Stems in larger size classes are relatively infrequent, and are generally larger than in Kokatahi and Copland. Over the census period in Taramakau, stems in the smallest size class grew into the next largest size class without compensatory recruitment, while the relative proportions of stems in the largest size classes remained more or less constant.

5.2.3 Decreaser

*Hall's totara (*Podocarpus hallii*) (Fig. 10)*

Hall's totara was a locally important component of the forests in the three Westland study areas. There was a substantial reduction in stem numbers over the census period in all these areas: by 25% in Taramakau and 20% in Copland, both over 14 years, and by 42% in Kokatahi over 23 years.

In all Westland study areas, biomass of Hall's totara declined over time by greater proportions than did stems: by 30% in Taramakau and 44% in Copland, both over 14 years, and by 46% in Kokatahi over 23 years. In all study areas, most plots showed reductions, in many cases substantial (i.e. >60%), in biomass of Hall's totara (Fig. 11). In contrast to Taramakau and Copland, a few plots in Kokatahi showed increases in biomass of Hall's totara; this reflects recruitment of a few small stems into plots in which Hall's totara had previously been rare or absent.

Population size structures were dissimilar among the three areas. In Taramakau, stems were most frequent in an intermediate (25–35 cm dbh) size class, but generally most size classes but the largest had similar frequencies of stems. In Kokatahi, stems were most frequent in the smaller size classes and there were no very large stems. In Copland stems had a bimodal distribution; stems were most frequent in the smallest size class and moderately frequent in intermediate size classes. Trends over time in all sites tended to raise the proportions of stems in the size class that already had the greatest frequency. Proportions of stems in the larger size classes generally declined over time.

5.2.4 Unclassified

*Papaumu (*Griselinia littoralis*) (Fig. 12)*

Papaumu was common in four of the five study areas (all but Orongorongo). No clear trend emerges to fit this species into the above categories. In Kokatahi, biomass of papaumu increased over 23 years, especially in lower altitude plots. In Copland, stem numbers remained more or less unchanged over 14 years, and biomass increased slightly. In Taramakau, biomass declined over 14 years (Appendix 1, Table A1.4), and stem numbers declined at a rate that exceeded 1% compounded per annum. The most dramatic change for this species was in plots in Pohangina, where it declined to extinction from a few medium to large-sized stems at the earliest census, and with no compensatory recruitment of seedlings (Appendix 2, Table A2.1).

In Copland, most plots showed little change in biomass of papaumu (see also Appendix 1, Table A1.7). In Taramakau, changes in biomass of papaumu among plots was quite variable, with plots showing both substantial gains and losses. In Kokatahi, changes in papaumu biomass at a plot level were variable, with some plots having more than 100% increase in biomass, while others lost as much as 80% (most likely to be the result of landslides).

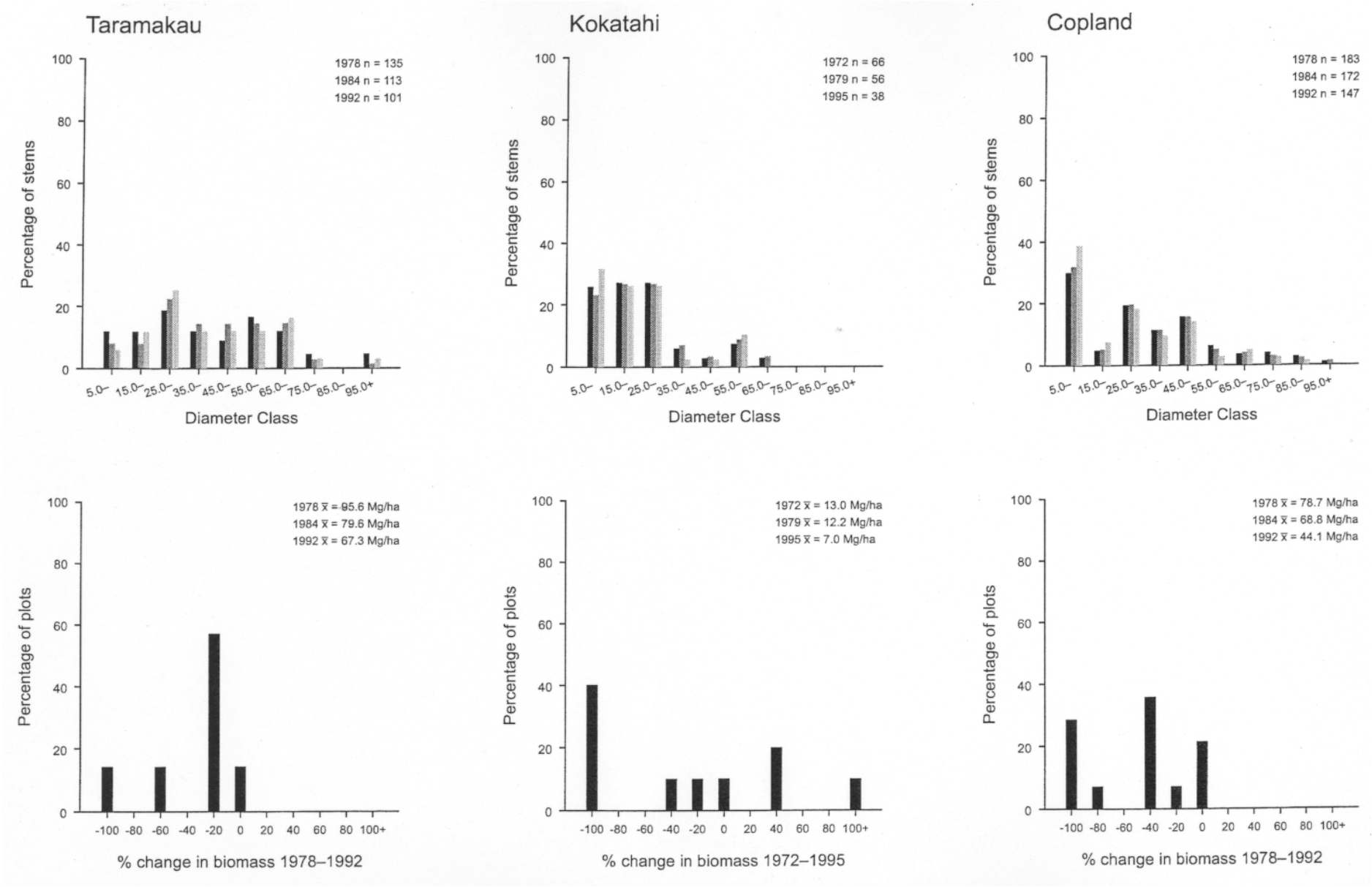

Figure 10. changes over time in stem size-class distribution and in biomass for Hall's totara (*Podocarpus hallii*) in three study areas. The size-class distribution is shown as percentage of stems in 10 cm diameter size-class intervals. Within each size class, bars in the histograms show the earliest census at the left and the most recent census at the right. Total numbers of stems at each census are shown. The percentage of plots exhibiting change in biomass of Hall's totara during the census period are shown in intervals of 20% change in biomass. Total biomass at each census is shown.

class distributions were similar in the three Westland study areas, i.e. a 'reverse J' heavily skewed to smaller stems. In Taramakau there were no large stems. In all three Westland sites there was a change in size class distribution over the census periods to a greater proportion in larger size classes. This reflects an aging population of stems, with recruitment of smaller stems typically occurring by resprouting.

5.3 REGENERATION OF CANOPY TREES

Seedling densities of common woody species were similar among three study areas (Pohangina, Kokatahi, and Copland), but were substantially greater in Taramakau. In contrast, sapling densities of most species in Taramakau were similar to those in Copland, whereas Pohangina and Kokatahi had much higher densities, especially at the more recent censuses (cf. Appendix 2, Tables A2.2 and A2.4 vs. A2.1 and A2.3).

Densities of seedlings remained similar over time for most species in Kokatahi and Copland. In Taramakau, seedling densities of species that were common at the earliest census (kamahi, tawheowheo, and haumakoroa (*Raukaua simplex*)) nearly doubled during the following 14 years. In contrast, in Pohangina seedling densities either remained constant or declined.

Figure 11. Spars of Hall's totara that died between 1979 and 1995. Upper Kokatahi Valley, Hokitika River, Westland, February 1995.

In all study areas, most tree species were represented in the seedling and sapling samples (for a single study area, compare densities of trees, Appendix 1, with those of seedlings and saplings for the same species, Appendix 2). Note, however, that seedlings of southern rata, the dominant canopy tree of Copland, were not recorded on seedling plots. The relative density of seedlings compared with that of trees often differs considerably among species, but this may not reflect the relative survivorship of seedlings of a given species. Sapling density should be a fairer representation of likely recruitment into the tree category, and relative proportions of saplings vs. trees are more similar. Nonetheless saplings of some species are rare relative to trees (e.g. southern rata in all Westland sites), but this probably reflects specific regeneration requirements of these species. Hall's totara, which we class as a 'decreaser' in its tree populations, was represented as seedlings and saplings in all Westland study areas, albeit generally at relatively low densities. Hall's totara was also present in Pohangina as infrequent saplings, in a study area where no trees were recorded in plots.

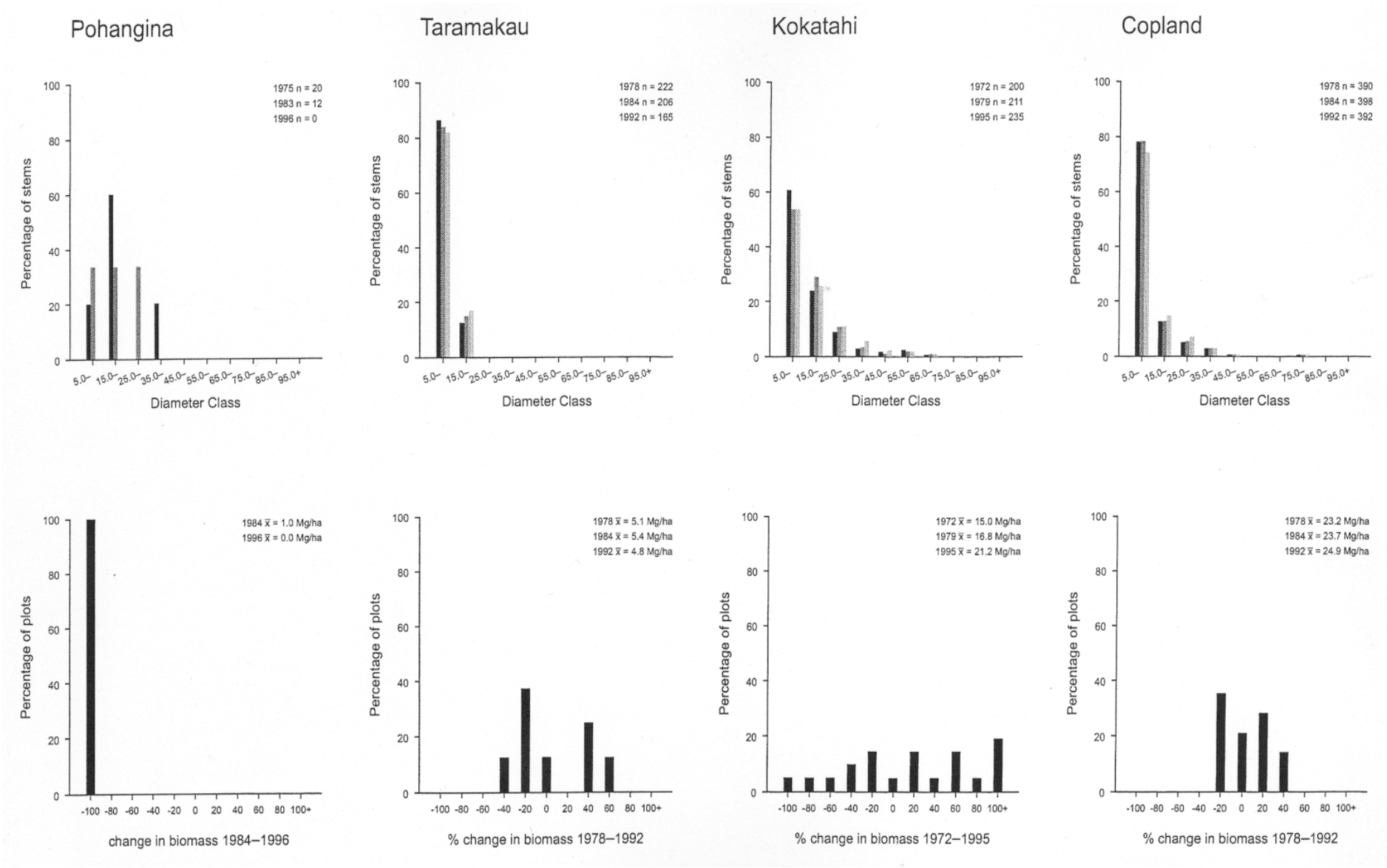

Figure 12. Changes over time in stem size class distribution and in biomass for Papaumu (*Griselinia littoralis*) in four study areas. The size-class distribution is shown as percentage of stems in 10 cm diameter size-class intervals. Within each size class, bars in the histograms show the earliest census at the left and the most recent census at the right. Total numbers of stems at each census are shown. The percentage of plots exhibiting change in biomass of papaumu during the census period are shown, in intervals of 20% change in biomass. Total biomass at each census is shown.

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