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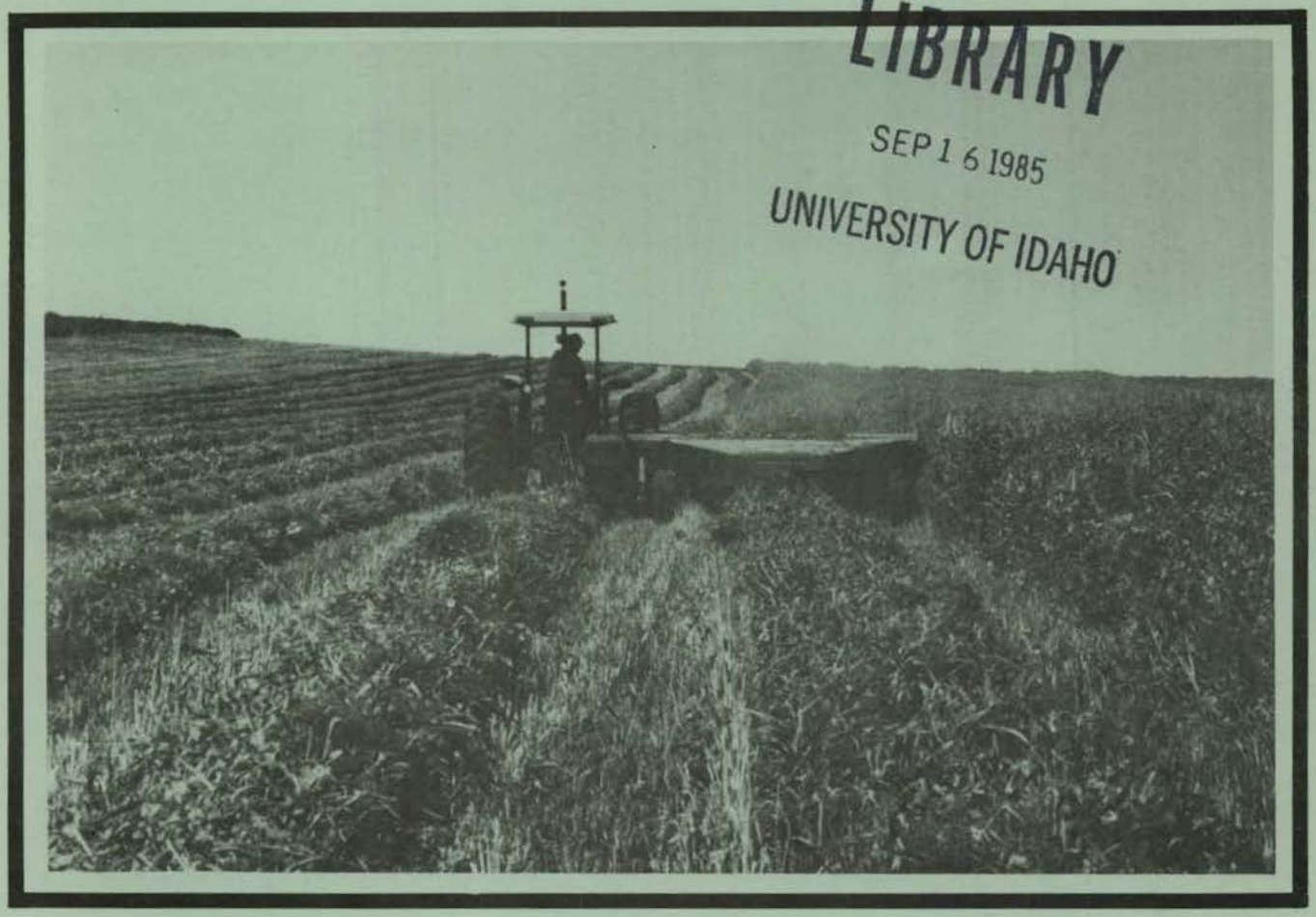
Winter Pea/Winter Cereal Mixtures As Potential Forage Crops In Northern Idaho



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COVER PHOTO — Winter pea/cereal mixtures can be swathed in early June using existing harvesting equipment.

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Winter Pea/Winter Cereal Mixtures as Potential Forage Crops in Northern Idaho

G. A. Murray, D. L. Auld and J. B. Swensen

Summary

Silage yields up to 38 tons per acre (70 percent moisture) were obtained from winter pea/winter cereal mixtures in northern Idaho. Mixtures of winter wheat and winter peas were generally more productive, easier to harvest and had less winter damage than either winter barley/winter pea mixtures or winter peas grown alone.

The winter pea variety 'Melrose' produced the highest forage yields of five varieties evaluated. 'Daws' winter wheat appears to have more forage yield potential than 'Boyer' winter barley. Mixtures cut when cereals were in the soft dough stage produced 34 percent more dry matter but 37 percent less protein than mixtures cut when cereals were in the early heading stage. Mixtures of winter barley and winter peas averaged 14.8 percent protein (dry matter basis) while winter wheat/winter pea mixtures averaged 14.0 percent. Protein percentage increased in proportion to the amount of peas in the mixture.

In most northern Idaho areas, nitrogen fertilization of 50 to 100 pounds per acre will be required for optimum yield and protein levels. Seeding rates of 70 pounds per acre were adequate for good yields of pea/cereal mixtures.

Potential

Mixtures of winter peas and winter cereals can provide higher forage yields, easier harvest and better forage quality than winter peas grown alone. They also can provide higher protein than winter cereals and more reliable production than either peas or cereals grown alone. The forage harvested from these mixtures should be suitable for replacement dairy heifers, beef cattle and, in some situations, lactating dairy animals. Because these cool-season crops are fall planted, these mixtures can be harvested in late May to mid-June and could be doublecropped with corn or beans in warm season locations such as the Magic and Treasure valley areas.

Fig. 1. Because of its high moisture content and slow drying characteristics, pea-cereal mixtures are developed for silage rather than baled hay.

Forage yield, nutritional analyses and cultural practices for producing winter pea/winter cereal mixtures under dryland conditions in northern Idaho are provided in this publication. Potential use of these mixtures in southern Idaho under irrigated conditions are suggested (see reference list).

Yield, Dry Matter and Protein Percentages

Forage yields, dry matter percentage and protein percentage of winter peas and winter cereals grown alone and in various mixtures were evaluated with different nitrogen levels, times of cutting and seeding rates. Two years of studies were conducted at Moscow and Grangeville, Idaho.

Table. 1. Silage and hay yield and dry matter percentage of winter peas and winter cereals grown alone and in mixtures at Moscow in 1978-79 and 1979-80 averaged over two seeding rates.

Mixture	Proportion of peas	Silage (hay) yield[2] 1978-79	Silage (hay) yield[2] 1979-80	Dry matter at harvest 1978-79	Dry matter at harvest 1979-80
(crop)	(%)	(tons/acre)		(%)	
WP	100	14.0 (4.9)	21.0 (7.4)	20	21
WW	-0-	15.7 (5.5)	38.3 (13.5)	39	38
WB	-0-	6.7 (2.4)	33.3 (11.8)	40	44
WW/WP	50	16.7 (5.9)	28.7 (10.1)	23	26
WW/WP	25	18.7 (6.6)	33.7 (11.9)	32	29
WB/WP	50	15.3 (5.4)	26.3 (9.3)	21	30
WB/WP	25	16.7 (5.9)	23.0 (8.1)	25	30
LSD (0.05)		5.3 (1.9)	5.3 (1.9)	5	4

[1]WP = Melrose winter pea; WW = Nugaines winter wheat in 1978-79; Daws winter wheat in 1979-80; WB = Boyer winter barley. Winter peas with several immature pods, winter cereals in soft dough stage at time of cutting.

[2]Silage and (hay) yield at 70 and 15 percent moisture, respectively.

Mixture Composition — At Moscow, winter wheat/winter pea (WW/WP) mixtures generally produced more forage than winter barley/winter pea (WB/WP) mixtures (Tables 1 and 2). In 1978-79 seeding rate studies, winter barley survival in pure stands was only 24 percent (Table 3). In mixtures with peas, barley averaged 34 percent survival while wheat mixed with peas averaged 61 percent survival. A similar pattern was noted in the nitrogen studies (Table 3). Thus, the relatively poor performance of

Table 2. Silage and hay yield, dry matter and protein percentage of winter pea/winter cereal mixtures grown in nitrogen fertilizer studies at Moscow. Data averaged over 2 years of study, 1978-79 and 1978-80.

Treatment	Silage (hay) yield[4]	Dry matter at harvest	Protein
(Mixture[1])	(tons/acre)	(%)	(%)
WW/WP	27.0 (9.5)	26.5	10.1
WB/WP	23.7 (8.4)	24.5	11.5
LSD (0.05)	2.0 (0.7)	1.4	1.0
(Percent peas[2])			
50	26.0 (9.2)	24.1	11.6
25	25.0 (8.8)	26.8	10.0
LSD (0.05)	NS	1.4	1.0
(lb of N per acre[3]			
0	24.3 (8.6)	24.5	10.3
50	25.0 (8.8)	25.2	11.8
100	27.0 (9.5)	26.7	10.4
LSD (0.05)	2.3 (0.8)	1.6	1.0

[1]WP = Melrose winter pea; WW = Nugaines winter wheat in 1978-79, Daws winter wheat in 1979-80; WB = Boyer winter barley. Winter peas with several immature pods and winter cereals in soft dough stage at time of cutting.

[2]Percentage of winter peas in mixtures on a seed number basis (see Table 4).

[3]Ammonium nitrate broadcast on soil surface on Sept. 14, 1978, and Oct. 4, 1979.

[4]Silage and (hay) yield at 70 and 15 percent moisture, respectively.

Table 3. Winter survival and plant stands of winter peas and winter cereals in seeding rate and nitrogen fertilization studies at Moscow in 1978-79 and 1979-80.

Mixture[1]	Proportion of peas[2]	Winter survival, 1978-79: Seeding rate study[3] Winter cereals	Seeding rate study[3] Winter peas	Nitrogen rate study[4] Winter cereals	Nitrogen rate study[4] Winter peas	Plant stands, spring 1980: Seeding rate study Winter cereals	Seeding rate study Winter peas	Nitrogen rate study Winter cereals	Nitrogen rate study Winter peas
(crop)	(%)	(%)	(%)	(%)	(%)	(Number of plants per foot of row)			
WP	100	—	66	—	—	0	3.6	—	—
WW	0	37	—	—	—	4.1	0	—	—
WB	0	24	—	—	—	3.9	0	—	—
WW/WP	50	69	70	83	76	1.5	2.3	1.9	3.0
WW/WP	25	52	73	51	82	2.7	1.7	3.2	2.5
WB/WP	50	33	70	48	72	2.1	2.4	2.7	2.8
WB/WP	25	35	74	35	100	3.0	1.7	3.8	1.7
LSD (0.05)		13	15	15	NS	0.4	0.4	NS	NS

[1]WP = Melrose winter pea; WW = Nugaines winter wheat in 1978-79, Daws winter wheat in 1979-80; WB = Boyer winter barley.

[2]Percentage of winter peas in mixtures on a seed basis (see Table 4).

[3]Survival and plant stands averaged over two seeding rates.

[4]Survival and plant stands averaged over three nitrogen rates. Winter peas, winter wheat and winter barley not grown alone in nitrogen rate studies.

WB/WP mixtures in the 1978-79 seeding rate study, and in both years of the nitrogen rate study, was caused in part by poor winter survival of the winter barley.

In the 1979-80 seeding rate studies, however, winter barley stands were better than or equal to winter wheat stands (Table 3), yet yield of WB/WP mixtures averaged 6.6 tons per acre less silage than yield of WW/WP mixtures (Table 1). These data indicate that 'Boyer' winter barley may not have the forage yield potential of 'Daws' winter wheat. Additional yield loss of WB/WP mixtures may have been caused by lodging. Mixtures of winter wheat and winter peas showed little or no lodging in these trials.

Dry matter percentage of mixtures generally ranged from 24 to 30 percent depending on proportion of peas and, to some extent, cereal species (Tables 1 and 2). Mixtures of winter wheat and peas had higher dry matter percentages than mixtures of winter barley and peas in all but one study. Winter wheat survived the winter better than winter barley, especially in mixtures with peas. Better survival of the wheat in mixtures with peas raised the dry matter percentage because the proportion of peas in the wheat mixtures were less than the proportion of peas in barley mixtures (Table 4).

In 1979-80, when winter peas in winter wheat mixtures were greater than the proportion observed in WB/WP mixtures, dry matter percentages of WW/WP mixtures were also lower than dry matter percentages of WB/WP mixtures (Table 1). These results indicate that the change in dry matter percentage is more likely a function of the proportion of peas in the mixture rather than a function of cereal species. Further evidence is provided in Table 2 that shows that dry matter percentage decreases as the portion of peas increase.

Protein percentage of mixtures was a function of proportion of peas and, to some extent, cereal species (Table 2). Mixtures with 50 percent peas averaged 11.6 percent protein, 1.6 percent better than mixtures with 25 percent peas. Mixtures with barley and peas averaged 1.4 percent higher protein than mixtures with wheat. This is probably a reflection on the higher proportion of peas in barley/pea mixtures rather than a reflection of higher protein in barley.

Time of Cutting — Stage of winter pea and cereal maturity had a large impact on yield and protein percentage of mixtures at Grangeville. Mixtures cut when winter peas had just begun flowering and winter cereals were in the early heading stage averaged 2.0 tons of hay per acre with 17.7 percent protein (Table 5). Delaying cutting until winter peas had several immature pods and cereals were in soft to medium dough stage increased yield 0.5 tons per acre but decreased protein levels to 12.8 percent.

In most years, a larger increase in yield and a greater decrease in protein would be expected from delayed cutting. Unfavorable weather patterns and low soil nitrogen levels reduced the yield potential of forages at this location. An increase in dry matter percentage from 20 to 47 percent as cutting was delayed to the soft dough stage further reflects the restricted growth of mixtures later in the season. Mixture composition had no significant effect on yield.

Nitrogen Fertilization — Application of nitrogen in the fall significantly increased yield, protein and dry matter percentage of forage mixtures (Table

Table 4. Proportion of winter peas in seed mixtures and winter pea establishment in the field in seeding rate studies at Moscow.

Seed mixtures				Field establishment[2]		
Weight		Seed number		1978-79		1979-80
Mixture[1]	Proportion of peas	Mixture[1]	Proportion of peas	Fall	Spring	Spring
(Crop)	(%)	(Crop)	(%)		(%)	
WW/WP	80	WW/WP	50	48	49	61
WW/WP	55	WW/WP	25	17	23	38
WB/WP	75	WB/WP	50	48	66	53
WB/WP	50	WB/WP	25	26	42	37

[1]WW = Nugaines winter wheat in 1978-79; Daws winter wheat in 1979-80; WB = Boyer winter barley; WP = Melrose winter pea.

[2]Averaged over seeding rates of 70 and 100 pounds per acre.

Table 5. Influence of cutting time and forage composition on silage and hay yield and protein production at Grangeville, 1973-74.

Mixture[1]	Proportion of peas[2]	June 17[3]			July 16[3]		
		Yield[4]	Protein	Dry matter	Yield[4]	Protein	Dry matter
(crop)	(%)	(tons/acre)	(%)	(%)	(tons/acre)	(%)	(%)
WP	100	5.3 (1.9)	21.0	16	11.7 (4.1)	12.0	66
WW/WP	40	7.7 (2.7)	17.3	21	8.3 (2.9)	13.5	45
WW/WP	25	6.3 (2.2)	16.5	21	8.7 (3.1)	12.4	49
WB/WP	40	6.0 (2.1)	18.0	18	8.0 (2.8)	12.4	47
WB/WP	25	6.0 (2.1)	19.0	19	9.0 (3.2)	13.1	49
LSD (0.05)		NS	—	—	NS	—	—

[1]WP = Fenn winter pea; WW = Nugaines winter wheat, WB = Idaho Club winter barley.

[2]Percentage of winter peas on a seed number basis.

[3]June 17 — Winter peas had three nodes with flowers; winter wheat in early heading stage.
July 16 — Winter peas with several immature pods and upper nodes with flowers; winter wheat in soft to medium dough stage.

[4]Silage and (hay) yield at 70 to 15 percent moisture, respectively.

2). Applications of 50 to 100 pounds per acre appeared optimum for protein and yield, respectively. Residual soil nitrogen in these studies was 90 pounds per acre in a 3-foot profile.

At Grangeville, under low residual soil nitrogen and reduced precipitation (10 inches below normal), yields were very low. Winter peas produced forage yields equal to WB/WP mixtures under these conditions (Table 6). In these trials, cereals were yellow and somewhat stunted at harvest time. Apparently winter peas did not produce and release enough nitrogen to supply the requirement of the companion cereal crop during this growing season. Reduced water availability may have also reduced the ability of peas to fix nitrogen.

Data from these trials indicate that protein and, to a lesser extent, yield will be influenced by nitrogen application when pea/cereal mixtures are grown on soils with less than 90 pounds per acre residual nitrogen. Up to 100 pounds of nitrogen per acre may be required for optimum yields on soils with less than 20 pounds of residual nitrogen per acre.

Seeding Rate — Forage yields were not improved as seeding rates increased from 70 to 100 pounds per acre. Dry matter and protein percentages remained constant as seeding rates increased. Seeding rates of 70 pounds per acre were optimum for yield and quality of mixtures raised for forage in northern Idaho.

Chemical Composition — Mixtures of commercially-grown spring barley and spring-planted winter peas and spring oats with spring-planted winter peas were analyzed for nutritional quality (Table 7). These mixtures were raised near Sterling, Idaho, and cut when cereals were in the soft dough stage. Crude fiber percentage is too high and protein percentage too low for lactating dairy animals in these mixtures. Cutting at the boot stage of cereal growth has been shown to reduce crude fiber levels and increase protein to an acceptable level. Of course, some yield reduction can be expected by earlier cutting times. Mixtures cut from boot to soft dough stage should provide acceptable forage for most categories of beef and dairy animals.

Winter Hardiness of Mixtures — Winter wheat in mixtures with winter peas showed significant improvement in survival over winter compared to survival in pure stands (Table 3). Winter wheat survival in mixtures with 50 percent peas averaged 69 percent while wheat in pure stands averaged 37 percent survival. Survival of winter wheat in mixtures with 25 percent peas was 16 percent better than in pure stands. Winter barley survival was not affected by the cereals. The basis for improved survival of cereals in mixtures with peas is unknown. The reliability of forage production of cereals and peas, however, was improved when grown in mixtures.

Establishment of Desired Mixture — To obtain the desired proportion of winter peas in mixtures with winter cereals, several considerations must be made. These are relative seed size, germination percentages, winter hardiness and disease reactions of winter peas and cereals, drill type, seedbed preparation and winter conditions. In our trials, a mixture of 8 pounds Melrose peas (80 percent by weight) and 2 pounds of 'Nugaines' or Daws wheat provided 10 pounds of mixture that when seeded provided field populations of 50 percent wheat and 50 percent peas (Table 4). Seedbeds had minimum trash and clod size. Seed germination of winter peas and cereals was 95 to 100 percent.

Winter hardiness and expected winter conditions should also be considered when mixtures are selected. Winter peas and winter barley are comparable in cold tolerance and can withstand brief exposures to 16°F without snow cover. Soft white winter wheats can tolerate exposure to 8°F. Seed, plant and environmental conditions different from those described above could be expected to alter established field populations.

Selection of Austrian Winter Pea Varieties — Five varieties of Austrian winter peas were planted at Moscow in pure stands in early September 1978 and 1979 to determine the best pea variety for use in pea/cereal mixture. The pea plants were harvested

Table 6. Silage and hay yield, protein and dry matter of winter peas and winter barley grown alone and in mixtures at Grangeville, 1972-73.

Mixture[1]	Proportion of peas[2]	Yield[3]	Protein[4]	Dry matter[4]
(crop)	(%)	(tons/acre)	(%)	(%)
WP	100	1.1	21.2	22
WB	0	1.1	7.8	40
WB/WP	20	0.9	10.5	33
WB/WP	40	1.0	15.2	27
WB/WP	60	1.0	16.8	28
WB/WP	80	1.1	15.8	28
LSD (0.05)		NS	—	—

[1]WP = Fenn winter pea; WB = Idaho Club winter barley.

[2]Percentage of peas on a seed number basis.

[3]Silage and (hay) yield of 70 to 15 percent moisture, respectively.

[4]Determined from duplicate subsamples from one replication. Statistical separation not possible.

Table 7. Chemical composition of mixtures of spring planted winter peas with either spring barley or oats.

Mixture[1]	Fat	Ash	Calcium	Phosphorus	Crude fiber	Protein	NFE
(crop)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
O/WP	2.7	11.3	0.5	0.16	52	13	21
B/WP	2.4	10.6	0.7	0.20	45	12	30

[1]O = oats; B = barley; WP = winter peas. Cut when cereals were in soft dough stage; commercial fields near Sterling, Idaho.

Table 8. Silage and hay yield, protein percentage and total protein production of five varieties of winter peas at Moscow in 1979 and 1980.

Variety	Silage (hay) yield[1]			Vine protein[2]					
	1979	1980	Avg.	1979	1980	Avg.	1979	1980	Avg.
	(tons per acre)			(%)	(%)	(%)	(lb per acre)		
Melrose	16.7 (5.9)a*	23.5 (8.3)a*	20.1 (7.1)	14.3c*	14.3b*	14.3	1,687	2,374	2,031
Fenn	15.0 (5.3)ab	17.6 (6.2)b	16.3 (5.8)	16.2b	14.7b	15.5	1,717	1,823	1,770
Common	13.6 (4.8)bc	17.0 (6.0)b	15.3 (5.4)	15.4bc	15.0b	15.2	1,478	1,800	1,639
ID-89-1	13.0 (4.6)bc	10.8 (3.8)c	11.9 (4.2)	21.3a	19.1a	20.2	1,960	1,452	1,706
Romack	12.2 (4.3)c	18.1 (6.4)b	15.2 (5.4)	16.5b	14.8b	15.7	1,419	1,894	1,656
Average	14.1 (5.0)	17.4 (6.1)		16.7	15.6		1,652	1,869	

[1]Silage and hay yield at 70 and 15 percent moisture, respectively.

[2]Protein calculated on a hay basis.

*Means within a column not followed by the same letter differ at the 0.05 level of probability according to Duncan's Multiple Range Test.

in mid-June 1979 and 1980 to determine forage yields, and a sample from each plot was evaluated to determine moisture and nitrogen content of the forage. Melrose produced the highest forage yields in both 1979 and 1980, averaging 7.1 tons of hay per acre (Table 8). 'Fenn' and 'Common' produced an average of 5.8 and 5.4 tons of hay per acre, respectively.

Neither the semi-dwarf line 'ID 89-1' nor the Georgia variety, 'Romack,' produced consistently high forage yields. The semi-dwarf lines ID 89-1 had the highest vine protein in both years, averaging 20.2 percent protein. Melrose had only 14.3 percent vine protein in both years. While Melrose had the highest forage yield, it also had the lowest protein concentration of the five varieties tested. But the highest total protein per acre was obtained from Melrose, indicating that this would be the preferred variety for use in a pea/cereal mixture.

Recommendations

For best yields, plant mixtures of 55 percent winter wheat and 45 percent winter peas (on a weight basis) to provide field populations of 75 percent wheat and 25 percent peas. Melrose winter pea should be used in these mixtures. Seeding rates should be 70 pounds per acre under dryland conditions and perhaps 100 pounds per acre under irrigation. Nitrogen rates should be 50 to 100 pounds per acre, applied in the early spring if residual soil levels are 0 to 50 and 50 to 100 pounds per acre, respectively.

Mixtures should be cut when cereals are in the soft dough stage for optimum yield and in the boot to early heading stage for optimum quality. Protein percentage can also be improved by increasing the percentage of peas in the mixture, but some yield loss will occur. Avoid planting in poorly drained fields, and avoid over irrigation.

Doublecropping with corn or beans should be possible in irrigated, warm season areas. Contact H. F. Mayland, Kimberly Research Center, Route 1, Kimberly, Idaho 83341, or Brad Brown, Parma Research and Extension Center, Route 2, Box 2126, Parma, Idaho 83660, for further information concerning production of winter pea/winter cereal mixtures under irrigated conditions in the Magic and Treasure valleys, respectively.

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