Kansas Geological Survey
Open File Report 93-50

Impact of Discovery and Development on Kansas' Petroleum Resource Base

by

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Missing Figures #5, #6, and #7

Impact of Discover and Development on Kansas' Petroleum Resource Base

There is no question that, in some sense, the petroleum resources trapped beneath the surface in Kansas represent a finite resource. Therefore, they are ultimately exhaustible. Evidence suggests, however, that the point of ultimate exhaustion is so far in the future that it is more important to understand the factors which control the ongoing production of those resources. From a public policy viewpoint, it is important to know which factors can be influenced by public policy and the expected response of the petroleum industry to changes in those factors.

The discovery and development of petroleum resources involves several phases (see Figure 1).

Prospects must be evaluated and selected for testing. The range of prospects worth consideration depends directly on the expected market value of the resources which may be found. (e.g. a change in prices changes the set of potential prospects)

Drilling of prospects may result in dry holes or discovery of additional producible reserves. In either case, additional information is obtained which influences subsequent evaluation of prospects.

Reserves represent those resources in the ground which can be expected to be produced with existing facilities and technology and the current economic environment for production. Discovery of new producible reserves and development of those new producing leases adds to the current reserves. Production from current leases results in a matching decrease in reserves.

Repeated emphasis will be given to the fact that the primary means for increasing reserves is through the discovery and development of new productive leases. Once a well or lease has been placed into production, the ultimate production from that lease is relatively independent of changes in economic conditions. On the other hand, exploration for new productive leases is extremely sensitive to changes in economic conditions.

The primary effect which a change in economic conditions has on a producing well occurs at the economic limit of production (see figure 2). For individual leases this tends to be a relatively minor effect compared to total production over the life of a well. With the large number of

producing wells in Kansas, however, the total effect of changes at the economic limit can be significant.

Figures 3 and 4 show the importance, for local tax revenues, of property taxes from oil and gas producing properties. The colors indicate oil and gas property taxes as a percent of total property tax revenue in each county for the years 1983 and 1987. The darkest color represents 70-80% from oil and gas, while the two lightest colors show counties with 0-1% revenue from oil and gas. The shift to lighter colors in 1987 is a reflection to the huge loss in assessed oil and gas property valuations due largely to the drop in oil prices in 1986.

Counties with significant losses in assessed property valuation typically responded with major increases in mill levies. In those counties, the tax burden on producing leases was significantly increased. Figures 5, 6 and 7 show the historic trend of increasing mill levies which have a direct effect on the tax burden on producing properties.

Figure 8 shows the historic trend in oil prices and rotary drill rig activity from 1970 to 1992. The strong correlation between price and rig activity is evident. It is important to recall that the primary means by which new reserves are added in Kansas is through discovery of new producing leases as the result of drilling new prospects.

The area of Lane County shown in Figure 9 is taken from KGS Open File Report 88-24 (Recent Drilling Trends in Kansas -- 1987 Completion Reports). Each circle represents one well drilled during 1987. The size of the circles represent the pre-drilling risk classifications. The largest circles show wildcat wells, the smallest circles show development wells. The color of the circle represents the post-drilling classification of the well. In this area, the light circles are for dry holes and the dark circles show producing oil wells. (The entire map is mounted on foam board for display.)

Figure 1 emphasized the connection between drilling, addition of reserves, and depletion of reserves through production. The following tables of production data will illustrate the realities of this process in Kansas.

Table 1 shows Kansas crude oil production from 1970 to 1991 from each major geologic province and the entire state. Reserve estimates in 1970 (post-1969 ultimate recovery) and 1992 are shown for all pre-1971 leases, along with the current estimate of their ultimate production after 1969. The last three columns show the effect on those initial estimates due to production from leases added after 1970. The importance of the Central Kansas Uplift and Western Kansas are evident.

Table 2 shows the same information for each county. The relationship between geologic provinces and counties is shown in Figure 10.

Table 3 shows the production from Kansas oil leases grouped by the year in which they first began production. Each row gives the annual production from 1970 to 1991 coming from all leases which began production in the year or group of years indicated in the left hand column. The first row gives total annual production from all leases which began producing oil prior to 1971. Note that annual production declines each year across this row. Note that production continues to decline even through the years 1979 and 1981 when the price of crude oil jumped from $10 to $40 per barrel (see Figure 8) and when all domestic crude oil prices were deregulated.

For leases which began production in each of the years 1971 through 1990 you can see that annual production increases in the second year of production and then begins to decline. This initial increase occurs because some leases only produced for part of the first year. There is also a short lag between the initial production from the first oil well on a lease and the completion of other development wells on the same lease. The second year of production in each row is the first year with all leases producing from the beginning of the year. Although the added production from new leases during each of the years from 1971 to 1978 is not extremely large, note that by 1978 the production from all post-1970 leases has increased to almost 32% of total production and more than 46% of production from all remaining pre-1971 leases. Note that total annual Kansas production, as shown in the bottom row, is declining throughout the years 1970-1978.

The years 1979-1985 cover the period of peak oil prices, yet the production from any single group of leases (any row) continues to decline through these years of rising or high prices. However, a dramatic change occurs in the amount of new oil production coming from new leases, peaking at 6.8 million barrels of oil from new leases in 1981. In 1982 the

production from pre-1971 leases (32.5 million barrels, shown in the top row) is less than half of the total state production (69.7 million barrels, shown in the bottom row). Because of the dramatic increase in production from new leases, total state production reverses its decline in 1979 and rises to a peak of 75.2 million barrels in 1985.

Comparing the data for lease groups in 1986 through 1991 with the oil price history shown in Figure 8, it is clear that the amount of new oil production capacity being added each year drops sharply with the collapse of oil prices in 1986. This is the direct result of the corresponding decline in drilling.

Figures 11-23 provide further illustration of the characteristics of the historic discovery-development-production process in Kansas. The bar graphs in Figures 11-14 show cumulative effects on production of new lease production. Each shade band in these graphs corresponds to a single row of data in Table 3. On the line graphs in figures 15-18, each line corresponds to an individual rows of data in Table 3.

Figure 19 compares total production from all pre-1971 leases in Kansas with the corresponding production from all leases which began production in Kansas after 1970. The bar graph in Figure 20 shows total oil production for each lease group from the initial year of lease group production until 1991. A single bar represents the production of all leases beginning production in that lease year.

Figures 21-23 illustrate reserve, production and post-1969 ultimate recovery characteristics by geologic province. Figure 21 shows current (1992) estimates of ultimate recovery from all leases and pre-1971 leases in each province. The difference between current (1992) estimates of ultimate recovery from pre-1971 leases and 1970 estimates of the same thing are shown in Figure 22. Current reserve estimates plus cumulative production to date equal current estimates of ultimate recovery. The relationship of these three values in each geologic province is shown in Figure 23.

This last figure shows that the characteristics of lease production histories which have been repeatedly illustrated in this report are essentially independent of the group of leases considered. Figure 24 considers only those leases producing in oil fields discovered in 1970. Each color band represents production from new leases added to those fields in a single year. The bottom black band represents production from the leases in the 1970 oil fields which began producing in the same year

the fields were discovered. The slight rise in production in 1976 from the 1970 leases indicates that there is some response from existing leases to changes in economic conditions. It can be seen, however, that this response is far less significant than the new production from new leases.

Conclusion

The overall perspective which this data should provide is an understanding that, in a practical sense, production capacity is renewable, even though there is some absolute finite limit to the quantity of oil or gas in the subsurface of Kansas. The yet undiscovered resources in Kansas still represent a large and valuable resource base. The rate at which these resources are discovered and developed will depend very strongly on the market value of the produced resource. Just as the exploration process responds to increases in price, it will also respond to decreases in cost due to technological improvements which make exploration more efficient and effective. One important area which results in improved efficiency is improvement in access to appropriate information. Such an improvement could result in improved efficiencies of exploration, development or production of the resource base.

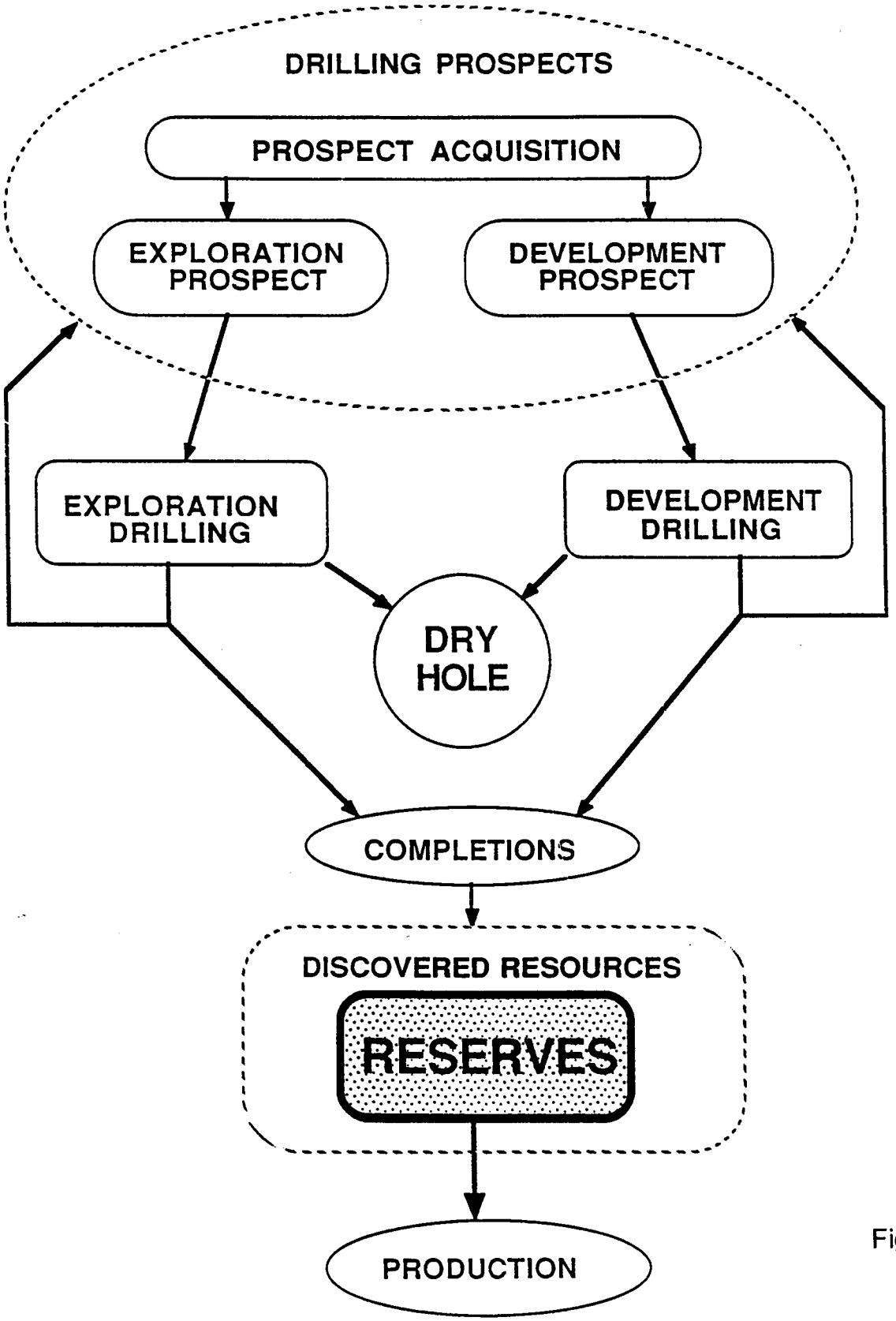
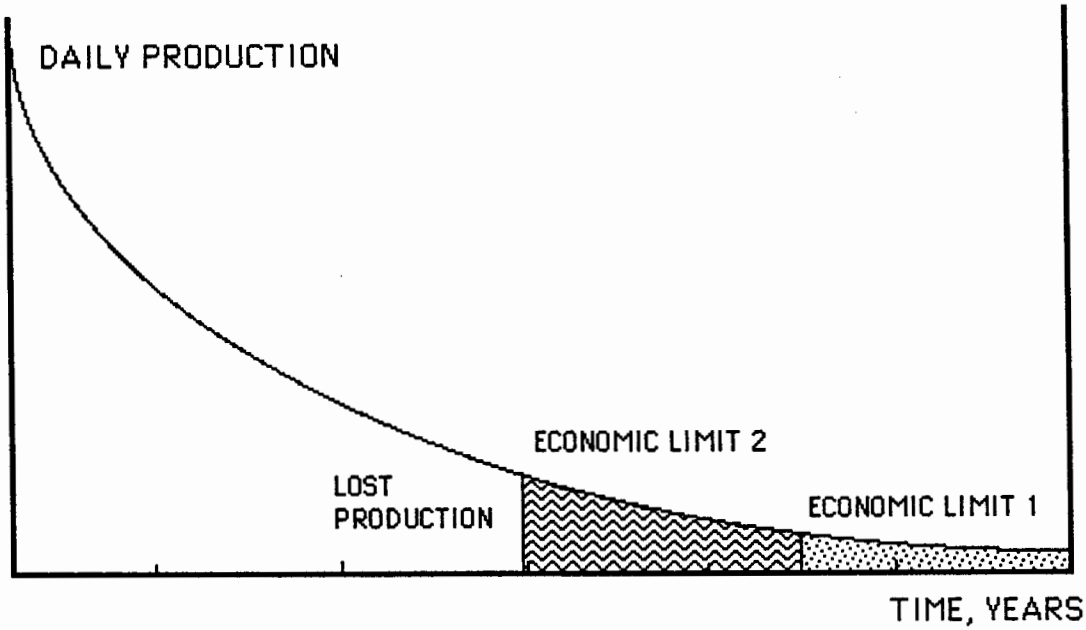
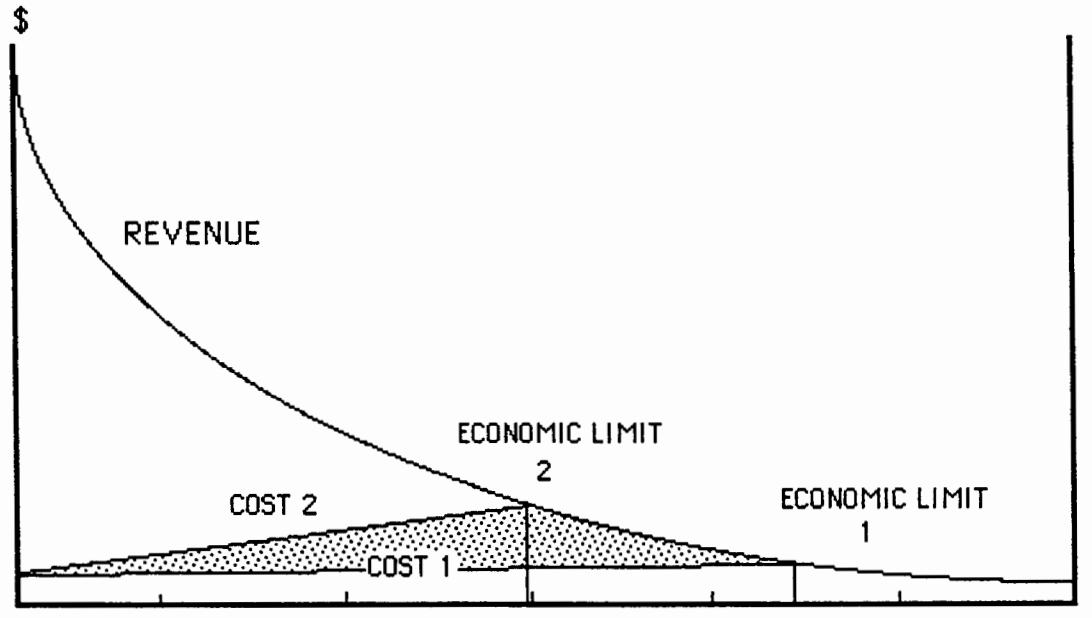

DRILLING PROSPECTS
PROSPECT ACQUISITION
EXPLORATION PROSPECT
DEVELOPMENT PROSPECT
EXPLORATION DRILLING
DEVELOPMENT DRILLING
DRY HOLE
COMPLETIONS
DISCOVERED RESOURCES
RESERVES
PRODUCTION

Figure 1



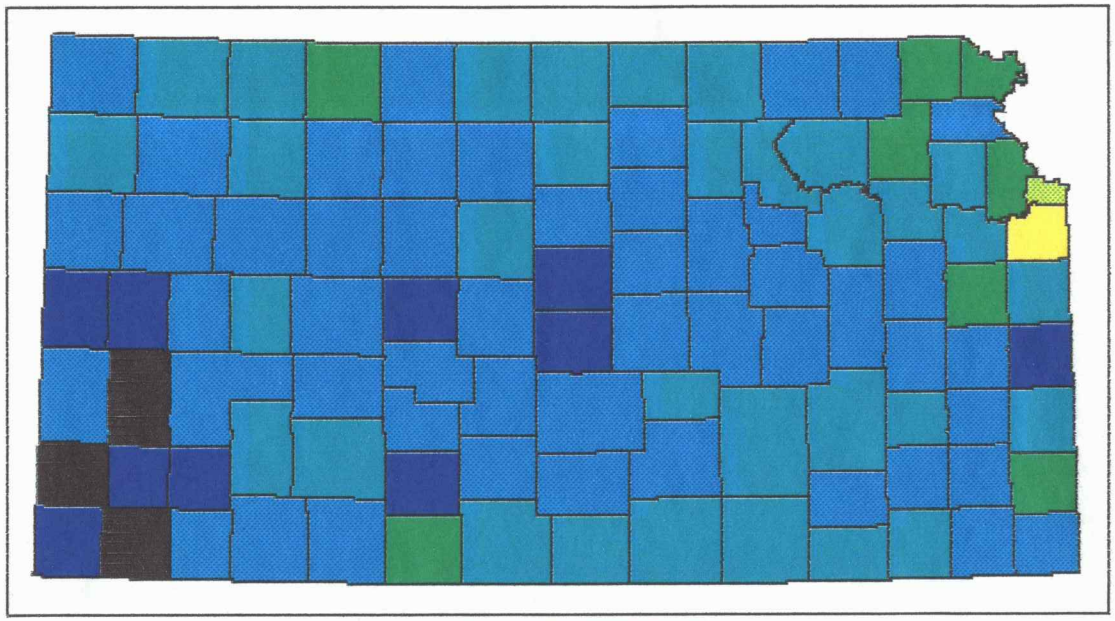


INCREASED COSTS = TAXES AND OPERATIONS

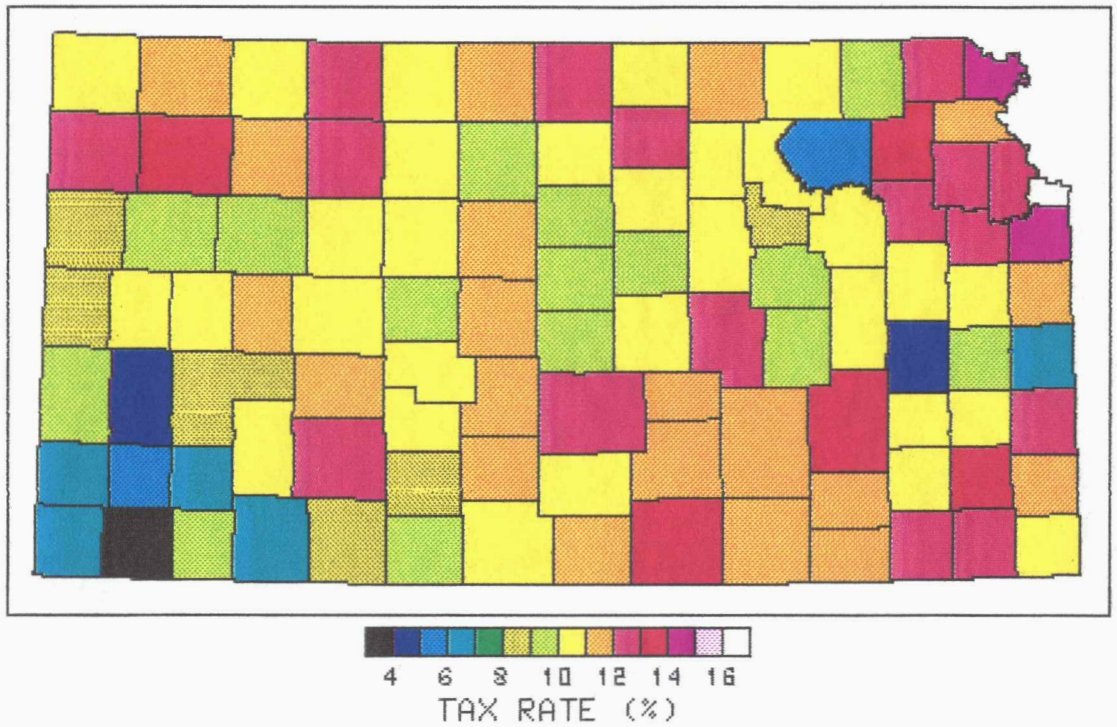
Figure 2

Figures 3 and 4

AVERAGE TAX RATE ON RURAL TANGIBLE PROPERTY -- 1973



AVERAGE TAX RATE ON RURAL TANGIBLE PROPERTY -- 1987



Figures 5, 6 and 7

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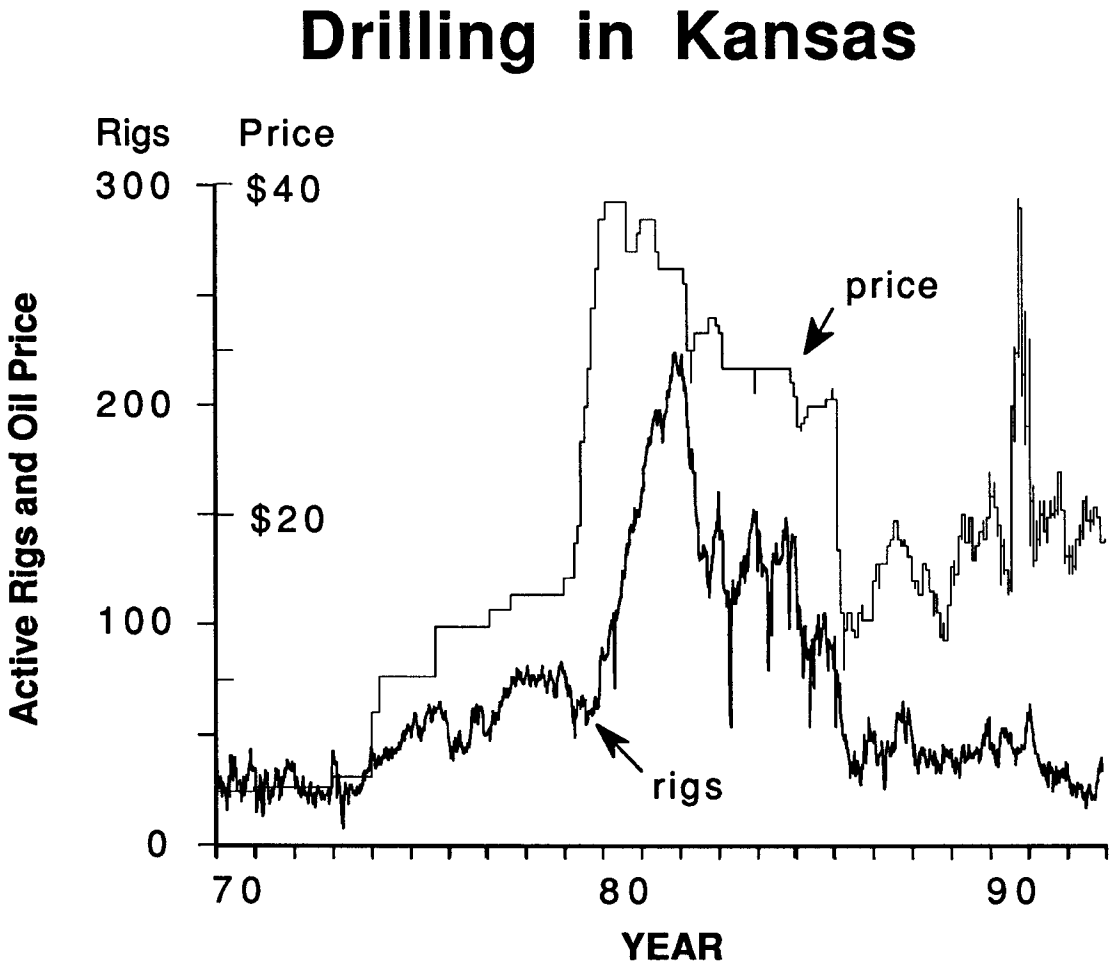
Drilling in Kansas
Rigs
Price
300
$40
200
$20
100
0
Active Rigs and Oil Price
price
rigs
70
80
90
YEAR

Figure 8

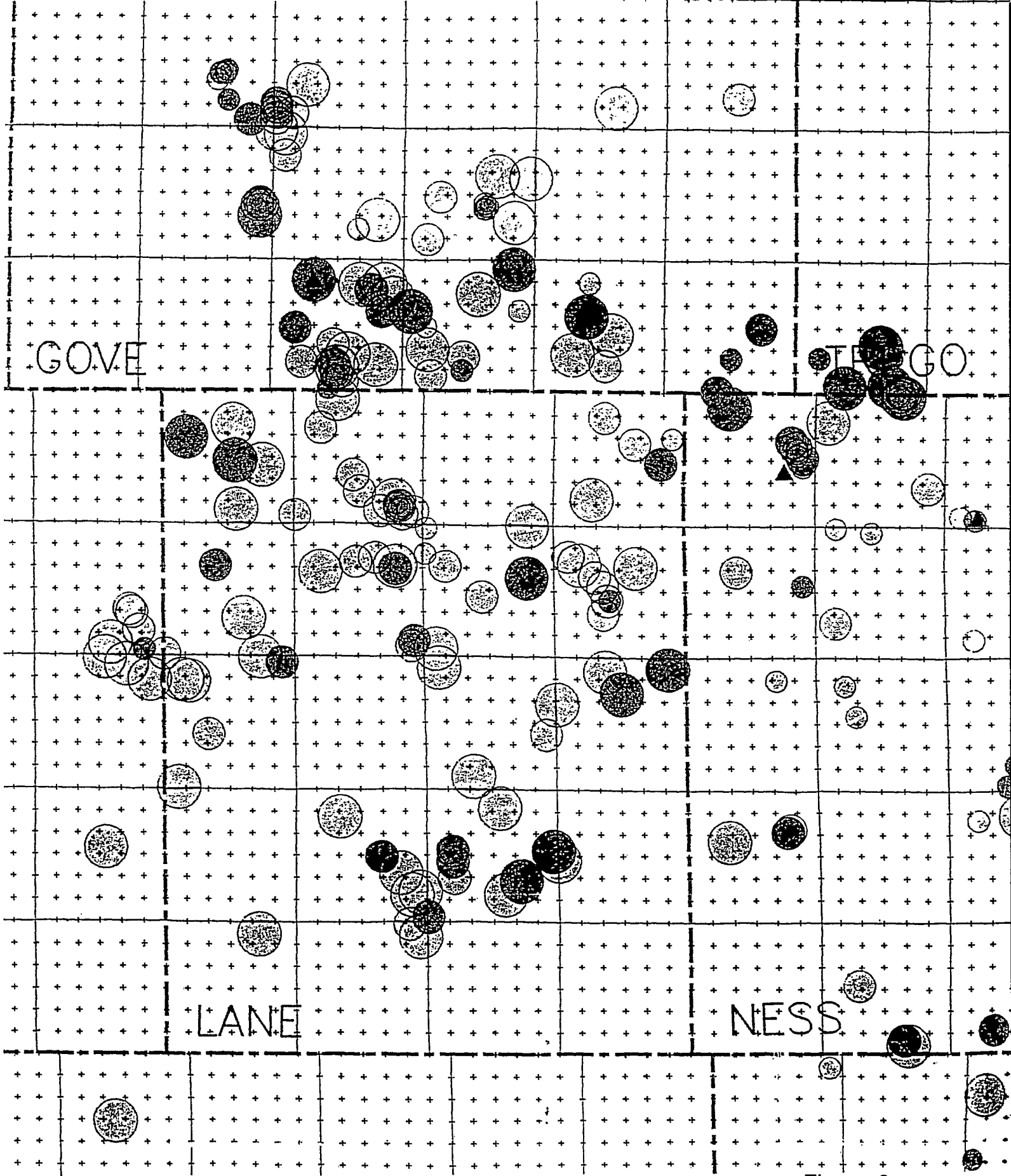

Figure 9

Geologic Provinces of Kansas

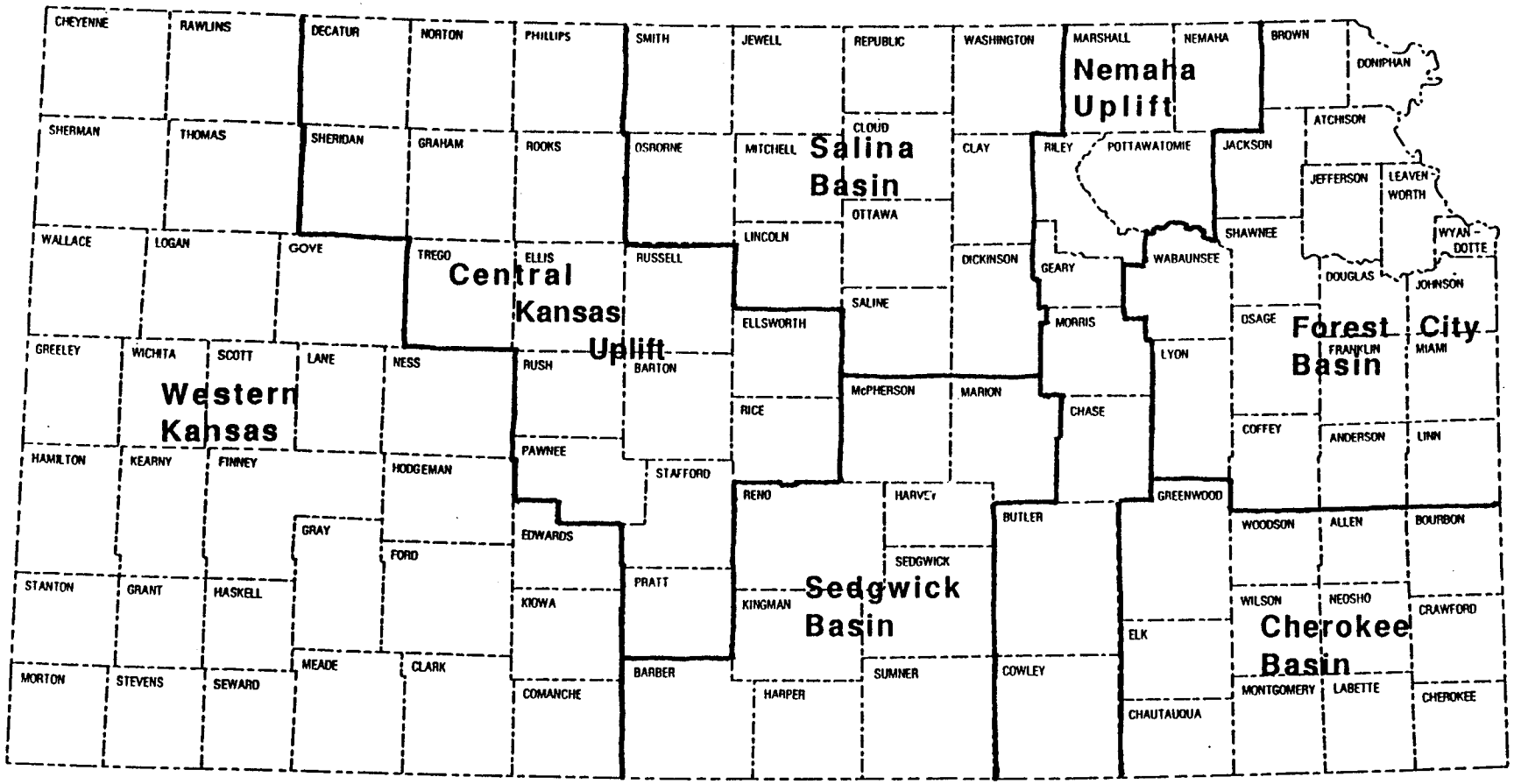

Figure 10

TABLE 1: Crude Oil Production, Reserves, and post-1969 Ultimate Recovery by Geologic Province

GEOLOGIC PROVINCE	All pre-1971 leases				All leases		
	ESTIMATED POST-1969 ULTIMATE RECOVERY (1/1/70)	PRODUCTION (1970-91)	CURRENT ESTIMATED RESERVES (1/1/92)	ESTIMATED POST-1969 ULTIMATE RECOVERY (1/1/92)	PRODUCTION (1970-91)	CURRENT ESTIMATED RESERVES (1/1/92)	ESTIMATED POST-1969 ULTIMATE RECOVERY (1/1/92)
Cherokee B.	48101472.	62763184.	13275712.	76038896.	99519200.	30382416.	129901648.
C. KS Uplift	422813952.	479678720.	94880512.	574559232.	668695808.	184882080.	853577728.
Forest City	11136882.	16741522.	3526448.	20267968.	38034496.	17380128.	55414624.
Nemaha Antcl.	59319408.	70121072.	14181032.	84302112.	107854592.	28673856.	136528416.
Salina Basin	3780191.	4911696.	940320.	5852016.	8003294.	2448101.	10451395.
Sedg. Basin	112139024.	112450464.	19272624.	131723088.	165682992.	39808080.	205491056.
Western KS	130822080.	132167856.	21475264.	153643120.	338533120.	149037584.	487570944.
State Totals	788113408.	878834944.	167551904.	1046386944.	1426322944.	452611840.	1878934784.

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KGS 10/6/93

TABLE 2: Crude Oil Production, Reserves, and post-1969 Ultimate Recovery by County

	All pre-1971 leases				All leases		
COUNTY	ESTIMATED POST-1969 ULTIMATE RECOVERY (1/1/70)	PRODUCTION (1970-91)	CURRENT ESTIMATED RESERVES (1/1/92)	ESTIMATED POST-1969 ULTIMATE RECOVERY (1/1/92)	PRODUCTION (1970-91)	CURRENT ESTIMATED RESERVES (1/1/92)	ESTIMATED POST-1969 ULTIMATE RECOVERY (1/1/92)
Allen	5304553.	6601872.	1615328.	8217200.	13253872.	4304766.	17558640.
Anderson	2434440.	3797571.	815840.	4613411.	6943151.	4232530.	11175681.
Atchison	0.	0.	0.	0.	264.	0.	264.
Barber	7199342.	5964573.	829232.	6793805.	20526768.	6445219.	26971984.
Barton	50935104.	61361968.	12413696.	73775664.	85231248.	21762688.	106993936.
Bourbon	1037999.	1072869.	174744.	1247613.	2569146.	932760.	3501906.
Brown	30044.	21707.	0.	21707.	72160.	17960.	90120.
Butler	34826544.	44351088.	9356488.	53707584.	59882688.	16268711.	76151392.
Chase	591392.	843583.	126040.	969623.	962790.	173400.	1136190.
Chautauqua	5509543.	8173435.	1732888.	9906323.	14681817.	5268240.	19950064.
Cherokee	0.	0.	0.	0.	0.	0.	0.
Cheyenne	0.	0.	0.	0.	1158004.	411168.	1569172.
Clark	898344.	793709.	98080.	891789.	10755754.	2879320.	13635074.
Clay	0.	0.	0.	0.	992.	0.	992.
Cloud	0.	0.	0.	0.	0.	0.	0.
Coffee	1236241.	2181254.	487664.	2668918.	6314957.	1608016.	7922973.
Comanche	1631431.	1397059.	181592.	1578651.	6109025.	2446294.	8555319.
Cowley	20399008.	19740640.	3150464.	22891104.	38415072.	9127204.	47542272.
Crawford	444385.	544565.	126216.	670781.	832485.	255408.	1087893.
Decature	6080975.	5841856.	734808.	6576664.	10503742.	2238072.	12741814.
Dickinson	329742.	564496.	157488.	721984.	789911.	264173.	1054084.
Doniphan	0.	0.	0.	0.	0.	0.	0.
Douglas	235977.	533176.	150048.	683224.	1193705.	658784.	1852489.
Edwards	2076471.	1901939.	255288.	2157227.	9941360.	3563611.	13504971.
Elk	2282169.	2644688.	419640.	3064328.	4766515.	1486033.	6252548.
Ellis	65879616.	86698144.	20759216.	107457360.	112024368.	31286144.	143310512.
Ellsworth	13427321.	14894668.	2297496.	17192160.	19348624.	3996490.	23345120.
Finney	11766274.	18004176.	4880568.	22884736.	31957584.	18563376.	50520960.

	All pre-1971 leases				All leases		
COUNTY	ESTIMATED POST-1969 ULTIMATE RECOVERY (1/1/70)	PRODUCTION (1970-91)	CURRENT ESTIMATED RESERVES (1/1/92)	ESTIMATED POST-1969 ULTIMATE RECOVERY (1/1/92)	PRODUCTION (1970-91)	CURRENT ESTIMATED RESERVES (1/1/92)	ESTIMATED POST-1969 ULTIMATE RECOVERY (1/1/92)
Ford	246960.	148339.	27576.	175915.	1218210.	888629.	2106839.
Franklin	976896.	1274245.	266752.	1540997.	5109251.	1745864.	6855115.
Geary	29745.	27880.	5272.	33152.	41551.	19232.	60783.
Gove	1836477.	1812688.	277088.	2089776.	16341911.	7668335.	24010240.
Graham	37421376.	38033312.	6287040.	44320352.	53993872.	15580037.	69573904.
Grant	784575.	1012017.	127520.	1139537.	5019926.	9565842.	14585768.
Gray	0.	0.	0.	0.	2522615.	1070555.	3593170.
Greeley	0.	0.	0.	0.	4641396.	2786110.	7427506.
Greenwood	19581920.	23600528.	4953816.	28554336.	28261904.	7368062.	35629968.
Hamilton	30420.	31831.	3696.	35527.	31831.	3696.	35527.
Harper	8019511.	9033988.	1644736.	10678724.	13935392.	3544039.	17479424.
Harvey	7716914.	6739898.	1104432.	7844330.	7933562.	1448304.	9381866.
Haskell	10516457.	13135552.	3069224.	16204776.	19992944.	10843062.	30836000.
Hodgeman	11963828.	10653350.	1991208.	12644558.	20928768.	5201413.	26130176.
Jackson	228347.	164667.	35992.	200659.	194433.	41136.	235569.
Jefferson	0.	0.	0.	0.	637187.	349775.	986962.
Jewell	0.	0.	0.	0.	0.	0.	0.
Johnson	211309.	346366.	91752.	438118.	1858697.	2041639.	3900336.
Kearny	986202.	1553543.	359264.	1912807.	6078926.	7320558.	13399484.
Kingman	23957888.	23714096.	3718088.	27432192.	28555472.	5517205.	34072672.
Kiowa	6692774.	7427503.	1822248.	9249751.	15226129.	4778010.	20004144.
Labette	38579.	85067.	18688.	103755.	261102.	100808.	361910.
Lane	348048.	831662.	65216.	896878.	18143024.	7098022.	25241040.
Leavenworth	9370.	21444.	6264.	27708.	1445492.	1370618.	2816110.
Lincoln	0.	0.	0.	0.	0.	0.	0.
Linn	330001.	559185.	256360.	815545.	1594994.	1416181.	3011175.
Logan	527798.	385401.	0.	385401.	5265171.	2078373.	7343544.
Lyon	1582981.	1805529.	390248.	2195777.	2450914.	490411.	2941325.
McPherson	22529488.	21843552.	4257704.	26101248.	27405504.	6022790.	33428288.
Marion	5540601.	5526449.	949968.	6476417.	8906145.	2180585.	11086730.
Marshall	0.	0.	0.	0.	0.	0.	0.

	All pre-1971 leases				All leases		
COUNTY	ESTIMATED POST-1969 ULTIMATE RECOVERY (1/1/70)	PRODUCTION (1970-91)	CURRENT ESTIMATED RESERVES (1/1/92)	ESTIMATED POST-1969 ULTIMATE RECOVERY (1/1/92)	PRODUCTION (1970-91)	CURRENT ESTIMATED RESERVES (1/1/92)	ESTIMATED POST-1969 ULTIMATE RECOVERY (1/1/92)
Meade	6347609.	4997407.	565216.	5562623.	9817954.	3358173.	13176127.
Miami	1058056.	1616447.	401376.	2017823.	5310148.	2270630.	7580778.
Mitchell	0.	0.	0.	0.	0.	0.	0.
Montgomery	2326240.	3876189.	686024.	4562213.	8457648.	2612806.	11070454.
Morris	2496663.	3741615.	1096664.	4838279.	4609823.	1380856.	5990679.
Morton	23244864.	25869344.	1651856.	27521200.	42319744.	11140085.	53459824.
Nemaha	52445.	79056.	18208.	97264.	2348153.	1246408.	3594561.
Neosho	2477255.	2262273.	158600.	2420873.	5046390.	1208936.	6255326.
Ness	23751392.	24945632.	3958208.	28903840.	53798816.	17578592.	71377408.
Norton	4370113.	4916023.	869208.	5785231.	6215141.	1391680.	7606821.
Osage	0.	0.	0.	0.	61609.	8944.	70553.
Osborne	353763.	502201.	115656.	617857.	2711278.	1177552.	3888830.
Ottowa	0.	0.	0.	0.	0.	0.	0.
Pawnee	9681595.	7785640.	942760.	8728400.	12323230.	3469913.	15793143.
Phillips	18158288.	23556032.	4666304.	28222336.	26445696.	5784120.	32229824.
Pottawatomie	0.	0.	0.	0.	147274.	10752.	158026.
Pratt	12629275.	10588595.	1479000.	12067595.	22441840.	7577673.	30019520.
Rawlins	7017221.	3633735.	367280.	4001015.	12286992.	5981213.	18268208.
Reno	10338940.	13250538.	2762808.	16013346.	18087120.	6027991.	24115104.
Republic	0.	0.	0.	0.	0.	0.	0.
Rice	40775936.	35921296.	5739512.	41660800.	46945648.	10489661.	57435312.
Riley	923618.	1337195.	427896.	1765091.	1447234.	447288.	1894522.
Rooks	37795168.	47985008.	10289792.	58274800.	75254592.	22629600.	97884192.
Rush	10440338.	7596928.	1170288.	8767216.	12460517.	4018939.	16479456.
Russell	60461344.	79052288.	17091040.	96143328.	97373680.	25839488.	123213168.
Saline	3096686.	3844999.	667176.	4512175.	4501113.	1006376.	5507489.
Scott	1492830.	1217260.	183952.	1401212.	3304139.	1288954.	4593093.
Sedgwick	11114474.	8067873.	976232.	9044105.	12527633.	2429696.	14957329.
Seward	8857566.	7199011.	1038016.	8237027.	20267904.	9984209.	30252112.
Shawnee	0.	0.	0.	0.	0.	0.	0.
Sheridan	6096017.	5023727.	805328.	5829055.	8859506.	4699371.	13558877.

	All pre-1971 leases				All leases		
COUNTY	ESTIMATED POST-1969 ULTIMATE RECOVERY (1/1/70)	PRODUCTION (1970-91)	CURRENT ESTIMATED RESERVES (1/1/92)	ESTIMATED POST-1969 ULTIMATE RECOVERY (1/1/92)	PRODUCTION (1970-91)	CURRENT ESTIMATED RESERVES (1/1/92)	ESTIMATED POST-1969 ULTIMATE RECOVERY (1/1/92)
Sherman	115731.	108657.	16104.	124761.	318878.	59624.	378502.
Smith	0.	0.	0.	0.	0.	0.	0.
Stafford	34354064.	39523856.	7596600.	47120448.	54117136.	17447776.	71564912.
Stanton	146592.	154106.	14216.	168322.	2203187.	2289376.	4492563.
Stevens	9413109.	4860675.	509936.	5370611.	10441964.	4780942.	15222906.
Sumner	15721863.	18309488.	3029424.	21338912.	27805392.	6192252.	33997648.
Thomas	110349.	80598.	11920.	92518.	4880345.	3391458.	8271803.
Trego	14307104.	10899586.	1738392.	12637978.	25157024.	6670404.	31827424.
Wabaunsee	2803220.	4419931.	624152.	5044083.	4846026.	1127643.	5973669.
Wallace	0.	0.	0.	0.	3080140.	1782308.	4862448.
Washington	0.	0.	0.	0.	0.	0.	0.
Wichita	18774.	12682.	0.	12682.	480350.	236288.	716638.
Wilson	1264941.	1554047.	279696.	1833743.	4167976.	1456037.	5624013.
Woodson	7833890.	12347643.	3110072.	15457715.	17220352.	5388587.	22608944.
Wyandotte	0.	0.	0.	0.	1501.	0.	1501.
State Totals	**788113408.**	**878834944.**	**167551904.**	**1046386944.**	**1426322944.**	**452611840.**	**1878934784.**
Province Totals:							
Cherokee B.	48101472.	62763184.	13275712.	76038896.	99519200.	30382416.	129901648.
C. KS Uplift	422813952.	479678720.	94880512.	574559232.	668695808.	184882080.	853577728.
Forest City	11136882.	16741522.	3526448.	20267968.	38034496.	17380128.	55414624.
Nemaha Antcl.	59319408.	70121072.	14181032.	84302112.	107854592.	28673856.	136528416.
Salina Basin	3780191.	4911696.	940320.	5852016.	8003294.	2448101.	10451395.
Sedg. Basin	112139024.	112450464.	19272624.	131723088.	165682992.	39808080.	205491056.
Western KS	130822080.	132167856.	21475264.	153643120.	338533120.	149037584.	487570944.

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TABLE 3: Kansas Crude Oil Production (1970-1991), aggregated by initial year of lease production

Lease Groups \ Production year	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	Total
	(million barrels)																						
pre'71	85.2	75.7	67.1	58.0	52.2	47.9	45.1	41.7	38.6	36.2	35.1	34.3	32.5	31.3	30.7	29.5	25.7	24.1	22.8	22.3	21.7	20.9	878.8
1971	.0	2.8	4.1	3.2	2.6	2.0	1.7	1.5	1.3	1.1	1.1	1.0	1.0	.9	.8	.8	.7	.6	.6	.6	.6	.6	29.4
1972	.0	.0	2.4	3.2	2.5	2.2	1.8	1.6	1.4	1.3	1.2	1.1	1.0	.9	.9	.8	.7	.6	.6	.5	.5	.4	25.4
1973	.0	.0	.0	1.8	2.3	2.0	1.8	1.5	1.1	1.0	.9	.8	.7	.6	.6	.6	.5	.5	.5	.4	.4	.4	18.3
1974	.0	.0	.0	.0	2.0	2.7	2.1	1.7	1.4	1.3	1.1	1.1	1.0	.9	.9	.9	.7	.6	.6	.6	.5	.5	20.7
1975	.0	.0	.0	.0	.0	2.4	3.4	2.8	2.3	2.2	2.1	1.9	1.8	1.6	1.5	1.5	1.4	1.3	1.2	1.1	1.2	1.0	30.8
1976	.0	.0	.0	.0	.0	.0	2.7	3.5	2.5	2.2	1.8	1.6	1.5	1.4	1.4	1.3	1.1	1.0	.9	.9	.8	.8	25.3
1977	.0	.0	.0	.0	.0	.0	.0	3.1	4.5	3.5	2.9	2.4	2.1	2.0	1.7	1.6	1.3	1.2	1.1	1.0	1.0	1.0	30.3
1978	.0	.0	.0	.0	.0	.0	.0	.0	3.4	4.6	3.7	3.1	2.6	2.2	2.0	1.8	1.5	1.3	1.2	1.2	1.1	1.1	30.7
1979	.0	.0	.0	.0	.0	.0	.0	.0	.0	3.5	5.3	4.4	3.4	2.7	2.2	2.0	1.6	1.4	1.3	1.2	1.1	1.1	31.4
1980	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	4.6	7.5	5.9	4.6	4.0	3.3	2.6	2.2	2.0	1.8	1.7	1.7	42.0
1981	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	6.8	9.6	7.4	6.3	5.5	4.4	3.5	3.1	2.9	2.6	2.4	54.5
1982	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	6.6	8.8	7.0	5.4	4.0	3.4	3.0	2.8	2.5	2.3	45.8
1983	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	5.9	8.6	6.2	4.5	3.7	3.2	2.7	2.4	2.0	39.2
1984	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	6.3	7.8	5.0	3.6	2.9	2.6	2.4	2.2	32.8
1985	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	6.3	7.5	5.4	4.4	3.7	3.1	2.8	33.3
1986	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	3.4	3.7	2.8	2.3	2.3	2.0	16.6
1987	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	2.5	3.7	2.6	2.3	1.8	12.9
1988	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	2.7	3.7	2.6	2.2	11.2
1989	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.9	3.1	2.8	7.8
1990	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	2.7	4.0	6.7
1991	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	2.4	2.4
All leases	85.2	78.5	73.5	66.2	61.6	59.2	58.7	57.4	56.5	56.7	59.7	66.0	69.7	71.4	75.0	75.2	66.7	60.5	58.6	56.8	56.8	56.3	1426.3

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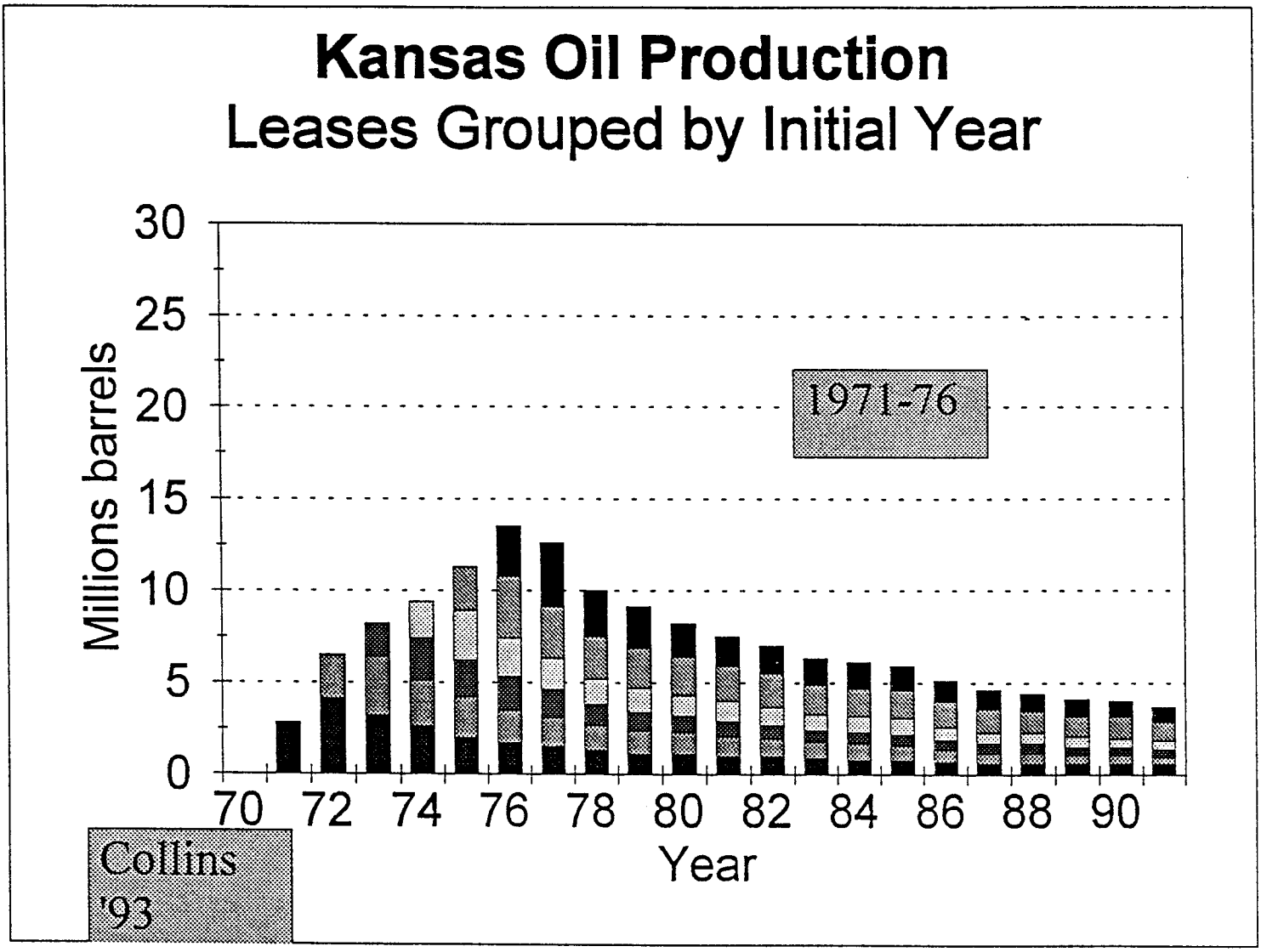

Kansas Oil Production
Leases Grouped by Initial Year
Millions barrels
30
25
20
15
10
5
0
1971-76
70
72
74
76
78
80
82
84
86
88
90
Year
Collins
'93

Figure 11

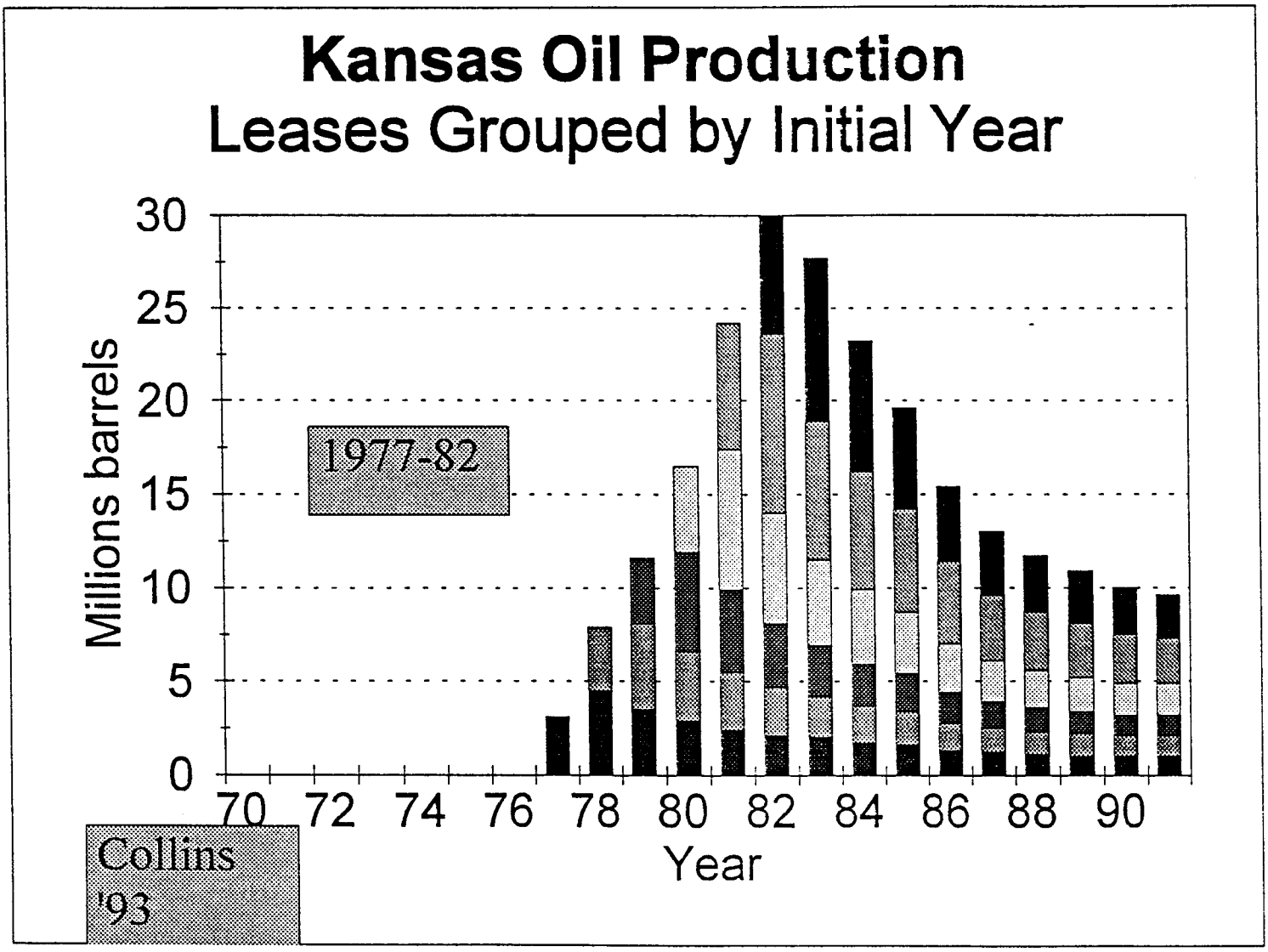

Kansas Oil Production
Leases Grouped by Initial Year
Millions barrels
30
25
20
15
10
5
0
1977-82
70 72 74 76 78 80 82 84 86 88 90
Year
Collins
'93

Figure 12

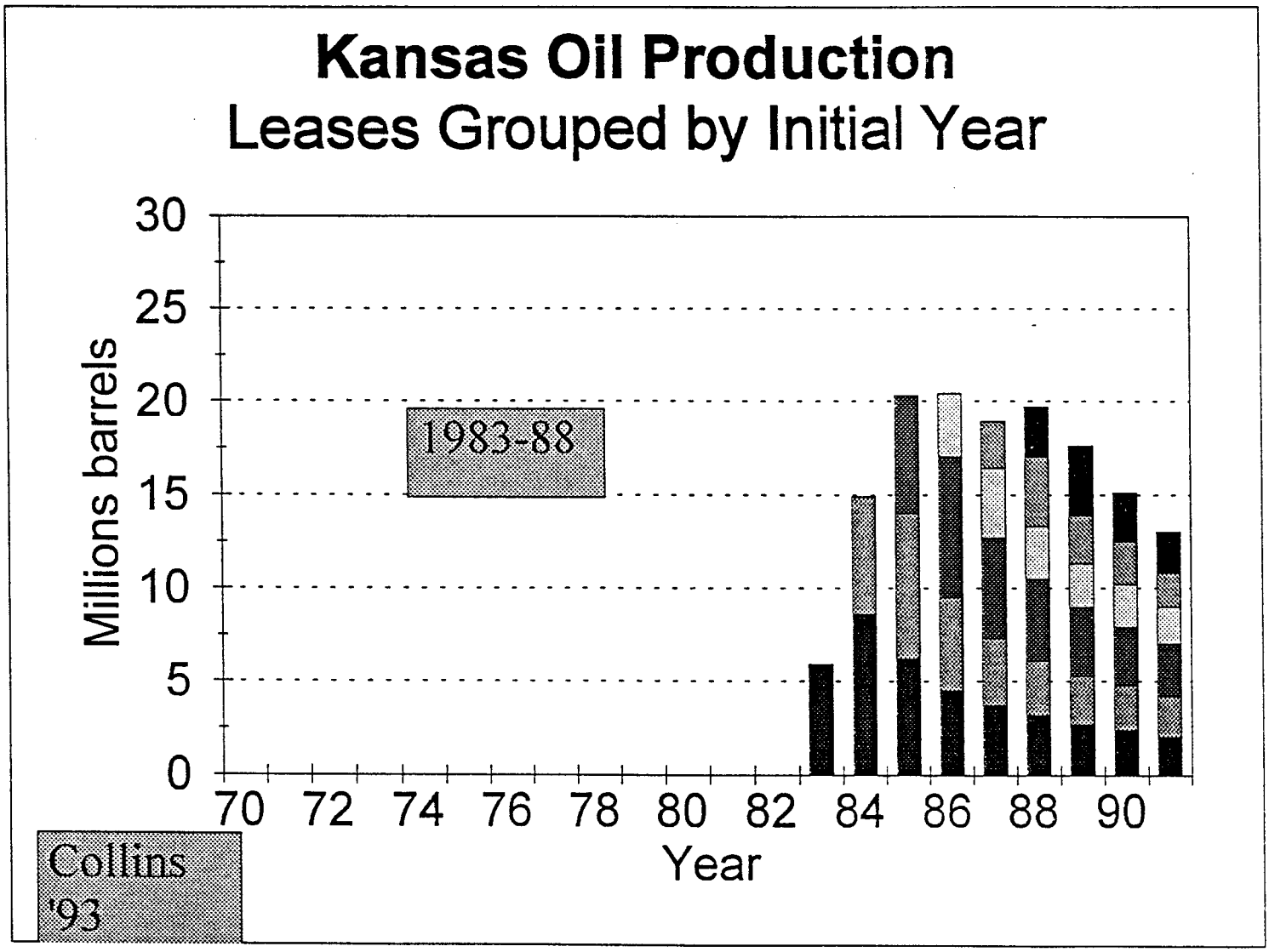

Kansas Oil Production
Leases Grouped by Initial Year
Millions barrels
30
25
20
15
10
5
0
1983-88
70
72
74
76
78
80
82
84
86
88
90
Year
Collins
'93

Figure 13

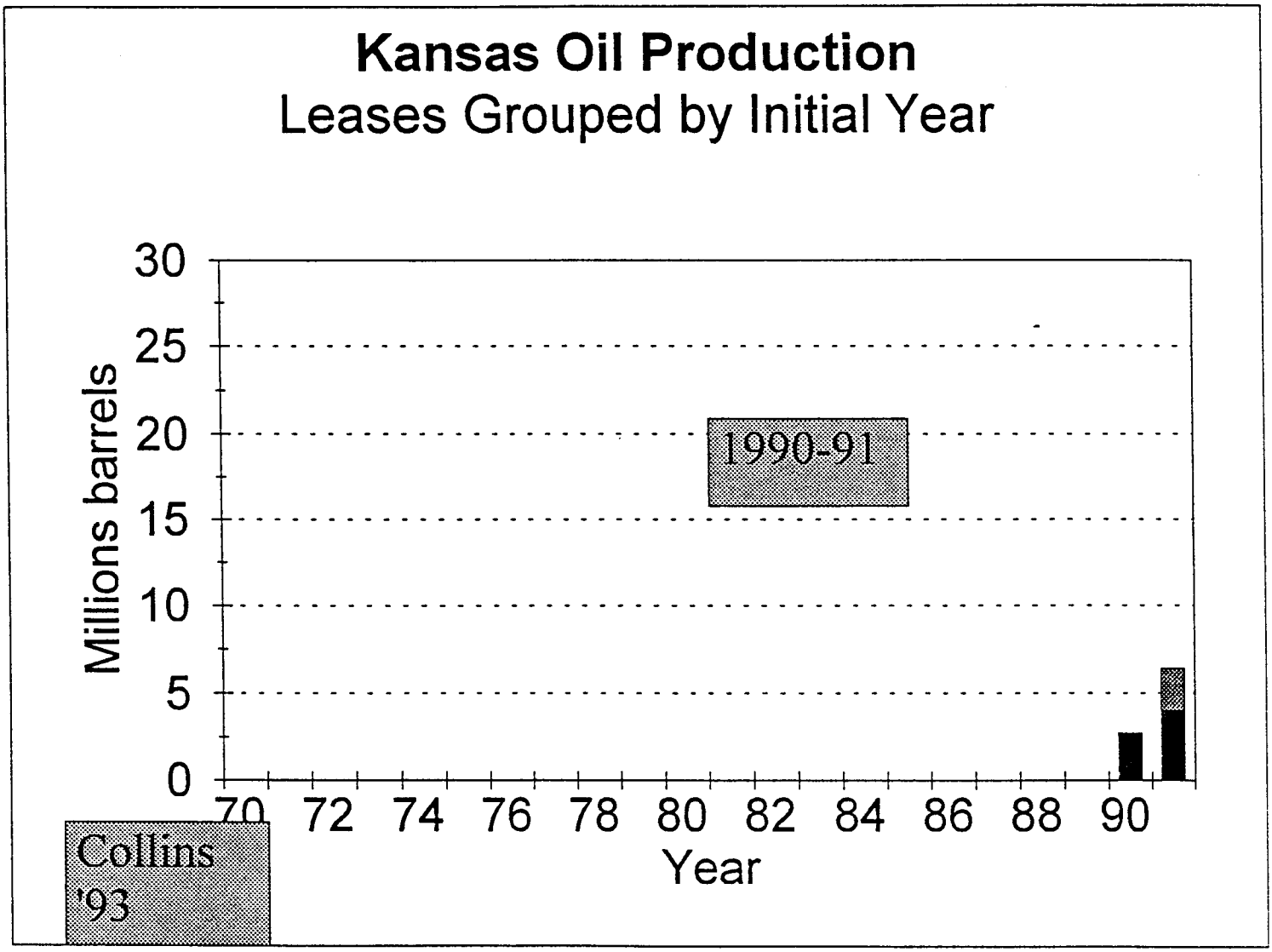

Kansas Oil Production
Leases Grouped by Initial Year
Millions barrels
30
25
20
15
10
5
0
1990-91
70
72
74
76
78
80
82
84
86
88
90
Year
Collins
'93

Figure 14

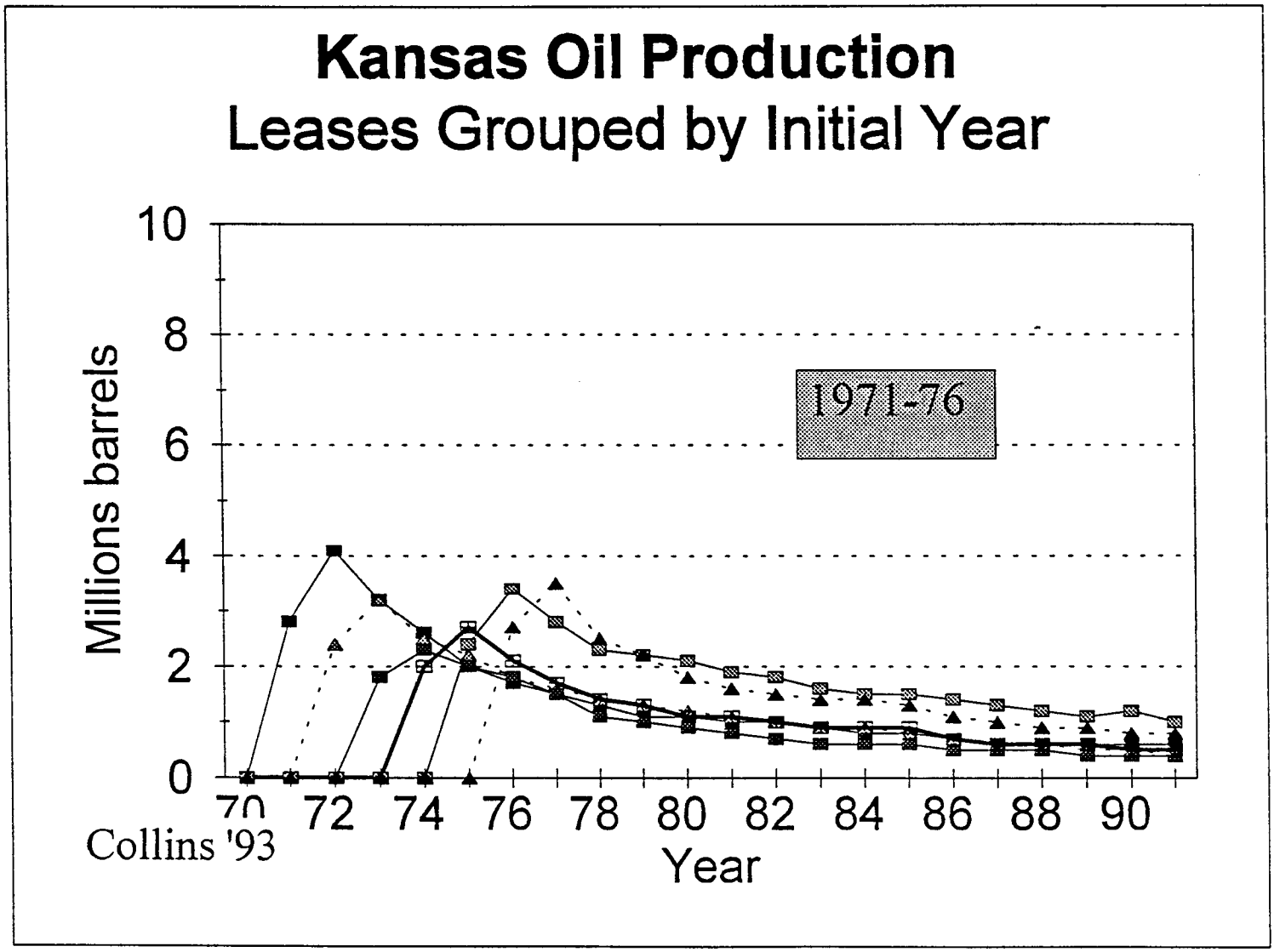

Kansas Oil Production
Leases Grouped by Initial Year
Millions barrels
10
8
6
4
2
0
1971-76
70
72
74
76
78
80
82
84
86
88
90
Year
Collins '93

Figure 15

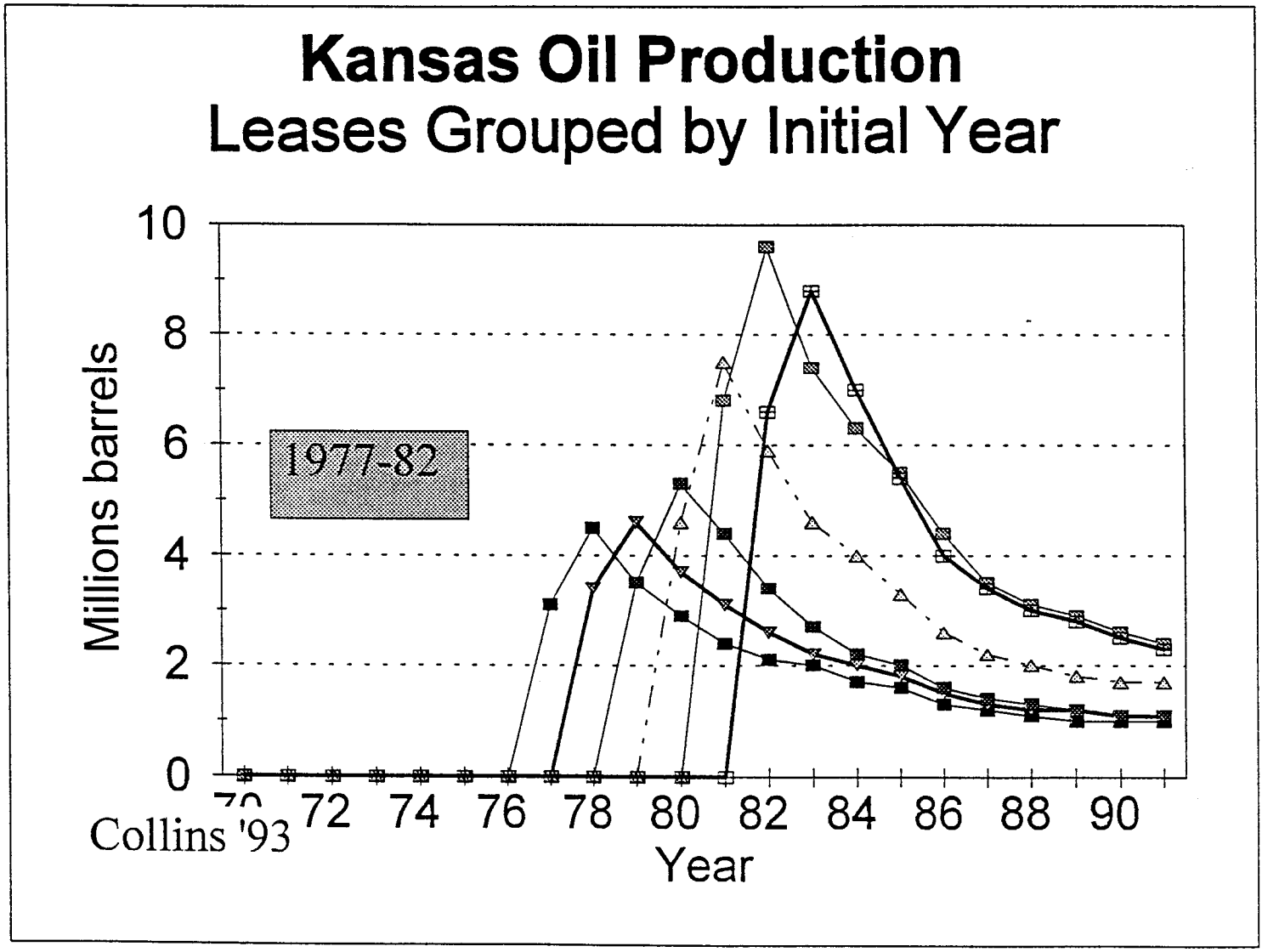

Kansas Oil Production
Leases Grouped by Initial Year
Millions barrels
10
8
6
4
2
0
1977-82
70
72
74
76
78
80
82
84
86
88
90
Year
Collins '93

Figure 16

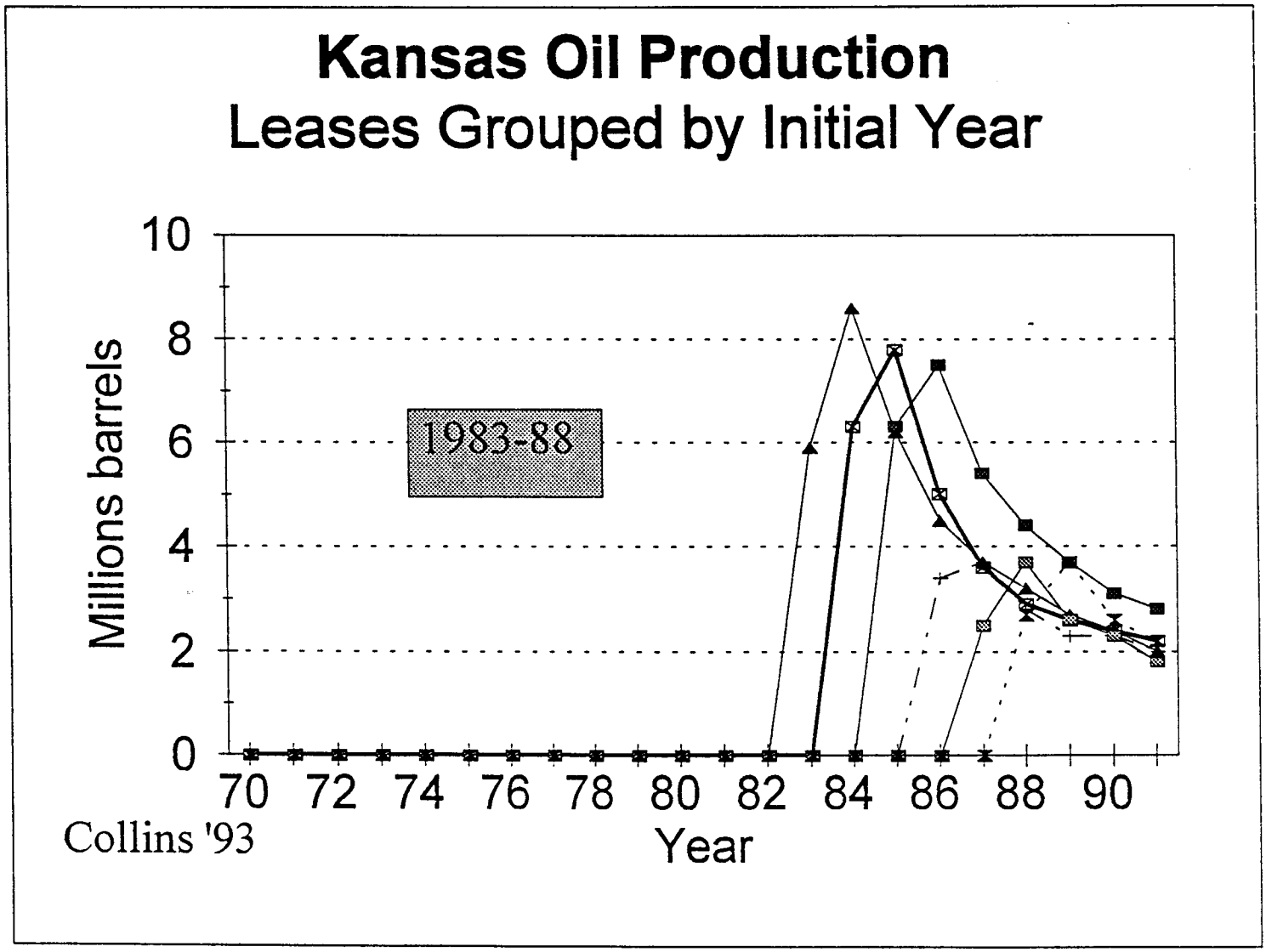

Kansas Oil Production
Leases Grouped by Initial Year
Millions barrels
10
8
6
4
2
0
1983-88
70 72 74 76 78 80 82 84 86 88 90
Year
Collins '93

Figure 17

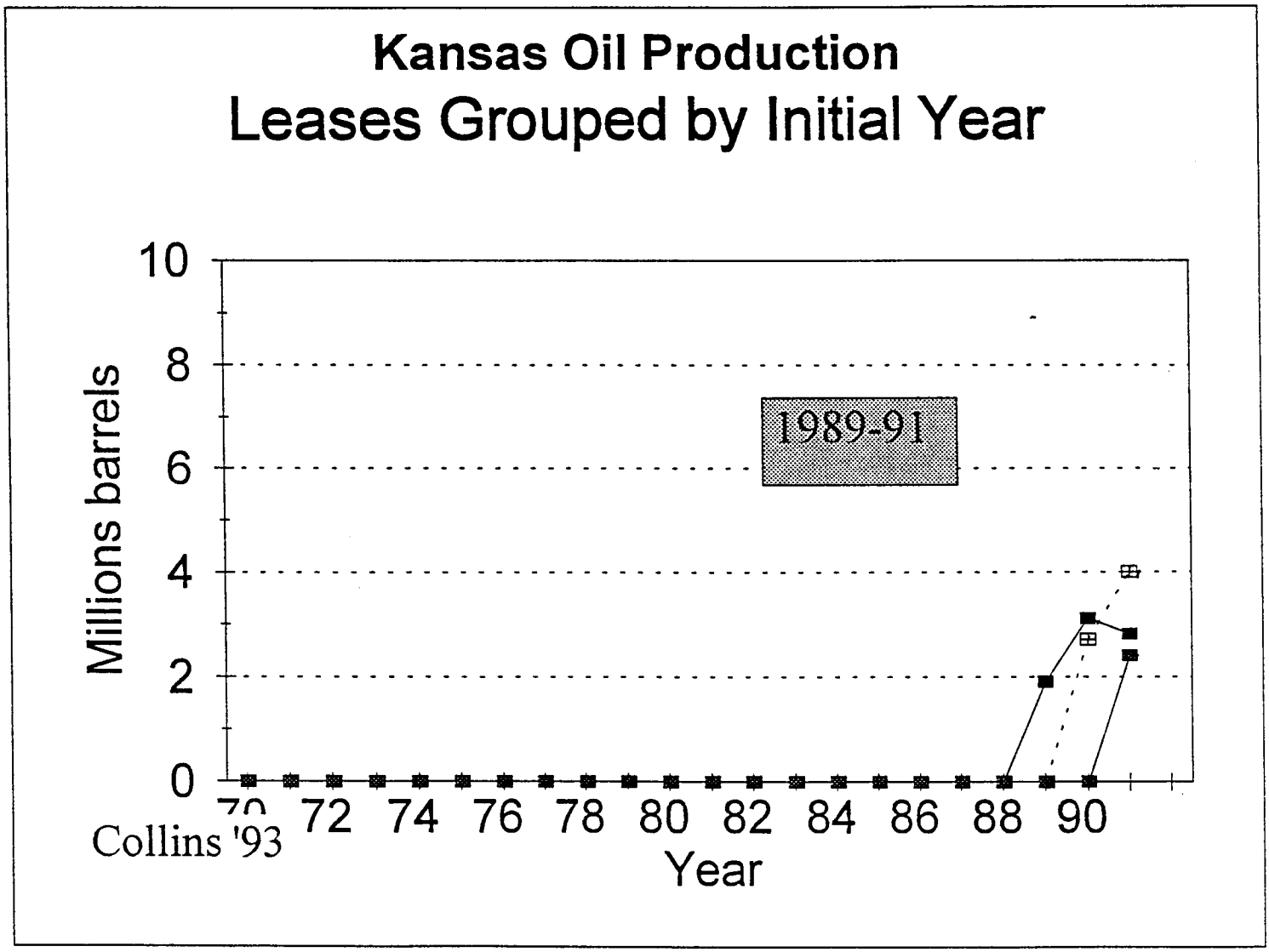

Kansas Oil Production
Leases Grouped by Initial Year
Millions barrels
10
8
6
4
2
0
1989-91
70
72
74
76
78
80
82
84
86
88
90
Year
Collins '93

Figure 18

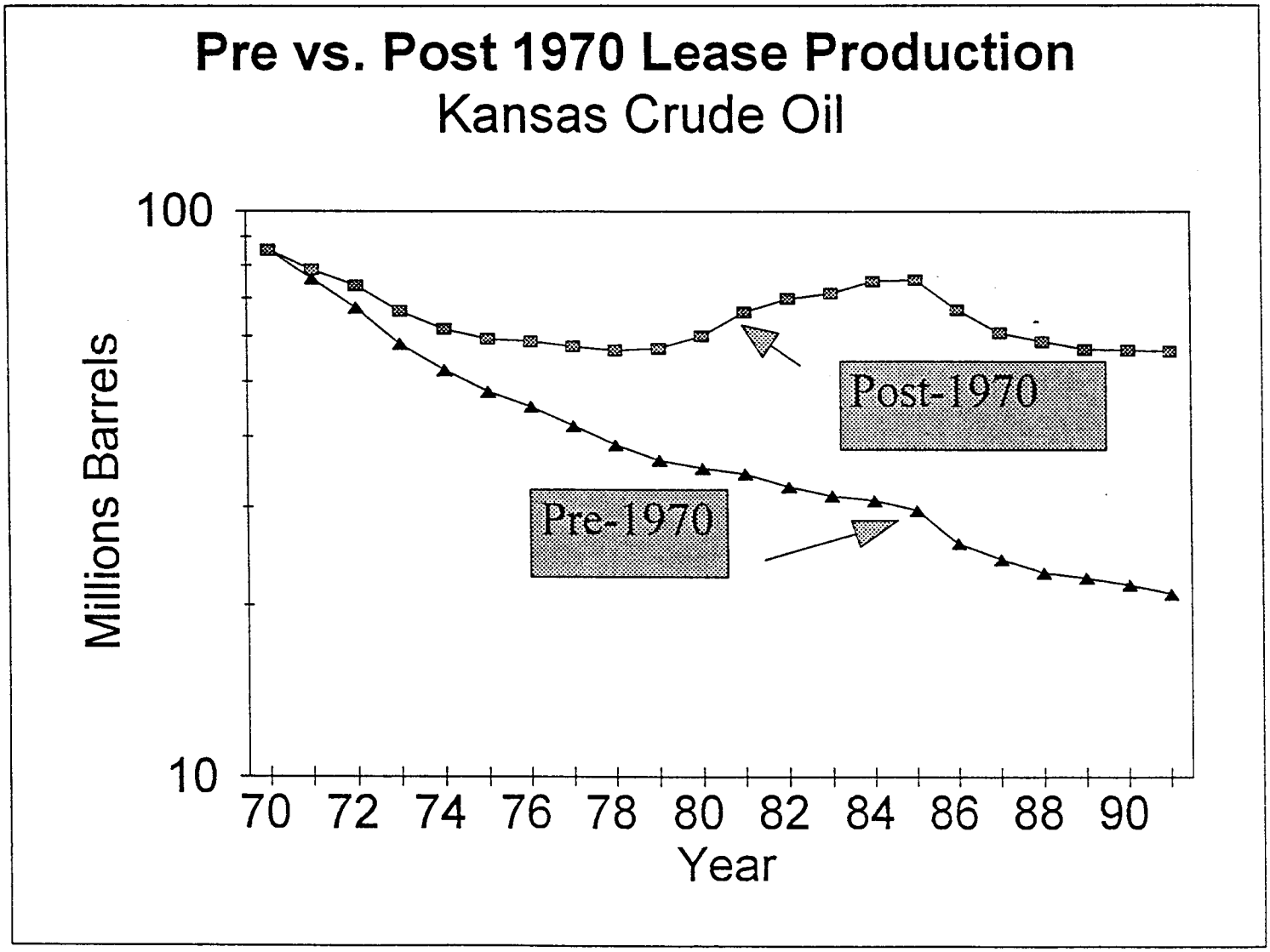

Pre vs. Post 1970 Lease Production
Kansas Crude Oil
100
10
Millions Barrels
Post-1970
Pre-1970
70 72 74 76 78 80 82 84 86 88 90
Year

Figure 19

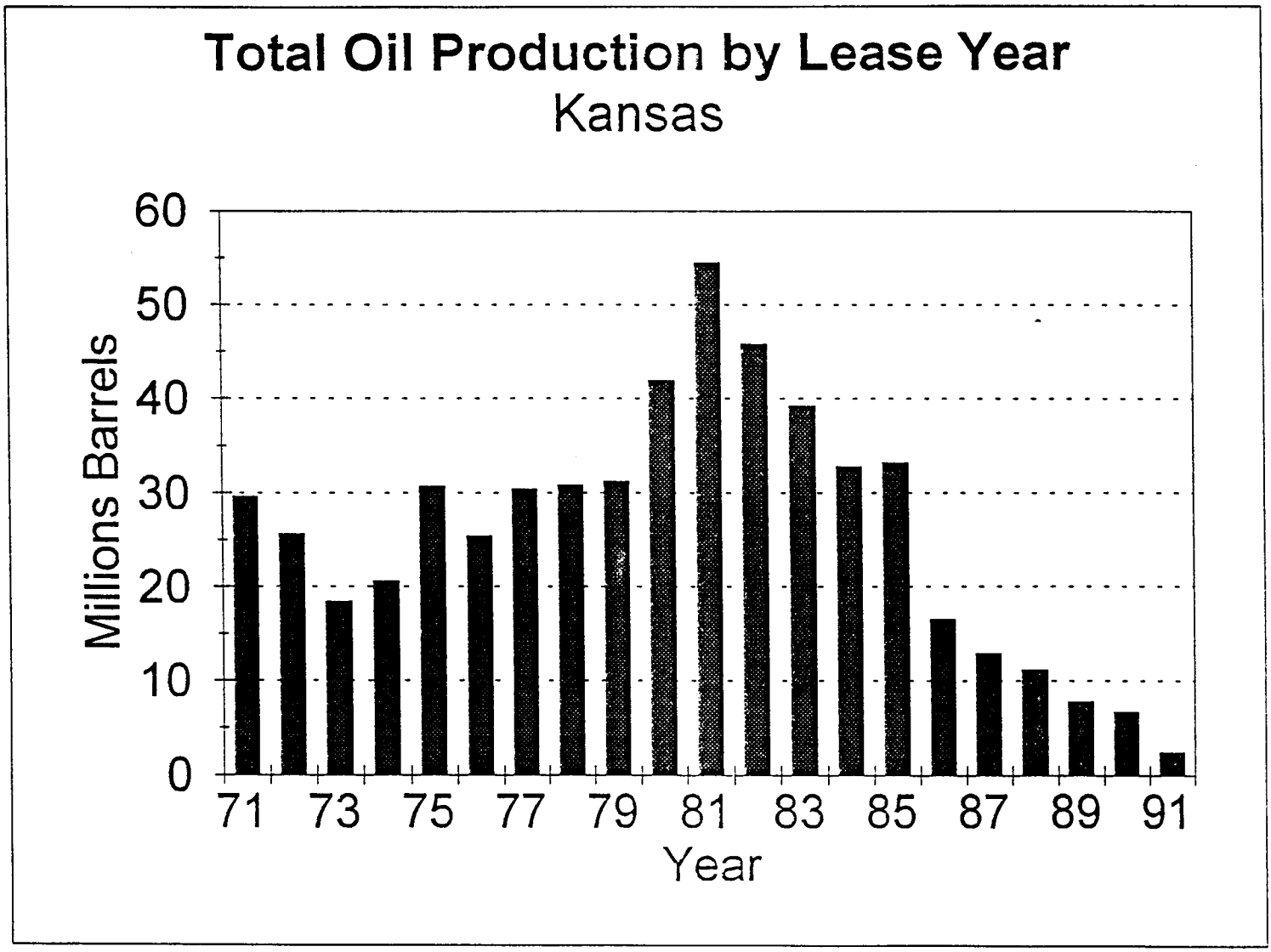

Total Oil Production by Lease Year
Kansas
Millions Barrels
60
50
40
30
20
10
0
71
73
75
77
79
81
83
85
87
89
91
Year

Figure 20

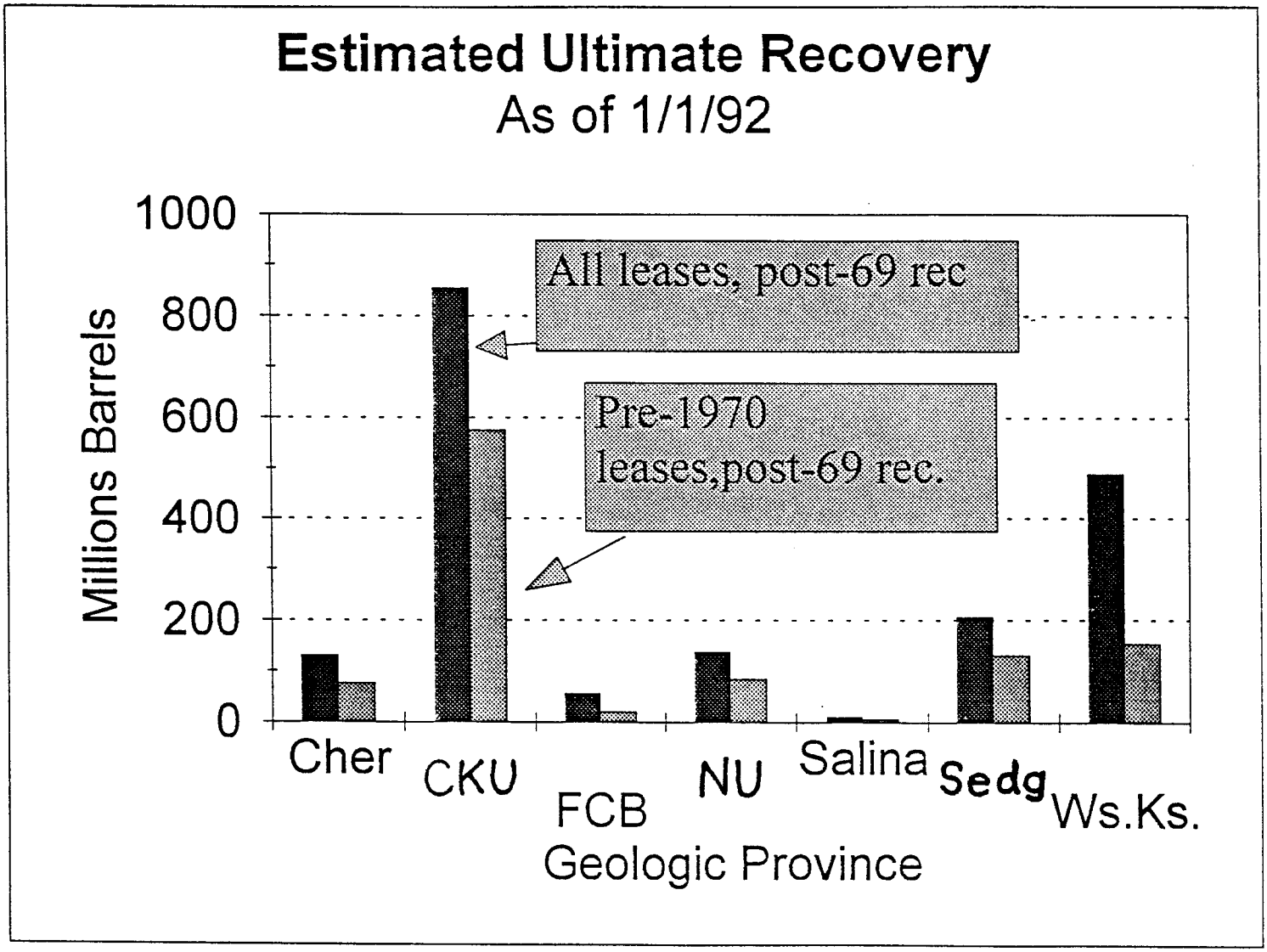

Estimated Ultimate Recovery
As of 1/1/92
1000
800
600
400
200
0
Millions Barrels
All leases, post-69 rec
Pre-1970
leases,post-69 rec.
Cher
CKU
FCB
NU
Salina
Sedg
Ws.Ks.
Geologic Province

Figure 21

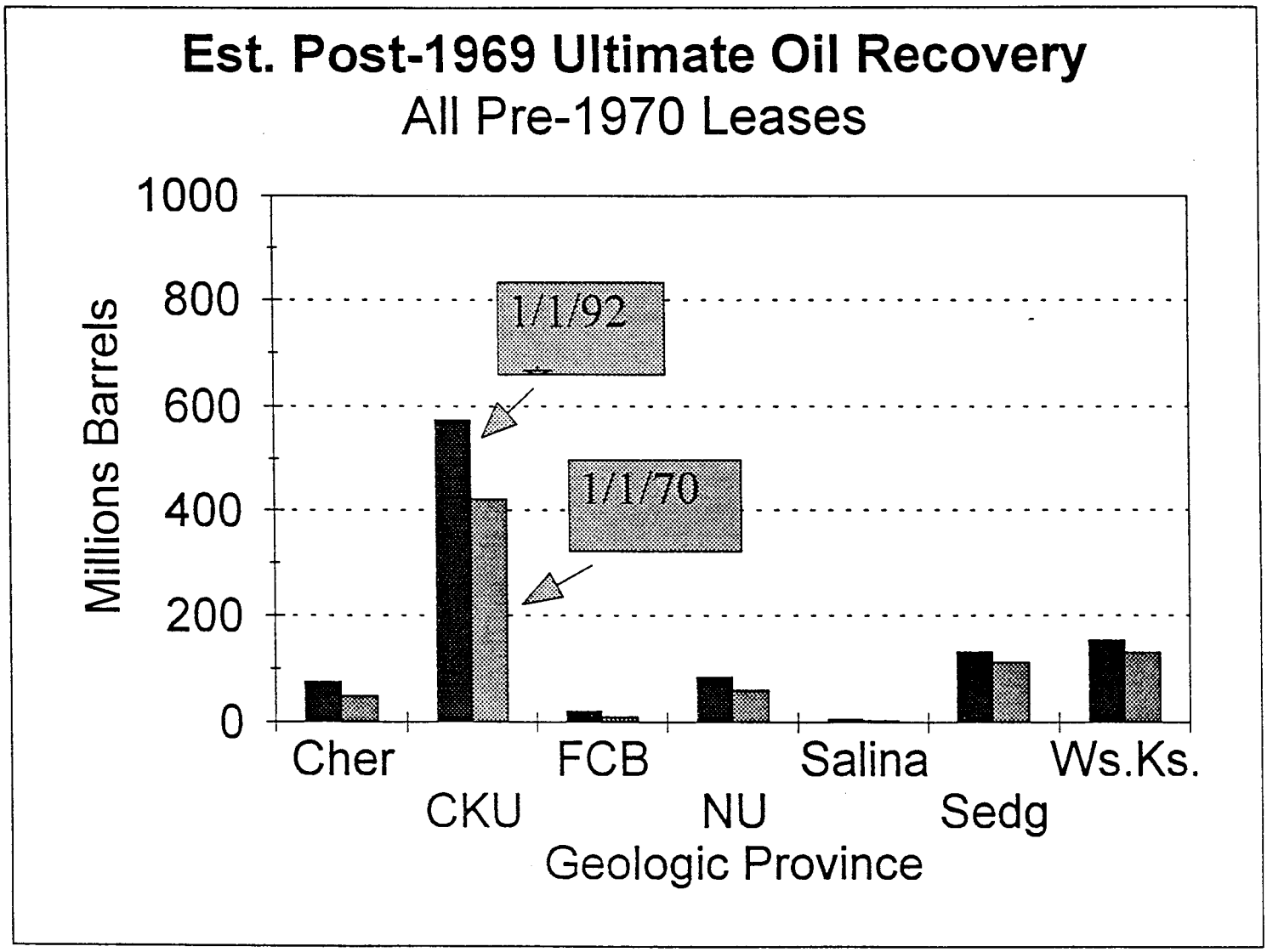

Est. Post-1969 Ultimate Oil Recovery
All Pre-1970 Leases
Millions Barrels
1000
800
600
400
200
0
1/1/92
1/1/70
Cher
CKU
FCB
NU
Salina
Sedg
Ws.Ks.
Geologic Province

Figure 22

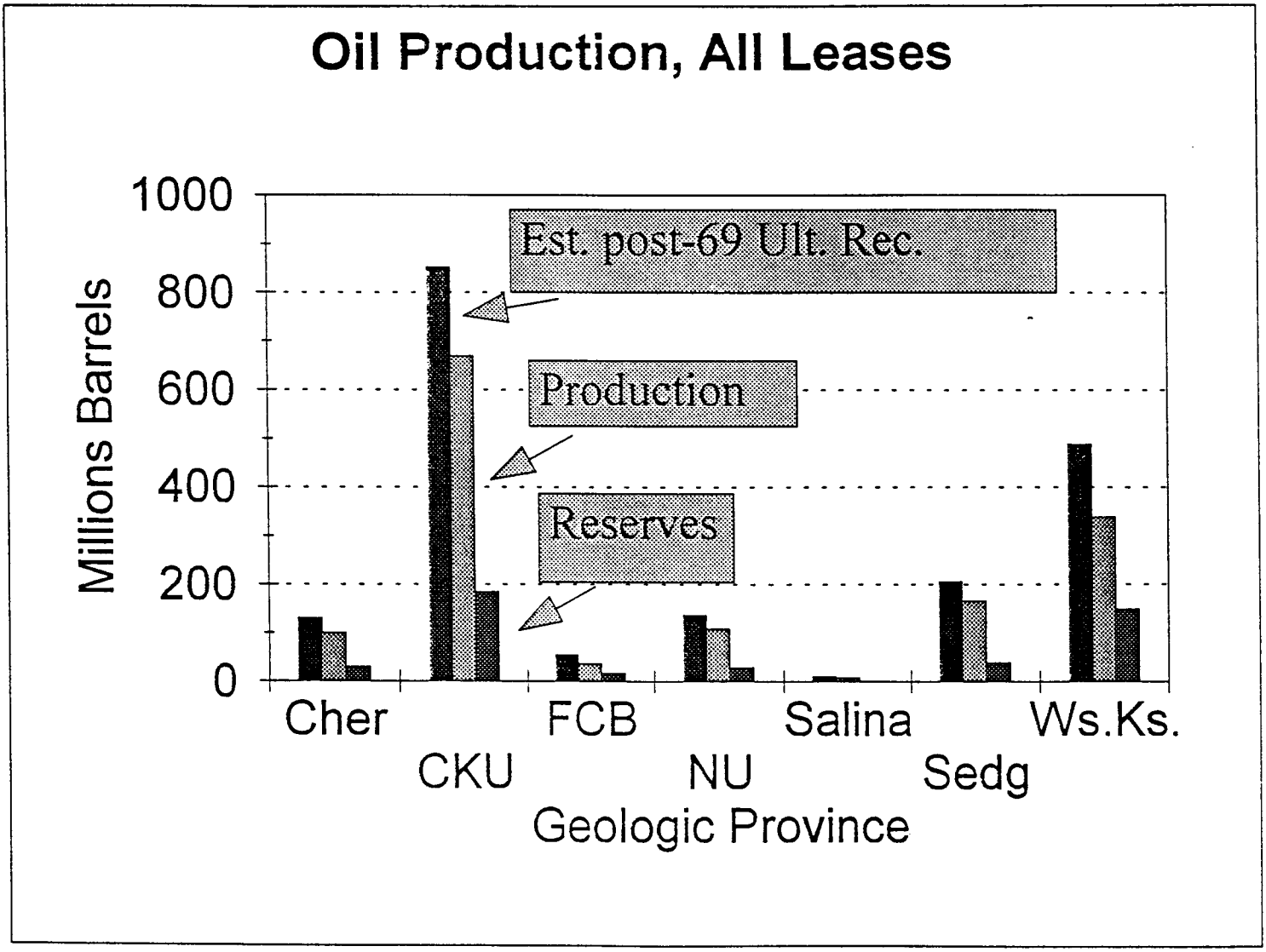
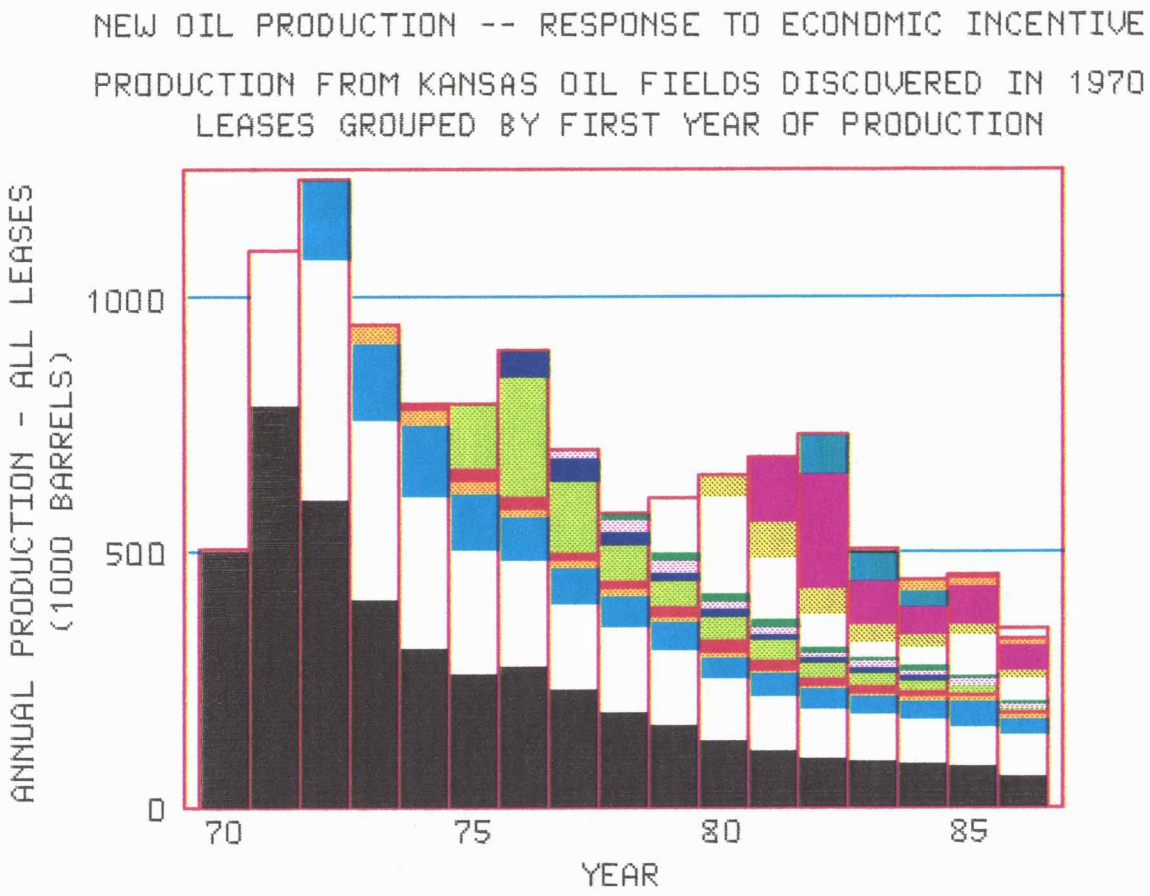

Oil Production, All Leases
1000
800
600
400
200
0
Millions Barrels
Est. post-69 Ult. Rec.
Production
Reserves
Cher
CKU
FCB
NU
Salina
Sedg
Ws.Ks.
Geologic Province

Figure 23

Figure 24


NEW OIL PRODUCTION -- RESPONSE TO ECONOMIC INCENTIVE
PRODUCTION FROM KANSAS OIL FIELDS DISCOVERED IN 1970
LEASES GROUPED BY FIRST YEAR OF PRODUCTION
ANNUAL PRODUCTION - ALL LEASES
(1000 BARRELS)
1000
500
0
70
75
80
85
YEAR