A SURVEY OF TRAVELLERS CARRYING HOST FRUIT OF QUEENSLAND FRUIT FLY, *BACTROCERA TRYONI* (FROGGATT), INTO A FRUIT FLY FREE AREA IN 1996/97

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Summary

Roadblocks were conducted on 32 days at the northern and eastern sides of the Fruit Fly Exclusion Zone (FFEZ) during 1996/97 to monitor the risk posed by road travellers into and through the Murrumbidgee Irrigation Area. Drivers of all vehicles stopped by roadblocks were asked to answer a questionnaire, and vehicles inspected for fruit. The 3579 completed survey forms were analysed for trends according to types of travellers, origin and destination of travellers, and fruit carried by travellers. Travellers from the North Coast of New South Wales and Queensland were high risk travel origins. Families and retirees were higher risk types of travellers. More fruit was found in cars towing a caravan than in cars without caravans. Local residents made up 71% of the traffic entering the FFEZ with tourists making up a smaller proportion of the total traffic flow. Pome fruit and bananas were the most commonly carried fruit. Compared with previous surveys, the average number of fruit carried increased slightly to 7.4 per vehicle but the proportion of vehicles carrying fruit declined to 12.7% of the traffic. Implication of the analyses are discussed in relation to incursion risk management and community awareness strategies.

INTRODUCTION

Queensland fruit fly (Qfly), *Bactrocera tryoni* (Froggatt), is a serious pest of horticultural crops in Queensland, and north eastern and many coastal parts of New South Wales. Many importing countries are sensitive to receiving produce from areas known to be infested by Qfly. The Fruit Fly Exclusion Zone (FFEZ) is on the ecological limit of the range of Qfly (Anon 1993) covering 135,000 square km (an irregular shaped area about 400 km by 700 km based on shire boundaries) including the major fruit production areas in New South Wales (NSW), Victoria and South Australia. It was established in 1994 to protect export markets valued at about $70 million p.a. by being demonstrably free from fruit fly.

The level of risk accepted by trading partners varies considerably based on negotiations and the level of concern regarding Qfly. Generally, the trapping of two male flies within 400 m of each other within two weeks constitutes an international fruit fly outbreak with a proclaimed quarantine radius of 15 to 80 km for up to one year, although there are many variations of any of these parameters. There has been considerable effort in the past to eliminate Qfly from the FFEZ. Other strategies are used each year to maintain the area's fruit fly free status. The impact is obvious given that several hundred Qfly (ten flies per trap per week) may be trapped each week in summer at Wagga Wagga, about 100 km to the east of the FFEZ border.

There are many activities in the FFEZ and the Risk Reduction Zone (RRZ) that minimise the chance of fruit flies entering the FFEZ; the RRZ is a zone about 100 km wide which surrounds the FFEZ. In the RRZ, these activities include town baiting (Skepper and Sweedman 1968), community awareness campaigns (Marrows and Dominiak 1997), controls on commercial fruit entry, cover sprays in orchard areas, and release of sterile fruit flies (Dominiak *et al.* 1998a; Dominiak and Webster 1998). Additional protection is afforded to the FFEZ by inspections of vehicles at random locations and times on roads entering the FFEZ for the presence of fruit (NSWA 1997; Dominiak *et al.* 1998b). This area-wide approach may be termed a 'Systems Approach' (Hendrichs 1996) or 'Integrated Commodity Management' (Evans and Graver 1987). According to Malavasi *et al.* (1994), maintenance of a fruit fly free area, such as the FFEZ, requires four programs: exclusion, detection, eradication/management, and public information.

The exclusion program aims to prevent the introduction of fruit flies by using strategies such as permanent inspection stations at borders, or roadblocks at random road sites and random times. Vehicle inspections at road sites on major highways serve two main functions:

1 they minimise the introduction of infested fruit. However, with only 32 days of operation during the 1996/97 year, this minimisation is unlikely to reach its maximum potential.
2 roadblocks are considered to be an effective strategy by raising public awareness of quarantine issues generally for the travelling public whether they carry fruit or not.

NSW commenced roadblocks near the Murrumbidgee Irrigation Area (MIA) in about 1970 and ceased activities in 1983. A review of fruit fly issues (HPC 1991) urged re-examination and possible reinstatement of roadblocks. Roadblocks were subsequently re-examined in a research project in 1994/95 (NSWA 1997). Following reinstatement of a random roadblock program, the outcomes of the Easter 1996 operation was reported by Dominiak *et al.* (1998b). This paper reports on the next period of operations covering 32 days during September 1996 to April 1997. Given that considerable resources are spent each year on the education of the travelling public, this survey should identify higher risk travelling groups which could be targeted by the community awareness campaign (Marrows and Dominiak 1997).

METHODS

Based on results of two previous surveys in 1994/95 (NSWA 1997) and Easter 1996 (Dominiak *et al.* 1998b), roadblocks were established on the Newell Highway, Sturt Highway, and at Kamarah. These operated for 8 hrs during daylight hours when the traffic flow is the highest. Holiday periods were previously identified as high risk periods and more than half of the roadblocks were conducted during holidays. Thirty-two roadblocks were operated: two in September 1996, seven in January 1997, six in February, nine in March and eight in April 1997. The sampling days were selected such that they were distributed equally between normal days and school holidays.

Once the roadblock was established, vehicles were directed into the inspection bay until the bay was full. Once the bay was full, other vehicles entering the roadblock site were waved through the roadblock site without entering the inspection bay. This process was repeated during the day. The driver of each vehicle stopped in the inspection bay was asked two questions: "Where did your trip originate?" and "Where are you going?". Inspectors also recorded observations on the type of vehicle, and type of traveller. The luggage compartment of vehicles was inspected for fruit and details of any fruit found was recorded on the survey form. Fruit was sliced in an examination for fruit fly larvae and any infested fruit was noted. One form was completed for each vehicle stopped.

While 3579 survey forms were completed, a small percentage of forms did not have all data lines completed and this lack is reflected in the respective tables. These forms were the same as those used at Easter 1996 (Dominiak *et al.* 1998b) but different to those used in 1994/95 (NSWA 1997).

All fruit intercepted at roadblocks was confiscated and destroyed. Some travellers with high risk fruit consignments were prosecuted through the court; consignments were deemed to be high risk if they contained large numbers of fruit, or medium numbers of fruit from high risk areas such as Queensland.

An attempt to assess the overall risk was made by multiplying the number of fruit carried by the proportion of fruit carriers from different origins and by types of travellers. While this is a simplistic approach, it does in part at least quantify the risk in the absence of other quantifiable risks.

Statistical analysis

The presence or absence of fruit fly hosts in vehicles inspected at the road block survey were analysed to establish their relationship with factors such as holidays, days of the week, origins of travel, destinations for travel, types of vehicle and types of travellers. We used a Generalised Linear Model (McCullagh and Nelder 1989) to test the above relationship and assumed the data to be binomially distributed. The response variable and the explanatory factors were linked by a log-odds (logit) function as follows:

$$\log [P(y=0,1)/\{1-P(y=0,1)\}]=\text{Holiday} + \text{Day} + \text{Origin} + \text{Destination} + \text{Vehicle} + \text{Traveller}$$

where P(y=0,1) is the probability of presence (y=1) or absence (y=0) of fruit fly hosts in a vehicle inspected at the road block survey.

Likelihood Ratio (LR) chi-square statistic was used to test the significant effects of the explanatory factors and 95% confidence limits were used to compare differences within each explanatory factor (Table 1).

Table 1. Chi-square values given by the Likelihood Ratio test.

	df	Fruit carrying	Total fruits	Stone fruit	Tomato
Holiday	1	1.51^{NS}	0.28^{NS}	16.15^{***}	22.85^{***}
Days of week	6	14.14^{*}	2.91^{NS}	10.66^{**}	25.91
Origins	6	17.04^{**}	70.53^{***}	18.13^{**}	6.41^{NS}
Destinations	4	59.45^{***}	5.30^{NS}	8.81^{NS}	22.34^{***}
Vehicle types	1	16.26^{***}	6.80^{**}	6.62^{*}	3.69^{NS}
Traveller types	3	46.22^{***}	25.84^{***}	1.43^{NS}	1.04^{NS}

^{NS} denotes not significant at 5% probability level

*, **, *** denote significance at 5%, 1% and 0.1% probability levels respectively

The total number of fruit fly hosts per vehicle, number of stone fruit, and number of tomatoes were analysed using the technique as above except that the numbers were assumed to follow a Poisson distribution and a logarithmic link was used. Only non-zero observations were included in the analyses and the analyses were run on SAS/STAT PROC GENMOD (SAS Institute Inc. 1997).

RESULTS

In this survey, there was strong evidence that the proportion of travellers carrying fruit into the MIA was related to several factors fitted in our model above (χ^2_{45}=284.0, P<0.001). The origin of travellers was one of the major factors associated with fruit carriers (P<0.001: Table 1) with Queensland travellers being the most likely (24%) to carry fruit and was significantly higher than those from inland NSW which were least likely to carry fruit (9%: Table 2). Medium range (15%–16%) fruit carriers were travellers from Australian Capital Territory, Greater Sydney, and North Coast NSW, and not significantly different from any other origins. Compared to the results of the previous surveys, there appeared to be a marginal decrease in the proportion of travellers from Queensland and inland NSW who carried fruit into the MIA. Fruit carriers from Australian Capital Territory remained constant at about 15%. The risk analysis indicated that North Coast NSW was by far the highest overall risk origin with Queensland being second; other origins were similar to each other.

Destination of travel was also a major factor affecting the chance of carrying fruit (P<0.001: Table 1). Only 8% of travellers with a destination of inland NSW carried fruit and they were statistically lower than heading elsewhere (23%: Table 2). In the overall risk rating, inland NSW was a smaller risk than other destinations.

Types of travellers were also associated with the carrying of fruit (P<0.001: Table 1) with retirees (Table 3) being the highest probability to carry fruit (24%), followed by family travellers (16%). Single travellers and commercial travellers (business trip in Table 3) were least likely (8% and 6% respectively) to carry fruit. This survey and the two previous surveys showed that retirees and families were consistently most likely to carry fruit into the MIA whereas day trippers were consistently least likely (about 7%). The risk analysis indicated that retirees were the highest overall risk followed by families.

Days of the week were not a major factor characterising the tendency of carrying fruit (P=0.06) though Tuesday was found the highest and Monday was found the lowest (Table 4). In this survey, holidays did not affect the carrying of fruit at all (χ^2_1=0.03, P>0.1); this varies to the results of the 1994/95 campaign.

This survey found pome fruit (Table 5) was the most common fruit carried (28%) and banana was next (22%). Other fruit fly hosts such as citrus, tomato, and stone fruit ranged from 13–14%. The high risk fruit, tomatoes (13%) and stone fruit (14%), are ranked about equal third. While tomatoes are classified as having a medium pest status (HPC 1991), they are regarded as high risk because of the proportion coming from home gardens (Ballantyne 1992). Stone fruit have a high risk classification (HPC 1991) and are considered high risk fruit at roadblocks. Comparisons with two other surveys are also included in Table 5. Compared with the other annual survey in 1994/95 (NSWA 1997), stone fruit has moved from 27% (ranked first in preference for type of fruit to be carried) to 14% (ranked third) in this survey; it was only 4.5% in Easter 1996. However this was a small survey period and this result is likely to be influenced by the availability of stone fruit at Easter. There were no consistencies in the ranks of fruit types carried by travellers into the MIA region between 1994/95 (NSWA 1997) and our survey (Table 5).

Pome fruit and bananas were classified as being high risk fruit in HPC (1991) but are now usually regarded as low risk at roadblocks because apples are grown in cold climates and bananas are picked green (unripe).

In this and the two previous surveys, the analysis on total number of fruit included only vehicles that carried fruit. This survey found an average of 7.4 pieces of fruit per vehicle which was higher than the two previous surveys (Table 5). From the model, we considered above significant factors contributing to the variation of fruit numbers were types of travellers (P<0.001), traveller origin (P<0.01) and types of vehicles (P<0.001). Among travellers, single adults carried the highest number (9.8 pieces), retirees and family were next (6.9 and 5.7 pieces respectively) and commercial travellers were the lowest (3.1 pieces). Comparing between traveller origins, North Coast NSW was the highest (27.8 pieces of fruit) and other origins carried in a range of 3.1 to 7.5 pieces. The car-caravan type of vehicle carried an average of 11.8 pieces compared to cars only with an average of 7.3 pieces.

Table 2. Numbers and proportions of vehicles and of travellers (with 95% confidence limits in brackets) carrying fruit (proportions followed by the same letter are not significantly different) going to or from different localities. Comparisons with two other reports are also given. The number of fruit carried by travellers from each origin and destination was multiplied by the proportion of travellers with fruit to calculate the overall risk rating for each location.

Trip details	Origin or destination of trip	Number and proportion of vehicles stopped	Proportion of travellers carrying fruit			Current survey	
			1994/95 (NSWA 1997)	Easter 1996 (Dominiak *et al.* 1998b)	1996/97 Current survey	Number of fruit carried	Overall risk rating
Queensland	Origin	488 (0.139)	0.31	0.35	0.23 (0.17 – 0.31) b	7.4	1.70
Australian Capital Territory	Origin	184 (0.052)	0.16	0.16	0.15 (0.09 – 0.24) ab	3.8	0.57
Greater Sydney	Origin	543 (0.154)	0.25	0.15	0.16 (0.11 – 0.23) ab	4.8	0.77
South Coast NSW	Origin	28 (<0.01)	0.20	0.15	0.21 (0.09 – 0.41) ab	3.1	0.65
Inland NSW	Origin	2170 (0.617)	0.12	0.12	0.09 (0.06 – 0.13) a	7.5	0.68
North Coast NSW	Origin	86 (<0.01)	0.31	0.07	0.15 (0.08 – 0.26) ab	27.8	4.17
Other	Origin	18 (<0.01)		0.06	0.05 (0.01 – 0.31)	6.0	0.30
Inland NSW	Destination	2498 (0.711)		0.12	0.08 (0.06 – 0.12) c	7.5	0.60
Other	Destination	1019 (0.289)		0.16	0.23 (0.17 – 0.30) d	7.3	1.68

Table 3. Types of travellers and proportion (with 95% confidence limits) of different traveller types carrying fruit (proportions followed by the same letter are not significantly different). Comparisons with two other reports are also given. The number of fruit carried by different types of traveller was multiplied by the proportion of travellers with fruit to calculate the overall risk rating for each traveller type.

Type of traveller	Number of vehicles stopped in current survey	Proportion of travellers carrying fruit			Number of fruit carried per vehicle	Overall risk
		1994/95 (NSWA 1997)	Easter 1996 (Dominiak *et al.* 1998b)	1996/97 Current survey	1996/97 Current survey	
Business trip	200 (0.057)	0.06	0.00	0.06 (0.03 – 0.10) b	3.1	0.186
Day tripper	1445 (0.411)	0.06	0.07	0.08 (0.05 – 0.11) b	9.8	0.784
Singles		0.13	0.07			
Retirees	314 (0.089)	0.37	0.13	0.24 (0.17 – 0.34) a	6.9	1.656
Families	1558 (0.443)	0.29	0.17	0.16 (0.11 – 0.22) a	5.7	0.912

Table 4. Proportion of travellers carrying fruit (with 95% confidence limits) on particular days of the week (figures followed by the same letter are not significantly different). There was no significant difference between holidays and normal days in 1996/97.

Source	1994/95 (NSWA 1997)		1996/97
	Holidays	Normal	Current survey
Monday	0.21	0.12	0.083 (0.046 – 0.146) a
Tuesday	0.12	0.17	0.168 (0.108 – 0.250) a
Wednesday	0.18	0.11	0.128 (0.082 – 0.192) a
Thursday		0.18	0.111 (0.078 – 0.155) a
Friday		0.16	0.143 (0.099 – 0.202) a
Saturday	0.20	0.14	0.148 (0.104 – 0.205) a
Sunday	0.16	0.14	0.134 (0.094 – 0.187) a
Average	0.189	0.146	0.127

Table 5. Proportion, number and type of fruit intercepted during this and two previous roadblock surveys. Also given are average number of fruit per carrying traveller.

Fruit	1994/95 (NSWA 1997)	Easter 1996 Dominiak *et al.* (1998b)	1996/97 Current survey
Pome fruit	0.24	0.37	0.28
Tomatoes	0.09	0.23	0.13
Bananas	0.13	0.16	0.22
Citrus	0.09	0.10	0.13
Tropical fruit	0.05	0.05	
Stone fruit	0.27	0.045	0.14
Others		0.045	0.10
Total fruit confiscated	1890	1357	3101
Average number of fruit per carrying traveller	5.2	6.4	7.4

Stone fruit is recognised as a high risk fruit for the movement of Qfly because it is a preferred and good host for Qfly. This survey recorded an average 5.5 pieces of stone fruit per vehicle which carried fruit. Out of six factors considered in the model, the factors of holiday/normal day and traveller origin were strongly associated with the quantity of stone fruit carried. During holidays, travellers brought in 6.7 pieces which was higher than normal days (3.4 pieces). The origin of inland NSW claimed the highest (7.4 pieces) and other origins had stone fruit at an average ranging from one to four fruit. North Coast NSW, which had an average 27.8 pieces of fruit, carried an average of one stone fruit.

Tomatoes, which are considered as a high risk host for Qfly, were intercepted on an average of 3.4 pieces per vehicle found to carry fruit. Unlike other fruit, the number of tomatoes intercepted varied significantly between holiday and normal days, between days of the week, and between destination (all $P<0.001$). Holidays were responsible for 4.1 tomatoes per vehicle carrying fruit whereas normal days claimed for 2.8 pieces. Sunday had the highest number of tomatoes (5.2 pieces) and Monday had the lowest (2 pieces). Travellers with fruit in their vehicle heading to inland NSW had an average 6 tomatoes whereas those heading to other destinations had tomatoes on average ranging from 1.8 to 2.9 pieces. Retirees carried 4.1 tomatoes compared with families with 3.1 tomatoes; however there was no significant difference between any of the types of travellers.

There was a significant difference ($P=0.001$: Table 1) between types of vehicles. Cars (including utilities and station wagons) made up 97.4 % of the vehicles, while cars with caravans made up 2.6 %. Of the two main types of vehicles, 12.05% of travellers in cars carried fruit and 40% travellers in car/caravan carried fruit.

NSWA (1997) reported about 72% of the traffic flow was going to the FFEZ and related areas compared with 71% in our survey. The proportion of traffic going to this area appears to remain constant.

Fruit confiscated was examined for fruit fly damage; a high proportion was sliced with a knife and the presence of larvae was checked. Using this method, no fruit fly infestations were detected however the detection of eggs and early instars is difficult using this method.

Overall percentage of vehicles carrying fruit in this survey was 12.7% which was slightly lower than two previous surveys, 15.8% in 1994/95 (NSWA 1997) and 13.5% in Easter 1996 (Dominiak *et al.* 1998).

DISCUSSION

There is circumstantial evidence to suggest that the presence of the periodic roadblocks themselves has caused a reduction in the amount of fruit being carried into the FFEZ. The annual carriage rate has changed from 15.8% in 1994/95 (NSWA 1997) to 12.7% in 1996/97 (our survey); the holiday-only fruit carriage rate has changed from 18.9% in 1994/95 (NSWA 1997), to 13.5% in Easter 1996 (Dominiak *et al.* 1998b), to 12.7% in 1996/97 (current survey). This is likely to be a reflection on the visual impact of the roadblock operation on local travellers who make up about 71% of the total traffic flow (irrespective of if the local traveller was stopped or not). Similarly the prosecution of local residents will have added to the impact. The fruit fly quarantine message would have been supported by the community awareness campaign (Marrows and Dominiak 1997) with messages on TV and local newspapers which was conducted during all three survey periods.

Though there was a decrease in the percentage of vehicles carrying fruit, the average number of fruit per vehicle intercepted at the roadblocks rose from 5.2 (NSWA 1997), to 6.4 (Dominiak *et al.* 1998b), to 7.4 pieces (current survey) per vehicle. This increase is a concern for incursion risk management for the FFEZ.

The community awareness campaign should induce intending visitors to the FFEZ not to take fruit into the Zone or be prepared to discard fruit into the disposal bins before entering the FFEZ. Retirees and families should be targeted as these types of travellers are frequent carriers of fruit. Travellers using cars towing caravans should also be targeted. The community awareness campaign on the Qfly risk to the fruit industry should be promoted or intensified in Queensland and North Coast NSW.

Travellers on holidays have a slightly higher rate of carrying stone fruit and tomatoes compared to those travelling on normal days. Other non significant trends support the conclusions in previous surveys that random roadblocks should target holiday periods.

All three surveys have found that families and retirees are the highest risk traveller type, however the proportion of these groups carrying fruit has decreased. The enhanced community awareness program conducted during the year (Marrows and Dominiak 1997), and general public awareness of quarantine issues created by the presence of random roadblocks themselves, may have contributed to this outcome. Overall risk assessment has identified retirees as being a considerably higher risk group than families. The community awareness campaign should target this group.

Origin of trips remain a major concern. Travellers from Queensland appear to remain a high risk origin group with travellers from North Coast NSW having a similar rate of fruit carrying to many other origins when comparing only the proportion of travellers carrying fruit. However the overall risk assessment clearly suggests that travellers from North Coast NSW posed more than twice the risk of travellers from Queensland. Based on this assessment, the North Coast NSW should be targeted with a community awareness campaign.

Travellers going to inland NSW were less likely to carry fruit compared with travellers going to all other locations. Residents in and near the FFEZ are exposed to a considerable community awareness campaign which could have contributed to this outcome.

If random roadblocks are to have maximum effect in New South Wales, the higher risk fruit carrying types of travellers should be targeted. Random roadblocks during holidays should have priority over normal days. Cars towing caravans should be targeted during roadblock operations. Strategies, such as a community awareness program, should target families and retirees to further decrease the rate of fruit carrying by these two types of travellers. The North Coast NSW should also be targeted in the community awareness campaign for 1997/98.

In conclusion, roadblocks are still needed as there remains a considerable amount of fruit being carried into the FFEZ. The strategy of community awareness programs on Qfly risk to fruit industries and roadblocks should be refined and implemented efficiently until fruit carrying rate reaches an asymptotic level which cannot be reduced any more.

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REFERENCES

Anon. (1993). Proposal to establish a Fruit Fly Exclusion Zone in south east Australia. Agriculture Victoria.

Ballantyne, I. (1992). Fruit fly, a review of the TriState community awareness program 1989–92. Australian Quarantine and Inspection Services.

Dominiak, B.C., Cagnacci, M., Rafferty, T. and Barchia, I. (1998a). Field cage release of sterile Queensland fruit fly (*Bactrocera tryoni* Froggatt). *Gen. appl. Ent.* **28:** 65–71.

Dominiak, B.C., Rafferty, T.D. and Barchia, I. (1998b). An analysis of the travellers carrying fruit near Griffith, NSW, during Easter 1996 to assess the risk for Queensland fruit fly (*Bactrocera tryoni* (Froggatt)). *Gen. appl. Ent.* **28:** 13–19.

Dominiak, B.C. and Webster, A. (1998). Sand bed release of sterile Queensland fruit fly (*Bactrocera tryoni* Froggatt) at Young. *Gen. appl. Ent.* **28:** 9–11.

Evans, D.E. and van S Graver, J. (1987). Integrated pest and commodity management: putting first things first. CSIRO Australian Division Entomology Report. **42:** 1–11.

Hendrichs, J. (1996). Action programs against fruit flies of economic importance; Session overview. In: Fruit fly pests—a world assessment of their biology and management. Eds. McPheron and Steck. 513–519.

HPC (1991). The impact of fruit flies on Australian horticulture. Horticultural Policy Council. pp 1–101.

Malavasi, A., Rohwer, G.G. and Campbell, D.S. (1994). Fruit fly free areas: strategies to develop them. In: Fruit Flies and the sterile insect technique. CRC Press. 165–180.

Marrows, M. and Dominiak, B.C. (1997). Annual Report 1996/97. Tristate Fruit Fly Community Awareness Program. New South Wales Agriculture. pp 50.

McCullagh, P. and Nelder, J.A. (1989). *Generalised Linear Model*. 2nd Edition. Chapman and Hall, London.

NSWA (1997). Measuring the amount of uncertified fruit carried by travellers into the Murrumbidgee Irrigation Area. Project FR435. HRDC Final Report. New South Wales Agriculture. pp 64.

SAS Institute Inc (1997). SAS/STAT Software: Changes and enhancements, Release 6.12. SAS, Cary, NC. USA.

Skepper, A.H. and Sweedman, R. (1968). Whole town treatment for fruit fly control. Agricultural Gazette. 79:12. 705–709.