CSIRO
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A PRELIMINARY REGIONALIZATION OF AUSTRALIAN BIOPHYSICAL ENVIRONMENTS

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Background to the Study

1. In October 1973, officers from the Department of Urban and Regional Development contacted the Division of Land Use Research, CSIRO, and requested that the Division provide, at very short notice, a regionalization of Australian biophysical environments and their distributions, which might be useful for policy and broad-scale planning decisions. To co-ordinate with other basic documents, this regionalization had to be completed by the end of March 1974.

2. Decisions concerning data inputs methodology and scale of working maps were left in the hands of Divisional personnel. The labour force for the project was to consist of two research scientists on a part-time basis, and one full-time technical staff member.

3. From discussions with DURD personnel, it became evident that a general, multi-purpose classification which would approximate a broad ecological classification of Australia, was required. This suggested that the classification should at once identify broad ecological regions at a continental scale and indicate local atypical biophysical environments. The Department officers also indicated a preference for using some form of water catchment as the basic mapping unit, and bias of regional boundaries, where possible, towards local government area boundaries.

Methodology

1. The basic classification strategy adopted involved initial subdivision of the continent into a large number of small areal segments and subsequent aggregation of these segments on the basis of shared attributes.

2. Wholly objective and repeatable procedures for subdivision of the continental area were narrowed down to two possible approaches:

(a) co-ordinate grid squares

(b) delineated catchment areas.

3. The catchment cell was chosen as the basic unit of information storage because:

(a) Catchments are wholly 'natural' domains within which important biophysical processes occur.

(b) Catchments have long been recognized as appropriate units for the integrated planning, development, and management of land and water resources.

(c) Catchment boundaries are relatively time-invariant - at least at human time scales.

(d) Catchment boundaries are readily delineated on topographic maps at a chosen scale, by relatively unskilled personnel.

(e) At any given scale, the size of catchments which can be mapped bears an inverse relationship to the complexity of the terrain. Thus, there is a strong tendency for the size of mapped catchments at a chosen scale to reflect landscape and biophysical diversity, i.e. smaller catchments in rugged dissected areas - larger catchments on smooth plains.

(f) DURD officers expressed a preference for the catchment cell over the co-ordinate grid cell. Few Local Government Authority areas have boundaries delineated by latitude and/or longitude co-ordinates, but very many have boundaries (either wholly or in part) which correspond with drainage divides or other natural features.

4. The catchment cells as the basic mapping units were delineated on the 1:1 million aeronautical map series for Australia in the following manner.

(a) Drainage divisions and basins as determined by the Department of National Development Drainage Divisions and River Basins Map (1967) were outlined on overlays of the 1:1 million sheets.

(b) Individual basins were subdivided into catchment cells on the basis of topographic information available at the 1:1 million scale. Where terrain was rugged and complex, catchment cells were as small as 500 km^2, but where terrain was relatively smooth and uniform, catchment cells were as large as 10,000 km^2 or, occasionally, even larger.

(c) Catchment cells were coded and listed on broad sheets preparatory to addition of attribute data.

5. The time constraint limited the biophysical attribute data to that already existing in map form. Fortunately, maps at the chosen scale were available for each of the major biophysical components : terrain and lithology (Löffler and Ruxton 1969); soils (Northcote et al. 1960, 1962, 1966, 1967, 1968); vegetation (Carnahan, in press) and climate (Nix, unpublished). Of the variety of climatic classifications prepared by Nix, the one adopted as most suitable for the current purpose was a slightly modified version of a classification divised by Oliver (1970) and based on the properties of air masses over the Australian region. The climatic classification is illustrated in Figure 1.

6. The climatic classification was not intended to be definitive, nor was it intended to provide the degree of subdivision offered by the other biophysical attribute maps. The basic objective was to subdivide the continent into segments of manageable size for catchment cell classification.

7. Each catchment cell then had enumerated the presence/absence of dominant landform, lithology, soil, and vegetation type. Estimation of the proportions of the catchment cell occupied by different classes of these attributes would be a desirable refinement where time permitted.

Numeric codes were developed for recording each of the biophysical attributes (see Appendix I) and compiled information was coded and punched on cards for each catchment or mapping region, e.g. in climatic zone COMPOUND MODERATE mP-cT (maritime polar - continental tropical), there are 143 catchments and 119 attributes.[1] A typical card would be coded thus:

6 / 8 / 32 / 42 / 61 / 65 / 83/. MD21 44

This corresponds to:

Landforms	Vegetation	Soils
6 - Ob	42 - eMiL	61 - Ug5
8 - Oa		65 - Gn2.1
32 - Ig		83 - Dr2

Ob - smooth plainlands: relief less than 20 ft, composed of alluvium, dark cracking clay (excluding residual clay on basalt)

Oa - smooth plainlands: relief less than 20 ft, composed of undifferentiated alluvium (including thick alluvial and colluvial spreads capping interfluves)

Ig - undulating or irregular plainlands: relief between 20 and 100 ft, composed of granitic rocks, including massive gneiss.

eMiL - Eucalyptus woodland with a low tree understory

e - Eucalyptus

M - trees 10-30 m

i - projective foliage cover of 10-30%

L - tallest subordinate stratum composed of trees below 10 m

Ug5 - the cracking clays

Gn2.1 - red earths

Dr2 - hard setting loamy soils with red clayey subsoils

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[1] For ease of coding, landform and lithology types and natural vegetation communities have different codes in different climatic zones, but soil types have the same code throughout the continent. This means that there will not necessarily be 119 attributes in the COMPOUND MODERATE mT-cT climatic zone, because some soil types that do not occur in that climatic zone (but do occur elsewhere on the continent) have been included.

The identification code on the far right of the card signifies catchment 44 of Basin 21 in the Murray-Darling drainage division.

A computer-based divisive classificatory system based on the program DIVINFRE (Weir, updated by Mayo 1972) was used to group the catchments within each climatic zone.[2]

Used without modification, this procedure is monothetic and liable to result in misclassification due to:

(a) The chance occurrence of an attribute on which a division is made.

(b) The creation of a heterogeneous group comprised of members which all lack all division attributes. Therefore, a polythetic re-allocation procedure designed to overcome these faults, is included in the program. The program also punches a matrix for use in the agglomerative program CENTPERC (Dale, Lance, and Albrecht, 1971). This program enables the groups created by DIVINFRE to be related to each other (see footnote 2).

Since climatic zones change over a gradient, and are not, in fact, defined by lines (as they are on the map), a comparison was made of adjacent regions across the climatic boundaries.

This was a manual comparison using,

(a) The P-matrix (printed by DIVINFRE)

(b) Data for individual catchments (when more detail was required).

The P-matrix gives the percentage of catchments in each group (biophysical region) which contain each attribute.

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[2] Since there are over 4000 catchments and somewhere in the order of 2000 attributes, the continent had to be divided into zones small enough to enable DIVINFRE to run efficiently. The genetic classification of air masses delineated 14 zones. Even so, three were still too large. One of those, cT (continental tropical) SUBDOMINANT was easily, logically divided in half, and each half run separately. mT-cT (maritime tropical - continental tropical) was also divided in half, but the resulting zones mT-cT (EAST) and mT-cT (WEST) were still too large. The agglomerative program CENTPERC was used to recombine the groups created by DIVINFRE in arbitrarily defined subzones of these three remaining large zones, i.e. mT-cT (EAST), mT-cT (WEST), and cT DOMINANT.

For example for climatic zone mT

	GROUP					
ATTR	1	2	3	4	5	etc.
1	0	0	142	0	0	
2	0	0	428	0	0	
3	0	0	142	0	1000	
4	0	0	0	0	0	
5	0	0	0	0	0	
6	0	0	142	0	0	
7	0	0	142	0	0	
etc.						

14.2% (the decimal point is omitted) of the catchments in group 3 have attributes 1, 3, 6, and 7. 42.8% of them have attribute 2. 100% of the catchments in group 5 have attribute 3. Thus, the dominant characteristics of each group could be determined, and comparisons made. If there was a similarity, a more detailed comparison was made using the data for individual catchments. The procedure resulted in some amalgamation of regions, particularly in the south-east and south-west of the contient. On the whole, however, the existing regions remained discreet, and their boundaries were sensible.

Conclusion

1. The primary aim of this study was to provide, at short notice, a preliminary regionalization of Australian biophysical environments. The procedure adopted provided a total of 300 biophysical regions. These varied in area from a few hundred square miles along the east coast fringe, to several thousands of square miles in interior Australia.

2. Preliminary investigation of regional characteristics and boundaries in selected areas indicates that the attribute composition and consequent boundaries for regions are sensible, but that in the case of eastern coastal Australia, and parts of south-west Western Australia, the catchments are too large to provide reasonably homogeneous biophysical regions. In addition, in lower rainfall inland regions where there are both high and low gradients of geographical change in attributes, recording only the presence of attributes may not be a sufficient criterion for regionalization. Some form of grading, e.g. predominance, subdominance, or proportion of catchment associated may provide a more useful regionalization.

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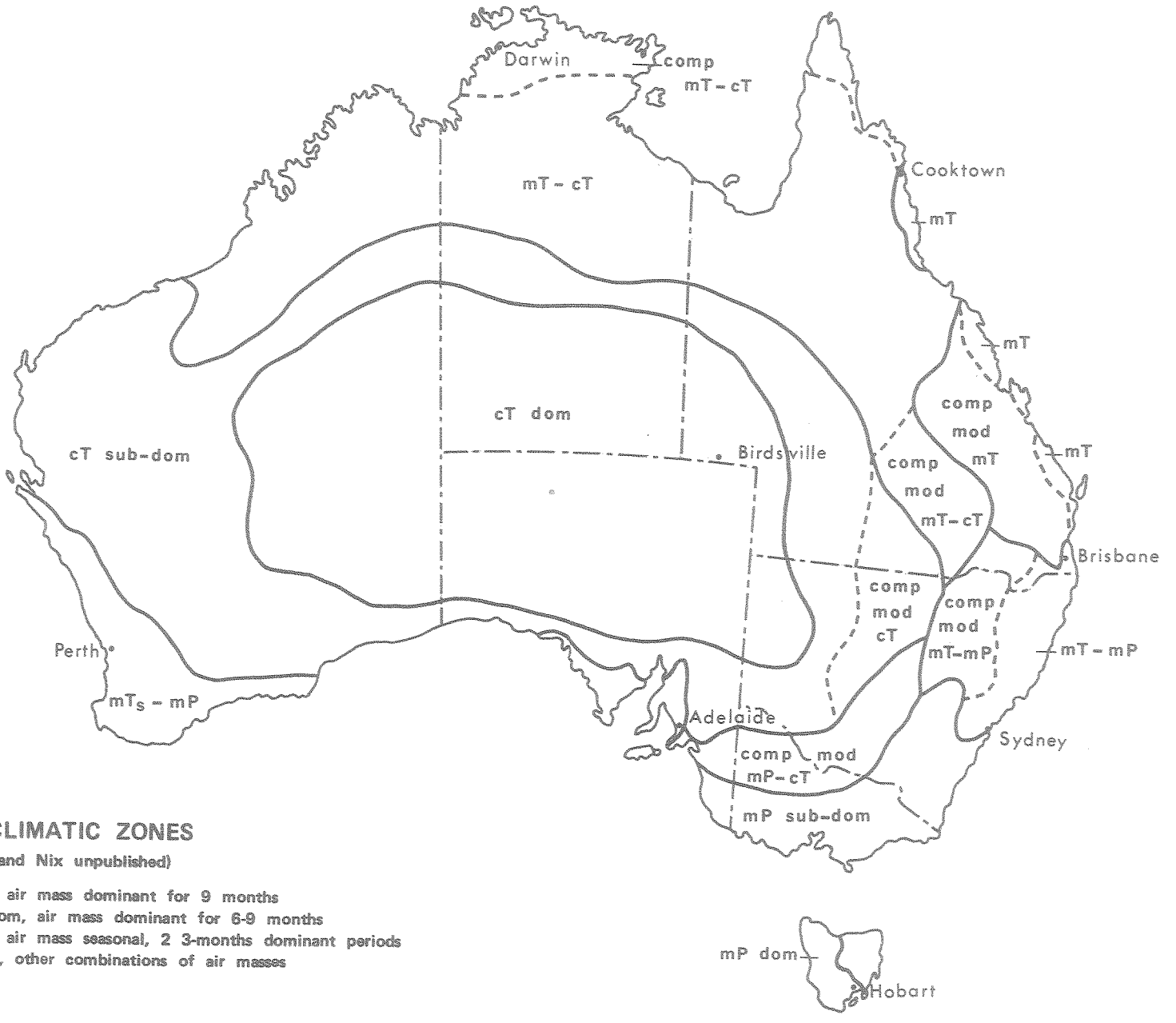

AUSTRALIAN CLIMATIC ZONES

(After Oliver (1970) and Nix unpublished)

s,	seasonal	dom,	air mass dominant for 9 months
m,	maritime	sub-dom,	air mass dominant for 6-9 months
c,	continental	mod,	air mass seasonal, 2 3-months dominant periods
T,	Tropical	comp,	other combinations of air masses
P,	Polar		

Fig. 1.

APPENDIX I

KEYS TO NUMERIC CODES OF ATTRIBUTES

1. The keys for landform and vegetation types are arranged in climatic zones, but the key for soil types is the same throughout the continent.

2. Listings of attributes for each biophysical region are available on request.

3. There is an identification code for every region. This code identifies the state or states and grid square or squares in which the region occurs. (The squares are 6° by 6° of lattitude and longitude. A map of the continent covered by the grid accompanies the map of the biophysical regions).

Example

Region 259	S.A. 21, 28, 29

Thus, region 259 occurs in South Australia in grid squares 21, 28, and 29.

SOILS

Key to Numeric Codes

1. Uniform Texture Profiles

Subdivision Uc

Sand soils of minimal development (Uc1)	46
Leached sand soils (Uc2)	47
Sand soils having an unbleached A_2 horizon (Uc4)	48
Sand soils with weak pedalogic development (Uc5)	49
Coherent sandy soils (Uc6)	50

Subdivision Um

Loamy soils of minimal development (Um1)	51
Leached loamy soils (Um2)	52
Loamy soils with a sporadic bleach (Um3)	53
Loamy soils having an A_2 horizon (Um4)	54
Loamy soils with weak pedalogic development (Um5)	55
Friable loamy soils (Um6)	56
Organic loamy soils (Um7)	57

Subdivision Uf

Clayey soils of minimal development (Uf1)	58
The sub-plastic clay soils (Uf5)	59
Plastic clay soils (Uf6)	60

Subdivision Ug

The cracking clays (Ug5)	61

2. Gradational Texture Profiles

Subdivision Gc

Brown calcareous earths (Gc)	62
Highly calcareous loamy earths (Gc1)	63
Pedal calcareous loamy earths (Gc2)	64

Subdivision Gn Section Gn2

Red earths (Gn2.1)	65
Yellow earths (Gn2.2)	66
Yellow leached earths (Gn2.3)	67
Brown earths (Gn2.4)	68
Mottled yellow earths (Gn2.6)	69
Mottled yellow leached earths (Gn2.7)	70
Grey earths (Gn2.8)	71
Grey leached earths (Gn2.9)	72

Cont.

Subdivision Gn Section Gn3

Red friable earths (Gn3.1) 73
Brown friable earths (Gn3.2) 74
Dark friable earths (Gn3.4) 75
Yellow-brown friable earths (Gn3.5) 76
Yellow friable earths (Gn3.7) 77
Grey friable earths (Gn3.9 & 3.0) 78

Subdivision Gn Section Gn4

Red friable porous earths (Gn4.1) 79
Brown friable porous earths (Gn4.3) 80
Dark friable porous earths (Gn4.4) 81

3. Contrasting (Duplex) Texture Profiles

Subdivision Dr

Crusty loamy soils with red clayey subsoils (Dr1) 82
Hard setting loamy soils with red clayey subsoils (Dr2) 83
Hard setting loamy soils with mottled red clayey subsoils (Dr3) 84
Friable loamy soils with red clayey subsoils (Dr4) 85

Subdivision Db

Hard setting loamy soils with brown (or mottled brown (Db2)) clayey subsoils (Db1 & Db2) 86
Friable loamy soils with brown clayey subsoils (Db3) 87

Subdivision Dy

Hard setting loamy soils with yellow clayey subsoils (Dy2) 88
Hard setting loamy soils with mottled yellow clayey subsoils (Dy3) 89
Sandy soils with mottled yellow clayey subsoils (Dy5) 90

Subdivision Dd

Hard setting loamy soils with dark clayey subsoils (Dd1) 91
Hard setting loamy soils with mottled dark clayey subsoils (Dd2) 92
Friable loamy soils with dark clayey subsoils (Dd3 & Dd4) 93
(Dd4 : B horizons are mottled)

Subdivision Dg

Hard setting loamy soils with gley clayey subsoils (Dg2) 94
Sandy soils with gley clayey subsoils (Dg3) 95
Friable loamy soils with gley clayey subsoils (Dg4) 96

4. Organic Profiles

Organic soils (O) 97

Key 1

COMPOUND mT-cT CLIMATIC ZONE

Key to Numeric Codes

TOPOGRAPHY		VEGETATION	
1	1shc	100	eMiG
2	0b	101	mMcG
3	1g	102	eMiL
4	23Rsh	103	eMcL
5	2Hg	104	eLr
6	23Ps	105	L
7	1cs	106	gGd
8	0shc	107	xLcG
9	2Rsh	108	eMcG
10	1sh	109	eLiG
11	1sg	110	eLrG
12	2Hsh	111	xZc
13	21Hh	112	eL
14	1h	113	eMcZ
15	0sh	115	xMd
16	t	116	mLcG
17	0s	117	mLiG
18	2Hsg	118	eLcG
19	1s	119	xGd
20	0a		
21	1hs		
22	34Ps		
23	1qg		
24	2Ps		
25	1ahs		
26	12Phs		
27	0^{a}_{c}		
28	12Ps		
29	21Ps		
30	23Rsd		
31	2Hsg		
32	(Sand)		
33	1gq		
34	31Hg		
35	34PHg		
36	0o		
37	34Hd		
38	2Rs		
39	3Hd		
40	4Ps		
41	10s		
42	3Ps		
43	2Hq		
44	3Hp		
45	4Hgp		
114	4Hg		

Key 2

mT-cT (WEST) CLIMATIC ZONE

Key to Numeric Codes

TOPOGRAPHY

1	O1a
2	Idhs
3	Oo
4	Oe
5	21Hd
6	21Hg
7	Oh
8	1s
9	(Sand)
10	Oo (dunes)
11	34Rpdc
12	2HRsdg
14	2RHs
15	3Rq
16	21Hdc
17	3HRdc
18	1g
19	4Rdc
20	2Rqg
21	4ch
22	3Rdc
23	3Rdhc
24	O1os
25	2Hs
26	O2Hoqg
27	Oeo
28	O1d
29	1sh
30	Ob
31	2Rsh
32	1hs
33	O^{b}_{c}
34	11
35	$2P^{b}_{gc}$
36	1h1
37	1so
38	1^{b}_{c}
39	t
40	23Ps
41	3Ps
42	23Pshc
43	1h
44	1o
45	1shcs
100	Oa
101	3PRo
102	Osh
103	2Hg
104	2Pc
105	3Hg
106	4RPsd
107	4Ps
108	2Hd
109	2Ps
110	23Rs
111	1d
112	34Ps
113	23RHp
114	2Rs
115	1gq
116	1pd
117	3Rs
118	4Rs
119	34RPs
120	3Rsd
121	2Psc
122	2Hh
123	2PRcs
124	4Psd
125	3RPsd
126	1qg
127	3Psd
128	3Hd
129	34Hd
130	23Hd
131	3Pd
132	4Pd
133	2Rc
134	1a
135	12Ps
136	5Ps
137	O1ds
138	1c
139	2PRd
140	O1s
141	1ob
142	3RPs
143	1q
144	3Hqg
145	2Hsh
146	4Hg
147	34Hg
148	45RS
149	1hdc
150	23Rps
151	2Pa
152	12Pd
153	2Psd
154	2Ph
155	2Pd
156	23Pd
157	1sc
158	12Hsh
159	23Rsh
160	12Phcs
161	12Pc
162	Oshc
163	1cs
164	12Phs
165	O1g
166	1shc
167	12Hh
168	O^{a}_{e}
193	4Rp
195	34Rs
196	O1sc
197	2Hsc
204	2Hch
205	23Rsd
206	$2P^{s}_{c}$
207	2Phs
208	12Rs
209	1b
210	12Rcs
211	21Ps
212	2Hsh
213	12Phc
215	2Hc
217	21Psh
218	12Hsc
219	2Pch
220	23PRhs
221	O1
225	10s

VEGETATION

169	aSrH
170	xLrH
171	aSrH
172	aSiG
173	eLrH
174	aSiZ
175	e/wLrS
176	xGd
177	xLrH
178	aGc
179	xLrS
180	eMiG
181	eLrG
182	eLiG
183	dGc
184	eMcL
185	wScH
186	eLrH
187	kZi
188	tHi
189	xGc
190	L
191	xLrG
192	aGc
194	eMiH
198	mLiH
199	aSiH
200	aLc
201	gGd
202	eLr
203	pMiG
214	xLcG
216	eMiL
222	kZiG
223	xSiH
224	eLrZ

Key 3

mT-cT (EAST) CLIMATIC ZONE

Key to Numeric Codes

	TOPOGRAPHY				VEGETATION	
1	1s	102	3Hpqg	148	45Hd	158	eLrH
2	(Sand)	103	2Hgp	149	34Hgd	159	eMcL
3	1dh	104	2Rpqg	150	2ag	160	L
4	1g	105	2Rgq	151	$2P^{s}_{c}$	161	eMiL
5	1sh	106	2Pq	152	$1g^{c}_{s}$	162	mLiG
6	0b	107	4Hdg	153	2Hch	163	mLiH
7	1hs	108	3Hph	154	23Rds	164	aGc
8	0^{b}_{c}	109	12Hqg	155	23Rg	165	XLrZ
9	1^{b}	110	4Hph	156	21Psh	166	eLrG
10	t^{c}	111	13Rqg	157	2Pch	167	dGc
11	23Ps	112	3PHs	171	32Psd	168	tHi
12	3Ps	113	3Hdg	179	2Phcs	169	XLiG
13	1h	114	23Phd	180	0o	170	aLrH
14	0a	115	23PHd	192	1ag	172	eLrZ
15	2Hg	116	12Hpg	193	12Hgq	173	XLrG
16	2Pc	117	1hd	194	5Hgp	174	aLrG
17	3Hg	118	12PpS	195	4Ps	175	eMrG
18	2Hd	119	23HpS	196	10s	176	aLc
19	2Ps	120	2Hgh	197	4Ppg	177	eMiG
20	23Rs	121	4Rq	200	5Hg	178	ehiG
21	1d	122	3Rp	201	1p	181	aSrH
22	2Rs	123	2Rpqs	203	34Hd	182	aLiG
23	+gq	124	34Hds	204	23Hg	183	eMrH
24	3Rs	125	0ab			184	pMcG
25	4Rs	126	0ba			185	eMrS
26	3Rsd	127	0s			186	eMiH
27	3Hd	128	12Rs			187	aMcL
29	23Hd	129	1b			188	XGd
30	2Rc	130	12Rcs			189	mLrG
31	1a	131	12Phc			190	XMd
32	12Ps	132	2Hc			191	eLcG
33	21Ps	133	12Hsc			198	mLcG
34	01s	134	1as			199	eMcG
35	1q	135	1^{a}_{c}			202	XLd
36	4Hg	136	1ha				
37	34Hg	137	12Rq				
38	2Pd	138	12Phd				
39	12HsH	139	2Phs				
40	12Pc	140	12Hg				
41	12Phs	141	2Hq				
42	0^{a}_{c}	142	10a				
43	23Psd	143	34PHg				
44	23PRhs	144	1oha				
45	3PRpqg	145	3Hs				
100	2HRhs	146	5Hd				
101	2Rhs	147	5Hgq				

Key 4

CT (EAST) CLIMATIC ZONE

Key to Numeric Codes

	TOPOGRAPHY		VEGETATION	
1	Oa	99	Oa(dunes)	115	kZiG
2	34Hg	100	21Ph	116	aLrZ
3	4Rp	101	10Ph	117	pLrS
4	2Hr	102	10sh	118	aSrG
5	31Rp	156	2Psh	119	eMiG
6	3HRsq	103	1sh	120	eSiZ
7	3Ps	104	1g	121	eLiG
8	10a	105	Ohc	122	xGc
9	(Sand)	106	1gq	123	xSiZ
10	11(dunes)	107	12Hosc	124	xLrZ
11	O1(dunes)	108	O2Hsc	125	eSiH
12	3HRgd	109	43Rs	126	cLiG
13	Ob	110	23Psh	127	eScG
14	Oo(dunes)	111	34Ps	128	kZi
15	1a	112	3Hgq	129	cLrG
16	21Psh	113	12Hgqs	130	aLiG
17	1hcs	114	21Hhs	131	aGc
18	3Rp	150	21Rg	132	aLiS
19	Oo1	151	34Rp	133	aLrG
20	11	158	23RHp	134	XZiG
21	O1o	159	23Pshc	135	eMrG
22	12Ps	160	12Hchs	136	cLiZ
23	1h	161	O1sc	137	eLiS
24	2Ph	162	O1ds	138	eMiL
25	1a(dunes)	163	O1d	139	xGi
26	O1a	164	O1s	140	kZr
27	12Ph	165	1ob	141	xLrG
28	12Phs	169	1q	155	aLrH
29	2Rs			142	aGr
30	2Ps			143	eLrH
31	1s			144	aSrH
32	1hs			145	eLrG
33	Oa1			146	eLrZ
34	2Phs			147	aGs
35	12Rh			148	aSrG
36	11h			149	kFr
37	3Hpqg			152	aSiH
38	1^{b}_{c}			153	aSrH
39	23Rg			154	tHi
40	2Pc			157	eLrH
41	12Rq			166	kSrH
42	3PRpqg			167	aSiG
43	1c			168	xLrH
44	Oo				
45	1oh				
98	10ha				

Key 5

CT (WEST) SUBDOMINANT CLIMATIC ZONE

Key to Numeric Codes

	TOPOGRAPHY						VEGETATION	
1	1aqg	40	2Hh	131	1ag	160	eSiZ
2	12Hg	41	2HRs	132	O1g	161	eMiZ
3	1gq	42	12Hh	133	1q	162	cScZ
4	O1s	43	t	134	O1gq	163	xSiZ
5	12Hqg	44	34R1	135	10gq	164	aSiZ
6	Oa	45	23Hdh	136	1aqg	165	aScZ
7	Ob	98	1a	137	2Rg	166	eLiZ
8	Oe	99	23Rh	138	12Rg	167	eMiL
9	Oo	100	3RHs	139	2Rqg	168	p/wLrs
10	Ooa	101	3RHsh	140	O2Hoqg	169	aSiF
11	3Ps	102	1h	141	Oeo	170	kZi
12	1ao(dunes)	103	1s	142	O1os	171	aSrH
13	2Hs	104	4Rscd	143	1ob	172	aSrH
14	12Hs	105	3Hhc	144	12Hchs	173	aSiG
15	1g	106	2Hg	145	O1sc	174	e/wSrH
16	12Rgq	107	4RPs	146	O1ds	175	eSrH
17	1dh	108	4Rdq	147	32Pqg	176	eLrH
18	12Rqg	109	23Hs	148	Oe1	177	aSiH
19	3Rq	110	2Rh	149	Ohc	178	w/kLrZ
20	O2Ras	111	23dh	150	2Rs	179	w/kSrZ
21	Oc(dunes)	112	1ba	151	1d	180	cLiS
22	11	113	34RPdc	152	1sh	181	aLrZ
23	3Rpg	114	12PRs	153	2Hsh	182	eLrH
24	12Rhg	115	1as	154	12Rs	183	kZiG
25	(Sand)	116	4Rhc	155	10qg	184	xSrH
26	O1a	117	12Hdg	156	O11	185	kZiF
27	O1a(dunes)	118	2Hdg	157	3HRgd	186	aSrF
28	12Rqhs	119	1dhs	158	12Rag	187	tHi
29	2Ps	120	21Hd	159	O1(dunes)	188	xGc
30	12qhs	121	3Hdg	195	2Rq	189	aZrH
31	1d	122	21Hg	196	3Rs	190	xZiG
32	13Rs	123	2HRsdg	197	1gr	191	L
33	1qg	124	Oh	198	12Hd	192	eLrS
34	23Hqg	125	3Rdhc	199	12Rq	193	eLrG
35	4Rcs	126	O1os	94	10qg	194	wScH
36	3Rd	127	3Hhs	95	1ao	78	aSrZ
37	11(dunes)	128	O1ao	79	O1	80	eScZ
38	23Rc	129	O1o	83	Oa1	81	c/wLrS
39	1sa	130	10ag				

Key 6

cT DOMINANT CLIMATIC ZONE

Key to Numeric Codes

TOPOGRAPHY

1	Sand	101	02Hog	148	12Hgqs
2	0e	102	03Hog	149	10ha
3	0o	103	1ga	150	aPch
4	1s	104	12Hg	151	11h
5	32Pqg	105	12Rag	152	12Hs
6	2RHs	106	3RHs	153	12Hsc
7	2Hs	107	1oa	154	12Pc
8	12Hchs	108	2HR	155	0a1
9	0e1	109	3HRsq	156	1hcs
10	2Rs	110	34Rp	157	12Hh
11	10og	111	3RHs	158	12Rh
12	1g	112	21Psh	159	23Rg
13	0hc	113	1H	160	2c
14	23Rs	114	23RHch	161	1c
15	3Hg	115	4Rp	162	0b(dunes)
16	3Rs	116	34Rp	163	01ha
17	3Rg	117	0o(dunes)	164	12Phs
18	1pg	118	23Hqg	165	01ha(dunes)
19	32Rshc	119	0b	166	10h
20	4Hgq	120	1hs	167	01a
21	4Rs	121	3Rqg	200	12Rs
22	4Rsh	122	23Pps	217	12Hhs
23	0eo	123	1a(dunes)	218	2Psh
24	1og	124	12Ph	219	4Rchs
25	01e	125	2Ph		
26	1a	126	3Rp		
27	1o	127	31Rp		
28	1sd	128	21Rg		
29	23Hg	129	0a(dunes)		
30	45Rg	130	1p		
31	34Rg	131	2Hg		
32	12Ps	133	1oh1		
33	2Rsch	134	21Rh		
34	02Hos	135	2Rg		
35	2oRso	136	21Ph		
36	0ea	137	12Hgq		
37	2Pq	138	2Phs		
38	1sh	139	1gq		
39	2Ps	140	4Rshc		
40	1hc	141	4Rsc		
41	2Hsh	142	3Ps		
42	0a	143	1cs		
43	01o	144	2Rsh		
44	10ag	145	43Rshc		
45	01e	146	2gq		
100	01	147	21Psc		

VEGETATION

168	aSiG	215	xZrG
169	aSiG	216	kZiF
170	eLrH	220	pFr
171	eLrh	221	xGi
172	cLrH	222	kFr
173	cLrH	223	aGr
174	aSaG	224	aGc
175	cLiG	225	LFr
176	KZi	226	aLrH
177	CLiZ	227	kZr
178	w/KLrZ		
179	c/wLrS		
180	wSrG		
181	eSrH		
182	eSrH		
183	CLiZ		
184	e/wSrH		
185	xGi		
186	cLrS		
187	eSiZ		
188	wSiG		
189	ZiG		
190	aLiZ		
191	aSrH		
192	aSrH		
193	aSiZ		
194	aSiH		
195	aLiG		
196	xLrH		
197	xLrF		
198	xLrG		
199	aZrG		
201	tHi		
202	pLrS		
203	xSiZ		
204	aSrG		
205	aLrG		
206	eLiG		
207	xZiG		
208	xGc		
209	xSrG		
210	aSrG		
211	xSrH		
212	KZiG		
213	eLrG		
214	aLrZ		

Key 7

COMPOUND MODERATE CT CLIMATIC ZONE

Key to Numeric Codes

TOPOGRAPHY		VEGETATION	
1	0a	17	eMiL
2	0b	18	eSiz
3	0o(dunes)	19	eSiH
4	21Psh	20	eLiG
5	2Pd	21	eLiG
6	1a	22	eLiS
7	2Pg	23	aGc
8	1ps	24	aMc
9	1g	25	aLig
10	1h	26	eMrG
11	0o	27	eMcG
12	1oh	28	kZiG
13	1bc	29	eMiG
14	01a	30	WeMc
15	12Phs	31	aLis
16	12Ph	32	pMiG
		33	xLrG
		34	aLrG

Key 8

COMPOUND MODERATE mT-cT CLIMATIC ZONE

Key to Numeric Codes

TOPOGRAPHY		VEGETATION	
1	0b	24	weMc
2	1h	25	eMiL
3	1b	26	cMcL
4	2Hh	27	eMiG
5	01s	28	eMrG
6	0a	29	aGc
7	12Ph	30	aMc
8	1s	31	aMcL
9	12Hsh	32	aMi
10	1sh	33	aLi
11	2PHs	34	aLc
12	12Rs	35	pMcG
13	4Rs	36	dGc
14	2Hs	37	eMcL
15	12Phs	38	eMiS
16	01b	39	aLiG
17	12Psh	40	aLs
18	10ha	42	xLd
19	2Psh		
20	1as		
21	1b/h		
22	3Hs		
23	2Rsh		
41	2Ph		
43	3PRhs		
44	3Rsh		
45	3Psh		

Key 9

COMPOUND MODERATE mT CLIMATIC ZONE

Key to Numeric Codes

TOPOGRAPHY				VEGETATION	
1	Oo	114	2Ps	100	eMiG
2	Oab	115	4Hd	101	aMcL
3	5Hg	116	3Hg	102	eMiL
4	t	117	4Hq	104	eMrG
5	2Rsh	118	23Hd	105	eMcL
6	4Hg	119	23Hg	106	xLd
7	4Rsh	120	23Hs	107	xMd
8	2Pd	121	3Hs	108	eMiS
9	3Rs	122	2Hgd	109	eMcS
10	Os	123	4Hgd	110	L
11	3Rq	124	4Pq	111	eLrG
12	2Hd	125	34Hdh	112	eMcG
13	1d	126	2Hhsd	113	xGd
14	Ob	127	1a	138	aGc
15	34Hg	128	2Hs	140	aLc
16	1hd	129	12Hs	141	dGc
17	1g	130	4Hs	142	pMcG
18	12Hg	131	4Hgq		
19	12Hsh	133	12Rd		
20	2Hg	134	O1s		
21	3PRhs	135	4Rd		
22	4Rs	136	1sh		
23	3Hd	137	1as		
24	1hs	139	2Rs		
25	2Hgd	143	34Hhs		
26	23Rs	144	2Hch		
27	4Rd				
28	2Hsh				
29	3Hsd				
30	34Hchd				
31	2Psh				
32	2Phs				
33	1^{b}_{h}				
34	2Hqg				
35	12Rsh				
36	4Rsh				
37	Rsh				
38	2Hq				
39	3Hhs				
40	23Hhs				
41	34Hgd				
42	34Hd				
43	1b				
44	43Rs				
45	1s				

Key 10

mT CLIMATIC ZONE

Key to Numeric Codes

TOPOGRAPHY		VEGETATION	
1	5Hgp	116	xMd
2	4Hph	117	eMcL
3	Oa	118	eMiG
4	4Ps	119	eMcG
5	(Sand)	120	eLiG
6	5Pgp	121	eLrG
7	34Pp	124	eMrG
8	2Hd	125	aMcL
9	4Hd	126	xGd
10	12Hspq	127	mLiG
11	1a		
12	Oab		
13	3Hq		
14	4Hg		
15	5Hgq		
16	1s		
17	3Hdg		
18	4Hdg		
19	3Hph		
20	2Hp		
22	23Hg		
23	12Hg		
24	1hd		
25	34Hds		
26	45Hd		
27	34Hgd		
28	34Hg		
29	1d		
30	Oo		
31	1hg		
32	34Hhs		
33	23Hhs		
34	12Hhs		
35	Ob		
36	1b		
37	2Hch		
38	4Hgd		
39	2Hqg		
40	2Hsh		
41	2Psh		
42	1sh		
43	2Hhsd		
44	1ao		
45	34Hdh		
114	2Hs		
115	23Hoa		
122	4Hd		
123	4Hq		

Key 11

mT-mP CLIMATIC ZONE

Key to Numeric Codes

TOPOGRAPHY

1	23Hs
2	2Hs
3	4Hs
4	4Rs
5	0a
6	4Rds
7	5Rds
8	2Pd
9	3HRsh
10	12Hsh
11	23Hsh
12	10a
13	2Psg
14	4Hg
15	4Hhp
16	12Hpg
17	34Hg
18	1ao
19	23Hd
20	3Hg
21	34Rpg
22	45Rhs
23	2Hsh
24	2Hp
25	1oa
26	1b
27	4Rhs
28	2Hsd
29	45Hds
30	1a
31	4Hsh
32	1sh
33	21Hsh
34	3Hhd
35	3Hd
36	45Ps
37	2Rh
38	5Hs
39	5Rsg
40	34Hs
41	2Hh
42	3PHsh
43	2Ps
44	4Hhs
45	4Hd
101	34Hhs
102	2Hsg
103	3Hgp
104	1h
105	3Hs
106	12Hh
107	12Rd
115	2Hao

VEGETATION

108	eMcZ
109	eMcG
110	eMiG
111	eTcL
112	xMd
113	eMcL
114	aMcL

Key 12

COMPOUND MODERATE mT-mP CLIMATIC ZONE

Key to Numeric Codes

TOPOGRAPHY		VEGETATION	
1	1b	39	eMiL
2	01s	40	eMiG
3	0b	41	aMcL
4	2Hsg	42	aGc
5	34Hhs	43	eMcG
6	12Rd	44	pMcL
7	4Hs	45	cMcL
8	0a	100	eMrG
9	12Hs	101	sGc
10	2Pd	102	eMcL
11	1h	103	eMcZ
12	3Hs	105	dGc
13	3Hgp		
14	12Hh		
15	45Rh		
16	2Hh		
17	4Rd		
18	1s		
19	45Hds		
20	12Psd		
21	12Hsd		
22	3Hd		
23	4Rs		
24	2Hp		
25	23Hsd		
26	12Ps		
27	5Hd		
28	1as		
29	3Pd		
30	21Hsh		
31	1g		
32	2Psh		
33	4Hsh		
34	1ds		
35	1sh		
36	4Rhs		
37	2Hsh		
38	4Hhs		
104	4Hd		

Key 13

COMPOUND MODERATE mP-cT CLIMATIC ZONE

Key to Numeric Codes

TOPOGRAPHY		VEGETATION	
1	Oo(dunes)	34	gGc
2	Olao	35	eLiZ
3	10os	36	eSiZ
4	11	37	cLrG
5	(sand)	38	eMcG
6	Ob	39	eSrZ
7	1a	40	xZc
8	Oa	41	eMcL
9	1ao	42	eMiL
11	31Hga	43	eMiG
12	12Hapg	44	eLiG
13	34Hqg	45	aLiS
14	Ool	100	eSiH
15	21Hhsa	101	kZiG
16	31Hha	102	cLiG
17	2Hg	104	eMiZ
18	3Hg	105	eMrG
19	32Hqg	106	sGc
20	21Hhso	107	eScG
21	23Rs	108	xGc
22	1s	109	eLrG
23	2Rsa	110	kZi
24	1pg	111	eScZ
25	12Hd	113	eMcZ
26	2Pg	118	eLiS
27	21Psh		
28	12Rp		
29	1sd		
30	12Rgs		
31	3Rsd		
32	1g		
33	12Psd		
103	21Hha		
112	34Hg		
114	4Hs		
115	34Hq		
116	11a		
117	23Ps		
119	1as		

Key 14

mT_s-mP CLIMATIC ZONE

Key to Numeric Codes

TOPOGRAPHY				VEGETATION	
1	1q	120	4Rp	36	eSrZ
2	12Hg	121	12H1	37	eSiZ
3	12Hgq	122	1sa	39	xScZ
4	34Hg	123	2Hqg	40	eMiZ
5	1g	124	11(dunes)	41	eMcZ
6	O11(dunes)	125	11	42	eTcL
10	1ao	126	3Rp	43	xZcG
11	O1o(dunes)	127	3H1	44	eMiL
12	3Hg	128	1gq	45	eLiZ
13	1sh	129	3Hs	146	aSiF
14	12Hqg	130	3Hgq	147	aScZ
15	23Hg	131	O1(dunes)	148	eLiG
16	12Haq	132	34Hg	149	kZi
17	45Rshd	133	3HRgd	150	mLrG
18	2Hg	134	13H1g	151	eMiG
19	(sand)	135	10a	152	xGc
20	12Hqp	136	3H1	153	rSiZ
21	21Hg	137	12H1g	154	eMrG
22	23Hqp	138	Oa1	155	eLiS
23	Oa	141	Oe	156	aLrZ
24	2Hq	142	O1g		
25	2Hs	143	1aqg		
26	2HPg	144	10gq		
27	21Hq	145	1s		
28	12Haqg				
29	12Hg1				
30	1ao1				
31	34HPg				
32	1ag				
33	12Hs				
34	21Hs				
35	O1o				
114	1a				
115	1ag				
116	O1s				
117	1ao(dunes)				
118	34Hq				
119	1a(dunes)				

Key 15

mP SUBDOMINANT CLIMATIC ZONE

Key to Numeric Codes

TOPOGRAPHY

1	2Psd	103	1s	152	1b
2	2Ps	104	3Hh	153	4PRps
3	32Hgd	105	1o	154	4Rsh
4	45Rps	106	3Ph	155	13Hpg
5	21Hg	107	2Hd	156	5Hhg
6	1a	108	23Pd	157	4Hqg
7	45Ps	109	12Pd	158	5Hpg
8	1sha	110	1d	159	1pg
9	12Hpg	111	Oe	160	3Hp
10	32Rp	112	4PHh	161	5Hgp
11	12Hsh	113	41Hga	162	21Hga
12	5HRg	114	12Hs1	163	5Hgs
13	3Hg	115	4HPsh	165	31Hga
14	45Hg	116	$1\frac{e}{a}$	166	3Pg
15	5RHg	117	2Ph	167	23Rh
16	34Rp	118	2Hsh	168	34Hha
17	4Hp	119	21Pd	169	12Hapg
18	1ao(dunes)	120	1sh	170	54Rs
19	Oa	121	1hs	171	32Hqg
20	12Hpa	122	2Hs	172	4Hh
21	5Hgh	123	1ae	173	24Hg
22	2Hpg	124	31Hha	174	41Hqa
23	31Hpg	125	4Ha	175	2HRpa
24	3Pd	126	(sand)	176	13Rpd
25	5Hha	127	Oo1	177	2HRdp
26	2Poa	128	12Ph	178	2Hdhs
27	12HPa	129	1oq	179	2Hp
28	3Hc	130	Owo	180	12Rgs
29	O1ot	131	23Psg	181	3Rsd
30	2Pdg	132	54Rs	182	23Hpg
31	54Hqg	133	4Rs	183	3PRdh
32	2Pd	134	1ao	184	1pd
33	5Rsg	135	Ob	185	1sd
34	34Hh	136	1Oos	186	4Rh
35	3Pg	137	12P1	187	2Hh
36	5RHs	138	O1ao	188	5Hs
37	5Hh	139	Oo(dunes)	189	4Hpg
38	1sa	140	34Hg	190	5Hha
39	1so	141	35HPds	191	34Hp
40	1os	142	4Hds	192	21Hha
41	Ohw	143	34hds	193	12Hg
42	23Hsh	144	42Hg	194	3Hgd
43	2Hsh	145	4PRps	195	32Hgd
44	O1so	146	13Pgp	196	32Rpd
45	4Hsh	148	3Hpg	215	21Hsh
100	O1ot(dunes)	149	13PHd	216	34Hs
101	5Hg	150	3Hdhp	217	34Rsh
102	4Hg	151	4PHdh	218	1g
				219	1ag
				220	21Ps

VEGETATION

197	eMiG
198	eMcZ
199	eTcL
200	eMcL
201	eMiZ
202	eMiL
203	eLiZ
204	cLrG
205	eMrG
206	eLcZ
207	xGc
208	xSiZ
209	xZc
210	gGc
211	xZcG
212	eLiG
213	eMcG
214	sGc

Key 16

mP DOMINANT CLIMATIC ZONE

Key to Numeric Codes

TOPOGRAPHY		VEGETATION	
1	34hds	22	eTiM
2	35HPds	23	eTcL
3	4Hds	24	gGc
4	5Pds	25	nMd
5	5Hds	26	eMcL
6	45Rq	27	eLiZ
7	13PHd	28	xZcG
8	45Hds	29	xZiG
9	5Ps	30	eMiL
10	23Pps	31	eLiG
11	21Psh		
12	5Hdps		
13	12Pspg		
14	3Pdsg		
15	34Hg		
16	45Rqs		
17	3PHdsp		
18	3PHsc		
19	4PHdh		
20	12Hac		
21	4Rsh		