	71	20		101	1.96
Blue Moki	3	9	17	3	32	0.62
Trumpeter				4	4	0.07
Wrasses	58	74	66	40	238	4.62
Butterfish		5	2	2	9	0.17
Blue Cod	2	11	11	10	34	0.66
Black Cod				2	2	0.03
Barracouta	2	21	113	1979	2115	41.11
Common Warehou		3			3	0.05
Flounders				2	2	0.03
Brill				1	1	0.01
Leatherjacket	169	1	56		224	4.35
Porcupine Fish	1				1	0.01
Totals	560	343	599	3645	5147	99.85

Sites: Andrewburn, Huriawa, Kelly's Beach, Avoca, Omimi, Pounaweia, Purakaunui, Riverton, Rotokura, Slipper Island, Tairua, Washpool, Whangamata, Cross Creek.

Source: Leach and Boocock 1993.

NNI = Northern North Island; SNI = Southern North Island; NSI = Northern South Island; SSI = Southern South Island.

samples, the calculation of MNI is various with respect to unit. Some of the MNI are calculated by treating the entire excavated assemblage as a single unit and counting the single most abundant element, by taxon and side, in each case. In other cases the total assemblage is divided by stratigraphic layer and/or by excavation area. I have taken the data as they are presented, but in the few instances where a choice is possible, I have preferred data presenting the minimum MNI, by taking the assemblage as a single unit. The difference can be considerable, especially with large assemblages from complex sites. At Shag River Mouth, for example, the data from the main excavation area (SM/C:Dune), provide a minimum MNI total of 1262 treated as a single assemblage, but a maximum MNI total of 2134 if each stratigraphic division and square meter of excavation is regarded as a discrete unit for MNI calculation (Anderson and Smith 1996).

TABLE 2. THE MODIFIED LEACH AND BOOCOCK (1993) SAMPLE (FBB) OF COLLECTIONS IDENTIFIED IN THE MONZ PROJECT

TAXA	REGION				TOTAL MNI	TOTAL %
	NNI	SNI	NSI	SSI		
Eel	3	29		1	33	0.27
Conger Eel		22	4	43	69	0.57
Morid Cods	4	11	120	1099	1234	10.37
Ling		3	25	390	418	3.51
John Dory	3	11			14	0.11
Scorpaenidae				405	405	3.41
Scorpion Fish		4		12	16	0.13
Red Gurnard	33	4		2	39	0.32
Groper	2	10	16	73	101	0.84
Trevally	3	13	1	1	18	0.15
cf. Jack Mackerel		14	1	17	32	0.26
Kingfish	3	6			9	0.07
Kahawai	27	78	2		107	0.89
Snapper	488	269	163	10	930	7.81
Marblefish		3		1	4	0.03
Tarakihi	19	16	5	191	231	1.94
Blue Moki	8	30	2	9	49	0.41
Trumpeter		1		52	53	0.44
Wrasses	34	129	11	1316	1490	12.52
Butterfish		38		19	57	0.47
Blue Cod	10	13	4	614	641	5.38
Giant Stargazer				4	4	0.03
Black Cod				56	56	0.47
Barracouta	21	57	338	5375	5791	48.66
Gemfish		1		1	2	0.02
Blue Mackerel		1			1	0.01
Common Warehou	1	5		5	11	0.09
Flounders		1		3	4	0.03
Sole			1	7	8	0.06
Leatherjacket	63		2	7	72	0.61
Totals	722	769	698	9720	11899	99.88

Sites: All MNI 2 (Leach and Boocock 1993: Table 139), minus eight sites of MNI > 5 and five sites of reidentified Chathams assemblages.

All of the FBB sample (the modified MNI 2 sample of Leach and Boocock 1993) has had MNI calculated according to the latter, maximal protocol. This almost certainly provides significantly larger numbers than there were individuals represented in many cases, and estimation of MNI by spatially undifferentiated chronological units is preferable, in my view. However, the virtue of a standardized approach, whichever is chosen, is that it allows relative differences between assemblages to be more accurately portrayed than when various different procedures have been employed.

There are several ways in which fish catches can be compared between regions. One of them is to place the data into rank order, a common procedure for small sample sizes where proportional data carry dubious significance. In the present case, the regional samples are large enough to justify the use of percentages, par-

TABLE 3. THE ADDITIONAL NORTHERN NORTH ISLAND (NNI) COLLECTIONS (IN SAMPLE FBC)

TAXA	SITES																		TOTAL	%
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R		
Eel			1		1	1	1								1	1			6	0.11
Red Cod			1			1						1							3	0.05
John Dory	1		2				1								1		6		11	0.21
Red Gurnard	1		1				1				1	3			3		2	13	25	0.49
Groper											1						1		2	0.03
Trevally	2		132			2	1								2		5	1	145	2.87
Jack Mackerel	1		10	1		1											115		128	2.53
Mackerel																		76	76	1.51
Kingfish			1			8	1												10	0.19
Kahawai	11	2	55				1					1		2	3	1	23	1	99	1.96
Snapper	592	9	2207	321		390	386	13	20	18	8	20	4	4	12	27	14	1	4046	80.15
Parore			1																1	0.01
Blue Maomao												2						2	4	0.07
Porae			1	1		1		1											4	0.07
Tarakihi	4	1	2				2	1				7					2		19	0.37
Red Moki	2						1									1			4	0.07
Blue Moki																		1	1	0.01
Trumpeter			2									4							6	0.11
Grey Mullet					1	1													2	0.03
Yellow-eyed Mullet					1	175	4								1				181	3.58
Wrasses	18	2	2	6	1	2						26	2			5	1	4	69	1.36
Butterfish												1							1	0.01
Blue Cod	1	1	1			1	1					3					1		9	0.17
Estuarine Stargazer																	1		1	0.01
Barracouta		2	2		1		1	1		3	2	1					2	4	19	0.37
Blue Mackerel															2		9	10	21	0.41
Flounders																		9	9	0.17
Leather Jacket	1	1	3			1						133	3				2		144	2.85
Porcupine Fish	1		1																2	0.03
Totals	635	18	2425	329	5	584	401	16	20	21	12	202	9	6	25	35	184	122	5048	99.81

Sites: A = Twilight Beach (Taylor 1984), B = Aupori Dunes (Leach 1989b), C = Houhora, D = Waipoua, E = NHB Site, F = Sunde Oyster lens, G = Sunde Softshore Midden (all Nichol 1988), H = Motutapu N38/30 (Allo 1970; Leahy 1972), I = N38/37 (Allo 1970), J = Westfield (Furey 1986), K = Hamlins Hill (Pearce 1977), L = Hahei N44/215 (Nichol 1986), M = N44/97 (Harsant 1985), N = Oruarangi (Best 1980), O = Raupa (Prickett 1990), P = Aotea (Fox and Cassels 1983), Q = Kohika (Nichol 1988), R = Matakana (Leach, Davidson, and Horwood 1994).

TABLE 4. THE ADDITIONAL SOUTHERN NORTH ISLAND (SNI)
COLLECTIONS (IN SAMPLE FBC)

TAXA	SITES						TOTAL	%
	A	B	C	D	E	F		
Conger Eel		2	5	2			9	1.19
Red Cod	4	1	19	3		2	29	3.84
Morid Cod	1						1	0.13
Ling				2			2	0.26
Sea Perch		1	25		4	4	34	4.51
Red Gurnard						1	1	0.13
Groper		1	6	3			10	1.32
Kahawai		1	10	4	1	2	18	2.38
Snapper	1		6	2		2	11	1.45
Marblefish		1	4				5	0.66
Tarakihi			30	5	2	5	42	5.56
Blue Moki		1	15	4		2	22	2.91
Wrasses		21	258	108	6	14	407	53.91
Butterfish		20	62	7	1	1	91	12.05
Blue Cod		6	17	5	1	3	32	4.23
Barracouta		1	37	1	2		41	5.43
Totals	6	56	494	146	17	36	755	99.96

Sites: A = Tiromoana (Fox 1978), B = Pond, C = Crescent, D = Black (Anderson 1973), E = Black Rocks Wall, F = Pararaki Wall (Leach 1976).

TABLE 5. THE ADDITIONAL NORTHERN SOUTH ISLAND (NSI)
COLLECTIONS (IN SAMPLE FBC)

TAXA	SITES								TOTAL	%
	A	B	C	D	E	F	G	H		
Conger Eels							1		1	0.15
Red Cod	12	85	25	5	79	5	36	24	271	43.29
Ling	1	7	1	1		1	10	1	22	3.51
Sea Perch						1			1	0.15
Red Gurnard		1			3				4	0.63
Groper							2		2	0.31
Jack Mackerel					6	1			7	1.11
Kahawai					2		2		4	0.63
Snapper		2	1		3	9	3		18	2.87
Tarakihi	5	11	4	1	4			18	43	6.86
Trumpeter		3			1	1			5	0.79
Yellow-eyed Mullet					2				2	0.31
Wrasses		4	1		1	1	5	10	22	3.51
Blue Cod				1	7				8	1.27
Black Cod							1		1	0.15
Barracouta	14	147	18	3	19	6	5	1	213	34.02
Blue Mackerel		1							1	0.15
Soles					1				1	0.15
Totals	32	261	50	11	128	25	65	54	626	99.86

Sites: A = Awaroa N26/18, B = N26/214, C = Bark Bay, D = Taupo Point, E = Appleby, F = Haula-shore Island (all Barber 1994), G = Panau (Jacomb 1994), H = Bruce Bay (Anderson unpub.).

TABLE 6. THE ADDITIONAL SOUTHERN SOUTH ISLAND (SSI) COLLECTIONS (IN SAMPLE FBC)

TAXA	SITES									TOTAL	%
	A	B	C	D	E	F	G	H	I		
Eel	1									1	0.04
Red Cod	241	15	28	18	12	75	9	3	3	404	19.01
Rock Cod	1									1	0.04
Ling	29	5	1	3	3	9	3	1		54	2.53
Scorpion Fish	6			1						7	0.32
Sea Perch	4								1	5	0.23
Red Gurnard				3						3	0.14
Groper	18				1	3			1	23	1.08
Carangid spp.			1							1	0.04
Jack Mackerel			1							1	0.04
Snapper	1							1		2	0.09
Marblefish		2		2						4	0.18
Tarakihi	2		2						1	5	0.23
Trumpeter	14			2				1	6	23	1.08
Yellow-eyed Mullet	1									1	0.04
Wrasses	74	6	4	4		4			13	105	4.93
Butterfish									2	2	0.09
Blue Cod	48	7	22	15		1		1	26	120	5.64
Black Cod	23	2	5	5						35	1.64
Barracouta	978	16	81	52	23	48	93	22	10	1323	62.22
Gemfish	3	1		1						5	0.23
Blue-nose Warehou	1									1	0.04
Totals	1445	54	145	106	39	140	105	29	63	2126	99.88

Sites: A=Shag Mouth (Anderson and Smith n.d.), B=Pleasant River (Anthropology unpub.), C=Pleasant River (Smith unpub.), D=Tumai (Allingham unpub.), E=Huriawa (Easdale and Jacomb 1984), F=Mapoutahi (Anderson 1983), G=Pukekura (Hamel 1992), H=Papatowai (Anderson and Smith 1992), I= West Point (Coutts and Jurisich 1972).

ticularly since there is a clear dominance of a few taxa in most cases and the discussion turns essentially upon them rather than on the numerically minor species. In addition, since Leach and Boocock (1993) turned their data (from the MNI 2 database) for each region into percentages, there is a virtue of comparability in my doing so as well. If I were to argue that the number of assemblages is important, then a different approach would be needed, such as turning all sets of MNI into percentages and deriving the means for each region. This would give equal weight to each assemblage and make some significant differences to the results. For instance, in the NNI regional sample, snapper would fall from 80 percent to 60 percent, through the influence of four assemblages in which it was represented at 10 percent or less. However, these include only 10 percent of the regional MNI total and there are 11 assemblages in which snapper occur at 66–100 percent frequency. The choice of method really depends on which features in the data are regarded as most important. The method adopted here is appropriate to the intention of treating all the data from each region as a single sample, and it gives equal weight to each identification, irrespective of whether it is part of a large or small assemblage.

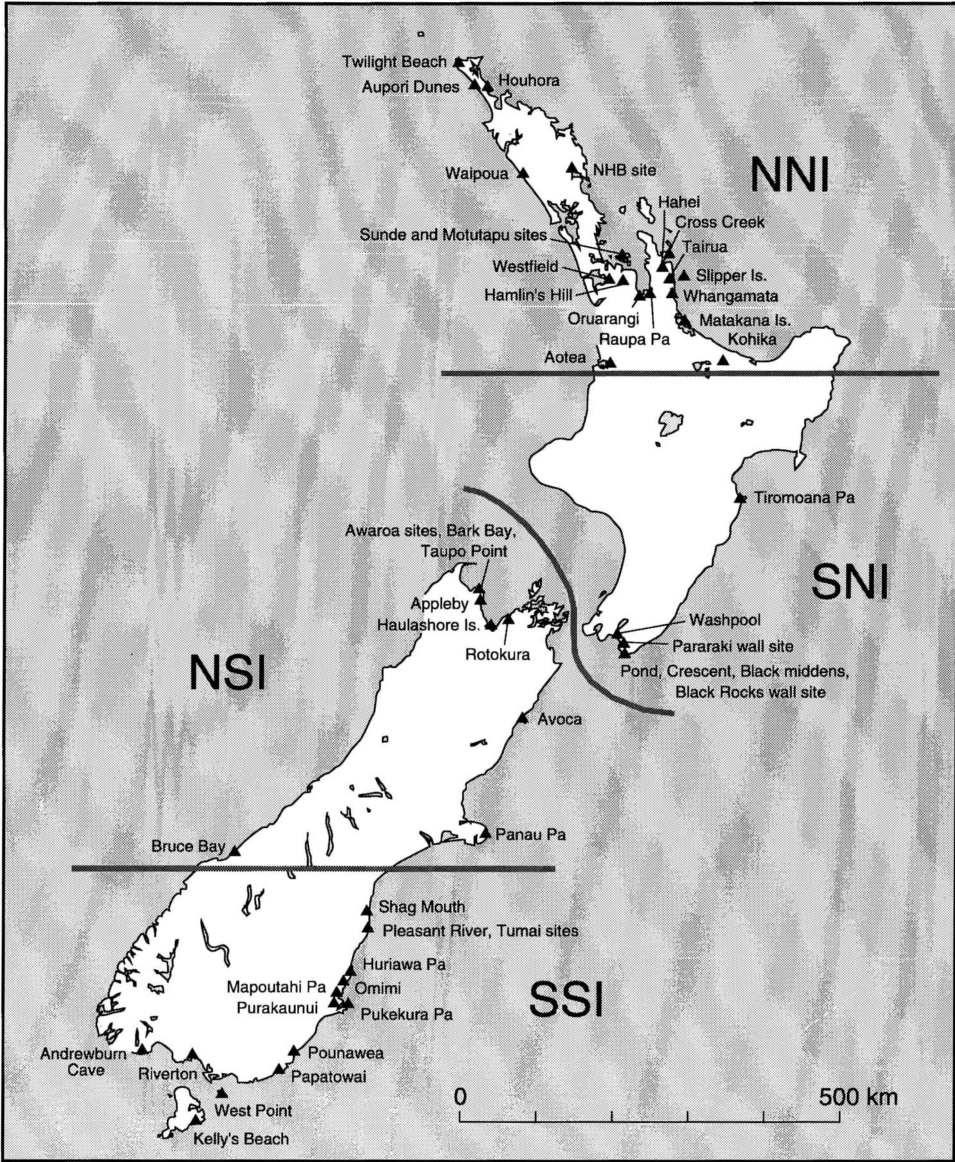


Fig. 1. Fish catch regions after Leach and Boocock (1993), and locations of sites in Tables 3–6.

To summarize, Leach and Boocock (1993) describe regional variation on the basis of their sample MNI 2, which I have modified to become sample FBB (50 sites, MNI = 11,899). My consideration of regional variation is based on a combination of two databases: FBA, which comprises Leach and Boocock's MNI 1 sample (reported but not used in their analysis) reduced to 14 sites (MNI = 5147), and FBC, which includes results from 41 additional sites (MNI = 8555). Together, these comprise sample FBD (55 sites, MNI = 13,702). Variation is discussed in terms of proportional data.

TABLE 7. COMBINED SAMPLE (FBD) OF RELIABLY IDENTIFIED COLLECTIONS (SAMPLES FBA PLUS FBC)

TAXA		REGION				TOTAL MNI	TOTAL %
		NNI	SNI	NSI	SSI		
Eel	<i>Anguilla</i> spp.	0.11	2.45	0.08	0.01	35	0.25
Conger Eel	<i>Conger verreauxi</i>	0	1.09	0.65	0	20	0.14
Red Cod	<i>Pseudophycis bacchus</i>	0.05	6.73	25.46	31.48	2206	16.11
Rock Cod	<i>Lotella</i> spp.	0	0	0	0.01	1	0.01
Morid Cods	Moridae	0	0.09	0	0	1	0.01
Ling	<i>Genypterus blacodes</i>	0	0.18	2.77	3.43	235	1.71
John Dory	<i>Zeus japonicus</i>	0.23	0	0	0	13	0.09
Scorpion Fish	<i>Scorpaena cardinalis</i>	0	0	0.24	0.12	10	0.06
Sea Perch	<i>Helicolenus papillosus</i>	0.01	3.18	0.08	0.11	43	0.31
Red Gurnard	<i>Chelidonichthys kumu</i>	0.48	0.91	0.65	0.05	48	0.35
Groper	<i>Polyprion oxygeneios</i>	0.03	1.45	0.48	1.16	91	0.66
Trevally	<i>Caranx georgianus</i>	2.65	0.18	0.08	0	152	1.11
Jack Mackerel	<i>Trachurus declivis</i>	2.28	0	0.57	0.01	136	0.99
Mackerels	<i>Trachurus</i> , <i>Scomber</i> spp.	1.35	1.09	0.32	0	92	0.67
Kingfish	<i>Seriola grandis</i>	0.17	0	0	0	10	0.06
Jacks	Carangidae	0	0	0	0.01	1	0.01
Kahawai	<i>Arripis trutta</i>	2.08	4.46	0.48	0	172	1.25
Snapper	<i>Chrysophrys auratus</i>	77.29	1.91	20.65	0.03	4609	33.64
Parore	<i>Girella tricuspidata</i>	0.01	0	0	0	1	0.01
Blue maomao	<i>Scorpius violaceus</i>	0.07	0	0	0	4	0.02
Marblefish	<i>Aplodactylus arctidens</i>	0.01	0.54	0	0.06	11	0.08
Porae	<i>Nemadactylus douglasi</i>	0.07	0	0	0	4	0.03
Tarakihi	<i>Nemadactylus macropterus</i>	0.51	10.29	5.14	0.08	210	1.53
Red Moki	<i>Cheilodactylus spectabilis</i>	0.07	0	0	0	4	0.02
Blue Moki	<i>Latridopsis ciliaris</i>	0.07	2.82	1.38	0.05	55	0.41
Trumpeter	<i>Latris lineata</i>	0.11	0	0.41	0.46	38	0.27
Grey Mullet	<i>Mugil cephalus</i>	0.03	0	0	0	2	0.01
Yellow-eyed Mullet	<i>Aldrichetta forsteri</i>	3.22	0	0.16	0.01	184	1.34
Wrasses	<i>Pseudolabrus</i> spp.	2.26	43.81	7.18	2.51	841	6.13
Butterfish	<i>Odax pullus</i>	0.01	8.74	0.16	0.06	103	0.75

Blue Cod	<i>Parapercis colias</i>	0.19	3.91	1.55	2.25	203	1.48
Estuarine Stargazer	<i>Leptoscopus macropygus</i>	0.01	0	0	0	1	0.01
Black Cod	<i>Notothenia</i> spp.	0	0	0	0.64	38	0.27
Barracouta	<i>Thrysites atun</i>	0.37	5.64	26.61	57.21	3711	27.08
Gemfish	<i>Rexea solandri</i>	0	0	0	0.08	5	0.03
Blue Mackerel	<i>Scomber australasicus</i>	0.37	0	0.08	0	22	0.16
Common Warehou	<i>Seriotelele brama</i>	0	0.27	0	0	3	0.02
Blue-nose Warehou	<i>Hyperoglyphe antarctica</i>	0	0	0	0.01	1	0.01
Flounders	<i>Rhombosolea</i> spp.	0.16	0	0	0.03	11	0.08
Brill	<i>Colistium guntheri</i>	0.01	0	0	0	1	0.01
Soles	<i>Pelotretis, Peltorhamphus</i>	0	0	0.08	0	1	0.01
Leatherjacket	<i>Parika scaber</i>	5.54	0.09	4.57	0	370	2.69
Porcupine Fish	<i>Allomycterus jaculiferus</i>	0.05	0	0	0	3	0.02
	% Totals	99.86	99.83	99.67	99.82		99.91
	MNI Totals	5608	1098	1225	5771	13702	

STRATEGIC UNIFORMITIES

What was characteristic, if anything, about the Maori sea-fishing strategy in general? Consideration of the taxonomic diversity, size ranges, and habitats of the taxa represented in catches indicates that fishing was quite narrowly focused throughout New Zealand. First, fishing was essentially confined to shallow, in-shore waters. Within the preferred depth range of snapper—20–60 m (Watkinson and Smith 1972:11)—most other important taxa in the prehistoric catch were also abundant (Ayling and Cox 1982; Graham 1956), and some were taken at shallower depths (wrasses and pelagic taxa such as barracouta, kahawai, mullets, and mackerels). None of the major species occurs most abundantly at depths below 60 m, and taxa that do occur more frequently at greater depth were caught only in relatively low numbers, for example groper (hapuku), gemfish, common warehou, and ling, which come into shallow waters on occasion but are mainly found below 100 m. Taxa that occur abundantly in deep waters, such as oilfish (*Ruvettus pretiosus*), hake (*Merluccius australis*), and hoki (*Macruronus novae-zelandiae*), do not appear in the catch at all. Offshore pelagic taxa, even those found fairly close to the coast such as skipjack (*Katsuwonis pelamis*), albacore tuna (*Thunnus alalunga*) and the larger tunas (*Thunnus* spp.), and billfish (Istiophoridae), do not appear in prehistoric catches.

Second, within shallow coastal waters, fishing focused on taxa of broad carnivorous habits. Common inshore herbivorous taxa, such as silver drummer (*Kyphosus sydneyanus*), parore (*Girella tricuspidata*), marblefish, and butterfish, were seldom caught. Similarly, common inshore plankton feeders such as demoiselle (*Chromis dispilis*) and blue and pink maomao (*Caprodon longimanus*) are scarce or absent.

Third, within the eclectic carnivores, the catch mostly comprised medium-sized taxa. The usual adult size range of snapper (30–80 cm long, 1–5 kg in weight) also encompasses the usual adult size ranges of nearly all the other common species in the catches: red cod, tarakihi, scorpionfish, kahawai, John Dory, jack mackerel, blue mackerel, blue moki, red moki, trevally, the larger wrasses and leatherjacket, and most blue cod and barracouta. Some barracouta would exceed it, but not by much, and most ling and groper would lie beyond the upper end of those ranges.

Lastly, within these parameters, there was a very strong dominance by a few taxa. The two major samples discussed here show that about 80 percent (FBB = 79.36 percent, FBD = 82.96 percent) of the bony fish catch was composed of only four families (Moridae, Sparidae, Labridae, and Gemphylidae), three of them represented essentially by single species and the fourth (Labridae) by two main species.

In attempting to understand such a narrow focus, researchers in New Zealand must acknowledge the low diversity of temperate-zone ichthyofauna at the species level compared to those of the tropics. The Philippines have at least 2500 shorefish species, and although diversity declines eastward, there are still more than 900 species in Samoa (Lieske and Myers 1994) and over 400 species in Hawai'i (Jordan and Evermann 1973). Despite its size, latitudinal extent, and coastal diversity, New Zealand has only about 150 shorefish species (Ayling and Cox 1982), of which fewer than 50 are recorded in archaeological contexts. This has considerable importance for variation in fishing strategies, but it also needs to

be understood in terms of archaeological analysis, for which a brief digression is warranted.

In tropical Polynesia, there is high species diversity within families. Even in the relatively depauperate Hawaiian Islands, there are 24 species in Carangidae, 21 in Acanthuridae, 10 in Serranidae, 48 in Labridae, 8 in Monacanthidae, 10 in Balistidae, and 11 in Scombridae (Jordan and Evermann 1973), to mention some of the families commonly represented there in archaeological fish bone collections. Therefore, between ten and twenty families in a fish bone collection, which is not unusual, might represent 100–200 species. Because few of these can be adequately identified, the routine level of identification is familial. In New Zealand, on the other hand, there is approximately the same number of families in the inshore environment, but very low species diversity (often only one or two per family), so that even large fish bone collections will commonly include less than twenty or thirty species, and they are relatively easily differentiated in bone collections. Therefore, the routine level of identification is specific. The difference means that it can be assumed that New Zealand catches are generally more narrowly focused, but that relative specialization of tropical catches, as measured by taxonomic richness and evenness (e.g., Sweeney et al. 1993), is not readily comparable with New Zealand evidence.

High species diversity, especially on coral reefs, ensures that biomass per species is relatively low. Consequently, tropical fishing commonly involves a highly diverse technology and catch. Low species diversity in temperate-zone conditions means that some exist at high biomass densities and that catching technologies can be more narrowly focused.

In northern New Zealand, the highest biomass of the larger shorefish taxa (i.e., of species more than 15 cm in adult length) is in the snapper, which averages about 24,000 kg per km of coastline in eastern Northland (from data in Ayling and Cox 1982:225). This is three times or more as high as the next most common taxa (goatfish, *Upeneichthys lineatus*, 8000 kg per km of coastline, and spotty, *Pseudolabrus celidotus*, 6000 kg per km of coastline; estimated from data in Ayling and Cox 1982). Modern catch data from inshore commercial fishing show that snapper is clearly the major species in northern New Zealand and is followed by trevally, groper, school shark (*Galeorhinus australis*), skipjack tuna (*Katsuwonus pelamis*), kahawai, and tarakihi (Waitangi Tribunal 1988:342).

No coastline biomass data are available for southern New Zealand, but the dominance of barracouta and red cod is shown in commercial inshore catches. About 20,000 tons of barracouta and 15,000 tons of red cod are caught annually, despite the fact that neither species is much valued today. There are 8000 tons of ling caught and 1000–4000 tons each of tarakihi, spiny dogfish (*Squalus acanthias*), blue cod, spotted smooth-hound (*Mustelus lenticulatus*), and school shark (Waitangi Tribunal 1992:251).

A fishing strategy that focused on a few readily available taxa of high biomass would be an efficient response to this pattern of resource distribution. However, it may not be the only factor involved in the narrow catch spectrum. Matters of technology and methodology were certainly involved, but until there has been a comprehensive and systematic study of the archaeological collections of fishing gear, most propositions about fishing strategy, including mine, are largely conjectural.

Weather and sea conditions generally, but especially in southern New Zealand

and about Cook Strait, are often dangerous for small craft (Anderson 1986b) and probably discouraged fishing expeditions from venturing far from land or staying out overnight. This possibly explains the absence of large pelagic taxa (absence of pearlshell to make the preferred lures might also have been significant, although similar materials were available). At the same time, these conditions encouraged shore fishing for some taxa, such as wrasses, which could be reliably caught in most conditions (Leach and Anderson 1979; Nichol 1986).

The scarcity of common large-bodied herbivorous taxa in prehistoric catches indicates that gill-netting was not employed to any extent, and in fact, it was possibly unknown prehistorically in New Zealand (Anderson 1986b). Most of the commonly caught species feed indiscriminately on a range of invertebrates and small fish and can be attracted by baited hooks or by lures, so a strong preference for hook and line fishing, rather than spearing, netting, or trapping, is inferred.

Bait-hook fishing was probably also selective of size ranges. A notable example is goatfish (adult length is 15–30 cm), the most common of the larger reef fish in the northern North Island (10,000 individuals per km of rocky coast in eastern Northland, compared to 6700 snapper per km; Ayling and Cox 1982). It is an eager biter, but it has a small mouth and probably could not be caught readily by many prehistoric hooks (and since it was only by catches that Maori knew what was readily available, they may have had little knowledge of this common in-shore species and therefore no incentive to adapt their technology). The scarcity of small-mouthed grey mullet compared to large-mouthed yellow-eyed mullet in catches, and the absence or scarcity of other small-mouthed carnivores that would otherwise fall within the target size range, possibly also reflects a Maori preference for the relatively large hooks that worked best in catching the main taxa (cf. Coutts 1975).

It is possible that the novel availability of large moa bones, which seems to have allowed early manufacture of relatively large one-piece hooks (at Shag River Mouth, most were 50 mm or more in maximum dimension; Anderson and Gumbley 1996) and large two-piece bait hooks as well (Coutts 1975; Hjarno 1967), simply locked the strategy on to the dense populations of medium-sized taxa. In addition, some aspects of the technology were very efficient at mass capture: for example, the use of huge seine nets in northern New Zealand harbors (Best 1929:10–12) and of the barracouta lure in southern New Zealand, where it had an observed catching rate of up to four fish per minute (Graham 1956:310–311). Undiminished productivity of the main taxa throughout the prehistoric era may have minimized any incentive to make significant changes to a successful strategy.

GEOGRAPHICAL VARIATION

Before looking at the regional differences, it is worth noting how the data set presented here indicates the need for change in conclusions drawn from the earlier database compiled by Leach and Boocock (1993). The major change is in the stronger position of snapper (Fig. 2). Sample FBB shows barracouta at 49 percent, followed by wrasses (13 percent), morid cods (10 percent), and snapper (8 percent). Sample FBD, however, shows snapper at 34 percent, followed by barracouta (27 percent), morid cods (16 percent), and wrasses (6 percent). The changes

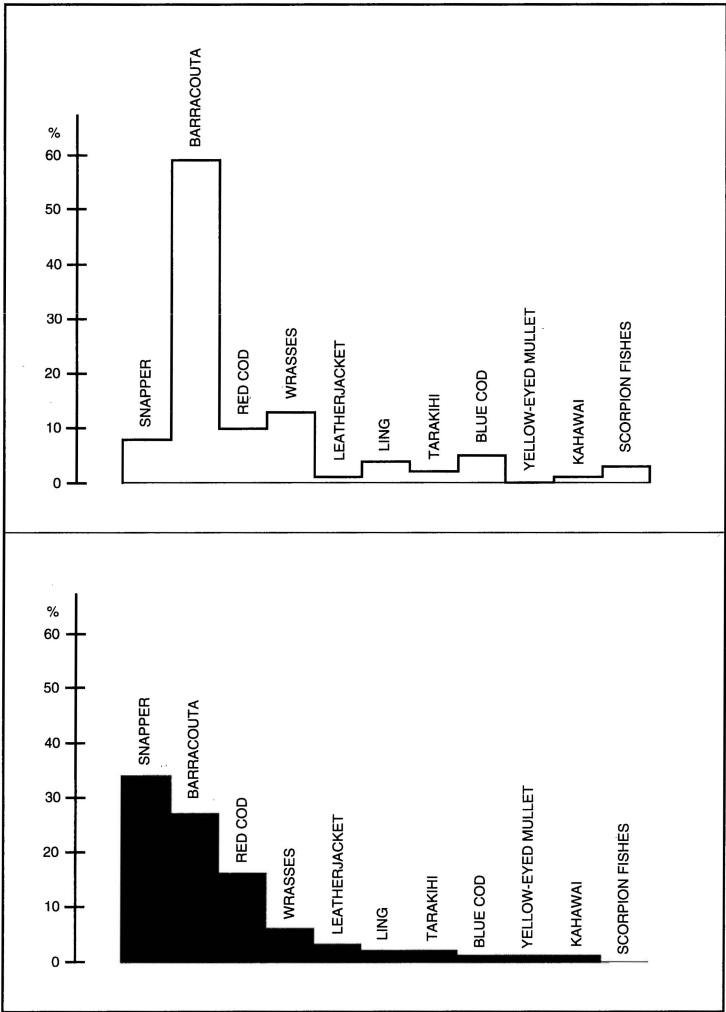


Fig. 2. Representation (percent) of major taxa in total samples of FBB (above) and FBD (below) data, showing two views of the overall pre-historic catch.

are the direct result of a balancing in the regional distribution of samples. Leach and Boocock noted that their data showed “a clear bias towards results from the South Island” (1993: 15). In fact, if the Chathams sites are removed, then South Island sites as a whole comprise 74 percent of the total. In the FBB sample, this bias is accentuated with 82 percent of MNI from SSI and 88 percent from the South Island as a whole.

In my FBD sample (Table 7), however, there are 29 North Island and 26 South Island sites, with MNI distributed as 48.9 percent in the North Island assemblages and 51.06 percent in the South Island assemblages. Consequently, the FBD sample, on this ground, offers a more balanced picture of the overall catch characteristics. In addition, if we think in terms of a fishing population that

was substantially concentrated toward the north, then snapper was probably the main species caught by Maori throughout the prehistoric era. The only caveat that might be entered is that some apparently late period middens in northern areas seem to contain relatively few fish bones, in which case the size of the northern catch may not have been proportionate to the human population density (Anderson 1989*b*). However, data are sketchy at best and this observation needs to be tested.

Within the strategic envelope of Maori fishing, there were substantial regional variations in the catch. This is expected given the geographical differentiation of the New Zealand marine ichthyofauna. It includes four components: Indo-Pacific tropical taxa (e.g., marlin, some wrasses); Indo-Pacific subtropical taxa (the dominant group, which includes snapper, trevally, tarakihi, and leatherjacket), which are mainly found north of Cook Strait; a cool-water fauna including barracouta, blue moki, blue cod, and ling among others; and a subantarctic fauna from which come the black cods or icefishes that are prominent in southern districts (Ayling and Cox 1982). The taxonomic distribution of regional catch data clearly reflects this latitudinal variation. Bearing in mind the evidence from northern and southern regions (as described above) indicating relative quantitative distribution of major taxa in the environment, it is now possible to discuss whether the current data provide descriptions of probable catch patterns by region that are more likely to withstand the addition of future evidence than those drawn from the Leach and Boocock MNI 2 database.

For NNI the main species is snapper in both cases (Fig. 3), but in somewhat different proportions (80 percent here, compared with about 65 percent in the Leach and Boocock data), and there are correspondingly lower proportions of other taxa common to both samples, such as leatherjacket and kahawai. It is probable that the broad picture of high snapper dominance, which is predictable from the biomass data described above, is secure and unlikely to change in the face of additional data.

In the SNI samples, wrasses are prominent, but otherwise the data are significantly different (Fig. 3). The Leach and Boocock results show a modest dominance of snapper (about 33 percent), followed by wrasses (16 percent) and kahawai (10 percent), whereas my data show that wrasses are more strongly dominant (54 percent), followed by butterflyfish (12 percent), and tarakihi and barracouta (5 percent each), with almost no snapper. These differences clearly reflect two geographically different samples—mine is mainly from the exposed rocky coasts of Palliser Bay, whereas the Leach and Boocock sample is mainly from western Wellington, where there are more sheltered bays and soft shores. Simply combining the MNI data from both samples suggests, fairly crudely, that wrasses would still dominate (34 percent), with snapper prominent (18 percent), and butterflyfish, kahawai, and barracouta commonly represented in catches. This seems a reasonable expectation for the southern extremities of North Island, but much of the shoreline in the region is not represented in either sample so that significant changes are anticipated in the catch data when new collections are analyzed.

Snapper remain quite prominent (22 percent) in the Leach and Boocock NSI sample, but the main species is barracouta (47 percent), with red cod at 16 percent (Fig. 3). My sample is rather different, with very little snapper and high proportions of both red cod (43 percent) and barracouta (34 percent). There is only a

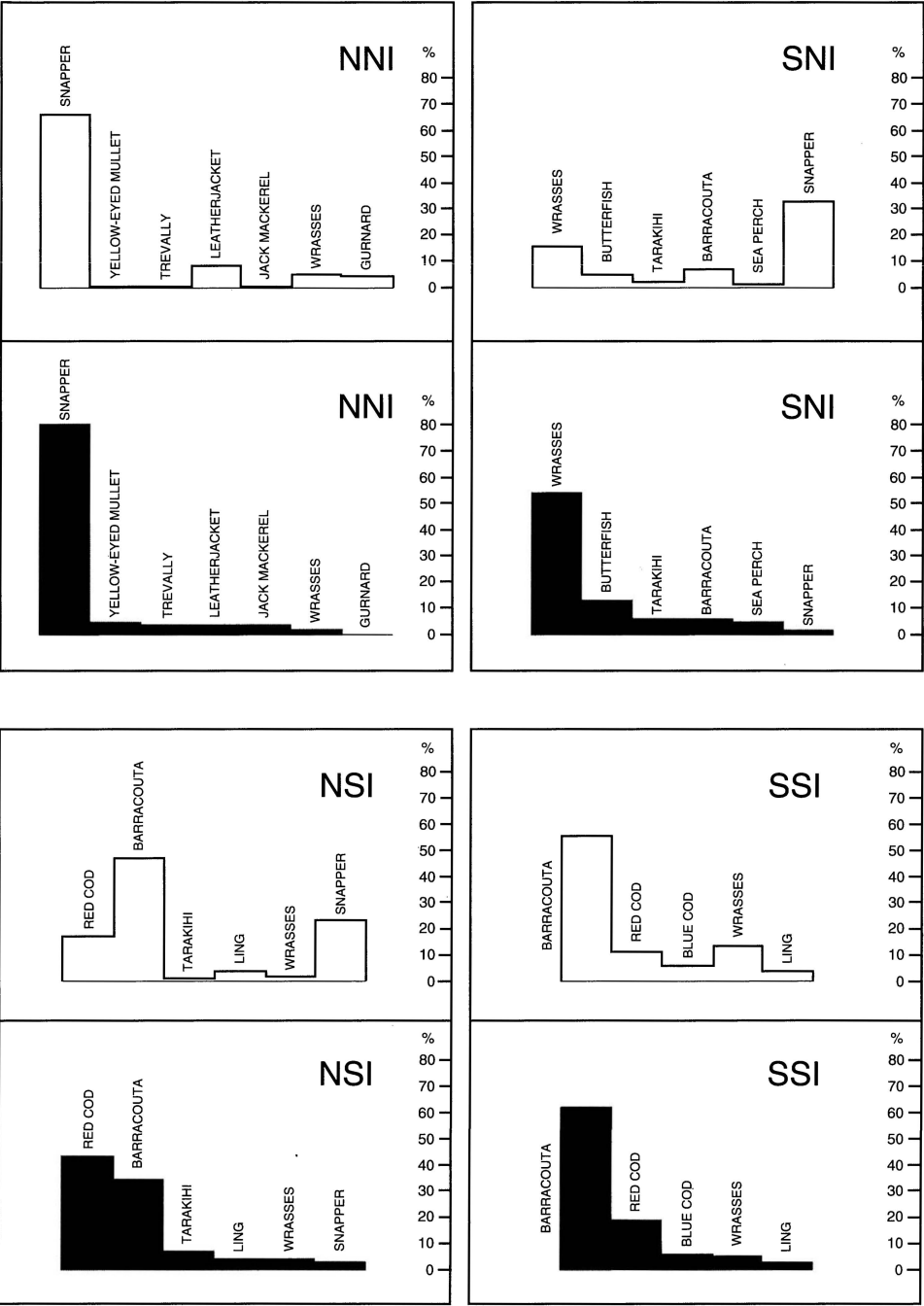


Fig. 3. Representation (percent) of major taxa in samples of FBB (above) and FBC (below) data: northern North Island (NNI), top left; southern North Island (SNI), top right; northern South Island (NSI), bottom left; southern South Island (SSI), bottom right.

broad correspondence here. The snapper in the earlier sample come mostly from a single site (The Glen), but there are other sites in the region where snapper was prominent (notably at Rotokura; Leach and Boocock 1993: Table 128), and there is a large snapper population in Tasman Bay. The rough estimate of barracouta 41 percent, red cod 29 percent, and snapper 13 percent, obtained by combining the data from both samples, might provide a better approximation of the regional picture, but further data are likely to indicate the need for additional changes.

In fish fauna and marine environments, there is general similarity across Cook Strait, so that it might be useful to combine SNI and NSI into a single regional sample. The main results would be: wrasses 31.06 percent (MNI = 429), red cod 21.72 percent (300), barracouta 18.39 percent (254), butterfish 6.58 percent (91), tarakihi 6.15 percent (85), and a range of minor species including snapper at 2.09 percent (29). These figures suggest, as do the SNI and NSI data, that the central districts of New Zealand, however they are defined, had a different catch signature from what might be predicted as merely transitional between the two geographical extremes (NNI and SSI). Much more work is needed in this interesting area.

For the SSI samples, the results are very similar between the samples (Fig. 3). Barracouta is the dominant species (62 percent in my sample, 55 percent in the Leach and Boocock sample), followed in both cases by red cod, blue cod, and wrasses, although in different orders. This pattern fits expectations arising from taxonomic availability and from ethnographic and commercial catch records, and it is unlikely to change significantly with new data.

The regional results show, as might be expected, that larger sample sizes and greater geographical spread of sites provide better correlation between the samples and with expectations based on other considerations. Although, for reasons noted above, it is not advisable to simply combine samples in which MNI have been differently calculated, the crude data that arise from doing so for regions where samples are smaller and geographically sparse suggest some trends that might be seen in more comprehensive data sets.

Looking at the regions together, the main trends are these: snapper is clearly dominant in NNI catches; wrasses are especially prominent about the northern shores of Cook Strait; barracouta and red cod are the main species in NSI; and barracouta is wholly dominant further south in SSI.

TEMPORAL VARIATION

Regional variation in catch patterns could reflect differential sampling of catches through time, which is a matter that needs to be addressed. Some changes in catch patterns during the prehistoric era ought to be expected. These could result from various processes: changes in fishing technology, changes in the relative abundance of species (or even in the availability of taxa) stemming from natural causes or over-exploitation, and changes in settlement patterns (seasonality, locations and functions of sites, etc.). There might also be some apparent changes resulting not from catch variation but from the differential operation of taphonomic processes. The evidence we have so far suggests that extinctions or taxonomic replacement and over-exploitation are not clearly demonstrated. In general they seem unlikely given a low density population and a short chronology,

but localized over-exploitation is possible, perhaps in Northland (Anderson and McGlone 1992; Leach 1989*b*). There are insufficient quantitative data currently available to enable estimation of the potential influence of technological change on catch patterns or of taphonomic influences on relative survival of fish bones between taxa and regions.

Leaving aside these sources of uncertainty, Leach and Boocock (1993) have argued that there are some significant changes in catch patterns. They divided their MNI 2 sample, undifferentiated by region, into early (essentially Archaic phase—up to the end of the fifteenth century), middle (Classic phase—sixteenth to eighteenth centuries), and late (protohistoric—early nineteenth century) assemblages. Leaving out sites of the last period, which need not be Maori—many are sites in Fiordland that contain metal, crockery fragments, and other European import items and likely reflect habitation by European sealers—the comparison of early and middle period data shows that barracouta declined substantially (from 62.4 percent to 37.0 percent), whereas rocky coast taxa, notably wrasses, blue cod, and scorpaenids, as well as tarakihi, increased proportionately. However, as Leach and Boocock (1993) concede, there are regional biases concealed in the overall pattern: early sites are mainly from the South Island, where barracouta are most abundant naturally, while middle period sites are largely from North Island, and the increase in rocky coast taxa arises from the large Chathams data set, which is placed in the middle period.

The largest regional sample is from SSI, and in this Leach (1989*c*) discerned a 10 percent decline in barracouta fishing, contrary to Anderson's (1981) conclusion that barracouta fishing increased by about 10 percent. However, reappraisal of the data showed that slightly different data sets had been used. Anderson (1989*a*: Table 33) aligned these and reworked the data to show that there was only a very insignificant change overall: barracouta comprised 66.3 percent of MNI in the Archaic phase assemblages in eastern South Island and 67.8 percent in the Classic phase assemblages. My earlier analysis of chronological effects in the southern Maori data as a whole (Anderson 1986*b*) also indicated that no significant changes had occurred.

The new data set for SSI can be divided into collections that probably date from before or after A.D. 1500: early (Shag River Mouth, Pleasant River [two collections], Tumai, Papatowai, Purakaunui, Omimi, Pounawea, and Riverton) and late (Huriawa [two collections], Mapoutahi, Pukekura, West Point, Andrewburn, and Kelly's Beach). The evidence for these (Table 8) shows that while the order of minor taxa changes slightly, the samples are wholly dominated by barracouta and red cod throughout. This looks like a stable catch pattern that was established early and never altered, although the difference in sample sizes should be noted.

How quickly stability was achieved is very difficult to say, since it depends on whether there are bone collections from the earliest sites among the assemblages. Certainly in SSI, the pattern is apparent in what seem to be the earliest sites, such as Pounawea (Anderson 1991). Shag River Mouth is somewhat later, but it is interesting to see that the lowest layers at that site contain a different suite, dominated by barracouta (37 percent), but with blue cod, wrasses, and trumpeter prominent (all species caught by bait hook over rocky ground). In the upper layers, barracouta is wholly dominant (67–80 percent), and red cod has replaced

TABLE 8. COMPARISON OF CATCH DATA BEFORE AND AFTER APPROXIMATELY A.D. 1500 FOR SOUTHERN SOUTH ISLAND (SSI)

TAXA	EARLY PERIOD		LATE PERIOD	
	MNI	%	MNI	%
Red Cod	1623	32.4	194	24.7
Ling	173	3.4	25	3.1
Groper	27	0.5	40	5.1
Wrasses	122	2.4	23	2.9
Blue Cod	100	2.1	28	3.5
Barracouta	2848	57.1	456	58.2
Other taxa	102	2.1	17	2.1
Totals	4995	100	783	99.6

TABLE 9. COMPARISON OF CATCH DATA BEFORE AND AFTER APPROXIMATELY A.D. 1500 FOR NORTHERN NORTH ISLAND (NNI)

TAXA	EARLY PERIOD		LATE PERIOD	
	MNI	%	MNI	%
Red Gurnard	7	0.1	20	4.3
Trevally	147	2.8	3	0.6
Jack Mackerel	127	2.4	—	—
Mackerels	—	—	76	16.4
Kahawai	108	2.1	10	2.1
Snapper	4197	81.8	136	29.4
Tarakihi	21	0.4	9	1.9
Yellow-eyed Mullet	179	3.4	—	—
Wrasses	87	1.6	40	8.6
Barracouta	9	0.2	14	3.1
Leatherjacket	176	3.4	137	29.6
Other taxa	70	1.3	17	3.6
Totals	5158	99.5	462	99.6

the earlier minor taxa (Anderson and Smith 1996). Since there is no difference in radiocarbon age between any of the layers, it can be assumed that the early deviation from the standard SSI pattern represents either a seasonal anomaly in the fishing strategy or a brief initial period of exploration of local resources before the regional pattern is rapidly asserted.

A rather different picture emerges in NNI (Table 9), which is similarly divided between early (Twilight Beach, Houhora, Waipoua, Sunde [two collections], Kohika, Tairua, Whangamata, Slipper Island, and Cross Creek) and late (Aupori, NHB, Motutapu N38/30, Westfield, Hamlin's Hill, Oruarangi, Matakana, Raupa, Hahei, and Aotea). Although snapper is very dominant early, it slips later and leatherjacket rises to codominance. Among minor taxa, trevally and mullet decline while mackerels, wrasses, red gurnard, and barracouta increase. It is possible to see this as evidence of significant change and to speculate that depletion of snapper stocks might be reflected (Anderson and McGlone 1992), but there is a great disparity in sample sizes, and other explanations are possible. The distribution of

sample locations, for instance, can be influential: the two largest early samples are from northern Northland harbors where snapper are very abundant, while Hahei, which accounts for nearly all of the leatherjacket numbers in the late sample, is from the rocky Coromandel coast.

Data are too few to make any meaningful chronological comparison within SNI and NSI. With respect to the SSI and NNI data, I conclude that these might eventually be seen to describe two different patterns of temporal variation, which might reflect a significant regional difference in gross consumption levels, but it is not yet established. On current data, temporality is not a significant factor in regional differentiation of catch patterns.

DISCUSSION AND CONCLUSIONS

Substantial gaps and deficiencies remain in the catch data. This is certainly true of coverage (all western coasts and the North Island eastern coast are poorly represented) and probably true of taxonomic representation and relative abundance. The standard procedure used to identify fish bone in New Zealand was introduced more than 20 years ago by Anderson (1973) and Leach (1976). It is very largely confined to five bones in the jaw (dentary, articular, premaxilla, maxilla, and quadrate), and it consequently favors taxa with robust jaws over those which have relatively delicate mouthparts but which could be identified on other cranial (including otoliths) or postcranial elements, as Nichol (1988) showed in the case of mackerels and grey mullet. Given the remarkable abundance of fish bones at many New Zealand sites, upgrading the recovery and identification procedures would have significant procedural consequences at all levels including excavation and recovery strategies. One result would be the increased possibility of calculating those basic dimensions of the database that are not possible in present circumstances, notably NISP, and from which some broader comparisons might be made with data from elsewhere in Oceania.

In terms of the wider understanding of prehistoric fishing in New Zealand, there is a substantial problem posed by the severe difficulty of finding remains of Chondrichthyes, which generally do not survive in archaeological contexts. Small schooling sharks and other cartilaginous taxa (e.g., elephant fish, *Callorhynchus milii*) are clearly a major component of the inshore ichthyofauna and loom large in commercial and recreational catches. There is ethnographic evidence to suggest that they were the major target of fishing all along the west coast of New Zealand from the large northern harbors (e.g., Firth 1972:227–230), to the South Island (e.g., Brunner 1847 in Taylor 1959), and in some eastern harbors as well (e.g., Beattie 1994). No general analysis of prehistoric Maori marine fishing patterns could lay claim to representativeness without establishing the dimensions of the dogfish and shark fishery.

The current catch data constitutes, therefore, only a partial record of the diversity of prehistoric marine fishing in New Zealand, to some extent even within Osteichthyes, and it can be anticipated that changing analytical processes and increasing geographical coverage will result in significant changes in the catch record. Nevertheless, it is unlikely that the strategic characteristics and current patterns of catch data in Osteichthyes will be overturned, so it is worth considering how they might be explained.

The salient features of the prehistoric catch, as it is presently known, can be attributed in the first instance to location within the southern temperate zone. The heavily weighted distribution of inshore Osteichthyan biomass into relatively few taxa is clearly reflected by the catch data. More than 60 percent of the MNI in each of the largest samples came from a single species: snapper in NNI and barracouta in SSI. The Chatham Islands data (Leach and Boocock 1993) disclose a similar pattern, with blue cod forming 53.3 percent and butterfish 26.3 percent of the catch.

High biomass in the populations of the principal taxa (barracouta, red cod) seems to have ensured a stable southern fishery. There is possibly some volatility in the northern data, although it is not yet sufficiently apparent to sink the null hypothesis. Given the abundance of snapper, which remained resilient in the face of commercial fishing until the 1960s (when northern stocks became severely, but temporarily, depleted [Waitangi Tribunal 1992]), it seems probable that a generally stable fishery persisted through the prehistoric period in that region as well.

Relative resource abundance is, however, not the only factor involved in shaping the prehistoric fishery. There was undoubtedly a strong technological component, about which it is only possible to speculate. The apparent confinement of Maori fishing close inshore, in relatively shallow waters, might reflect either the efficiency of harvest in that zone or the dangers of proceeding further to sea or both. The targeting of carnivorous species probably reflects the lack of alternative devices, such as set nets, which could have exploited some of the common herbivores, notably butterfish, while the size range of bait hooks may have precluded effective exploitation of small-mouthed taxa, some of which were comparatively abundant (e.g., goatfish).

There may also have been a strong impulse, generated by the broader economic situation, to intensify extraction of the most accessible taxa. Maori had relatively few sources of reliably abundant food supplies. Horticulture was extensive rather than intensive and marginal or absent over most of the country, and dogs were the only domestic animal. Wild food plants were neither diverse nor generally productive without considerable effort, and once the vulnerable big game was gone or severely depleted, which seems to have been a rapid process, the weight of subsistence fell upon fishing and to a lesser extent on coastal and forest fowling (McGlone et al. 1994).

Fishing was able to fill the position of a subsistence mainstay not only because of high resource capacity and accessibility to mass harvest (i.e., efficiency of energy capture), but also because the climate suited easy preservation by drying and subsequent long-term storage in bulk (i.e., efficient retention and transfer of energy). With those mechanisms available, as they generally were not elsewhere in Polynesia, it was possible in prehistoric New Zealand to turn fish into a standard currency of subsistence.

A more precise and comprehensive formulation of the nature and role of marine fishing in prehistoric New Zealand than has been possible in this survey of the catch data depends upon addressing current deficiencies in analytical procedures and also upon instituting a detailed description and analysis of Maori fishing gear in archaeological and ethnographical collections. Both are matters of some urgency if the archaeology of fishing in New Zealand is to contribute to the wider analysis of prehistoric maritime activity in Oceania.

ACKNOWLEDGMENTS

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NOTES

1. In the text I have used the common names, in English where these exist (there is no English name for kahawai, for example). For most taxa, the scientific names are shown in Table 7. Otherwise, scientific names are given in the text.

REFERENCES

- ALLEN, M.
1996 Style and function in East Polynesian fish-hooks. *Antiquity* 70:97–116.
- ALLO, J.
1970 Analysis of midden from two sites on Motutapu Island, New Zealand. *Records of the Auckland Institute and Museum* 7:83–91.
- ANDERSON, A.
1973 Archaeology and Behavior: Prehistoric Subsistence Behavior at Black Rockes Peninsula, Palliser Bay. M.A. thesis, University of Otago, New Zealand.
1981 Barracouta fishing in prehistoric and early historic New Zealand. *Journal de la Société des Océanistes* 34:145–158.
1983 *Salvage Excavations at Mapoutahi Pa, Otago*. Working Papers No. 1. New Zealand: University of Otago, Anthropology Department.
1986a “Makeshift structures of little importance”: A reconsideration of Maori round huts. *Journal of the Polynesian Society* 95:91–114.
1986b *Mahinga kai o te moana*: Selection in the pre-European fish catch of southern New Zealand, in *Traditional Fishing in the Pacific*: 151–166, ed. Atholl Anderson. Pacific Anthropological Records No. 37.
1989a Pre-European Maori utilization of marine resources in the Ngai Tahu Territory. Report to Southpac Fisheries Consultants for New Zealand Maori Council, Wellington, New Zealand.
1989b Pre-European Maori utilization of marine resources in Muriwhenua. Report to Southpac Fisheries Consultants for New Zealand Maori Council, Wellington, New Zealand.
1991 The chronology of colonization in New Zealand. *Antiquity* 65:767–795.
- ANDERSON, A., AND W. GUMBLEY
1996 Fishing gear, in *Shag River Mouth: The Archaeology of an Early Southern Maori Village*: 148–160, ed. A. J. Anderson, B. J. Allingham, and I.W.G. Smith. Research Papers in Archaeology and Natural History No. 27. Canberra.
- ANDERSON, A., AND M. MCGLONE
1992 Living on the edge: prehistoric land and people in New Zealand, in *The Naive Lands*: 199–241, ed. J. Dodson. Melbourne: Longman Cheshire.
- ANDERSON, A., AND I. SMITH
1992 The Papatowai site: new evidence and interpretations. *Journal of the Polynesian Society* 101:129–158.
1996 Analysis of fish remains, in *Shag River Mouth: The Archaeology of an Early Southern Maori Village*: 237–244, ed. A. J. Anderson, B. J. Allingham, and I.W.G. Smith. Research Papers in Archaeology and Natural History No. 27. Canberra.
- AYLING, T., AND G. J. COX
1982 *Collins Guide to the Sea Fishes of New Zealand*. Auckland: Collins.
- BARBER, I.
1994 Culture Change in Northern Te Wai Pounamu. Ph.D. diss., University of Otago, New Zealand.

- BEATTIE, H.
1994 *Traditional Lifeways of the Southern Maori*, ed. Atholl Anderson. Dunedin: University of Otago Press.
- BEST, E.
1929 *Fishing Methods and Devices of the Maori*. Dominion Museum Bulletin No. 12. Wellington.
- BEST, S.
1980 Oruarangi Pa: Past and present investigations. *New Zealand Journal of Archaeology* 2:65–91.
- COUTTS, P.
1975 Marine fishing in archaeological perspective: techniques for determining fishing strategies, in *Maritime Adaptations to the Pacific*: 265–306, ed. R. W. Casteel and G. I. Quimby. New York: Mouton.
- COUTTS, P., AND M. JURISICH
1972 *Results of an Archaeological Survey of Ruapuke Island*. Otago University Monographs in Prehistoric Archaeology No. 5.
- CROSBY, E.
1966 Maori Fishing Gear. Unpublished M.A. thesis, University of Auckland, New Zealand.
- EASDALE, S., AND C. JACOMB
1984 Salvage excavations at Huriawa Pa, Karitane, Otago. Report to Lands and Survey Department, Dunedin, New Zealand.
- FIRTH, R.
1972 *Economics of the New Zealand Maori*. Wellington: Government Printer.
- FOX, A.
1978 *Tiromoana Pa, Te Awanga, Hawkes's Bay Excavations 1974–5*. Otago University Studies in Prehistoric Archaeology No. 11.
- FOX, A., AND R. CASSELS
1983 Excavations at Aotea, Waikato, 1972–75. *Records of the Auckland Institute and Museum* 20:65–106.
- FUREY, L.
1986 The excavation of Westfield (R11/898), South Auckland. *Records of the Auckland Institute and Museum* 23:1–24.
- GOLSON, J.
1959 Culture change in prehistoric New Zealand, in *Anthropology in the South Seas*: 29–74, ed. J. D. Freeman and W. R. Geddes. New Plymouth: Thomas Avery.
- GRAHAM, D.
1956 *A Treasury of New Zealand Fishes*. Wellington, New Zealand: Reed.
- GREEN, R.
1975 Adaptation and change in Maori culture, in *Biogeography and Ecology in New Zealand*: 591–641, ed. G. Kuschel. The Hague: W. Junk.
- HAMEL, J.
1992 Fish bones to plastic at Pukekura Pa. Report to The Otago Peninsula Trust, Dunedin, New Zealand.
- HAMILTON, A.
1908 *Fishing and Sea Foods of the Ancient Maori*. Dominion Museum Bulletin No. 2. Wellington.
- HARLOW, R.
1979 Regional variation in Maori. *New Zealand Journal of Archaeology* 1:123–138.
- HARSANT, W. J.
1985 The Hahei (N44/97) assemblage of Archaic artefacts. *New Zealand Journal of Archaeology* 7:5–37.
- HJARNO, J.
1967 *Maori fish-hooks in southern New Zealand*. Records of the Otago Museum, Anthropology No. 3. Dunedin, New Zealand.
- JACOMB, C.
1994 Panau, Periodisation and Northeast South Island Prehistory. M.A. thesis, University of Otago, New Zealand.

- JORDAN, D., AND B. EVERMANN
1973 *The Shore Fishes of Hawaii*. Tokyo: Charles Tuttle.
- KIRCH, P.
1990 Regional variation and local style: A neglected dimension in Hawaiian prehistory. *Pacific Studies* 13:41–54.
- LEACH, B. F.
1976 Prehistoric Communities in Palliser Bay, New Zealand. Unpublished Ph.D. diss., University of Otago, New Zealand.
1989a The archaeology of Maori marine food harvesting. Waitangi Tribunal, WAI-27: DOC #S4. Wellington, New Zealand.
1989b The archaeology of marine food exploitation in Muriwhenua. Report to Crown Law Office, Wellington, New Zealand.
1989c Archaeological time trends in South Island Maori fishing. Waitangi Tribunal, WAI-27: DSOC #S5. Wellington, New Zealand.
- LEACH, B. F., AND A. ANDERSON
1979 The role of labrid fish in prehistoric economics in New Zealand. *Journal of Archaeological Science* 6:1–15.
- LEACH, B. F., AND A. S. BOOCOCK
1993 *Prehistoric Fish Catches in New Zealand*. Oxford: British Archaeological Reports.
- LEACH, B. F., J. M. DAVIDSON, AND L. M. HORWOOD
1994 *Identification of Archaeological Fish Bones from Matakana Island*. Museum of New Zealand, Te Papa Tongarewa Technical Report No. 2.
- LEACH, H.
1976 Horticulture in Prehistoric New Zealand: An Investigation of the Function of the Stone Walls of Palliser Bay. Ph.D. diss., University of Otago, New Zealand.
1984 *1000 Years of Gardening in New Zealand*. Wellington, New Zealand: Reed.
- LEAHY, A.
1972 Further excavations at site N38/30, Motutapu Island, New Zealand. *Records of the Auckland Institute and Museum* 9:15–26.
- LEWTHWAITE, G. R.
1950 The population of Aotearoa: its number and distribution. *New Zealand Geographer* 6:35–52.
- LIESKE, E., AND R. MYERS
1994 *Coral Reef Fishes*. London: Harper Collins.
- MCGLONE, M., A. ANDERSON, AND R. HOLDAWAY
1994 An ecological approach to the Polynesian settlement of New Zealand, in *The Origins of the First New Zealanders*: 136–163, ed. D. G. Sutton. Auckland: Auckland University Press.
- NICHOL, R.
1986 Analysis of midden from N44/215: hard times at Hahei? in *Traditional Fishing in the Pacific*: 179–198, ed. A. Anderson. Pacific Anthropological Records No. 37. Honolulu.
1988 Tipping the Feather Against a Scale: Archaeozoology from the Tail of the Fish. Unpublished Ph.D. diss., University of Auckland, New Zealand.
- PEARCE, P.
1977 Hamlins Hill. M.A. thesis, University of Auckland, New Zealand.
- PRICKETT, N.
1990 Archaeological excavations at Raupa: The 1987 season. *Records of the Auckland Institute and Museum* 27:73–153.
- SKINNER, H. D.
1921 Culture areas in New Zealand. *Journal of the Polynesian Society* 30:71–78.
- SWEENEY, M., M. W. GRAVES, AND T. L. HUNT
1993 A reappraisal of evidence for subsistence change at the Hane dune site, Marquesas Islands, French Polynesia. *Asian Perspectives* 32(2):225–238.
- TAYLOR, M.
1984 Bone Refuse from Twilight Beach. M.A. thesis, University of Auckland, New Zealand.

TAYLOR, N., ED.

1959 *Early Travellers in New Zealand*. Oxford: Clarendon.

WAITANGI TRIBUNAL

1988 *Muriwhenua Fishing Report*. Wellington, WAI 22.

1992 *Ngai Tahu Sea Fisheries Report*. Wellington, WAI 27.

WATKINSON, J. G., AND R. SMITH

1972 *New Zealand Fisheries*. Marine Department, New Zealand.

WILLEY, G. R., AND P. PHILLIPS

1958 *Method and Theory in American Archaeology*. Chicago: University of Chicago Press.

ABSTRACT

Catch patterns of prehistoric Maori fishing, including their regional variations, have been described by Leach and Boocock (1993) for one large sample of archaeological assemblages. A second large sample is described here, and the results compared. The new data strengthen evidence of a narrow focus upon snapper fishing in the northern North Island and upon barracouta fishing in the southern South Island. The central regions are still inadequately represented by catch data. The overall emphasis upon a few medium-sized, shallow water, carnivorous species; regional variation in the taxa of these; and signs of a broad stability in catch patterns can be related fundamentally to the nature of a temperate-zone ichthyofauna and secondarily to probable features of the fishing gear and subsistence economy. There are some deficiencies in current data and approaches that need to be addressed. **KEYWORDS:** New Zealand, catch patterns, regional variation, fishing strategy.