Poultry diseases in Iran: an epidemiological study on different causes of mortality in broilers

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Abstract

Understanding the distributions of poultry diseases will help planning for disease control and prevention more effectively. Studies on poultry diseases in Iran are scarce. We investigated the incidence of mortality in broiler chicken flocks in Iran as part of a national project. Specifically, documents from September 2004 to November 2005 related to the mortality of broilers that were covered by the national insurance scheme were analyzed retrospectively. Of the 439,188,406 broiler chickens that were covered by insurance services, 188,680,459 chickens were exposed to different diseases. The most common diseases (in descending order) were infectious bursal disease (IBD), infectious bronchitis (IB), chronic respiratory disease (CRD), colibacillosis and avian influenza (AI; subtype H9N2). The mean mortality rate in broilers was 7.89%. Mortality rates were higher during chicks between the third to sixth weeks of age. AI (H9N2) produced the highest mean mortality rate of 26.1%, followed by IB with a mean mortality rate of 22.1%. Most of the mortalities were recorded from the southern provinces of Iran. The distributions of diseases were differed in different regions which could be related to regional conditions and management parameters.

Introduction

Commercial production and the lack of supervision and control in importing new breeds from different regions of the world have caused many types of poultry diseases that were previously not seen in Iran. This situation is worsened by the concentration of intensively housed birds in certain areas and their close proximity to each other; it is claimed that these are the main causes of the widespread disease-related problems that the country has experienced in recent years (Shariatmadari, 2006).

Studies concerning poultry diseases in Iran have mainly focused on specific diseases in some regions of the country (Nilli and Asasi, 2002, 2003). This paper reports on the prevalence of mortality in broiler flocks in Iran according to a national project. To our knowledge, this is the largest such report, and the first to cover all provinces of Iran with regards to broiler diseases and mortalities.

Materials and Methods

Study population

In this cross-sectional study, documents related to the mortality of broilers that were covered by the national insurance program for broilers in Iran during a 15-month period between September 2004 and November 2005 were evaluated. According to the collected reports from broiler farms, 439,188,406 broilers (30,118 flocks) were covered by the insurance program during this period, which constituted an estimated 48.79% of all broilers in Iran. Overall, 11,751 folders (one per flock) related to 188,680,459 broilers were returned to the Agricultural Products Insurance Organization (APIO) due to mortality. Mortalities were caused by a broad spectrum of infectious/noninfectious diseases and natural or unexpected causes, such as fire, flood or heat stress.

Statistical analysis

In order to assess the effects of different factors on broiler mortality, the prevalence of mortality was calculated according to the following parameters:

(1) Different ages of broilers,
(2) Different periods of the project (1st to 5th season),
(3) Different provinces numbered from 1 to 30, according to Figure 1.
(4) Different diseases.

In addition, parameters that were related to insurance coverage and frequency of diseases in

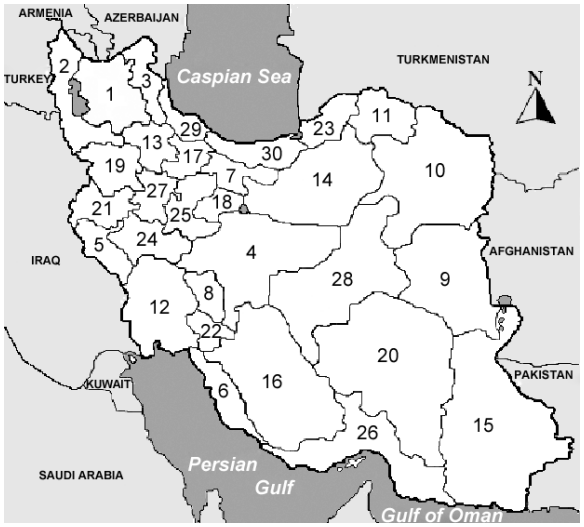


Figure 1: The location of the Iranian provinces.

different provinces and ages were reported in this paper.

Data were analyzed by SPSS11.5 software (SPSS Inc., Chicago, IL, USA). A Chi-square, one-way analysis of variance (ANOVA) and post-hoc analyses based on Tukey's test were used for data analysis.

Results

During the study period, a total of 34,667,005 broilers out of a total population of 439,188,406 died due to different causes. Therefore, the incidence of mortality among the covered broilers was 7.89%.

Figure 2 shows the number of covered flocks and folders returned to APIO during the five trimesters of this study. As shown in this Figure, the number of covered flocks and returned folders increased during the course of the study. However, statistical analyses (Chi-square test) showed that the relative frequency of the returned folders (ratio of returned folders to covered flocks) was not statistically different (P= 0.2) between trimesters. The increase in returned folders has been attributed to the increase in the number of flocks covered by the insurance program.

Figure 3 shows the distribution of mortality rates in each flock for each trimester. A one-way ANOVA was employed to compare the distribution of mortality rates between each trimester and showed no statistically significant difference in mortality rates between these periods (P= 0.4). These results imply that mortality rates did not increase during the course of this study.

Figure 2: Number of covered flocks and returned folders during the five season of the study.

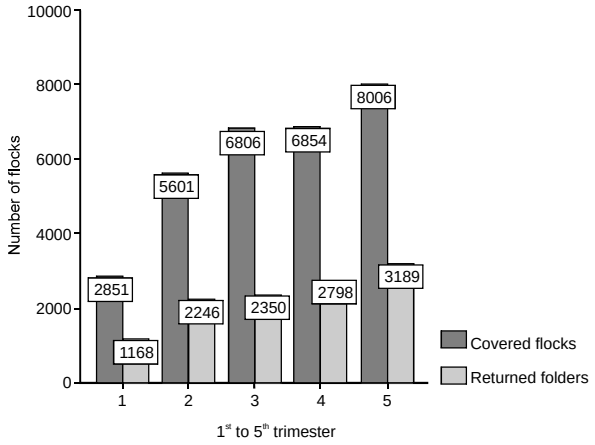


Figure 3: Distribution of mortalities during consecutive trimesters of the study.

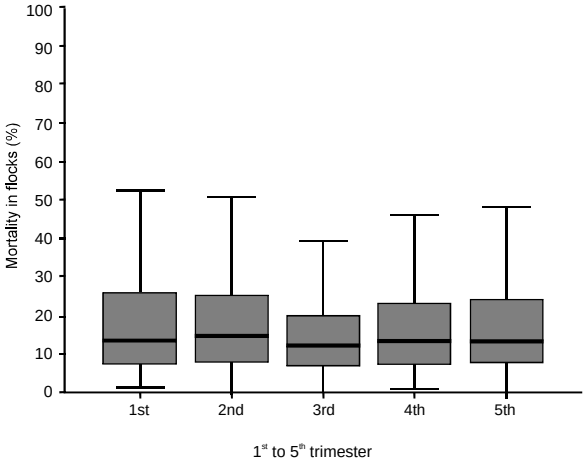
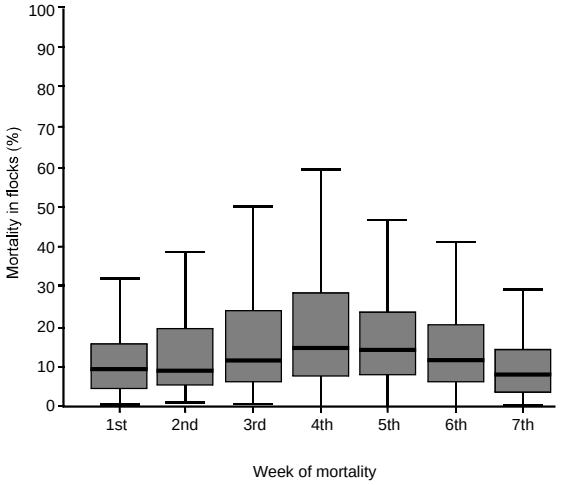


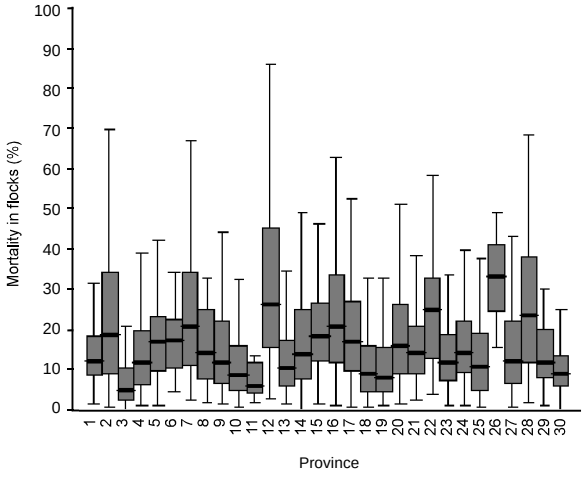
Figure 4 shows the distribution of mortality prevalence in different ages. A one-way ANOVA of the mean mortality incidence in different flocks showed higher mortality rates in chicks aged between the third and the sixth week of life (P= 0.001).

Figure 4: Distribution of mortalities during consecutive ages of the chickens.



Since no data were available for the number of broilers from different provinces, it was impossible to analyze the prevalence of mortality in these regions. To assess the burden of mortality in different provinces we compared the number of returned folders for each province, and the distribution of mortalities of different flocks in each province (shown in Figure 5).

Figure 5: Distribution of mortalities in different provinces of Iran, (1) Azarbaijan, East, (2) Azarbaijan, West, (3) Ardabil, (4) Isfahan, (5) Ilam, (6) Bushehr, (7) Tehran, (8) Chahar Mahaal and Bakhtiari, (9) Khorasan, South, (10) Khorasan, Razavi, (11) Khorasan, North, (12) Khuzestan, (13) Zanjan, (14) Semnan, (15) Sistan and Baluchistan, (16) Fars, (17) Qazvin, (18) Qom, (19) Kurdistan, (20) Kerman, (21) Kermanshah, (22) Kohkiluyeh and Buyer Ahmad, (23) Golestan, (24) Lorestan, (25) Markazi, (26) Hormozgan, (27) Hamadan, (28) Yazd, (29) Gilan and (30) Mazandaran.



One-way ANOVA revealed that in some provinces, such as Hormozgan, the mortality rates in flocks were significantly higher than in others provinces ($p = 0.001$). According to post-hoc analysis (Tukey's test) the provinces shown in Table 1exhibited the highest frequency of broiler mortality per flock.

The nine most common concurrent infections that were reported in the returned folders are shown in Table 2.

The most common diseases in different age groups of broilers are summarized in Table 3.

The distribution of the most common diseases in different provinces of Iran and the incidence of mortality due to the five most common diseases are shown in Tables 4 and 5, respectively.

Figure 6 shows overall mortality rate across the country for the top five diseases that caused increased mortality rates. One-way ANOVA and post-hoc analysis (Tukey's test) showed that avian influenza (AI; H9N2) with a mean mortality rate of 26.1%, followed by infectious bronchitis (IB) (mean mortality rate 22.1%), caused the highest rates of mortality that were statistically different from other three most common diseases with mortality rates of approximately 13% ($P= 0.001$).

Table 1: The provinces with the highest frequency of broiler mortality per flocks.

Province	Mortality rate		Mortality rate(%)
	Mean	Standard deviation (SD)	
Khuzestan	0.3695	0.5	36.95
Hormozgan	0.3254	0.1	32.54
Yazd	0.2652	0.2	26.52
Kohgiluyeh & Buyer Ahmad	0.2642	0.1	26.42
Azarbaijan, West	0.2482	0.2	24.82
Fars	0.2436	0.2	24.36
Tehran	0.2435	0.1	24.35
Kerman	0.2200	0.3	22.00

Table 2: The nine most common concurrent infections.

Mixed Infections		Number of folders*
IB	IBD	617
CRD	Colibacillosis	564
CRD	IBD	535
CRD	IB	331
IBD	Colibacillosis	243
IB	Colibacillosis	210
AI	IB	165
AI	IBD	136
AI	ND	129

*Does not contain other mixed infections.

Table 3: The most common diseases in different age groups (numbers in parentheses show the percentages of diseases in different age groups).

Age	Number of returned folders with reported disease/diseases*					
	Colibacillosis	IB	CRD	IBD	AI	Total
1st week	27 (1.3)	25 (0.80)	20 (0.75)	16 (0.42)	5 (0.34)	86
2nd week	58 (2.84)	51 (1.63)	38 (1.43)	49 (1.30)	13 (0.88)	155
3rd week	126 (6.17)	248 (7.93)	137 (5.16)	197 (5.24)	49 (3.34)	510
4th week	389 (19.09)	645 (2.64)	500 (18.83)	730 (19.43)	217 (14.81)	1764
5th week	743 (36.42)	1248 (39.93)	969 (36.51)	1640 (43.66)	529 (36.10)	3604
6th week	540 (26.47)	758 (24.25)	766 (28.86)	946 (25.18)	498 (33.99)	2568
7th week	157 (7.69)	150 (4.80)	224 (8.44)	178 (4.73)	154 (10.51)	690

* In cases of combined etiologies, the number of each combination was added to each parts of that combination separately.

Discussion

The results of this study showed an overall mortality rate of approximately 8% in broiler farms in Iran. To the best of our knowledge, there is no previously published literature concerning the rate of broiler mortality in Iran and neighboring countries except for Pakistan. The broiler mortality rate in Pakistan has been reported to range between 6 and 13% (Naveed *et al*., 1999; Zahir-ud-Din *et al*., 2001).

According to the literature, mortality rates of more than 10% usually involve disease outbreaks (Delgado *et al*., 2003). The 8% estimated mortality rate in Iran is between the 4% natural mortality rate (Chou *et al*., 2004; Heier *et al*., 2002; Tabler *et al*., 2004) and the 10% limit for mortality due to disease outbreak. As our data was gathered from flocks with different causes of mortality, including disease outbreaks and rarer risks such as fire, the higher rate of mortality compared to the

Table 4: Most common diseases in different provinces (numbers in parentheses show the percentage of diseases in different provinces)

Province	Number of returned folders with reported disease/diseases*					
	Colibacillosis	IB	CRD	IBD	AI	Sum
Azarbaijan, East	39 (1.87)	53 (1.66)	47 (1.73)	84 (2.18)	7 (0.47)	215
Azarbaijan, West	401 (19.27)	231 (7.23)	414 (15.27)	209 (5.43)	45 (3.03)	843
Ardebil	31 (1.49)	28(0.87)	54 (1.99)	64 (1.66)	-	142
Isfahan	68 (3.26)	222 (6.95)	130 (4.79)	407 (10.58)	217 (14.62)	765
Ilam	-	78 (2.44)	122 (4.50)	72 (1.87)	2 (0.13)	221
Bushehr	19 (0.91)	17 (0.53)	16 (0.59)	8 (0.20)	-	48
Tehran	105 (5.04)	284 (8.89)	128 (4.72)	213 (5.54)	87 (5.86)	451
Chahar Mahal & Bakhtiari	51 (2.45)	47 (1.47)	26 (0.95)	21 (0.54)	8 (0.53)	90
Khorasan, South	129 (6.20)	5 (0.15)	103 (3.80)	66 (1.71)	135 (9.09)	284
Khorasan, Razavi	192 (9.23)	49 (1.53)	145 (5.35)	238 (6.19)	235 (15.83)	705
Khorasan, North	6 (0.28)	7 (0.21)	6 (0.22)	11 (0.28)	2 (0.13)	24
Khuzestan	46 (2.21)	-	20 (0.73)	62 (1.61)	75 (5.05)	148
Zanjan	45 (2.16)	26 (0.81)	16 (0.59)	17 (0.44)	19 (1.28)	96
Semnan	64 (3.07)	228 (7.14)	119 (4.39)	153 (3.98)	39 (2.62)	457
Sistan & Baluchistan	19 (0.91)	20 (0.62)	89 (3.28)	-	12 (0.80)	136
Fars	27 (1.29)	155 (4.85)	77 (2.84)	77 (2.00)	20 (1.34)	317
Qazvin	71 (3.41)	401 (12.56)	98 (3.61)	239 (6.21)	61 (4.11)	711
Qom	146 (7.01)	416 (13.03)	53 (1.95)	280 (7.28)	101 (6.80)	641
Kurdistan	16 (0.76)	34 (1.06)	30 (1.10)	35 (0.91)	3 (0.20)	97
Kerman	99 (4.75)	95 (2.97)	79 (2.91)	79 (2.05)	20 (1.34)	253
Kermanshah	46 (2.21)	146 (4.57)	204 (7.52)	211 (5.48)	17(1.14)	467
Kohgiluyeh & Buyer Ahmad	15 (0.72)	9 (0.28)	26 (0.95)	33 (0.85)	21 (1.41)	83
Golestan	22 (1.05)	-	30 (1.10)	119 (3.09)	-	143
Lorestan	121 (5.81)	221 (6.92)	235 (8.67)	210 (5.46)	33 (2.22)	470
Markazi	92 (4.42)	154 (4.82)	26 (0.95)	226 (5.87)	135 (9.09)	420
Hormozgan	4 (0.19)	-	7 (0.25)	1 (0.02)	-	11
Hamadan	60 (2.88)	102 (3.19)	72 (2.65)	151 (3.92)	34 (2.29)	349
Yazd	75 (3.60)	61 (1.91)	70 (2.58)	63 (1.63)	155 (10.44)	329
Gilan	25 (1.20)	-	21 (0.77)	35 (0.91)	-	57
Mazandaran	46 (2.21)	103 (3.22)	247 (9.11)	460 (11.96)	1 (0.06)	607

* In cases of combined etiologies the number of each combination was added to each parts of that combination separately.

Table 5: Mortality according to different diseases*

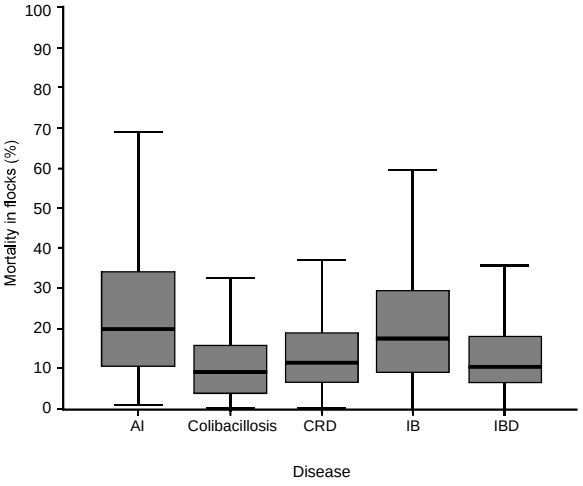
Disease	Number of broilers exposed to the disease	Number of dead broilers	Disease prevalence in exposed broilers	Prevalence among total covered Broilers (n = 439,188,406)
AI	11,227,560	2,575,632	22.9%	0.59%
IB	26,805,103	5,243,958	19.6%	1.19%
IBD	29,799,860	3,919,817	13.2%	0.89%
CRD	11,918,327	1,497,215	12.6%	0.34%
Colibacillosis	8,004,826	848,112	10.6%	0.19%

* Data relate to mortality due to a single disease, and not its combination with other diseases/causes.

4% mortality rate in a natural production cycle would be predictable.

Another important parameter in the analysis of mortality in avian flocks is the age at the point of death. In this study mortality rates during the third to sixth weeks of chicks' age were high. Tabler *et al*. (2004) and Xin *et al*. (1994) showed that broiler mortality usually peaks at approximately 3 to 4 d after placement, declines until approximately day 9 or 10 and then stabilizes until approximately day 30. After day 30, a gradual increase is seen until approximately day 40 to 45. After day 45, mortality rates increase until the harvest. The data presented in the above mentioned papers (Tabler *et al*., 2004; Xin *et al*., 1994) are related to natural death. In this study, the reported mortality rates are only due to disease outbreaks.

Figure 6: Mortality rates due to different diseases.



The most common diseases in broiler flocks in Iran were (in descending order) infectious bursal disease (IBD), infectious bronchitis (IB), chronic respiratory disease (CRD), colibacillosis and avian influenza (AI; H9N2), respectively. IBD virus (IBDV) is resistant to a variety of disinfectants and is environmentally very stable, which accounts for its persistent survival and ubiquity in poultry houses (Saif, 1998). The persistent

survival of IBDV in poultry houses even after thorough cleaning and disinfection procedures is thought to be the major reason for IBD infection of chickens in their early stages of life (Lukert and Saif, 2003).

Although the obvious losses through morbidity and mortality are not noted in subclinical infections by IBDV, the immunosuppressive effects on the humoral immune system may be equally as great as in a clinical form of disease. This immunosuppression is primarily related to the destruction of precursor lymphocytes in the bursa of Fabricius and the degree of immunosuppression is directly related to the age at which the damage occurs, with birds less than three weeks old being at greatest risk (Armstrong *et al*., 1981). Moreover, Rosenberger *et al*. (1975) described the phenomenon of "problem progeny" flocks with abnormally high mortality rates, which were related to the immunosuppressive effects of subclinical IBDV damage to bursae. In another study, Hirai *et al*. (1974) demonstrated decreased humoral antibody response to other vaccines as well. They also showed that young chicks infected with IBDV were more susceptible to inclusion body hepatitis, coccidiosis, Marek's disease, hemorrhagic-aplastic anemia, gangrenous dermatitis, infectious laryngotracheitis, infectious bronchitis, chicken anemia agent, salmonellosis, and colibacillosis. These findings might explain why chickens infected early with IBDV become infected more frequently with various diseases after three weeks of age (Lukert and Saif, 2003).

The present study revealed that IBD was the most common disease in broiler farms in Iran. The fact that all the flocks that were infected with IBD were previously vaccinated shows that in most cases vaccination could not protect the birds. According to Godwin (2001), the following factors affect the performance of a vaccine: 1) vaccine type, storage and handing; 2) the condition of the bird including the level of maternal antibody; and 3) the administration of a vaccine. Further research will be conducted to determine the exact causes of vaccination failure and to identify a potent vaccine to protect the animals from this disease.

In the case of IBD, chicks between three and six weeks old have the highest susceptibility to clinical disease. Those below three weeks of age do not exhibit clinical signs but have subclinical infections that are economically important as a result of histopathological lesions in the bursa (Lukert and Saif, 2003). IB is most severe in young chicks but all ages are susceptible (Cavanagh and Naqi, 2003). CRD is more prevalent in broilers between four to eight weeks of age (David, 2003). Colibacillosis usually infect birds between two and 12 weeks old, with most losses occurring in broilers at the age of around four to nine weeks (Wray and Davies, 2002). Previous studies from Iran showed that AI (H9N2) outbreaks in broilers occurred between three and seven weeks of age (Nilli and Asasi, 2002, 2003). In this study, we evaluated the mortality rate which is a manifestation of clinical diseases. Therefore, our findings that most of the mortalities occur at the age of four to six weeks in chicks are in accordance with the literature (Cavanagh and Naqi, 2003; David, 2003; Lukert and Saif, 2003; Nilli and Asasi, 2002, 2003; Wray and Davies, 2002).

According to the results of this study, higher mortality rates were observed in the southern provinces of Iran. In a FAO report from Thailand (Delgado *et al*., 2003) it has been argued that animal welfare issues should be considered to reduce mortality rates. Because of the high mortality rates in the southern regions, this factor may be less effective. The outbreaks are often related, at least partially, to farm mismanagement (Delgado *et al*., 2003). In countries where labor cost is high or where broiler workers are scarce, some farms would maximize their profit by employing small numbers of workers per animal, which would result in relatively high mortality rates (Delgado *et al*., 2003; Zahir-ud-Din *et al*., 2001). It should be mentioned that smaller farms had higher mortality rates compared to very large farms (>20,000 birds). For the latter, almost 75% of the farms had a mortality rate below 5% and none of them had a rate over 10%. It is likely that the enlargement process of farms would result in better management protocols that probably improve animal welfare and decrease mortality rates as well (Delgado *et al*., 2003). Therefore, higher mortality rates in southern provinces which have smaller sized farms with limited facilities and different geographical and weather conditions could be predicted. In addition, different outbreaks in different regions might be the cause of mortality differences between regions (Delgado *et al*., 2003). It has been shown that longer transport distances and transportation in summer and winter months lead to an increase in death losses among broilers transported to processing plants not only during the first days but also during the entire life (Vecerek *et al*., 2006). This may be another cause of higher mortality in southern provinces; however, the type of diseases as the main cause of death may also be another important factor.

The province of Tehran with densely crowded farms also showed higher mortalities. Short distances between different farms may cause disease dissemination from one to another and higher mortality rates, in addition to a lack of effective management. Provinces with a higher distribution of rural and immigrant avian (e.g., Western Azarbaijan) may also be more harmed by disease outbreaks.

Conclusions

This is the first study to report on the mortality rates of broiler chickens in industrial farms in Iran. Due

to the large sample size of the coverage, results of this study can be considered as an accurate estimation of poultry disease distribution in Iran. This study showed different distributions of diseases in different regions of Iran, which are potentially related to regional differences in conditions and management parameters.

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