

ROBERTO AJASSA (\*), AUGUSTO BIANCOTTI (\*), ALESSANDRO BIASINI (\*\*),  
GERARDO BRANCUCCI (\*), ALBERTO CARTON (\*) & MARIA CRISTINA SALVATORE (\*\*)

## CHANGES IN THE NUMBER AND AREA OF ITALIAN ALPINE GLACIERS BETWEEN 1958 AND 1989

ABSTRACT: AJASSA R., BIANCOTTI A., BIASINI A., BRANCUCCI G., CARTON A. & SALVATORE M.C., *Changes in the number and area of Italian Alpine glaciers between 1958 and 1989*. (IT ISSN 0391-9838, 1997).

A comparison is made between the data for the year 1958 shown in the Register of Italian Glaciers and the updated Survey prepared from aerial photos taken in 1989 and published by the Ministry for the Environment in 1993. Variations in the number (+ 118 units) and area (- 2005 hectares) of the glaciers on the Italian side of the Alps are assessed to determine their relation to slope exposure. The conclusion is drawn that exposure provides the main explanation of the fluctuations in the glaciated areas during these 31 years.

KEY WORDS: Glacier fluctuations, Italian Alps.

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Gli autori prendono in considerazione i dati forniti dal Catasto dei ghiacciai italiani redatto nel 1958 e quelli aggiornati per conto del Ministero dell'Ambiente nel 1993. Viene effettuata un'analisi sulle variazioni numeriche ed areali dei ghiacciai del versante alpino italiano, al fine di individuare le relazioni esistenti tra le variazioni stesse e le esposizioni dei versanti. I dati evidenziano, nei 31 anni di intervallo considerato, differenze sia nella consistenza numerica (+ 118 unità) sia in quella areale (- 2.005 ha). L'esposizione appare il carattere che maggiormente influenza le variazioni delle coperture glaciali.

TERMINI CHIAVE: Variazioni glaciali, Alpi italiane.

### INTRODUCTION

The Italian Glaciological Committee (Cgi) has recently completed a survey of Italian ice bodies on behalf of the Ministry for the Environment (Ajassa & Brancucci, 1993; Ajassa & *alii*, 1994). This survey was based on the «Volo Italia 1988-89» aerial photographic coverage of the coun-

try. Its main purpose was to update the register of Italian Glaciers prepared in 1958 and published by the Italian National Research Center and the Comitato Glaciologico Italiano in 1961.

Use has now been made of the register and the survey, together with the observations in the annual reports of glaciological campaigns conducted by Cgi operators in the Alps, to assess variations in the number and area of the glaciers on the Italian side of the Alps. It should be noted, however, that the superior features of the aerial photographic coverage (Biasini, 1995) have meant that the ensuing survey gave rise to operating standards which are considerably different from those behind the register, and may in some cases influence the results suggested below. Identification of the limits of ice bodies, in fact, in the 1989 survey, has always been based on air photos and hence, by examining all its points on the picture, with the same perspective, irrespective of a glacier's altitude.

The method employed for the survey, on the other hand, gives more precise results than «expeditious» surveying, since the coordinates of these limits are determined by means of digital photogrammetry in the Utm system and related to known points on the Italian Military Geography Institute's 1:25,000 maps. Another advantage is that the same points can be used to plot the corresponding limits derived from earlier or future aerial photos and thus very quickly obtain highly accurate area comparisons via computer (Biasini & Salvatore, 1993).

This paper takes a closer look at the relations between the areas covered by ice and the exposure of their slopes by reviewing the entirety of the data with geographical exposure as the common analysis factor. A comparison is made between the number of individual «active» glaciers in the Register and the Survey. An assessment is also made of those that have broken up and those that were classed as «extinct» on the register, or not detected, and now appear as «new glaciers» in the Survey (Ajassa & *alii*, 1993). Diffe-

(\*) Dipartimento di Scienze della Terra, Università degli Studi di Torino.

(\*\*) Dipartimento di Scienze della Terra, Università degli Studi di Roma «La Sapienza».