

Can Pikas Adapt to Climate Change?

A 30-Year Perspective



Climate Change

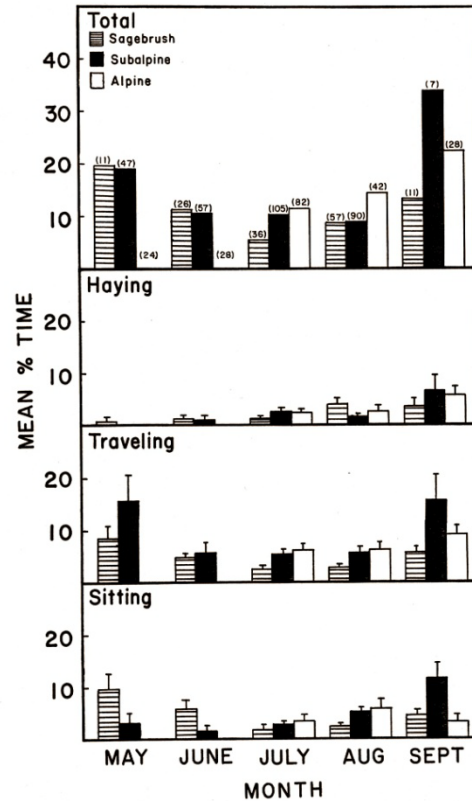
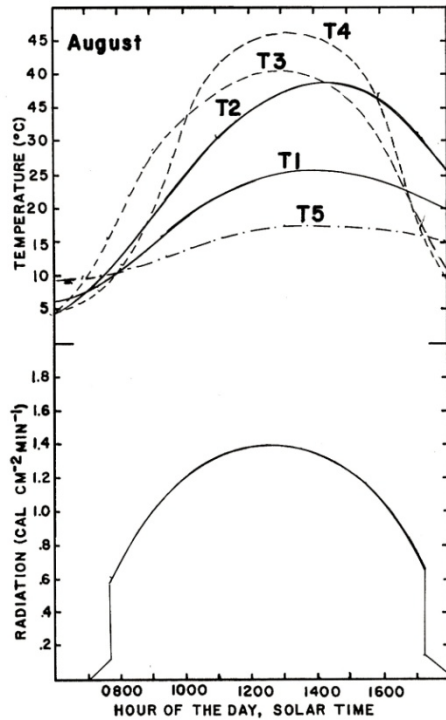
**Altithermal
Habitat Change**

**Species
Adaptive Capacity**



Edward W. West, Ph.D.
West Ecosystems Analysis, Inc.

1974 – 1980 PIKA ADAPTIVE CAPACITY RESEARCH

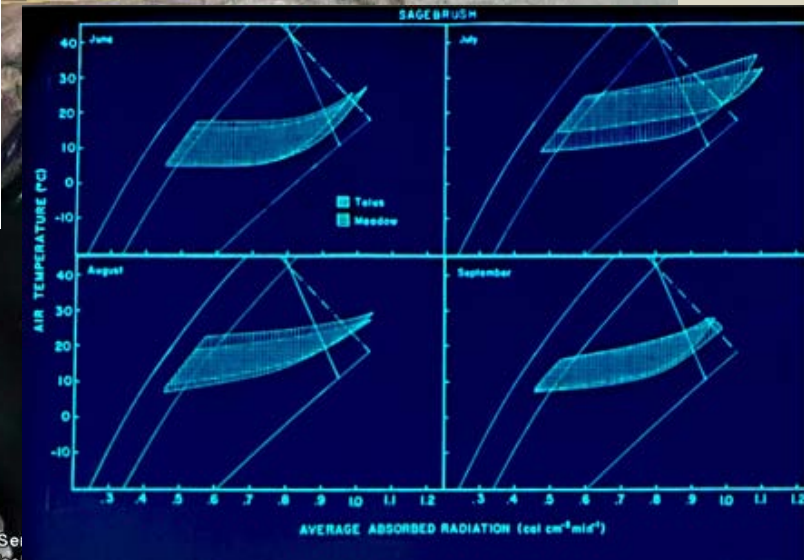


SPSS STATISTICS FOR OCHOTONA PROGRAM *

FILE OCHOTONA (CREATION DATE = 04/03/82)
SUBFILE SUB1

	TEMP	QABS	TOT	SIT	TRAV	HAY
TEMP	1.0000 (52) P=*****	0.7856 (52) P=0.001	-0.3815 (52) P=0.023	-0.0869 (52) P=0.270	-0.3924 (52) P=0.002	-0.2424 (52) P=0.042
QABS	0.7856 (52) P=0.001	1.0000 (52) P=*****	-0.1206 (52) P=0.177	0.0254 (52) P=0.429	-0.1775 (52) P=0.104	0.0366 (52) P=0.398
TOT	-0.3815 (52) P=0.003	-0.1206 (52) P=0.197	1.0000 (52) P=*****	0.5115 (52) P=0.001	0.9266 (52) P=0.001	0.6452 (52) P=0.001
SIT	-0.0869 (52) P=0.270	0.0254 (52) P=0.429	0.5115 (52) P=0.001	1.0000 (52) P=*****	0.2242 (52) P=0.001	0.3295 (52) P=0.001
TRAV	-0.3924 (52) P=0.002	-0.1775 (52) P=0.104	0.9266 (52) P=0.001	0.2242 (52) P=0.001	1.0000 (52) P=*****	0.4160 (52) P=0.001
HAY	-0.2424 (52) P=0.042	0.0366 (52) P=0.398	0.6452 (52) P=0.001	0.3295 (52) P=0.001	0.4160 (52) P=0.001	1.0000 (52) P=*****

(COEFFICIENT / CASES / SIGNIFICANCE) (A VALUE OF 99.0000 IS PRINTED IF A



Lee Vining, California

Pioga Pass Rd

120

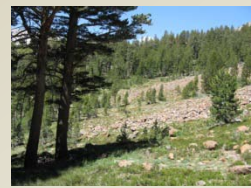
Image USDA Farm Ser

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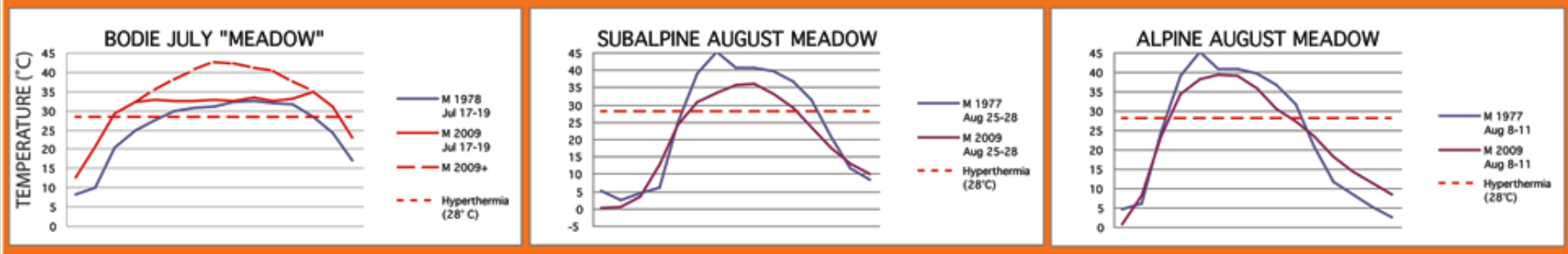


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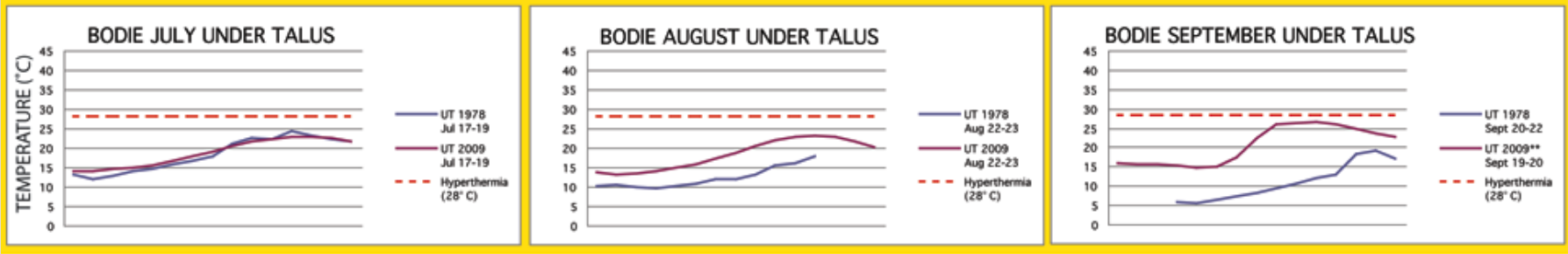
TEMPERATURE PROFILES – A 30 YR COMPARISON



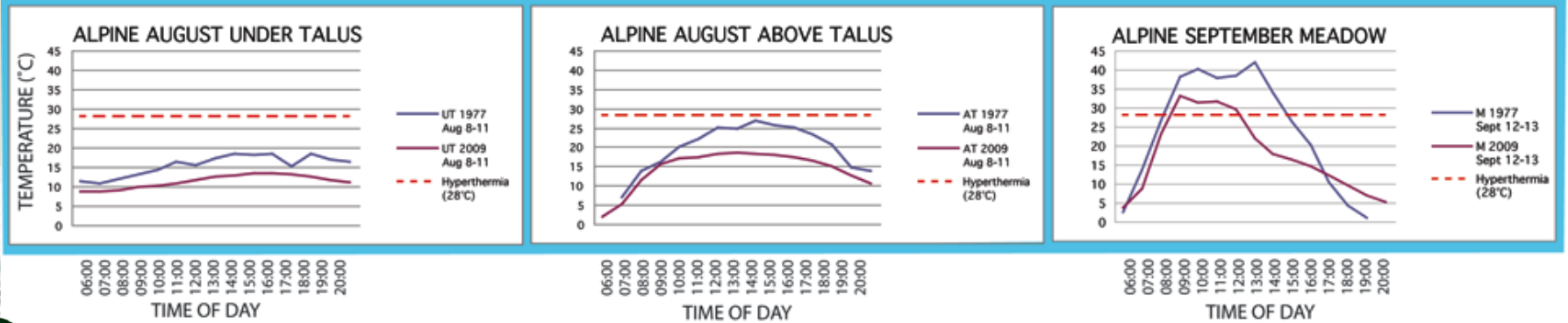
ALL MEADOWS
COMPARABLE HOT



DELAYED COOLING
IN FALL AT BODIE



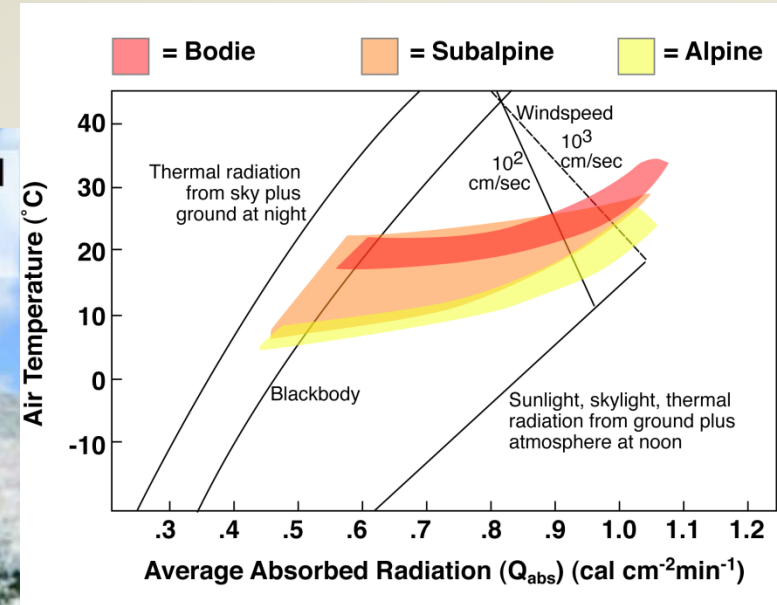
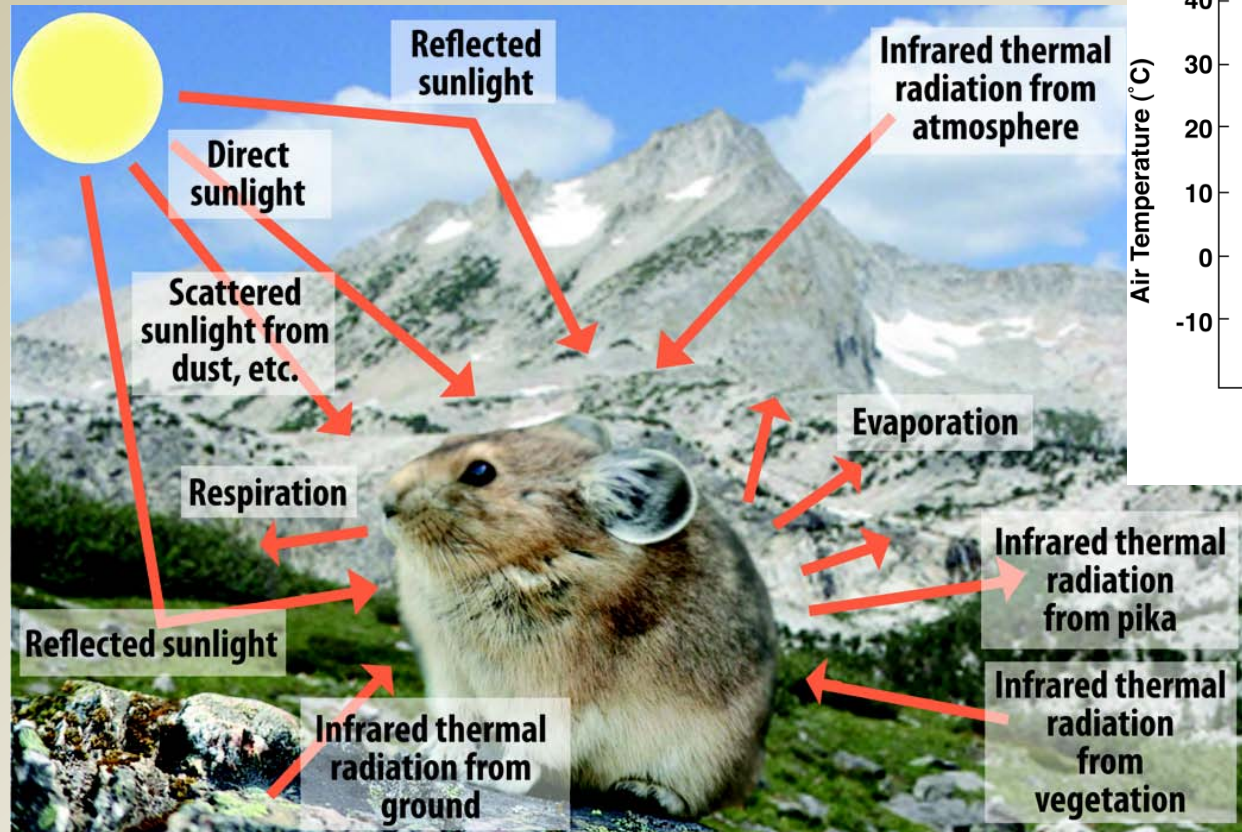
POTENTIAL COOLING
IN ALPINE



PIKA HABITAT THERMAL PROFILES

BODIE UNDER TALUS										SUBALPINE UNDER TALUS										ALPINE UNDER TALUS											
0.15	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	0.15	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	0.15	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50		
0.45	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	0.45	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	0.45	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50		
1.15	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	1.15	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	1.15	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50		
1.45	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	1.45	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	1.45	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50		
2.15	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	2.15	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	2.15	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50		
2.45	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	2.45	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	2.45	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50		
3.15	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	3.15	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	3.15	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50		
3.45	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	3.45	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	3.45	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50		
4.15	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	4.15	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	4.15	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50		
4.45	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	4.45	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	4.45	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50		
5.15	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	5.15	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	5.15	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50	50.50		
5.45	43.39	47.43	50.75	56.06	55.70	55.70	55.70	55.70	55.70	5.45	43.49	47.79	49.70	56.13	57.09	57.09	57.09	57.09	57.09	5.45	46.58	49.10	54.00	56.07	56.71	57.71	57.71	57.71	57.71		
6.15	43.06	47.02	50.18	55.72	55.46	49.97	53.88	53.47	6.15	43.51	47.33	48.84	55.57	56.69	44.83	51.30	51.05	6.15	46.52	48.97	53.82	55.94	46.62	49.92	49.68	6.15	46.52	48.97	53.82	55.94	
6.45	43.20	46.99	49.91	55.50	55.30	49.75	53.32	53.10	6.45	43.39	43.97	48.88	55.82	56.42	44.53	51.00	50.71	6.45	46.57	48.89	53.75	55.84	46.13	49.86	49.65	6.45	46.57	48.89	53.75	55.84	
7.15	43.53	47.30	50.10	55.46	55.48	49.78	53.40	53.21	7.15	43.72	43.67	48.90	55.26	56.35	44.68	50.68	50.43	7.15	47.17	49.61	54.05	55.73	46.40	49.64	49.56	7.15	47.17	49.61	54.05	55.73	
7.45	44.13	47.73	50.53	55.74	55.80	50.09	52.03	53.92	7.45	44.32	42.31	49.00	55.04	55.91	44.46	50.39	50.05	7.45	47.40	50.07	54.52	55.84	46.64	49.89	49.77	7.45	47.40	50.07	54.52	55.84	
8.15	44.42	47.99	51.10	55.90	56.01	50.58	52.87	52.63	8.15	44.38	43.98	50.26	56.65	56.55	46.31	50.36	50.18	8.15	47.82	50.55	55.02	56.32	47.31	50.32	50.44	8.15	47.82	50.55	55.02	56.32	
8.45	44.68	48.09	51.60	56.91	56.63	51.12	53.49	53.36	8.45	44.75	44.52	52.28	58.24	57.63	48.61	50.96	50.83	8.45	48.47	51.11	55.47	57.09	47.99	51.29	51.06	8.45	48.47	51.11	55.47	57.09	
9.15	45.10	48.28	52.13	56.86	56.85	51.72	54.13	54.12	9.15	47.75	48.04	53.00	58.27	58.54	48.32	52.79	52.52	9.15	49.32	51.60	56.12	58.14	48.90	52.26	52.31	9.15	49.32	51.60	56.12	58.14	
9.45	45.62	48.53	52.72	57.42	57.24	52.45	54.96	54.94	9.45	48.75	50.51	53.33	58.81	58.83	48.34	53.47	52.34	9.45	49.95	52.13	57.24	59.07	50.08	53.37	53.27	9.45	49.95	52.13	57.24	59.07	
10.15	46.36	48.83	53.48	58.26	57.90	53.42	55.92	55.90	10.15	49.62	49.26	54.21	60.11	59.78	48.44	54.39	52.79	10.15	50.52	52.66	58.13	59.64	50.77	53.63	53.68	10.15	50.52	52.66	58.13	59.64	
10.45	47.10	49.27	54.39	59.18	58.89	54.59	57.07	56.88	10.45	50.36	48.00	54.87	60.87	60.83	48.86	55.20	53.48	10.45	50.57	53.38	58.63	60.21	51.24	53.80	53.58	10.45	50.57	53.38	58.63	60.21	
11.15	48.17	49.86	55.63	60.29	59.95	56.00	58.54	58.10	11.15	51.30	49.23	55.82	63.86	63.80	49.57	56.20	53.94	11.15	46.11	51.25	53.65	59.05	60.45	51.74	54.31	53.58	11.15	46.11	51.25	53.65	59.05
11.45	49.22	50.45	57.07	61.56	61.05	57.63	60.36	59.55	11.45	53.44	51.30	56.50	62.72	62.62	50.28	57.18	54.68	11.45	43.32	51.44	54.07	59.22	60.45	52.11	54.79	53.70	11.45	43.32	51.44	54.07	59.22
12.15	50.63	53.07	58.43	63.05	62.66	59.27	62.24	63.07	12.15	52.29	52.72	57.53	64.39	63.75	53.54	58.07	55.62	12.15	43.98	51.61	54.50	59.76	60.78	52.60	55.57	54.83	12.15	43.98	51.61	54.50	59.76
12.45	51.75	53.47	60.15	64.56	64.00	60.34	64.33	62.55	12.45	52.89	53.67	58.55	65.06	64.36	53.68	59.16	56.28	12.45	44.49	52.01	54.67	60.24	61.30	52.75	55.95	54.74	12.45	44.49	52.01	54.67	60.24
13.15	53.72	54.71	61.68	65.95	65.31	62.35	66.38	64.03	13.15	55.30	54.35	59.55	65.59	64.53	52.38	60.20	57.31	13.15	44.92	52.48	54.99	60.66	61.35	52.72	56.82	55.20	13.15	44.92	52.48	54.99	60.66
13.45	54.70	55.73	63.83	67.39	67.12	63.63	68.37	65.68	13.45	57.32	54.98	60.17	66.52	64.92	52.74	61.28	57.67	13.45	45.43	53.11	55.34	60.84	61.30	52.72	57.28	55.75	13.45	45.43	53.11	55.34	60.84
14.15	55.68	55.49	65.75	68.96	68.63	65.24	70.58	67.05	14.15	57.84	55.56	60.95	67.68	65.03	53.35	62.25	58.47	14.15	45.68	53.88	55.81	61.08	61.81	52.83	57.55	55.73	14.15	45.68	53.88	55.81	61.08
14.45	56.82	56.20	66.42	70.55	69.35	66.59	72.71	68.60	14.45	58.35	56.04	61.81	67.96	65.05	53.97	63.26	58.88	14.45	45.75	54.44	56.41	61.16	61.73	53.17	57.71	55.59	14.45	45.75	54.44	56.41	61.16
15.15	57.84	57.10	67.59	71.75	70.08	67.72	74.48	69.84	15.15	58.51	56.71	62.50	68.13	65.13	54.78	64.26	59.49	15.15	45.85	54.92	56.47	61.10	60.83	53.27	58.29	55.77	15.15	45.85	54.92	56.47	61.10
15.45	58.77	57.97	68.54	72.96	70.17	68.83	76.05	70.82	15.45	58.66	57.28	62.80	69.90	65.02	54.89	64.71	59.71	15.45	45.83	54.74	56.26	61.09	60.18	53.09	58.26	55.68	15.45	45.83	54.74	56.26	61.09
16.15	58.63	58.96	69.52	73.73	70.01	69.40	77.36	71.49	16.15	58.48	57.66	63.15	70.49	64.77	55.20	64.97	59.91	16.15	45.68	54.71	56.27	60.83	59.58	52.70	58.19	55.44	16.15	45.68	54.71	56.27	60.83
16.45	57.02	59.25	70.02	74.47	70.08	69.92	77.92	71.96	16.45	58.29	57.21	63.50	69.56	64.58	55.21	64.96	60.11	16.45	45.00	54.52	55.80	60.66	59.81	52.58	57.88	55.02	16.45	45.00	54.52	55.80	60.66
17.15	56.28	59.46	70.21	75.18	69.40	69.94	78.17	72.13	17.15	57.54	57.01	63.05	69.02	64.51																	

THERMAL TRACKING



$$M + Q_{abs} = \epsilon \sigma (T_r + 273)^4 + k(V^{1/3}/D^{2/3})(T_r - T_a) + E$$

