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Landscape Change in Sagarmatha (Mt. Everest) National Park, Khumbu, Nepal

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This study uses repeat photography as the primary research tool to analyze processes of physical and cultural landscape change in the Khumbu (Mt. Everest) region over a 40-year period (1955-1995). The study is a continuation of an on-going project begun by Byers in 1984 that involves replication of photographs originally taken between 1955-62 from the same five photo points. The 1995 investigation reported here provided the opportunity to expand the photographic data base from five to 26 photo points between Lukla (2,743 m) and the upper Imja Khola valley (5,500 m+) and resulted in a number of new insights useful to the scientific, national park, and local communities. Evidence from this repeat photography investigations suggests that:

(1) forest extent remains essentially unchanged from the 1950s,

(2) natural forest regeneration appears to be increasing in many areas, and significant tree growth in the vicinity of Namche Bazar and other villages has occurred as a result of successful plantation efforts over the past 15 years,

(3) substantial growth in infrastructure (primarily lodges) has occurred in most villages as a result of continued increases in tourism and population,

(4) approximately 60 percent of the juniper cover in the vicinity of Dingboche has been lost since 1962, and

(5) little change in the region's surficial geomorphology has occurred, although significant damage from the 1985 Langmoche flash flood and 1990 Pangboche torrent is apparent.

Those contacted were interested to learn of the generally positive indicators of environmental change found except in the alpine zone. Collectively, the results can provide preliminary insights for scientists and managers about (a) historic and contemporary landscape change processes, (b) human vs. natural impacts and trends, and (c) future management options. The techniques and methods developed during the Khumbu work are currently being applied and tested in the relatively understudied Cordilleras Blanca and Huayhuash of Peru, as well as elsewhere in the Himalaya.

Introduction

Repeat photography, or precise replication and interpretation of historic landscape scenes, is an analytical tool capable of broadly clarifying the patterns and possible causes of contemporary landscape/landuse changes within a given region (see: Byers 1987a1996; 1997). As a research tool, it has enjoyed some utility in the United States during the past thirty years (see: Byers 1987b; Walker 1968; Heady and Zinke 1978; Gruell 1980; Vale, 1982; Rogers et al. 1984; Veblen and Lorenz 1986); to a lesser extent in the Nepal Himalaya (Byers 1987a, 1987b, 1996, 1997; Ives 1987; Fisher 1990:144-145); and rarely, with the exception of glacial recession studies (e.g., Ames 1996) in the Peruvian Andes (see: Byers and Kolff 1997). When supplemented by ground truth analyses of disturbance, interviews with local people, and literature reviews, significant insights regarding historical and contemporary forest loss, changes in high altitude pasture conditions, glacial recession, village growth, catastrophic events, impacts of mining and logging, and the effectiveness of management interventions during the past 30-50 years can be obtained within a relatively short period. Results can clarify contemporary landscape change processes, human vs. natural impacts, and future management and restoration options for a particular mountain setting. A sequential replication of photographs over time, augmented by detailed oral history, can avoid the often misleading "slice in time" interpretation of only two photographs while providing a more accurate assessment of events and factors of possible influence (Stevens 1993:490).

Challenges to the now-famous "degradation scenarios" of the Sagarmatha National Park, Khumbu, Nepal (Figure 1, next page) began to emerge in the late 1980s with the completion of more detailed, longer-term studies of the park and its people (Byers 1987a; Fisher 1990; Brower 1991; Stevens 1993). Geographers have played key roles in the clarification of human disturbance and landscape change processes in the Khumbu, using a range of field tools and methods from the social and physical sciences (see also: Byers 1996a). The objective of the present study was to complement this growing understanding of the Khumbu

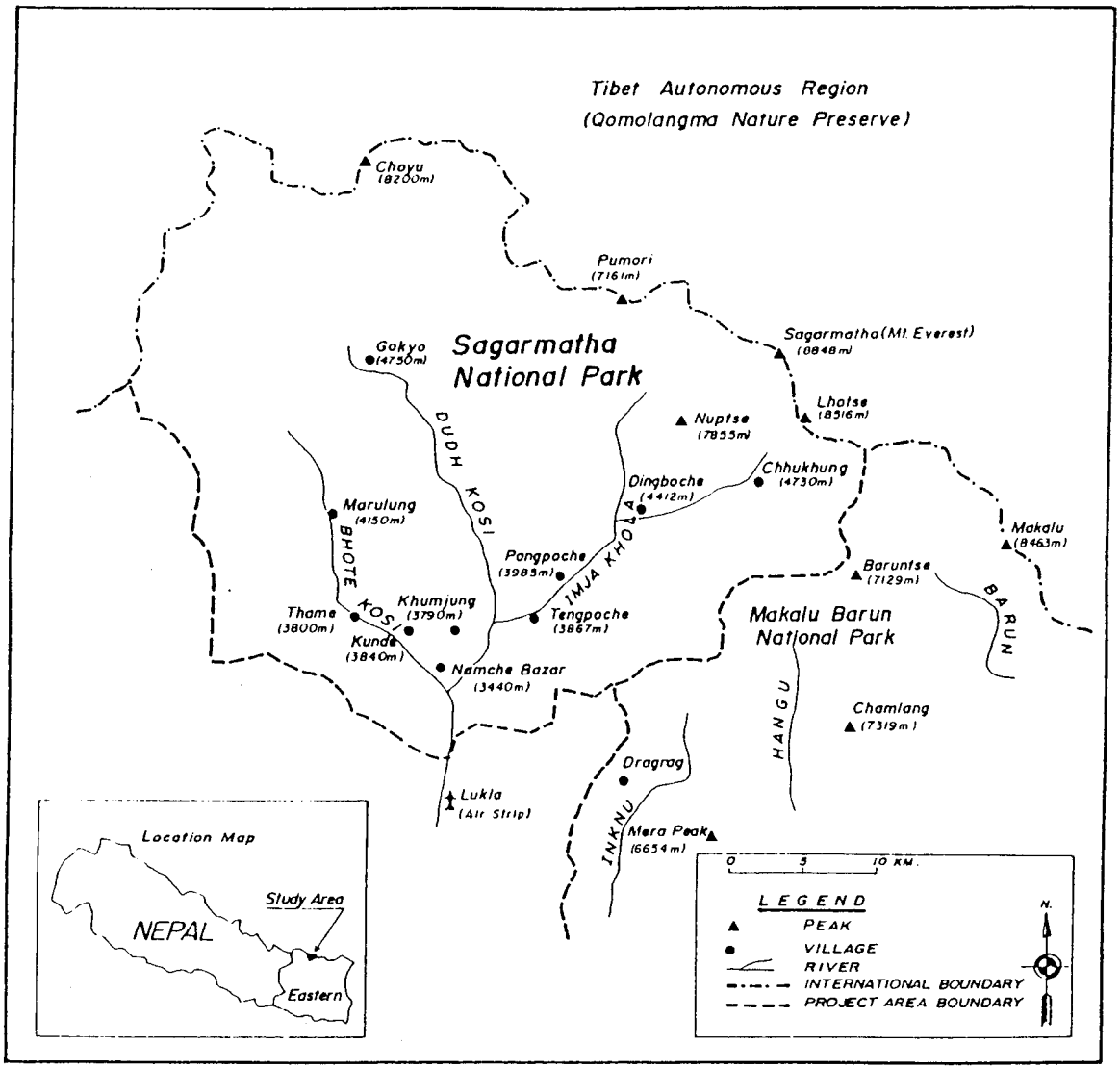

Figure 1. Sagarmatha (MT Everest) National Park--Khumbu, Nepal

environment and its people through an integrated analysis of physical and cultural landscape change processes over a 40 year period (1955-1995), using repeat photography as the primary tool (Byers 1996b). The project represents the continuation of an on-going project initiated by the early participants in the Mountain Hazards Mapping Project in 1982 (Ives and Messerli, 1981) and taken on by the author since 1984.

Background

Between 1955 and 1963, the Austrian cartographer/mountaineer Erwin Schneider completed a field survey of the Khumbu (Mt. Everest) region that included terrestrial photogrammetry (landscape panoramas) taken from numerous high altitude, trigonometrical points throughout the valley (Schneider 1963; Kostka 1993; Penz 1997). His work was a continuation of the high mountain cartography and exploration of the Arbeitsgemeinschaft fur Vergleichende Hochgebirgsforschung (Association for Comparative Alpine Research/Munich) and Oesterreichischer Alpenverein (Austrian Alpine Association/ Innsbruck)(see: Kostka 1993:2; Borchers 1935; Kinzl 1940; Kinzl and Schneider 1950; Kinzl *et al.* 1954; Byers 1997), originally initiated in the Cordilleras Blanca and Huayhuash of northwestern Peru in 1932 (see: Byers and Kolff 1997). In 1984, five of Schneider's photo points that provided the most complete view of the lower Khumbu Valley, (Namche Bazaar to Tengboche) were located, and the original black and white photographs replicated (Byers 1987a, 1987b). Between October-November 1995, 26 of Schneider's photo points between Lukla (2,743 m), Namche Bazar (3,440 m), and the upper alpine region in the valley (5,000 m+) were located (Figure 2),

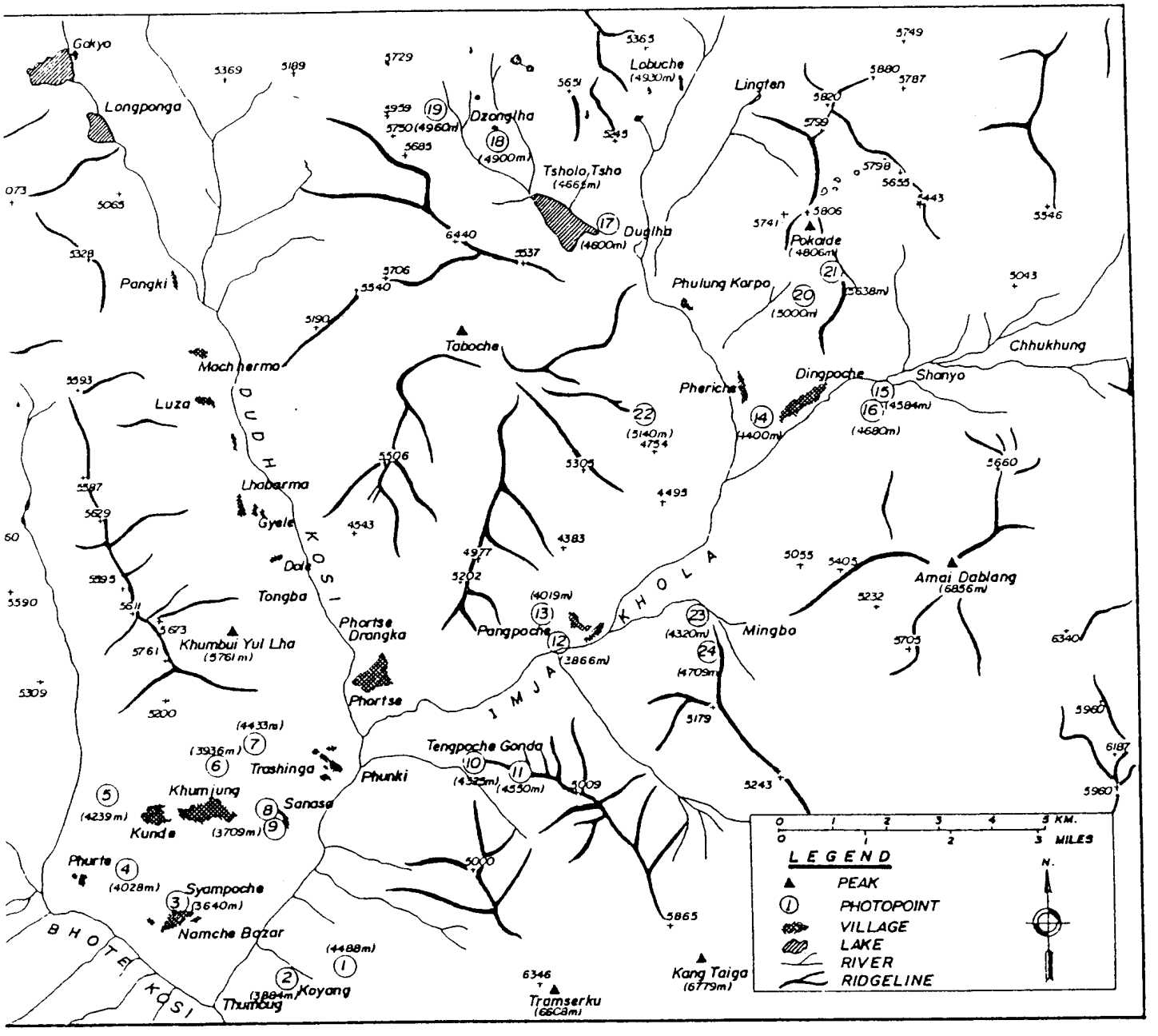

Figure 2. Photo points of Erwin Schneider relocated in 1995 (Circled Numbers)

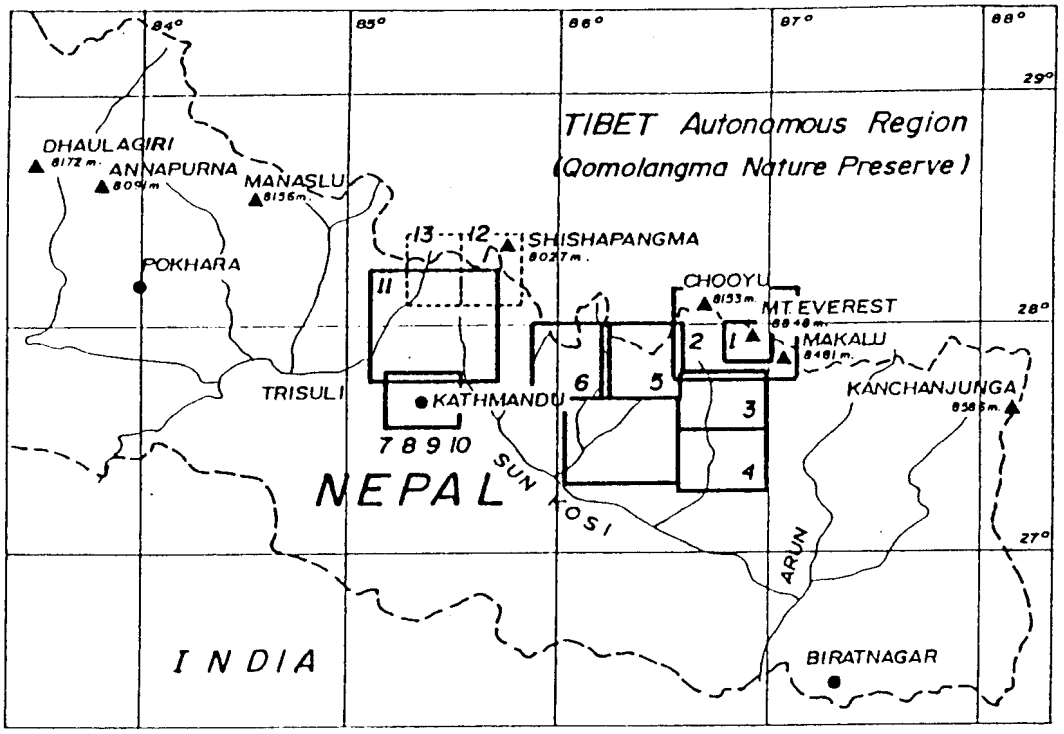

Figure 3. Maps produced by the Austrian Association for Comparative Research and Austrian Alpine Association for the Nepal Himalaya, showing the extent of Schneider's Himalayan work between 1954 and 1980. Box 2 represents Khumbu (Mt. Everest) Himal map at 1:50,000, used by Byers during the 1984 and 1995 studies.

and nearly 1,500 black-and-white and color replicates of the original panoramas and individual landscape scenes were made. Comparisons between the ca. 1955/62 (Schneider), 1984 (Byers), and 1995 photographs were then made, providing a preliminary assessment of landscape change processes (i.e., forest cover, infrastructural, alpine vegetation, and geomorphology) in the Khumbu over the past 40 years.

Methods

Logistics

Between 25 October and 15 November, 1995, team members located and traveled to Schneider's photo points throughout the Dudh Kosi, Imja Khola, and Bhote Kosi valleys (Figure 2)[1]. Photo points were located using Schneider's "Khumbu Himal" map (Freytag-Berndt und Artaria 1988), which was helpful in identifying many of his original high altitude stations. and the 1955/62 and 1984 landscape photographs (Figure 3). The superb local knowledge of the project's Sherpa staff, and their ability to recognize landscape features, panoramas, and corresponding photo points. enabled rapid location of all photo points in even the most remote and least visited sites.

On a typical day the team departed at daybreak from camp and headed towards the next targeted photo point. Most locations were reached within three hours, or by 9:00 a.m., as ascents of 1,000-2,000 m above the camp (often through unfamiliar landscapes) were normally required. Photography, note taking, and staff interviews about the photographs and landscapes in question continued until the winds of early afternoon began (1:00-2:00 p.m.), followed by a descent to camp and departure for the next camping site by late afternoon. Perfect, clear fall weather prevailed during most of the three week period, with the exception of the catastrophic snowstorm of 9-11 November that occurred near the conclusion of the expedition (see: *Newsweek International*, 27 November, 1995, pp. 17-18).

[1] Schneider's 1955/62 photographic coverage of the Gokyo and Thami valleys was largely under snow cover and so was not included within this study, with the exception of several repeat photographs taken of Thami village on 13 November, 1995.

Table 1. Photo Point Attributes, 1995 Repeat Photography Expedition, Sagarmatha National Park, Khumbu, Nepal

Date	Time	Vicinity	Site #	Alt. (m)	Scene Replication
10/25/95	1630	Above Lukla	na	3,183	Lukla airstrip ca. 1962 (Schneider)
10/26/95	0845	Above Lukla	na	3,183	Lukla airstrip & panorama (clear skies); note numerous satellite dishes, electric lines, telephones.
10/26/95	1415	Salung	na	2,700	Salung village, as seen from Choplung
10/26/95	1515	Ghat	na	2,756	Ghat region (Schneider); extensive '85 flood damage; Cherma (new village) established since '62; note increased tree growth
10/28/95	0800	N-facing slopes of Tamserku	na	4,146	From cairns (dividing line between Namche and Khumjung grass cutting region) en-route to Schneider's '62 photopoint, panorama of lower valley
10/28/95	1034	N-facing slopes of Tamserku	1	4,488	Panorama of entire Imja valley (Schneider '62)
10/29/95	0746	Tamserku camp	2	3,884	S-facing slopes of Imja Khola (Namche, Kunde/Khumjung, Phortse, Everest
10/30/95	0915	Namche Bazaar	3	3,440	Namche village and vicinity: Houston (1950) and Byers (1973, 1984)
10/31/95	0913	Ridge west of Kunde	4	4,028	Thami valley (note '85 flood damage), Kunde and Khumjung villages (Schneider '62)
11/1/95	0937	Kunde	7	4,443	Phortse, Tengboche, and Tamserku slopes as seen from S-facing slopes NE of Kunde
11/2/95	0920	Kunde	6	3,983	Kunde village, looking south from exclosure (Byers 1984)
11/2/95	1011	Sanasa	8	3,755	Phortse; Tengboche hill (terminal moraine) as seen from Sanesa (Byers 1984)
11/3/95	0910	Tengboche	11	4,550	Upper Imja Khola valley panorama (Everest, Ama Dablam, Tengboche, Namche)(from Schneider '62)
11/4/95	1032	Pangboche	12	3,866	Lower Omoga and Yaral fields as seen from SW of Pangboche (Byers '84); village and gompa (Byers '73)
11/5/95	0900	Dingboche	15,16	4,646	Dingboche and hill slopes (Schneider '62)
11/6/95	0815	Tsholo Tsho (Dzonglha)	18,19	4,843; 4,900	Tsholo Tsho (lake) and vicinity (Schneider '62)
11/7/95	0946	Below Pokhalde peak	20,21	5,638	Pheriche valley & Taboche from 5,638 m and cairns at 5,500 m, presumably left by Schneider
11/8/95	0933	Below Taboche peak	22	5,140	Pheriche valley from slopes of Taboche (Schneider '62)
11/9/95	1013	Mingbo	24	4,709	Pangboche, Ama Dablam, and upper Imja valley as seen from ridge SW of Nare Drangka (Schneider '62); day 1 of severe snowstorm
11/11/95	1002	Namche	3	3,440	Namche village from top of depression (Byers '84)
11/13/95	0920	Thame	na	4,085	Thame and vicinity (snow covered); avalanche prevented access to Schneider's point at 4,292 m

Table 1 describes the photo points reached and includes date, time, vicinity, site number, altitude, and scene description. Figure 2 shows the location of each photopoint. Backup color slide landscape replicates were also made during the fieldwork, including the village and landscape scenes taken by various individuals over the past 45 years (e.g., Houston's 1950 photographs of Namche Bazar; Byers' 1973 and 1984 photographs of the regions).

Photography

We used a Nikon F4S camera fitted with a 35-70 2.8 D zoom lens and an MF23 Multi-Control Databack, on a Bogen 3221 tripod with a 3026 ball joint head. The databack was used because it provides automatic exposure bracketing of -.5, normal, and +.5 EV (exposure values) per scene. In addition to automatic bracketing, scenes were replicated using Tiffen red, green, yellow, and polarizing filters, to maximize the range of tonal values and characteristics available for comparison and analysis. Kodak T-Max 100 black-and-white film was used for most photographic replications, and Fuji 100 color slide-film for color transparencies of the same scene.

Ideally, older photographs should be replicated using the same equipment, under the exact circumstances, as the original (e.g., camera type, lens, tripod height, film). The season, time of day, and weather conditions should be replicated as closely as possible. For the present investigation, seasonal attributes and weather conditions were adequately addressed since most of Schneider's photographs were taken under the clear skies of autumn. Budgetary and practical constraints, however, prevented the acquisition of the original equipment as used by Schneider (eg. the "terrestrische ausruestungfinsterwalder--'TAF," or lightweight terrestrial phototheodolite developed by professor Richard Finsterwalder, Technische Universitataet Munich; Kostka 1993, pers. comm.; Kaser, 1977, pers. comm.). Nevertheless, the fundamental objective of the investigation--i.e., high quality replication of older photographs which would enable the assessment of large-scale landscape changes in the Khumbu--suggested that the equipment and techniques as outlined above would be entirely adequate for the desired results (Bishop 1992, pers. comm.). All film was processed upon arrival in Kathmandu on 15 November, 1995. Contact prints were made of the black-and-white negatives and the color slides were developed and archived.

Results

Further, more detailed analysis (in progress) of contemporary landscape change processes in the Khumbu over the past 40 years as reflected in the photographs is necessary. However, there are a number of preliminary findings about forest cover, infrastructure, alpine vegetation, and geomorphology. Sample comparative photographs of Kunde and Khumjung villages in 1962, 1984, and 1995 are shown as Plates 1, 2, and 3 respectively:

Forest Cover

Forest cover remains essentially unchanged from the 1950s, which challenges the popular hypotheses of accelerated deforestation and landscape degradation in the region during the past 40 + years.

This was one of the conclusions of the author's previous work in the Khumbu during 1984, further clarified by the results of the 1995 study. During the past decade, detailed bibliographies and analyses which trace the theme of contemporary landscape degradation in the Khumbu have been compiled by several authors (Byers 1986, 1987a; Ives and Messerli 1989; Brower 1991; Stevens 1993). Generally acknowledged by all is that during the 1970s and 1980s, degradational trends may have been somewhat overstated for the Khumbu partly because of a number of inter-related factors. They include a general adherence to the popular crisis-scenarios of the 1970s and 1980s (e.g., see: Eckholm 1976), the sometimes hasty conclusions drawn by short-term consulting work, and/or as a strategy to expedite the national park establishment process (see: Brower 1991: 73-80). Two references that capture the tone of much of the literature of the 1970s and 1980s include the following (from: Byers 1987b: 77):

(a) ". . . forests in the vicinity of the [Khumbu] villages have...been seriously depleted, and particularly near Namche Bazar whole hillsides which were densely forested in 1957 are now bare of tree growth..." (Fürer-Haimendorf 1975: 97-98);

(b) ". . . more deforestation [has occurred in the Khumbu] during the past two decades than in the preceding 200 years . . . "[2] (Hinrichsen *et al.* 1983: 204).

Results from the 1984 and 1995 repeat photography investigations, derived through a greater areal coverage of the park, challenge these statements. As concluded in the 1984 project, ". . . comparisons between the 1962 and 1984 [and 1995] photographs of the Namche-Kunde-Khumjung region show that (1) most forests appear to be relatively unchanged, (2) considerable thinning of certain juniper woodlands has occurred, (3) little change of a medium- to large-scale geomorphic nature can be discerned, and (4) several distinctive tourist- and Park-related structures [hotels, Park headquarters] have been established. In general, the photographic evidence does not support the hypothesis

[2] In fact, complementary pollen analysis and 14C dating of buried charcoal fragments, funded by the National Geographic Society in 1985, suggested that large-scale landscape modification in the Khumbu has been occurring for several thousand years (see: Byers 1987a: 192-205).

Erwin Schneider, *Kunde and Khumjung villages from photo point 5 (4,239 m)*, 1962

Alton Byers, *Kunde and Khumjung villages*, 1995

of widespread deforestation, nor the assumed linkages between tree removal, grazing, and geomorphic damage within the specific geographic areas under discussion" (Byers 1987b).

Not documented in 1984, but readily observable in 1995, was the fact that:

natural forest cover appears to have increased in certain areas, and significant tree growth in the vicinity of Namche Bazar and other villages has occurred as a result of successful plantation efforts over the past 15 years.

This observation needs further comparison and analysis, although observations made during the course of the fieldwork suggest that active forest regeneration processes and increased forest cover appear in several places. This is particularly evident along the Imja Khola en route to Namche Bazaar, in the Kunde/Khumjung region, and on the south-facing aspects of the Tengboche terminal moraine. Research conducted in 1990 (Brower and Dennis, in press) documents active regeneration in natural forest near Namche and nearby villages, which was apparent, too, in sample data from the 1984 UNU/MAB investigation (Byers 1987a:340-348). Also noted was a distinct increase in wildlife evidence (see: Byers 1995a) and sightings within the valley, an observation later endorsed by wildlife specialists (Kattel 1995, pers. comm.) and park experts with many years of wildlife experience in the region (Sherpa, L.N. 1995, pers. comm.). Both agree that the increasing populations of certain species (notably Himalayan tahr) during the past 10-20 years were furthering the growing problem of crop depredation throughout the Khumbu region.

Forest cover is clearly increasing in the vicinity of Namche Bazaar. On the hill slopes surrounding the village and in the vicinity of Park headquarters, *Abies* and *Pinus* seedlings which were planted by park personnel in the 1980s are now between 1 and 3 meters tall. Park personnel, and even local residents, expressed considerable and enthusiastic surprise over the comparative abundance of trees now growing in the vicinity of Namche Bazar, as were various NGO organizations that have promoted and/or subsidized the park's nurseries and plantations for more than two decades (e.g., the Himalayan Trust).

At this point, an additional value of repeat photography became apparent--a visual "morale boost" to those working with natural resource management issues, which by nature often require many years before change (e.g., increases in biodiversity, reduced soil loss rates, and increased forest cover) is visible. Substantial value seems to be added to conservation work, as well as to the achievement of institutional and organizational goals, when positive change can be photographically and/or thematically demonstrated.

Infrastructure

Mentioned in the 1984 work, but dramatically obvious in 1995, is the fact that:

significant infrastructure growth (primarily lodges has occurred in the Khumbu, particularly during the pas 11 years as a result of continued increases in tourist an local populations.

Tourism in the Khumbu has grown exponentially since the 1960s, with 20 visitors reported for 1964 3,200 in 1973, approximately 5,000 in 1984, and mor than 13,000 in 1995. Although the negative impacts o tourism on local forests are in question, an indisputabl consequence can be found in most villages: increase infrastructure. This is particularly evident withi villages situated along the main tourist/expedition trail and intersections (e.g., Namche), spaced conveniently between daily destinations (e.g., Tengboche), and/o exhibiting more economically "progressive" attitude than the more remote, traditional villages such a Phortse (Brower 1991). In these places, numerou lodges, restaurants, and campgrounds have develope rapidly over the past 10 years, perhaps mos dramatically in Namche Bazaar. Further analytical wor to be done includes the actual quantification o infrastructure growth in Namche since 1950 and through the integration of detailed cultural and socio economic studies (e.g., Stevens 1993; Brower 1991) provide insight as to why these phenomena may have occurred.

While local forests do not appear to have been a adversely impacted by tourism as previously thought substantial forest loss outside of the park has beer reported and directly linked to the fuelwood and timbe demands of increased tourist and structural growt (Stevens 1993). Although not a component of the present study, such external impacts and consequence are clearly in need of further study.

Continued Alpine Degradation

In 1984, concern was expressed for the condition o certain alpine pasture areas, particularly those in the vicinity of Dingboche (4,412 m). During the 1984-85 geoecological field study of the Khumbu, the Dingboche study plots showed the highest rates of soil loss within the Namche to Dingboche study area[3] in spite of its significantly lower annual precipitation (Byers 1987a). At that time, "...a presently unknown combination of historical, natural (freeze-thaw, turf exfoliation) and anthropogenic (shrub and turf removal, grazing) factors, exacerbated by a colder and comparatively less resilient environment...," was felt to

[3] Twenty-eight (28) soil loss study plots were installed within the north-facing forests, south-facing shrub/grasslands, and alpine vegetation formations between Namche Bazaar and Dingboche.

have "...resulted in seasonally exposed soils and surficially dynamic hill slopes in certain alpine areas" (Byers 1987a: 245-247). Also uncertain at the time were the factors and time frames involved in creating these conditions which, for Dingboche specifically, this investigation was able to help clarify:

Approximately 60 percent of the shrub juniper growth in the vicinity of Dingboche has been lost since the early 1960s, and conditions in many other alpine areas remain in similarly poor condition. Apparently uncontrolled juniper harvesting has commenced in new areas since the last field survey of 1984.

Comparison of Schneider's ca. 1962 photographs of Dingboche-adjacent hillsides, unavailable during the 1984 study, and those taken in November, 1995 clearly show substantial loss in juniper cover during the past 30+ years. The photographic evidence partly contradicts Vuichard (reported in Brower 1991: 178), who suggested that the exposed soils and lack of alpine vegetation in the vicinity of Dingboche was a result of the steep, unconsolidated morainal material found in this location which is subject to recurrent rock-fall from the cliffs above. Rather, the record suggests that active anthropogenic factors, particularly fuelwood harvesting during the rapid tourism growth years of 1970-1985, are the main cause of decreased shrub juniper coverage (and increased soil loss) of the Dingboche and other nearby hill slopes surveyed (e.g., Pheriche)[4]. In 1995, the author was informed that juniper was no longer harvested in quantity in the vicinity of Dingboche, but that rapid depletion of stock was in progress further up-valley in nearby (4,730 m). As in 1984, a heightened awareness of these detrimental and on-going processes, combined with appropriate management interventions and the application of alternative energy sources, would appear to offer the most promise for the future of the fragile Khumbu alpine.

Geomorphology

One of the results of the 1984 work was to further dispel certain assumptions concerning land-use practices and resultant landscape features, such as the "growing gully" (torrent) between Khumjung and Kunde villages linked to the presence of presumed over-grazing (e.g., Lucas *et al.* 1974; see Brower 1983). "Likewise, other bare surfaces that existed in 1962 do not appear to have increased in size significantly, and this supports the impression that monsoonal precipitation in the Khumbu usually maintains the fresh appearance of seemingly erosive features while in fact accounting for little [geomorphic] work" (Byers 1987b).

Similar conclusions may be drawn from the 1995 investigation, as little change in the geomorphic features noted in 1984 (torrents, landslides, gullies) can be seen in the photographic comparisons. One exception is the tremendous damage caused by the Langmoche flash flood of 1985 (Vuichard and Zimmerman 1986), which deeply scoured the channels of the Bhote and Imja rivers located within the park. The effects of the flash flood are dramatically apparent on a number of the photographic replicates. Other features of note include the recession of the Ama Dablam glacier and the effects of a 1990 torrent in the vicinity of Pangboche (3,985 m). Further work is needed to provide a more detailed analysis of these geomorphic processes, as well as the damage they have inflicted upon the peoples and landscapes of the Khumbu.

Conclusions

Results of the repeat photography investigation of 1995 reinforced those from the 1984 initiative by covering a much larger area of the park. New and unexpected evidence about positive landscape change indicators within the region were found, particularly regarding increases in forest coverage in the vicinity of various villages. The value of the method as a management, policy-influencing, and monitoring and evaluation tool was shown. It represents a reliable method for providing preliminary clarification of the following areas (annotated from: Byers 1987b).

1. The immediate reduction of uncertainty about landscape change in the Khumbu, with clear potential for application elsewhere in the mountain world. Comparisons between old and new photographs can qualitatively, and in some cases quantitatively, verify the existence or absence of a worst-case scenario (e.g., massive forest removal, increased slope instability), change vs. non-change (e.g., stability of tree line and forest cover), and/or improvements in landscape condition (e.g., afforestation progress),

2. The clarification of what existed in the past at various locations (e.g., woodland, forest, or shrub/grassland) in order to discourage misinterpretations or the misuse of terminology within future scientific- and management-oriented analyses (e.g., the "forests" above Namche in the 1950s may have been, at best, juniper woodlands, and the reduced shrub juniper coverage near Dingboche was most likely a result of anthropogenic, rather than geomorphic, factors),

3. The ability to correlate physical and cultural landscape change with known intensities of internal and external variables of influence, such as population growth, increased tourism, and refugee impacts,

[4] Indicators include the stockpiles of shrub juniper fuelwood found near hotels and restaurants, as well as evidence of random juniper harvesting throughout the upper Khumbu valley. These conditions appear to have changed little since last surveyed by the PI in 1984 (Byers 1987a: 235-238).

4. The ability, in some cases, to quantify change such as forest cover, infrastructure, and geomorphic damage resulting from catastrophic events, and

5. The identification of "problem areas" in need of attention (e.g., the Khumbu alpine zone), with hope of facilitating re-direction of limited conservation resources capable of addressing priority ecological issues.

Clearly, the method is enhanced when used in conjunction with ground truth disturbances analyses, interviews with local people, literature reviews, and the insights of colleagues with extensive experience in the region. Collectively, these sources of information have the potential to provide insights useful to in understanding (a) historic and contemporary landscape change processes, (b) human vs. natural impacts and trends, and (c) future management and restoration options. Although more detailed analyses concerning historical and contemporary landscape change processes in the Khumbu are forthcoming, repeat photography shows particular promise as a reliable and cost-effective monitoring and evaluation tool for project managers, field practitioners, and local communities.

Finally, the photographic archives of the German/Austrian expeditions, currently located at the Austrian Alpine Association and Department of Geography at Innsbruck, are clearly a global resource for similar studies in the high mountains of Asia, Africa, and South America; efforts should be made to ensure their preservation as well as ease of accessibility to mountain scholars worldwide. In collaboration with the field programs of The Mountain Institute, the techniques and methods developed during the Khumbu work are now being tested in the Andes (Huascaran National Park and Buffer Zone Project, Huaraz; and Huayhuash Cordillera Conservation Initiative, Peru); Nepal Himalaya (Langtang Ecotourism Project), and India (Sikkim Biodiversity and Ecotourism Project).

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View north up Imja Khola, Khumbu