Duck numbers and duck hunting in southern Alberta, 1975–82, and their implications for waterfowl management

by H. Boyd* and F.G. Cooch†

Abstract

From 1975 to 1982, southern Alberta’s estimated May population of ducks fell from 6.5 to 3.6 million, a mean rate of -5.6% annually. Mallard declined more steeply, from 1.4 million to just under 800,000 (-7.4% annually). In the same period, the July index of the US Fish and Wildlife Service (USFWS) for breeding production of all ducks fell from 160.0 to 40.6 (-80.0% annually), while mean brood size fell from 4.6 to 3.8, the lowest yet reported. The late nesting index also fell, from 117.2 to 28.5 for all ducks, and from 30.8 to 7.5 for Mallard. Meanwhile, in 1975–81, estimates of successful duck hunters in southern Alberta fell from 22,400 to 15,700 (-6.4% annually), and to 14,300 in 1982, a further -9.0%. The reported kill of ducks fell from 299,000 to 201,000 (-7.9% annually) and of Mallard from 153,000 to 138,000 (-4.6% annually). The reported kill of all ducks in 1982 was 139,000, including 96,000 Mallard.

Most of the decline in duck numbers and production can be attributed to unfavourable habitat conditions, which are persisting, but the impact of local hunting is also serious under such poor conditions. Any substantial increase in the permitted Alberta kill would put severe pressure on the USFWS to abandon its efforts to hold down the US kill through the 5-year stabilization program for the Pacific and Central flyways.

Introduction

Duck numbers in the prairies show large fluctuations, principally in response to varying amounts of precipitation, especially snowfall, and consequent variations in the numbers and biological productivity of potholes and other small water bodies, and in lake levels. In the last half-century, drainage of wetlands for agriculture or urban and industrial development has been added to this long-term cycle, and has been especially intense in the last decade with the advent of larger machines both for cultivation and for clearing and draining land. Thus we need to look especially closely at the size and success of prairie duck populations in this period of high potential stress.

A second reason for concern, less fundamental in ecological terms but of considerable tactical importance in the context of North America waterfowl management, relates to the current experiment in which the USA and Canada have agreed to leave waterfowl hunting regulations unchanged for at least 5 years, while monitoring duck populations and duck harvests more intensively than

before. This is expected to provide a better understanding of the roles of hunting and other factors in regulating duck populations, and hence to improve the international approach to their exploitation. Some hunting organizations in parts of both countries have become increasingly critical of this “program of minimal change”, for quite different reasons. Some groups argue that their hunting opportunities are being unnecessarily restricted and that seasons should be lengthened or bag limits increased at once in their regions, whatever may be happening elsewhere. Others fear that the current regulations are dangerously permissive at a time when prairie conditions are unfavourable for ducks, and argue that serious long-term damage to duck stocks must be prevented by abandoning “no change” in favour of further restrictions on hunting, so as to allow increased numbers of ducks to return to potential breeding places. To proponents of both arguments, allowing the 5-year program to run until 1984 before deciding on future directions is a reprehensible example of bureaucrats giving more weight to their own interests than to those of the hunting constituency or of the ducks themselves.

The decision to persist with the current program or to deviate from it in one direction or the other therefore must be justified afloat before Canada and the USA promulgate waterfowl hunting regulations for 1984. This progress note originated in a contribution to the 1983 review process. It highlights events in southern Alberta, where recent reductions in duck numbers and breeding success, and in the activity and success of duck hunters, have been exceptionally large.

We have obtained the data from routine surveys — the USFWS/CWS surveys of waterfowl breeding numbers in May and production in July, the CWS National Harvest Surveys (NHS) based on sales of migratory game bird hunting permits (MGBH permits), and the recoveries of ducks banded pre-season in western Canada and adjacent states. No novel methods of analysis were employed. Many interested people have reservations about the reliability and usefulness of these large-scale surveys, which are not intended to be precise measures. However, we see no reason to suppose that any changes occurring in the surveys’ effectiveness would have caused the downward trends in duck numbers and kill revealed in this report.

We have used 1975–82 in analysing population changes, so as to give a sufficient run of years to detect current trends without being led astray by erratic year-to-year variations; 1975 was a good year for prairie ducks, but by no means an exceptional one. For Canadian harvest data, the period of analysis is 1975–81; the results for 1982 not being available at time of preparation.

The principal questions we address are:

(1) How have numbers of breeding ducks in southern
Alberta changed since 1975, and in relation to changes in other areas sampled in Canada and the USA.

(2) How has duck hunting effort and the reported kill of ducks changed since 1975 in southern Alberta and adjacent states and provinces?

(3) How far is it possible to account for the observed changes in duck numbers in southern Alberta since 1975 in terms of production, local, kill, distant, and local habitat conditions?

(4) What predictions can be made about the likely numbers of breeding ducks in southern Alberta in May 1983 and in later years?

(5) What effect on the kill of ducks in southern Alberta in 1983 might result from advancing the opening of the duck season to 5 September?

Results: Duck populations and production

Numbers of ducks in southern Alberta in May

Table 1

<table>
<thead>
<tr>
<th>Species</th>
<th>Mean</th>
<th>SE</th>
<th>Trend (% pa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mallard (A. platyrhynchos)</td>
<td>1024</td>
<td>259.3</td>
<td>7.5</td>
</tr>
<tr>
<td>Gadwall (A. strepera)</td>
<td>314</td>
<td>52.6</td>
<td>-3.6</td>
</tr>
<tr>
<td>American Wigeon (A. americana)</td>
<td>303</td>
<td>97.8</td>
<td></td>
</tr>
<tr>
<td>Green-winged Teal (A. crecca)</td>
<td>244</td>
<td>62.1</td>
<td>-6.5</td>
</tr>
<tr>
<td>Blue-winged Teal (A. discors)</td>
<td>770</td>
<td>278.7</td>
<td></td>
</tr>
<tr>
<td>Shoveler (A. clypeata)</td>
<td>390</td>
<td>103.4</td>
<td></td>
</tr>
<tr>
<td>Pintail (A. acuta)</td>
<td>943</td>
<td>427.7</td>
<td></td>
</tr>
<tr>
<td>Total dabblers</td>
<td>3991</td>
<td>912.3</td>
<td>5.9</td>
</tr>
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</table>

Table 2

<table>
<thead>
<tr>
<th>Species</th>
<th>Mean</th>
<th>SE</th>
<th>Trend (% pa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redhead (A. americana)</td>
<td>127</td>
<td>108.9</td>
<td>-8.0</td>
</tr>
<tr>
<td>Canvasback (A. valentinius)</td>
<td>82</td>
<td>26.2</td>
<td>-</td>
</tr>
<tr>
<td>Lesser Scapu (A. afnsis)</td>
<td>521</td>
<td>105.9</td>
<td>-</td>
</tr>
<tr>
<td>Ring-necked Duck (A. collaris)</td>
<td>8</td>
<td>4.0</td>
<td></td>
</tr>
<tr>
<td>Total pochards</td>
<td>783</td>
<td>177.4</td>
<td></td>
</tr>
</tbody>
</table>

American Goldeneye (Bucephala clangula) 18 13.9 -
Bufflehead (B. albohias) 46 11.6 -
White-winged Scoters (Melanitta undulata) 22 12.1 -
Common Merganser (Mergus merganser) 7 4.3 -
Ruddy Duck (Oxyura jamaicensis) 85 52.0 -16.4

Among the diving ducks, the variability of the annual estimates, as indicated by the coefficient of variation (CV), was inversely proportional to population size ($r = -0.553$). For the dabblers, the relationship between size and variability was direct ($r = 0.511$), reflecting the tendril-like distribution in southern Alberta since 1975, and in relation to changes in the Canadian and US prairie regions as a whole.

Duck production in southern Alberta

Although we can convert the number of ducks seen in May to estimates of thepopulation of each species, allowing for differences in their detectability as measured by air-ground comparisons, this cannot be achieved in estimating production. The proportion of broods seen at all is much less than that of the adults in May, and many of the broods cannot be identified by species.

The number of broods seen in 1975 extrapolates to 122,300 for southern Alberta as a whole; the correspond ing figure in 1982 was only 21,200. The highest estimates were from March 1975 ($r = 0.43$) and 1979 ($r = 0.44$ million respectively), well below the 6.54 million of 1975. Despite that short-lived boom, the boom in duck numbers peaked at 1.14 million ($r = 0.56$, Table 3). The mean size of Class II and III broods was 4.8 $\pm$ 0.6, range 3.8 (1982) to 5.7 (1975). Although the 1982 broods were the smallest, the tendency for broods to decrease over the period as a whole was not statistically significant ($r = 0.401$, $p<0.10$)

Changes in the numbers of single and paired adults seen in July, which are used as an indication of how many ducks may still be attempting to breed, are remark able for their unanimous downward trend (Fig. 3), which falls short of the conventional level of signifi cance (for $n = 8$, $p = 0.05$, $r = 0.632$) only for pronghorn ($r = 0.583$, $p<0.01$), Merganser ($r = 0.061$, $p<0.10$), and Ruddy Duck ($r = 0.423$). The total decline in potential late nest ers is dramatic, from 160,000 in 1975 to 40,800 in 1982, a drop of nearly 75%.

We can produce a combined production index by cal culating $P = (B + L)/3$, where $B$ is the brood index and $L$ the late-nesting index. The true form of the relationship of $B$ to $L$ is not known, but in most years the output of young from first broods is likely to exceed that from last broods. Figure 3 shows that the unadjusted values of $B$ and $L$ are closely correlated ($r = 0.821$, $p<0.001$); the correlation remains after the removal of the late-nesting index. The true form of the relationship is $B = 1.18L - 0.265L^2$. (A. collaria)

Blue-winged Teal 18.7 9.6 -17.3
Green-winged Teal 7.2 3.8 -18.6
Blue-winged Teal 6.7 3.4 -15.1
Shoveler 11.6 9.3 -19.9
Shoveler 6.5 4.7 -21.7
Pintail 7.2 4.9 -18.4
Lesser Scapa 65.8 36.0 -15.3
Ring-necked Duck 21.8 14.7 -20.6
Lesser Scapa 6.0 4.7 -17.3
Total ducks 96.5 52.5 -18.0

Figure 4 shows that production fell more steeply than breeding numbers, although the two were positively correlated ($r = 0.70$, $p<0.05$).

Because of the apparent collapse in production in 1982, we extended the review of Duck hunting and duck production back to 1965. Figure 5 illustrates the following points: (1) the drop in duck numbers since 1974 has been more than compensated for by a much lower for duck hunting. The 22.7% of duck hunters who said they would not add significantly to the bulk of this report.

Duck hunting and duck kill in southern Alberta

Students" activities' average across all the surveys, in CWS zone 09, 01, which is nearly equivalent in ext ension to provincial bird game zones 5, 6, and 7. Side by side with the review of Duck hunting and duck production back to 1965. Figure 5 illustrates the following points: (1) the drop in duck numbers since 1974 has been more than compensated for by a much lower for duck hunting. The 22.7% of duck hunters who said they would not add significantly to the bulk of this report.
Activity and kill are assumed to cease at the end of November, although the open season continues into December.

Table 3
Reported duck hunting activity and duck kill (in thousands) by months within seasons, 1975-81, in relation to numbers of days during which waterfowl hunting was not permitted in southern Alberta. We obtained the adjusted kill from the NHS estimates of local kill multiplied by 1.1 x 1.25 = 1.375. The addition of 10% allows for unreported kill, i.e. that by Indians, who are not required to possess MGBH permits, and who are consequently not sampled by the NHS, and that of other hunters acting illegally, such as those hunting during the closed season or in excess of the daily bag limit. We allow a further 25% for birds hit and not retrieved, but dying from their wounds. Both these adjustments are arbitrary. There are undoubtedly local and seasonal variations in such factors but detailed records do not exist, except from intensive studies in small areas, whose representativeness can always be questioned. The point of a standard upward adjustment of the kill is to avoid underestimating the scale of local losses.

The estimates of net production (Fig. 10) are dominated by the major decreases in Saskatchewan and Alberta. They also show that net output probably fell everywhere from 1975 to 1981, except in the Mackenzie Valley, NWT. The estimates of adjusted kill in Figure 11 are also dominated by declines in Saskatchewan and Alberta, with the latter markedly less steep (at a mean rate of -2.5% compared with -5.1% in Saskatchewan).

In this section, we examine the relative impact of local hunting on different western groups of Mallard by comparing "net Polduction" ($P'$) with the local kill ($K$).

$P' = M - FN - FN + M'

where $M$ is the number of adults in May and $F_N$, the "net fall flight", = 0.9 M (1 + $P$). We use the factor 0.9 to reduce the May population by an estimate of adult mortality during the period May-August; with no detailed estimates available, the use of this uniform figure is arbitrary. $P'$ is a production index obtained from the monthly production surveys but from the kill in the province or state of interest. $P' = E/A$, where $E/A$ is the ratio of young to adult Mallard wings in the provincial sample of the Species Composition Survey (SCS). $V$, the vulnerability quotient, is given by $V = (R_A / R_B) / (R_A / R_B)$ where $R_A$ and $R_B$ are the number of adult and young Mallard respectively banded in that province in July-September ("pre-season") and $R_A$ and $R_B$ are the reported direct (in first season) recoveries from that province. $V$ vary from place to place and year to year, due to the vagaries of sampling and to biological variability. The provincial and state values of $M$ and $E/A$, are listed in Table 4.

In Figure 7, we allocate the reported hunting effort and kill by month. "November" is shorthand for "rest of the hunting season", which legally remained open until 31 December, but in practice probably ended well before 30 November. The way in which late-season data are aggregated by the retrieval programs prevents study of how hunting pressure may have declined to the departure of the ducks and the onset of cold weather. The interesting point made by Figure 7 is that the mean rates of decline in effort and kill were greater in October than in September: September hunter-days = -4.9%, Kill October-September -- days kill -6.9%; October hunter-days -- 5.3%, kill -8.4%.

There is more hunting in October than in September, chiefly because there are more open days; the mid-September opening date allows only 11-15 hunting days in that month, compared with 26 or 27 in October (depending on the number of Sundays in the month). In Figure 8, averages for 1975 and 1976 show about 3500 active hunters in CWS zone 09 each day in September, compared with more than 3000 daily in October. By 1980 and 1981, the corresponding numbers were down to 2800 in September and 2900 in October. Successful hunters took more ducks per day in September (mean 1.59) than in October (1.33), the average number declining by -2.3% in October but less, if at all, in September (2.1% but more 0.418, not significant at the 10% level).

The kill in the southern provincial hunting zones is shown in Figure 9. The rate of decrease was greater in zones 3 and 6, from Stettler and Drumheller east to the Saskatchewan border, than in the much larger zone 7, making up the remainder of the south, and including Calgary, Lethbridge, and Medicine Hat.

Mallard populations, production, and kill in Alberta and adjacent provinces and states, 1975-81

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Some striking changes in the local vulnerability quan-
tity, $V_1$ (Fig. 15), while that calculated from all direct 
recoveries had fluctuated at 0.67. Figure 13 suggests, the 
size of the local fluctuations is due mostly to changes in 
the local direct recovery rate of young birds.

The changes in local direct recovery rates in 1975-81 were not associated with changes in net production or in 
kill. Nor, though the point will not be pursued in this paper, were they related to the estimated survival of 
Mallard in Alberta or elsewhere in Canada (Boyd, in prep.). Thus, despite their striking nature, they may reflect 
nothing more significant than a loss of local interest in 
reporting recoveries. As the result of a plain increase in 
effort, many more Mallard were banded annually in 
Alberta in 1975-81 (annual average 6000) than in most 
previous years (average 1962-68, 2200; 1969-74, 3100). There have been many instances in different parts of 
the world of a decline in local reporting associated with 
increased banded samples as well as with long-conti-
nuous banding operations.

On the basis of direct recoveries per 1000 banded, 12.0
tons Mallard banded in Alberta were reported shot there 
with compared with only 0.39 marked in surrounding areas, 
so that only 3.1% of the Mallard killed were to be 
found outside the province immediately prior to the 
first hunting season.

A very different impression is given by the indirect 
recoveries (Table 5), which are far more numerous. It 
is improbable to express these accurately in terms of 
the numbers of banded ducks at risk in 1975 or in 1981. 
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At the annual survival rates
found in the study, though these are not functional relationships in a strict sense, enabling us to make conditional forecasts in the form "if there are 3.5 million ducks in southern Alberta in May, the production index will be 49". We use point, rather than interval, forecasts, in both 1982 and 1983 are lower on the basis of the relationship between kill and effort than are the extrapolated values. The predicted late-nesting indices look more plausible, because less extreme. The number of broods predicted to be seen is 3.5 million greater than the local kill is falling. In such circumstances, it would surely be misguided to pursue the objective of relaxing regulations so as to increase the kill, unless the manager and the critics might be satisfied with more hunting for less return.

References

Table 6

<table>
<thead>
<tr>
<th>Ducks</th>
<th>Mean 1975-81</th>
<th>Forecast 1982</th>
<th>% change from 1982</th>
<th>Reported 1983</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mallard in May</td>
<td>NT 5 170</td>
<td>3 560</td>
<td>-3.1</td>
<td>3 450</td>
</tr>
<tr>
<td>Mallard in May</td>
<td>NM 1 060</td>
<td>776</td>
<td>-21.4</td>
<td>610</td>
</tr>
<tr>
<td>July production indices</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Duck broods seen</td>
<td>B 95.7</td>
<td>21.2</td>
<td>+34.9</td>
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<tr>
<td>Mean brood size</td>
<td>\bar{B} 4.9</td>
<td>3.8</td>
<td>+15.8</td>
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<tr>
<td>Late nesting index, total ducks</td>
<td>LN 104.5</td>
<td>40.6</td>
<td>+97.8</td>
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<tr>
<td>Late nesting index, Mallard</td>
<td>\bar{LN} 20.3</td>
<td>7.5</td>
<td>-88.0</td>
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<tr>
<td>Production index</td>
<td>P 110</td>
<td>51</td>
<td>+122.6</td>
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Table 7
Forecasts (in thousands) of (a) duck production in southern Alberta in 1983 and (b) the kill of ducks in the autumn of 1983 based on empirical relationships between duck numbers and production in 1975-82 and between duck kill and hunting activity in 1975-81.

| Duck broods | \bar{B} = 0.025X-39.94 | 47.8 | +125.5 |
| Late-nesting Anas | \bar{L}_A = 0.023X-60.86 | 51.9 | +11.9 |
| Mallard | \bar{LM} = 0.031X-13.42 | 7.7 | +2.7 |
| Diver | \bar{LD} = 0.862X-54.16 | 14.9 | +23.1 |
| Total ducks | \bar{LN} = 0.030X-158.33 | 29.4 | -37.6 |
| Production index | \bar{P} = 57 | 57 | +83.9 |
| Kill of ducks | | | | |
| Total ducks | \bar{K} = 1.749HD-62.54 | 148.4 | +132.4 |
| Mallard | \bar{K}_M = 20.48 + 0.7140 | 106.1 | 99.7 |

References

Table 5
Recoveries in Alberta, 1975-81, of Mallard banded in adjacent provinces and states

<table>
<thead>
<tr>
<th>Province</th>
<th>No. banded</th>
<th>Direct no.</th>
<th>Recoveries per 1000 banded*</th>
<th>1976-78</th>
<th>1979-81</th>
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<tr>
<td>NWT</td>
<td>5 635</td>
<td>14</td>
<td>2.48</td>
<td>15</td>
<td>2.19</td>
</tr>
<tr>
<td>BC</td>
<td>722</td>
<td>0</td>
<td></td>
<td>8</td>
<td>7.1</td>
</tr>
<tr>
<td>Sask.</td>
<td>69 822</td>
<td>64</td>
<td>0.92</td>
<td>167</td>
<td>3.55</td>
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<tr>
<td>Man.</td>
<td>70 266</td>
<td>0</td>
<td></td>
<td>46</td>
<td>0.75</td>
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<tr>
<td>Ont.</td>
<td>30 959</td>
<td>0</td>
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<td>19</td>
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<tr>
<td>Montana</td>
<td>4 286</td>
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<td>0.70</td>
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<td>15 556</td>
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<td>23</td>
<td>1.36</td>
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<tr>
<td>S. Dak.</td>
<td>2 457</td>
<td>1</td>
<td>0.41</td>
<td>58</td>
<td>18.93</td>
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<tr>
<td>Total</td>
<td>207 733</td>
<td>82</td>
<td>0.39</td>
<td>376</td>
<td>1.83</td>
</tr>
</tbody>
</table>

*Approximation assuming all recovered in 2nd and 3rd years after marking.
Figure 1
Estimates (in thousands) of the numbers of ducks in southern Alberta (USFWS strata 26-29) in May 1975-82

Figure 2
Changes in the estimated numbers of ducks (in millions) in southern Alberta in May 1975-82 compared with those in the entire area of western Canada and the northern USA sampled by USFWS aerial surveys.
Figure 3
Indices (in thousands) of duck broods seen and of late nesting pairs in southern Alberta, 1975-82

Figure 4
Duck populations (in thousands) in May and production in July, southern Alberta, 1975-82: (a) indices of breeding ducks ($M'$) and of production ($P'$) standardized so that the period mean of each is 100; (b) correlation of indices of population and production
Figure 5
Indices of duck populations (in thousands) in May ($M'$) and production ($P'$) for southern Alberta, 1965-82, based on mean 1975-82 = 100.

Figure 6
Duck hunting effort and success in southern Alberta (CWS zone 09, 01) 1971-81, with projections to 1983.
Figure 7
Changes (in thousands) in duck hunting activity and reported kill in southern Alberta in September, October, and November 1975-81: (a) reported kill; (b) reported hunter-days

Figure 8
Average numbers of successful duck hunters each day in September and October in southern Alberta, 1975-81, and mean kill per hunter-day
Figure 9
Duck kill (in thousands) reported from southern Alberta provincial bird game zones 5, 6, and 7, 1975-81; data from NHS

Figure 10
Net production of Mallard (in thousands) in western provinces, NWT, Alaska, and north-central USA, 1975-81
Figure 11
Estimates (in thousands) of Mallard kill in Alberta and adjacent provinces and states, 1975-81, adjusted for unreported hunting and crippling losses.

Figure 12
Local kill of Mallards as % of local net production, 1975-81, in Alberta and adjacent areas: linear regressions on years.
Figure 13
Local direct recovery rates (per thousand banded) of Mallard banded pre-season in Alberta, 1965-81

Figure 14
Direct recovery rates (per thousand banded) of Mallard banded pre-season in Alberta and shot outside the province, 1965-81
Vulnerability quotients for young Mallard banded pre-season in Alberta, 1965-81: \( V_L \) = "local quotient"

based on shooting recoveries in Alberta only;

\( V \) \( = \frac{(R_1 / M_1)}{(R_1 / M)} \) is based on all reported direct recoveries of shot, banded Mallard irrespective of locality.