1
00:00:05,990 --> 00:00:50,020
yes

2
00:00:54,380 --> 00:00:52,490
Alaska's Glacier Bay has fascinated

3
00:00:58,009 --> 00:00:54,390
naturalists and glaciologists for

4
00:01:02,689 --> 00:00:58,019
centuries named the National Monument in

5
00:01:05,570 --> 00:01:02,699
1925 and a national park in 1980 Glacier

6
00:01:09,710 --> 00:01:05,580
Bay today attracts more than 250,000

7
00:01:12,700 --> 00:01:09,720
visitors a year just 200 years ago the

8
00:01:15,200 --> 00:01:12,710
entire Bay was covered by glacier ice

9
00:01:17,540 --> 00:01:15,210
with the help of ground and satellite

10
00:01:19,850 --> 00:01:17,550
measurements study of the recession of

11
00:01:21,859 --> 00:01:19,860
the glaciers of Glacier Bay as well as

12
00:01:24,320 --> 00:01:21,869
in other areas is providing us with

13
00:01:30,790 --> 00:01:24,330

important clues about changes in global

14
00:01:37,750 --> 00:01:33,790
a glacier is a dynamic system consisting

15
00:01:39,460 --> 00:01:37,760
of snow ice and often rock debris that

16
00:01:42,190 --> 00:01:39,470
transports material from higher

17
00:01:45,480 --> 00:01:42,200
elevations where snow accumulates to

18
00:01:49,390 --> 00:01:45,490
lower elevations where snow and ice melt

19
00:01:51,040 --> 00:01:49,400
snow becomes glacier ice over time when

20
00:01:53,700 --> 00:01:51,050
the pressure of increasing layers are

21
00:01:56,530 --> 00:01:53,710
snow accumulating year after year

22
00:01:59,590 --> 00:01:56,540
transforms the snow first into fern

23
00:02:08,290 --> 00:01:59,600
which is very dense snow and eventually

24
00:02:10,720 --> 00:02:08,300
into ice today there are over 200

25
00:02:13,270 --> 00:02:10,730
separate smaller glaciers in Glacier Bay

26
00:02:15,960 --> 00:02:13,280
National Park to the delight of park

27
00:02:21,190 --> 00:02:15,970
visitors who view them from cruise ships

28
00:02:22,870 --> 00:02:21,200
private boats and kayaks glaciers at the

29
00:02:25,840 --> 00:02:22,880
head of tar inlet of the most

30
00:02:29,740 --> 00:02:25,850
spectacular these include the Grand

31
00:02:31,960 --> 00:02:29,750
Pacific and the margaery together they

32
00:02:35,680 --> 00:02:31,970
comprise three kilometers of ice front

33
00:02:37,930 --> 00:02:35,690
which is cowling into the sea the Johns

34
00:02:40,120 --> 00:02:37,940
Hopkins and Marjorie glaciers are each

35
00:02:44,530 --> 00:02:40,130
about one-and-a-half kilometres wide and

36
00:02:47,110 --> 00:02:44,540
22 kilometers long they are both dwarfed

37
00:02:49,510 --> 00:02:47,120
by the Grand Pacific glacier a tall

38
00:02:52,750 --> 00:02:49,520

towers 60 to 90 meters above the water

39
00:02:55,660 --> 00:02:52,760
at their term and I with another 120

40
00:02:57,729 --> 00:02:55,670
meters below the water surface these

41
00:03:00,550 --> 00:02:57,739
glaciers calve icebergs into the ocean

42
00:03:06,110 --> 00:03:00,560
on a regular basis grilling visitors

43
00:03:09,800 --> 00:03:08,270
written records of the glaciers in

44
00:03:14,240 --> 00:03:09,810
Glacier Bay began with George

45
00:03:16,610 --> 00:03:14,250
Vancouver's visit in 1794 ground

46
00:03:18,500 --> 00:03:16,620
observations beginning in the late 1800s

47
00:03:20,600 --> 00:03:18,510
and ground-based and satellite

48
00:03:23,809 --> 00:03:20,610
measurements in recent years have shown

49
00:03:32,500 --> 00:03:23,819
that many glaciers in and near Glacier

50
00:03:37,270 --> 00:03:35,259
when a glacier recedes water from the

51
00:03:40,990 --> 00:03:37,280
melting ice is released into the ocean

52
00:03:42,880 --> 00:03:41,000
and sea level rises though the greatest

53
00:03:44,289 --> 00:03:42,890
potential for sea level rise is from

54
00:03:47,380 --> 00:03:44,299
melting of the Antarctic and Greenland

55
00:03:49,990 --> 00:03:47,390
ice sheets the small glaciers of the

56
00:03:52,569 --> 00:03:50,000
world such as those in Glacier Bay would

57
00:03:54,640 --> 00:03:52,579
contribute to a sea-level rise of about

58
00:04:02,649 --> 00:03:54,650
six-tenths of a meter if they were to

59
00:04:04,330 --> 00:04:02,659
melt completely precise measurements of

60
00:04:07,449 --> 00:04:04,340
glacier changes may be made by

61
00:04:10,210 --> 00:04:07,459
ground-based surveying the light

62
00:04:12,250 --> 00:04:10,220
glaciologist William O field began

63
00:04:17,050 --> 00:04:12,260

photographing and measuring glaciers in

64
00:04:19,270 --> 00:04:17,060
Glacier Bay in 1926 many of the glacier

65
00:04:21,219 --> 00:04:19,280
terminus positions map by field and his

66
00:04:23,409 --> 00:04:21,229
colleagues are shown on the map of

67
00:04:27,700 --> 00:04:23,419
Glacier Bay prepared by the National

68
00:04:29,320 --> 00:04:27,710
Park Service glacier work in the early

69
00:04:32,700 --> 00:04:29,330
part of this century was even more

70
00:04:35,110 --> 00:04:32,710
difficult and hazardous than it is today

71
00:04:37,480 --> 00:04:35,120
scientists had to roll through iceberg

72
00:04:40,570 --> 00:04:37,490
laden water to reach many of the glacier

73
00:04:43,270 --> 00:04:40,580
fronts detailed measurements in Glacier

74
00:04:45,250 --> 00:04:43,280
Bay made by field and others have

75
00:04:47,770 --> 00:04:45,260
provided an excellent description of the

76
00:04:53,860 --> 00:04:47,780
dates and magnitude of changes in the

77
00:04:59,900 --> 00:04:57,620
the once enormous Muir glacier located

78
00:05:02,300 --> 00:04:59,910
in what is now mere Inlet in the East

79
00:05:05,390 --> 00:05:02,310
arm of Glacier Bay was named for John

80
00:05:07,939 --> 00:05:05,400
Muir the famous naturalist and explorer

81
00:05:12,560 --> 00:05:07,949
who visited Glacier Bay in the late 19th

82
00:05:15,670 --> 00:05:12,570
century in 1905 just 26 years after

83
00:05:17,719 --> 00:05:15,680
mirrors first visit Fremont Morris wrote

84
00:05:20,330 --> 00:05:17,729
formally the mirror presented a

85
00:05:22,640 --> 00:05:20,340
perpendicular front at least 200 feet in

86
00:05:25,280 --> 00:05:22,650
height from which huge Berg's were

87
00:05:27,350 --> 00:05:25,290
detached at frequent intervals the sight

88
00:05:29,540 --> 00:05:27,360

and sound of one of these vast masses

89
00:05:32,060 --> 00:05:29,550
falling from the cliff or suddenly

90
00:05:34,550 --> 00:05:32,070
appearing from the submarine I slit was

91
00:05:37,670 --> 00:05:34,560
something which once witness was not to

92
00:05:40,430 --> 00:05:37,680
be forgotten it was grand and impressive

93
00:05:42,620 --> 00:05:40,440
beyond description fortunately the

94
00:05:44,570 --> 00:05:42,630
recent changes in the mirror have not

95
00:05:46,820 --> 00:05:44,580
increased its impressiveness from a

96
00:05:49,250 --> 00:05:46,830
scenic standpoint instead of the

97
00:05:51,920 --> 00:05:49,260
imposing cliff of ice the front is

98
00:05:56,390 --> 00:05:51,930
sloping and seems to be far less active

99
00:05:58,400 --> 00:05:56,400
than formerly the Muir glacier is now

100
00:06:00,680 --> 00:05:58,410
but a small remnant of its former glory

101
00:06:03,800 --> 00:06:00,690
and has nearly retreated up out of the

102
00:06:05,900 --> 00:06:03,810
ocean in fact many of the large

103
00:06:08,870 --> 00:06:05,910
Tidewater glaciers that John Muir first

104
00:06:11,920 --> 00:06:08,880
observed in 1879 have been reduced to

105
00:06:14,570 --> 00:06:11,930
small glaciers that terminate on land

106
00:06:17,480 --> 00:06:14,580
land that is uncovered as glaciers

107
00:06:25,279 --> 00:06:17,490
recede from its plant and animal life to

108
00:06:27,490 --> 00:06:25,289
appear and flourish beginning with the

109
00:06:31,100 --> 00:06:27,500
launch of the first Landsat satellite in

110
00:06:33,469 --> 00:06:31,110
1972 we have with a spatial resolution

111
00:06:35,210 --> 00:06:33,479
of up to 30 meters been able to acquire

112
00:06:37,520 --> 00:06:35,220
detailed satellite images of the

113
00:06:41,089 --> 00:06:37,530

glaciers of Glacier Bay and measure

114
00:06:43,610 --> 00:06:41,099
changes in those glaciers to satellite

115
00:06:46,100 --> 00:06:43,620
sensors the multispectral scanner and

116
00:06:48,469 --> 00:06:46,110
the more advanced thematic mapper allow

117
00:06:55,159 --> 00:06:48,479
us to measure glaciers without having to

118
00:06:59,360 --> 00:06:57,589
maps drawn by earlier explorers of

119
00:07:01,879 --> 00:06:59,370
Glacier Bay can be registered to or

120
00:07:05,839 --> 00:07:01,889
overlaying on satellite images using

121
00:07:07,939 --> 00:07:05,849
computer techniques common stable points

122
00:07:10,070 --> 00:07:07,949
between the map and the images are

123
00:07:13,580 --> 00:07:10,080
located and digitally overlaying using

124
00:07:15,519 --> 00:07:13,590
image processing techniques one image is

125
00:07:18,619 --> 00:07:15,529
stretched in relationship to the other

126
00:07:20,330 --> 00:07:18,629
once the images are registered we can

127
00:07:22,550 --> 00:07:20,340
measure changes in glacier terminus

128
00:07:29,260 --> 00:07:22,560
positions from the time of the earliest

129
00:07:34,040 --> 00:07:31,820
using computer techniques we can

130
00:07:37,400 --> 00:07:34,050
register elevation data to satellite

131
00:07:39,170 --> 00:07:37,410
images this allows us to obtain a

132
00:07:42,260 --> 00:07:39,180
three-dimensional perspective and

133
00:07:54,760 --> 00:07:42,270
actually appear to fly by an area

134
00:07:58,900 --> 00:07:56,830
measurements of the Muir glacier have

135
00:08:00,850 --> 00:07:58,910
shown that the terminus retreated up the

136
00:08:03,210 --> 00:08:00,860
mirror inlet at a rate of about four

137
00:08:07,330 --> 00:08:03,220
tenths of a kilometer per year between

138
00:08:10,809 --> 00:08:07,340

1794 and 1892 for a total retreat to

139
00:08:12,640 --> 00:08:10,819
more than 40 kilometers satellite

140
00:08:19,659 --> 00:08:12,650
measurements derived from images

141
00:08:21,610 --> 00:08:19,669
acquired in 1973 1980 1983 and 1986 show

142
00:08:24,820 --> 00:08:21,620
that the Muir glacier terminus went back

143
00:08:27,730 --> 00:08:24,830
more than seven kilometres between 1973

144
00:08:36,920 --> 00:08:27,740
and 1986 with most of that retreat

145
00:08:42,990 --> 00:08:39,600
mcBride glaciers the most active glacier

146
00:08:45,210 --> 00:08:43,000
and mirror inlet it is still receding

147
00:08:48,330 --> 00:08:45,220
and over the last two decades has formed

148
00:08:50,550 --> 00:08:48,340
an impressive Inlet as recorded by

149
00:08:52,530 --> 00:08:50,560
satellite datum the terminus of the

150
00:08:57,570 --> 00:08:52,540
McBride glacier retreated almost three

151
00:08:59,430 --> 00:08:57,580
kilometres between 1973 in 1986 and the

152
00:09:01,800 --> 00:08:59,440
nearby Burroughs glacier shrank

153
00:09:04,920 --> 00:09:01,810
considerably filling lakes with its

154
00:09:06,750 --> 00:09:04,930
meltwater note the increase in the

155
00:09:11,250 --> 00:09:06,760
amount of vegetation the vicinity of

156
00:09:13,830 --> 00:09:11,260
burrows glacier in 1986 the burrows is

157
00:09:21,370 --> 00:09:13,840
now a dying ice field having been cut

158
00:09:27,800 --> 00:09:23,750
still other glaciers have been in

159
00:09:29,960 --> 00:09:27,810
equilibrium or advancing some like the

160
00:09:31,850 --> 00:09:29,970
Johns Hopkins have stopped their retreat

161
00:09:35,960 --> 00:09:31,860
and have advanced during the period

162
00:09:39,350 --> 00:09:35,970
covered by the satellite record also the

163
00:09:43,030 --> 00:09:39,360

lamp Lou Reed Marjorie and Grand Pacific

164
00:09:45,800 --> 00:09:43,040
glaciers are all advancing at this time

165
00:09:49,880 --> 00:09:45,810
the nearby Brady glacier has been

166
00:09:51,830 --> 00:09:49,890
advancing since 1794 however the major

167
00:09:53,780 --> 00:09:51,840
feature of Glacier Bay is the

168
00:09:57,580 --> 00:09:53,790
large-scale retreat of its Tidewater

169
00:10:00,260 --> 00:09:57,590
glaciers and both mirror and tar inlets

170
00:10:03,430 --> 00:10:00,270
Tidewater glaciers like the mirror and

171
00:10:05,450 --> 00:10:03,440
the Marjorie terminate in the sea

172
00:10:07,520 --> 00:10:05,460
Tidewater glaciers follow their own

173
00:10:15,290 --> 00:10:07,530
cycles that are independent of

174
00:10:17,720 --> 00:10:15,300
short-term climate changes there are

175
00:10:21,950 --> 00:10:17,730
also non Tidewater glaciers near Glacier

176
00:10:23,960 --> 00:10:21,960
Bay many of which are receding recession

177
00:10:26,390 --> 00:10:23,970
of non Tidewater glaciers in the area is

178
00:10:29,660 --> 00:10:26,400
probably due to amelioration of the

179
00:10:32,330 --> 00:10:29,670
regional climate meteorological data

180
00:10:35,240 --> 00:10:32,340
from the nearby stations at juneau Sitka

181
00:10:36,680 --> 00:10:35,250
and Yakutat show a tendency toward an

182
00:10:38,870 --> 00:10:36,690
increase in average summer air

183
00:10:44,689 --> 00:10:38,880
temperature since about nineteen forty

184
00:10:48,479 --> 00:10:46,859
combining the extensive records of

185
00:10:50,699 --> 00:10:48,489
explorers beginning the late 18th

186
00:10:53,099 --> 00:10:50,709
century with more recent efforts of

187
00:10:55,139 --> 00:10:53,109
glaciologists and computer scientists a

188
00:10:57,329 --> 00:10:55,149

wealth of information has been obtained

189
00:11:00,839 --> 00:10:57,339
about the d glaciation of Glacier Bay

190
00:11:02,879 --> 00:11:00,849
Alaska as these glaciers and others

191
00:11:05,609 --> 00:11:02,889
continue to change or if they remain

192
00:11:07,289 --> 00:11:05,619
stable over time the satellite record

193
00:11:09,359 --> 00:11:07,299
will permit assessment of the impact of

194
00:11:11,939 --> 00:11:09,369
changing climate on the glaciers and

195
00:11:14,549 --> 00:11:11,949
many of the non Tidewater glaciers are

196
00:12:42,440 --> 00:11:14,559
excellent indicators of regional climate