Review of black stilt management data (1981-1995)

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1. Introduction

Black stilts (*Himantopus novaezelandiae*) are now confined to a single population of less than 100 adults, including approximately 12 pairs which nest on braided riverbeds and associated wetlands of the Mackenzie Basin, South Canterbury. Introduced predators, loss of habitat through hydro-electric power development, wetland drainage, and hybridisation with the pied stilt (*H. himantopus leucocephalus*) are all factors which have led to the decline of this species.

Winter counts of the remnant black stilt population indicated a decline in adult numbers from 51 in 1979 to 23 in 1980 and 1981 (Robertson *et al.* 1983). The New Zealand Wildlife Service then initiated an intensive management programme both *in-* and *ex-situ* to reverse this decline. The Department of Conservation took over responsibility for the project in 1987.

Intensive management included:

- the establishment of a captive population at the National Wildlife Centre in 1979, and later at Twizel in 1987;
- protection of nest-sites in the wild through intensive predator trapping from 1981 to 1986 (and a reduction in effort from 1987 to 1995); and
- the enhancement of productivity by multiple clutching, artificial incubation of eggs and cross-fostering to pied, hybrid and black pairs.

A Recovery Plan for black stilt has been approved (Reed *et al.* 1993a) and a technical audit has been completed (Saunders *et al.* 1996).

As a result of the computerisation of Twizel Field Centre black stilt records onto database in 1994 and early 1995, it has been possible to summarise records of all nesting pairs managed throughout the 14 year programme.

Data from 1981 to 1986, and 1987 to 1995 are presented separately as there was a major shift away from wild population management to captive rearing and release in 1987.

2. Sources for data compilation

Data were collated through checking and cross-referencing 3 sources held within Twizel Field Centre;

1) black stilt breeding season reports,

2) breeding pair card files, and

3) DBase files (input by R.J. Nilsson.)

Discrepancies in the data gathered from the 3 sources were noted and appear on Twizel File BIR034 (13 November 1995). These inconsistencies will be worked through in the future. The DBase file was considered authoritative in cases where data discrepancies arose.

Predator trapping data were compiled from annual reports and, where these were missing, from the original data sheets.

Winter population trend data were taken from annual reports on file at Twizel.

3. Black stilt management 1979-1986

3.1 BRIEF DECRIPTION OF THE TECHNIQUES USED IN MANAGEMENT

3.1.1 Captive breeding

A captive population was established at the National Wildlife Centre in 1979 with 8 eggs from the wild. The breeding programme was transferred to Twizel in 1987 by which time the captive population had increased to 20.

3.1.2 Artificial incubation and multiple clutching

All eggs laid by wild black stilt pairs or hybrid black and node I pairs (see Pierce 1984 for a decription of hybrid plumage types) were artificially incubated from 1980 onward. Some pairs were induced to lay more than one clutch by leaving the nest bare. Other pairs were given ceramic eggs until hatching eggs were returned to them.

3.1.3 Cross-fostering

Surplus eggs were fostered to pied, hybrid and black parents. Although this produced a large number of chicks in some years, juveniles migrated away from the Mackenzie Basin and did not return to breed (Reed et al. 1993b). Cross-fostering was reduced in use from 1985 onward.

3.1.4 Predator trapping

From 1981 until 1985, between 1 and 3 river valleys were line-trapped annually to remove predators. In addition, traps were set around most black stilt nest-sites from pre-nesting until chicks could fly. Trapping in 1986 was around nest-sites only.

3.2 RESULTS (1979-1986)

3.2.1 Captive breeding

One pair successfully bred at the NWC and 16 clutches of eggs (a total of 38 eggs) were fostered to wild parents. 12 chicks were parent-reared from second clutches of eggs, and were retained as breeding stock. The captive population steadily increased to 20 in 1987, producing between 1 and 3 captive-reared chicks per season, in addition to 6-13 eggs per year for fostering to the wild (Table 1).

Eight birds hand-reared at the National Wildlife Centre in 1979 were released into Micks Lagoon (Lake Tekapo) as one-year old black stilts in October 1981 and January 1982. None of these birds survived longer than one month.

3.2.2 Artificial incubation

Fertility of artificially incubated eggs from the wild ranged from 66.6 to 90.9% (mean = 79.9%) up to the 1986/87 season (Table 3). Up to 29 eggs died each season during incubation (mean = 10.8) (Table 5). Hatchability was variable, between 51.6 and 98% from fertile eggs (mean = 78.3%) (Figure 1). These fluctuations resulted from problems in controlling humidity and incubator malfunctions (Reed 1995, *in prep*).

3.2.3 Cross-fostering

Fifty chicks were fostered to 2 black parents and 21 to hybrid or pied pairs between 1981 and 1987 (Table 7). Few chicks fostered to hybrid or pied parents were resighted as most migrated from the Mackenzie Basin and did not return to breed (Reed *et al.* 1993a). Between 1985 and 1987 fewer black stilt pairs were induced to re-nest, and cross-fostering was scaled down to avoid migration with foster parents.

3.2.4 Predator trapping

Trapping effort was high from 1981 until 1986 when up to 26,399 trap nights (i.e. number of traps set x number of nights set) per season were maintained (Table 8). This involved 9 staff and volunteers from 1981 to 1984. As personnel numbers dropped, so did trapping effort. Table 9 shows the number of chicks fledged from untrapped and trapped areas in 1977-80 (from Pierce 1986), and 1981-87. Few nests were left entrapped from 1981 to 1986. More chicks flew from trapped than entrapped areas from 1983/84 until 1987/88 (X^2=13.2, P=0.0003, df= 1) (Figure 2, Tables 9&10). However, there is also a significant effect of year (X^2=26.01, P=0.0002, df=6). A log-linear model applied to 1983/84 to 1986/87 data indicated that the fledge:fail ratio varies with both treatment (i.e. trapped vs. entrapped) and year (X^2=36.6, df=10, P=0.0001). Year was the most important factor in determining level of fledging success (X^2=8.6, df=4, P=0.0719).

4. Management 1987-1995

4.1 TECHNIQUES

4.1.1 Captive rearing

In late 1986 a facility was established on 15 ha of ECNZ land adjacent to the lower Ohau river near Twizel. One aviculturalist was employed and three 45 m x 14 m aviaries constructed by 1991. A management facility containing an incubator room, chick-rearing room, outdoor aviaries, food preparation area, laboratory, insect colony and store room, was built in August 1992. Staff accommodation was replaced in May 1994.

From June 1987 to May 1992, breeding pairs and their juveniles were transferred from the NWC and juveniles from one pair at Queenstown Kiwi and Birdlife Park to Twizel. Twizel pairs were allowed to hatch and rear their own or fostered chicks to about 9 months of age. Most juveniles were then released into the wild. From the 1992/93 season onward, large numbers of chicks were hand-reared from wild eggs for eventual release into the wild (Reed 1994a). The rearing success of these birds is described in Reed (1994b).

Rearing for release had 2 main aims - in the short term to boost production of chicks and in the longer term to maximise black stilt pairings by concentrating juveniles in one area and reducing the occurrence of hybridisation.

4.1.2 Artificial incubation and multiple clutching

Artificial incubation proceeded as in earlier years except that from the 1989/90 season onward, eggs from all hybrid black and dark plumage (node F-I) pairs were also artificially incubated and managed in the same way as pure black stilt eggs. Fewer pairs were induced to re-nest between 1987 and 1991.

After 1992, some pairs (particularly on the lower Ahuriri river) were multiple clutched to provide eggs for hand-rearing. Management priority was given to the collection of wild-laid eggs for captive rearing, sometimes at the expense of maximising fledging success in the wild.

4.1.3 Cross-fostering

Eggs surplus to rearing by black stilts or hand-rearing continued to be fostered where possible to non-migratory (generally black) parents.

4.1.4 Predator trapping

No valleys were line-trapped after the 1985/86 breeding season and the emphasis changed to ring-trapping nests which were particularly accessible (i.e. lower Ahuriri and Ohau rivers). Trapping around nests did not occur in 1991/92 and 1992/93.

4.2 RESULTS

4.2.1 Captive rearing

The captive population expanded from 16 adults/subadults and 1 juvenile in 1987/88, to 22 adults/subadults and 31 juveniles in April 1996. Up to 36 juveniles were reared for release into the wild annually from 1992 to 1995 (Table 2). The mean number of chicks parent-reared to fledging was approximately the same as in early years (2.75/annum). The mean number of eggs fostered to the wild decreased from 6 to 0.6 per annum.

The management plan for captive black stilts was completed in late 1994 and is presently being revised for approval.

A total of 86 juveniles and 5 adults were released from the Twizel facility between 1987 and 1995 (Table 11). As at the summer of 1996, 17 of these were still alive.

4.2.2 Artificial incubation

Fertility of artificially incubated wild-laid eggs remained approximately the same as in earlier years with a mean of 81.7% from 1981 to 1986, and between 68.5 and 90.4% (mean = 81.5%) since 1987 (Table 4). A number of female-female pairs laid infertile eggs and 1-2 wild pairs each year produced infertile clutches (and often re-laid a fertile clutch). Losses of eggs during incubation continued to be variable after 1987 (mean = 8/annum), as did hatchability from fertile eggs (mean = 84.3%). Two of the last 3 breeding seasons did, however, achieve a 94-98% hatching success from fertile eggs (Figure 1).

4.2.3 Cross-fostering

Fewer chicks were given to wild pairs and reared to fledging during this period (1987-1995) (Figure 3). The mean number fledged between 1981 and 1986 was 19 per annum, and the range was 13-33; whereas the mean number fledged per annum between 1987 and 1995 was 6.3, and the range was 0 to 13.

4.2.4 Predator trapping

As personnel levels involved in wild population management decreased from 9 in 1981-1984 and 4.5-5 in 1985 and 1986 to 2 in 1987, predator trapping effort decreased. Trap-nights decreased from between 9757 and 26,399 (mean = 18,088), to between 0 and 2942 (mean = 1800 in 1987-1994). Between 0 and 104 animals were removed annually from 1987-1995 (mean = 49) compared with between 78 and 404 from 1981-1987 (mean = 283). No valleys were line-trapped, and between 0 and 8 nesting areas (mean = 3.25) were ring-trapped each season (cf. mean = 6.3 from 1981-1986) (Table 8).

Fledging success was higher in trapped areas in 1987; in untrapped areas in 1988; and approximately equal in 1989. No trapping was carried out around chick-rearing areas after 1989/90 (Table 10). Thirty-one chicks fledged after

160 eggs were put out to unprotected nests from 1988 to 1994 (19.4%), compared with 18 fledglings from 51 protected eggs (35.3%).

5. Research

Pierce (1982) studied the ecology of black and pied stilts in the Mackenzie Basin. He attributed the low productivity of black stilts to predation by introduced mammals (Pierce 1986). An analysis of predator removal as a management technique led Pierce to conclude that more chicks fledged from protected versus unprotected nests (Pierce 1986).

In an effort to understand more of predator populations in the Mackenzie Basin Pierce (1987) studied their diet, population dynamics and impact on birds in relation to the availability of rabbits. He suggested that a combination of passive and active management of predators was needed. Passive management included staff recognising comparatively "safe" nesting areas, active management included deterrents to predators around nests on vegetated banks. Pierce also concluded that there had been a weak recovery in the black stilt population during the 10 years (to 1987) of predator control. The failure of the population to respond better to management was linked with a high level of post-fledging mortality and wide dispersal of cross-fostered young.

The habitat requirements of black stilts on the Ahuriri river was quantitatively studied by Robertson *et al*. (1983) for submission as evidence in the Ahuriri River Water Conservation Order application.

No research followed that of Pierce (1987), with no Science and Research input into the black stilt programme until 1995. NPP and Science and Research bids were funded in the 1995/96 financial year for video surveillance at black stilt nests. Eighteen proposals were submitted from the black stilt management team for S&R funding between 1987 and 1995. None of these was supported. Project River Recovery (funded by ECNZ as part of the compensatory agreement for renewal of the Upper Waitaki Basin water rights in the late 1980s) has contributed to our knowledge of the effects of weed removal on predation of ground-nesting birds. They have also assisted with student research on predator-training captive-released juveniles and monitoring their survival post-release through radio-telemetry and observation. Monitoring of captive-released birds was a specific task outlined in the Upper Waitaki water right agreement but this agreement excludes financial support of all other directly management-orientated black stilt research.

6. Trends in wild black stilt population numbers

Figure 4 (and Appendix 1) shows summer population numbers for each year from 1984 to 1995, and winter counts from 1982 to 1995. Population numbers during summers prior to 1984 are unavailable, as most birds were then unbanded and breeding season reports did not include population counts.

Winter counts were generally lower than those of summer as:

1. some adults migrated away from the Mackenzie Basin in winter;

2. some wild birds (particularly juveniles) died between the breeding season and the following winter; and

3. many of the captive-released juveniles from 1993 and 1994 releases died or were missing before the subsequent winter count.

The summer population increased to a maximum of 81 in 1989, with fluctuations until 1994 (79) and an apparent decline in 1995 (72). Wild-reared juveniles produced from 1984 to 1990 have been replaced to a large extent by captive-released juveniles from 1990 onward. In the summer of 1995, only 54% of the population had been reared by wild parents.

The winter count (Figure 4) also indicates a population decline after 1989 which is particularly marked from 1993 to 1995. In these latter years, many of the captive-reared juveniles counted in the preceding summer had died before spending 6 months in the wild. As a result, the summer population counts overestimate the number of juveniles which are likely to survive into winter. It also appears that a larger proportion of adults are migrating from the Mackenzie Basin in winter.

7. Trends in rabbit/predator populations 1990-91

Rabbit numbers declined rapidly at the initiation of the Rabbit and Land Management Programme in 1990, from 61.6 rabbits per kilometre night count in autumn 1990 to 5.6 in spring 1991 (Mackenzie area) and remained at 0.9-1.8 during 1992 and 1993 (CRC 1995). The population has recently increased again with night counts of 3-5.5 per kilometre (Glentworth pers. comm.).

There are limited data available on predator numbers during the same period but some predators (particularly cats and ferrets) would undoubtedly have declined in response to the decline of their main prey. The total number of

animals caught per trap night in 1990, 1991 and 1994, however, is comparable with that of 1982-1990 (Table 8).

8. Discussion

The black stilt management programme underwent a major shift in direction from wild population management to captive rearing and release from 1987 until present. The shift from wild to captive management was the result of many factors including a reduction in financial and staffing allocations. The *intent* of the rearing and release programme was to boost wild management by adding juveniles reared in captivity. The *result*, however, was that rearing and release reduced effort and funding for wild management.

Predator removal from valleys and around nest-sites had been successful in increasing the fledging success of wild chicks in earlier years of the programme. This type of management was achievable as a result of high seasonal staff numbers including permanent team members, Wildlife Service trainees, wageworkers and volunteers. With the advent of DoC in 1987, this former source of staff (and indirectly volunteers) disappeared with the abolition of the trainee system for wildlife management. Predator management in the wild was no longer achievable by the two permanent staff employed to manage all collection of eggs, return of chicks to the wild, and population follow-up work.

More chicks fledged from untrapped than trapped nests between 1988 and 1994 (with the exception of 1989), but this probably reflected the greater number of eggs put out to untrapped compared with trapped areas. A greater proportion of eggs was placed into untrapped areas at that time, but a higher percentage of eggs survived to fledging in trapped areas (Saunders et al. 1996).

Operational funding from within DoC was difficult to obtain from an already incredibly supportive Twizel Field Centre and Canterbury Conservancy. Capital grants for aviary development were forthcoming, though. As the captive management facility was allowed to expand, more time and operational money was diverted from wild population management to *ex-situ* conservation. Additional staff were required at the aviary to assist with chick-rearing, and permanent team members were increasingly drawn away from wild and into captive management. Other Field Centre demands on black stilt managers continue to decrease time available for wild population management.

The lack of research support since 1987 has meant that long-term answers to the control of decline factors in the wild population were not addressed. While captive-rearing and release can maintain recruitment into the wild population, the agents of species decline have continued to operate without remedial management. Rearing and release (although still not proven to increase the breeding population) has the potential to maintain the wild population. However, there is little long-term gain in releasing young birds into an environment where predation is still the major cause of species decline. Captive rearing and release can only hold the population while we find longer term solutions to problems in the wild.

Multiple clutching and cross-fostering from 1981 to 1985 provided the potential to increase productivity and recruitment. While it was successful in fledging a larger number of young into the wild, recruitment was hindered by migration with foster parents. The potential gains in productivity provided through predator trapping and artificial incubation were unfortunately negated through fostering chicks to migrating parents. This potential for enhancing productivity through multiple clutching has not been lost, but additional eggs can now be used more efficiently through the captive rearing and release aspect of the programme. Used together - multiple clutching, predator control and captive rearing for release could be powerful tools for enhancing population growth. Until now, the first 2 techniques have been used in isolation from the third. Resources spent at this critical stage of population recovery will in the longterm reduce funding required for the programme by allowing a faster exponential rate of growth.

Multiple clutching can result in wild pairs being less successful in rearing chicks of their own, as often they will re-nest later in the season when food supplies are thought to be less available and predator numbers higher. This technique is therefore best used with pairs which migrate in winter or are at high risk of nest loss.

Predator control through trapping is time-consuming, resource and labour intensive, and cannot be maintained over the longer term. It has been an effective method of boosting recruitment, but should eventually be replaced by other methods of predator removal, e.g. poison baits, exclusion from nesting areas, vegetation control, immunocontraception, genetic engineering. These techniques will require research for their development and assessment.

A programme ecologist will be appointed in the 1997/98 financial year and predator trapping will again be initiated within a scientifically robust scientific design.

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APPENDIX 1. Summer and winter population counts

Year	Wild-reared adults	Wild-reared sub-adults	Wild-reared juvenile	Captive-reared adult	Captive-released sub-adult	Total
Jul-82	30	*	8	0	0	38
Jul-83	19	*	3	0	0	22
Jan-84	32	5	27	0	0	64
Jul-84	36	*	11	0	0	47
Jan-85	39	12	15	0	0	66
Jul-85	38	*	4	0	0	42
Jan-86	42	2	21	0	0	65
Jul-86	31	*	16	0	0	47
Jan-87	40	16	17	0	0	63
Jul-87	37	10	11	0	0	58
Jan-88	37	8	13	0	1	59
Jul-88	39	5	7	0	1	52
Jan-89	57	9	13	1	1	81
Jul-89	49	3	7	1	1	61
Jan-90	57	5	10	3	1	76
Jul-90	46	5	8	1	0	60
Jan-91	49	6	3	2	3	63
Jul-91	51	2	3	0	2	58
Jan-92	66	2	5	4	0	77
Jul-92	48	2	3	2	0	55
Jan-93	59	0	4	3	2	68
Jul-93	33	0	3	2	1	39
Jan-94	43	3	2	6	25	79
Jul-94	34	2	0	3	7	46
Jan-95	35	0	3	13	17	72
Jul-95	29	0	1	8	7	45

* includes adults and sub-adults

Table 1. Captive population 1979-1986

Year	Number adults/ subadults	Number juveniles parent-reared	Number eggs fostered to wild
1979-1982	8	0	0
1982/83	12	3	0
1983/84	14	3	10
1984/85	16	2	13
1985/86	19	1	9
1986/87	20	3	6
Total		12	38
Mean		2	6

Table 2. Captive population 1987-1995

Year	Number adults/ sub-adults	Number juveniles parent-reared	Number juveniles hand-reared	Number eggs fostered to wild
1987/88	16	1	0	0
1988/89	15	1	0	3
1989/90	30	3	10	0
1990/91	21	1	1	2
1991/92	21	5	6	0
1992/93	20	4	32	0
1993/94	17	2	32	0
1994/95	15	5	27	0
1995/96	22	7	24	0
Total		22	108	5
Mean		2.75	13.5	0.6

Table 3. Fertility of artificially incubated black stilt eggs 1981-1986

Season	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87
No. of wild-laid eggs incubated	21	66	45	46	64	39
No. of captive-laid eggs incubated	0	0	11	13	8	18
No. infertile wild eggs	7	6	7	8	7	9
No. infertile captive eggs	0	0	1	0	0	14
% fertility wild eggs incubated	66.6	90.9	84.4	82.6	89	76.9
% fertility captive eggs incubated	0	0	85.7	100	100	22.2

Table 4. Fertility of artificially incubated black stilt eggs 1987-1995

Season	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96
No. of wild-laid eggs incubated	54	61	73	73	34	97	81	70	56
No. of captive-laid eggs incubated	7	17	1	11	5	5	17	5	7
No. infertile wild eggs	17	8	7	8	8	18	13	17	1
No. infertile captive eggs	7	15	0	4	1	2	9	0	3
% fertility wild eggs incubated	68.5	86.9	90.4	89	76.5	81.4	83.9	75.7	98.2
% fertility captive eggs incubated	0	11.8	100	50	80	60	30.8	100	64.3

Table 5. Number of black stilt eggs dying during artificial incubation 1981-1986

Season	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87
No. died in incubation	1	29	10	1	13	2
No. died hatching	2	0	1	0	6	0

Table 6. Number of black stilt eggs dying during artificial incubation 1987-1995

Season	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96
No. died in incubation	3	13	5	13	8	2	10	3	0
No. died hatching	0	2	1	2	2	0	0	0	0

Table 7. Band recoveries (to April 1992) for all black stilt chicks fledged 1981-1987 (from Reed *et al.* 1993)

Survival	Parent type (No.)	
	Black (*a)	Hybrid (*b)
<1 yr	17	17
1-2 yr	10	2
2-3 yr	0	1
3-4 yr	2	0
4-5 yr	8	0
>5 yr	13	1
No. chicks fostered	50	21
No. resighted (*c)	33	4
Total No. recruited	5	1

*a Includes 1 non-migratory black x hybrid pair

*b Black x pied, pied x pied, hybrid x pied, hybrid x hybrid, black x hybrid

*c Number of juveniles re-sighted that were reared by black x black versus hybrid pairs differed ($P<0.01$), Chi-square = 13.064, 1 df.

Table 8. Trapping effort (1981-1994)

Year	No. areas valley trapped	No. nest areas ring-trapped	No. trap nights	No. animals caught[1]	Animals per 100 trap nights[2]	Number of staff[3]	Number of volunteers
1981/82	3	2	14000[3]	182	0.58[3]	5	4
1982/83	3	2	26399	341	1.3	6	3
1983/84	2	6	18985	348	1.83	7	2
1984/85	1	5	26239	404	1.54	4	5
1985/86	1	13	13151	271	2.06	4.5	0
1986/87	0	10	9757	152	1.56	5	0
1987/88	0	8	2942	78	2.65	3[5]	0
1988/89	0	4	1770	37	2.09	3.5[5]	0
1989/90	0	5(*6)	2310(*6)	104	4.5	4.5[5]	0
1990/91	0	4(*6)	2480	62	2.23	3.5[5]	0
1991/92	0	3(*6)	2780(*6)	64	2.3	4[5]	0
1992/93	0	0(*6)	0(*6)	0	0	4[7]	0.5
1993/94	0	0(*6)	0(*6)	0	0	5[7]	0
1994/95	0	2	2114	48	3.26	6[8]	0

* 1 Excludes hedgehogs, harriers, non-predators
* 2 Approximated from length of stay per individual = equivalent of full season
* 3 Estimated, as original data from Cass, Tasman, missing except animal numbers
* 4 No predator trapping report on file for this season. November trapping in Godley also missing
* 5 One person at the aviary almost full-time
* 6 Excludes pre-season trapping
* 7 Two people at the aviary full-time
* 8 Three people at the aviary full-time

Table 9. Survival of black stilt eggs/chicks in trapped/untrapped areas (1977-1986)

Year	No. nests trapped	No. nests not trapped	Nest area trapped		Nest area not trapped	
			No. eggs	No. chicks fledged	No. eggs	No. chicks fledged
1977-80[1]	13	15	40	13	33	2
1981/82	11	0	20	13	0	0
1982/83	22	2	40	18	2	0
1983/84	16	3	40	31	6	2
1984/85	14	2	41	13	11	2
1985/86	14	4	38	17	8	3
1986/87	7	5	22	13	14	5
Total	84	16	241	120	74	14

' From Pierce 1986

Table 10. Survival of black stilt eggs/chicks in trap ped/untrapped areas (1987-1994)

Year	No. nests trapped	No. nests not trapped	Nest area trapped		Nest area not trapped	
			No. eggs	No. chicks fledged	No. eggs	No. chicks fledged
1987-88	7	4	22	10	12	2
1988/89	5	7	12	1	23	7
1989/90	6	9	15	5	31	8
1990/91	4	8	14	0	28	3
1991/92	1	3	2	0	6	0
1992/93	0	15	0	0	43	6
1993/94	0	10	0	0	27	2
1994/95	0	8	0	0	20	7
Total	23	64	65	16	190	35

Table 11. Juveniles released from the Twizel aviary

Year	No. released	No. alive @ Summer 1996
1987	3	1
1988	3	1
1989	1	0
1990	7	1
1991	4	1
1992	5	0
1993	33 (+ 3 adults)	6
1994	30 (+2 adults)	3
1995	22	4

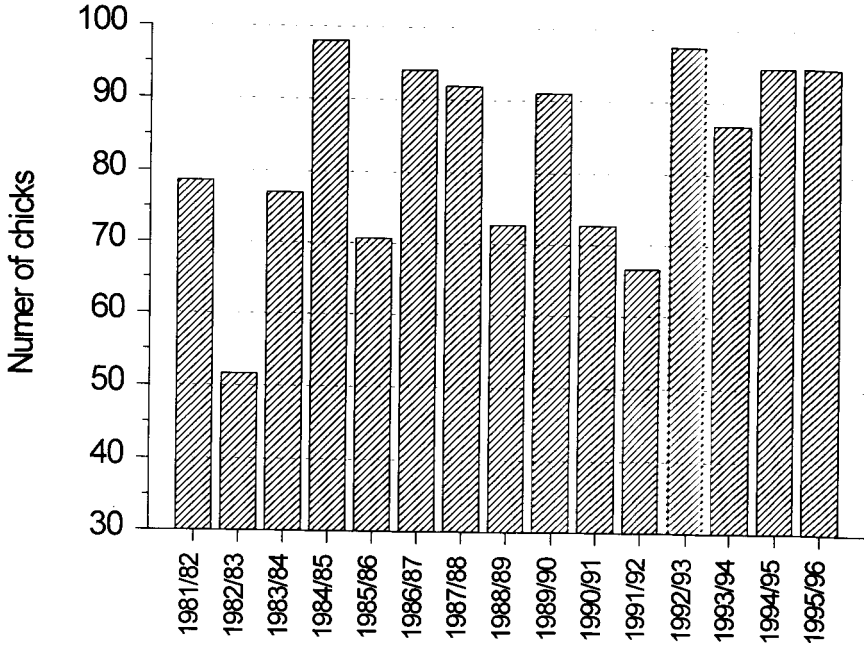

Figure l. Hatchability of artificially incubated fertile black stilt eggs.

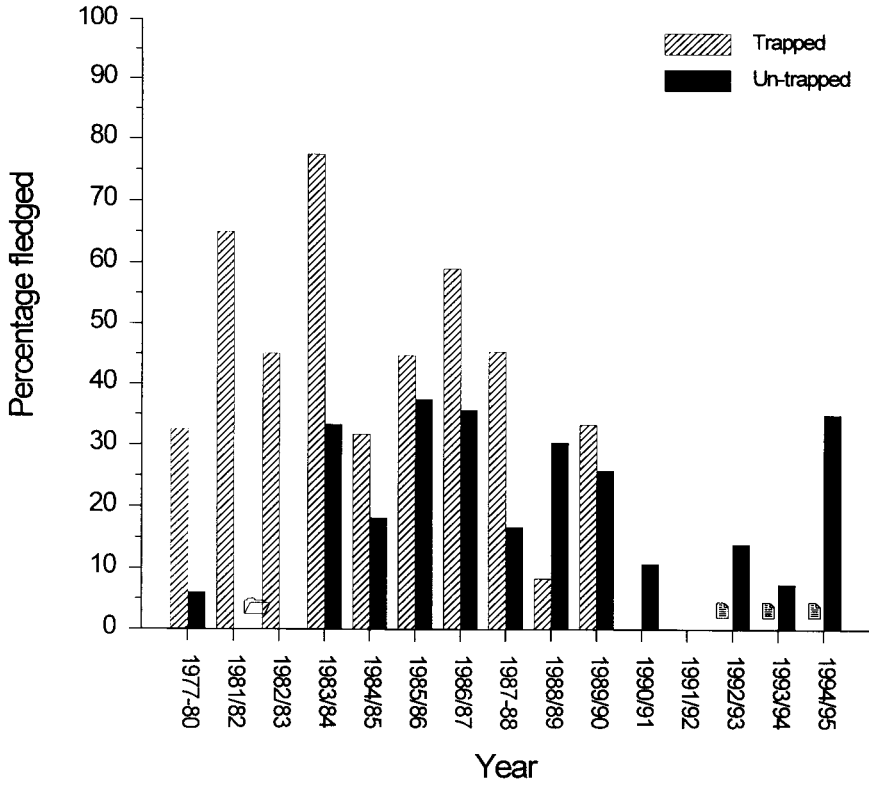

Figure 2. Fledging success of black stilt chicks in trapped vs untrapped nesting areas (🗁 indicates no untrapped nests, 🗎 indicates no trapped nests).

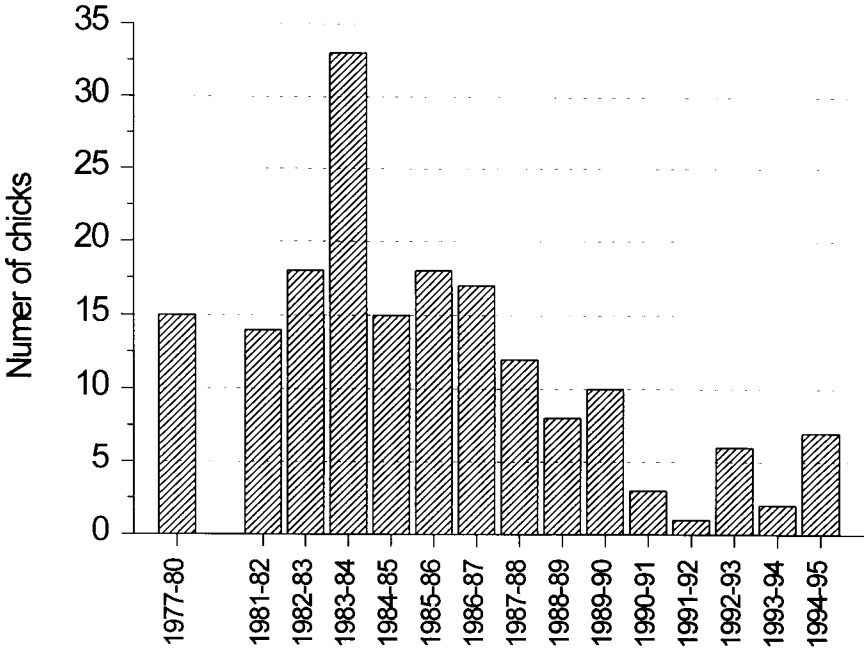

Figure 3. Number of chicks parent-reared to fledging in the wild

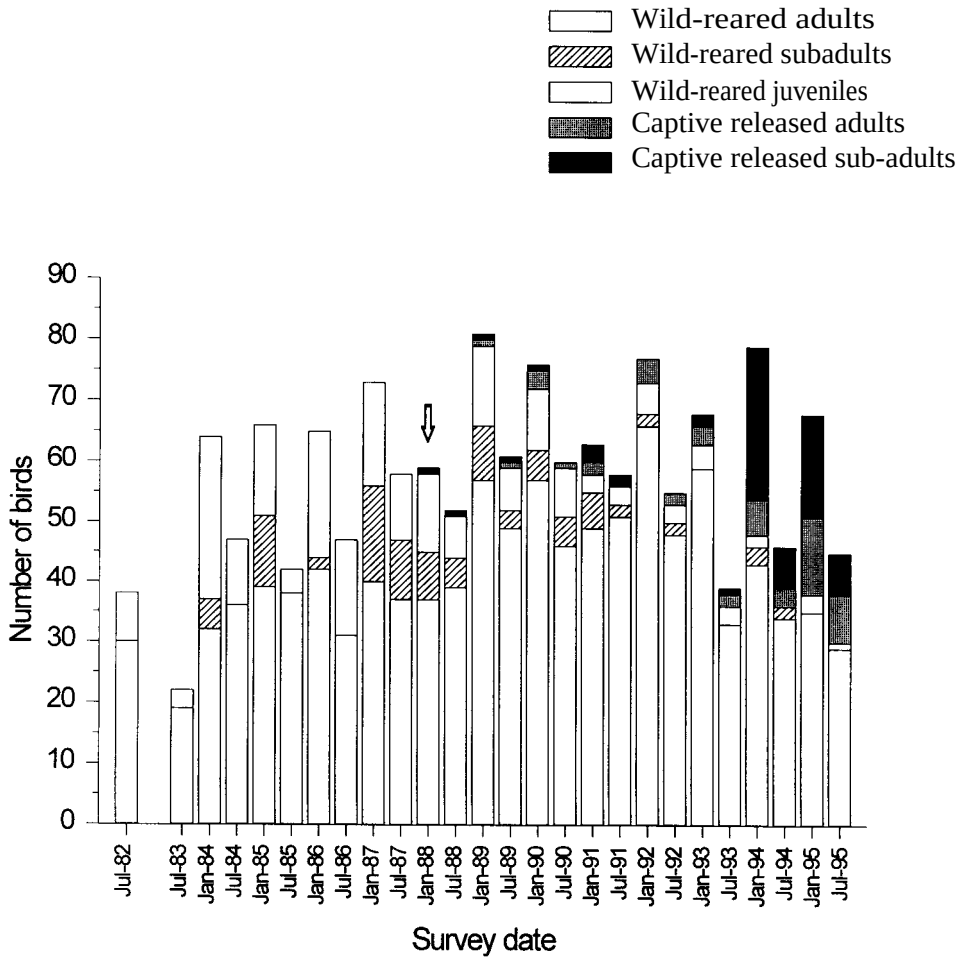

Figure 4. Black stilt population counts in January (summer) and July (winter). ⇩ indicates first count involving captive release birds