

## Life Cycle of an Oriental Blow Fly, *Lucilia porphyrina* (Walker) in Nagasaki, Western Japan

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**Abstract:** An investigation was made of the life history of *Lucilia porphyrina* (Walker) in Nagasaki prefecture, Western Japan from January, 1990 to December, 1992. A trap baited with horse meat was maintained at each of 3 altitudes, 5m, 500m and 1,000m, on Mt. Gokahara-dake. The number of flies captured was recorded once a month. The larvae and pupae which had bred from meat in the trap were also counted and transferred into a separate trap for emergence. The upper region of the mountain was considered as a primary habitat of this blow fly. At all altitudes, mature larvae were observed to enter dormancy/diapause in fall. Before winter adult flies at higher altitudes probably migrate to lowland for hibernation. After hibernation, males and females copulate, and females migrate again to highlands for oviposition during spring and early summer. During summer the highland seems to be the main habitat because all life stages were observed, while the lowland trap held only dormant/diapause larvae in summer. These latter individuals pupated and emerged in September.

*Key words:* *Lucilia porphyrina*, dormancy, life cycle, seasonal prevalence, altitudinal migration, hibernation

### INTRODUCTION

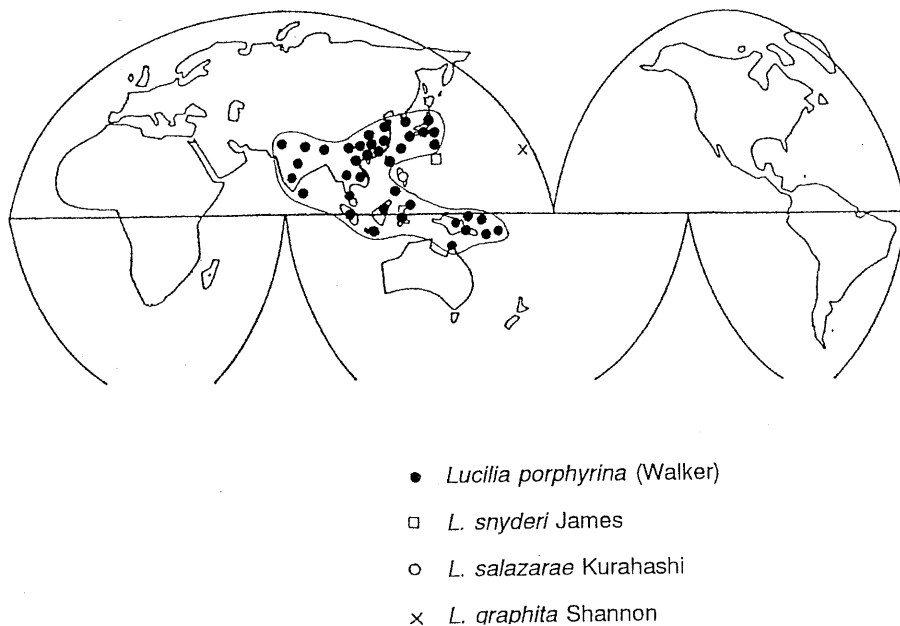
As shown in Fig. 1, *Lucilia porphyrina* (Walker) is widely distributed mainly in Southeast Asia ranging from Japan (south of Miyagi prefecture) and Santon province of China in the north, to New Guinea, Queensland in Australia in the south, and also to Kashmir near the boundaries of Pakistan and India in the west. In the east of the range, 3 very similar species, *Lucilia salazaræ* Kurahashi, *L. snyderi* James and *L. graphita* Shannon have been reported from Philippine islands, Ogasawara islands and Midway islands, respectively (Kurahashi, 1979; James, 1962; Shnnon, 1926). In the center of distribution in tropical and subtropical areas, this species occurs at high altitude, usually more than 1,500 m above sea level. It seems, therefore, that the origin of *L. porphyrina* is the cool mountainous area in the tropical and subtropical zones. However, their life history is still unknown.

In Japan located in the temperate zone, the natural history of this fly is not clear. In the

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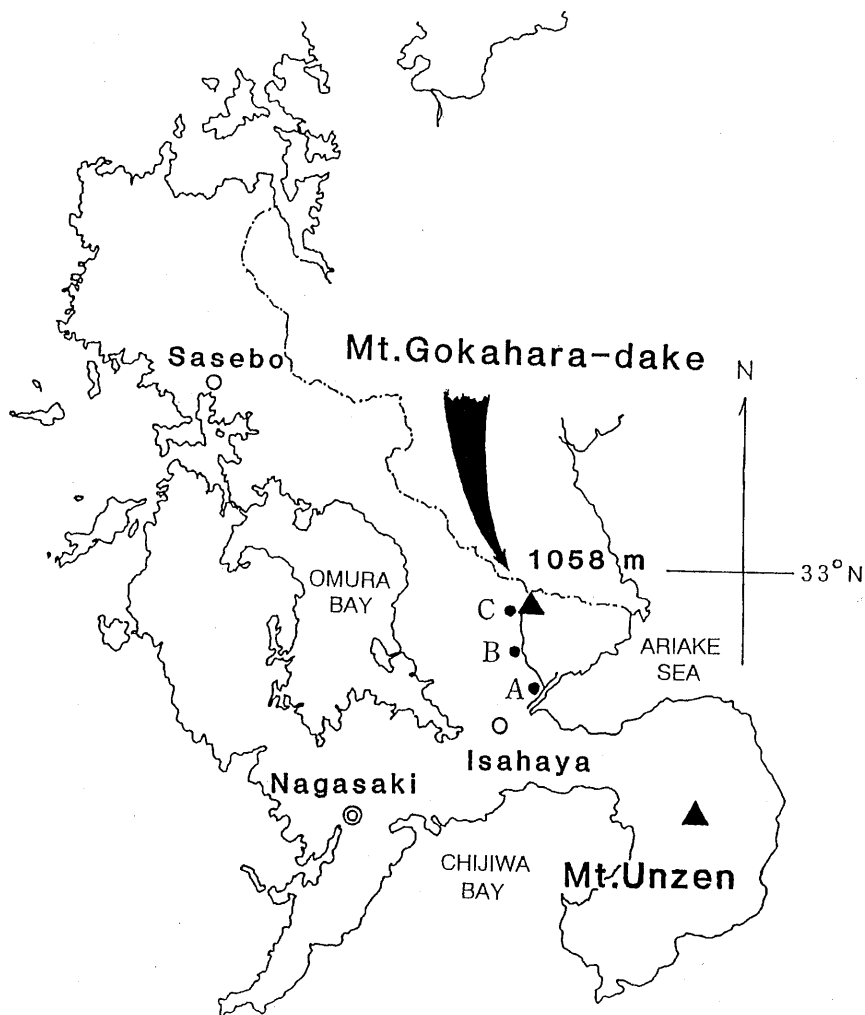
**Fig. 1.** Geographical distribution of *Lucilia porphyrina* (Walker) and 3 closely allied species in the world.

Main Island, this species invades private houses together with an other species, *Melinda pusilla* (Villeneuve) for overwintering, and causes trouble as a nuisance insect (Kurahashi *et al.*, 1982). In Nagasaki area where the climate is mild even in winter, *L. porphyrina* may be on the wing, and trapped throughout the year. We considered that this area is a suitable place in Japan to study the life history of this oriental blow fly preferring a moderate climate to a hot one.

#### MATERIALS AND METHODS

Field examinations to know the life cycle of *L. porphyrina* were made at Mt. Gokahara-dake (1,058m), which lies in Nagasaki prefecture, Kyushu, South-West Japan (Fig. 2). One horse meat baited fly trap (hereafter baited trap) with associated fly emergence trap (emergence trap) (Kurahashi *et al.*, 1984; Suenaga and Kurahashi, 1994) was set up at 3 survey stations of different altitudes, 5m (A, Nishizato, lowland), 500m (B, Hegi, mountainside) and 1,000m (C, near the top of the mountain) along the Nagate River. Field survey was continued for 3 years from January, 1990 to December, 1992.

The baited trap captures adults after they have had an opportunity to contact with the 150g horse meat bait. Its samples, therefore, reflect adult density, and eggs and/or larvae deposited on the bait will reflect their oviposition activity. Some trapped females were examined for insemination and egg maturity, and the degree of wing wear (Jackson, 1946; Kurahashi *et al.*, 1984). Traps were baited monthly, at which time the eggs and larvae on the previous horse meat in the trap were transferred together with the meat into the emergence trap, and feeding larval (or larval), postfeeding larval (or prepupal) and pupal periods were examined monthly until all flies in the emergence trap had emerged.

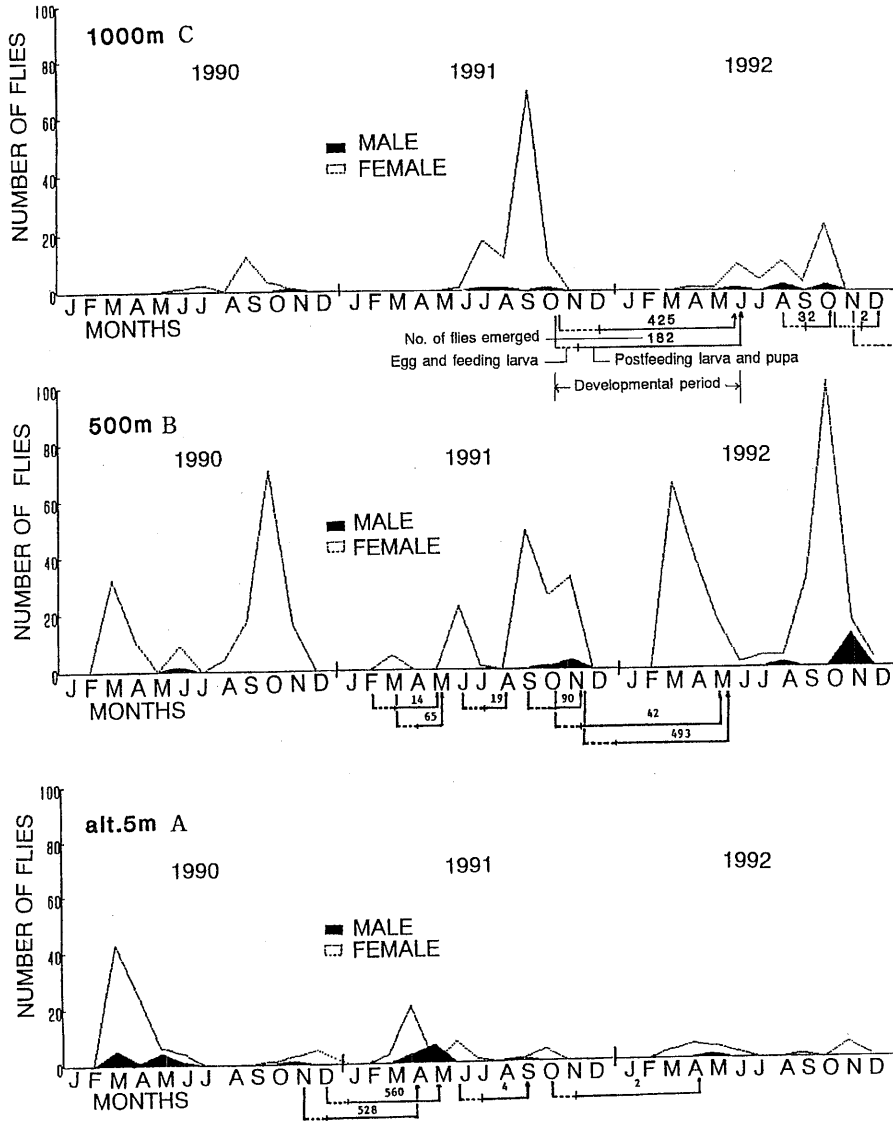


**Fig. 2.** A map of Nagasaki Prefecture showing 3 fly survey stations, A (alt. 5m), B (alt. 500m) and C (alt. 1,000m) at Mt. Gokahara-dake, Nagasaki, Japan.

#### RESULT AND DISCUSSION

Monthly number of adult flies collected by the baited trap, developmental periods, and number of flies that emerged in the emergence trap at the 3 survey stations during 1990, 1991 and 1992 are shown in Fig. 3. The white and black line graphs shown the number of female and male flies collected by the baited traps, respectively. The dotted line (egg and feeding larva or larva) and solid line (postfeeding larva or prepupa and pupa) and arrows under the months show the developmental periods (month), and figures on the lines are number of emerged flies.

At the Station A (lowland, Fig. 3A), although the number of adult flies trapped in each year was fairly different, they appeared in almost the same seasons every year, with no flies being collected in late summer (August), mid and late winter (January and February).



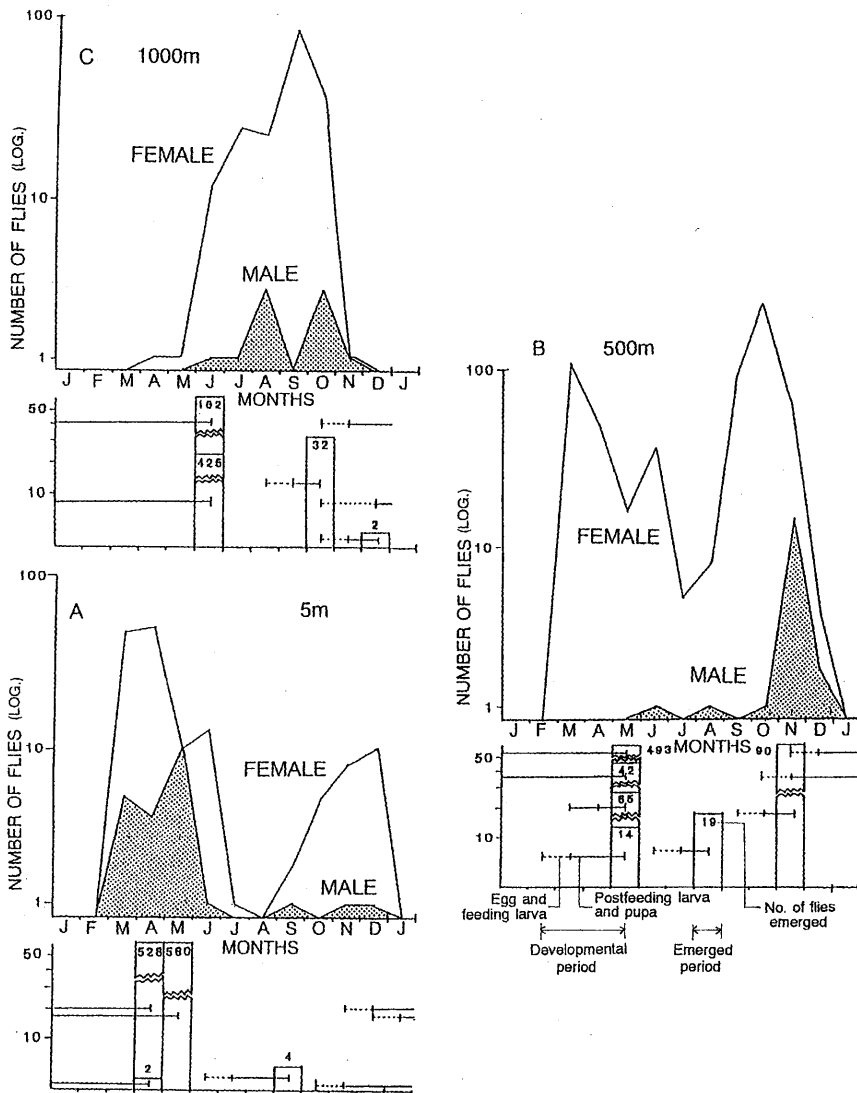
**Fig. 3.** Monthly number of adult flies collected by the horse meat baited fly trap, developmental periods and emerged number of flies bred out in the fly emergence trap at 3 stations, A, B and C in 3 years, 1990, 1991 and 1992. Explanation of each mark is shown in the upper figure, 1000m C.

At the Station B (mountainside, Fig. 3B), seasonal prevalence patterns of the fly were fairly different according to year. In 1990 and 1991, they showed 2 peaks of appearance before summer season, and after that the number of flies decreased in July and August, and showed a large peak again in fall. In 1992, however, they showed 2 large peaks in spring through early summer and early fall through early winter. Though the number is small, they appeared during the summer continuously. From the results of observation by the emergence trap, it became clear that their

developmental periods are 2–3 months in spring and summer seasons, and they have 3 generations in this period.

At the Station C (near the top of mountain, Fig. 3C), the fly was collected from May to November continuously with 3 possible peaks. Among them, the fall peak was clear every year. The results of observation by the emergence trap showed that the flies bred in summer and fall (in part) emerged within 2 months, while most of the flies bred in October overwintered as postfeeding larval (or prepupal) stage and emerged in June of the next year.

Fig. 4 shows the seasonal change of the number of adult flies collected by the baited trap,



**Fig. 4.** Seasonal change of the total number of adult flies collected by the baited trap in 3 years, 1990, 1991 and 1992, developmental periods, emerged months, and number of emerged flies at the 3 fly survey stations, A, B and C. Explanation of each mark is shown in the right figure, B 500m.

the developmental period, and the number of emerged flies at the stations, A, B and C in 3 years, 1990, 1991 and 1992. Total number of adult flies collected in each month in 3 years is shown by the upper line graph on a logarithmic scale. Developmental and emerged periods of flies are indicated by the lower dotted line (egg and feeding larva), following solid line (postfeeding larva and pupa), and the histogram with the number of emerged flies. Fig. 5 shows the seasonal change of the percentage of female flies not inseminated and with immature ovaries and the degree of wing

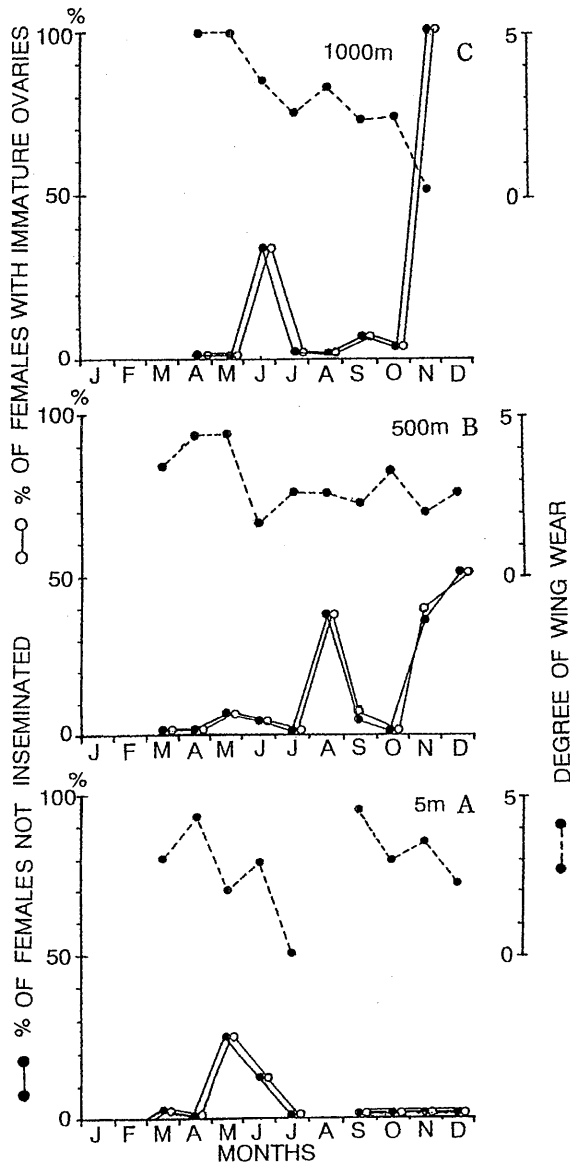


Fig. 5. Seasonal change of the percentage of female flies not inseminated or with immature ovaries, and the degree of wing wear of flies collected by the baited trap shown in Fig. 4.

wear of flies collected by the baited trap shown in Fig. 4.

At the Station A (alt. 5 m, Fig. 4A), it became clear that the seasonal prevalence of female flies shows peaks in spring and fall with valleys in summer (August) and winter (January and February). In males, however, the peak of appearance is observed 4 times a year, early spring (March), late spring (May), early fall (September), and from late fall to early winter (November and December). The peak activity in males generally coincides with their emerging seasons, which are early summer, early fall and late fall. At the peak in March, no flies emerged from the emergence trap. It is considered that the males trapped in March in lowland seem to have overwintered there, because the degree of wing wear of the flies trapped in this month is high as shown in Fig. 5A. During this season in lowland, we were able to observe male and female flies awakened from hibernation gathering and copulating at sunny spots. We believe that the male flies collected in November and December in lowland (Station A) had emerged in highland and/or mountainside and altitudinally migrated to lowland for hibernation.

At the Station B (alt. 500m, Fig. 4B), many adult flies were collected throughout the year, and it seems that the mountainside zone is the most suitable habitat of *L. porphyrina* in this area. The peaks of the prevalence in male flies were observed in June, August and November, and coincided with their emerging periods shown by the lower histograms in Fig. 4B. The peak of female flies that appeared in March–April was not accompanied by the collection of male flies, and no flies emerged from the emergence trap during this season. It is considered that these female flies probably hibernated in lowland, and after hibernation, males and females copulated there, and only females with matured eggs altitudinally migrated to the suitable habitat, mountainside and/or highland, for oviposition. This is because all females collected at Station B in this season had very high degree wear wings, and contained sperm and matured eggs as shown in Fig. 5B.

The result of surveys at Station C (alt. 1,000m) are shown in Figs. 4C and 5C. The seasonal prevalence of female flies trapped at this place showed one large peak centering in summer almost exactly opposite to that by the lowland trap (Fig. 4A). Peak of prevalence in males, however, appeared in June, August and October. Among them, though the emergence of flies in the traps was observed in July and October, but not in August. Because we observed many ants, beetles, and parasitic wasps and also many dead fly larvae in the traps during the summer season, we may have failed to detect an August emergence in highland. A large number of male and female flies bred in and after October in highland and mountainside seem to altitudinally migrate to lowland for hibernation. This is because the degree of wing wear of adult flies trapped in fall in highland is very low as shown in Fig. 5C.

#### CONCLUSION

*Lucilia porphyrina* breed 2–4 times in a year in Nagasaki area, Western Japan, depending upon the altitude of their habitat. Fig. 6 shows a schematic diagram showing the life cycle of this species including seasonal and altitudinal migration at Mt. Gokahara-dake in Nagasaki. Comparing Figs. 4 and 6, one can see the change in life cycle from low to high altitude. In lowland

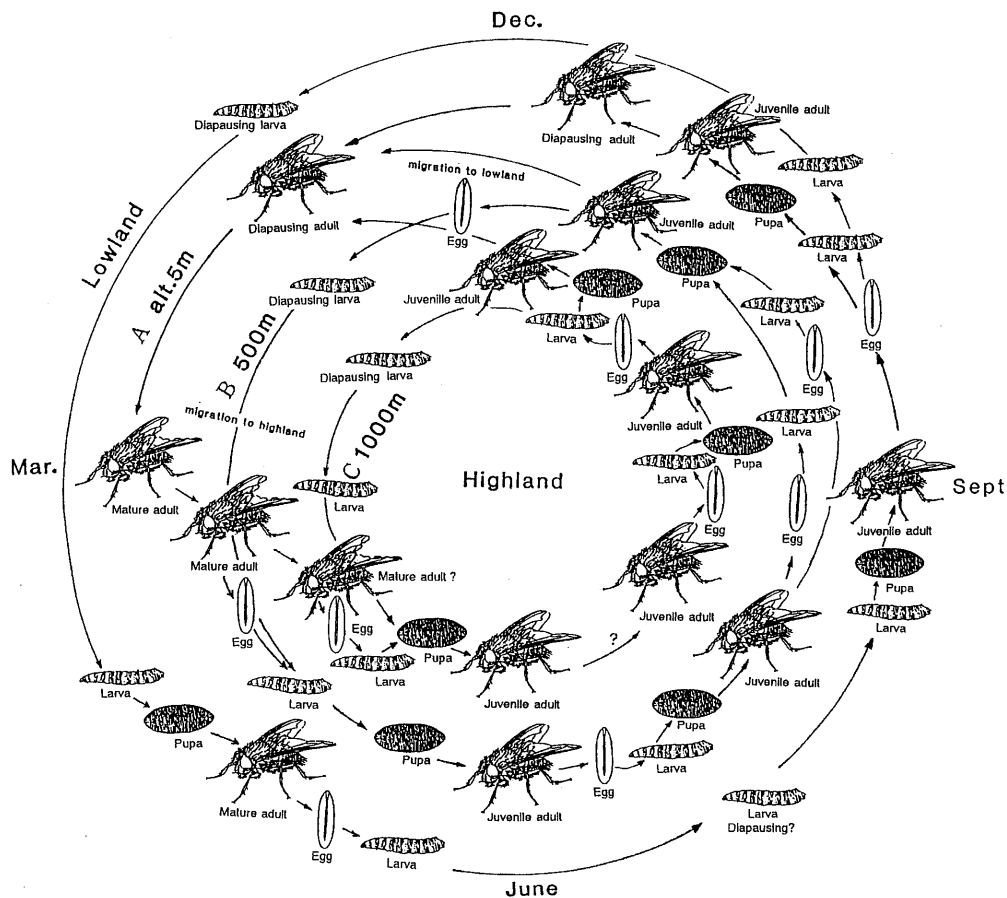


Fig. 6. Schematic diagram showing the life cycle of *Lucilia porphyrina* (Walker) including seasonal and altitudinal migration at Mt. Gokahara-dake, Nagasaki, Japan. Juvenile adult means newly emerged adult, and mature adult means aged or hibernated and migrated adult.

there are two periods of adult activity separated by periods of both summer and winter dormancy/diapause, while in highland there is a single period of adult activity in summer with a winter dormancy/diapause. In mountainside at 500m, *L. porphyrina* is less exposed to extremes of either hot or cold weather, and can complete the greatest number of generations in a year.

It is interesting that *L. porphyrina* has two distinct overwintering stages, the postfeeding larva probably at all altitudes and the unmated adult which migrates to the lowland. The return of these adults to higher altitudes then coincides with the emergence of those individuals that have not migrated. The overwintering stage is determined by the time of oviposition, i.e., late individuals dormancy/diapause as larvae and early individuals migration, then dormancy/diapause as adults.



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