CONSERVATION ADVISORY SCIENCE NOTES

No. 42

ASSESSMENT OF TINTED GLASS FOR PUBLIC OBSERVATORY,
TAIAROA HEAD NATURE RESERVE

(Short Answers in Conservation Science)

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Department of Conservation, P 0 Box 10-420, Wellington, New Zealand

ISSN 1171-9834

Reference to material in this report should be cited thus:

Robertson, C.J.R., 1993.
Assessment of tinted glass for public observatory, Taiaroa Head nature reserve.
Conservation Advisory Science Notes No. 42, Department of Conservation,
Wellington. 9p.

Commissioned by: Otago Conservancy
Location: NZMS

ASSESSMENT OF TINTED GLASS FOR PUBLIC OBSERVATORY, TAIAROA HEAD NATURE RESERVE.

C.J.R. Robertson
Science & Research Division, Department of Conservation,
P O Box 10420, Wellington.

INTRODUCTION

Public viewing of Royal albatrosses and other wildlife at the Taiaroa Head Nature Reserve has been operated by the Otago Peninsula Trust from an observatory within the reserve since 1972. There have been two different observatory types with the current one (Richdale Observatory), being built in 1982.

Robertson (1993) (Otago Daily Times. 1992) and other unpublished analyses (Robertson *in litt.*) have recently shown that there has been a significant proportional shift of albatrosses, away from the observatory site. This has been especially obvious since viewing was allowed during the hatching period (also the peak time for adolescent courtship and display). The prime reason for the shift appears to have been the disturbance of adolescent birds during their pre-breeding pair formation behaviour. Once a pair is formed and commences nesting it remains closely related to that original nesting area while the pair continues to breed.

The areas which have shown the greatest increases in nesting density are those not directly in front of the Richdale public observatory or the nearby Signal Station. There has also been an increasing tendency for some late laying pairs to lay eggs outside the period when the observatory is closed to visitors during egg laying. Some of these have been at nest sites close to and on view from the observatory.

Any modification to the observatory making visitors less visible will remove some of the more direct effects of disturbance. However, it will not remove any of the significant disturbance in other parts of the nature reserve caused by visitors moving about in the open (inside and outside the nature reserve) to get to the observatory site. In 1992-93 almost 45,000 visitors entered the reserve with 72 percent of them visiting from the November opening of the reserve in 1992, until the end of March 1993.

The first observatory was some 55% smaller than the present one, and had small observation windows just above natural ground level. As the main viewing area was round, each of the small observation windows faced slightly different directions. The observatory floor was below ground level, with visitors in smaller parties (10 people) being less visible from outside. The present Richdale Observatory is basically a rectangular building, with the main observation windows facing in three directions at one end of the rectangle. Its floor is at natural ground level and the windows are considerably higher and bigger, resulting in two tiers (using an internal raised platform) of visitors (up to 25 people) being visible through the windows.

The use of an observation slit rather than windows, or reducing viewable glass in the existing windows, while substantially reducing the external visibility of visitors, would also significantly reduce the number of visitors who could be catered for in the observatory and markedly reduce the visual experience, especially of flying birds. Accordingly, various methods of re-glazing the Richdale observatory to reduce the visibility of observers have been considered.

OBJECTIVES

1. To assess different methods of screening visitors in the observatory from outside view.

2. To prevent the illumination and silhouetting of visitors.

3. To avoid any external mirroring effects which might affect birds or shipping.

4. To assess the effects of different types of glass on photography undertaken by visitors inside the observatory.

5. To make recommendations to Otago Conservancy, Department of Conservation, and the Otago Peninsula Trust to enable modifications to be completed by 15 September 1993.

METHODS

Preliminary discussions were held with Tim Heath (Salmond, Anderson & Heath, architects, landscape architects and town planners, Dunedin) designer of the observatory. Various methods and modifications were reviewed or eliminated at that stage due to:- impracticality; necessity for major structural changes to the building; significant reduction in viewing experiences; or potential for further disturbance of the birds.

Though some of the options below should be reconsidered if the Richdale Observatory is ever replaced, those rejected at this stage of the investigation were:-

a. replacement of complete structure with new observatory substantially below ground with a glassed viewing slit; *[Not currently a practical alternative due to costs involved]*

b. modification of the existing observatory to provide smaller windows or windows angled downwards from the vertical; *[Not currently a practical alternative without major structural changes probably better considered under (a) above j*

c. the use of applied plastic screen tints to the inside of the observatory windows; *[A cheap option, but impractical due to scratching of film by observers.]*

d. any form of one-way glass; *[High mirroring effects on exterior, and reversion to clear glass if lighting inside building exceeds exterior natural lighting.]*

e. use of laminated glass with included screen tints including possible clear panel for photography. *[Clear panel not possible, and potential problems with differential expansions of laminates in high sun and hot conditions.]*

This left a range of tinted or coloured glass for consideration

> Bronze tint float glass, Grey tint float glass, `Greylite'. *[Blue-green or green tints were not tested as their colours were considered to unnaturally modify the viewing experience and were significantly poorer than other colours in both transmittance and reflectance of light - see Table 1.]*

Sample panes of glass (ca. one foot square) were tested in bright sunny and overcast light conditions throughout the day during May and June 1993. Photographic methods involved both internal and external still photography (black & white, colour print and transparency) and colour video. The still cameras used included standard and telephoto 35mm manual or automatic cameras with manual light meters or through the lense meters, and a compact fixed focus camera with a 38 mm lense. All film types used (B/W, colour print, colour transparency) were rated at ASA100 film speed.

All photographs were taken with the camera hand held. When inside the observatory the photographers rested their elbows on the window ledge for balance (ca. 300 mm wide inside the window). In each test case photos were taken (a) through an open window, (b) with the lense edge touching the sample glass (to obtain a view inside the reserve, rather than the open sea, the lense was always at an angle to the glass), (c) with the lense half covered by sample glass and half with no glass, and (d) with the lense edge ca. 300 mm from the glass (similar to most visitors).

Cameras were hand held for all photographs or video taken outside the observatory. Photography outside the observatory was from one or more fixed photopoints within the area of the reserve on view from the observatory. Black and white photographs had been taken from these photopoints monthly and in various light conditions to record the visibility of people in the observatory throughout the 1992-93 summer. These photographs were taken at the height of the eye of a sitting Royal albatross to simulate the view from a nest site.

Finally tests were undertaken with all windows except the front viewing windows of the observatory covered with brown paper to reduce both the light available inside the observatory, and the silhouetting of visitors against side windows.

GLASS PERFORMANCE DATA

Each type and thickness of glass reviewed had different transmittance and reflective properties (see Table 1). Clear float glass had the highest transmittance of light (clarity of view) but also the highest reflectance of light (mirroring).

TABLE 1 GLASS PERFORMANCE DATA * Samples tested
Ref. in part Ford (1993)

PRODUCT	GLASS THICKNESS mm		TRANSMITTANCE Daylight %	REFLECTANCE Daylight %
Clear float	3		90	8
	6		89	8
Blue-Green tint	6		76	7
Evergreen	6		66	7
Bronze tint	4	*	63	6
	6	*	54	6
Grey tint	4	*	56	6
	6	*	45	5
	10	*	28	5
'Greylite'	6	*	14	5

The thicker tinted glass transmitted the least light and also had increasingly low reflectance. The brand glass "Greylite" had the lowest transmittance of light and its reflectance was equivalent to the thickest of the grey tinted float glass. The architect and others noted that 'Greylite' has a tendency to break in hot sunny conditions. It can break along a line where fixed shadow lines fall across the glass in very sunny and hot conditions which heat the glass to high temperatures.

RESULTS

1. Effects of tinted glass on photography.

The present observatory has a total of 13.33 m^2 of clear glass in 18 separate panels including two related to doors. The viewing end (16 panels) of the observatory facing outwards has 4.07 m^2 facing south down the Otago harbour; 4.6 m^2 facing west (main viewing - front of observatory) across the nature reserve and the harbour entrance; 3.65 m^2 facing north towards the fence and Signal Station. Two panels totalling 1.01 m^2 are at the rear corner of the building facing east and overlooking the entrance and access path to the observatory. There are also various ceiling and wall lights used for illumination and spotlighting displays. Visitors are not allowed to open windows or use flashguns for photography.

The most successful photography through glass normally involves the close juxtapositioning of the lense flush to the window glass to overcome the effects of any dirt on the glass and any reflection from the glass back to the camera. The greater the angle of the lense to the glass, and the further away the lease is from the glass, the greater the chance of reflection, especially when there are high levels of light behind or to the side of the camera, such as occurs in the present observatory.

Photographic trials covered a number of days to obtain the range of results required. Though every effort was made to have common conditions (sunny or overcast) there were variations within those states during the days when tests were made (see differing light conditions when glass was absent in Table 2). The darker grades of glass were not available at the time when sunny conditions were being tested. The mechanical representation of results shown in Table 2 represents a coarse representation of conditions using fixed (not zoom) lenses and fixed settings of f-stops and shutter speeds. Automatic cameras and those that automatically adjust shutter speeds to fixed f-stops will make less coarse adjustments.

Table 2 **TEST CONDITIONS USED TO ASSESS THE EFFECTS OF TINTED OBSERVATION WINDOW GLASS ON PHOTOGRAPHY** **All film ASA100.**
Aperture -/- shutter speed

	SUNNY CONDITIONS				OVERCAST CONDITIONS			
LENSE SIZE	50mm	50mm	200mm	200mm	50mm	50mm	200mm	200mm
Glass present or absent	Absent	Present	Absent	Present	Absent	Present	Absent	Present
GLASS TYPE								
Bronze tint 4mm	11-/- 125	11-/- 125	11-/- 125	11-/- 125	8-/- 60	5.6-/- 60	8-/- 60	5.6-/- 60
Bronze tint 6mm	11-/- 125	8-/- 125	8-/- 125	8-/- 125	4-/- 60	4-/- 60	4-/- 60	4-/- 60
Grey tint 4mm	8-/- 125	8-/- 125	8-/- 125	8-/- 125	11-/- 60	8-/- 60	8-/- 60	5.6-/- 60
Grey tint 6mm	11-/- 125	5.6-/-125	8-/- 125	4-/- 125	8-/- 60	5.6-/- 60	8-/- 60	5.6-/- 60
Grey tint 10mm	11-/- 125	4-/- 125	8-/- 125	4-/- 125	8-/- 60	5.6-/- 60	8-/- 60	3.5-/- 30
'Greylite' 6mm	11-/- 125	4-/- 125	8-/- 125	3.5-/- 125	8-/- 60	5.6-/- 60	8-/- 60	3.5-/- 30

The results are summarised as follows

a. In bright sunny conditions the 4 & 6 mm tinted glass reduced glare considerably and could be considered to have 'improved' some photographs because of that reduction. As expected from Table 1, the bronze tints with the highest transmittance of light ratings had the least effects on photography, except for a slight tendency towards a warmer bronze colour cast.

b. There was a clear relationship between reducing available light (sunny to overcast) and reducing levels of performance as glass transmittance levels dropped (see Table 1) and camera lenses moved into the telephoto category.

c. In the present observatory conditions, reflections back to the camera were highest from inside the window (photography as for a member of the public) in overcast conditions. The reflections also increased, proportionate to the decreasing transmittance of light levels in the tested glass (the worst reflections were from 10mm Grey tint and 'Greylite'). These reflections were substantially reduced or eliminated however, by shading light from the side windows by another sheet of tinted glass or by screening the side windows (see below).

d. By reducing the light inside the observatory (from side and rear windows covered with brown paper) reflections on the inside of the present front windows were virtually eliminated (i.e. when inside of observatory darker than outside).

e. Automatically focusing cameras and videos had difficulty focusing if the camera lense was not within 50 mm of the tinted glass samples. Any greater distance and there was a tendency for the auto focus to treat the tinted glass sample (now only part of the picture) as a separate object and attempting to focus on the glass. It is possible that this effect will be reduced when all glass is of the same tint. However, the use of auto-focus cameras will be affected if the lense is too far from the glass and especially the darker types.

f. While a professional photographer might notice some modification of results when photographing through the darkest glass, good photographs will be obtained in all but the dullest light conditions. In bright conditions (especially with reflections from the sea) photography will be improved when photographing through the tinted glass. These results will be conditional upon all observatory windows being modified, the observatory being kept as dark internally as possible, and the photographer placing their lense close to the window, to minimise any backward reflections into the camera.

2. The effects of tinted glass on the external visibility of activity inside the observatory.

Photographs taken at the fixed photopoints throughout the 1992-93 summer showed that people and movement within the observatory were most noticeable:-

(a) directly in front of the observatory in all light conditions;

(b) in any direction where people or movements were silhouetted against other windows;

(c) where light fell directly onto people i.e. especially in sunny conditions in late afternoon when the low angle of the sun projected bright light further back into the observatory;

(d) in conditions of low light when electric lights within the observatory were brighter than external natural light, and

(e) when cameras with automatic flash systems 'fired' because of the low light conditions especially late in the day or in very dull overcast conditions. It is possible to switch off the automatic flash facility in most cameras of this type.

Only the 10 mm Grey tint and 6 mm 'Greylite' had a significant effect on reducing the visibility of people and movement inside the observatory as defined above. Most significantly they both substantially eliminated viewing of the contents of the observatory even with the high ambient light levels from the unshaded side observation windows. With the shading of the side windows no discernable movement or colour changes could be seen from the outside through these darkly tinted glasses. The use of flash, though still visible, was reduced to a small 'bubble' of light rather than a wide flashing illumination.

The test of shading the side windows was important, because even with the front viewing panels remaining in clear glass, the darkening of the inside of the observatory in the middle of the day significantly reduced the visibility of people, but made the ceiling light clearly visible outside on a sunny day. However, people were still clearly visible when standing close to the viewing window in .direct sunlight even with 6 mm bronze and Grey tint glass.

While there was some slight visual difference between the 10 mm Grey tint and the 6 mm 'Greylite', with the latter reducing visibility the most (see also Table 1), any visibility of people or movement through the 10 mm Grey tint was only very slightly obvious at close range (ca. 10 metres), but was not obvious when further away from the observatory.

3. The effect of glass types on external mirroring of observatory windows.
The present observatory windows are of clear float glass which have the highest reflectance levels of the range of glass tested (see Table 1). ' Mirror' type glass (such as one way glass) was not assessed for that reason. Photographs from the fixed photopoints in the reserve during the 1992-93 summer in a range of light conditions demonstrated the significant mirroring effects visible in various parts of the reserve according to time of day and direction of view. In February 1992, in the hour after dawn, significant reflected bright glare from sunlight (Robertson pers. obs. recorded on video) was directed onto the 'Quarry' nest-site off the NE facing side-windows of the observatory. The most significant mirroring effects occur late in the afternoon from the front windows of the observatory.

During the tests where the sliding panels of the observatory windows were open (for the testing of tinted glass) the mirroring effect was substantially increased where two panels of clear glass overlapped.

Table 1 shows the reflectance of 10 mm Grey tint and 'Greylite' to be some 64% less than clear float glass. This was confirmed in the tests with 6 & 10 mm Grey tint and 'Greylite' showing little discernable difference from each other in reflectance when videoed from the fixed photopoints in the reserve. They showed little discernable mirroring compared to the existing clear glass.

DISCUSSION.

Only the 10 mm Grey tint and the 6 mm 'Greylite' fulfilled both the requirements of reducing the visibility of people in the observatory and the external mirroring effect. Satisfactory general photographic results were obtained through both types of glass.

The 10 mm Grey tint would require a modification to the existing aluminium window frames by the insertion of a suitable aluminium moulding into the existing frames to allow 10 mm glass to be used. This glass is of a suitable thickness to cope with local climatic conditions, though toughening is possible as an extra precaution.

The 6 mm 'Greylite' may require a modification to the existing window frames if the existing glass is not of the same dimensions. The major disadvantage of this glass type is the advised propensity for breakage along permanent shadow lines. It is not clear whether this can be overcome by toughening treatment. Accordingly, though this glass seemed to perform the best for the requirements needed, the extra performance should be balanced against the known disadvantage in any final decisions for a public viewing area.

An additional benefit of tinted windows in the observatory will be a reduction in the amount of heat transmitted into the observatory especially on hot sunny days.

RECOMMENDATIONS.

1. That all glass in the Richdale Observatory (13.33 m^2) and the associated scientific office (3.5 m^2) be replaced with 10 mm Grey tint float glass.

2. That all external glass associated with the Disappearing Gun Complex (OP, viewing box in roof over gun, shell hoist) be replaced with 10 mm Grey tint float glass.

3. That all glass be replaced no later than 15 September 1993 to avoid disturbance of breeding birds arriving for the new breeding season.

4. That all internal lights be shaded so that direct light is directed away and shaded from all windows in the public and scientific observatories.

5. That the operators of the Signal Station be encouraged to modify all windows in the Signal Station according to the same or similar specifications as recommended in 1 & 4 above.

6. That there is a continuing prohibition on opening windows and the use of photographic flash inside the Richdale Observatory except when done under special permit.

7. That any future modifications or reconstruction of the observatory, incorporate design features which include smaller, narrower, angled and tinted viewing windows, which are placed close to natural ground level.

ACKNOWLEDGEMENTS

Thanks are due to Isobel Burns, Shirley Webb and Sandra McGrouther for conducting the photographic tests and review of the draft manuscript; the manager Otago Peninsula Trust for permission to use the Richdale Observatory and to screen its windows for one of the tests; John Wigley (Auckland) and Davy McGonville (Dunedin) of Winstones Ltd, Mike Abercrombie of Pilkington Glass Ltd, and Lloyd Gore of Morgan & Aitken Ltd for advice and technical specifications on the glass types published in Table 1; Tim Heath for architectural advice and with John Wigley and Chris Pugsley for review of the draft manuscript.

REFERENCES

Ford, L. O., 1993. Glass for Architecture. Buyline 2759. Pilkington Group.

Otago Daily Times., 1992. Royals keeping out of limelight. p 21. 26/9/1992

Robertson, C.J.R., 1993. Effects of Nature Tourism on Marine Wildlife. pp. 53-60 in Conference Proceedings, Marine Conservation & Wildlife Protection Conference, May 1992 . NZ Conservation Authority, Wellington.