^{14}C CHRONOLOGY OF STONE AGE CULTURES IN THE RUSSIAN FAR EAST

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ABSTRACT. *Ca.* 150 unequivocal ^{14}C dates from the prehistoric cultures in the Russian Far East can be used to elucidate chrono-cultural boundaries in that region. Microblade technology started as early as *ca.* 20,000 BP, and continued to exist in the middle Amur River basin until *ca.* 10,500 BP, and in Primorye until *ca.* 7800 BP. The emergence of pottery-making in the lower Amur River basin goes back to *ca.* 13,300 BP. The transition from Upper Paleolithic to Neolithic took place during the time interval 13,300–7800 BP and pottery was widely spread in the Russian Far East by *ca.* 6700–8400 BP. The first evidence of shellfish collection is estimated to *ca.* 6400 BP at Peter the Great Gulf coast, Sea of Japan. The beginning of agriculture in Primorye, based on finding of both millet seeds (*Setaria italica* L.) and pollen of cultivated cereals (*Cerealia*), is ^{14}C-dated to *ca.* 4200–3700 BP (*ca.* 1980–2900 cal BC). The Neolithic/Early Iron Age boundary was estimated at *ca.* 3100–3300 BP (1400–1600 cal BC) in the mainland Russian Far East, and to *ca.* 1800–2300 BP (400 cal BC–200 cal AD) on the Sakhalin and southern Kuril Islands.

INTRODUCTION

Radiocarbon dating of prehistoric and medieval cultures of the Russian Far East, including the Amur River basin, northwestern Sea of Japan coast, Primorye, Sakhalin Island, and southern Kuril Islands, started in the late 1950s–early 1960s (Okladnikov 1964; Butomo 1965). Before 1986, the number of published ^{14}C dates from the Stone Age sites was only *ca.* 25–30 measurements (Kuzmin 1989). Since 1986 (Kuzmin 1990, 1992; Kuzmin *et al.* 1989, 1994, 1995, 1997), we have used dating by series, that is using at least two or three ^{14}C dates for each site or even for each pit-dwelling.

Today, we have >150 undisputed ^{14}C dates from *ca.* 50 sites (Fig. 1; Table 1). This marks a new direction in the study of ^{14}C chronology of prehistoric cultures for the entire Russian Far East. With the help of a large collection of ^{14}C dates, we can use the most important innovations in prehistoric technology and subsistence such as the microblade technique, pottery invention, shellfish gathering, and primitive agriculture, to establish chrono-cultural boundaries. In general, the Stone Age cultures in the Russian Far East can be subdivided into Paleolithic and Neolithic. The Mesolithic as a separate stage (*e.g.*, Koltsov 1989) does not exist in the latest compilations concerning archaeology of the Russian Far East (*e.g.*, Derevianko and Petrin 1995; Derevianko and Medvedev 1995; Kajiwara 1996).

MATERIAL AND METHODS

For ^{14}C-dating of the prehistoric sites from the Russian Far East, we use both liquid scintillation counting (LSC) and accelerator mass spectrometry (AMS) equipment. All the Russian laboratories use the LSC technique; AMS was performed at the University of Arizona and Woods Hole Oceanographic Institution. In total, 12 facilities took part in this study at different times (Table 1). Five laboratories, located in Novosibirsk, St. Petersburg, Tucson, Magadan and Moscow (Geological Institute), made the largest contribution (almost 90% of dates) toward establishing the ^{14}C chronology of prehistoric cultures in the Russian Far East.

The samples were collected from 53 ancient settlements ranging in age from the Early Upper Paleolithic to the Late Neolithic (Table 1); their cultural affiliation was described previously (Krushanov

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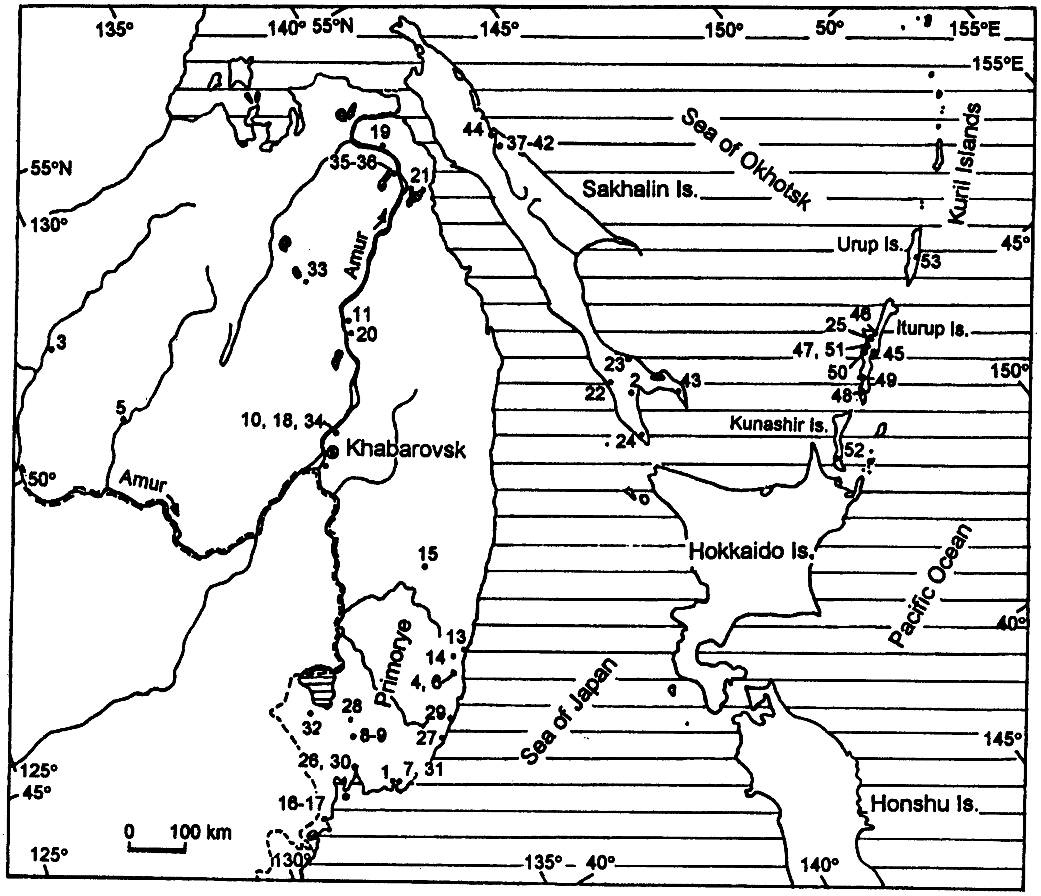

Fig. 1. The distribution of the ^{14}C-dated Stone Age sites from the Russian Far East (numbers correspond to those in Table 1)

1989; Kuzmin *et al.* 1994; Kuzmin 1995a). The sites are widely distributed over both mainland and island territories of the Russian Far East (Fig. 1). There are several site clusters comprising up to six ^{14}C-dated sites (*e.g.*, Imchin 2-12 and Tankovoye Ozero). Each site and site cluster location is characterized by its geographic coordinates, latitude and longitude, measured using U.S. Operational Navigation Charts for Northeastern Asia, scale 1:1,000,000.

The material dated includes charcoal, animal and human bones, marine mollusc shells, and humates (*i.e.*, humic acids derived from paleosols and sediments in general). For calibration of the ^{14}C dates younger than 10,000 ^{14}C years BP, we used both the Groningen Calibration computer program (van der Plicht 1993) and extended up to 10,000 BP calibration curves based on German and Irish oaks sequence (Pearson, Becker and Qua 1993; Kromer and Becker 1993). When using the Groningen program, we combined all the possible time intervals together.

TABLE 1. ^{14}C Dates for the Stone Age Sites from the Russian Far East

Site no., name, layer	Coordinates	^{14}C age (yr BP)	Lab code	Material	Calibrated age, cal BC (± 2 σ, 95.4%)	Reference
Upper Paleolithic						
Middle Amur River basin						
1 Ust-Ulma 1, layer 2 b	51°49′N, 129°12′E	19,350 ± 65	SOAN-2619	Charcoal		Orlova (1995)
2 Malyie Kuruktachi	50°17′N, 130°19′E	14,200 ± 130	SOAN-3287	Charcoal		This paper
		13,815 ± 150	AA-13399	Charcoal		This paper
		13,310 ± 105	AA-13398	Charcoal		This paper
		12,485 ± 80	AA-17212	Charcoal		This paper
		11,730 ± 70	AA-17211	Charcoal		This paper
		11,355 ± 370	SOAN-3591	Charcoal		This paper
		10,520 ± 95	SOAN-3590	Charcoal		This paper
Primorye						
3 Geographic Society Cave	42°52′N, 133°00′E	32,570 ± 1510	IGAN-341	Bone		Kuzmin (1989)
4 Suvorovo 4	44°15′N, 135°19′E	15,300 ± 140	Ki-3502	Charcoal		Kuzmin *et al.* (1994)
		15,105 ± 110	AA-9463	Charcoal		Kuzmin *et al.* (1994)
5 Ustinovka 6	44°16′N, 135°18′E	11,750 ± 620	SOAN-3538	Charcoal		Kuzmin *et al.* (1994)
6 Pereval	42°53′N, 133°06′E	11,150 ± 100	LE-1565	Charcoal		Okladnikov & Medvedev (1995)
		10,100 ± 100	LE-1566	Charcoal		Okladnikov & Medvedev (1995)
7 Gorbatka 3 (below artifacts)	43°57′N, 132°24′E	13,500±200	SOAN-1922	Humates		Kuzmin *et al.* (1994)
8 Ilistaya 1	43°57′N, 132°26′E	7840 ± 60	Ki-3163	Charcoal	7000–6465	Kuzmin *et al.* (1994)
Sakhalin						
9 Ogonki 5, layer 2 b	46°46′N, 142°30′E	19,320 ± 145	AA-20864	Charcoal		This paper
Initial Neolithic						
Lower Amur River basin						
10 Gasya, lower layer	48°45′N, 135°38′E	12,960 ± 120	LE-1781	Charcoal		Kuzmin *et al.* (1997)
		10,875 ± 90	AA-13393	Charcoal		Kuzmin *et al.* (1997)
11 Khummi, lower layer (low)	50°34′N, 137°06′E	13,260 ± 100	AA-13392	Charcoal		Kuzmin *et al.* (1997)
(middle part)		12,425 ± 850	SOAN-3583	Charcoal		This paper
		10,345 ± 110	AA-13391	Charcoal		Kuzmin *et al.* (1997)
(upper part)		7760 ± 120	GIN-6945	Charcoal	7010–6345	Kuzmin *et al.* (1997)
12 Goncharka 1, layer 3 b	49°20′N, 134°55′E	9890 ± 230	GaK-18981	Charcoal		Shevkomud (1996)
Early Neolithic						
Primorye						
6 Pereval		8380 ± 60	LE-1565A	Charcoal	7540–7130	Okladnikov & Medvedev (1995)
13 Rudnaya, lower layer	44°21′N, 135°48′E	7690 ± 80	GIN-5983	Charcoal	6610–6360	Kuzmin *et al.* (1994)
		7550 ± 60	GIN-5631	Charcoal	6460–6210	Kuzmin *et al.* (1994)
		7390 ± 100	GIN-5984	Charcoal	6400–5990	Kuzmin *et al.* (1994)
14 Chertovy Vorota	44°29′N, 135°23′E	6825 ± 45	SOAN-1212	Bone	5740–5600	Kuzmin *et al.* (1994)
		6710 ± 105	LE-4182	Bone	5740–5420	Kuzmin *et al.* (1994)
		6575 ± 45	SOAN-1083	Charcoal	5580–5420	Kuzmin *et al.* (1994)
		6380 ± 45	MGU-504	Charcoal	5420–5230	Kuzmin *et al.* (1994)
		5890 ± 45	LE-4181	Bone	4932–4682	Kuzmin *et al.* (1994)
15 Almazinka	45°58′N, 135°46′E	7545 ± 80	AA-9818	Charcoal	6450–6190	Kuzmin *et al.* (1994)
		7430 ± 65	AA-9817	Charcoal	6390–6060	Kuzmin *et al.* (1994)
		7410 ± 60	AA-9819	Charcoal	6360–6050	Kuzmin *et al.* (1994)

TABLE 1. (Continued)

Site no., name, layer	Coordinates	^{14}C age (yr BP)	Lab code	Material	Calibrated age, cal BC (± 2 σ, 95.4%)	Reference
16 Boisman 1, lower layer	42°47′N, 131°16′E	5690 ± 45	OS-3030	Shell	4710–4462	Jones *et al.* (1996)
17 Boisman 2, lower layer	42°47′N, 131°16′E	6355 ± 60	AA-9561	Charcoal	5420–5150	Kuzmin *et al.* (1994)
		6140 ± 40	OS-3033	Shell	5090–4930	Jones *et al.* (1996)
		6070 ± 35	OS-3031	Shell	5200–4902	Jones *et al.* (1996)
		6010 ± 220	GIN-6958	Bone	5360–4350	Kuzmin *et al.* (1994)
		5330 ± 55	AA-9460	Charcoal	4336–4004	Kuzmin *et al.* (1994)
		5300 ± 215	SOAN-3020	Bone	4660–3650	Kuzmin *et al.* (1994)
		5160 ± 140	SOAN-3019	Bone	4340–3700	Kuzmin *et al.* (1994)
		5030 ± 140	GIN-6957	Bone	4230–3520	Kuzmin *et al.* (1994)
Lower Amur River Basin						
18 Sikachi-Alan	49°44′N, 135°43′E	6900 ± 260	MGU-345	Humates	6200–5280	Kuzmin (1989)
19 Malaya Gavan	52°43′N, 140°07′E	6985 ± 70	AA-13395	Charcoal	5970–5700	This paper
20 Voznesenovka	50°06′N, 136°54′E	5115 ± 160	Bln-698	Charcoal	4340–3550	Kuzmin (1989)
21 Suchu	51°45′N, 140°10′E	5830 ± 65	SOAN-843	Charcoal	4352–4042	Orlova (1995)
		5455 ± 155	SOAN-1658	Charcoal	4670–3980	Orlova (1995)
		5170 ± 90	SOAN-1123	Charcoal	4234–3782	Orlova (1995)
		4650 ± 55	SOAN-1281	Charcoal	3620–3146	Orlova (1995)
		4380 ± 40	SOAN-1280	Charcoal	3258–2916	Orlova (1995)
Sakhalin Island						
22 Sadovniki 2	47°10′N, 142°04′E	6740 ± 150	MAG-694	Charcoal	5940–5330	Vasilevsky (1995)
		6100 ± 300	MAG-691	Charcoal	5540–4350	Vasilevsky (1995)
23 Starodubskoye 3	47°25′N, 142°49′E	6465 ± 85	TIG-269	Charcoal	5530–5240	Vasilevsky (1995)
24 Kuznetsovo 3	46°04′N, 141°56′E	5960 ± 140	LE-4044	Charcoal	5150–4510	Vasilevsky (1995)
		5770 ± 140	LE-4043	Charcoal	4910–4340	Vasilevsky (1995)
Kuril Islands						
25 Yankito	45°16′N, 147°53′E	6980 ± 50	LE-3230	Charcoal	5950–5710	Zaitseva *et al.* (1993)
Late Neolithic						
Primorye						
6 Pereval		5780 ± 60	LE-1567	Charcoal	4784–4512	Okladnikov & Medvedev (1995)
		3090 ± 35	SOAN-788	Charcoal	1434–1268	Orlova (1995)
26 Oleny A, layer 3	43°21′N, 132°17′E	5370 ± 65	SOAN-1549	Charcoal	4348–4042	Orlova (1995)
		5010 ± 30	SOAN-1534	Charcoal	3942–3708	Orlova (1995)
27 Valentin-peresheek	43°07′N, 134°18′E	4900 ± 200	MAG-422	Charcoal	4230–3100	Kuzmin *et al.* (1994)
		4500 ± 120	MAG-398	Charcoal	3600–2910	Kuzmin *et al.* (1994)
		4320 ± 90	MGU-544	Charcoal	3326–2625	Kuzmin *et al.* (1994)
28 Mustang	44°09′N, 132°35′E	4660 ± 60	Ki-3151	Charcoal	3626–3146	Kuzmin *et al.* (1994)
		4050 ± 70	Ki-3152	Charcoal	2874–2462	Kuzmin *et al.* (1994)
29 Phusun	43°20′N, 134°48′E	4250 ± 60	RUL-193	Charcoal	3032–2620	Butomo (1965)
30 Kirovsky	43°20′N, 132°17′E	4150 ± 60	RUL-177	Charcoal	2900–2582	Butomo (1965)
13 Rudnaya, middle layer		4130 ± 40	GIN-5980	Charcoal	2878–2588	Kuzmin *et al.* (1994)
		4040 ± 40	GIN-5630	Charcoal	2862–2470	Kuzmin *et al.* (1994)
		4030 ± 40	GIN-5982	Charcoal	2860–2466	Kuzmin *et al.* (1994)
		4000 ± 40	GIN-5981	Charcoal	2852–2462	Kuzmin *et al.* (1994)
31 Under the Linden	42°53′N, 133°07′E	3915 ± 50	SOAN-1530	Charcoal	2572–2216	Orlova (1995)
		3635 ± 30	SOAN-1532	Charcoal	2132–1934	Orlova (1995)
32 Novoselische 4, lower layer	44°37′N, 131°47′E	3840 ± 70	AA-13400	Charcoal	2492–2050	This paper
17 Boisman 2, middle layer		3710 ± 40	OS-2341	Charcoal	2278–1980	Kuzmin *et al.* (in press)
Lower Amur River Basin						
33 Kondon	51°16′N, 136°36′E	4520 ± 25	GIN-170	Charcoal	3346–3102	Kuzmin (1989)

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TABLE 1. (Continued)

Site no., name, layer	Coordinates	^{14}C age (yr BP)	Lab code	Material	Calibrated age, cal BC (± 2 σ, 95.4%)	Reference
		3370 ± 30	SOAN-179	Charcoal	1744–1538	Firsov *et al.* (1985)
21 Suchu		4200 ± 80	GIN-8291	Charcoal	3024–2512	This paper
		3950 ± 90	SOAN-1657	Charcoal	2860–2204	Orlova (1995)
		3875 ± 60	SOAN-1659	Charcoal	2562–2146	Orlova (1995)
		3260 ± 75	SOAN-1661	Charcoal	1738–1432	Orlova (1995)
19 Malaya Gavan		4855 ± 65	AA-13390	Charcoal	3782–3388	This paper
		4210 ± 75	AA-13396	Charcoal	3024–2584	This paper
34 Malyishevo	49°44′N, 135°37′E	3875 ± 120	Bln-699	Charcoal	2860–1980	Kuzmin (1989)
		3590 ± 60	LE-663	Charcoal	2136–1772	Kuzmin (1989)
35 Kolchem 3	52°07′N, 139°50′E	4200 ± 60	SOAN-3412	Charcoal	2920–2610	Orlova (in press)
		3980 ± 30	SOAN-3014	Charcoal	2578–2462	Orlova (in press)
		3905 ± 85	SOAN-3413	Charcoal	2574–2202	Orlova (in press)
36 Kolchem 2	52°07′N, 139°51′E	3880 ± 35	SOAN-3018	Charcoal	2468–2216	Orlova (in press)
		3830 ± 30	SOAN-3016	Charcoal	2454–2200	Orlova (in press)
		3790 ± 40	SOAN-3017	Charcoal	2452–2050	Orlova (in press)
		3725 ± 95	SOAN-3015	Charcoal	2454–1930	Orlova (in press)
Sakhalin Island						
37 Imchin 2	51°42′N, 143°01′E	5890 ± 90	SOAN-1145	Charcoal	5044–4532	Orlova (1995)
		5650 ± 250	MAG-680	Charcoal	5070–3970	Vasilevsky (1995)
		4750 ± 300	MAG-674	Charcoal	4240–2700	Vasilevsky (1995)
		4550 ± 100	MAG-683	Charcoal	3600–2930	Vasilevsky (1995)
		4250 ± 30	SOAN-1040	Charcoal	2918–2706	Orlova (1995)
		4060 ± 50	SOAN-1041	Charcoal	2868–2494	Orlova (1995)
		3700 ± 250	MAG-673	Charcoal	2870–1520	Vasilevsky (1995)
		3500 ± 100	MAG-689	Charcoal	2130–1530	Vasilevsky (1995)
		3120 ± 50	SOAN-1146	Charcoal	1514–1270	Orlova (1995)
		2460 ± 100	MAG-670	Charcoal	800–300	Vasilevsky (1995)
23 Starodubskoye 3, dwell. 99		4500 ± 140	SOAN-3580	Charcoal	3620–2890	This paper
Final Neolithic layer		2265 ± 50	AA-20865	Charcoal	402–200	This paper
38 Imchin 4	51°42′N, 143°01′E	4040 ± 85	SOAN-1148	Charcoal	2882–2354	Orlova (1995)
		3730 ± 70	SOAN-1149	Charcoal	2452–1946	Orlova (1995)
		3490 ± 75	SOAN-1147	Charcoal	2032–1636	Orlova (1995)
39 Imchin 7	51°42′N, 143°01′E	3750 ± 150	MAG-685	Charcoal	2580–1760	Vasilevsky (1995)
40 Imchin 10	51°42′N, 143°01′E	4200 ± 200	MAG-686	Charcoal	3360–2210	Vasilevsky (1995)
41 Imchin 11	51°42′N, 143°01′E	4200 ± 200	MAG-688	Charcoal	3360–2210	Vasilevsky (1995)
		3950 ± 100	MAG-690	Charcoal	2870–2150	Vasilevsky (1995)
		3500 ± 100	MAG-687	Charcoal	2130–1530	Vasilevsky (1995)
42 Imchin 12	51°42′N, 143°01′E	3430 ± 70	MAG-745	Charcoal	1924–1530	Vasilevsky (1995)
		3340 ± 20	MAG-744	Charcoal	1686–1534	Vasilevsky (1995)
43 Yuzhnaya 2	46°18′N, 143°24′E	3560 ± 140	TIG-251	Shell	2320–1530	Vasilevsky (1995)
		3005 ± 125	TIG-249	Charcoal	1520–920	Vasilevsky (1995)
		2550 ± 160	LE-4038	Charcoal	1090–250	Vasilevsky (1995)
		2450 ± 100	LE-4041	Charcoal	810–390	Vasilevsky (1995)
		2360 ± 110	LE-4040	Charcoal	790–200	Vasilevsky (1995)
		2320 ± 160	LE-4039	Charcoal	800–40	Vasilevsky (1995)
44 Nyuivo 9	51°51′N, 143°12′E	2695 ± 50	SOAN-3248	Charcoal	980–800	Orlova (in press)
Kuril Islands						
45 Kasatka	45°00′N, 147°44′E	4220 ± 160	LE-4462	Charcoal	3340–2410	Zaitseva *et al.* (1993)
		2720 ± 60	LE-3231	Charcoal	996–804	Zaitseva *et al.* (1993)
46 Olya	45°17′N, 148°02′E	4020 ± 30	LE-4220	Charcoal	2850–2470	Zaitseva *et al.* (1993)
		3610 ± 40	LE-2167	Charcoal	2128–1888	Zaitseva *et al.* (1993)
		2410 ± 40	LE-2419a	Charcoal	762–398	Zaitseva *et al.* (1993)
47 Rybaki	45°13′N, 147°51′E	3980 ± 60	LE-4083	Charcoal	2862–2324	Zaitseva *et al.* (1993)
48 Berezovka	44°38′N, 147°06′E	3610 ± 40	LE-2820	Charcoal	2128–1888	Zaitseva *et al.* (1993)
		2710 ± 40	LE-2821	Charcoal	974–806	Zaitseva *et al.* (1993)
49 Lesozavodsk	44°46′N, 147°12′E	3560 ± 40	LE-2374	Charcoal	2032–1774	Zaitseva *et al.* (1993)
		3020 ± 40	LE-2373	Charcoal	1408–1136	Zaitseva *et al.* (1993)

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TABLE 1. (Continued)

Site no., name, layer		Coordinates	^{14}C age (yr BP)	Lab code	Material	Calibrated age, cal BC (± 2 σ, 95.4%)	Reference
50	Tankovoye Ozero	45°05'N, 147°40'E	3550 ± 20	LE-4459	Charcoal	1957–1788	Zaitseva *et al.* (1993)
			2990 ± 110	LE-4458	Charcoal	1500–920	Zaitseva *et al.* (1993)
			2930 ± 40	LE-2369	Charcoal	1264–1020	Zaitseva *et al.* (1993)
			2710 ± 40	LE-2372	Charcoal	974–806	Zaitseva *et al.* (1993)
			2520 ± 40	LE-2621	Charcoal	802–522	Zaitseva *et al.* (1993)
			2460 ± 40	LE-3226	Charcoal	766–410	Zaitseva *et al.* (1993)
			2350 ± 80	LE-4081	Charcoal	766–210	Zaitseva *et al.* (1993)
			2320 ± 40	LE-2368	Charcoal	516–254	Zaitseva *et al.* (1993)
			2210 ± 40	LE-2371	Charcoal	386–192	Zaitseva *et al.* (1993)
			2170 ± 80	LE-2370	Charcoal	392–48	Zaitseva *et al.* (1993)
			2030 ± 40	LE-2620	Charcoal	160 cal BC–60 cal AD	Zaitseva *et al.* (1993)
			1775 ± 80	SOAN-1273	Charcoal	74–418 cal AD	Orlova (1995)
51	Malaya Kyibyshevka	45°06'N, 147°42'E	2710 ± 40	LE-4460	Charcoal	974–806 cal BC	Zaitseva *et al.* (1993)
			2110 ± 80	LE-4461	Charcoal	378 cal BC–20 cal AD	Zaitseva *et al.* (1993)
			2050 ± 50	LE-3224	Charcoal	190 cal BC–56 cal AD	Zaitseva *et al.* (1993)
			1930 ± 40	LE-2623	Charcoal	40 cal BC–176 cal AD	Zaitseva *et al.* (1993)
52	Alekhino	43°56'N, 145°33'E	2460 ± 40	LE-2367	Charcoal	766–410 cal BC	Zaitseva *et al.* (1993)
			2180 ± 65	SOAN-1276	Charcoal	390–104 cal BC	Orlova (1995)
			1895 ± 40	SOAN-1275	Charcoal	20–214 cal AD	Orlova (1995)
			1790 ± 40	LE-2622	Charcoal	124–336 cal AD	Zaitseva *et al.* (1993)
53	Kompaneiskaya	45°48'N, 149°55'E	2350 ± 65	SOAN-1990	Charcoal	764–214 cal BC	Orlova (1995)

RESULTS AND DISCUSSION

Upper Paleolithic Cultures

The Upper Paleolithic cultures may be subdivided into early and late stages. So far, the only ^{14}C-dated early Upper Paleolithic site with a macroblade industry is the Geographical Society Cave, dated to 32,570 ± 1510 BP (IGAN-341). The earliest evidence for manufacture of microblades on the Russian Far East is known from the Ust-Ulma 1 site (Derevianko 1996; Derevianko and Zenin 1995). This may be used to establish the boundary between the early and late stages of the Upper Paleolithic in northern Asia (Abramova 1989: 241). Layer 2b on this site was dated to 19,320 ± 65 BP (SOAN-2619). Since this time, we have the continuous sequence of ^{14}C dates from the late Upper Paleolithic sites in both Primorye and the Amur River basin (Table 1). The most recent Paleolithic sites with microblades are dated in the Amur River basin to *ca.* 10,500 BP, and in Primorye to *ca.* 7800 BP (*ca.* 6700 cal BC).

Neolithic Cultures

The Paleolithic/Neolithic Boundary and Evidence for the Earliest Pottery

The earliest evidence for pottery-making in the lower Amur River basin (*i.e.*, from Khabarovsk City to the Amur River mouth), which marks the beginning of the Neolithic in Russian archaeology (Krushanov 1989), is dated to *ca.* 13,000–13,300 BP on both Khummi and Gasya sites. The Goncharka site is slightly younger at *ca.* 9900 BP. All three sites belong to the Osipovka Initial Neolithic culture (Kuzmin *et al.* 1997; Shevkomud 1996; Lapshina 1995), and the date of the upper level of

Osipovka layer on the Khummi site is 7760 ± 120 BP (7010–6345 cal BC) (GIN-6945). This is probably the upper limit of the Osipovka culture; thus, it existed during *ca.* 7800–13,300 BP.

By *ca.* 7000–8000 BP, Neolithic cultures had appeared in the whole of the Russian Far East. In Primorye, the beginning of the Neolithic may be placed as early as *ca.* 8400 BP. On Sakhalin Island, the earliest Neolithic sites have ^{14}C dates *ca.* 6500–6700 BP, and on the southern Kuril Islands *ca.* 7000 BP. Thus, we can draw the Paleolithic-Neolithic boundary in the lower Amur River basin *ca.* 10,500–13,300 BP; and in Primorye *ca.* 7800–8400 BP. The lack of ^{14}C-dated Paleolithic sites on both Sakhalin and Kuril Islands prohibits us from determining the Paleolithic-Neolithic chronological boundary in these territories.

The Earliest Utilization of Shellfish

The first evidence for gathering of marine molluscs is found at the Boisman Bay sites on Peter the Great Gulf shore, northwestern Sea of Japan. There are 11 ^{14}C dates for both the Boisman 1 and 2 shellmiddens, made on different kinds of material such as charcoal, animal bones, human bones from burial, and mollusc shells (Jull *et al.* 1994; Kuzmin *et al.* 1994, 1995; Jones and Kuzmin 1995; Jones, Kuzmin and Rakov 1996). The majority of dates fall within the interval *ca.* 5030–6400 BP (Table 1).

There is a discrepancy in the ^{14}C dates obtained on both human bones and mollusc shells. For the burial 1 at Boisman 2 site, there are two dates on bone collagen, 5160 ± 140 BP (4340–3700 cal BC), SOAN-3019; and 6010 ± 220 BP (5380–4370 cal BC), GIN-6958 (Kuzmin *et al.* 1995). We cannot explain such a big difference between dates from the same skeleton. The younger determination, *ca.* 5160 BP, corresponds better to site stratigraphy and the remaining ^{14}C dates (Jull *et al.* 1994). In a series of dates obtained on shells of thermophilous molluscs *Meretrix lusoria* Rod. and *Anadara subcrenata* Lisch., there is one value, 7640 ± 35 BP (OS-2318), which is much older than all the other dates from the Boisman 2 shellmidden (Jones and Kuzmin 1995; Jones, Kuzmin and Rakov 1996). This situation may be explained if we assume that ancient people accidentally collected the empty shell of *A. subcrenata* along with living oysters (*Crassostrea gigas* Thun.). The source of *A. subcrenata* was possibly the early mid-Holocene marine sediments, eroded and transported to the shore zone by river flow (Kuzmin 1995b). The reservoir correction for Peter the Great Gulf shells is *ca.* 500 ^{14}C years (Jones and Kuzmin 1995), and the corrected age of thermophilous mollusc shells from the Boisman 1 and 2 shellmiddens is therefore *ca.* 5200–5600 BP. Thus, the first evidence of shellfish gathering in the Russian Far East can be placed *ca.* 6400 BP (*ca.* 5300 cal BC).

Dryland Millet Agriculture

Before the 1990s, in Primorye a cultural stratum at the Kirovsky site that contained seeds of foxtail millet [*Setaria italica* (L.) Beauv.] has been dated to 4150 ± 60 BP (RUL-177). Recently, pollen of cultivated cereals (*Cerealia*) was identified on the Late Neolithic layers from two multilayered sites, Boisman 2 and Novoselische 4 (Verkhovskaya and Kundyishev 1993; Verkhovskaya and Esipenko 1993). Small samples of charcoal from these layers were dated by the AMS technique. We obtained AMS ^{14}C dates for the Boisman 2 site, 3710 ± 40 BP (OS-2341); and for the Novoselische 4 site, 3840 ± 70 BP (AA-13400) (Table 1).

Archaeological studies of stone tool assemblages suggest the appearance of agriculture in the Amur River basin and Primorye in the Late Neolithic, in the 3rd–2nd millennia BC (Krushanov 1989). ^{14}C dating established the beginning of plant cultivation in Primorye between 3700 and 4150 BP, *i.e., ca.* 1980–2900 cal BC. Taking into consideration the presence of anthropogenic pollen at the Valentin-peresheek site (Kuzmin and Chernuk 1995), we can expect this interval to be extended up to 4900 BP, *i.e.*, *ca.* 3700 cal BC. In all the other regions of the mainland Russian Far East, the earliest evidences of plant cultivation correspond to the Early Iron Age, *ca.* 3000 BP (*ca.* 1300 cal BC) (Kuzmin 1995c). On the island territories, agriculture was introduced as late as AD 1600–1800 (Krushanov 1989).

General Sequences of ^{14}C Dates for the Neolithic Cultures

To understand the general trend in the ^{14}C chronology of the Russian Far East Neolithic, plots of site age distribution were generated (Figs. 2–5) using the most updated list of ^{14}C dates (Table 1). In the mainland territories, the Neolithic cultures may be subdivided into several stages. In the lower Amur River basin, Neolithic cultures existed from *ca.* 13,300 BP to *ca.* 3300 BP. In Primorye, we have evidence for the existence of Neolithic cultures down to *ca.* 8400 BP. The latest Neolithic sites existed in Primorye until *ca.* 3100 BP; thus, the "gap" in the sequence of Neolithic ^{14}C dates from 3600 to 3000 BP (Kuzmin *et al.* 1994: 366) no longer exists (Fig. 3). The earliest Bronze and Early Iron Age sites, co-existed in the mainland Russian Far East and are dated to *ca.* 3000 BP (Kuzmin *et al.* 1994).

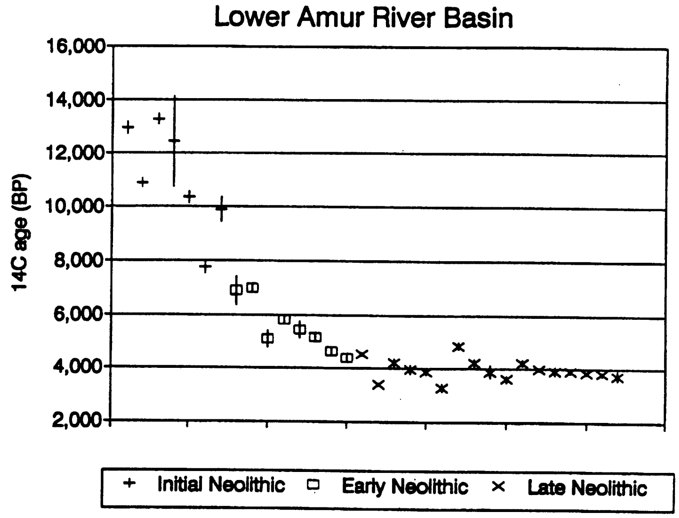

Fig. 2. The sequence of ^{14}C dates from the Neolithic cultures in Lower Amur River basin (dates are plotted with ± 2 σ; 95.4% probability)

On the island territories, the Neolithic is described as a unified cultural epoch (Krushanov 1989; Vasilevsky 1995). On the Sakhalin Island, we have continuous sequence of the Neolithic ^{14}C dates from *ca.* 6700 to *ca.* 2300 BP (Fig. 4). For the Yuzhnaya 2 site, belonging to the Aniva culture of transitional character from the Neolithic to Early Iron Age (Vasilevsky 1995), almost all the calibrated dates overlap (Table 1). Only one value, 3560 ± 140 BP (2320–1530 cal BC) (TIG-251), does not correlate with the other ones. Unfortunately, we do not know the ^{14}C reservoir effect correction for the southern Sakhalin, and can only suspect that this date, made on a marine mollusc shell, may be at least 500 ^{14}C yr younger than in Peter the Great Gulf (Jones and Kuzmin 1995). For the Imchin cluster of ^{14}C dates, only one, 2460 ± 100 BP (800–300 cal BC) (MAG-670), does not fit with the general boundaries of Imchin culture, *ca.* 5900–3100 BP (*ca.* 4800–1400 cal BC). This particular ^{14}C date belongs to the inter-dwelling space near dwelling 20 (Vasilevsky 1995), which needs to be re-dated.

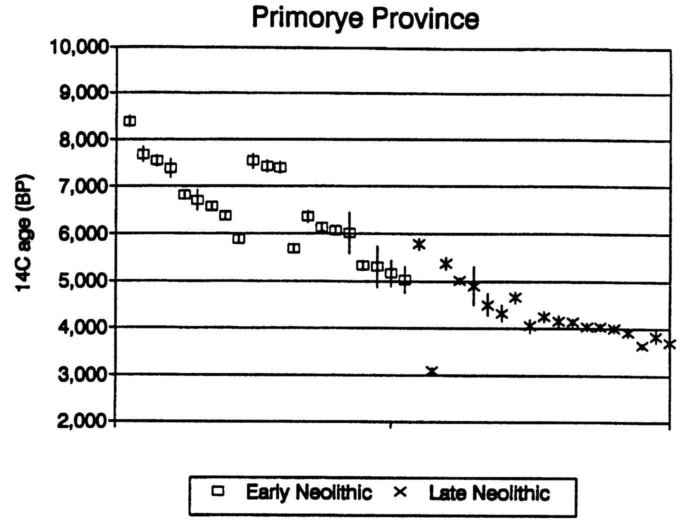

Fig. 3. The sequence of ^{14}C dates from Neolithic cultures in Primorye (dates are plotted with ± 2 σ; 95.4% probability)

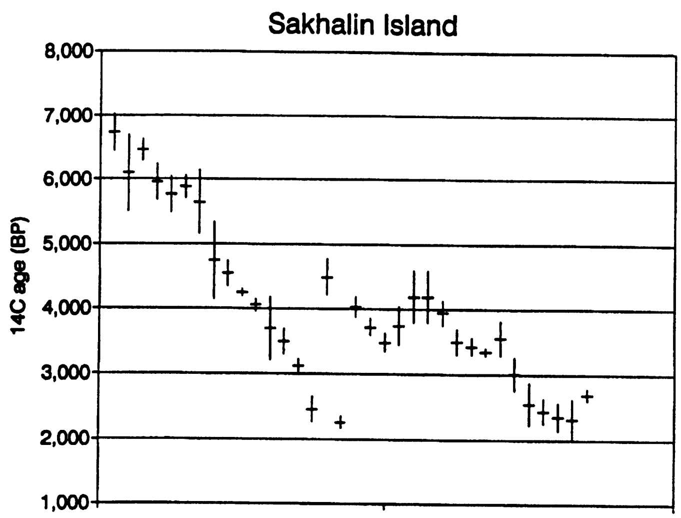

Fig. 4. The sequence of ^{14}C dates from the Neolithic cultures in Sakhalin (dates are plotted with ± 2 σ; 95.4% probability)

On the southern Kuril Islands, there are few ^{14}C dates for the Neolithic on Kunashir Island, Alekhino site, and only one date for Urup Island, the Kompaneiskaya site (Fig. 1; Table 1). The best series of ^{14}C dates is obtained for Iturup Island. However, here there is a significant "gap" of almost 2800 ^{14}C years (or 3000 calendar years) in the sequence of the Neolithic ^{14}C chronology (Fig. 5). This probably shows that some cultural stages for the southern Kuril Islands have still not been found and excavated.

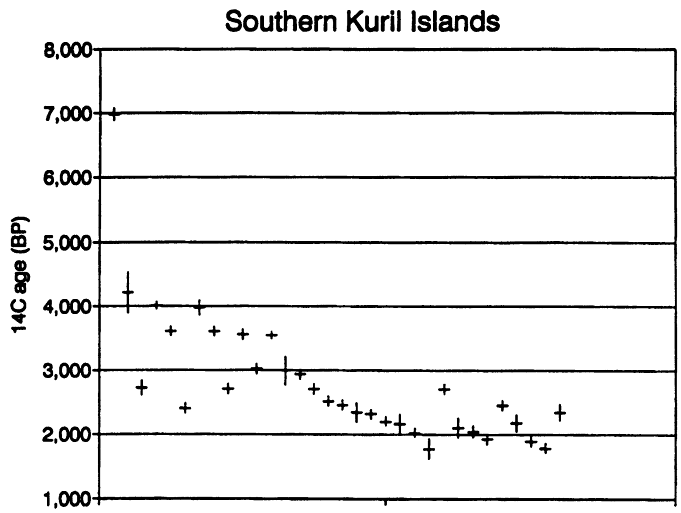

Fig. 5. The sequence of ^{14}C dates from the Neolithic cultures in Kuril Islands (dates are plotted with ± 2 σ; 95.4% probability)

Conclusion

Based on the data obtained and our interpretations, we can place the Paleolithic/Neolithic transition on the mainland of the Russian Far East *ca.* 13,300–7800 BP. The Neolithic/Early Iron Age boundary may be traced in the mainland part *ca.* 3100–3300 BP (cal 1400–1600 BC; roughly 1500 cal BC), and on the island territories *ca.* 1800–2300 BP (400 cal BC–200 cal AD; roughly 100 cal BC).

Using the calibration of ^{14}C dates, we can establish a significant chronological difference (almost 1400 calendar years) between the time of Neolithic/Early Iron Age transition on the mainland and the island territories of the Russian Far East. This probably reflects either the islands' isolation from the mainland and deceleration of cultural processes, or the fact that the Sakhalin and the southern Kuril Islands were incorporated into a different cultural area such as Hokkaido and Tohoku (northern part of Honshu Island) (Aikens and Higuchi 1982; D'Andrea 1995).

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