Dragonflies of Conservation Concern in Northern British Columbia

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1. Project Name:
The Status of Dragonflies of Conservation Concern in Northern British Columbia

2. HCTF Project File #: 0-122

3. Type of Report: Final

4. Fiscal Years: 2000-01 to 2003-04

5. Location:
The study area includes the interior of the province north of about Williams Lake (approximately 52ºN), with an emphasis on the regions west of the Rocky Mountains. The annual breakdown of inventory areas was (Figure 1):

- 2000: the region east and south of Prince George; that is, the western slopes of the Rockies from Tête Jaune Cache north to Pine Pass, south to the northeastern Chilcotin Plateau (Nazko area) and the northern Cariboo Mountains (Likely, Quesnel Lake).
- 2001: Vanderhoof-Omineca-Williston regions.
- 2002: North Tweedsmuir-Babine-Bulkley-Skeena regions.
- 2003: the Northwest, including the Highway 37 corridor, Telegraph Creek Road, Atlin area, Skagway and Haines Roads.

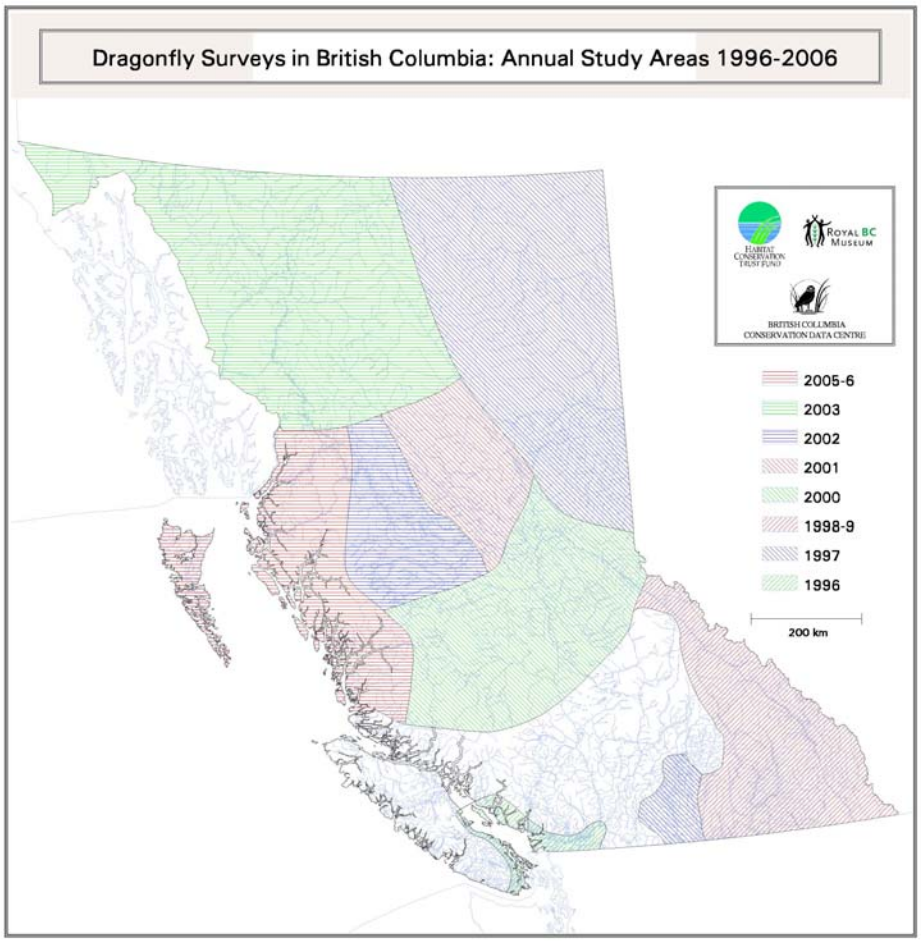

Figure 1: Study areas by year for this project as well as focus areas the prevous 4 years.

6. Project Overview

a) Executive Summary

This project addresses the problem of monitoring aquatic ecosystem integrity and diversity in northern British Columbia through an extensive and, at certain sites, intensive survey of the Odonata (dragonflies and damselflies). In the field seasons of 2000 to 2003 we combined our efforts with researchers funded through the Royal British Columbia Museum's (RBCM) *Living Landscapes* project.

The broad goals of the project are to: i) determine the present status and habitat/management needs of the 69 species of Odonata probable in the region, with an emphasis on the nine species considered to be at risk; ii) increase public awareness of dragonflies, their ecology and conservation; and iii) foster an ongoing, local interest in dragonfly monitoring and research. It is important to establish this baseline in order to be able to use the information for long-term monitoring of odonate species status and ecosystem health**.**

<u>Accomplishments</u>

- Approximately 716 separate sites were visited at least once.

- Approximately 9690 adult and 950 larval dragonflies (total of 10,640) were collected and deposited in the RBCM.

- 56 species known in region at beginning of survey; 9 more species were discovered: *Lestes forcipatus, Amphiagrion abbreviatum, Aeshna tuberculifera, Rhionaeschna californica, Epitheca spinigera, Somatochlora brevicincta, S. forcipata, Sympetrum corruptum* and *S. madidum.* Two of these, *Amphiagrion* and *Epitheca*, were not on the list of probable species at the start. Three species from the original probable list still remain to be found in the study area. One species, *S. brevicinta*, is new to BC. A total of 65 species is now known for the study area (north of latitude 52º) and at least three additional species probably occur in the region. The total of 68 species represents 78% of the provincial fauna.

- Between 2000 and 2003 the conservation status ranks of 15 species found in northern BC were changed, based upon the information gathered from the surveys. The result is a list of dragonflies of conservation concern that is much more defensible and credible. As of December 2004, nine of this total of 68 dragonfly species are considered at risk and are listed by the Conservation Data Centre. Fourteen species were given a rank that denoted less concern and one is considered more at risk.

- Four types of colour distribution maps (including histograms showing flight period) for each of the 87 dragonfly species in BC were produced.

- A more comprehensive and detailed knowledge of dragonfly habitat and species habitat preferences has come out of the project. Hundreds of site descriptions are on file. Some initial correlation of dragonfly communities with the wetland site associations presented in the recent BC wetland classification by MacKenzie and Moran (2004) was undertaken. This will help standardize BC dragonfly habitat with classifications used by botanists and foresters.

- Approximately 32 local volunteers from various regions participated in the project.

- Nine publications or reports based on specimens and data collected in the project, have been published or are in press. Three more are being prepared.

Evaluation

In general the project was successful on all fronts; all objectives were met and in some cases exceeded. However, there were still areas where more work would be useful. For example; more and better site association descriptions would improve our database of habitat types. More inventory is needed to better describe individual species requirements and more documentation of species of conservation concern is required. We still do not have more than general statements of management implications for most of the nine red and blue listed species. More precise knowledge of larval distribution in relevant habitat is needed for decision-making regarding the health of specific dragonfly populations. General recommendations include: i) recreational activities that potentially disturb shorelines of water bodies should be monitored if particular at risk species are present; ii) development, logging, road building, and other activities that may affect the hydrology of a catchment area should be managed to minimize impacts; iii) management practices that ensure the continued viability of wetlands should be followed.

This is project was a fine example of interministerial cooperation in action. Many biologists of varied backgrounds – plant ecologists, foresters, ungulate biologists, rare and endangered species specialists, museum systematists and collection managers, conservation biologists, and others took part. The sharing of logistical support, vehicles, and other resources was extraordinary.

The volunteer response to the project was gratifying. Long-term monitoring is more readily and efficiently accomplished with local experts and interested volunteers participating. Through public education and volunteer participation the project aimed to develop regional expertise in dragonfly observation and collection so that the survey activity will continue with local people interested in local wetlands.

b) Issue

The dragonflies and damselflies (Order Odonata) comprise a relatively well-known order of insects that breeds in a wide variety of aquatic habitats. Some species are specialists using discrete habitats; others are generalists, able to survive in a wide variety of environments. In British Columbia wetland habitats have been, and continue to be,

altered, lost or destroyed because of urban development, agriculture and resource extraction (Stevens *et al*. 1995). Estimates indicate that 65 to 80% of wetlands have been altered or destroyed, depending on the region.

Despite the fact that aquatic invertebrates make up a key part of freshwater ecosystems, little is known of the distribution and ecology of most aquatic invertebrate groups, especially in the northern part of British Columbia. This is true of even normally well-studied groups such as dragonflies (Cannings and Stuart 1977; Cannings 2002a). No comprehensive survey for dragonflies had ever been made in this region, and some populations are known only from 60-year-old collections.

The first dragonfly records from the northern parts of British Columbia were published by Walker (1912, 1925, 1927), Buckell (1938) and Whitehouse (1941). Walker (1953, 1958), Walker and Corbet (1975), Scudder *et al*. (1976) and Cannings and Stuart (1977) updated and summarized the information known for British Columbia. Since then, general collecting, mostly by RBCM, CDC and University of BC (UBC) staff, has improved our understanding of species distributions (Cannings 1980, Cannings *et al*. 1980, Cannings and Cannings 1987, Cannings and Cannings 1994, and Cannings and Cannings 1997). The main sources of distributional information on the species of the region are the databases of the Spencer Entomological Museum at UBC in Vancouver and the RBCM in Victoria.

Dragonflies are a priority group for inventory (Scudder 1996) because, unlike most invertebrates, they can be identified in the field and because field personnel experienced in dragonfly collecting are available. They are upper level predators in the invertebrate food-chain and have often been identified as indicators of ecosystem health (Walker and Corbet 1975, Carle 1979, Takamura *et. al*.1991, Clarke and Samways 1996, Trevino 1997, Corbet 1999). Many species are habitat-specific and their presence can be used to characterize healthy wetlands of all sorts. Indeed, in the many aquatic systems that have no fish (e.g. many marshes, peatlands, ponds and small lakes), invertebrates such as dragonflies are the only animal indicators of ecosystem health. Within the constraints of weather, these surveys are well suited for long-term monitoring programs. Finally, because they are large, colourful, diurnal creatures with interesting behaviours, dragonflies are excellent subjects for nature interpretation programs and public education about aquatic ecosystems in general. The inventories complemented similar projects undertaken throughout much of southern British Columbia over the previous four years.

Inventories will produce thousands of specimens with associated detailed collection data on habitat, behaviour and other life-history parameters. This information, housed in the collections and databases of the Royal BC Museum and in the databases of the Conservation Data Centre, will act as a resource for future research, public interpretation and management decisions.

The specimens will be vouchers for taxonomic questions, habitat relationships and life-history investigations. They and the information gathered with them form a baseline for future studies. Although development in northern British Columbia has been concentrated

for the most part in a few centres, and most freshwater habitats (with some notable exceptions, such as those flooded by the WAC Bennett and Kenney Dams) remain close to their pristine state, there is a need to establish baseline information regarding the distribution and habitat choice of aquatic invertebrates. The pace of development in the north is increasing and will undoubtedly continue to increase dramatically in the next century. Beetle killed forests will result in unprecedented logging and road building in the region, and areas remote today will be disturbed at higher rates. Predicted climate warming undoubtedly will alter wetland ecosystems and modify dragonfly communities as weather patterns and water tables change. As a well-studied and readily monitored aquatic invertebrate group, the Odonata can serve as an indicator of such change.

Such long-term monitoring is more readily and efficiently accomplished with local experts and interested volunteers participating. Through public education and volunteer participation the project aims to develop regional expertise in dragonfly observation and collection so that the survey activity will continue with local people interested in local wetlands.

c) Project objectives

i) To determine the status, precise locations of occurrences, and habitat associations of the approximately 68 species of Odonata known or expected from this region, with a search emphasis on the nine species considered to be potentially at risk as ranked by the Conservation Data Centre.
ii) To have the above (objective i) as a baseline for questions and assessments pertaining to environmental quality, assessment and possible monitoring of ecosystem health.
iii) To improve the scope and utility of RBCM research collections.
iv) To develop management guidelines for each of these nine species.
v) To present a revised list of the Odonata of British Columbia with conservation ranks assigned to species.
vi) To leave a legacy of awareness and knowledge of dragonflies in the region.
vii) To foster an ongoing, local interest in dragonfly monitoring and research.

7. Activities/Techniques

a) General methodology

- The study area is divided into five zones, four of which were sampled in 2000-2003. The fifth zone, the Northeast, was surveyed in 1997. Each summer, field surveys will be undertaken through the primary adult activity season from mid-June through at least August.

- Adult dragonflies seen were identified and noted. Often, specimens were netted for close examination. Voucher specimens were deposited in the Royal BC Museum. Larval specimens or the cast skins of larvae were also collected as indicators of a species' use of a particular site. Both adult and larval specimens were presented to the Museum in a ready-to-accession state; that is, fully prepared, documented and identified. The RBCM purchased cabinets to house the specimens.

- The survey was undertaken by recognized experts in dragonfly collection and identification; several such experts reside in British Columbia. Other experts in the discipline were brought in as subcontractors or volunteers.

- Data recording: Details of numbers of dragonflies, their behaviour and ecology, as well as precise UTM grid coordinates were recorded on Conservation Data Centre (CDC) field forms. The distribution of larvae and breeding adults was analyzed to determine critical habitats. The physical and floristic characteristics of the wetland habitats were also described using CDC forms. Dominant plant species were recorded. Vegetation data were used to characterize dragonfly habitats according to the recently published wetland classification of MacKenzie and Moran (2004) (Appendix 4). This makes the dragonfly data applicable to classifications used by other BC government researchers.

- The sites visited were chosen based on the study of historical records, recommendations by local biologists and naturalists, examination of topographical maps and air photographs and by scouting the region by vehicle, and in a few cases by helicopter. The timing of visits to particular sites was determined by the known flight times of the species being searched for there. The field season encompassed mid-June to early September in order to cover all species' flight periods. We planned to survey a minimum of forty sites per year (160 in total).

- As specified in the Resource Information Standards Committee's standardized methodology of arthropod sampling, each site was to be visited for at least five hours (or for a shorter time if population estimates can be done more quickly) during fine weather during the period of the study to ensure that no species is missed. We anticipated that this will mean a minimum of 45 days of fieldwork each year.

- We have included brief management recommendations for each of the nine listed species remaining after the inventory. These are found in the species accounts in Appendix 2.

- An internet Web page for the RBCM's *Living Landscapes* is being prepared to include the final project report, species accounts, distribution maps, colour photos, and field identification keys.

- The distribution maps for each of the species are available at http://srmwww.gov.bc.ca/atrisk/toolintro.html

- A number of local volunteers were recruited and trained in dragonfly survey techniques to ensure that this work will continue in following years.

- Publications on project results were published in the scientific literature.

b) Yearly activities

2000

In the 2000 field season, inventory was concentrated around Prince George and the regions east and south of the city, that is, the western slopes of the Rockies from Tête Jaune Cache north to Pine Pass, south to the northeastern Chilcotin Plateau (Nazko area) and the northern Cariboo Mountains (Likely, Quesnel Lake). Sporadic collecting also occurred along Highway 20 to the eastern boundary of Tweedsmuir Park. Rob Cannings and Leah Ramsay each visited the study area twice, and Syd Cannings made one trip, for a total of 39 days in the field by the principal biologists. Sid Dunkle (Plano, Texas), one of the leading dragonfly biologists in North America, joined Syd Cannings for part of his trip. Five additional provincial government biologists were temporarily assigned to this project, and contributed about 29 days total. Three biologists were contracted to search for and collect dragonflies: Gina Roberts surveyed the Horsefly Forest District, Crispin Guppy surveyed the Quesnel Forest District, and Gordon Hutchings surveyed the southern portion of the Prince George Forest District. Pamela Hengeveld was hired to visit major sample sites and describe the habitat in detail, and Will MacKenzie, the provincial wetlands ecosystem specialist, spent three days with us, training us in the provincial wetlands classification scheme

2001

In the 2001 field season we surveyed dragonflies in selected areas throughout the Vanderhoof-Omineca-Williston region, concentrating on the areas around the south end of Williston Lake, the Omineca mountains west of the lake, the Fort St. James – Takla Lake region and the Highway 16 area near Vanderhoof. Rob Cannings, Leah Ramsay, and Syd Cannings each visited the study area once, for a total of 35 days in the field by the principal biologists. Six additional provincial government biologists were temporarily assigned to this project, and contributed about 33 days total. Two government vehicles were made available to us at cost, reducing our expected costs. Two biologists were contracted to search for and collect dragonflies: Cris Guppy surveyed the Fort St. James Forest District, and Gord Hutchings surveyed the southern portion of the Mackenzie Forest District. Pamela Hengeveld was again hired to visit major sample sites and describe the habitat in detail. A total of six professional biologists, dragonfly specialists and local naturalists volunteered their services. We were especially fortunate to secure the volunteer participation of Tim Vogt, Illinois State Museum, one of North America's leading experts on boreal dragonflies.

2002

In the 2002 field season we surveyed northern Tweedsmuir Park, the Babine and Bulkley regions, the upper Skeena region, including the Kispiox Valley and the southern parts of the Highway 37 corridor. A side trip to Williams Creek Ecological Reserve near Terrace was undertaken because of strong BC Parks interest in the project. Two contractors who were hired to search for and collect dragonflies: Syd Cannings worked in the Smithers-Skeena regions early in the season, scouted for good mid and late season sites and undertook mid season sampling. Gord Hutchings surveyed the western portion of the study area. Rob Cannings, Leah Ramsay, and Leah Westereng each visited the study area once, for a total of 37 days in the field by the principal biologists. Four additional provincial government biologists were temporarily assigned to this project, and contributed about 41 days total.

2003
In the 2003 field season, collections work focused on the Hwy 37 (Stewart-Cassiar) corridor, the Telegraph Creek Road, The Atlin and White Pass areas and the portion of the Alaska Highway (#97) in BC along the Swift River. Because access to the extreme Northwest is through Whitehorse, we were joined by staff from the Yukon Department of the Environment. Two contractors were hired to search for and collect dragonflies: Syd Cannings worked along with Dave Fraser and two Yukon government workers in the Atlin-White Pass regions in July. Gord Hutchings surveyed Hwy 37 in early July and the Atlin area later in the month. Several other teams collected Hwy 37 and Alaska Hwy: Rob Cannings/ Leah Ramsay (also covered the Telegraph Creek road) and Mike Badry/ Anne Hetherington in July; Rob Cannings/ Andrew Harcombe and Leah Ramsay/ Ian Hatter in August. In addition, Rob Cannings/ Andrew Harcombe visited the Atlin area in August and during the same month, Leah Ramsay/ Ian Hatter drove the Haines Road. During five days from June to August, Rosamund Pojar of Smithers collected along Hwy 37, at Bella Coola and in Tatlatui Provincial Park. Five principal investigators members were in the field for a total of 53 person-days. Eight additional provincial and territorial government biologists were temporarily assigned to this project, and contributed about 41 days.

8. Remaining activities: Not applicable.

9. Measures of Results:

a) Yearly results

2000
Two hundred fifty-six sites were visited at least once. Approximately 4000 adult and 300 larval specimens of at least 51 species were collected. Fifty-eight species were known from the region before the start of the project; four species new to the region were discovered in 2000. These additions were *Amphiagrion abbreviatum, Aeshna tuberculifera, Epitheca spinigera*, and *Somatochlora brevicincta*. The latter is new to the provincial list as well; this was the "*range extension of the year*" according to the newsletter of the Dragonfly Society of the Americas. *S. brevicincta* is a very rare species previously known only from a handful of localities in the world, all from central Quebec, the Atlantic Provinces and Maine; it was found at *four* sites in B.C.: three on the wet windward slopes of the Rockies and one in the Cariboo Mountains near McBride.

2001
A total of 250 sites were visited at least once. Again, poor weather plagued the survey, especially in the early weeks. Until August 8, the summer was almost uniformly cloudy and wet, so fewer adult dragonflies were encountered and sampled than would be expected with the effort made. Approximately 2500 adult and 200 larval specimens of at least 50 species were collected. *Somatochlora forcipata* was added to the regional list, bringing the total to 63 species. This species of mountainside fen springs was only added to the provincial list during our Rocky Mountain survey in 1998; this year's collection represents a range

extension of over 600 kilometres to the northwest. Three species formerly on the Blue List were found with such frequency that they were delisted: *Aeshna septentrionalis, Ophiogomphus colubrinus,* and *Somatochlora cingulata.* Thus, after the 2001 field season, the number of species of management concern dropped from 14 to 11. The major discovery of 2000, *Somatochlora brevicincta,* was found at several more sites, and its rank was changed from S1 to S2 to reflect its greater range, although records are still very sparse. A new ranked provincial dragonfly list was produced in October 2001 and was posted on the CDC's website.

2002

A total of 175 sites were recorded. Approximately 2200 adult and 250 larval specimens of at least 50 species were collected. *Rhionaeschna californica* was the only species added to the regional list in 2002. This southern species of rich, lowland marshes was known from just south of the study area in the southern Cariboo-Chilcotin, but in 2002 was found in the Smithers area, far to the north. We downlisted the conservation ranks of several species. *Epitheca canis* was downlisted from S2S3 to S3 and *Somatochlora forcipata* from S1S2 to S2; a significant population of the latter species was found at Cinema, near Quesnel, on Highway 97. *Somatochlora septentrionalis* was collected at two more sites and went from S2 to S3. *Somatochlora brevicincta,* although not collected in 2002, was listed at S2S3, down from S2; this rank reflects the wide distribution range of this rare and local species. Another significant record represents the second site of *Ischnura damula* in the province. Previously known only from the warm waters of Liard River Hot Springs, this red-listed damselfly was found in the Kispiox Valley. This is a major range extension, about 450 km southwest of Liard and the first record of this species west of the Rocky Mountains in Canada. There was no evidence of springs at this site.

2003

A total of about 85 sites were recorded and each site was visited at least once. Approximately 990 adult and 200 larval specimens of at least 34 species were collected. No new species were added to the regional list in 2003. The conservation ranks of several species were downlisted as a result of the collections in 2003. *Somatochlora septentrionalis* was found at many more sites (In BC it appears most common in the extreme northwest) and dropped from S3 to S4. The big story in 2003 was the change in our understanding of the distribution and rarity of *Somatochlora kennedyi*, which we collected in four places, doubling the provincial locality list. We downlisted the species from S1S2 to S3S4.

b) Conservation Status

The inventories provided critical information for assigning and modifying existing conservation status ranks for dragonfly species. Preliminary conservation status ranks were updated in 2000 after the first year of the northern surveys. Subsequently, we focused inventory efforts on the species considered at risk in order to more accurately determine their status. During these surveys, known ranges of many species were extended, knowledge of habitat requirements increased, and one new species was confirmed for the province. Many of the targeted species were more abundant than

previously thought, and their conservation ranks were changed accordingly. Others were found only rarely or not at all

Criteria for conservation rank assessments for 1995 were number of element occurrences, population, trend, threats and protection. The latest assessments, made in 2004 separated threats into severity, scope and immediacy; the trends were divided into long and short term and environmental specificity and intrinsic vulnerability were added. The criteria are only used when the relevant information is known. A summary of changes for all BC species as of 2004 is given in Table 1.

The original list of probable species in northern BC contained ten species. We were successful in recording all but three species on this list and added nine. Ranking poorly known species is challenging, particularly if samples are small or habitats are difficult to access. By increasing our knowledge of these species and their requirements, we can assign them more accurate ranks, thus ensuring that conservation efforts will target the species and habitats that truly require them.

Between 2000 and 2003 we changed the rank of 15 species (17% of BC species) -- 14 now have a rank denoting they are less at risk and one has been given a rank denoting that it is more at risk (Table 1). The complete list of conservation ranks for these and all other BC species is in Appendix 5.

Table 1: Changes in the conservation status of British Columbia Odonata: 1995 to 2004. Species with scientific names in bold are found in northern British Columbia.

Scientific Name	**English Name**	**1995**	**2000**	**2004**	**Rank Change**
Lestes forcipatus	Sweetflag Spreadwing	unknown	S3	S4	+2.0
Coenagrion angulatum	Prairie Bluet	S1S2	S4	S3S4	+2.0
Coenagrion interrogatum	Subarctic Bluet	S4	S4	S4S5	+0.5
Ischnura erratica	Swift Forktail	S3?	S4	S4	+0.5
Nehalennia irene	Sedge Sprite	S4	S5	S5	+1.0
Aeshna constricta	Lance-tipped Darner	S2S3	S2S3	S2	-0.5
Aeshna septentrionalis	Azure Darner	S4S5	S3S4	S4	+0.5
Aeshna tuberculifera	Black-tipped Darner	S2S3	S3	S4	+1.5
Gomphus graslinellus	Pronghorn Clubtail	S2	S2	S2S3	+0.5
Ophiogomphus colubrinus	Boreal Snaketail	S3?	S3?	S4	+0.5
Stylurus olivaceus	Olive Clubtail	S2	S2	S1S2	-0.5

Epitheca canis	Beaverpond Baskettail	S2S3	S2S3	S3	+0.5
Somatochlora brevicincta	Quebec Emerald	unknown	S1	S3	+2.0
Somatochlora cingulata	Lake Emerald	S2S3	S3	S4	+1.5
Somatochlora forcipata	Forcipate Emerald	unknown	S1S2	S2S3	+1.0
Somatochlora franklini	Delicate Emerald	S4S5	S4S5	S5	+0.5
Somatochlora hudsonica	Hudsonian Emerald	S5	S4S5	S4S5	-0.5
Somatochlora kennedyi	Kennedy's Emerald	unknown	S1S2	S3S4	+2.0
Somatochlora septentrionalis	Muskeg Emerald	S3S4	S3?	S4	+0.5
Somatochlora whitehousei	Whitehouse's Emerald	S4	S4	S5	+1.0
Erythemis collocata	Western Pondhawk	S2S3	S2	S3	+0.5
Leucorrhinia patricia	Canada Whiteface	S3S4	S3?	S4	+0.5
Pachydiplax longipennis	Blue Dasher	S2S3	S2S3	S3S4	+1.0

c) Other knowledge

In addition to increasing our knowledge of the habitats and distributions of the species of dragonflies considered at risk we learned much more about the habitat needs, status and behaviour of the more common species. A few examples of the latter species are given here. *Somatochlora walshii* (Scudder) was originally known only from half a dozen locations scattered throughout the southern half of the province. It is now clear that this species is widespread across the southern two-thirds of the province and that it inhabits many spring-fed wetlands containing slow moving water. We had always assumed that *Aeshna subarctica* was more common than the scanty records indicated; our surveys confirmed this. Even though it was known from the southern Yukon (Cannings *et al.* 1991), *Somatochlora minor* had been only found in British Columbia south of 52°N. We now have several records from as far north as Fort Nelson.

These results highlight the value of intensive, targeted surveys and illustrate the dynamic nature of the ranked lists. A common question posed by wildlife or land managers and policy makers is, "How can we reduce the number of species on tracked or "at risk " lists"? Undertaking inventories focused on particular species is the most straightforward way to answer the question. Intensive collecting often reveals that many species appear rare only because they are poorly sampled. In the course of establishing distributions and numbers during inventories, other criteria that are used to establish conservation status ranks can be determined; including habitat or threats. The resulting lists can then be used to focus efforts and resources on those species or habitats that are truly at risk, either by

addressing the threats or considering recovery planning. This is, of course, true for not only the Odonata but for all taxa. Inventories not only fill key gaps in our knowledge, but also focus future studies on species and regions for which there is still a lack of information.

d) Distribution Maps

Four types of colour distribution maps for each species in BC were produced in both jpg and pdf format. The maps for species found in northern BC are included in the species accounts and show BC distribution based on the collections of the Royal BC Museum and Spencer Entomological Museum, University of BC. Map 1 is the basic distribution map. Map 2 separates records made before 1996 and those made from 1996 to 2004. This highlights the effectiveness of intensive surveys in improving our understanding of dragonfly distribution in BC. Map 3 shows species distribution and the relative abundance of collection records in each 1/50,000 NTS map sheet in BC. Map 4 shows the same, except the number of localities in each map sheet, rather than total specimen records, is shown. Each map also presents a histogram of collection records of adult dragonflies graphed in 10-day periods throughout the year. These represent the known flight period of the species. Two summary maps representing the combined data from all species used in Maps 3 and 4 were also produced and are included herein (Figures 2 and 3). A map showing annual survey regions was also made.

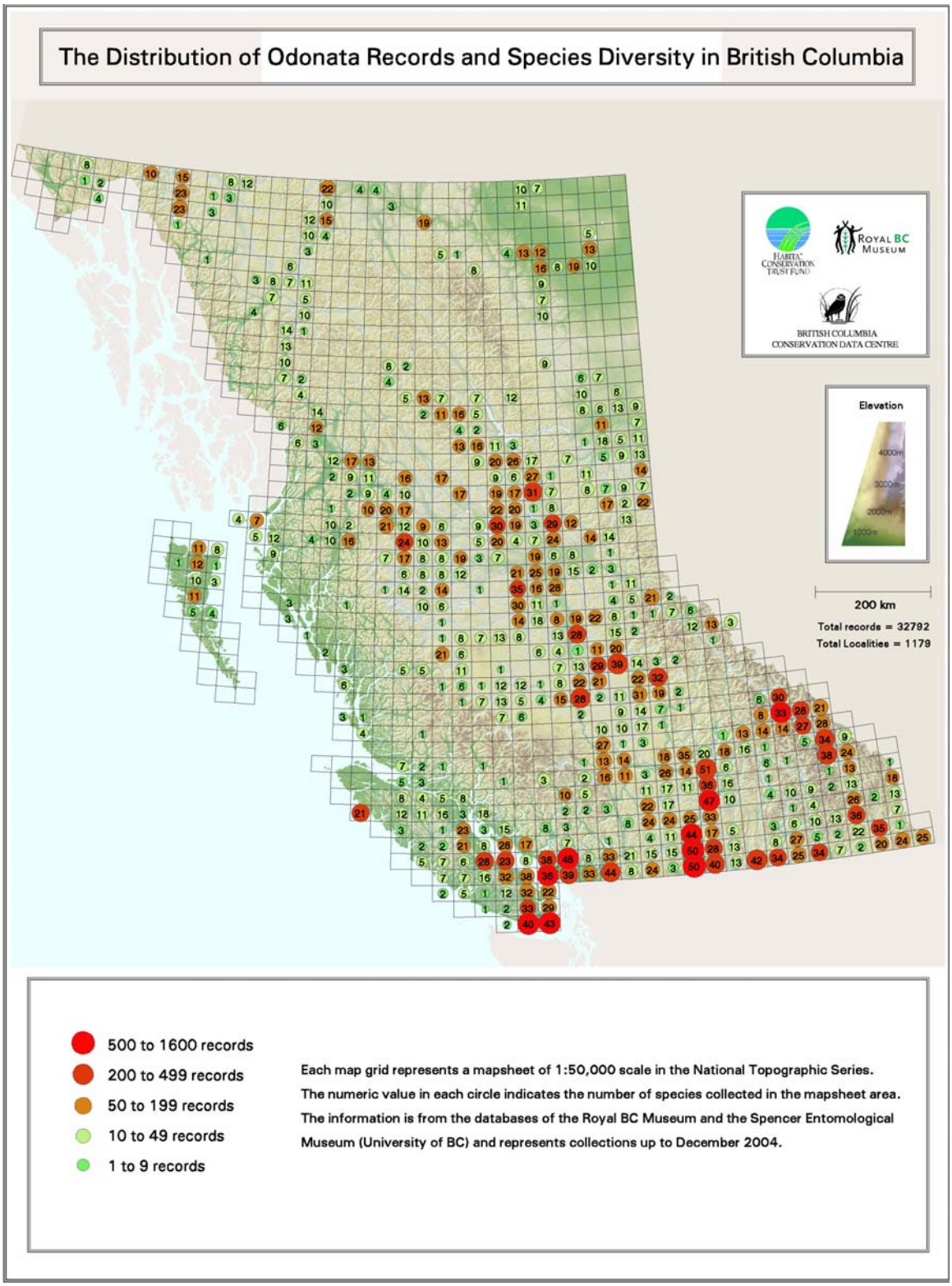

Figure 2: Species distribution and the relative abundance of collection records in each 1/50,000 NTS map sheet in BC.

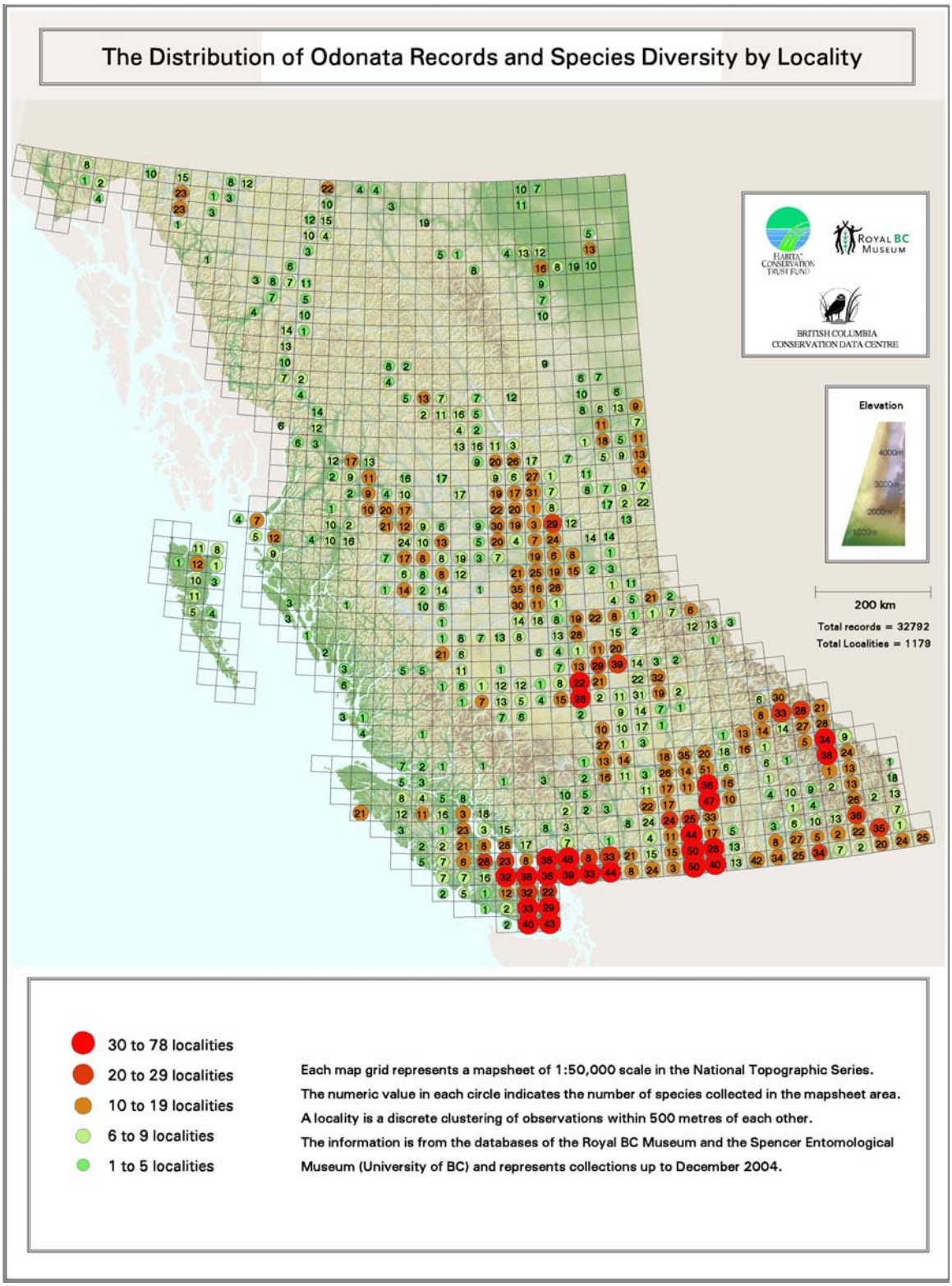

Figure 3: Species distribution and the relative abundance of collection localities in each 1/50,000 NTS map sheet in BC.

e) Summary of Results 2000-2003

- Approximately 716 separate sites were visited at least once.

- Approximately 9690 adult and 950 larval dragonflies (total of 10,640) were collected and deposited in the Royal BC Museum.

- 56 species were known in the region at the beginning of the survey; 9 more species were discovered: *Lestes forcipatus, Amphiagrion abbreviatum, Aeshna tuberculifera, Rhionaeschna californica, Epitheca spinigera, Somatochlora brevicincta, S. forcipata, Sympetrum corruptum* and *S. madidum.* Two of these, *Amphiagrion* and *Epitheca,* were not on the list of probable species at the start. Three species from the original probable list still remain to be found in the study area. A total of 65 species is now known for the study area (north of latitude 52º) and at least three additional species probably occur in the region. The total of 68 species represents 78% of the provincial fauna.

- One species, *Somatochlora brevicincta* was the only species recorded new to BC. This was a surprising discovery; previously it was known from only a few locations in Quebec, Maine and the Atlantic provinces. After its initial discovery on Bell Mountain near McBride in 2000, we collected it at another nine locations, all along the eastern margin of the Rocky Mountains.

- Between 2000 and 2003 the conservation status ranks of 15 species found in northern BC were changed. This is 17% of BC species; 14 species are now less at risk and one is considered more at risk.

- Four types of colour distribution maps (including histograms showing flight period) for each dragonfly species in BC were produced. These 348 maps (plus 3 summary maps) are a major product of this project.

10. Benefits and Risks

- The changes to the provincial Red and Blue lists as a result of this inventory mean that we are more able to focus on species truly in need of individual attention.

- The amount of new habitat-association information that can be gleaned from associating 10,640 dragonfly records with the ecological data of sites is considerable.

- The ensuing baseline information for long-term ecosystem health monitoring is also considerable.

- The range extensions documented have allowed the production of new and updated distribution and collection-density maps.

- The risks to dragonfly populations and other organisms from these collecting efforts is minimal. There are essentially no risks to populations, even of rarely encountered species, from this sort of collecting.

- Specimens in research collections have many values. For example, they serve as standards for species identification and unequivocally document historical status, distribution, and present geographical variation, including 'hidden', as yet undescribed species. In addition, they contain life-history and ecological information such as the habitat choice of species and the time of adult emergence and breeding.

- Our knowledge of the distribution and status of northern dragonfly taxa has been enhanced. As the region they inhabit is being altered by human development, improved understanding of the fauna will help considerably in their conservation. Locating viable populations will give agencies and organizations concerned with conservation critical knowledge to enable them to secure habitat through land designation, habitat enhancement, or stewardship agreements with landowners. Once the true status and detailed distribution of the dragonflies of conservation concern is known, management guidelines can be drawn up. Preliminary management information is a product of the project.

- Public knowledge and appreciation will increase significantly as a result of the information gathered by the inventory and distributed via publications, presentations, and the RBCM's Living Landscapes Web page.

11. Extension/Public Information/Participation/Partners

a) Yearly results

2000

Rob Cannings visited the Prince George in June and gave an evening presentation on dragonfly biology and identification, followed by a day-long field workshop to those who had expressed enthusiasm in developing their inventory skills. A total of 12 professional biologists, dragonfly specialists and local naturalists from Williams Lake, McBride, Prince George, Mackenzie, and Burns Lake volunteered their services. We were especially fortunate to secure the participation of Sid Dunkle (Texas) (11 days) and Dennis Paulson (Washington State) (1 day), two of the leading dragonfly experts in North America.

Publications. See list below for full references. A popular article on the discovery of the Quebec Emerald is posted on the Conservation Data Centre website and was published in the Entomological Society of BC's newsletter Boreus. A draft report for an internet Web page on the RBCM's *Living Landscapes* site was begun and, when available on the web, will provide yearly reports, species accounts, distribution maps, colour photos, and field identification keys (see publications list).

2001

The response from the naturalist community for the project was again encouraging; we had a positive response from six local biologists and naturalists from Mackenzie and Fort St. James. Syd Cannings and Cris Guppy visited the area in July and gave evening presentations in Mackenzie and Fort St. James on dragonfly biology, collection and identification, followed by a day-long field workshop to those who had expressed enthusiasm in developing their inventory skills. A successful partnership was forged with Slocan Forest Products and Forest Renewal B.C. where helicopter time was shared, allowing the project into areas that were otherwise not accessible.

Publications. Preliminary communications of important findings were sent to the volunteers involved via electronic mail

2002

The naturalist community in Smithers, Terrace, Houston and New Hazelton responded positively to our request for volunteers. Fourteen naturalists and biologists living in the study area volunteered their time during the project. Syd Cannings visited the area in June and gave an evening presentation in Smithers on dragonfly biology and identification, followed by a day-long field workshop to those enthusiastic attendees who were interested in developing their inventory skills. A successful partnership was forged with BC Ministry of Forests; helicopter time was shared, allowing the project into an area that was otherwise inaccessible.

From 2 to 5 May, 2002, The Royal BC Museum held a series of public programs in Williams Lake as part of its Living Landscapes project. The Northern Dragonfly Survey is a significant part of this project, and an exhibit and specimens were on display. During this event, Rob Cannings presented several school programs and public talks on dragonflies in the north. The exhibit on the dragonfly project was displayed at a similar public event in Quesnel the next week, but no school programs or lectures were presented

Rob Cannings was an invited speaker at the symposium entitled "North American Dragonflies" held at the joint annual meeting of the Entomological Society of Canada and the Entomological Society of Manitoba, 9 October 2002, in Winnipeg. Representatives from most regions of Canada presented overviews of dragonfly inventories undertaken in their jurisdictions. Cannings outlined the purpose and results of the Northern Dragonfly Survey project in British Columbia. A workshop entitled "Dragonflies: a status assessment" was also held. This was the first time researchers from across Canada had gathered to discuss the national conservation status of all the species on the Canadian list. Results from the BC inventories played an important role in these discussions. Rob Cannings also gave a lecture on the BC dragonfly survey at the annual Invertebrate Symposium held at the University of Victoria on 21 March 2003.

The Royal BC Museum held a series of public programs in Prince George from 17 to 20 October 2002 to wrap up the Upper Fraser Basin portion of the Living Landscapes project. As in Williams Lake earlier in the year, the exhibit on the Northern Dragonfly Survey was on hand, and Rob Cannings gave a lecture about the dragonfly survey during the symposium that highlighted all the projects undertaken in the Living Landscapes

program. Copies of the recently published field guide to the dragonflies of British Columbia and the Yukon (Cannings 2002a) (written by Rob Cannings as part of the Northern Dragonfly Survey project) were sold.

Publications. A Species at Risk brochure on rare dragonflies of BC came out in May 2002, published jointly by the Ministry of Sustainable Resource Management and Ministry of Water, Land and Air Protection (Cannings 2002b). The brochure is distributed throughout BC in paper format and is on the web: (http://wlapwww.gov.bc.ca/wld/documents/dragonflies.pdf). Information from the Northern Dragonfly Survey surveys was used in the publication.

Rob Cannings wrote a new book, *Introducing the Dragonflies of British Columbia and the Yukon*, as part of the project (Cannings 2002a). This is a 96-page field guide with colour photos, species descriptions, and information on distribution, habitat and behaviour for every species in British Columbia and the Yukon. An introduction to dragonfly biology and dragonfly study is also included. Copies were distributed to survey volunteers. As of April 2005, almost all copies have been sold and a new printing has been completed, and about 1200 of 2000 books printed have been sold.

2003

Syd Cannings gave a talk to about 200 interested people in Whitehorse on the project and dragonfly biology, setting the stage for inventory in the Northwest. Rob Cannings was invited to participate in the COSEWIC general ranking meetings in Ottawa in November 2003. The Odonata are being considered for inclusion in a new COSEWIC subcommittee on endangered invertebrates. The general ranking meeting establishes baseline rankings for all species so that rare and endangered ones can be defined. Leah Ramsay used the new Conservation Status Ranks to apply General Status ranks to the dragonflies of BC for the federal government.

Publications. Rob Cannings published an article, “Resources for the study of the Odonata in Canada” in the Newsletter of the Biological Survey of Canada (Terrestrial arthropods) 23: 25-33. The article outlines the major publications, web sites, museum collections and databases that are useful in studying dragonflies. A paper entitled “Determining the status of British Columbia’s dragonflies” was prepared by Leah Ramsay and Rob Cannings for the Species at Risk Conference held in Victoria in early March 2004. The paper was delivered by Ramsay and will appear in the conference proceedings. The results of the project have not yet been fully compiled. An electronic report for the Royal BC Museum *Living Landscape* website is being produced.

Ongoing

More publications will appear as they are prepared. Some are listed below in c).

b) Publications and reports based (in whole or in part) on collections and data gathered in the northern dragonfly surveys.

Cannings, R.A. 2002. Rare dragonflies of British Columbia. Wildlife at Risk in British Columbia brochure. British Columbia Ministry of Sustainable Resource Management and Ministry of Water, Land and Air Protection, Victoria, B.C. 6pp.

Cannings, R.A. 2002. Introducing the Dragonflies of British Columbia and the Yukon. Royal British Columbia Museum, Victoria, B.C. 96 pp.

Cannings, R.A. 2004. Resources for the study of the Odonata in Canada. Newsletter of the Biological Survey of Canada (Terrestrial Arthropods). 23 (1): 25-33.

Cannings, R.A., S.G. Cannings, L.R. Ramsay and G.E. Hutchings. 2005. Four dragonflies new to British Columbia. Notulae odonatologicae 6(5): In press.

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Cannings, S.G. 2000. The Quebec Emerald out West. Boreus 20(2): 11.

Catling, P.M., R.A. Cannings and P.M. Brunelle. 2005. An annotated checklist of the Odonata of Canada. Bulletin of the Dragonfly Society of the Americas 9(1): 1-20.

Ramsay, L.R. and R.A. Cannings. 2005. Determining the status of British Columbia's dragonflies. In T.D. Hooper (Ed.) Proceedings of the Species at Risk 2004 Pathways to Recovery Conference March 2-6, 2004, Victoria, British Columbia. Species at Risk 2004 Pathways to Recovery Conference Organizing Committee, Victoria, BC. Soon to be available on the internet at www.speciesatrisk2004.ca

Simaika, J.P. and R.A. Cannings. 2004. *Lestes disjunctus* Selys and *L. forcipatus* Rambur (Odonata: Lestidae): Some Solutions for Identification. Journal of the Entomological Society of BC 101: 101-109.

c) Publications and reports in preparation

Cannings, R.A., S.G. Cannings and L.R. Ramsay. The status of the Odonata of British Columbia: annotated lists and zoogeographic discussion. To be submitted to the Bulletin of American Odonatology on completion of northern dragonfly survey.

Cannings, R.A., L.R. Ramsay. S.G. Cannings. The dragonflies (Insecta: Odonata) of Northern British Columbia: field surveys, collections development and public education. Royal British Columbia Museum: *Living Landscapes* Project. The web report will include species accounts, biogeographical and habitat information, keys, collections data and photographs.

Simaika, J.P and R.A. Cannings. *Lestes disjunctus* Selys and *L. forcipatus* Rambur (Odonata: Lestidae): re-evaluation of status and distribution in British Columbia. To be submitted to the Journal of the Entomological Society of British Columbia.

d) Partners

- Northern dragonfly inventory was the priority of the entomological research and inventory efforts Royal British Columbia Museum in its *Living Landscapes* project for 2000-06, a major effort to link regional participation with museum inventory, research and public activities.
- B.C. Ministry of Sustainable Resource Management, through the B.C. Conservation Data Centre, was the main partner in the inventory. Other headquarters personnel of this ministry and the Ministry of Water, Land and Air Protection as well as regional staff participated. BC Parks provided Park Use Permits and mapping and vegetation studies, and gave advice on study areas. Parks will use the information gathered for park interpretation and school programs and hopefully management of wetlands within their prevue.
- Habitat Conservation Trust Fund. Significant support from the fund financed the hiring of field contractors and coop students and supported the costs associated with field work. Detailed distribution maps of species were also funded by the HCTF.
- B.C. Ministry of Forests. The Research Branch supported the work designed to link inventory results to their wetland classification scheme. They also provided vehicles at a lesser cost than a rental and were able to provide helicopter time in one instance.
- The University of Northern British Columbia (UNBC) was a partner, contributing volunteer collecting time through its entomology students under the direction of Dr. S. Lindgren. A synoptic collection of dragonflies from the project will be deposited at UNBC to aid in future teaching and research.
- The Peace/Williston Fish and Wildlife Compensation Program (BC Hydro) shared some helicopter time in the 2000 field season. This shared helicopter use allowed the project into areas that were otherwise not accessible

12. Contractor Performance

In general, we were happy with the performance of the contractors we hired. The field biologists brought hard-to-find experience and skills in fieldwork and dragonfly collecting and some had a detailed knowledge of dragonfly biology. Cris Guppy (2000, 2001), Gord Hutchings (2000-2003), Gina Roberts (2000) and Syd Cannings (2002, 2003) were hired primarily for collection of specimens. Although some were more experienced than others, all performed this task adequately. Completion of field data forms varied between the contractors. Some collected much more habitat data or quantified their catch more thoroughly or gave more complete and accurate directions to collection sites. Some were less experienced in dragonfly identification (Guppy, Roberts) than others and did not identify some of the more difficult species or made some identification errors. These problems were corrected by more experienced taxonomists at

the RBCM. Gord Hutchings had some difficulty getting completed data forms to us in a couple of the years.

Syd Cannings (2002 [Osiris Consulting], 2003) was also hired to plan and organize the logistics of the project during two seasons. He assembled maps and information on potential collection sites, contacted local naturalists and government employees for information, scouted potential sites and gave a lecture and field workshop on collecting. This greatly improved the efficiency of planning field schedules, finding the best collecting sites and involving local volunteers.

Pamela Hengeveld (2000, 2001) and Rosamund Pojar (2002) were hired to help with some of the detailed habitat descriptions. Unfortunately, a miscommunication with Pamela prevented the scheduled completion of some of the requested work.

Clover Point Cartographics: Mike Shasko produced excellent species distribution and status maps and flight period histograms from the RBCM and UBC Odonata databases. These were produced in both jpg and pdf formats. Mike spent considerable time with Rob Cannings correcting database errors that were revealed during the mapping process. Several drafts of the products were reviewed and modified before final formats and content were established and approved.

13. Photographic Record

Included here are just two pictures of survey activities. There is a more complete photographic record in the rest of the report, including pictures of dragonfly species, dragonfly biology and habitat types. More images are available on request.

Volunteers played a major role in the surveys: they recommended collecting sites, helped with logistics and participated in collecting specimens and habitat data. They form a useful local resource for future monitoring of wetlands. Joanne Vinnedge and her daughter Laura at a peatland pond near Fort St. James. Photo: Robert A. Cannings

Andrew Harcombe drying dragonfly specimens in the sun north of Fort St. James. Specimens are placed in envelopes and submersed in acetone for 24 hours to preserve colours. The envelopes and specimens are later dried. Photo: Robert A. Cannings.

15. Acknowledgements

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Appendix 1. Introduction to the Dragonflies

The insect order Odonata (Greek for “toothed jaws”) contains the groups of insects known in English as dragonflies and damselflies, but “dragonflies” is often used to refer to the whole order. “Odonates” is another name that is gaining popularity. The Odonata contains about 5,500 named species in 33 families worldwide. For comparison, there are roughly the same number of mammal species in the world and almost twice as many birds. Most dragonflies live in the tropics, but a few have adapted to the cooler temperatures of higher latitudes; even in our region there are many more species living in the south than the north.

Dragonflies are large and abundant insects and, because of this, the order forms one of the predominant groups in standing freshwater communities in the northern regions of British Columbia. We have recorded 87 species in the province. In the western mountains, species are less abundant in running water than they are in standing water habitats. Dragonflies live around most types of fresh water. Certain kinds prefer lakeshores, others are found only along streams, or around springs and in peatlands. Ponds and marshes rich in aquatic vegetation support the most species.

Dragonflies are among the most ancient insects – their ancestral line goes back to the Carboniferous Period, about 300 to 350 million years ago. They have retained many primitive characteristics and developed some specialized features for a successful aerial and predatory lifestyle. Dragonflies share with mayflies the ancient inability to fold their wings flat over the body. They differ from all other insects in their combination of biting mouthparts; their two equal (or almost equal) pairs of long, membranous, net-veined wings; their large, bulging eyes and short, thread-like antennae; and their long, slender abdomen that, in the male, bears secondary genitalia at the base.

A dragonfly leads a dual life – in its immature stage, the larva lives in water, obscure and camouflaged. When it is time to mature, the changing larva emerges from the water and transforms into a colourful, flying adult.

Some early dragonfly-like insects were enormous – fossils from the Carboniferous Period show that one had a wingspan of 70 cm – but the largest North American species found today measures about 14 cm across the wings. The greatest wingspans in modern times – about 17 cm – belong to the giant damselflies of the American tropics.

Many dragonflies around the world are as colourful and flashy as the most spectacular birds and butterflies. Most of our local dragonflies are more subdued, but they are still lovely and striking insects. They come in a myriad of colours, from iridescent metallic green to breathtaking crimson. Their bodies can be boldly spotted or striped, and their wings are often strongly patterned with spots and bands of colour.

The order Odonata is divided into three suborders: the Zygoptera (damselflies), the Anisoptera (true dragonflies) and the Anisozygoptera (a tiny group of two rare species from the mountains of eastern Asia). Damselflies are slimmer, often smaller and usually fly more slowly than true dragonflies. At rest they usually hold their equal-sized wings together above the body – Zygoptera means “joined wings”. Anisoptera means “unequal wings”, because the hindwings of the true dragonflies are broader than the forewings. When perched they hold their wings out away from the body.

The flying ability of dragonflies amazes most people. Although the wing structure and arrangement of the flight muscles are primitive, the flight performance and efficiency are remarkable. Unlike most insects, dragonflies usually beat their forewings and hindwings separately – when the forewings are up, the hindwings are down. Each wing also has much independent control, accounting for the surprising manoeuvrability of many species, which can fly upwards, sideways, backwards and forwards. A large darner can fly up to 60 km per hour. Aeshnidae (darners), Corduliidae (emeralds), Cordulegastridae (spiketails), Macromiidae (river cruisers) and some Libellulidae (skimmers) are called *flyers* because they spend most of their active life flying – they even generate additional body heat from their wing muscles. Damselflies, Gomphidae (clubtails) and most Libellulidae are often called *perchers*, because they spend more time perching than flying. Perchers gain much of their body heat from basking in the sun and make only short flights to catch food or mate.

Dragonflies are amazing fliers. *Aeshna palmata* male. Photo: George Doerksen, RBCM.

For millennia, dragonflies have instilled superstitious fear in humans, even though they do not sting or bite people. Maybe their boldness takes us aback, or their speed startles us. To the uninitiated, their strange appearance up close can make them seem fearsome. The English name “dragonfly” echoes the feelings these insects sometimes arouse – they are the fanciful “devil’s darning needles” that sting venomously or sew up the lips; they are “snake doctors” with the power to bring dead snakes back to life. These legends and folktales are groundless – dragonflies are harmless to humans.

Dragonflies spend their youth as aquatic larvae preying on other underwater animals. Dragonfly larvae – sometimes called nymphs – have an enormous (for their size) hinged labium, a sort of lower lip armed with pincers, that they use as an extendible grasping organ for capturing prey. They are voracious predators, eating small aquatic insects, crustaceans and even fish and tadpoles.

Aeshna interrupta larva. Photo: Robert A. Cannings, RBCM

Biologists place dragonfly larvae into three categories, according to their feeding behaviour: *Claspers* (Zygoptera and Aeshnidae stalk their prey while using their clasping legs to hold onto vegetation; their colour patterns of green and brown help camouflage them among the water plants. *Sprawlers* (Macromiidae, Corduliidae and most Libellulidae) lie spread-eagled on the bottom mud and debris or on vegetation, waiting to ambush prey; they often keep hidden under a coating of mud and algae. *Burrowers* (Gomphidae) and Cordulegastridae) dig into the sand and silt, where they await their prey.

Damselfly larvae, like the adults, are slender animals. The tip of the abdomen bears three leaf-like gills, richly laced with the fine tubes that carry oxygen and carbon dioxide throughout the body. The stouter larvae of the true dragonflies do not have external gills; instead, they pump water in and out of the gut and breathe through gills lining the rectum. Damselflies use their gills to help them get around, sweeping them back and forth like swimming fins. Larvae of true dragonflies also use their breathing mechanism to help them move: they can blast pressurized water out the anus, jet-propelling them through the water – an effective tactic for escaping predators or attacking prey.

Dragonflies, like grasshoppers and many other insects, develop without a pupal stage. After the larva pops out of the egg, it eats, grows and moults 8 to 17 times (usually 10 to 14), depending on the species and the conditions. The developing wingbuds get larger with each

moult. For many species in British Columbia, the life cycle takes about a year. Some *Lestes* (spreadwings) and *Sympetrum* (Meadowhawks) that live in temporary ponds overwinter as eggs, hatch in the spring, grow rapidly and emerge as adults in the summer. Many species overwinter as larvae and emerge the following spring or summer; others spend two years in the larval stage. For some dragonflies (especially certain Aeshnidae and Corduliidae), the larval life may last six years or longer. Development time depends on the species and also on altitude, latitude and amount of daylight. Growth slows with the shorter summers and colder temperatures of northern habitats and high altitudes.

In British Columbia, dragonflies live only a short time as adults – about one to two months. A dragonfly begins its adulthood when the fully grown larva metamorphoses into an adult inside its last larval skin, then crawls out of the water, up a plant stalk or some other support. Gomphidae and Coenagrionidae (pond damsels)can emerge horizontally on rocks, floating logs and plants, or the shore.

Now exposed to air, the dragonfly begins its final moult: the top of the thorax splits open and the adult dragonfly squeezes out of the larval skin. It pumps blood into its wings and abdomen, which expand slowly, and gradually, the body hardens. After an hour or two the dragonfly can fly, weakly at first, on fragile, glistening wings. It leaves the empty larval skin, the exuvia, clinging to the support. Once its body has hardened, the adult dragonfly will not grow larger even though it eats a lot.

The mature larva crawls out of the water and the adult dragonfly emerges from the larval skin.
Aeshna interrupta male. Photo: Robert A. Cannings, RBCM

Emergence can occur by day or night. Most Zygoptera , Gomphidae and some Libellulidae emerge during the day. Many darners emerge at night, but in cool weather or in the far north, may transform during the day. The newly emerged adult, called a teneral, is vulnerable to predators and bad weather.

Dragonflies have characteristic flight periods. This is the period during which adults may be seen and does not necessarily represent the adult lifespan of a particular individual. Many species may live in the same locality: some emerge early in the spring and are rare by summer; others appear in mid summer and fly into the fall; still others fly from spring to fall.

After emergence, most adults leave the shoreline to hunt and eat for a few days or even weeks as they mature. They are powerful predators that hunt by sight. They usually capture prey while flying, grabbing it with long, spiny legs and then chewing it with powerful jaws. Adult dragonflies eat mainly flying insects, but some species will pluck insects, spiders and even small frogs off vegetation or the ground.

Immature adults are pale in colour, but gradually become darker and often brighter as they mature. Some species produce a waxy, white or pale blue powder, called pruinescence, over parts of the body and wings; this is especially obvious in some male Libellulidae and *Lestes* and some female *Ischnura* (Forktails).

When they are sexually mature, dragonflies return to the water to breed. Most of the dragonflies you see near water are males aggressively searching for mates. In many species (Zygoptera, Petaluridae (Petaltails), Gomphidae, Corduliidae) and many Libellulidae), mature males defend a territory against other males of the species, patrolling the habitat or sallying out from perches. This territorial behaviour limits aggression by spacing males along the shore and helps prevent undue disturbance of egg-laying females.

Females coming to the water to breed quickly attract mates. With the appendages at the tip of the abdomen, a male grasps a female by the front of the thorax (Zygoptera) or by the top of the head (Anisoptera). This head to tail arrangement is called the tandem position. Before joining with a female

Mating *Enallagma boreale*. Photo: George Doerksen, RBCM

or even while in the tandem position, the male transfers sperm from the tip of his abdomen to his penis, which is under the second abdominal segment. The female then loops the end of her abdomen up to the penis so that the male can transfer the sperm to her. The Odonata are the only insects that mate in this circular formation, called the wheel position, which they maintain for a few seconds or several hours, depending on the species. Female dragonflies usually mate more than once, and in an attempt to ensure that their sperm fertilizes her eggs, males may spend much of the copulation period removing the sperm of other males – the penis is modified to pull another's sperm out of the female or push it aside so that it is inactivated.

The female lays her fertilized eggs by the hundreds. All Zygoptera, Aeshnidae and Petaluridae have a knifelike egg-laying structure with pointed blades, called an ovipositor, at the tip of the abdomen; they lay their eggs in plant tissue, although some darners and petaltails insert eggs into soil. Cordulegastridae shovel the eggs into a streambed. Other species – without ovipositors, or with simply a scoop-shaped plate called a vulvar lamina – drop eggs into the water, tap the eggs into mud and moss, or simply dip the tip of the abdomen into the water and wash the eggs off.

Lestes disjunctus ovipositing. Photo: George Doerksen, RBCM

Competition for mates is usually fierce, and male aggression can prevent females from laying their eggs. Females that lay their eggs alone, especially mosaic darners, often do so stealthily, flying low among the plants along the shore, wings rustling in the stems as they settle to deposit the eggs. Some Zygoptera actually crawl below the water's surface to escape the attention of males, often remaining submerged for more than an hour – they take a film of air down with them, trapped in the hairs on their body, so they can breathe while they

lay their eggs. In many Zygoptera, *Sympetrum* and *Anax junius* (Common Green Darner), the male stays in tandem, retaining his hold on the female while she lays her eggs. In some other species, the male hovers protectively nearby, guarding the egg-laying female from any other males who may attempt to mate with her, and allowing her to lay her eggs undisturbed.

Aeshna palmata female ovipositing in wet log. Photo: George Doerksen, RBCM

Appendix 2. Systematic Review of the Dragonfly Fauna of Northern British Columbia

The 68 species known, or expected (*), to occur in Northern British Columbia are treated below. An outline of each family and genus is included but the genus description is omitted if there is only one species in the family. Families are listed in phylogenetic order, which reflects our understanding of the sequence of dragonfly evolution. The genera and species are in alphabetical order of their scientific names. A systematic checklist of the species, including their English names and faunal element (a designation of range type), is also given in Appendix 3. The faunal elements are defined in Appendix 3.

In each species account, the following information is presented:

Species status is given by the provincial conservation rank and colour list (BC Conservation Data Centre); definitions are listed in Appendix 5. The nine species at risk in northern BC, that is, those considered potentially endangered, threatened or of special concern, are given a more detailed treatment (including management issues) than the more common ones. The red and blue lists and the ranks are briefly defined in Appendix 6.

Descriptions are limited to information that helps separate species. A photograph of each species is included, except for *Somatochlora septentrionalis*, which we have not yet photographed.

Global range and distribution in British Columbia are summarized. Maps 1-4 show BC distribution based on the collections of the Royal BC Museum and Spencer Entomological Museum, University of BC. Map 1 is the basic distribution map. Map 2 separates records made before 1996 and those made from 1996 to 2004. This highlights the effectiveness of intensive surveys in improving our understanding of dragonfly distribution in BC. Map 3 shows species distribution and the relative abundance of collection records in each 1/50,000 NTS map sheet in BC. Map 4 shows the same, except the number of localities in each map sheet, rather than total specimen records, is shown. Each map also presents a histogram of collection records of adult dragonflies graphed in 10-day periods throughout the year. These represent the known flight period of the species.

The Biology Section contains other relevant information about the species, such as its abundance, preferred habitat and behaviour. Preferred habitats are outlined generally and some examples of typical site associations are given (MacKenzie and Moran 2004); see Appendix 5 for details. The flight period is an estimate of the length of time adults can be seen throughout BC, and is often longer than the flight period in any one location. This estimate is based on museum specimen records, reliable sight records, records from nearby states and provinces, and extrapolations from these records and other biological clues. The graphs on the species distribution maps give the flight period based only on specimen records.

For the nine species of conservation concern, a brief outline of management and protection considerations is given.

Order Odonata
Suborder Zygoptera (Damselflies)

Family Lestidae (Spreadwings)
A small but widely distributed family in BC, containing only one genus here, *Lestes*, with five species. All of these occur in the northern BC study area. The common name comes from the characteristic posture of the adults – they usually perch with wings half-spread.

***Lestes* (Spreadwings)**
Large damselflies, brown, black, metallic-green or bronze above, mostly pale below. As they age, parts of the body, including the tip of the abdomen in males, often become pruinose bluish white. Females lay eggs in tandem with males, usually in plants above the surface of the water. The larvae are long and slender with banded gills and an unusually elongated labium. Some species are adapted to temporary ponds; the eggs overwinter and the larvae grow rapidly after the basin fills with water in the winter or spring.

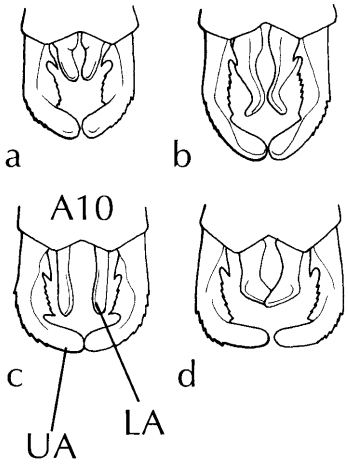
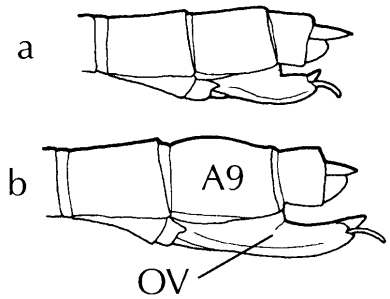


Figure 1. Spreadwings, male appendages, top view: a, Spotted; b, Lyre-tipped; c, Common; d, Emerald. A10 = abdominal segment 10; UA, LA = upper, lower appendages.

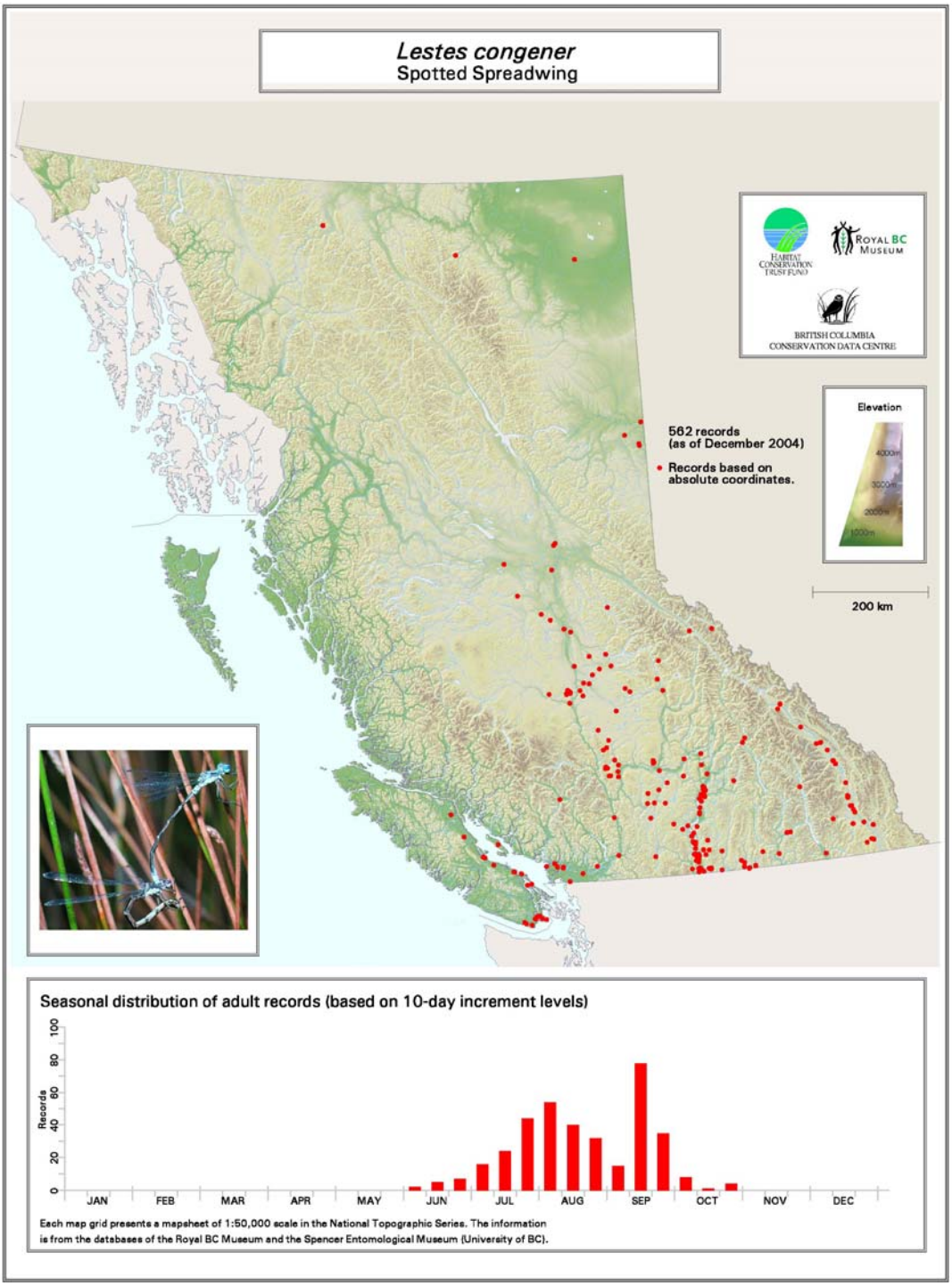
Figure 2. Spreadwings, tips of female abdomen: a, Common; b, Sweet-flag. A9 = abdominal segment 9; OV = ovipositor.



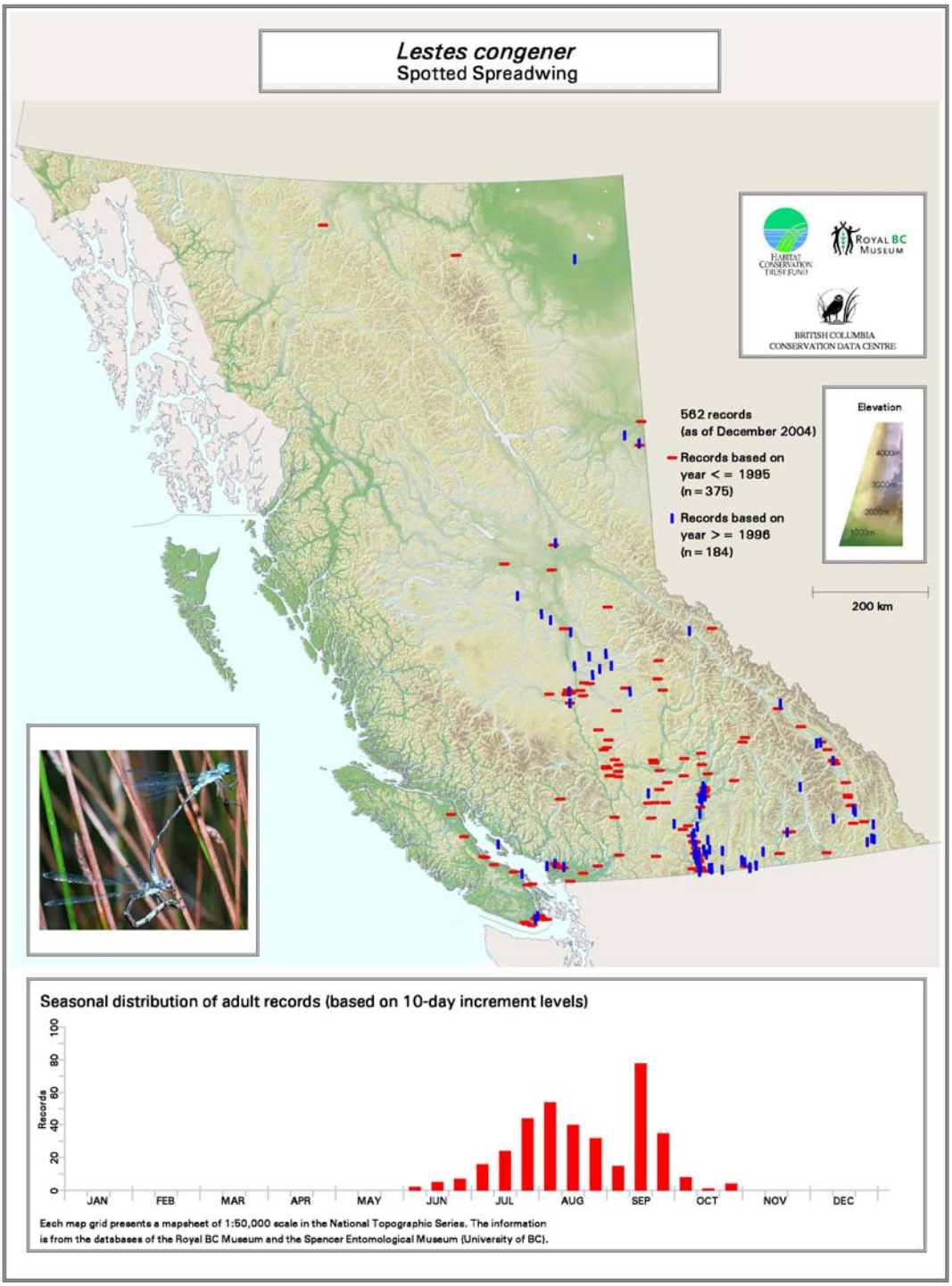
***Lestes congener* (Spotted Spreadwing)**

BC conservation rank: S5. Yellow List.
Description: Thorax top is dark brown or black with narrow pale stripes; the pale underside has several (usually three) dark spots on each side. The male's lower appendages are much shorter than those of any other BC species – only half as long as upper appendages (fig. 1). Length: male, female 40 mm.
Global Range: British Columbia east through the Northwest Territories to Labrador and Newfoundland; south to Alabama, Missouri, New Mexico and California (Westfall and May 1996). Faunal element: Widespread. (see Appendix 3).
BC Distribution: Widespread, especially in the south; seldom collected north of Prince George, especially westward.
Biology: Common in many types of wetlands, from alkaline ponds (Gs01-03) to sedge, cattail and bulrush marshes (Wm01-02, Wm04-07) and peatlands (Wf05-08). In BC, it emerges later than other spreadwings and is the last damselfly seen in autumn.
BC flight period: early June to mid November; most records are from mid July to early October.

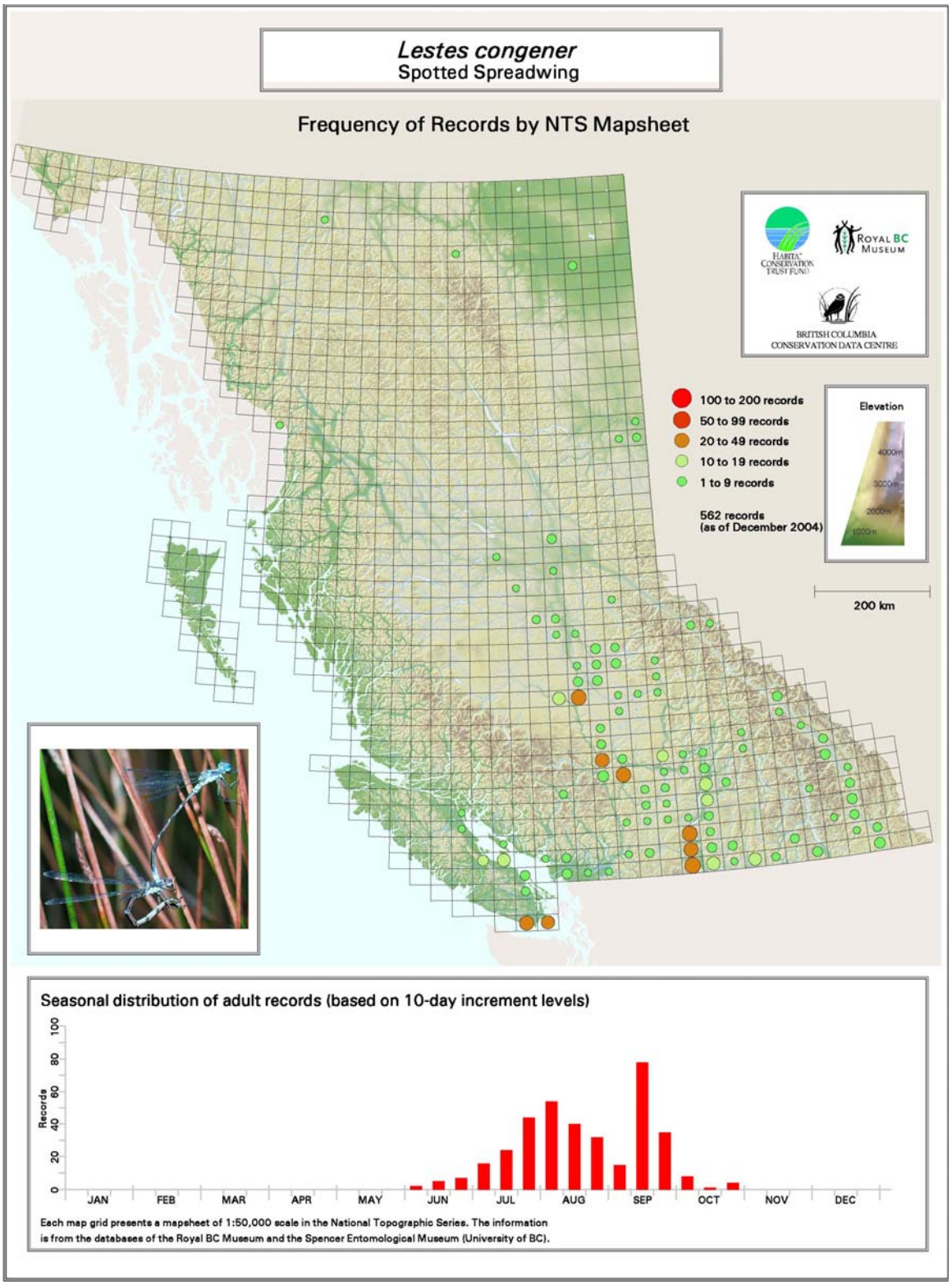
Lestes congener mating pair. Photograph: George Doerksen, RBCM



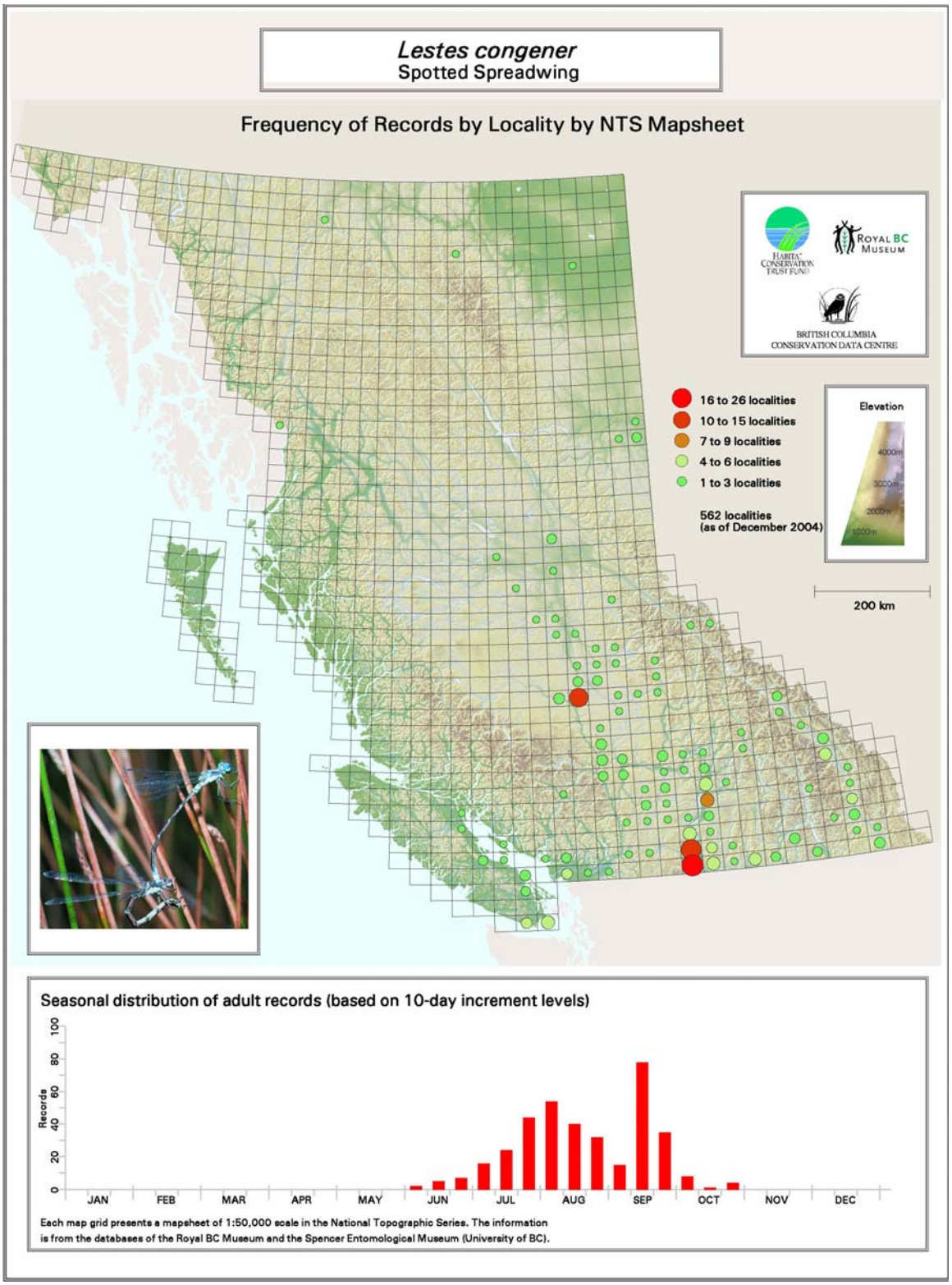
Lestes congener Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Lestes congener Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Lestes congener Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



Lestes congener Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Lestes disjunctus* (Northern Spreadwing)**

BC conservation rank: S5. Yellow List.

Description: The mature male's thorax has blue stripes on top, but turns pruinose grey with age; eyes are dark above and pale blue below. The top of abdominal segment 2 is usually completely pruinose in mature specimens (Simaika and Cannings 2004). On both sexes, the back of the head is black; this is especially useful in separating female *L. disjunctus* and *L. unguiculatus*. The male's lower appendages are long and straight (fig. 1). The end of the female's ovipositor does not reach the tip of the abdomen (fig. 2). Length: male 37 mm, female 35 mm.

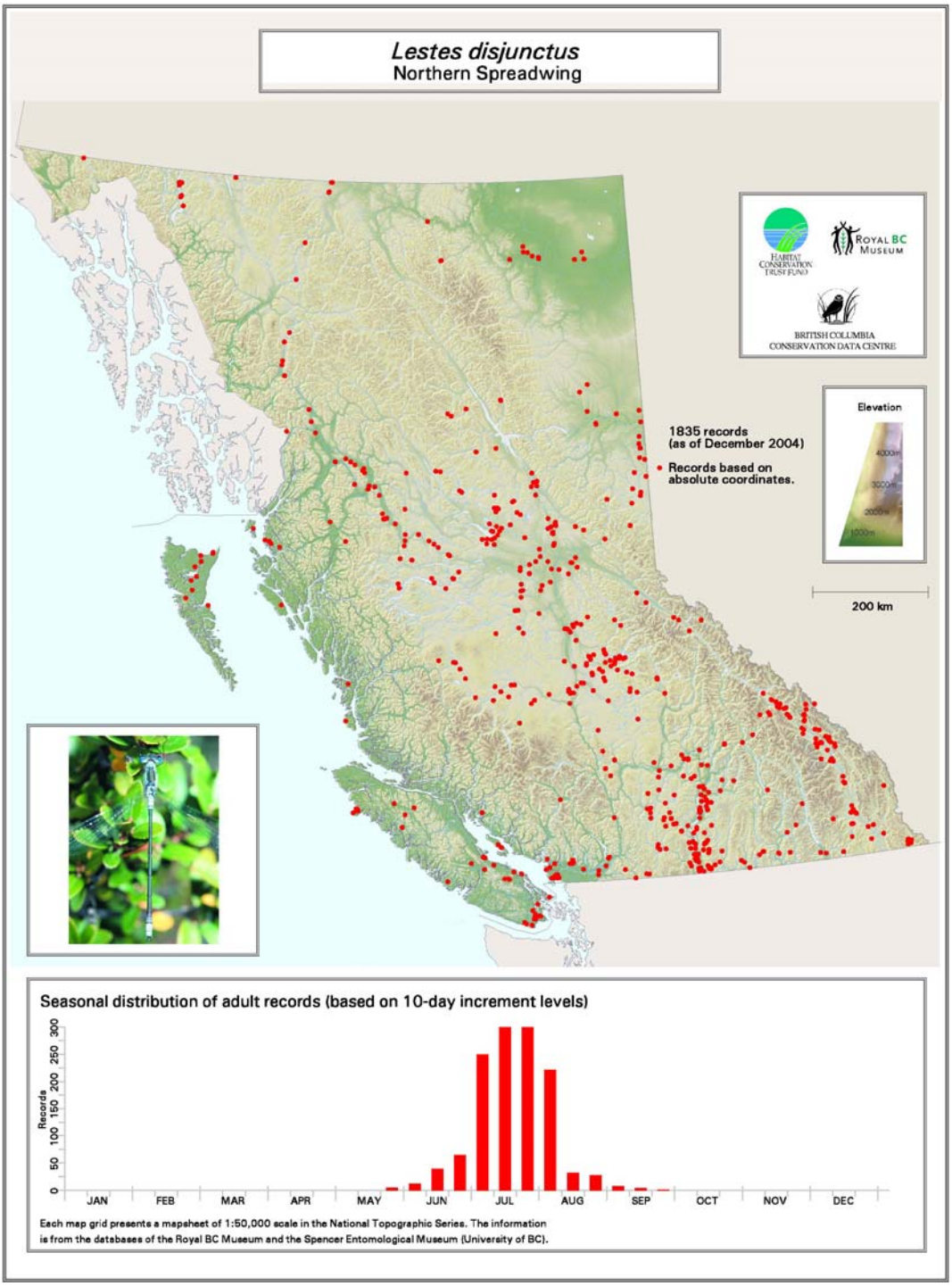
Global Range: Alaska east to the Northwest Territories, Labrador and Newfoundland; south to Florida, Texas and California (Westfall and May 1996). Faunal element: Widespread (see Appendix 3).

BC Distribution: This is the most common and widespread *Lestes*, found almost everywhere odonates live in the province.

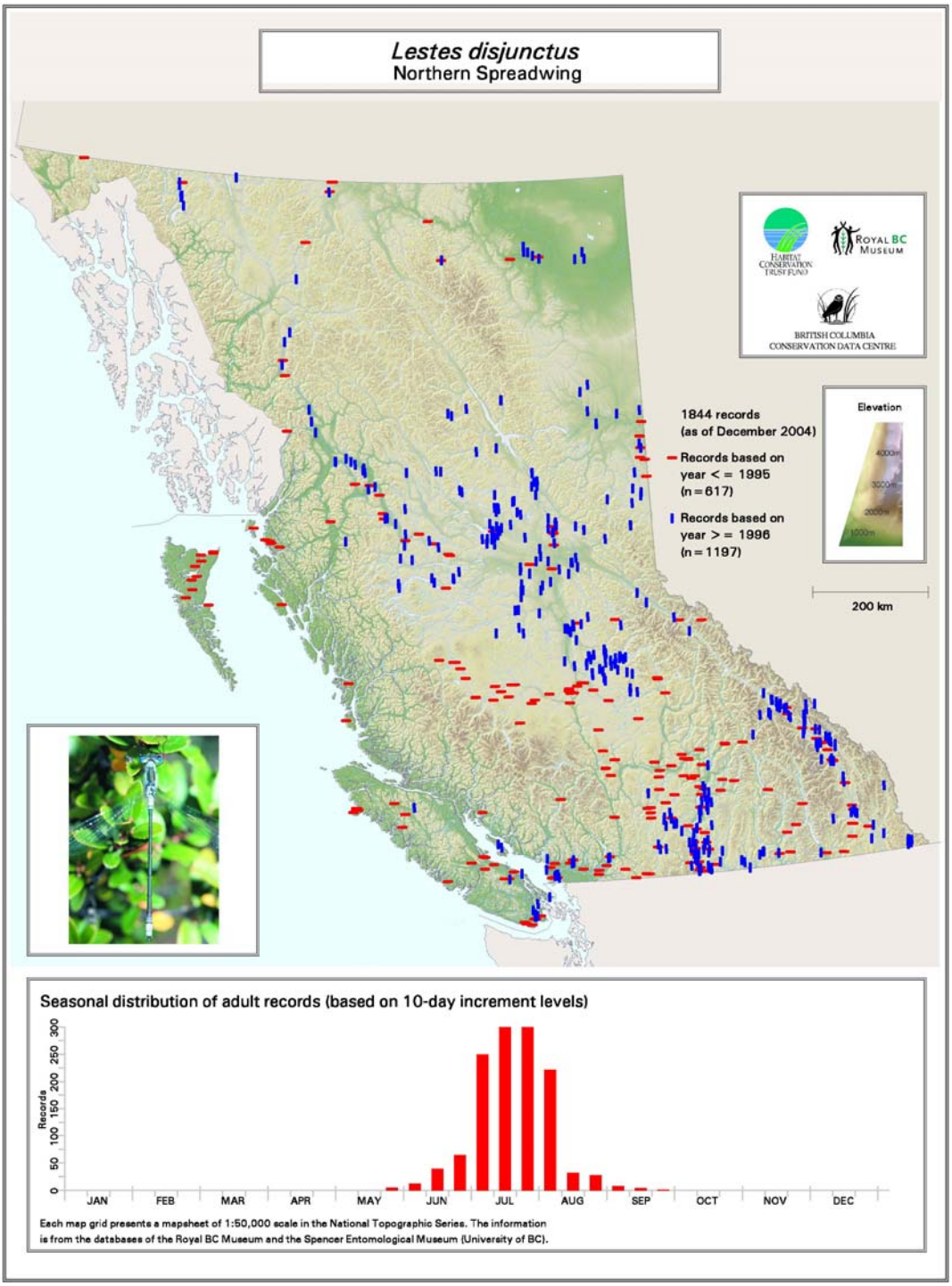
Biology: Common around most types of standing water with abundant aquatic vegetation (e.g.Gs01-03; Wm01-02, Wm04-07; Wf01, 05-08; Wb13, 50-52). There are more records of *L. disjunctus* from BC than for the other four spreadwings combined. In most places, *L. disjunctus* emerges after the first *L. dryas* adults but before most *L. congener* individuals. This temporal separation of species was documented in the Chilcotin by Cannings *et al*. (1980).

BC flight period: early June to mid October; collections mostly between early July and late August.

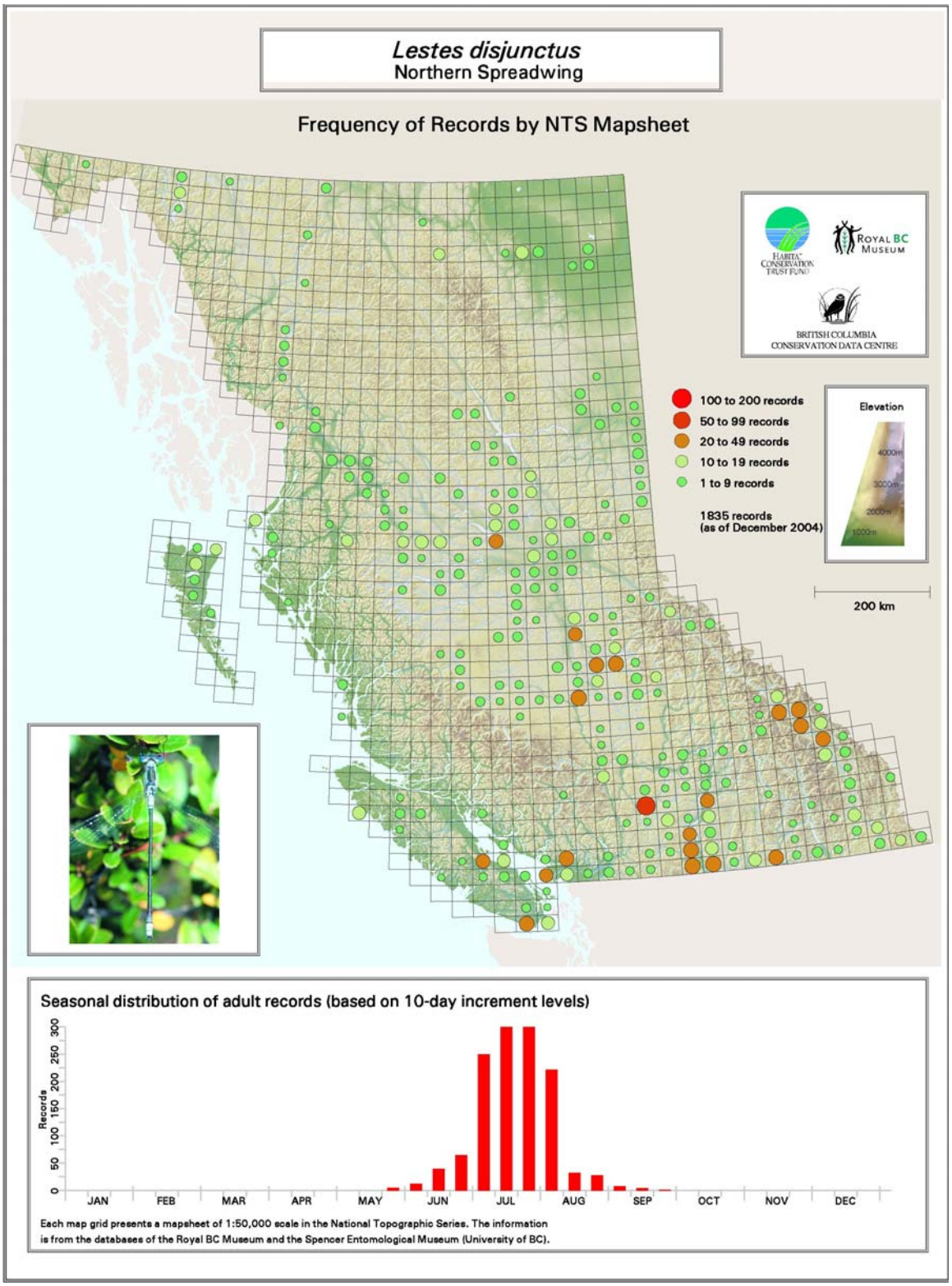
Lestes disjunctus male. Photograph: George Doerksen, RBCM



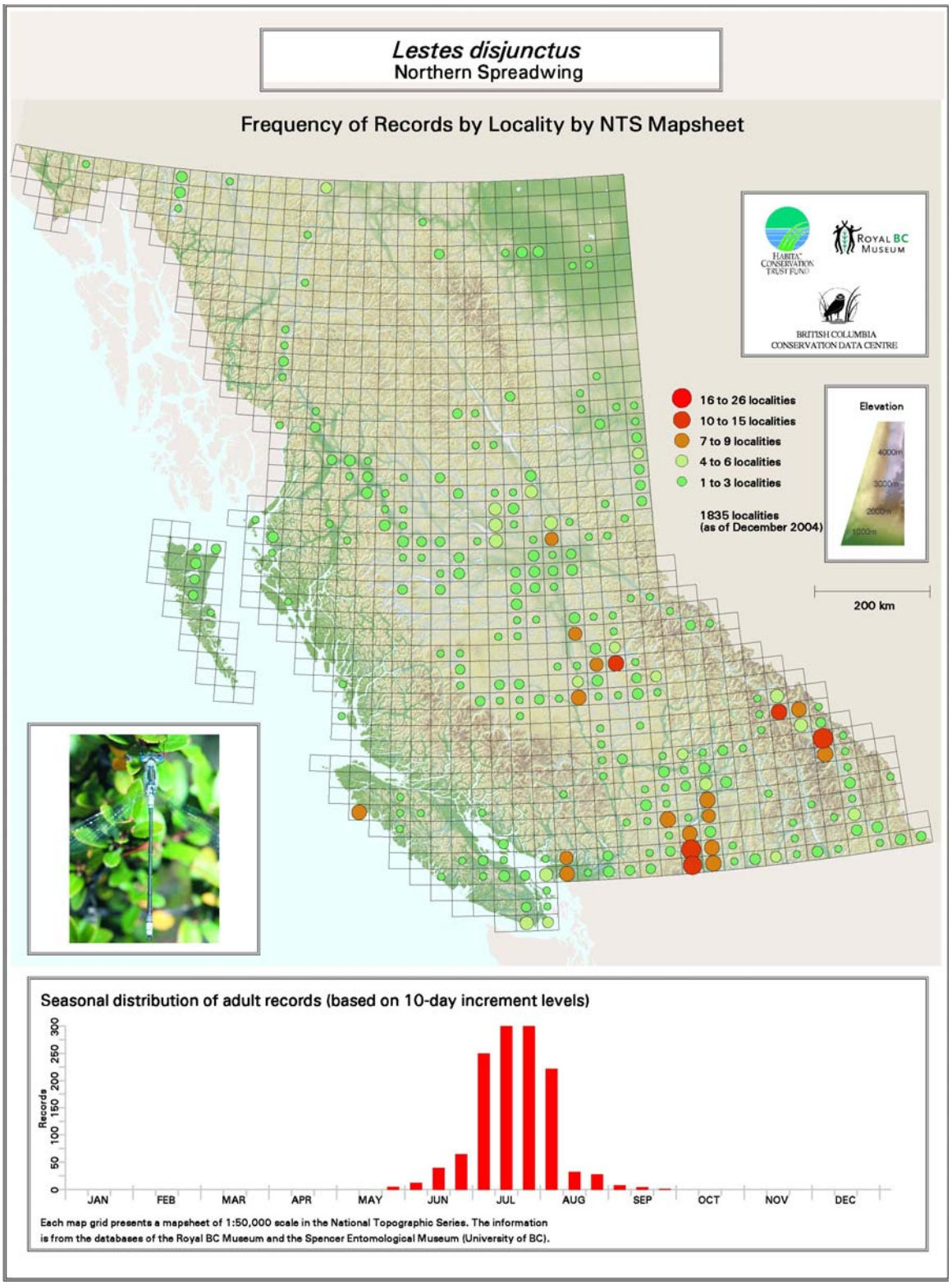
Lestes disjunctus Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Lestes disjunctus Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Lestes disjunctus Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.

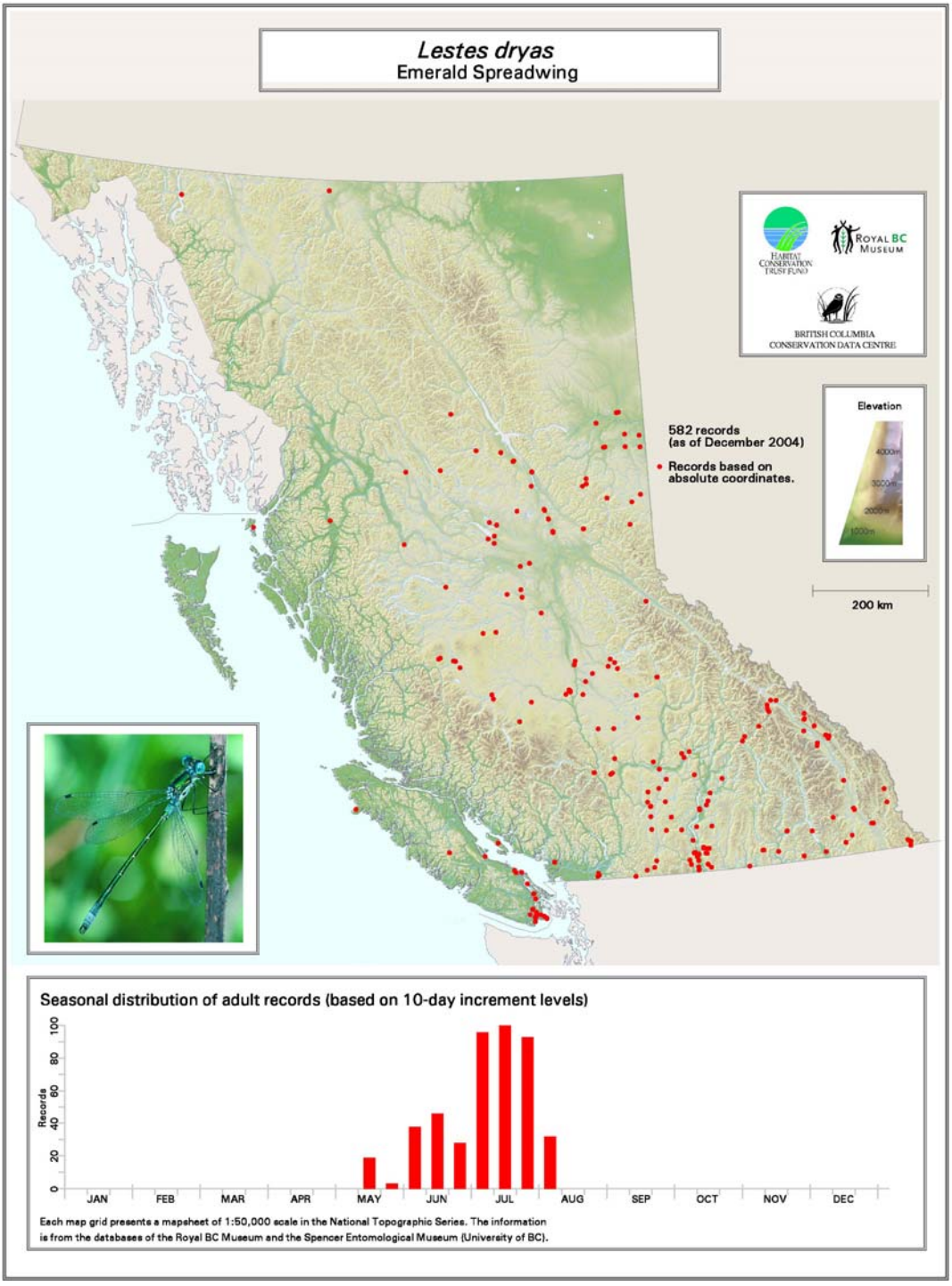


Lestes disjunctus Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

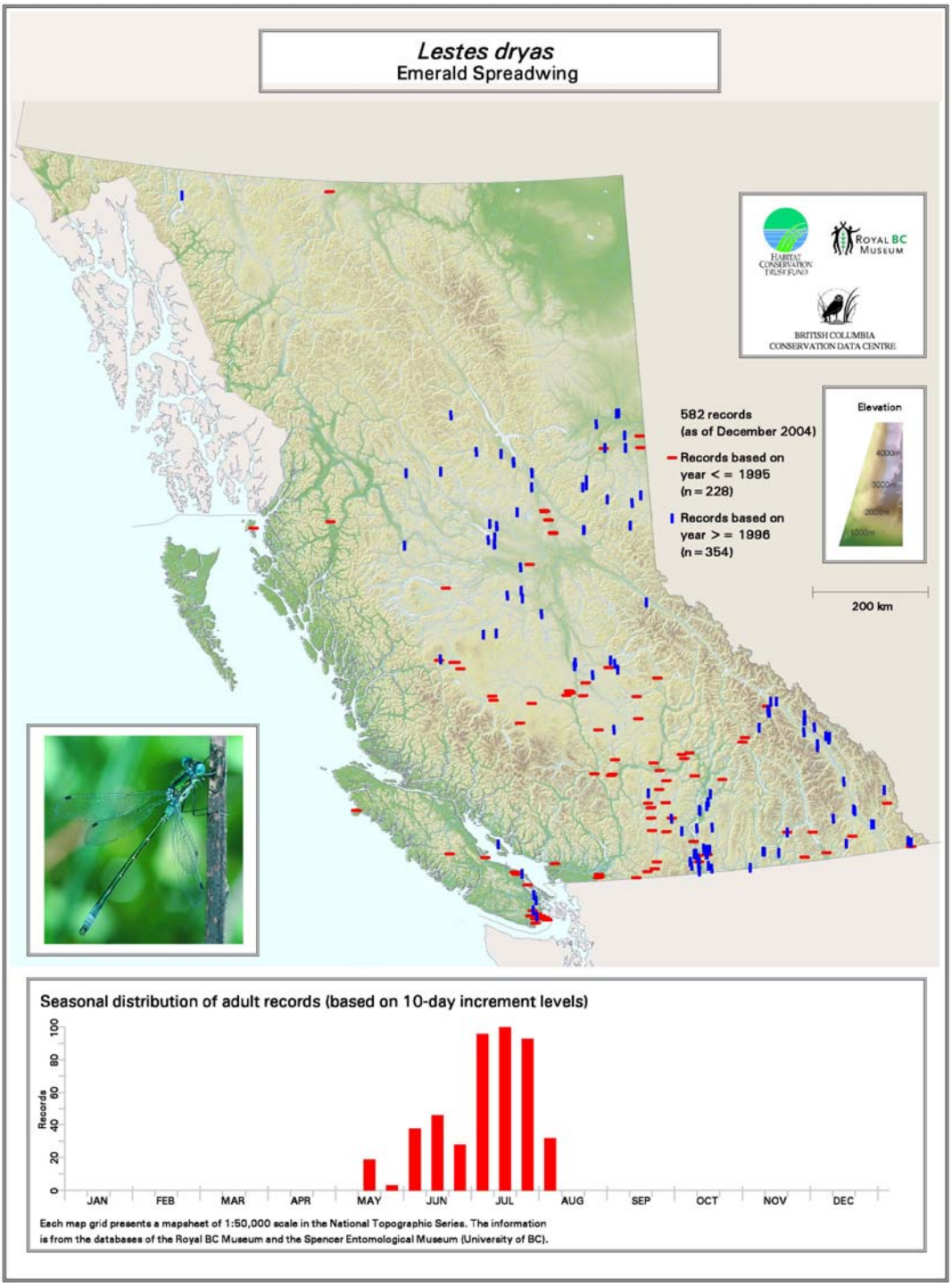
***Lestes dryas* (Emerald Spreadwing)**

BC conservation rank: S5. Yellow List.
Description: The thorax top is bright metallic green. Male's lower appendages are foot-shaped (fig. 1). The end of the female's ovipositor reaches the tip of the abdomen. Length: male 36 mm, female 35 mm.
Global Range: Alaska east to the Northwest Territories, James Bay and the north shore of the St. Lawrence River and Nova Scotia; south to Virginia, Nebraska and California (Westfall and May 1996). Faunal element: Widespread (also northern Eurasia) (see Appendix 3).
BC Distribution: Throughout most of BC, but only a few localities north of 57ºN.
Biology: Usually the first spreadwing to emerge in the year. In the south, it is common in early summer, especially around small ponds and places that may dry up in summer. It is less common northwards. Habitat site associations include Wm01, Wm04-06; Wf05-08.
BC flight period: late May to mid September; mostly collected between early June and mid August.

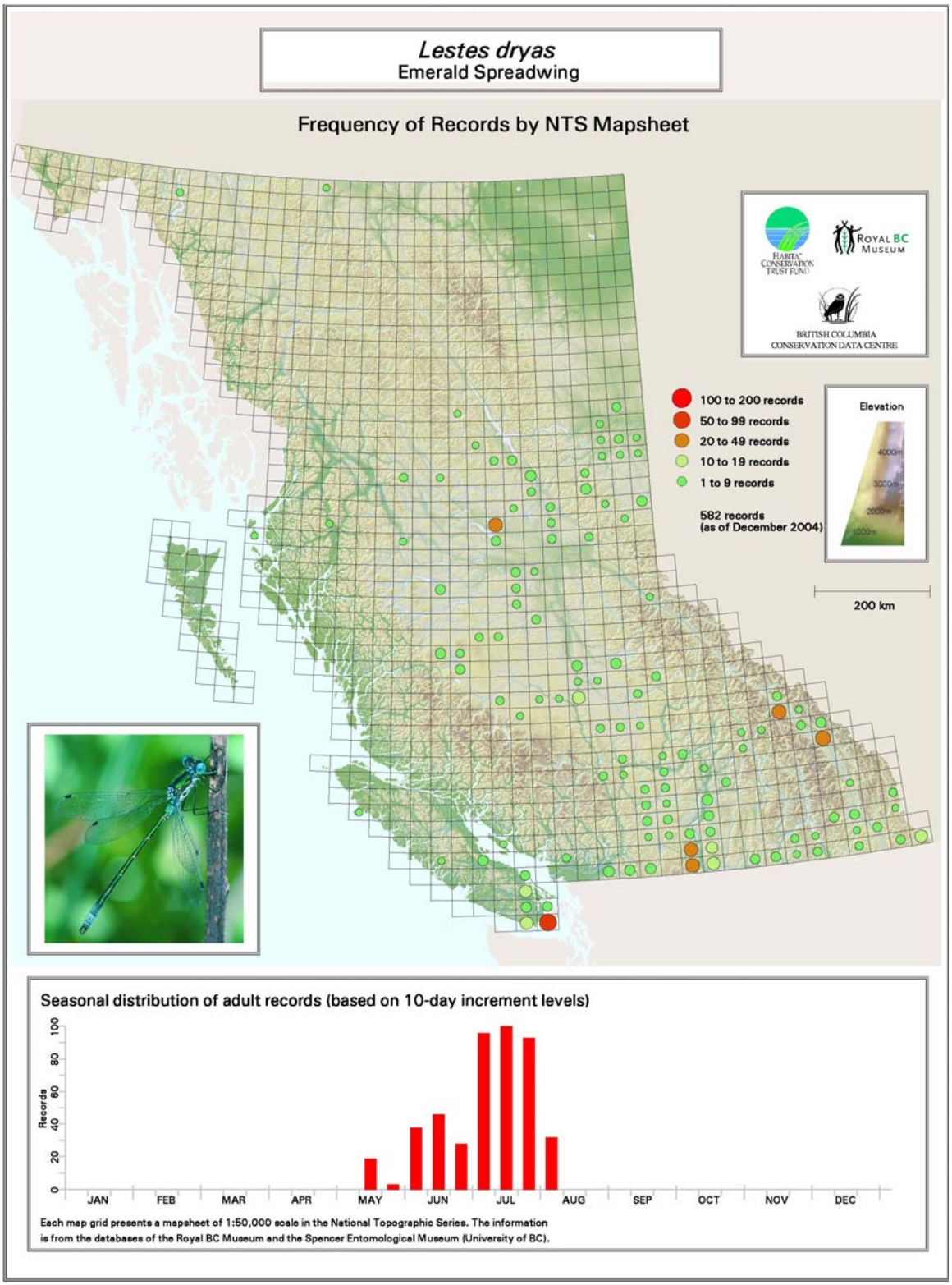
Lestes dryas male. Photograph: George Doerksen, RBCM



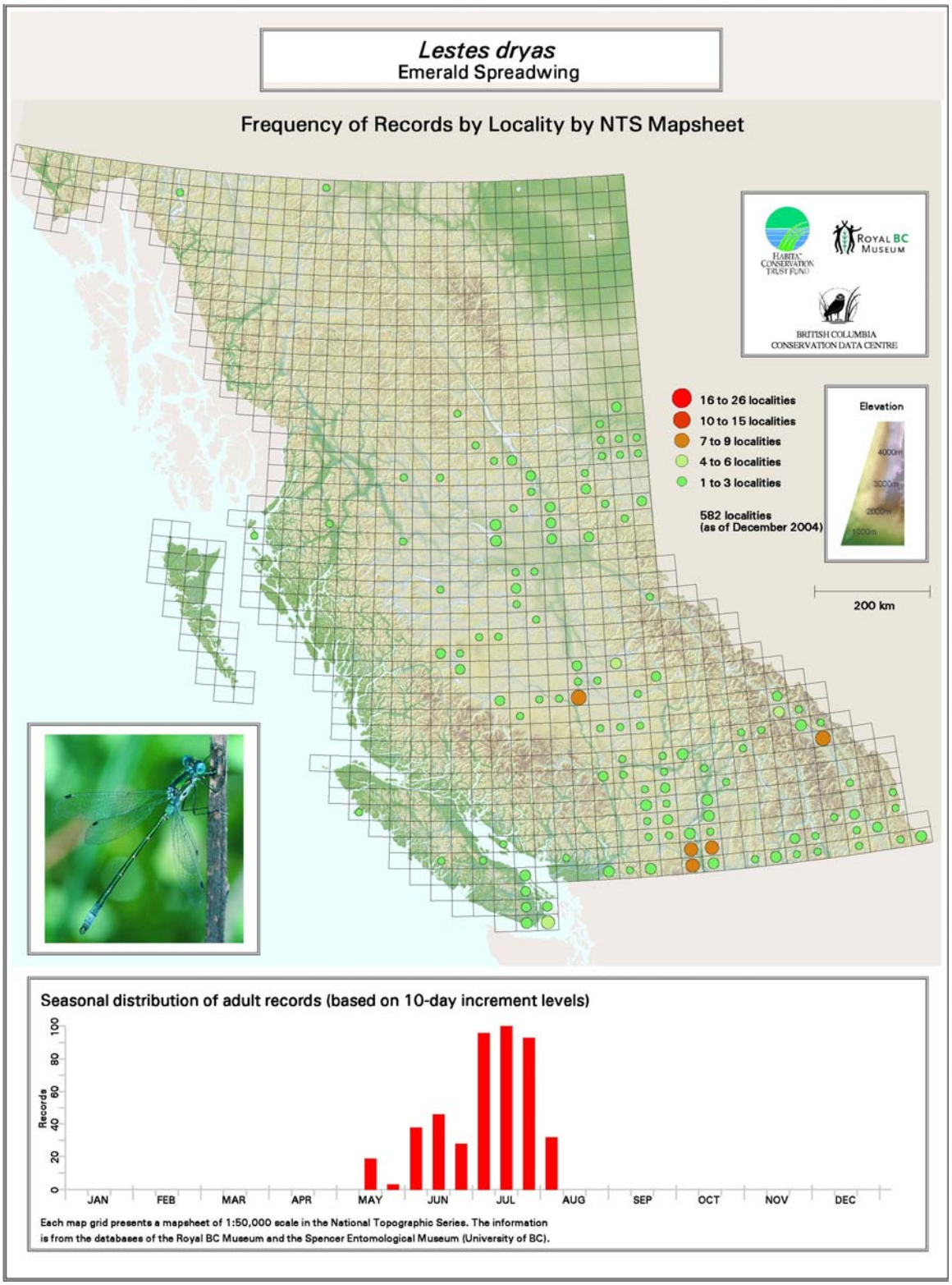
Lestes dryas Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Lestes dryas Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



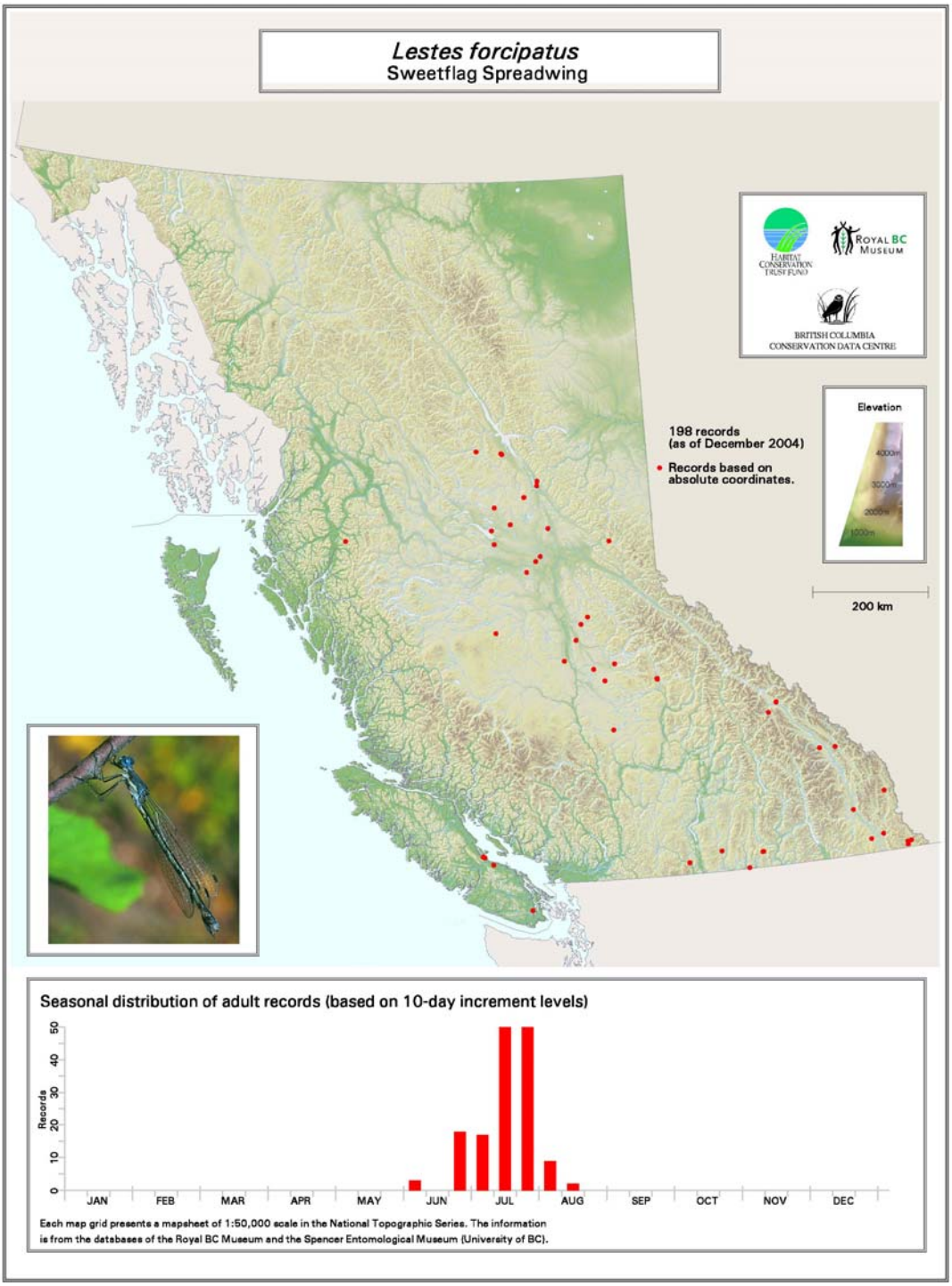
Lestes dryas Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



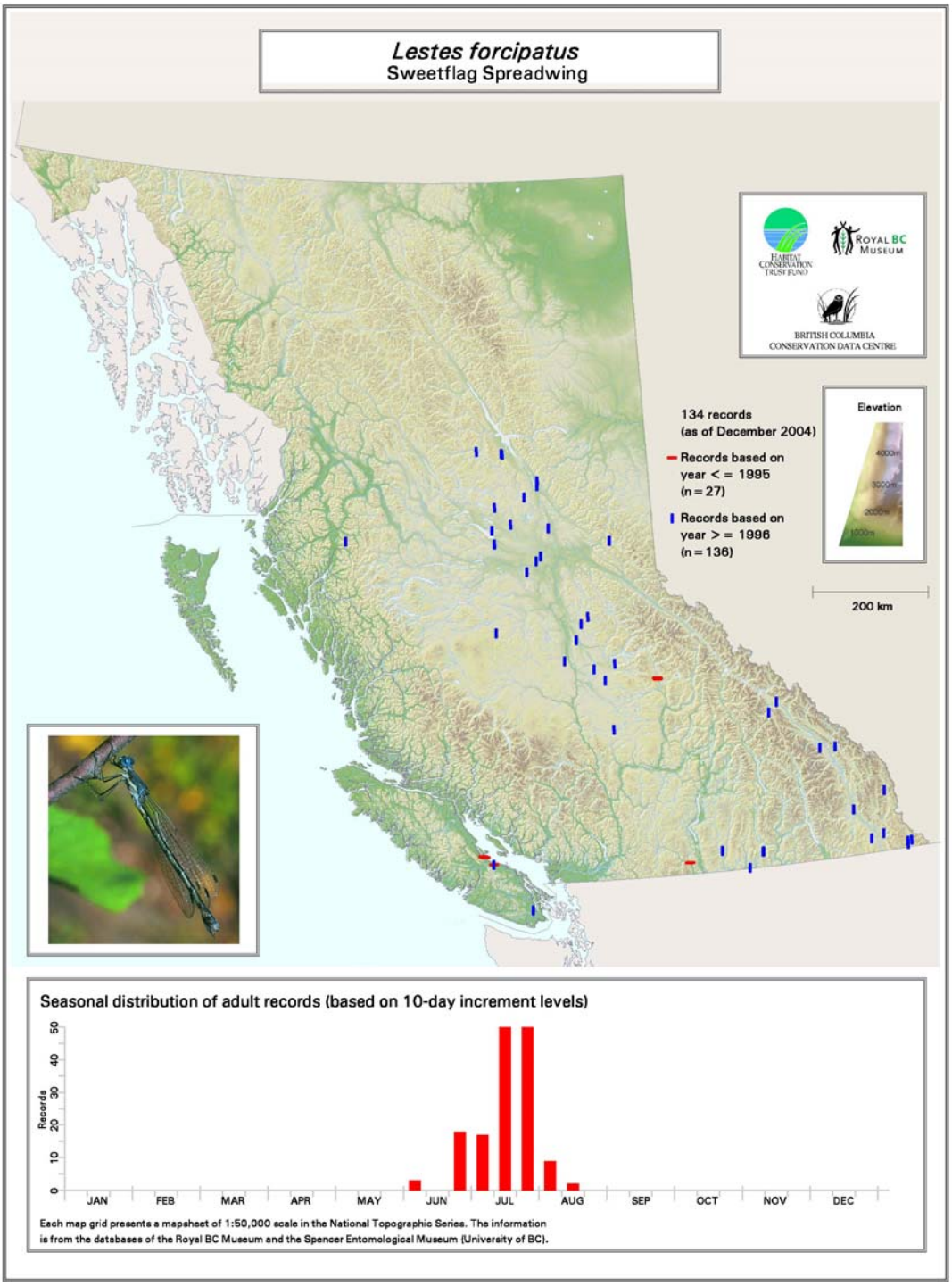
Lestes dryas Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Lestes forcipatus* (Sweetflag Spreadwing)**
BC conservation rank: S4. Yellow List. Ranked S3 when first discovered in BC, *L. forcipatus* is now known to be more widespread and common. The northern surveys have greatly increased our knowledge of this species in BC.
Description: The male is very similar to the Northern Spreadwing, but mature specimens of *L. forcipatus* can usually be identified by the lack of pruinosity on the rear third of the top of abdominal segment 2 (Simaika and Cannings 2004). Females are unmistakable; the large, distinctive ovipositor extends beyond the end of the abdomen (fig. 2). Length: male, female 40 mm.
Global Range: British Columbia east to Nova Scotia, south to Alabama, Missouri, Wyoming and Washington (Westfall and May 1996). Faunal element: Austral (see Appendix 3).
BC Distribution: Scattered localities south of 56°N, but known in the southern Yukon.
Biology: A common species of eastern North America, *L. forcipatus* was unknown in BC until 1998, when it was found in the Rocky Mountain trench. The species is so similar to *L. disjunctus* that it had been overlooked (Simaika and Cannings 2004, Ramsay and Cannings 2005, Cannings *et al.* 2005). Since then, although it is uncommon, it has been found in a variety of ponds, marshes and marshy lakes (Wm01-02, Wm04-06), but is probably most common in sedge fens (Wf05-08). Walker (1953) described *L. forcipatus* habitat in eastern Canada as “ponds, both temporary and permanent, marshy lakes, and slow, weedy streams In eastern North America, at least, this damselfly commonly lays eggs in the sweetflag, a kind of aquatic iris, thus its English name.
BC flight period: mid June to mid September; mostly collected between mid July and mid August.

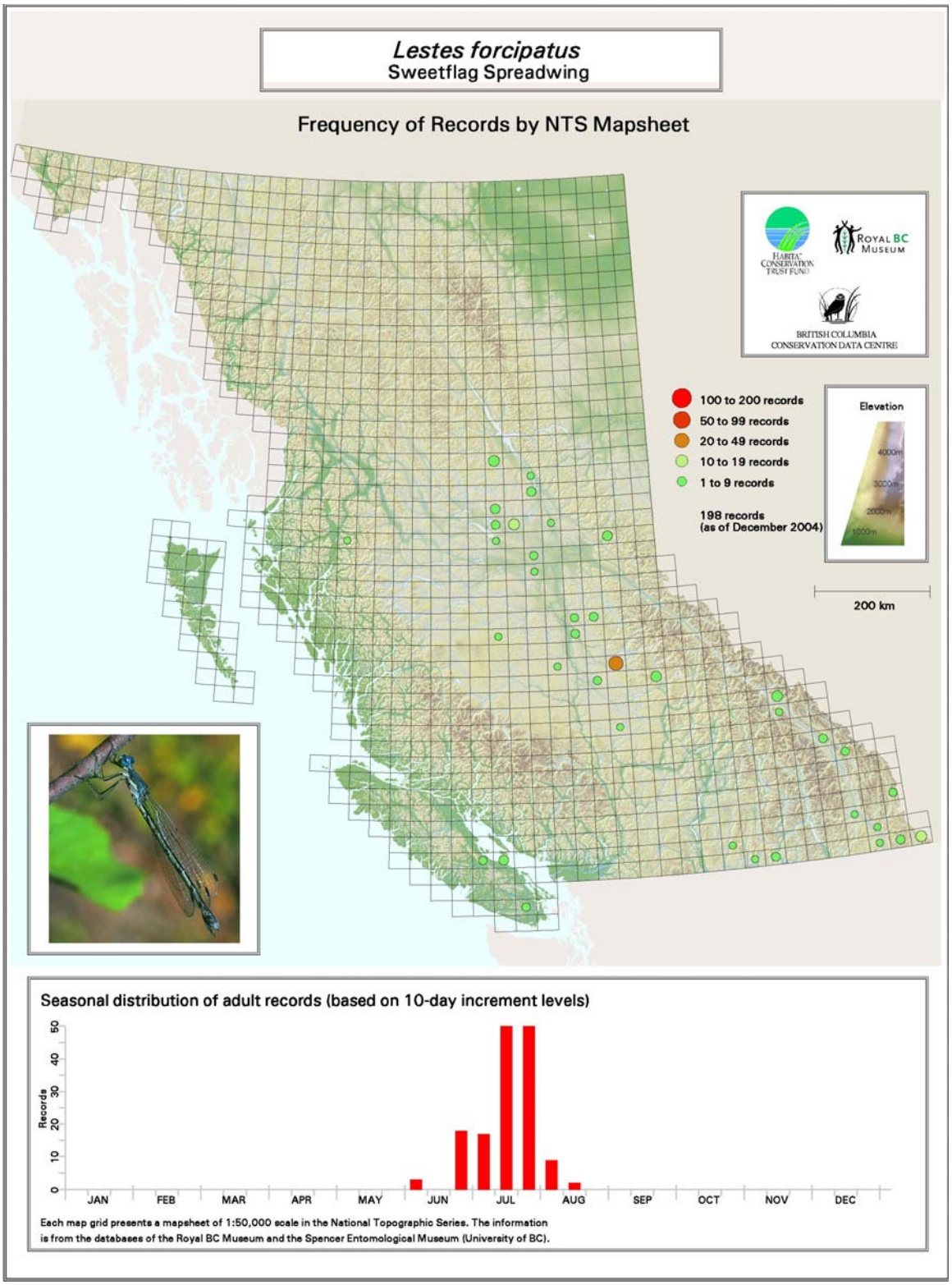
Lestes forcipatus female. Photograph: Rob Cannings, RBCM.



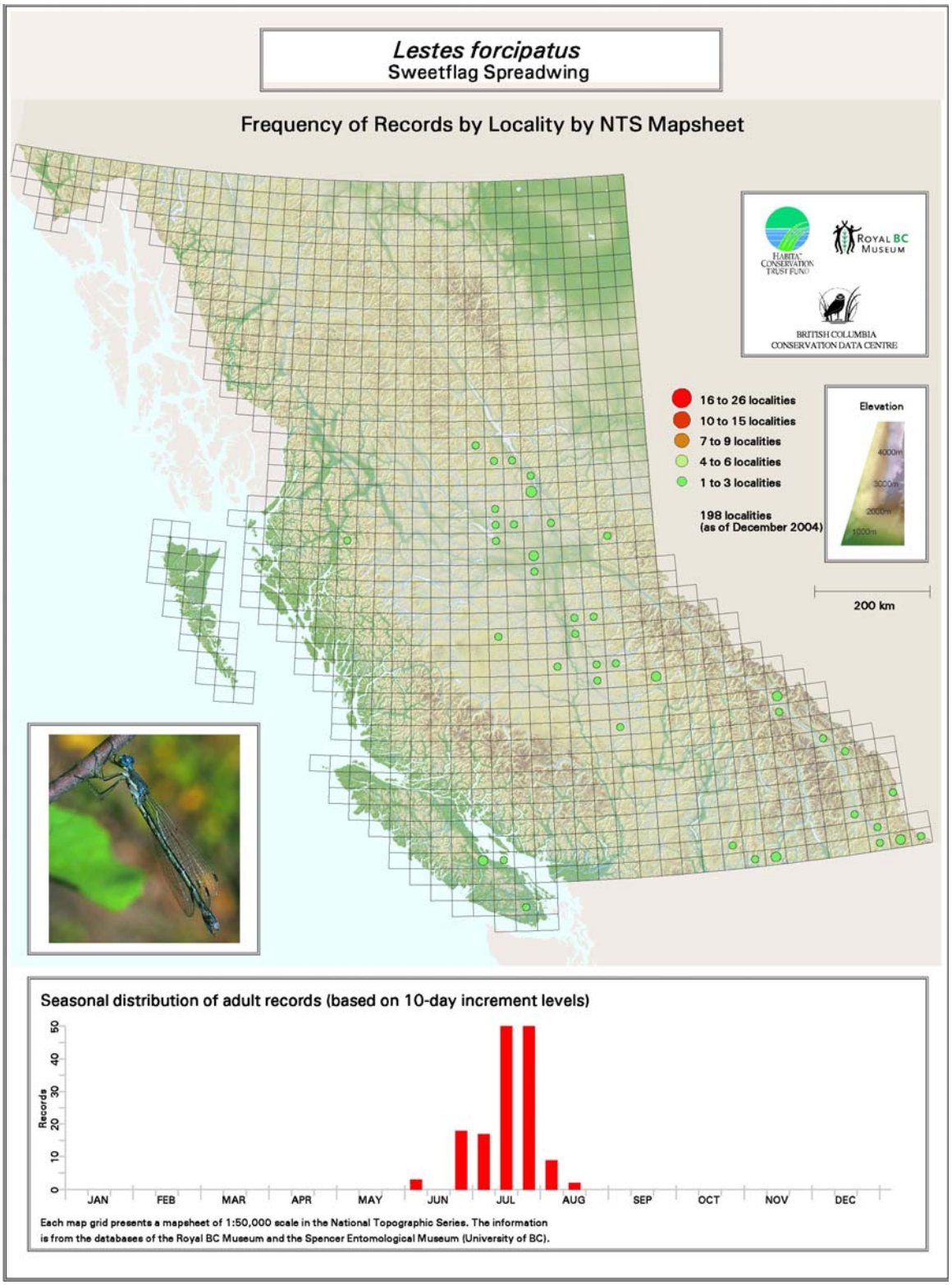
Lestes forcipatus Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Lestes forcipatus Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Lestes forcipatus Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.

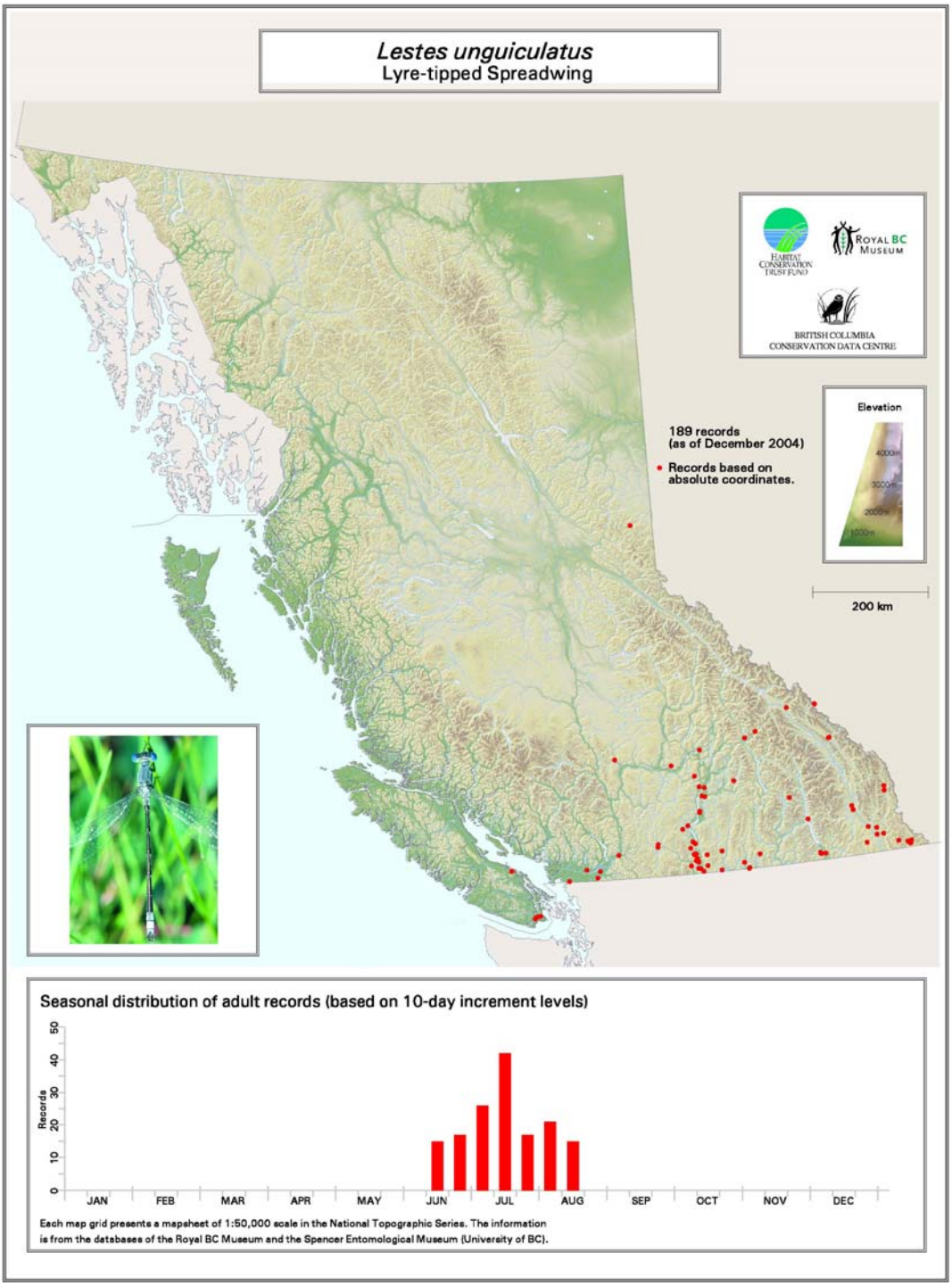


Lestes forcipatus Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

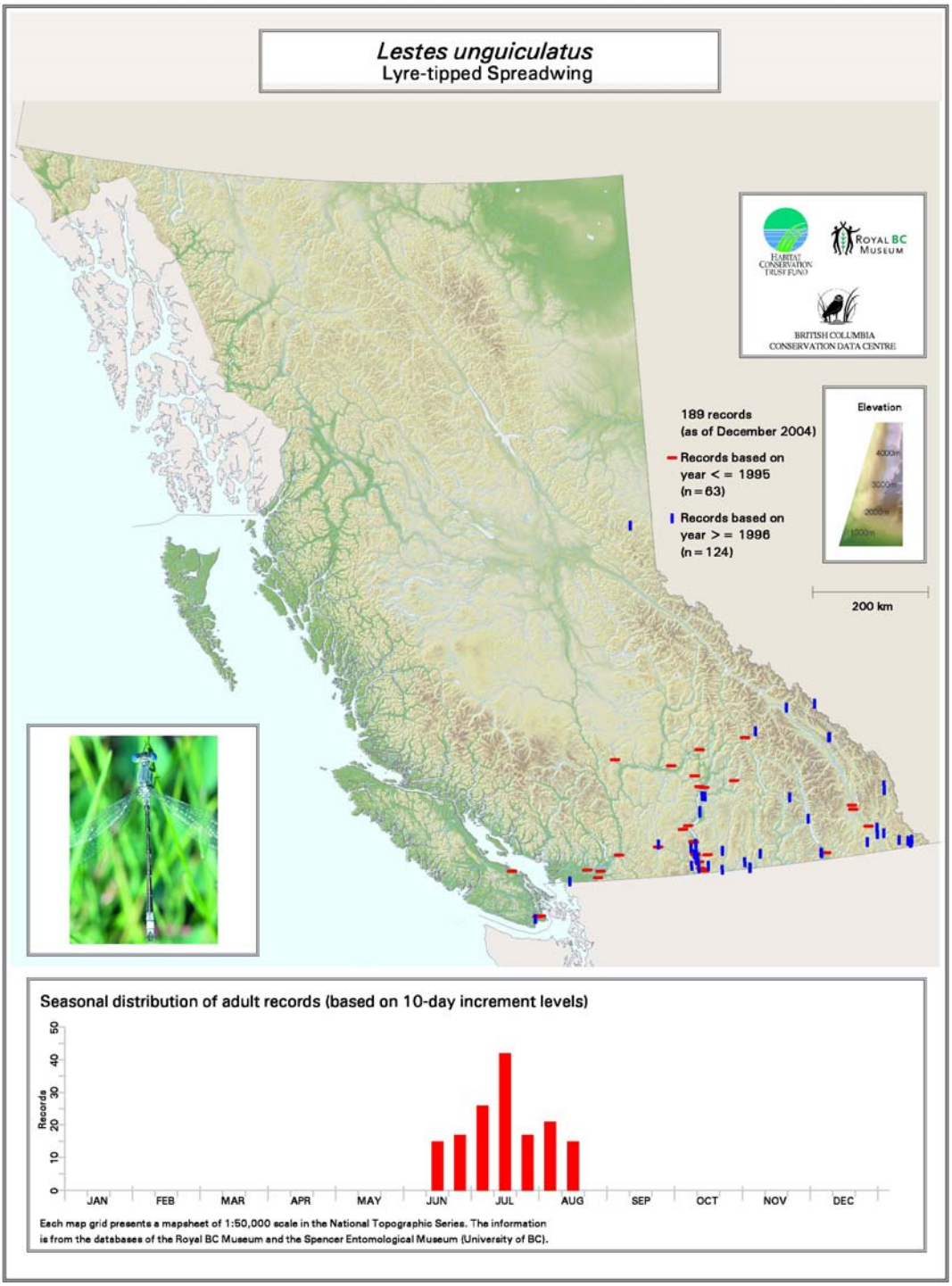
***Lestes unguiculatus* (Lyre-tipped Spreadwing)**

BC conservation rank: S5. Yellow List.
Description: Similar to the Common Northern Spreadwing, but the tips of the male's lower appendages curve outward something like the shape of a lyre (fig. 1), which gives the species its English name. On most, the back of the head is mostly pale, especially in females, which do not darken with age as much as males. Length: male 37 mm, female 35 mm.
Global Range: British Columbia east to Nova Scotia; south to District of Columbia, Tennessee, Texas and California (Westfall and May 1996). Faunal element: Widespread (see Appendix 3).
BC Distribution: A distinctly southern species; most common in the southern valleys. Widespread south of about 56°N; the only locality in the northern BC study area is in the Tumbler Ridge area, over 400 km north of the other BC records (see species distribution map).
Biology: Typical of warm ponds at low elevations, especially temporary and alkaline ponds (Gs01-03; Wm04-07). Less commonly, it lives in peatland pools and sedge fens in the mountains (Wm01; Wf01, 05-06). This is a species that deserves more ecological study.
BC flight period: early June to mid September; all records are from late June to late August.

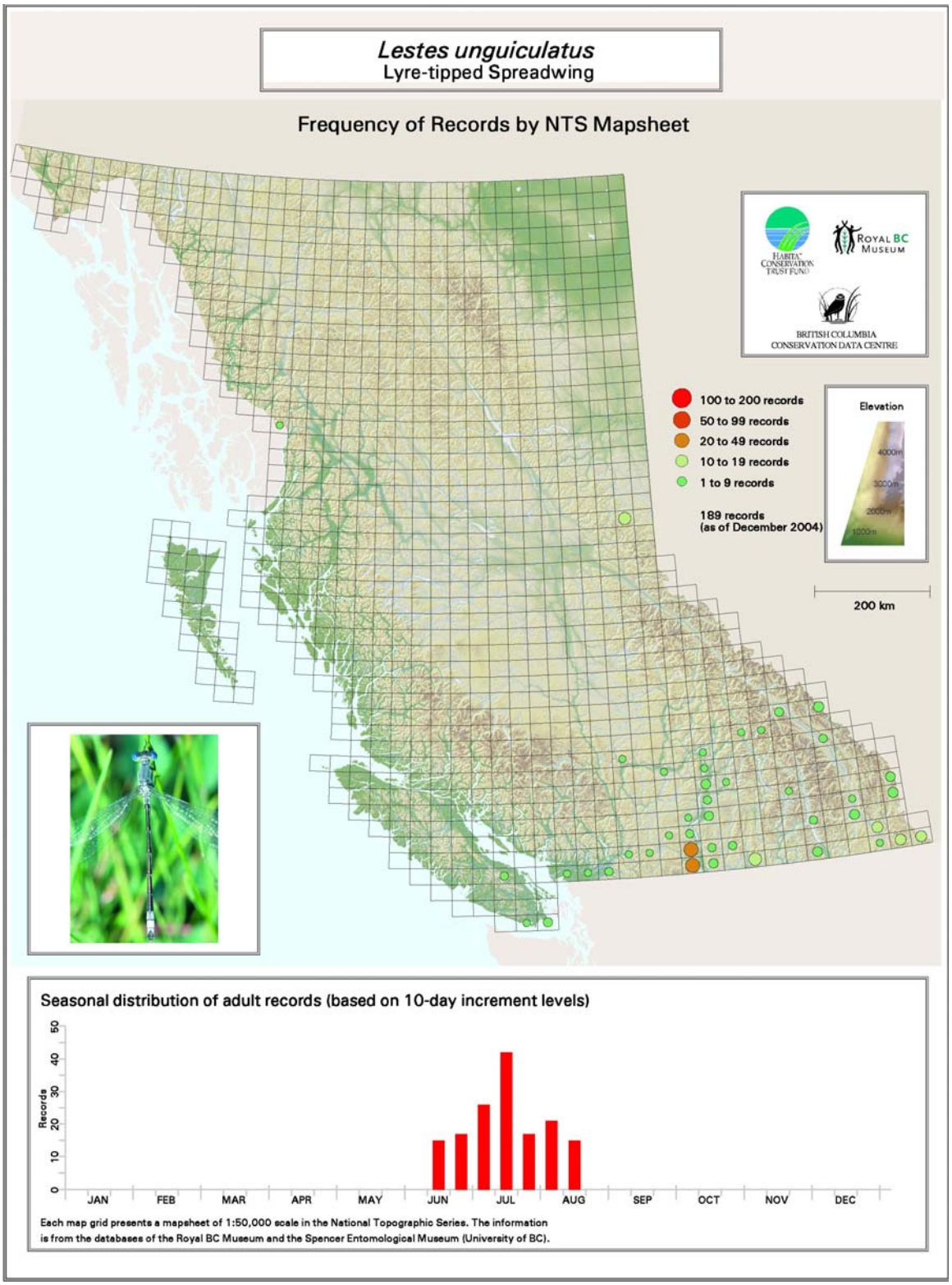
Lestes unguiculatus male. Photograph: George Doerksen, RBCM



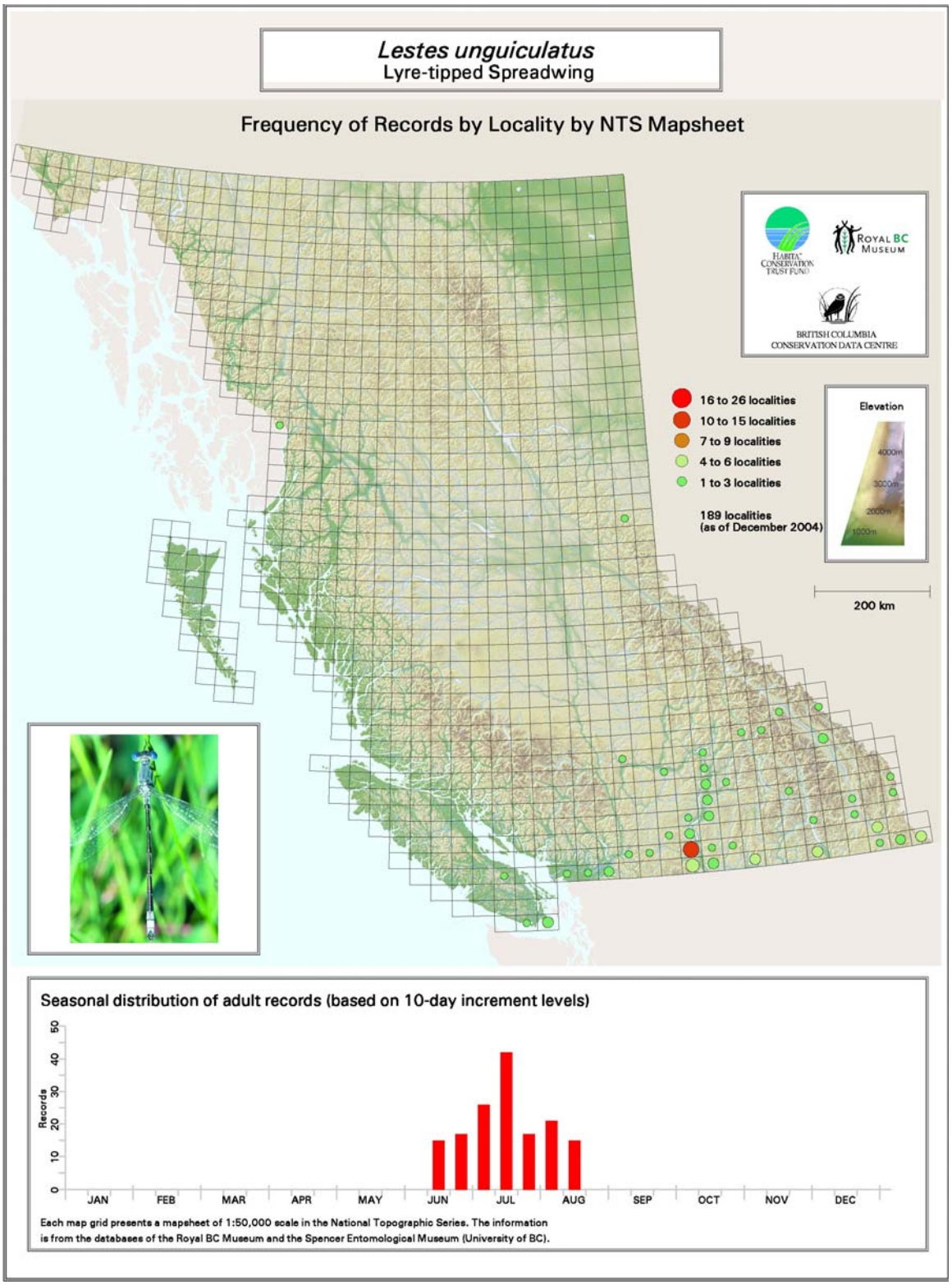
Lestes unguiculatus Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Lestes unguiculatus Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Lestes unguiculatus Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



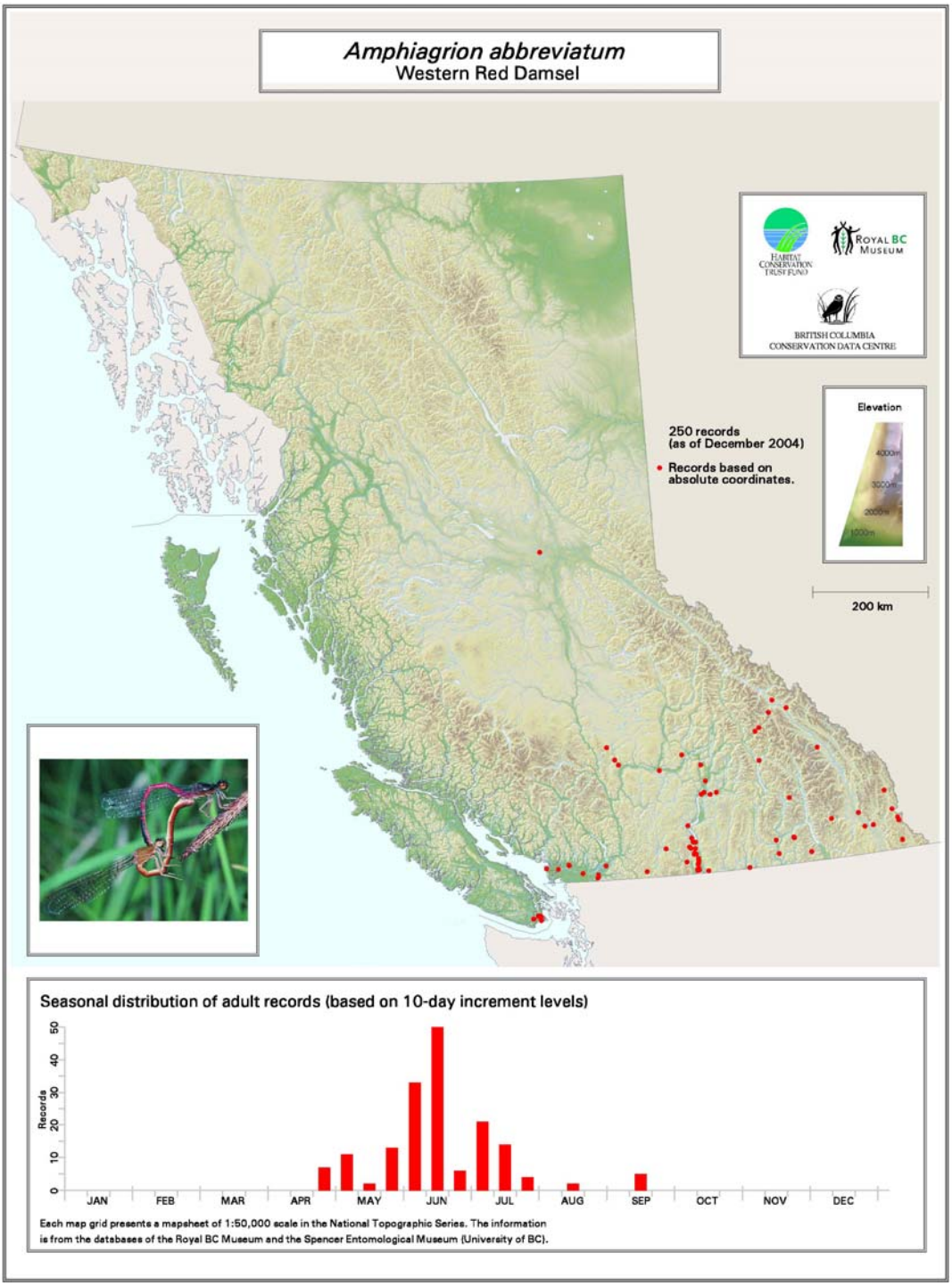
Lestes unguiculatus Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

Family Coenagrionidae (Pond Damsels)
Small damselflies that normally perch with wings closed above the abdomen. Most males are blue marked with black, but the main colour may be green, yellow, orange, red or purple. Females often have two colour forms per species, one similar to the male (usually blue). Females lay eggs in the tissues of water plants, sometimes completely submerging themselves for a long time while laying. Larvae are not as long as spreadwing larvae and have short labia, unstalked at the base. There are five genera and 14 species of pond damsels in northern BC, and one additional species, *Enallagma civile*, may occur in the extreme south of the study area. The American Bluets (*Enallagma*) and European Bluets (*Coenagrion*) are the most common groups in the study area. *Ischnura* is uncommon in northern BC, but abundant in the South. BC's two species of *Argia* are absent north of 52ºN.

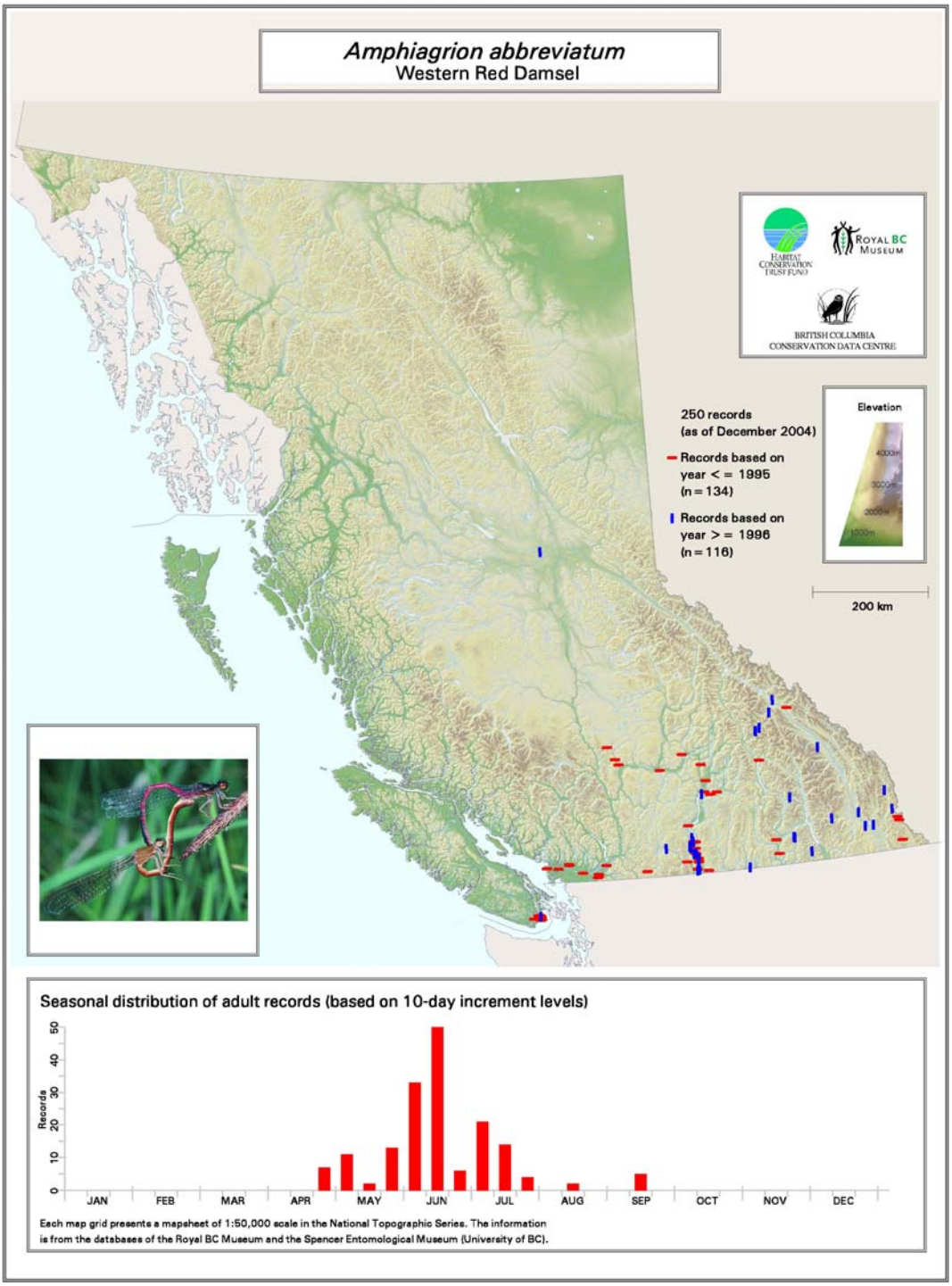
***Amphiagrion* (Red Damsels)**
Restricted to North America; the only damselfly genus in BC whose adults are red in both sexes. Adults are robust, with stubby abdomens and short legs; they have a prominent tubercle on the underside of the thorax. The larvae have the hind corners of the head pointed and turned outward. There are only two species, one eastern and one western.

***Amphiagrion abbreviatum* (Western Red Damsel)**
BC conservation rank: S4. Yellow List.
Description: Males are red, the thorax black on top. Females are all red or orange. Length: male 26 mm, female 27 mm.
Global Range: British Columbia east to Saskatchewan, south to New Mexico and Baja California (Westfall and May 1996). Faunal element: Western (see Appendix 3).
BC Distribution: From the Prince George area south.
Biology: *Amphiagrion* can be common in scattered localities at low and mid elevations in BC's southern valleys. In the region we have defined as northern BC, there is a single record west of Prince George. This damselfly lives in marshy places with plenty of grasses and sedges: shallow ponds, sloughs, spring-fed pools and slow streams; the *Eleocharis palustris* site association (Wm04) is typical. Adults fly close to the ground and perch frequently in low vegetation.
BC flight period: early May to early October; most records are from early May to early August.

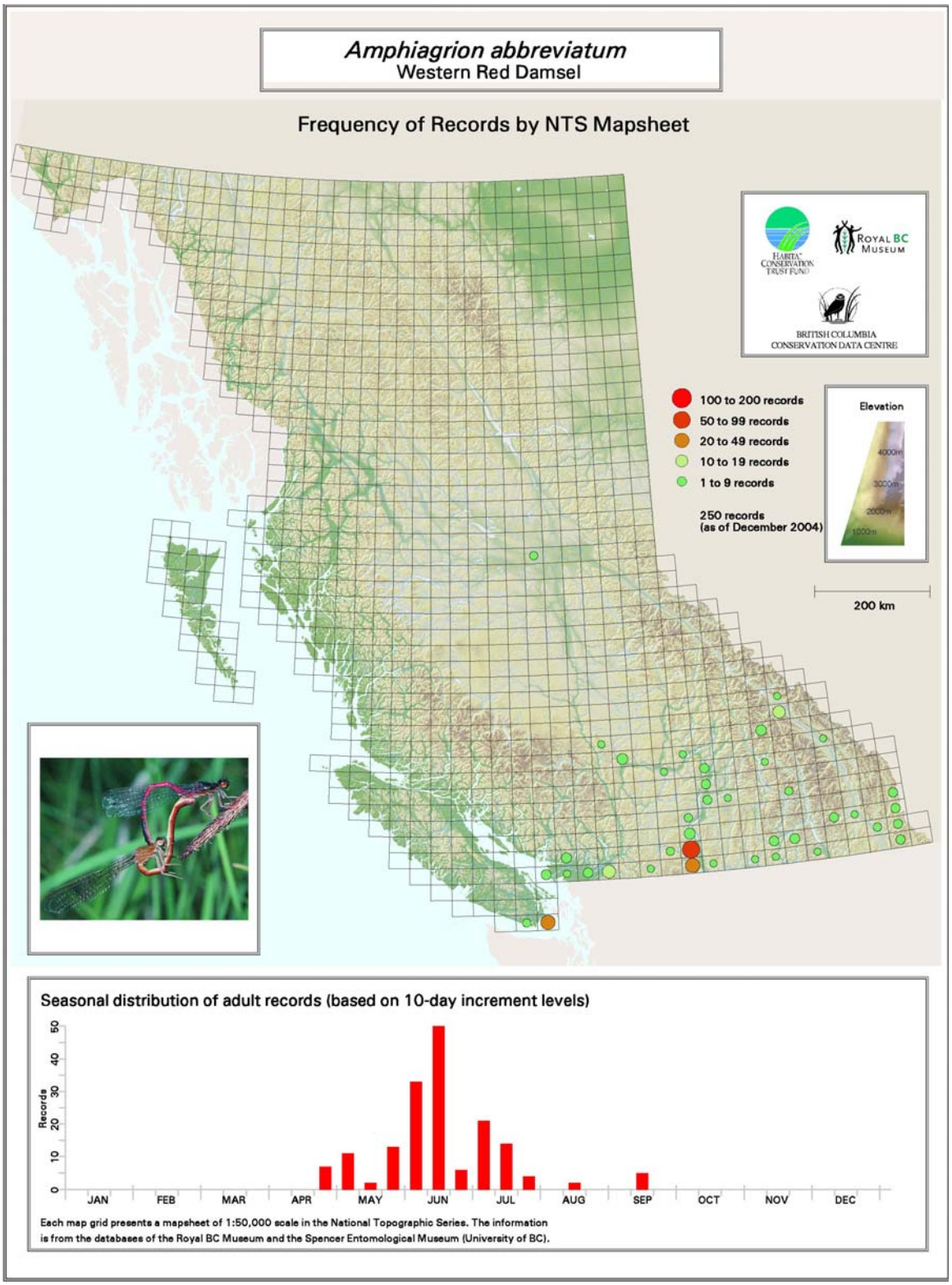
Amphiagrion abbreviatum mating. Photograph: George Doeerksen, RBCM



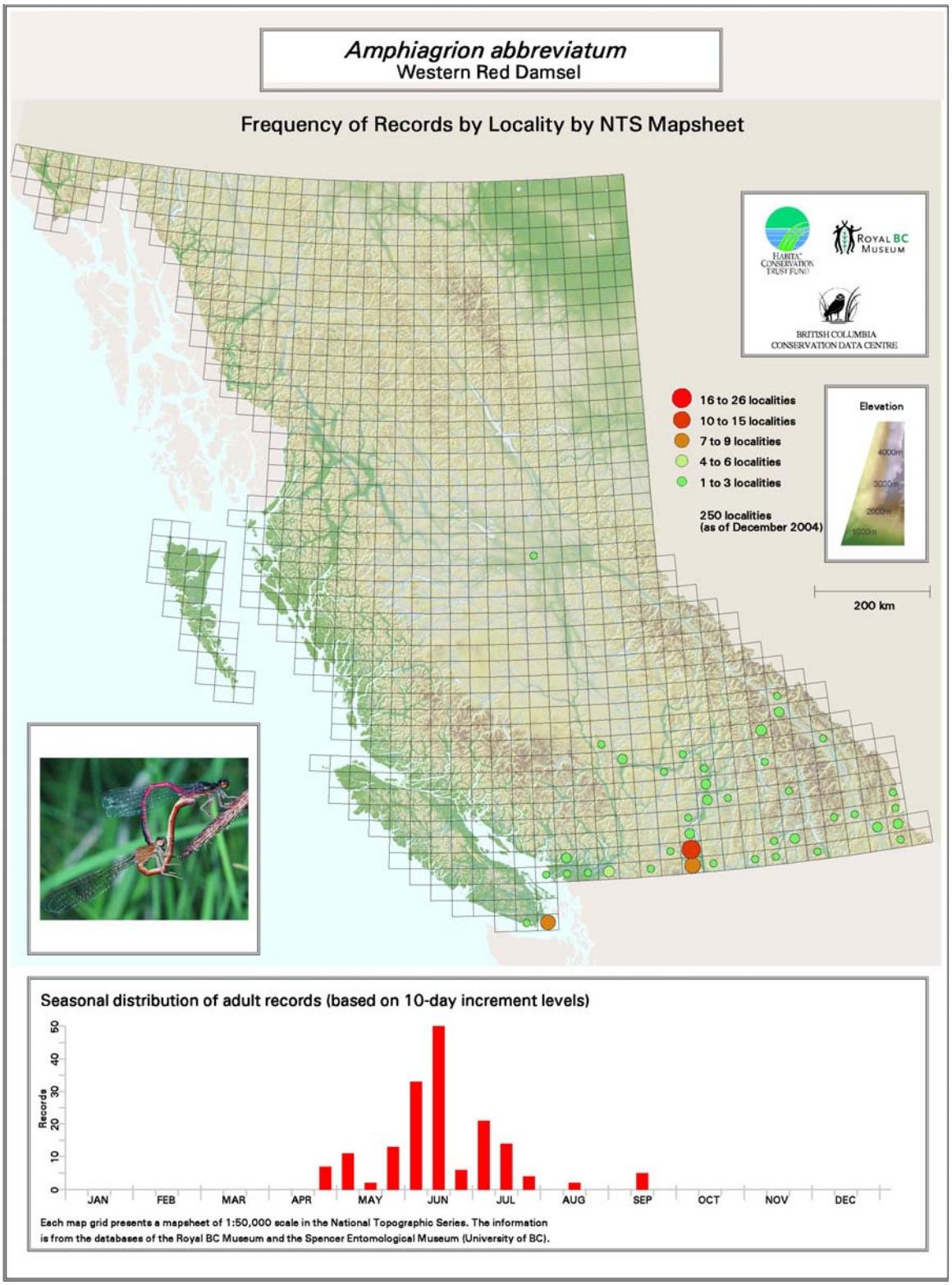
Amphiagrion abbreviatum Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Amphiagrion abbreviatum Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Amphiagrion abbreviatum Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



Amphiagrion abbreviatum Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Coenagrion* (Eurasian Bluets)**

There are two genera of bluets: *Coenagrion* and *Enallagma*. *Coenagrion* species live mainly in Europe and Asia. Two species range across most of northern North America: the common Taiga Bluet and the rarer Subarctic Bluet. A third, the Prairie Bluet, flies on the Great Plains. Most Eurasian Bluet adults fly in late spring or early summer. They are similar to those of *Enallagma* -- males are blue and black but unlike Enallagma species in BC, they are green under the thorax or have divided blue stripes on top of the thorax, or both. Also, the structure of the male appendages is different and females have no vulvar spine near the end of the abdomen.

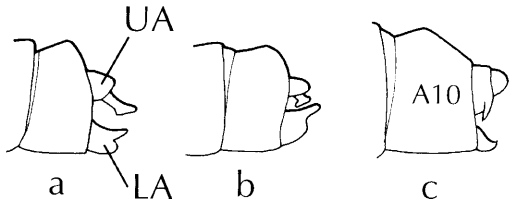


Figure 3. Male appendages of Eurasian Bluets, side view: a, Taiga; b, Subarctic; c, Prairie. A10 = abdominal segment 10; UA, LA = upper, lower appendages.

Coenagrion angulatum* (Prairie Bluet)

BC conservation rank: S3S4. Blue List. Surveys east of the Rocky Mountains in 1997 changed the status from S1S2 to S4, but we have modified the rank since to indicate our lack of knowledge of the species. Further collecting perhaps will show this to be a common species in the Northeast.

Description: The top of the thorax has undivided blue stripes. Abdominal segment 2 has a black mark on top, but usually none on the sides. Appendages, fig. 3c. Female yellow-green to tan, marked with black; the bases and sides of abdominal segment 8 are mostly pale, and the tops of segments 9 and 10 mostly black. Length: male 28 mm, female 31 mm.

Global Range: British Columbia, Alberta and Northwest Territories east to Ontario, south to Iowa, South Dakota and Montana (Westfall and May 1996). Faunal element: Western (see Appendix 3).

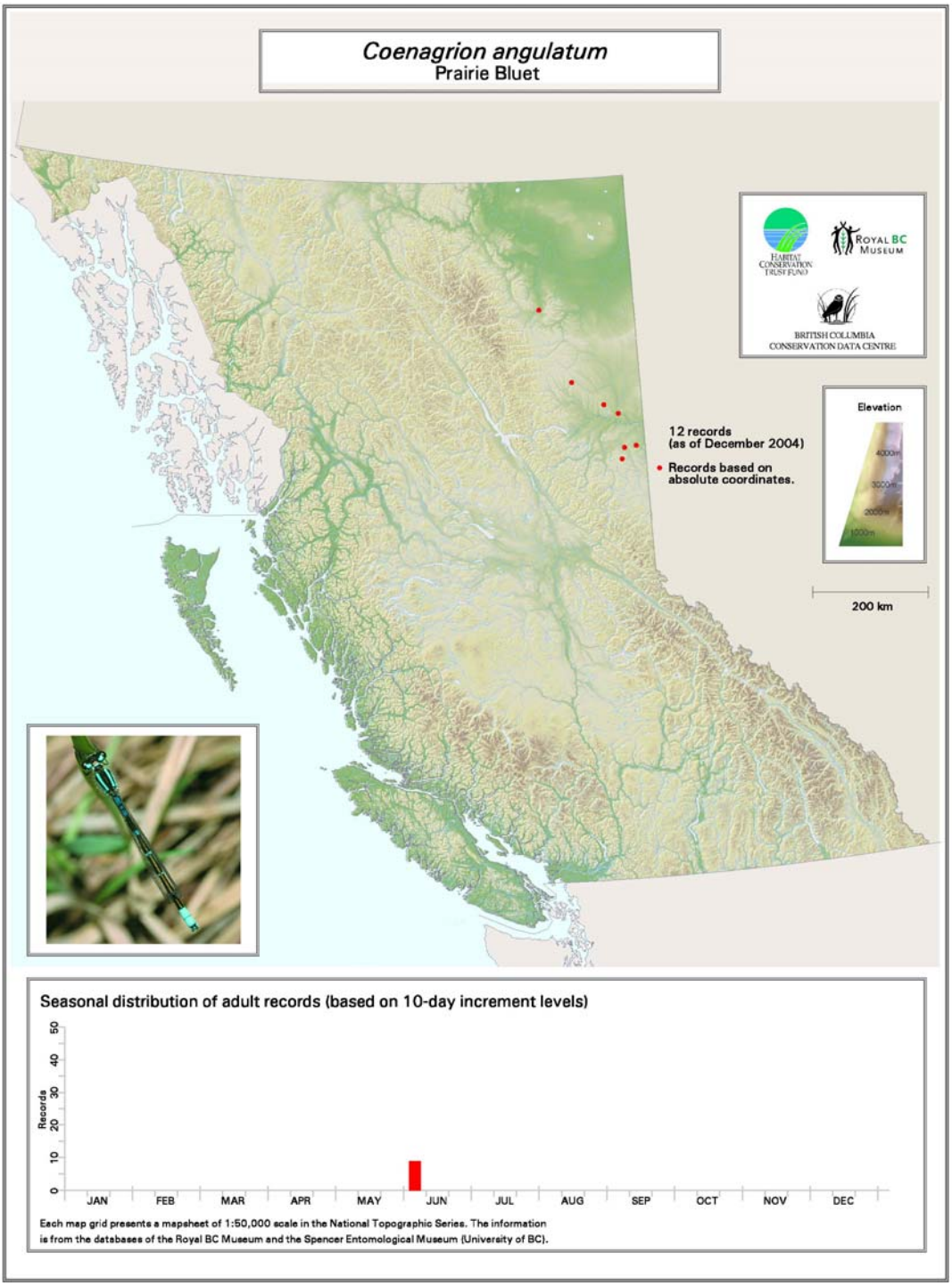
BC Distribution: East of the Rocky Mountains in the Peace River and Fort Nelson regions.

Biology: Common at grassland ponds and forest marshes (Wm01, Wm04-07) on the northern Great Plains and adjacent boreal forests, but little-known in BC.

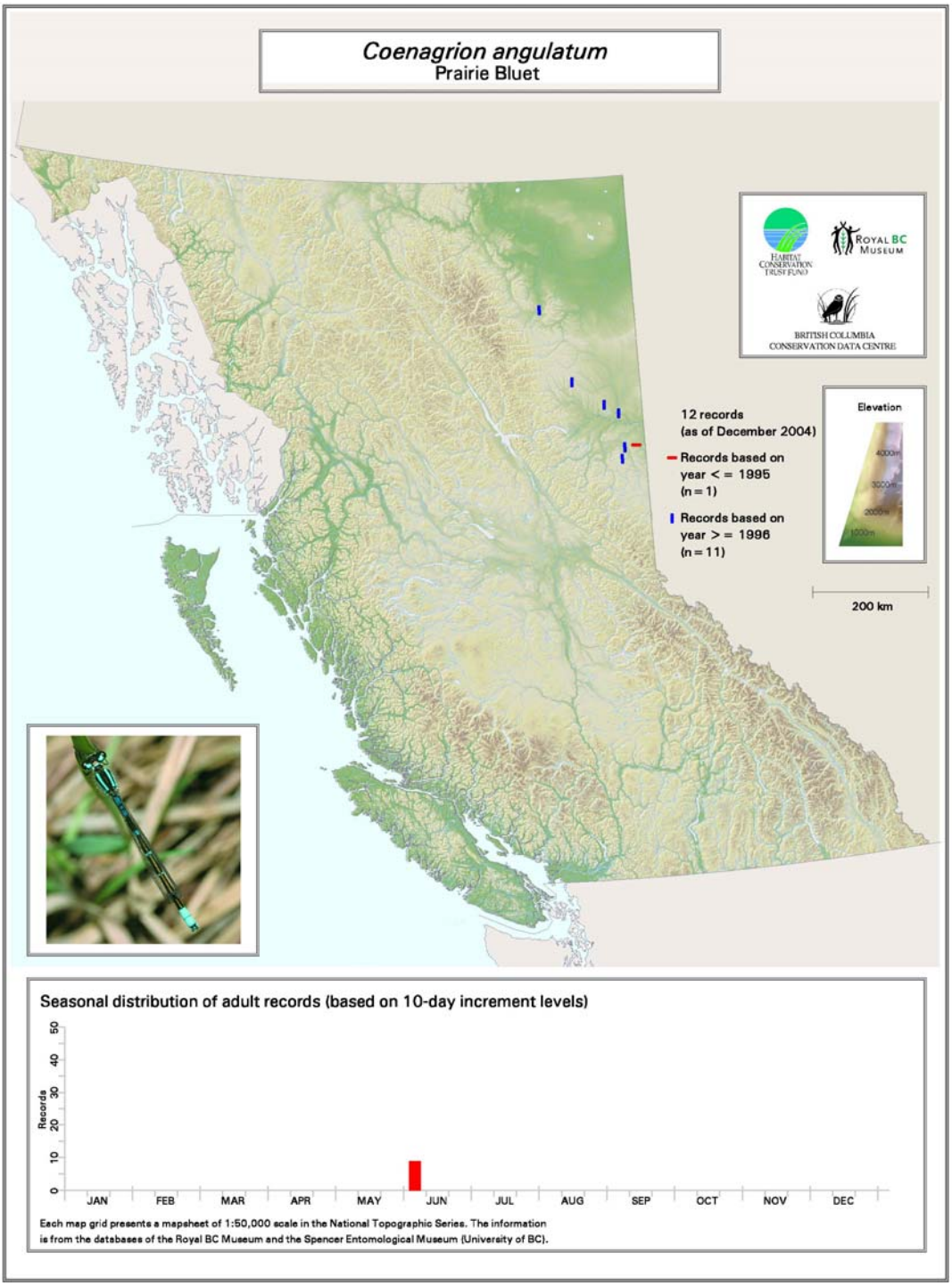
BC flight period: late May to early August; all records come from mid June.

Management and protection considerations: Wetlands, particularly in low lying areas, always run the risk of being drained, filled for development or polluted; undoubtedly many wetlands in the Peace River region, especially around towns, farmland and hydroelectric installations already have been lost. Management practices that ensure the continued viability of wetlands along lakeshores and around ponds should be followed. Remaining ponds and marshes that appear suitable for this species should be protected. The impacts of development, land drainage, logging, livestock trampling and harmful water runoff should be minimized.

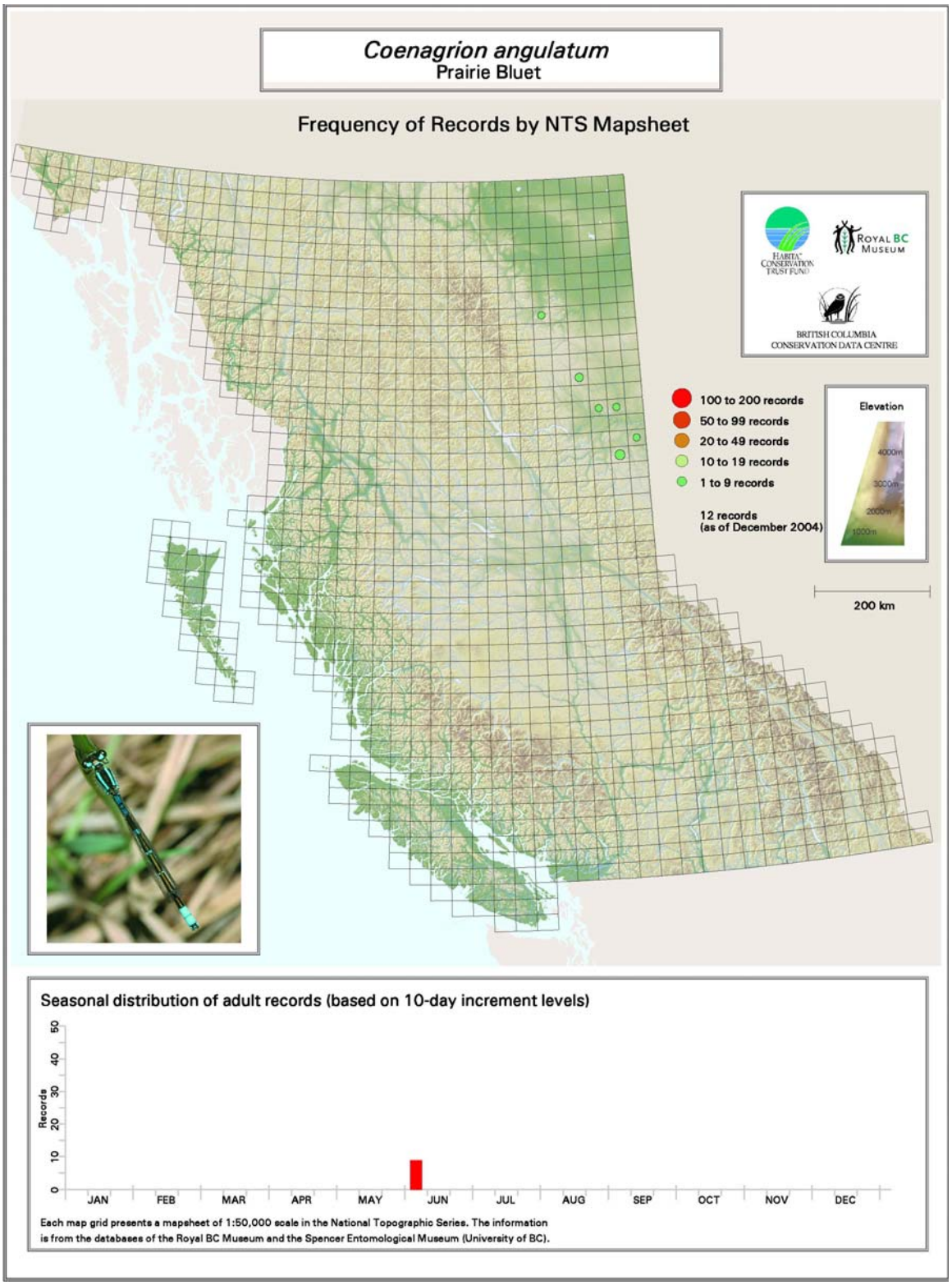
Coenagrion angulatum male. Photograph: John Acorn



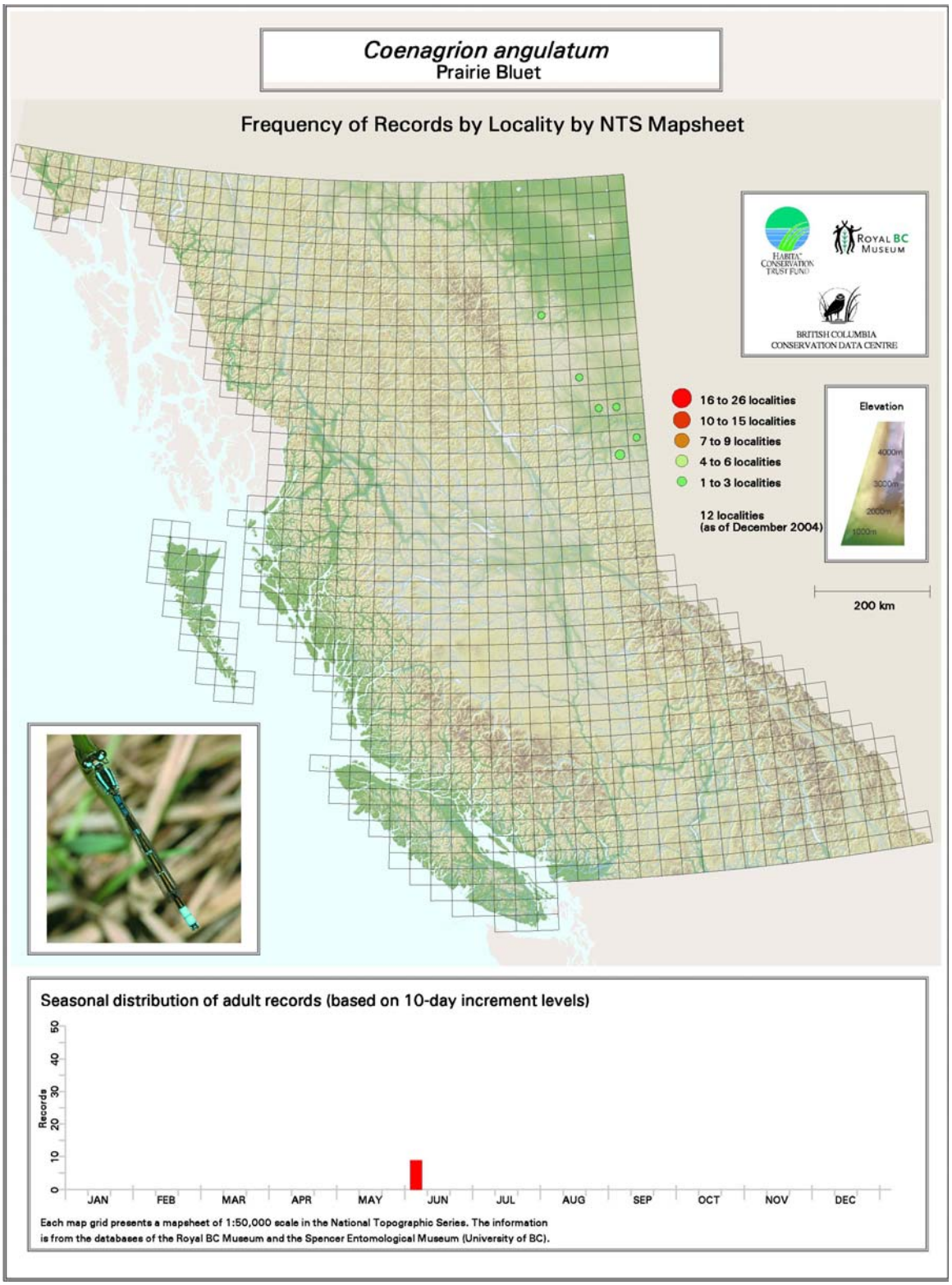
Coenagrion angulatum Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Coenagrion angulatum Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



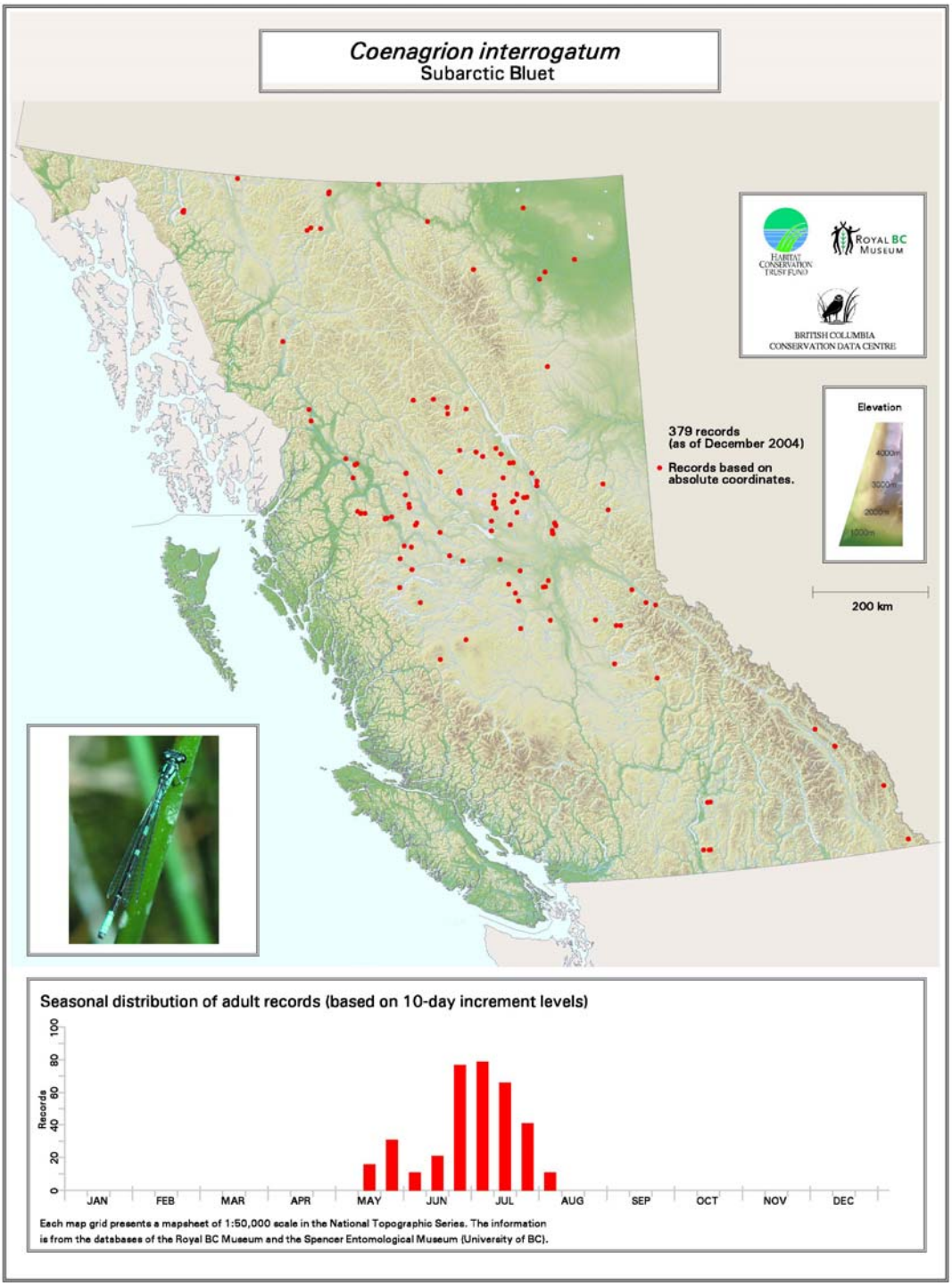
Coenagrion angulatum Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



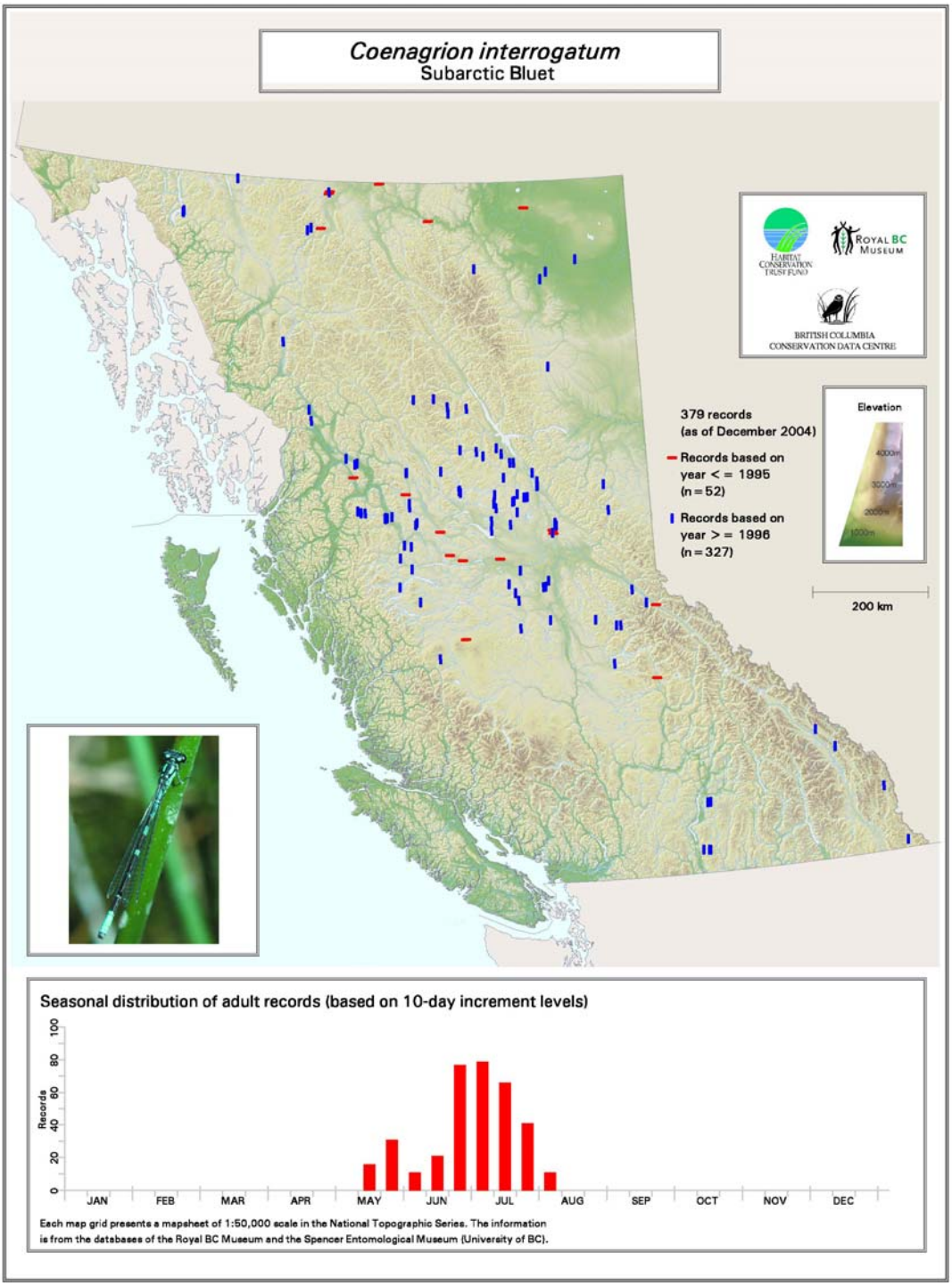
Coenagrion angulatum Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Coenagrion interrogatum* (Subarctic Bluet)**
BC conservation rank: S4S5. Yellow List. Before the northern surveys, *C. interrogatum* was considered S4, but intensive observation has shown it to be rather common.
Description: The male's thorax has strong dark marks underneath; blue stripes on top are divided like a thick exclamation mark; abdominal segment 2 has a black mark on top and a large mark on each side; appendages, fig. 3b. Female is blue or greenish, marked with black; abdominal segment 8 is black at the base, segments 9 and 10 are mostly blue, and 9 has a black spot on top. Length: male 30 mm, female 31 mm.
Global Range: Yukon and British Columbia east to Labrador and Newfoundland; south to Maine, Wisconsin and Montana; absent from the Great Plains (Westfall and May 1996). Faunal element: Northern Boreal (see Appendix 3).
BC Distribution: Widespread east of the Coast Mountains from the Arctic treeline to the US border; common over most of the north.
Biology: The most boreal of North American damselflies, this species lives in a variety of peatlands (e.g., Wf01, 05-08; Wb13), although it is common only in those containing floating aquatic moss (Cannings and Cannings 1994). In southern BC it occurs only in subalpine wetlands in the mountains and high plateaus.
BC flight period: late May to late August; all collections are from late May to mid August.

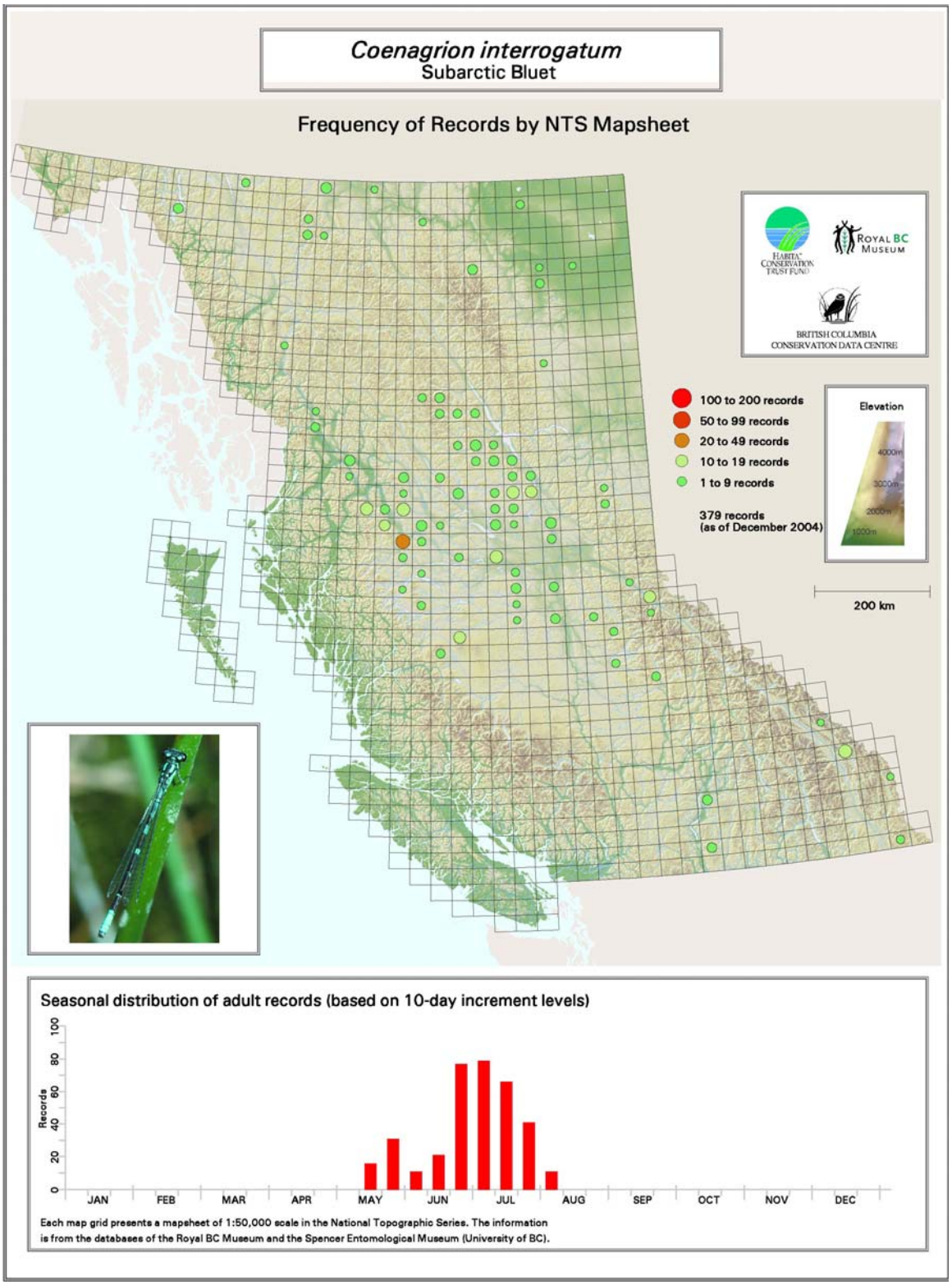
Coenagrion interrogatum male. Photograph: George Doerksen, RBCM



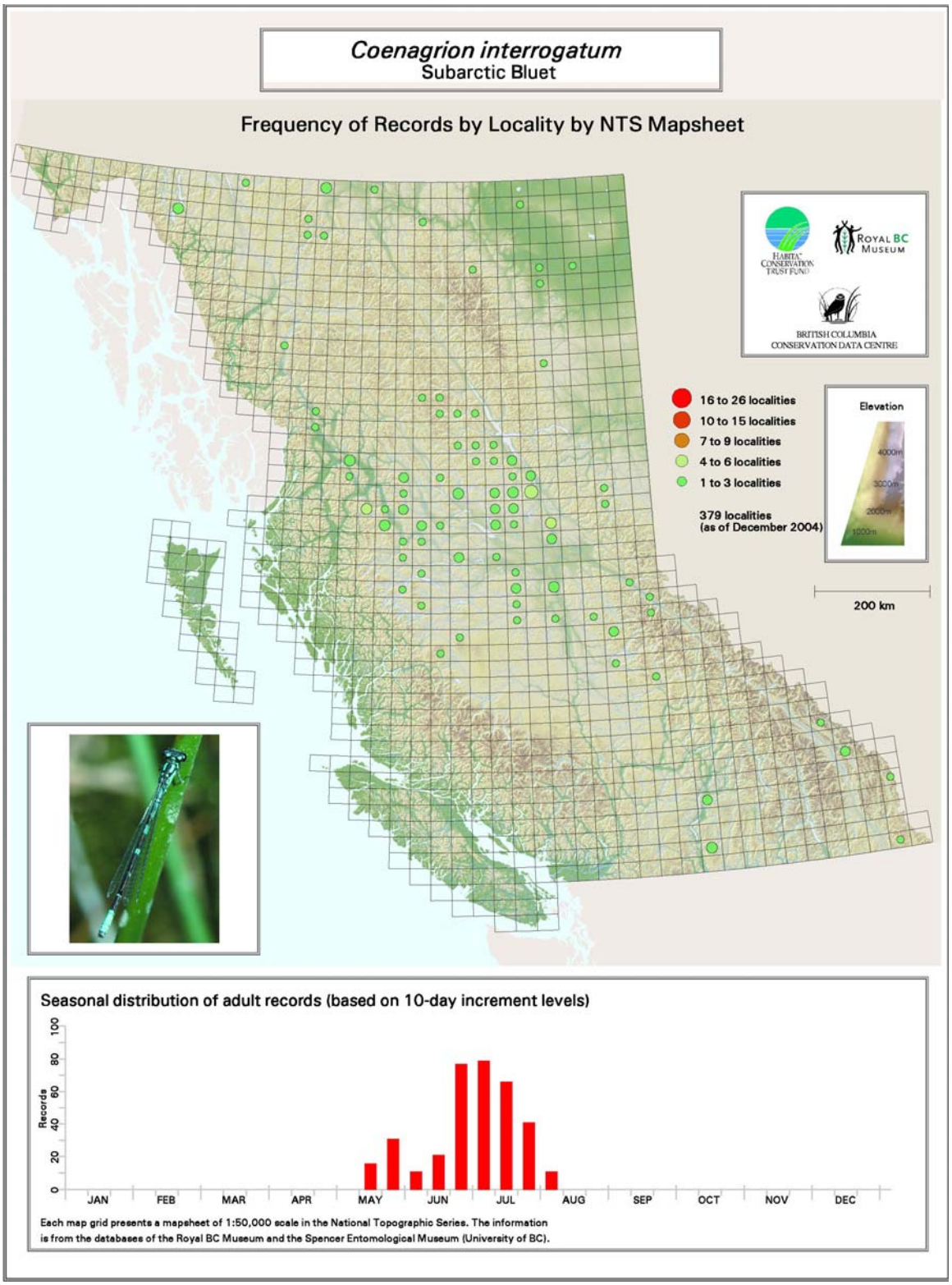
Coenagrion interrogatum Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Coenagrion interrogatum Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Coenagrion interrogatum Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



Coenagrion interrogatum Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

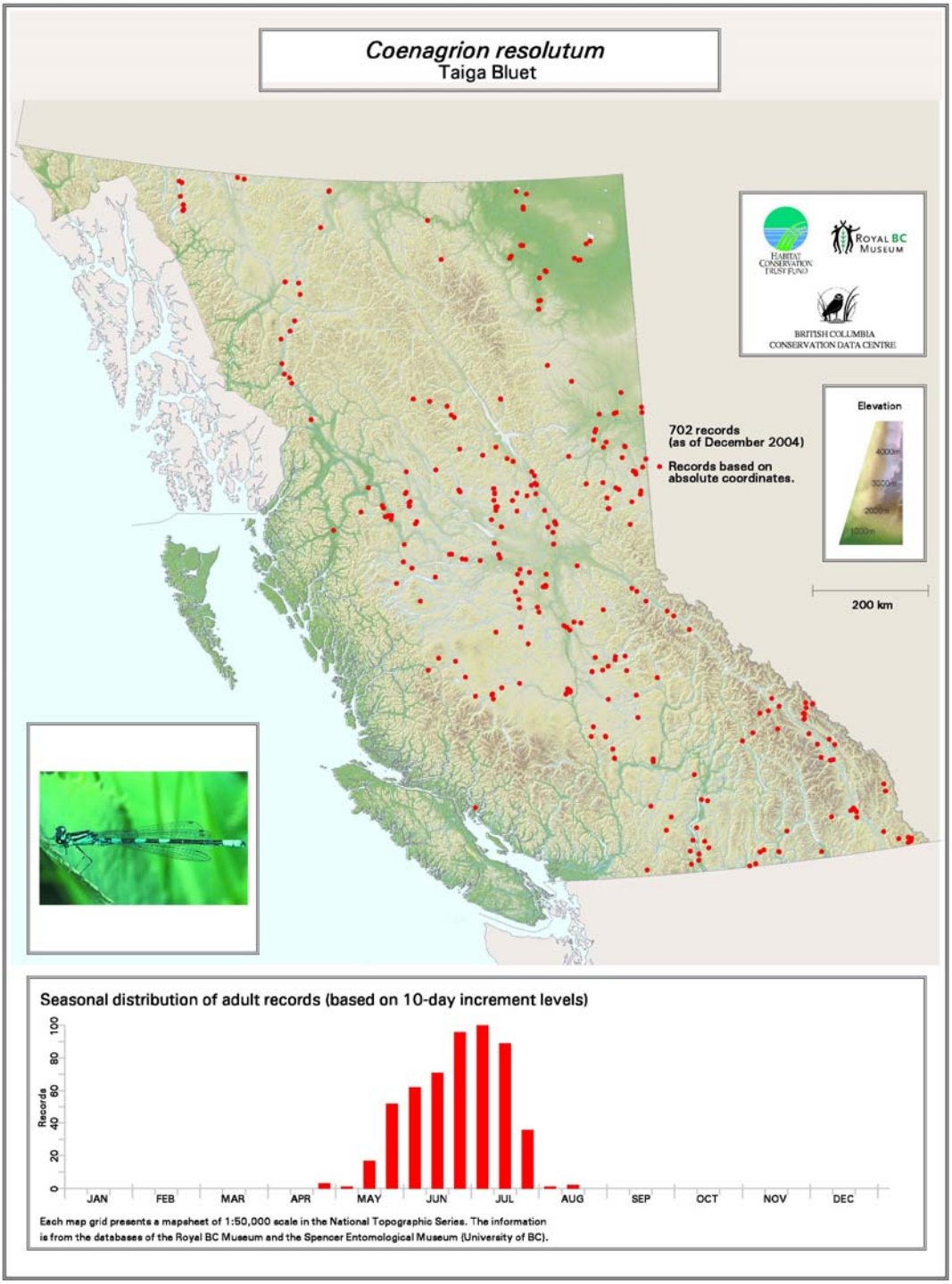
***Coenagrion resolutum* (Taiga Bluet)**
BC conservation rank: S5. Yellow List.
Description: Male's thorax has blue stripes on top, usually undivided; the underside is unmarked; abdominal segment 2 has a U-shaped black mark on top; appendages, fig. 3a. Female is blue to yellow-green or tan, marked with black; tops of segments 8 to 10 are black. Length: male 29 mm, female 30 mm.
Global Range: Alaska east to Labrador and Newfoundland; south to New York, Ohio, Nebraska, Colorado, Arizona and California (Westfall and May 1996). Faunal element: Widespread Boreal (see Appendix 3).

BC Distribution: Widespread throughout the interior, almost absent from the coast. North to the arctic treeline.

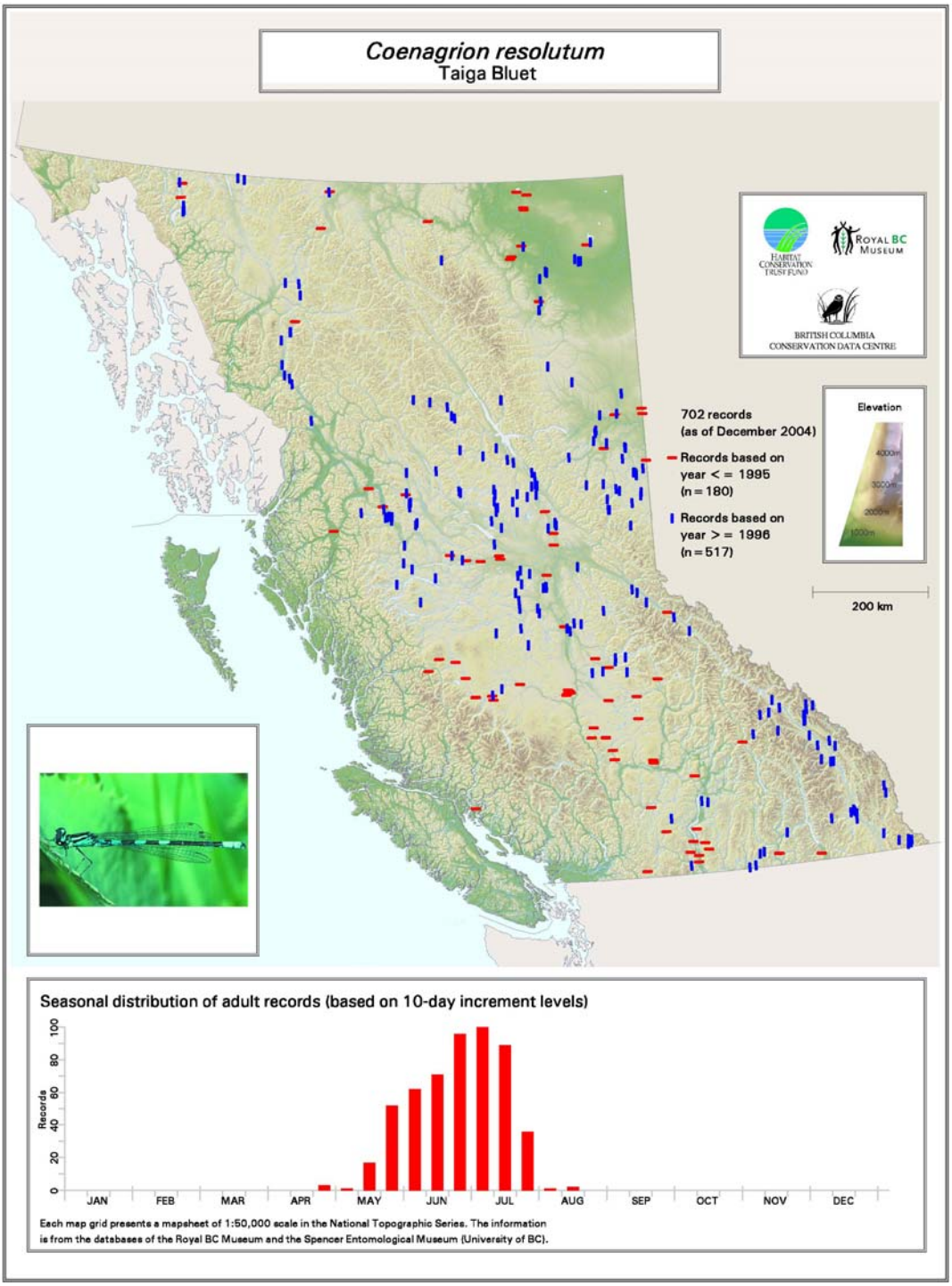
Biology: Common throughout BC's interior but, in the South, mostly at higher elevations; extremely rare on the coast, it has not been found in the Lower Mainland, on Vancouver Island, or on the north coast. Lives in many types of habitats, but is most common in sedge marshes and peatlands (e.g., Wm01-02, 04; Wf01, 05-08; Wb13).

BC flight period: early May to early September; the vast majority of the records are from late May to early August.

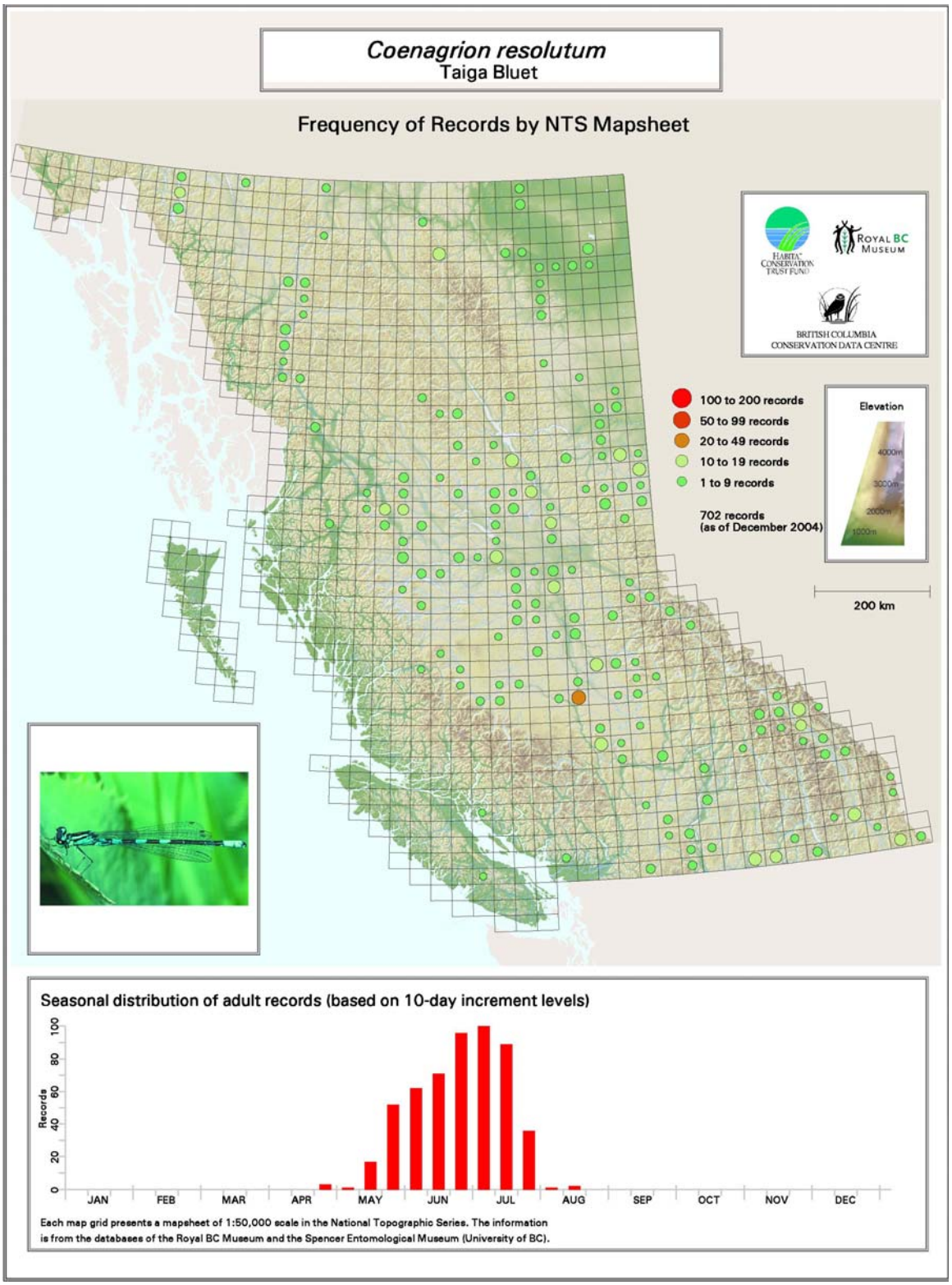
Coenagrion resolutum
male. Photograph: George Doerksen, RBCM



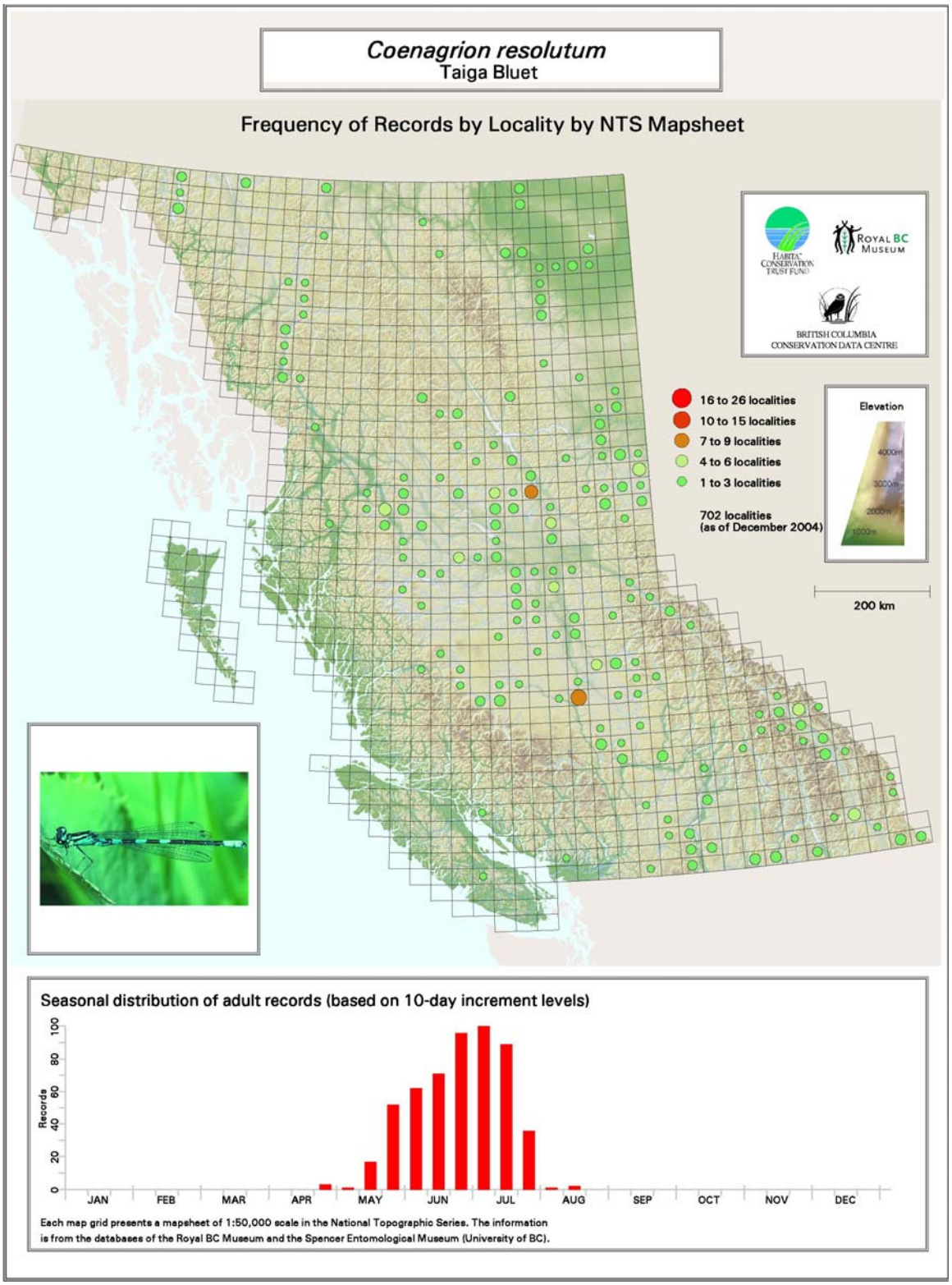
Coenagrion resolutum Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Coenagrion resolutum Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Coenagrion resolutum Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



Coenagrion resolutum Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Enallagma* (American Bluets)**

There are two genera of bluets: *Coenagrion* and *Enallagma*. *Enallagma* is a large genus, predominantly North American, containing most of the common blue-and-black damselflies in our region. Species identification requires close inspection. Females can be especially tricky: they are blue, green or brown; on most, the base of the abdominal segments is pale and the tips black; and all have a vulvar spine (fig. 4). Males are mostly sky blue with black stripes on the thorax and black rings around the abdominal segments; their appendages offer the best identification clues. The larvae, similar to those of *Coenagrion*, are patterned in brown or green and usually climb in aquatic vegetation.

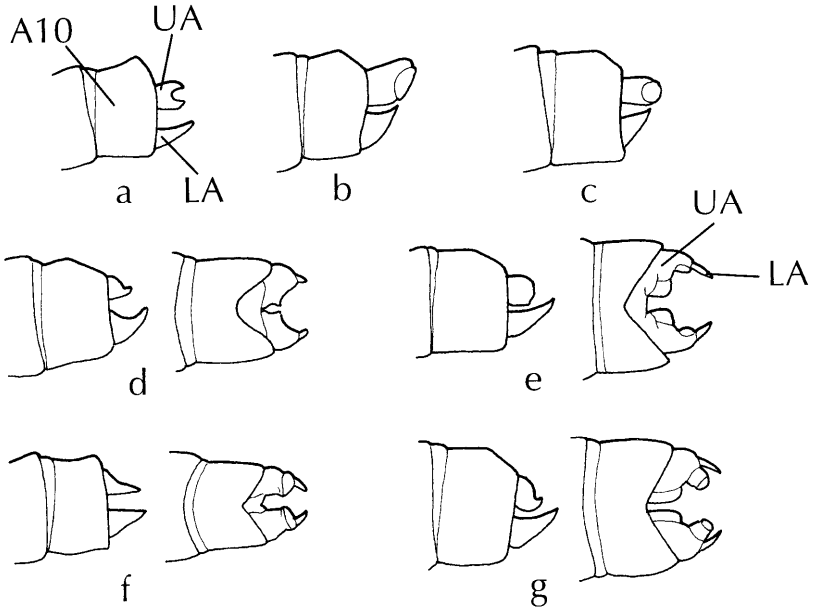


Figure 4. Male appendages of American Bluets, a-c, side view; d-g left, side view; d-g right, top view. a, Marsh; b, Familiar; c, Tule; d, Alkali; e, Boreal; f, Hagen's; g, Northern. A10 = abdominal segment 10; UA, LA = upper, lower appendages.

***Enallagma boreale* (Boreal Bluet)**

BC conservation rank: S5. Yellow List.

Description: Male's appendages, fig. 4e (the view from above is most distinctive). The rear half of female's segment 8 is black, and a pale area at the base is sometimes divided by a black line. Length: male 33 mm, female 35 mm (largest in the far north).

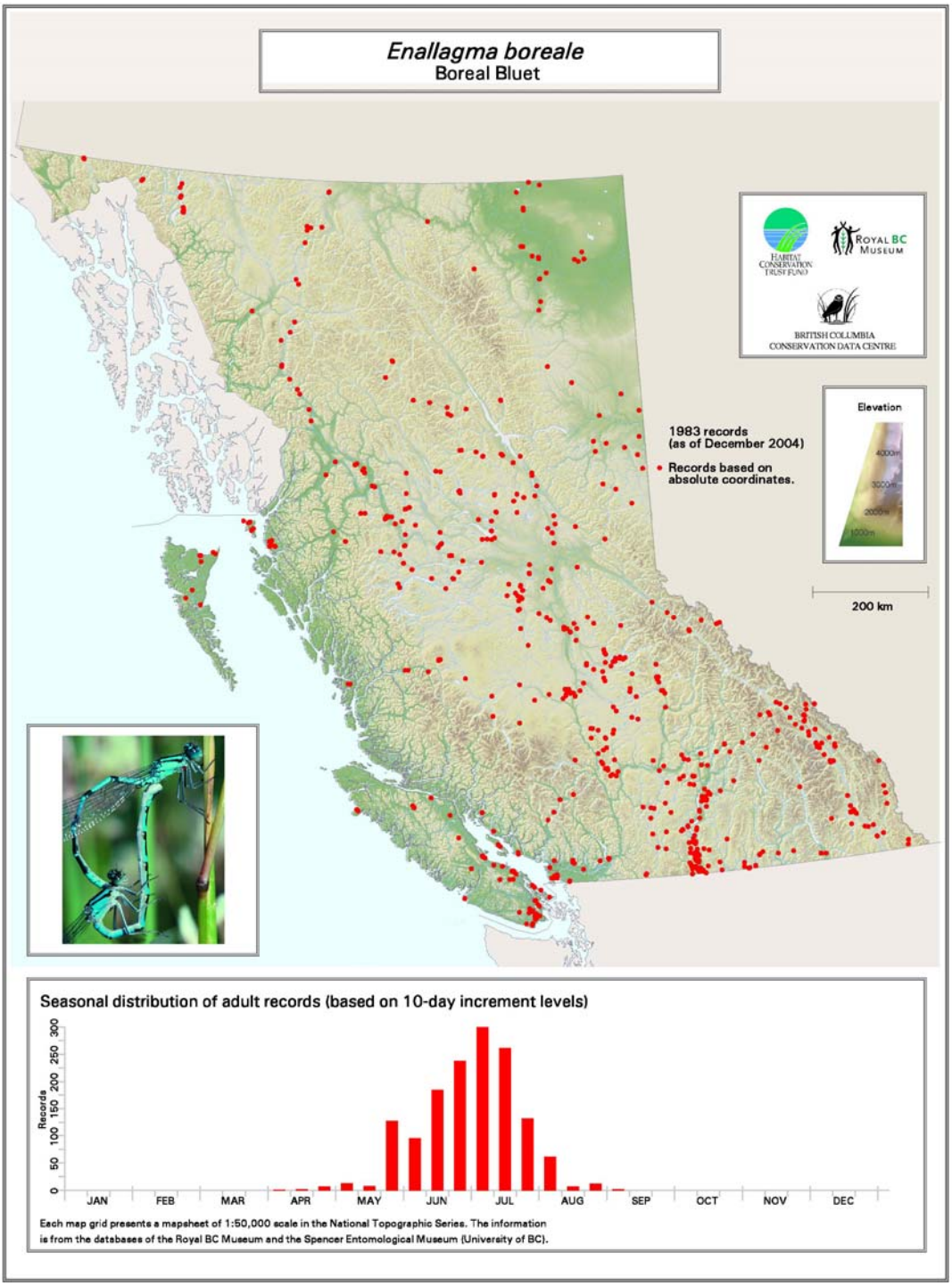
Global Range: Alaska east to Labrador and Newfoundland; south to West Virginia, Nebraska, and along the mountains to New Mexico and California (Westfall and May 1996). Faunal element: Widespread Boreal (see Appendix 3).

BC Distribution: Throughout BC and north to the Arctic treeline.

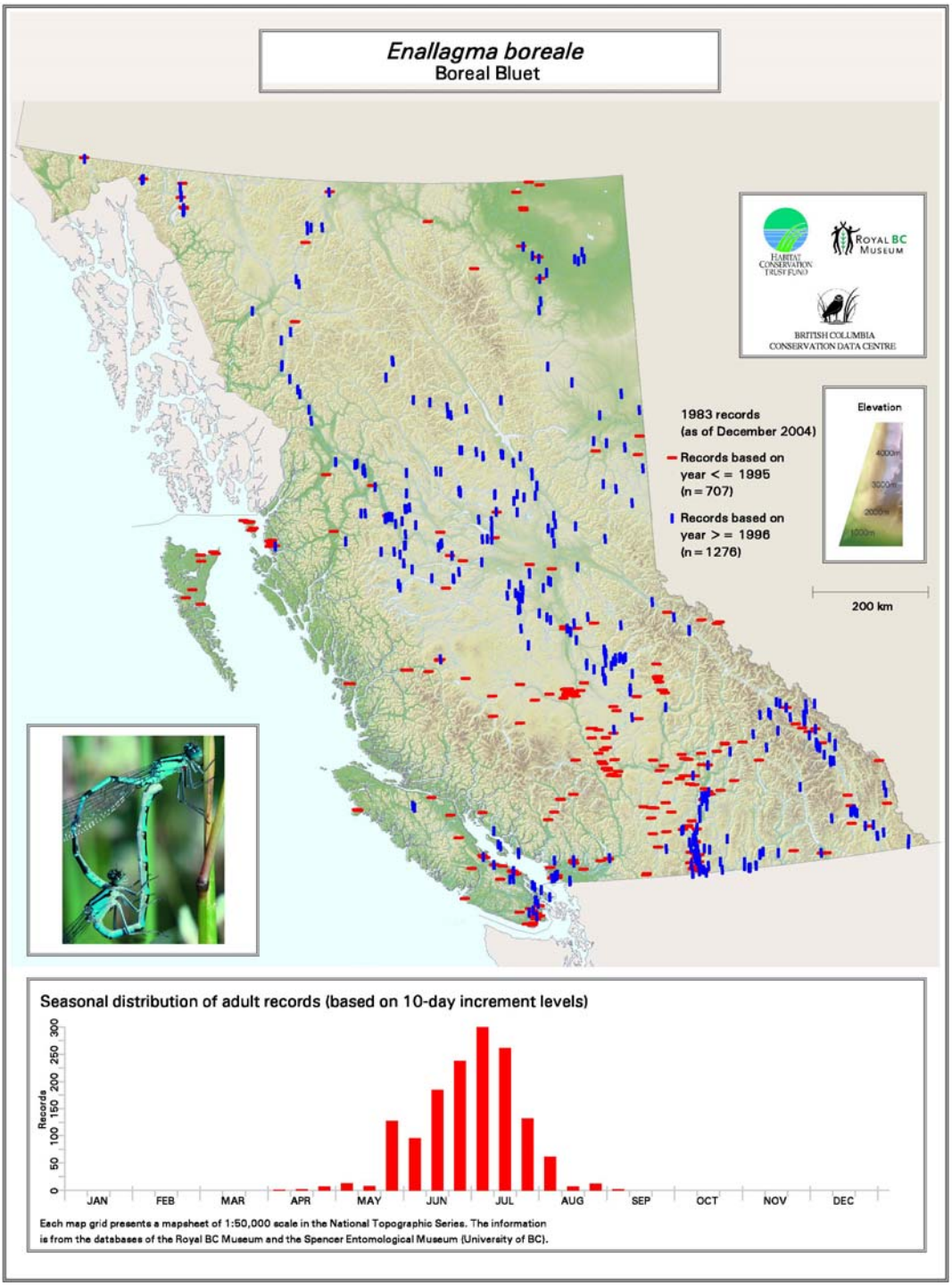
Biology: One of BC's most abundant odonates. This abundance and its wide distribution is partly the result of its tolerance of a wide variety of habitats – it swarms around warm saline ponds (Gs01-03, Wm07) in dry grasslands, can be common along the marshy shores of lakes and ponds (Wm01-02, Wm04-06), and is a typical resident of cold peatland waters (Wf01, 05-08; Wb13, 50-52). Usually inhabits water bodies lacking fish.

BC flight period: mid April to mid October; mainly from early June to mid August**.**

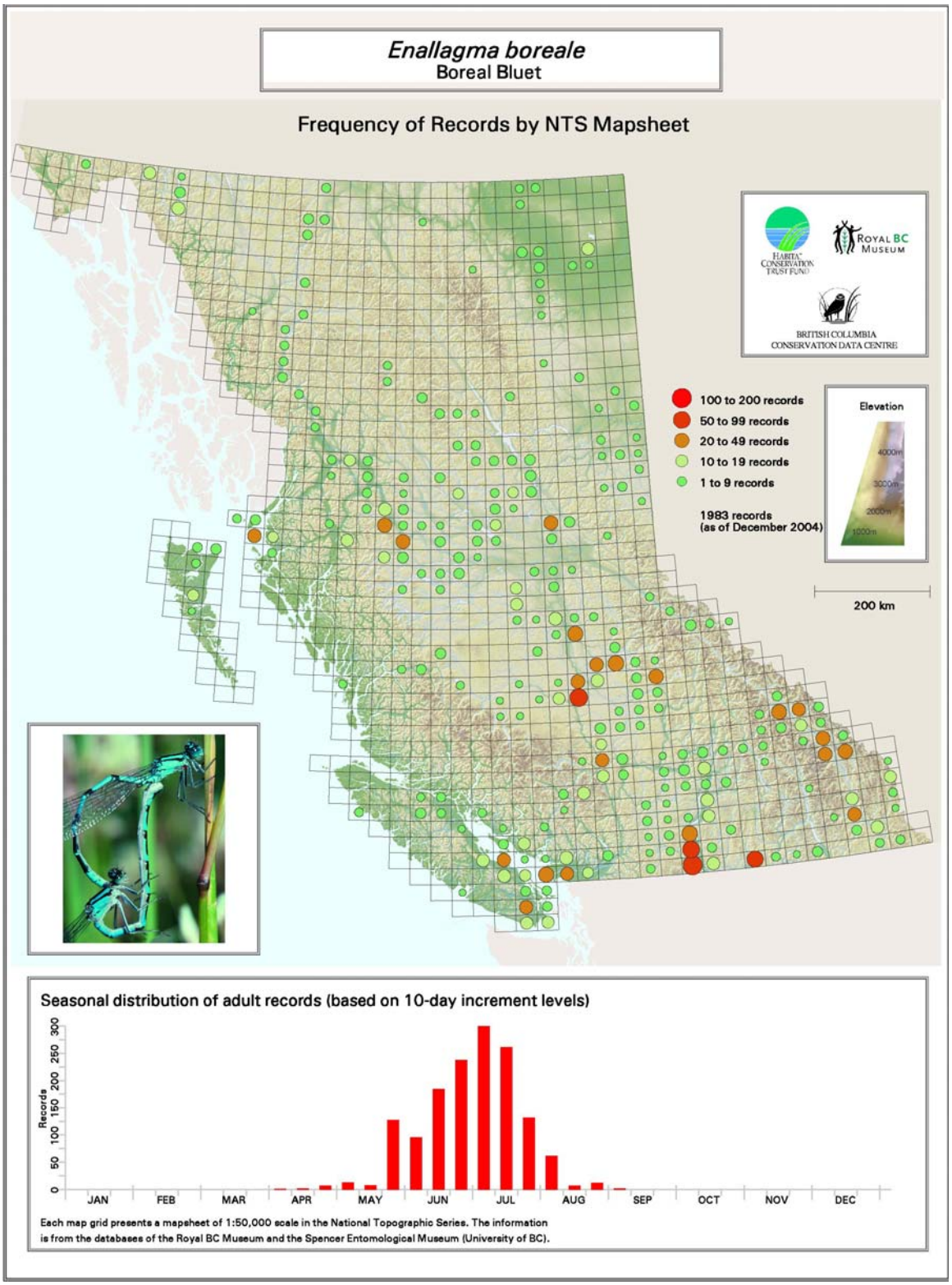
Enallagma boreale mating. Photograph: George Doerksen, RBCM



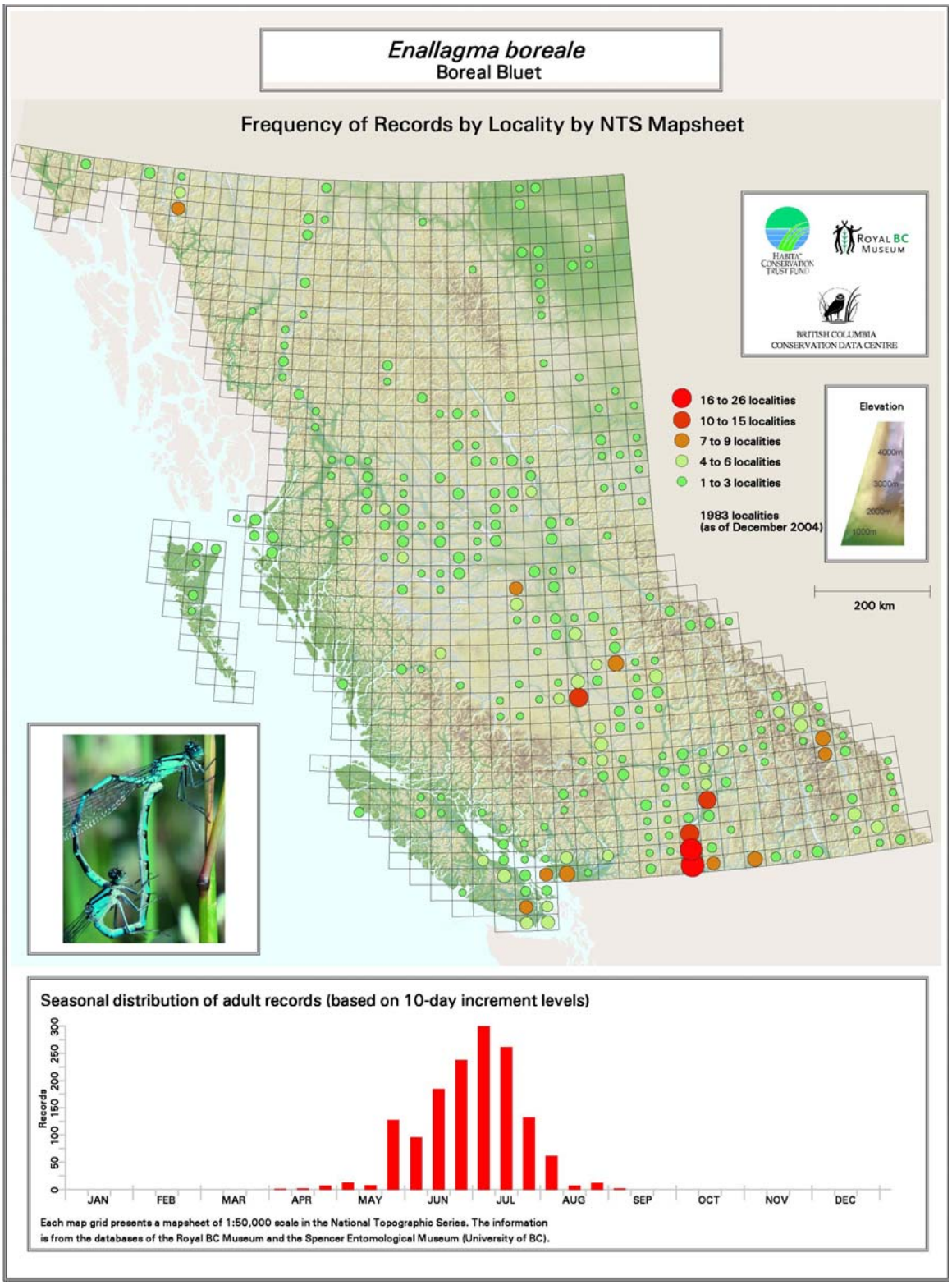
Enallagma boreale Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Enallagma boreale Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



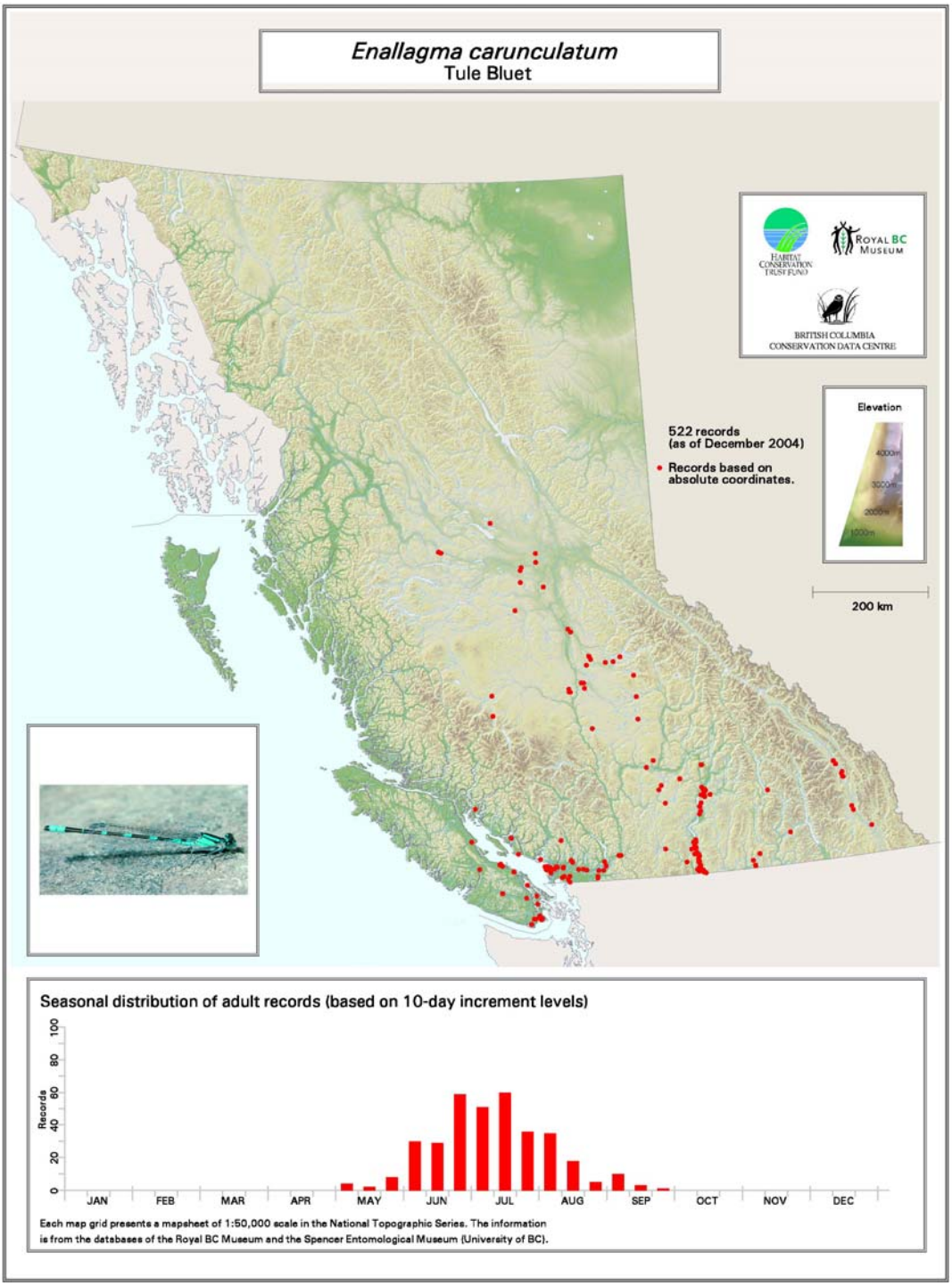
Enallagma boreale Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



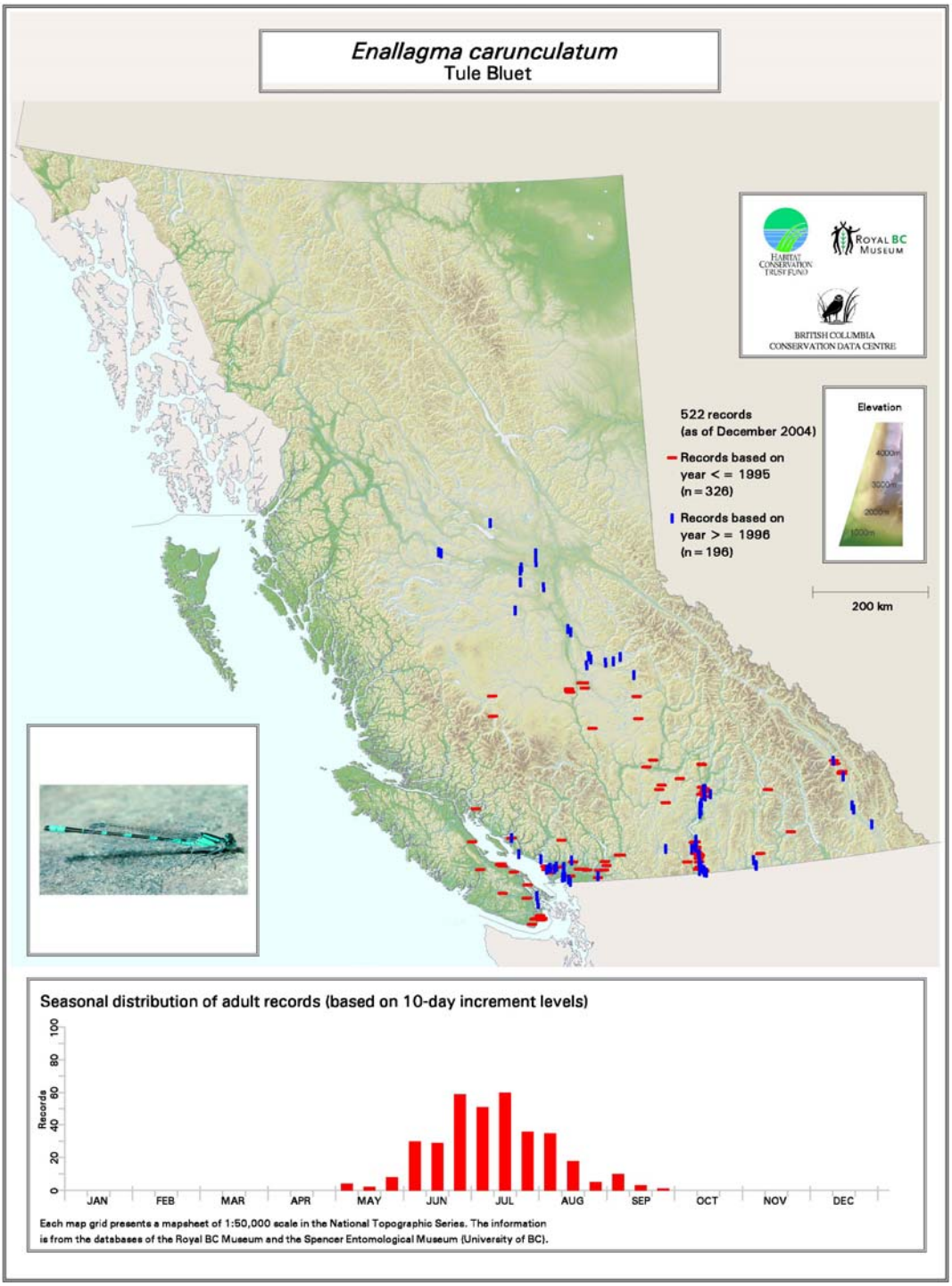
Enallagma boreale Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Enallagma carunculatum* (Tule Bluet)**
BC conservation rank: S5. Yellow List**.**
Description: Male has more black than blue on the middle abdominal segments (other species have more blue); appendages, fig. 4c. Female has a black stripe along the top of abdominal segment 8. Length: male 32 mm, female 33 mm.
Global Range: British Columbia east to Nova Scotia; south to Maryland, Kentucky, Oklahoma, New Mexico and Baja California (Westfall and May 1996). Faunal element: Austral (see Appendix 3).
BC Distribution: Widespread over the southern half of the province. In northern BC, restricted to the central interior, from the Cariboo-Chilcotin north to the Fort St. James region.
Biology: Common at low and moderate elevations. In BC, typical of lakes and large marshes (Wm01-02, Wm05-06) rather than small ponds. Tolerates alkaline conditions and is often common along exposed lakeshores, especially where there are stands of cattails or bulrushes (Wm05-06).
BC flight period: mid May to late October; most records range from mid June to late August.

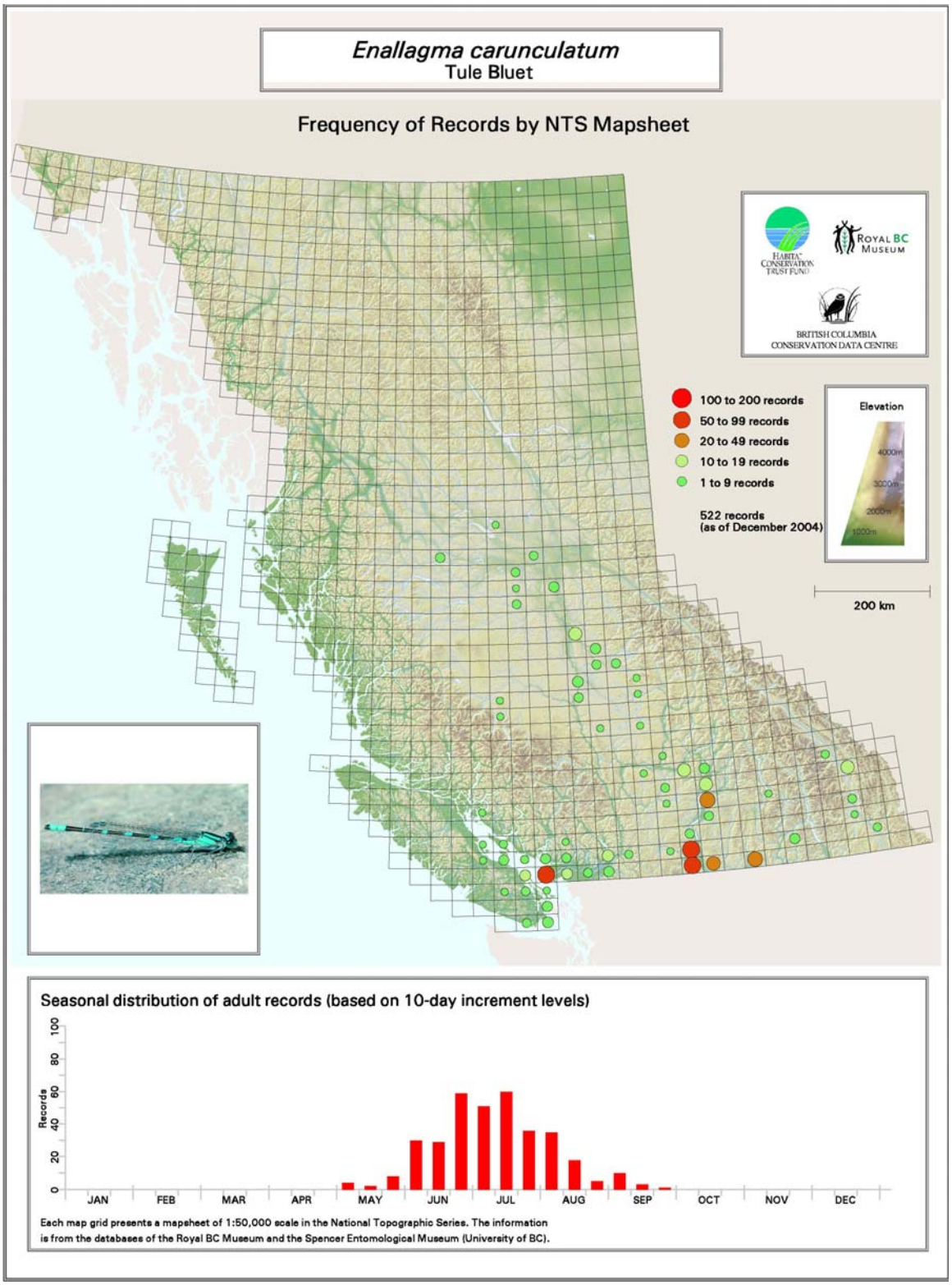
Enallagma carunculatum male. Photograph: George Doerksen, RBCM



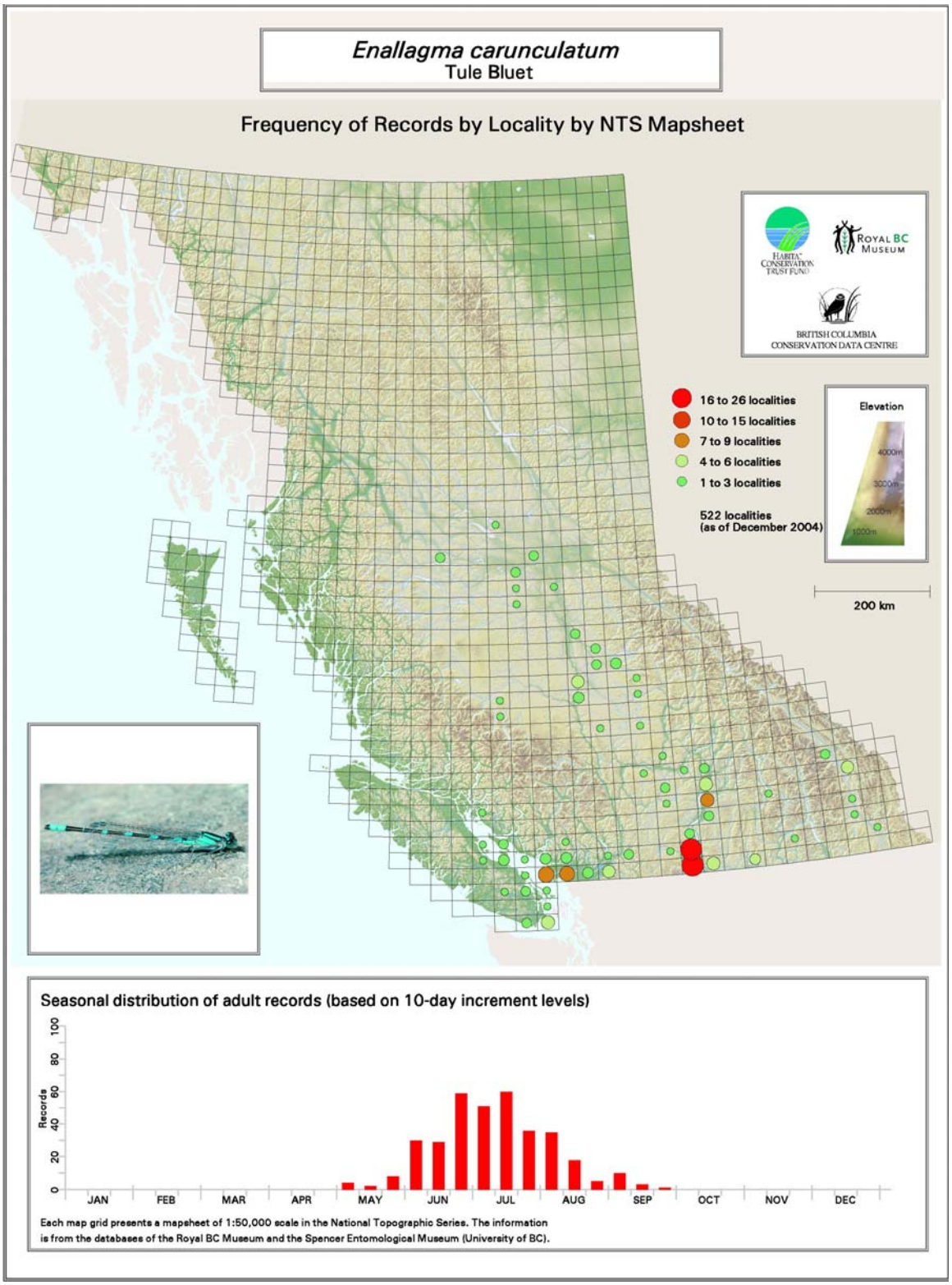
Enallagma carunculatum Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Enallagma carunculatum Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Enallagma carunculatum Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



Enallagma carunculatum Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

Enallagma civile* (Familiar Bluet)

BC conservation rank: S1. Red List. The record of *E. civile* at Bridge Lake (23 July 1934, E.R. Buckell) has posed many questions because it is far from its normal range and has not been seen in BC since the first collection. Is the record valid? The specimens were collected by a well-known entomologist, E.R. Buckell, who collected many dragonflies in BC. They are properly identified. There is no suggestion of a data mixup. Why is this species, usually very common and abundant where it is found, not recorded elsewhere in BC? Assuming the record is good, the logical explanation is that this population is a naturally disjunct one, far from the other most westerly populations in Oregon and Montana. The Bridge Lake area is poorly collected and no inventory has specifically been undertaken to look for the species. For the present, S1 is the reasonable rank.

Description: Male's appendages, fig. 4b. Female has no pale area on top of segment 8. Length: male 35 mm, female 33 mm.

Global Range: British Columbia east to Newfoundland, south to the West Indies, Mexico and South America. Also in Hawaii. (Westfall and May 1996). Faunal element: Austral (see Appendix 3).

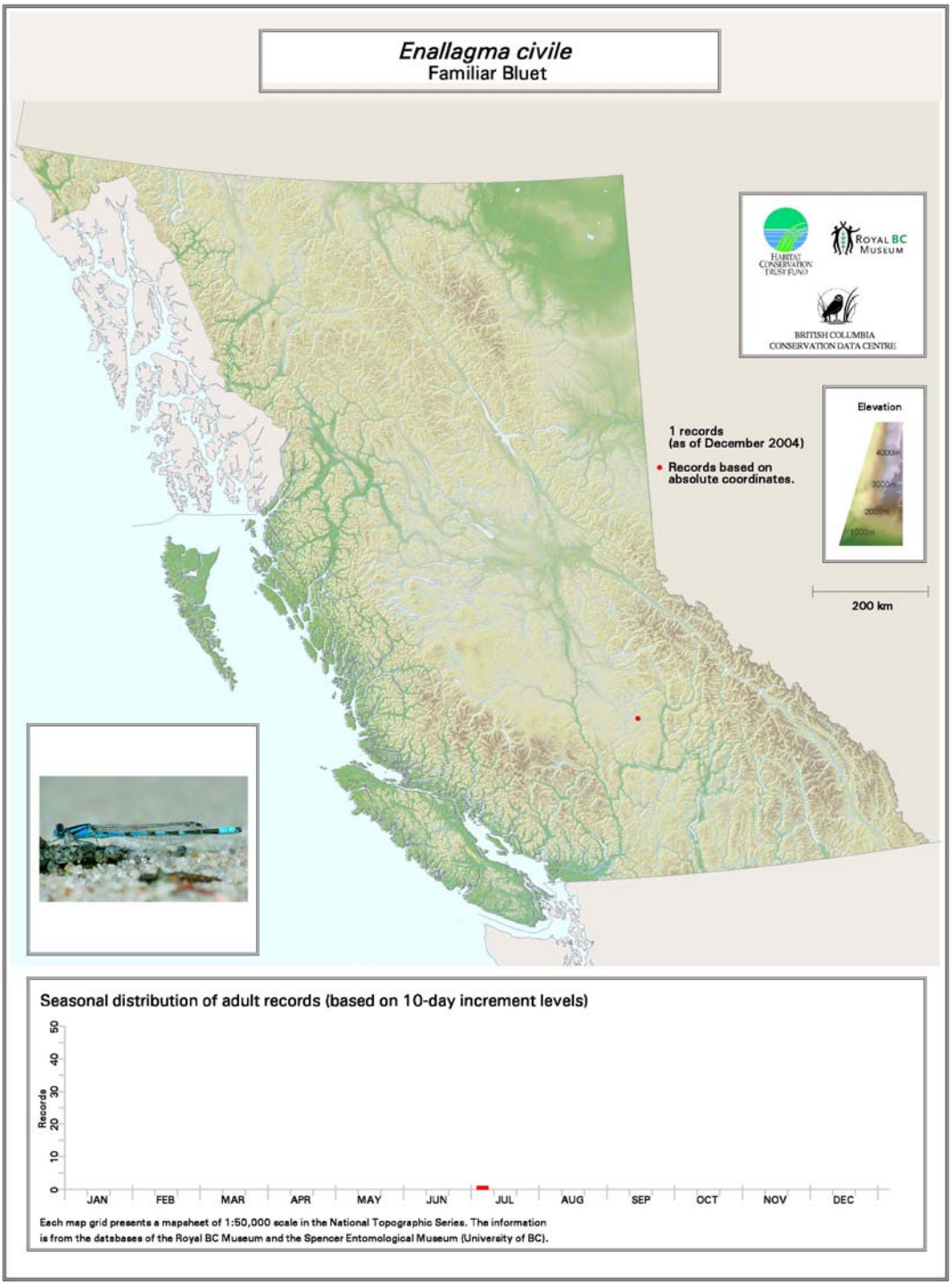
BC Distribution: Recorded only in the Cariboo region south of the northern study area (Bridge Lake). To be looked for.

Biology: One of the most common and widespread American damselflies, especially east of the Rockies, but recorded only once in BC. Closely related to *E. carunculatum*. Prefers marshy ponds and lakeshores (Wm01-02, Wm04-06); often colonizes temporary and newly created water bodies such as farm dugouts and gravel pit ponds.

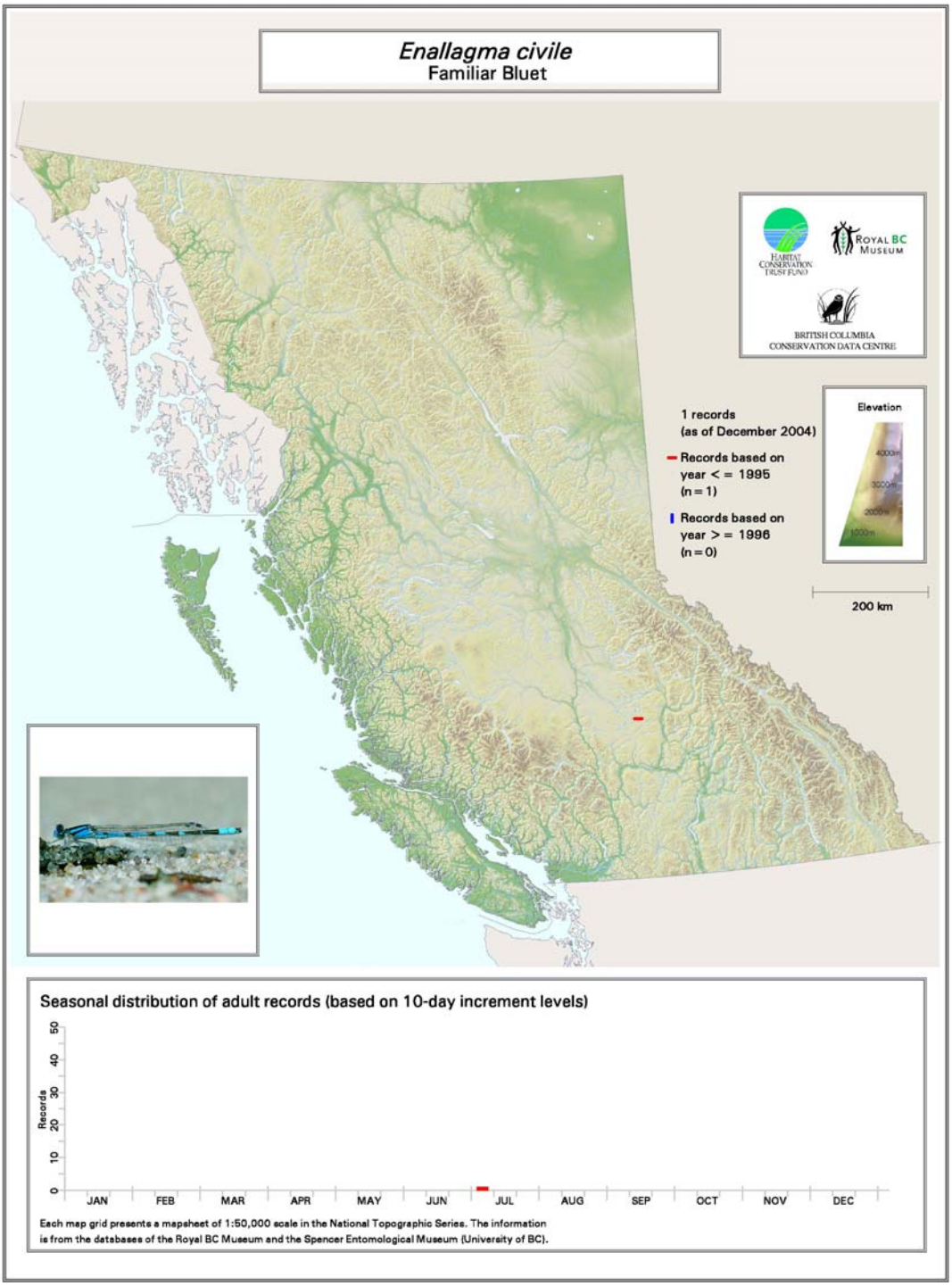
BC flight period: (probably) early June to mid October; the only BC record is from 23 July.

Management and protection considerations: Inventory of ponds and lakeshores in the Bridge Lake area is required to confirm the presence of *E. civile* in the region. Only after site-specific information is available can management issues be addressed.

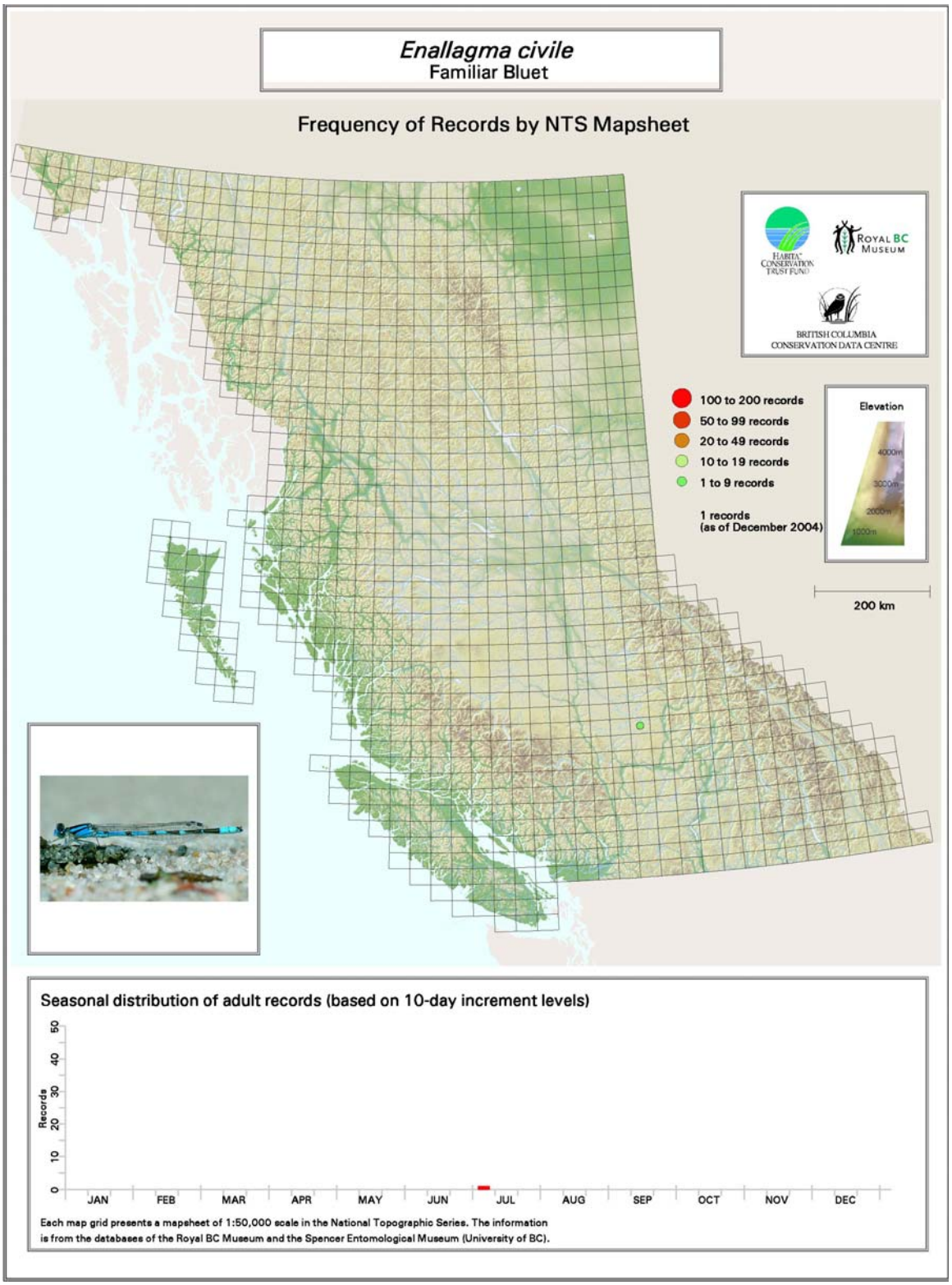
Enallagma civile male. Photograph: Blair Nikula



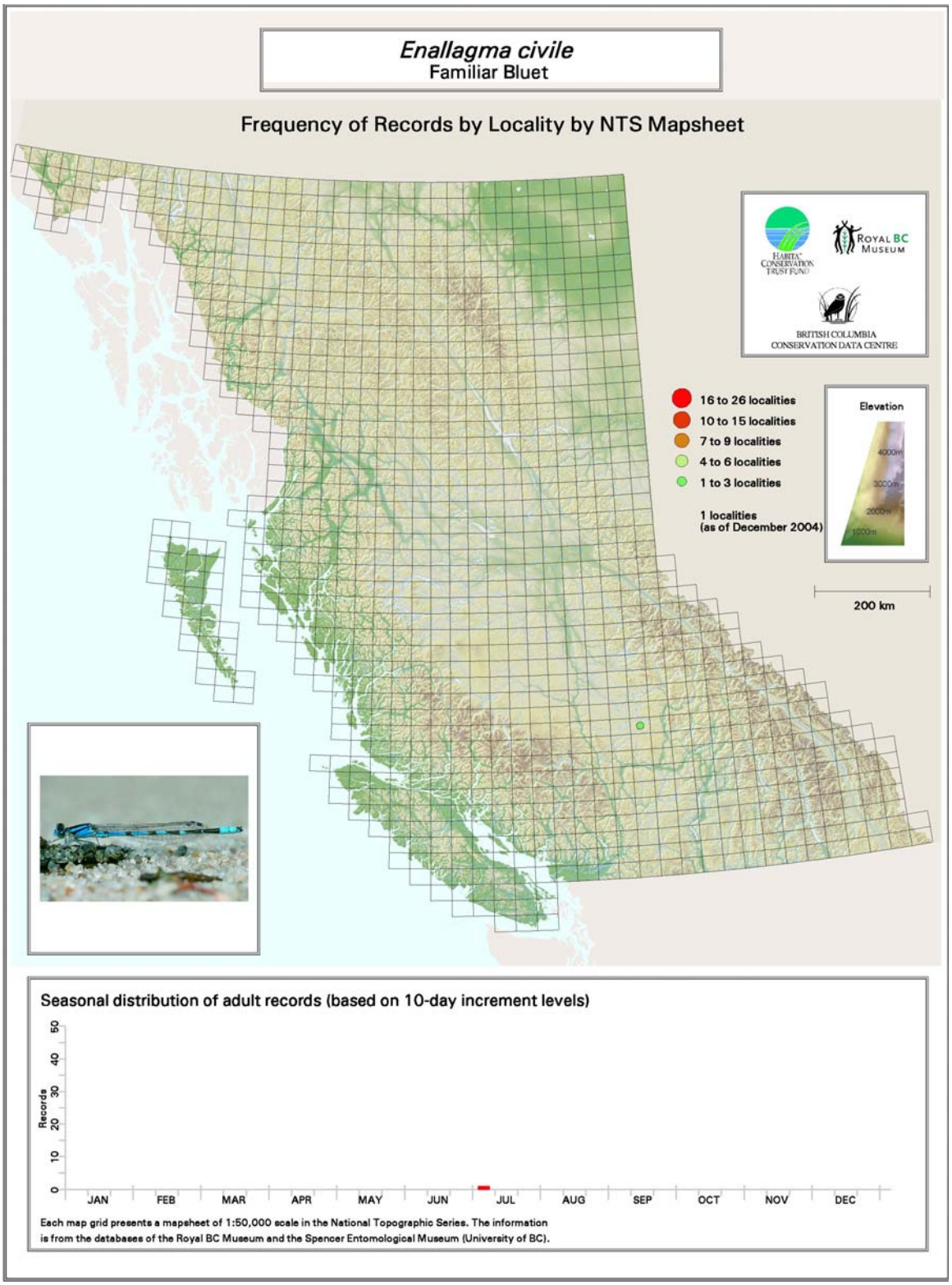
Enallagma civile Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Enallagma civile Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



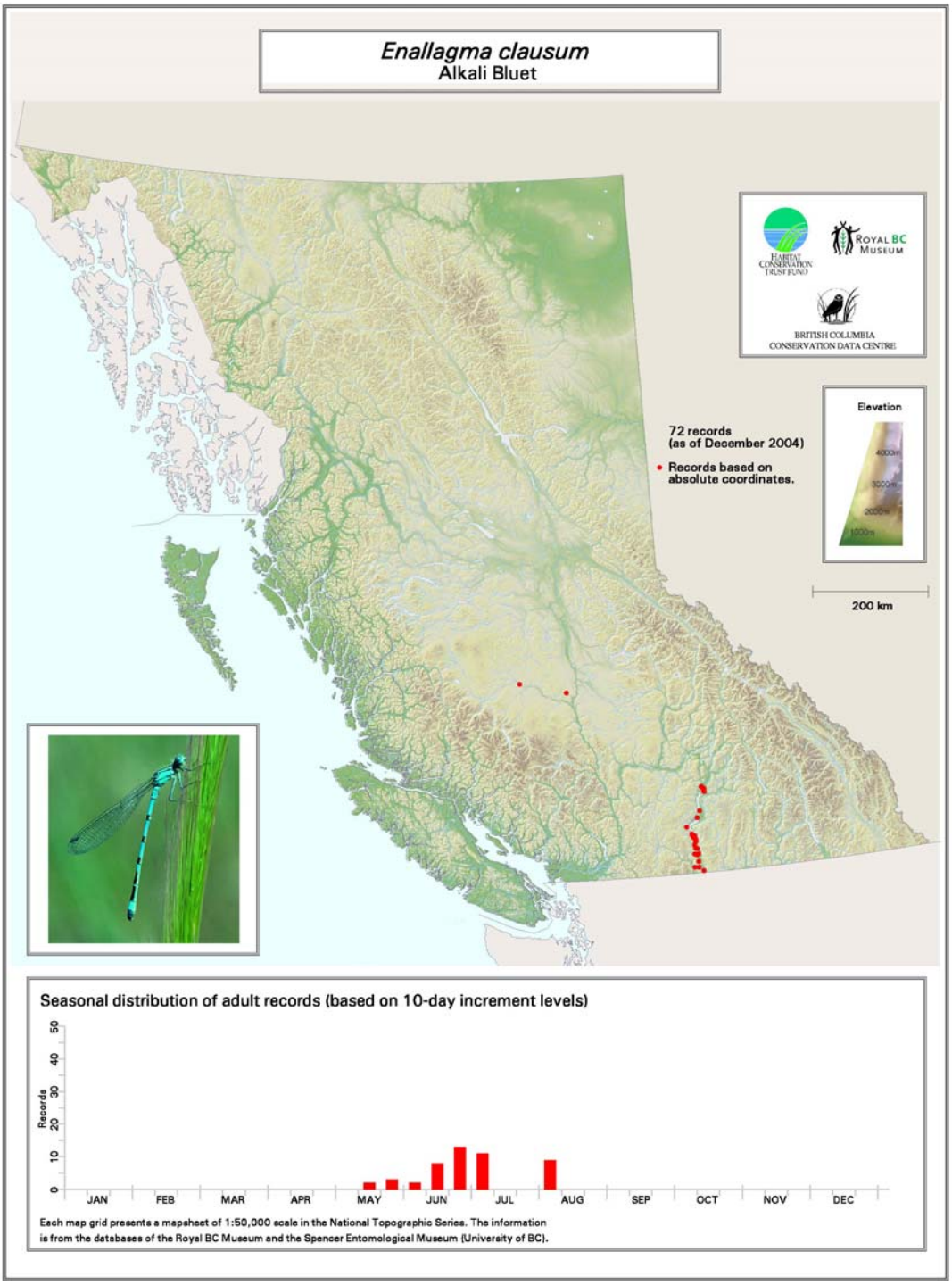
Enallagma civile Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



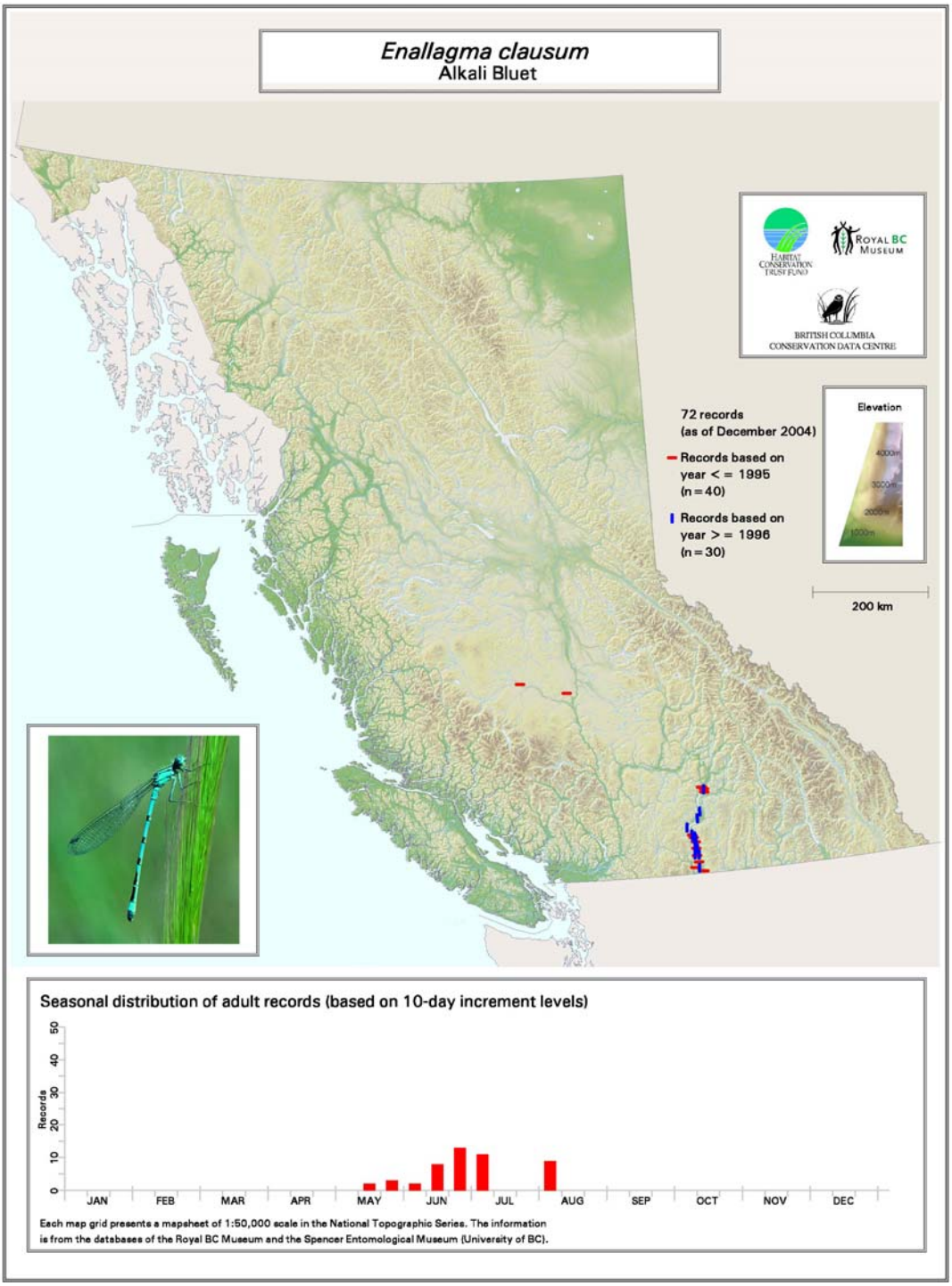
Enallagma civile Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Enallagma clausum* (Alkali Bluet)**
BC conservation rank: S4. Yellow List
Description: Male's appendages, fig. 4d. All or most of female's segment 8 is pale.
Length: male 35 mm, female 34 mm.
Global Range: British Columbia east to Quebec, south to Kansas, New Mexico and California (Westfall and May 1996). Faunal element: Austral (see Appendix 3).
BC Distribution: Scattered localities in BC's Thompson-Okanagan region north to the Chilcotin region. In Northern BC, recorded at only two localities at the extreme southern border of the study area (52ºN).
Biology: Uncommon, except in particular locations that meet its habitat requirements. Prefers saline ponds and lakes in grasslands and dry forests (Wm05-07; Gs01-03)
BC flight period: late May to early September; mainly late June to mid August.

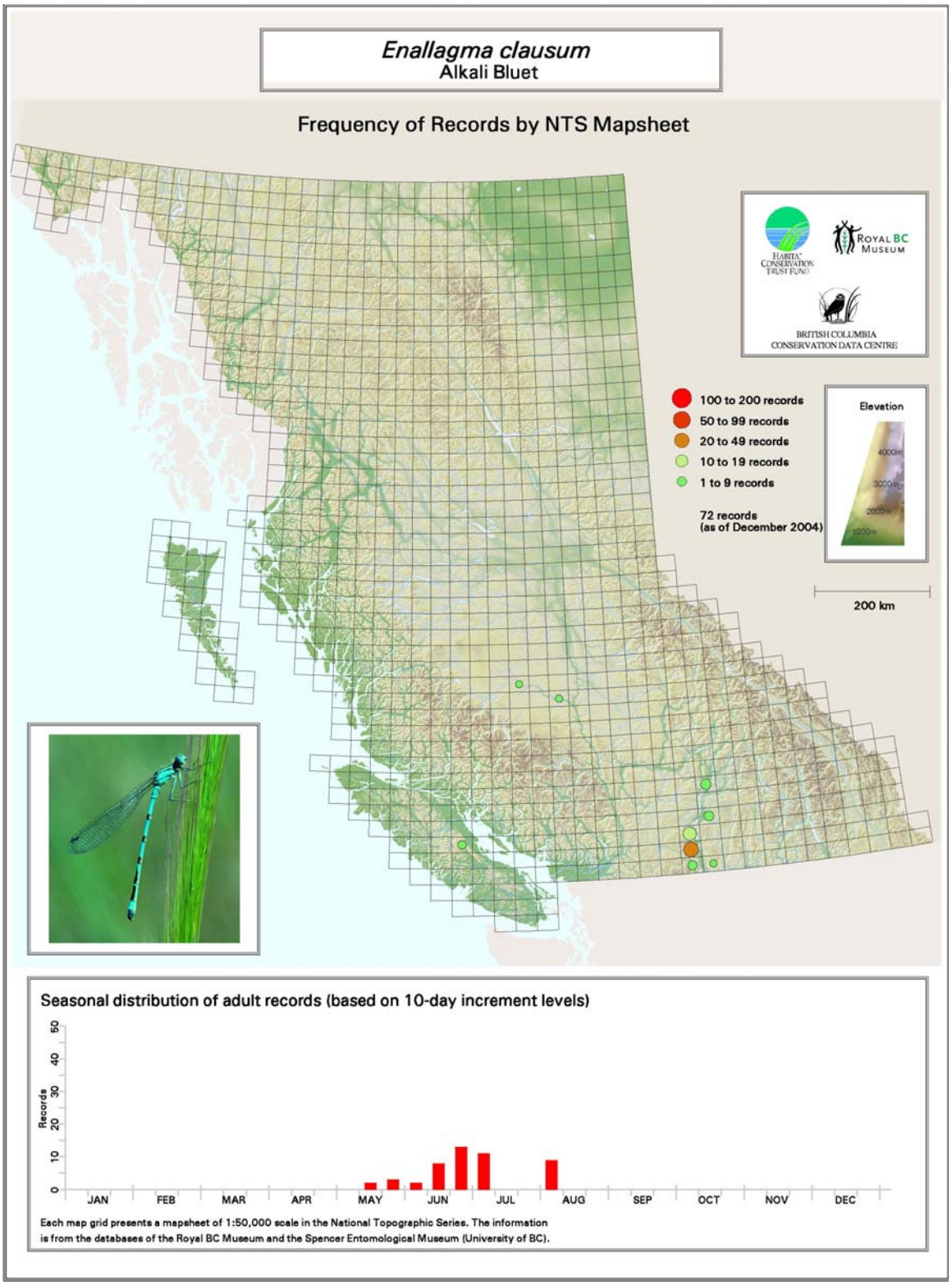
Enallagma clausum male. Photograph: Robert A. Cannings



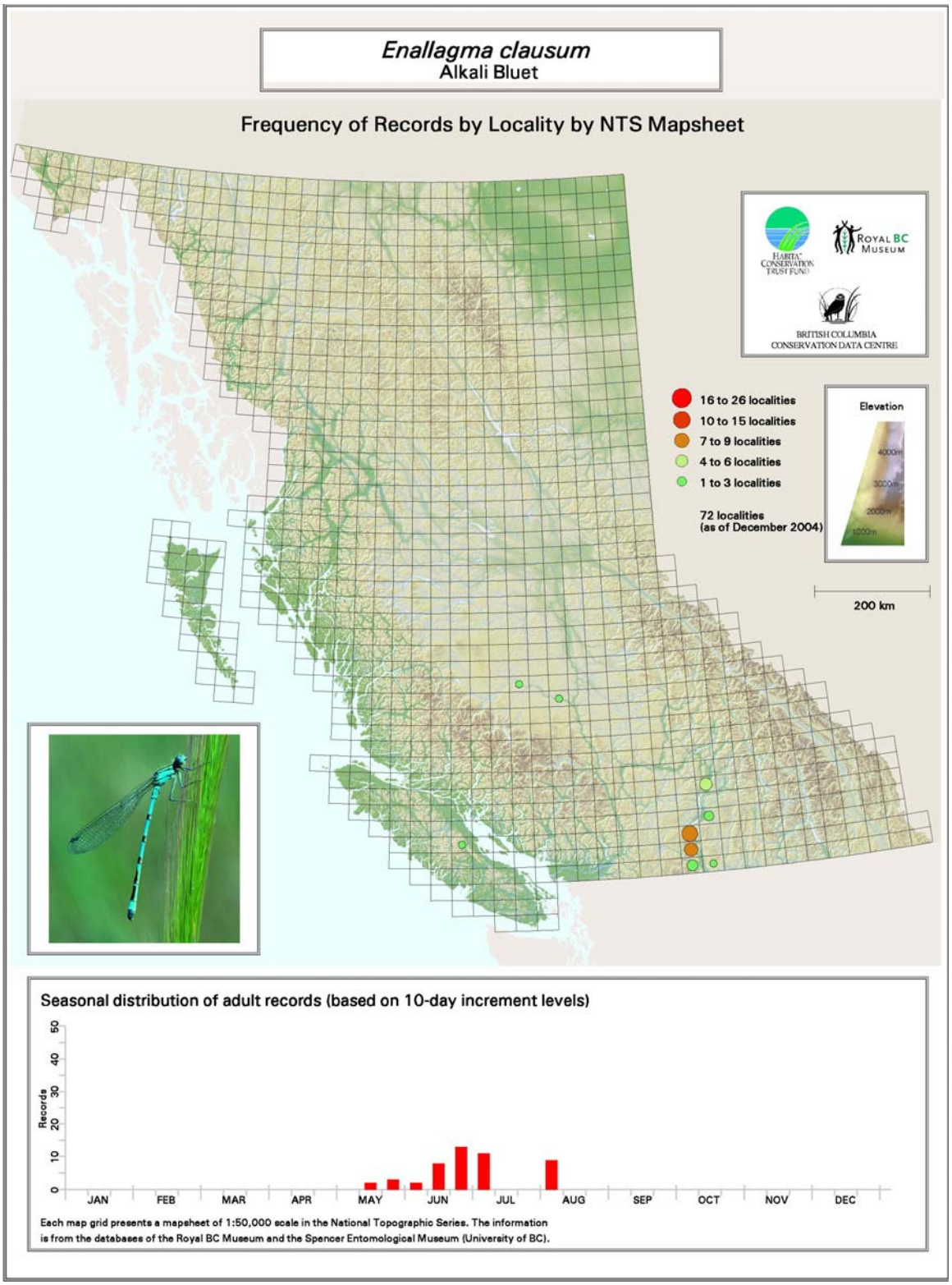
Enallagma clausum Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Enallagma clausum Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Enallagma clausum Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



Enallagma clausum Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Enallagma cyathigerum* (Northern Bluet)**
BC conservation rank: S5. Yellow List
Description: Male's appendages, fig. 4g. The rear half of female's segment 8 is usually black on top, the pointed end dividing a pale area at the base. Length: male 33 mm, female 32 mm.
Global Range: Eurasia; Alaska east to Newfoundland; south to Virginia, Iowa, Nebraska, New Mexico and Baja California (Westfall and May 1996). Faunal element: Widespread Boreal; Holarctic (see Appendix 3).
BC Distribution: Widespread throughout.
Biology: The most common damselfly in southern BC. Lives mostly along the marshy shores of ponds and lakes (Wm01-02, Wm04-07, Wf01); usually avoids acidic and saline waters, but can occur there. In BC, adults usually emerge a week or two after those of its close relative, *E. boreale*.
BC flight period: early May to late October; most records are from mid May to mid August.

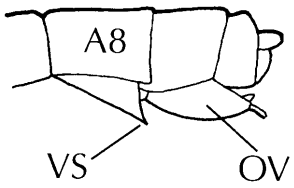
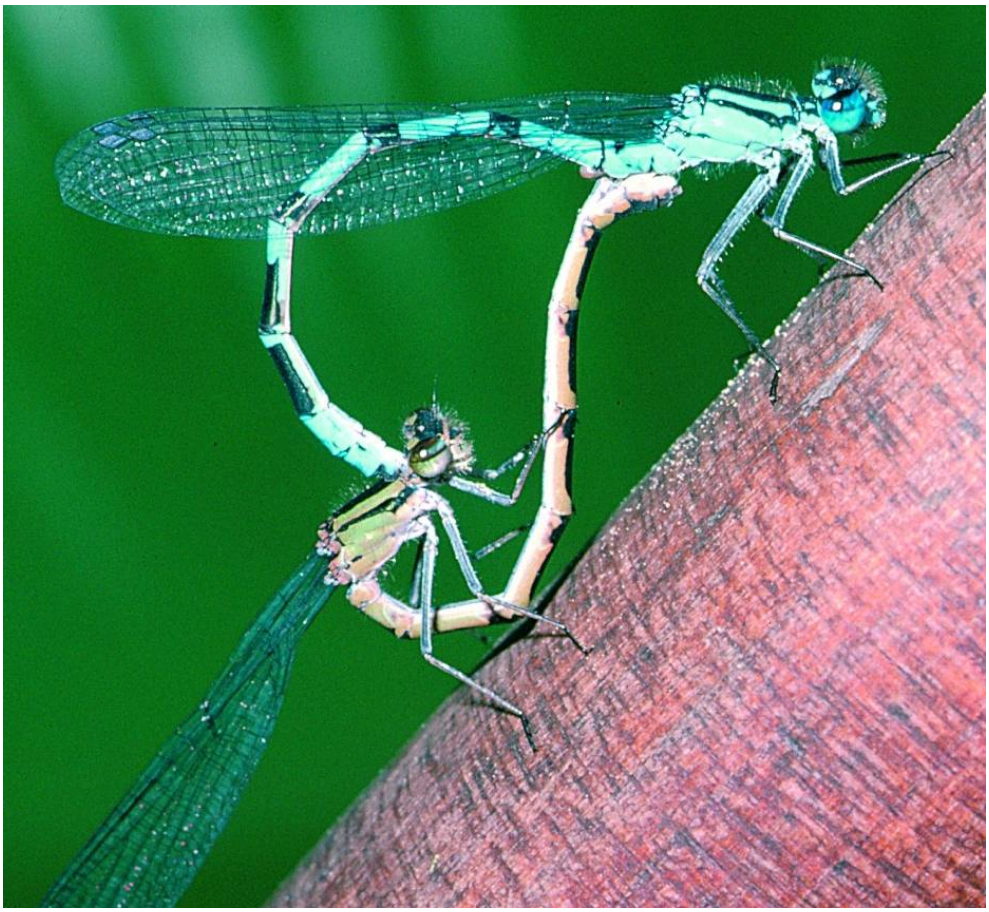
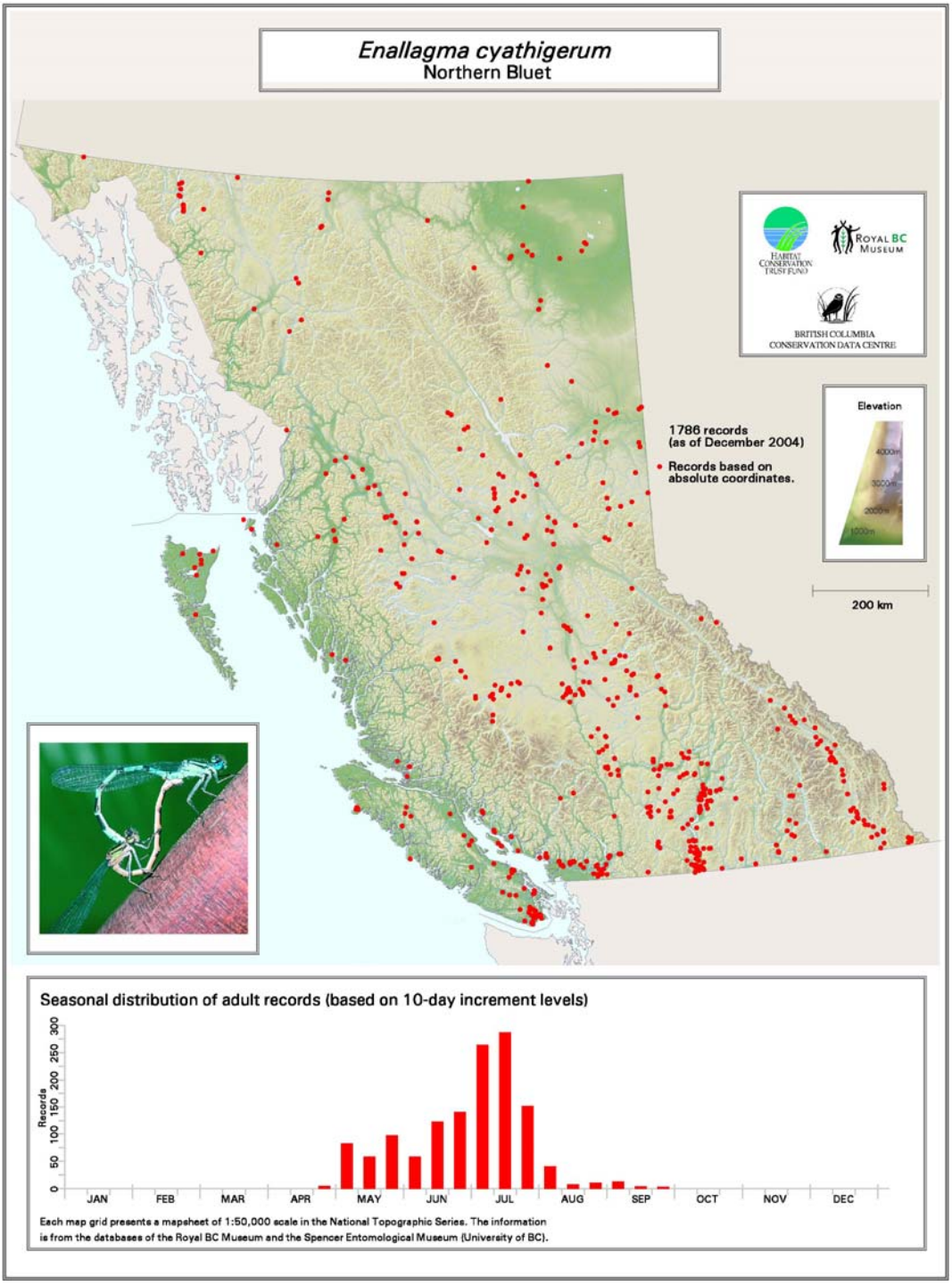


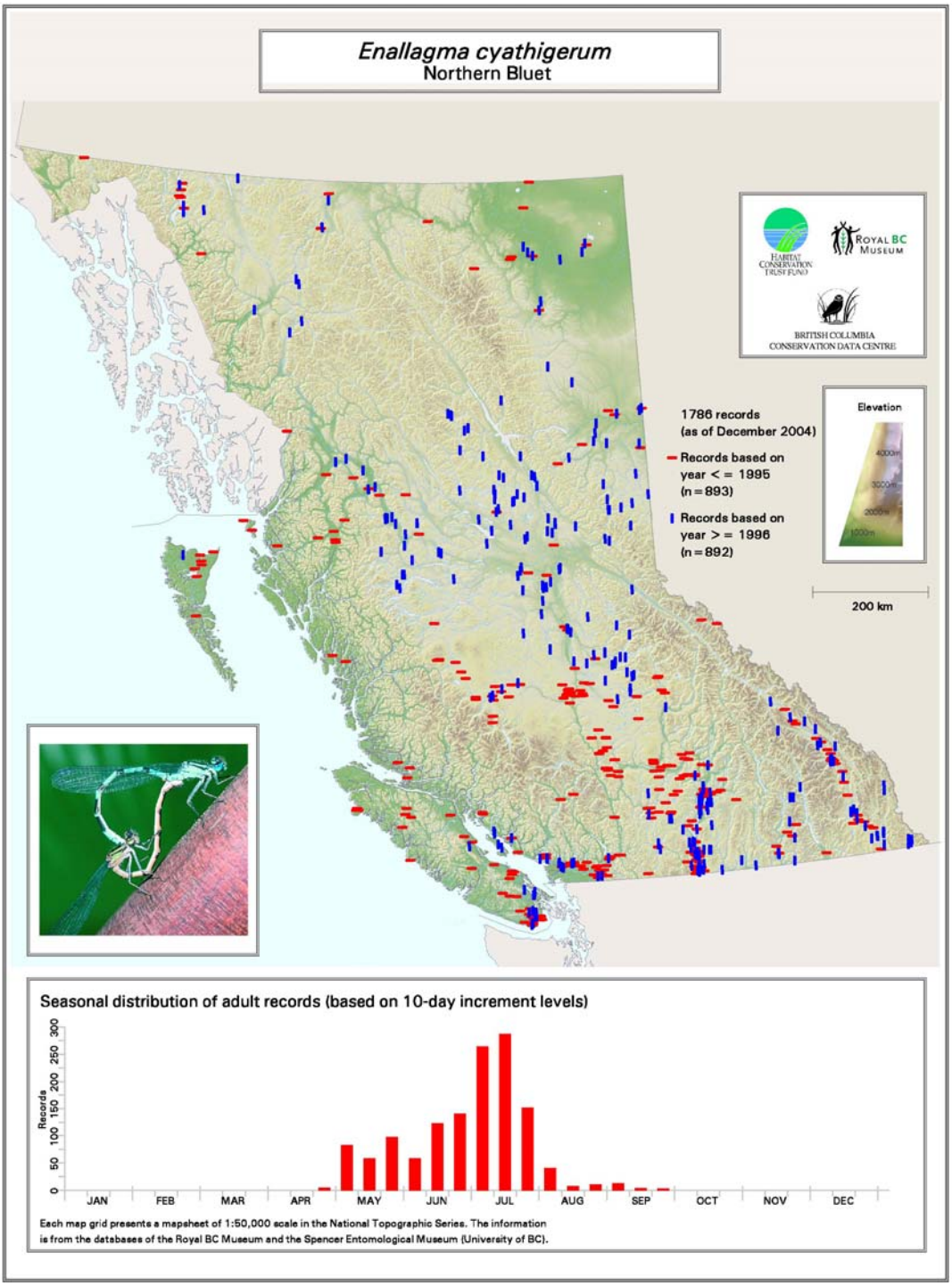
Figure 5. Northern Bluet female's abdomen tip (side view). A8 = abdominal segment 8; OV = ovipositor; VS = vulvar spine.



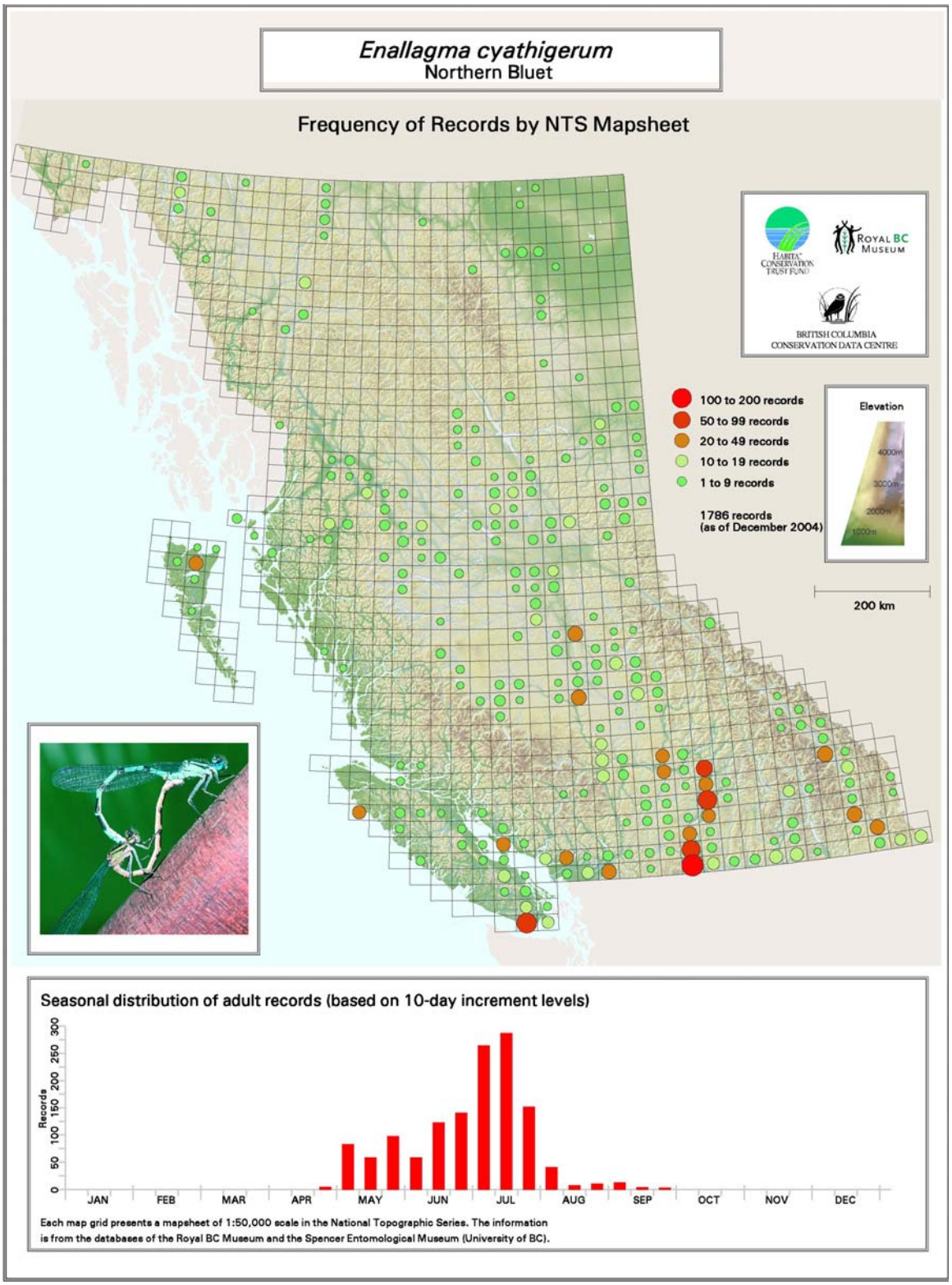
Enallagma cyathigerum mating. Photograph: George Doerksen, RBCM



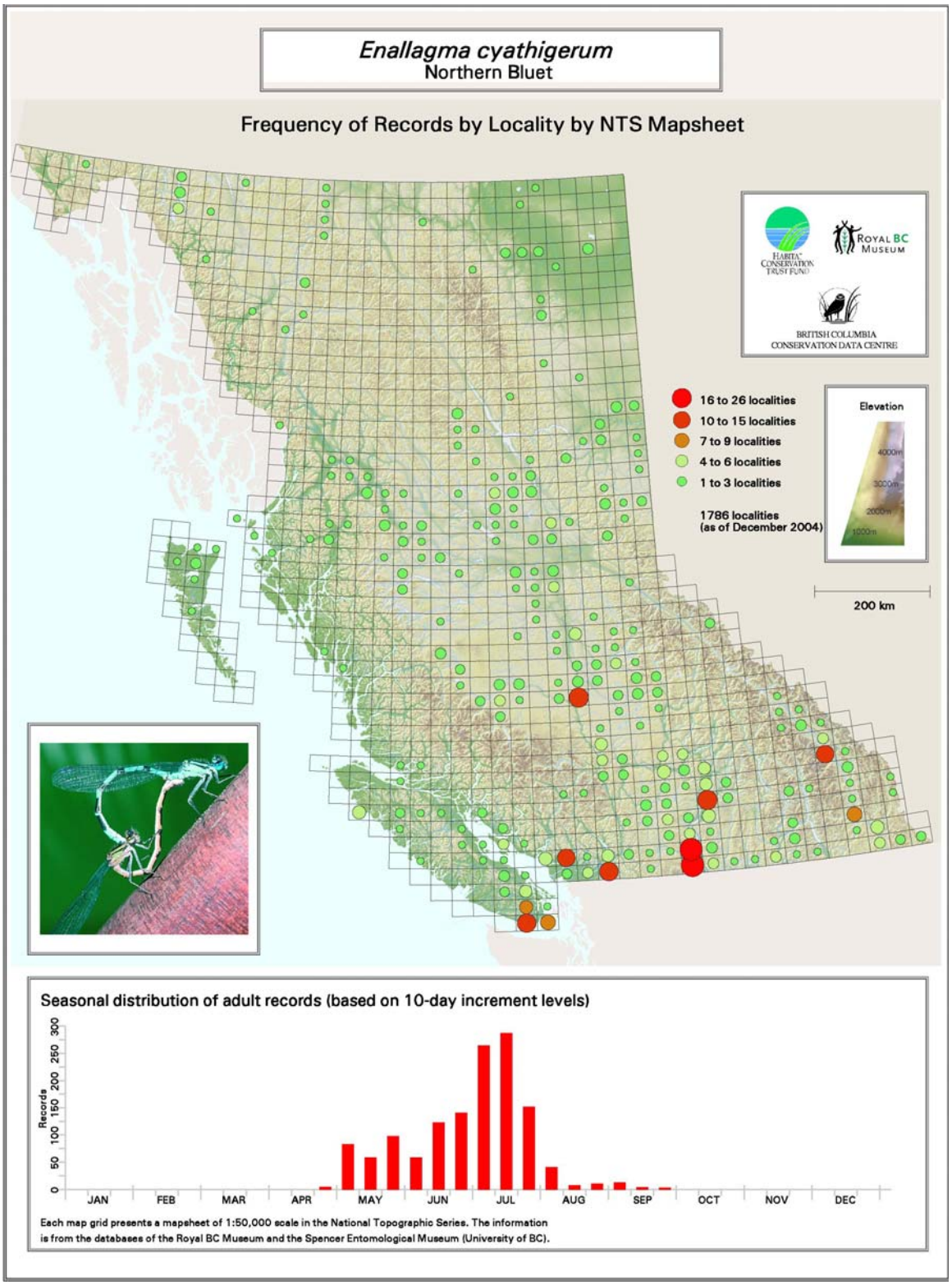
Enallagma cyathigerum Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Enallagma cyathigerum Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



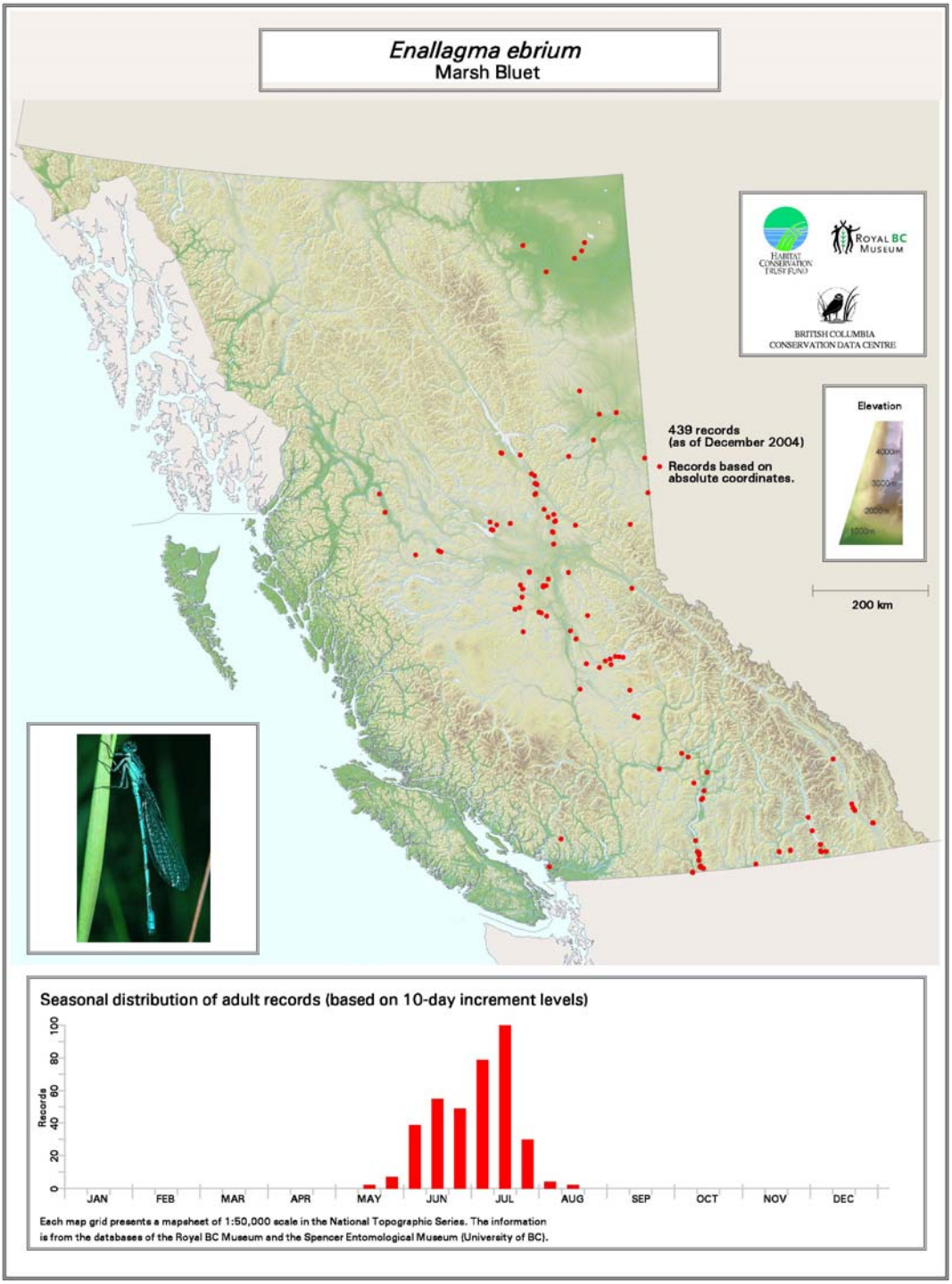
Enallagma cyathigerum Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



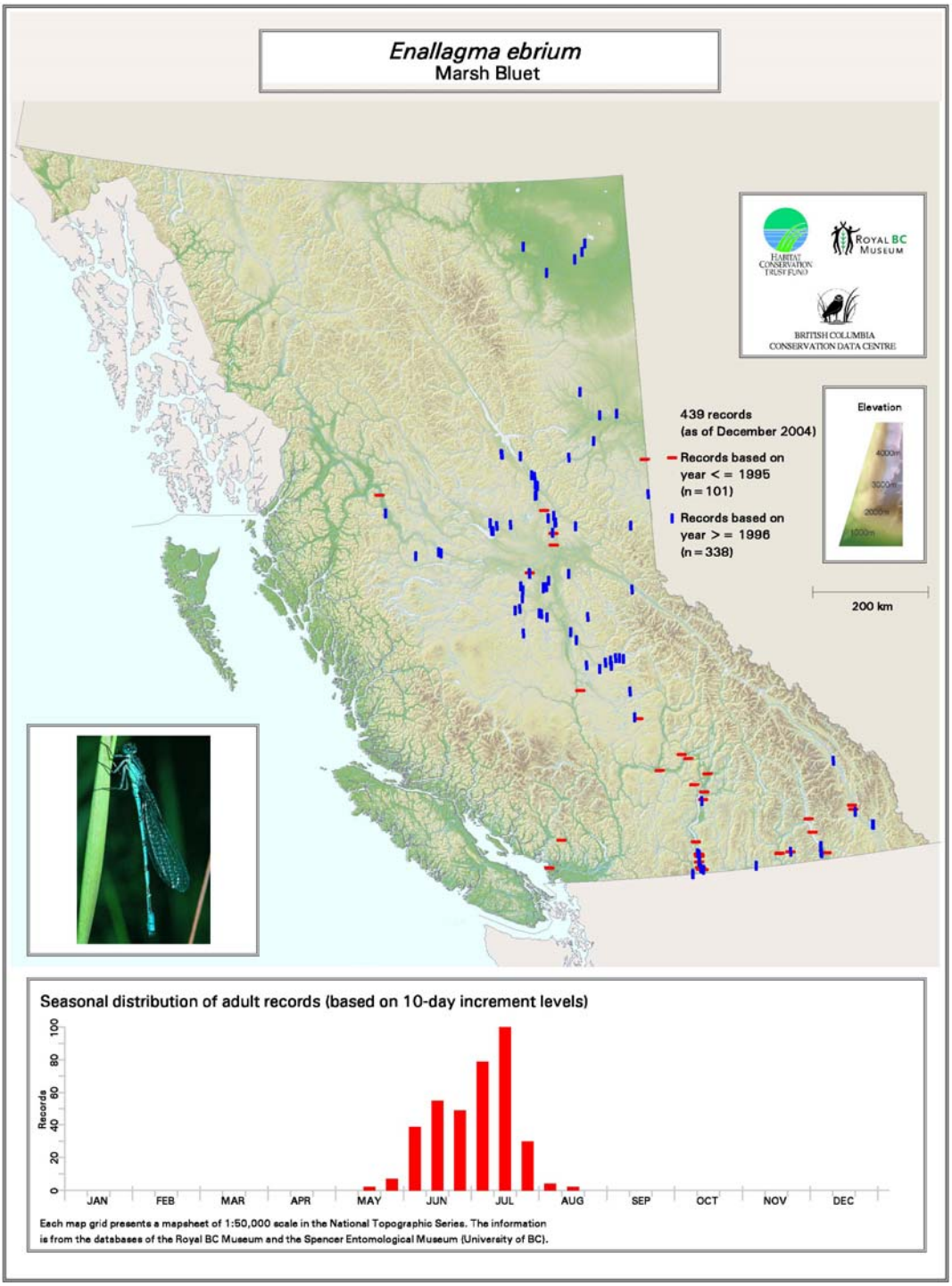
Enallagma cyathigerum Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Enallagma ebrium* (Marsh Bluet)**
BC conservation rank: S5. Yellow List
Description: Male's upper appendages are forked, fig. 4a. Female's segments 8 to 10 are entirely black above. Length: male 29 mm, female 30 mm.
Global Range: British Columbia east to Newfoundland; south to Virginia, Tennessee, Nebraska, Colorado and Washington (Westfall and May 1996). Faunal element: Transition (see Appendix 3).
BC Distribution: Widespread east of the Coast Mountains, ranging north into the Peace and Fort Nelson regions; two records on the Lower Mainland.
Biology: Common in the southern half of the province. Can be abundant, especially in marshes or open lakeshores (Wm01-02, Wm04-07, Wf01). Usually avoids peatlands and other acidic habitats.
BC flight period: late May to mid September; most records are from mid June to early August.

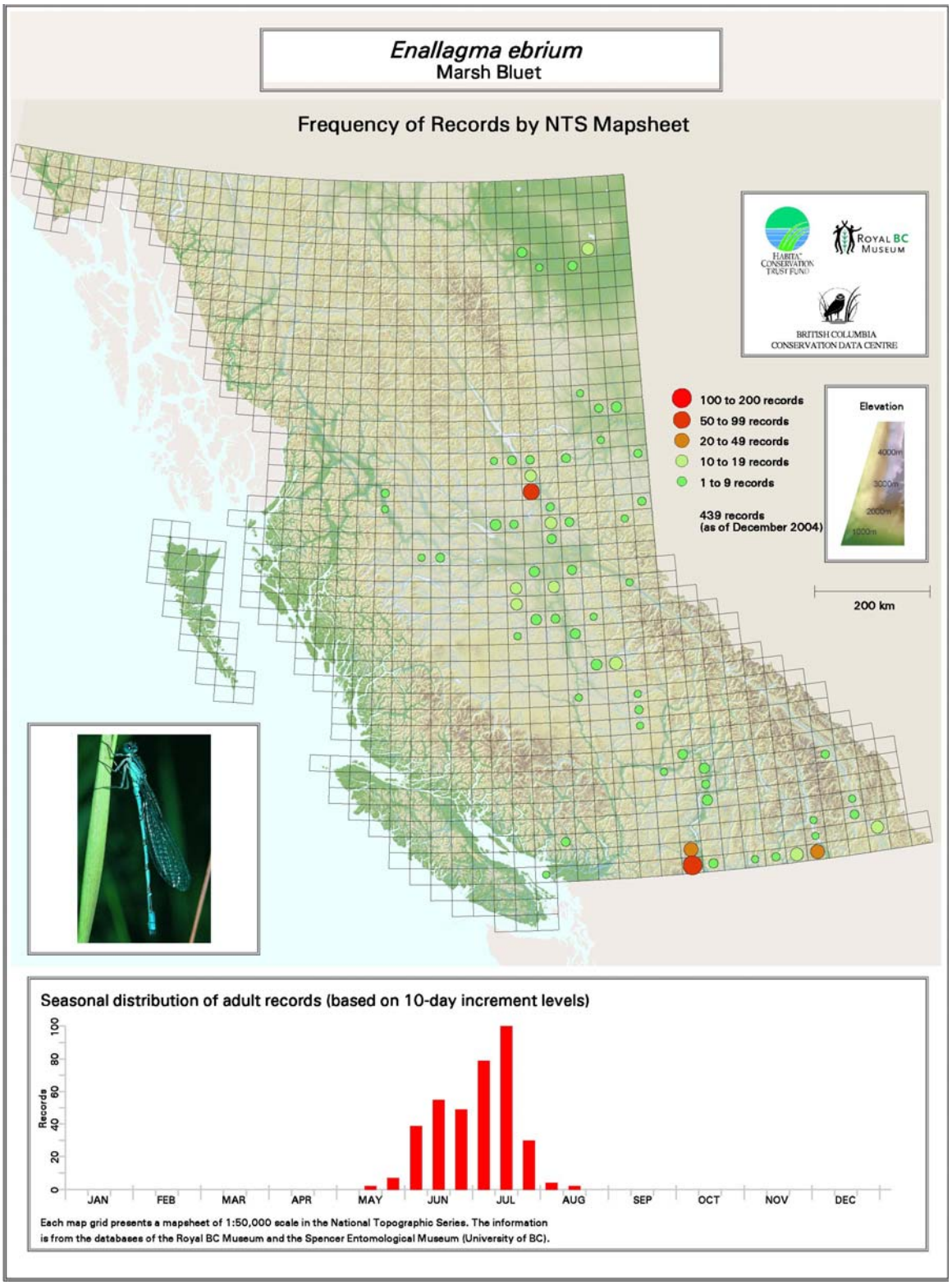
Enallagma ebrium male. Photograph: George Doerksen, RBCM



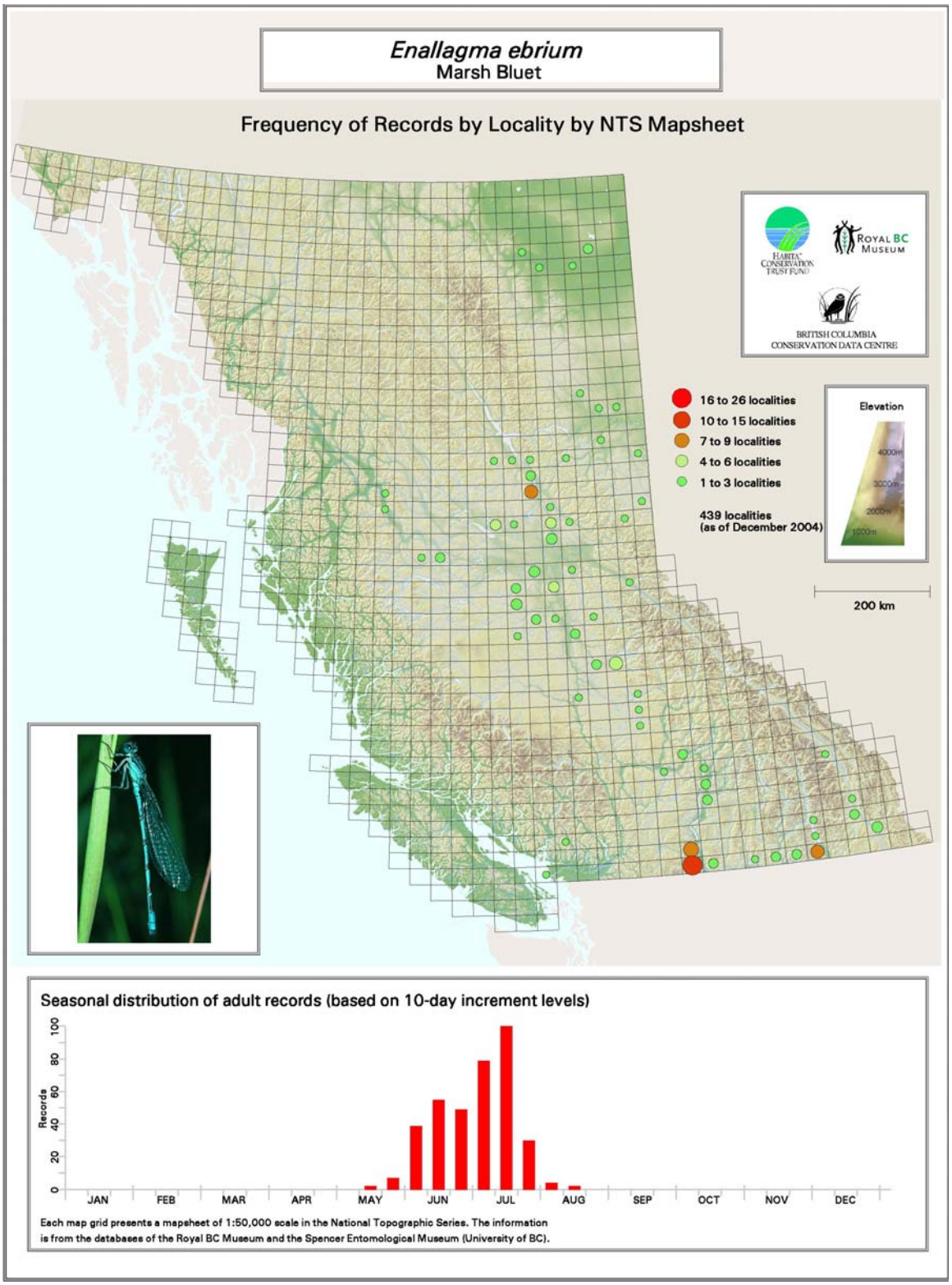
Enallagma ebrium Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Enallagma ebrium Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Enallagma ebrium Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



Enallagma ebrium Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

Enallagma hageni* (Hagen's Bluet)

BC conservation rank: S3S4. Blue List. *E. hageni* is on the verge of dropping off the list of species of management concern. It is maintained on the Blue List largely because of its uncommonness over a relatively restricted area of BC and because we have difficulty in predicting, with confidence, where it might be found.

Description: Closely related to *E. ebrium*. Male's appendages, fig. 4f. Female's segments 8 to 10 are entirely black on top. Length: male 30 mm, female 31 mm.

Global Range: British Columbia east to Nova Scotia; south to Georgia, Virginia, Missouri, Nebraska and Montana (Westfall and May 1996). Faunal element: Transition (see Appendix 3).

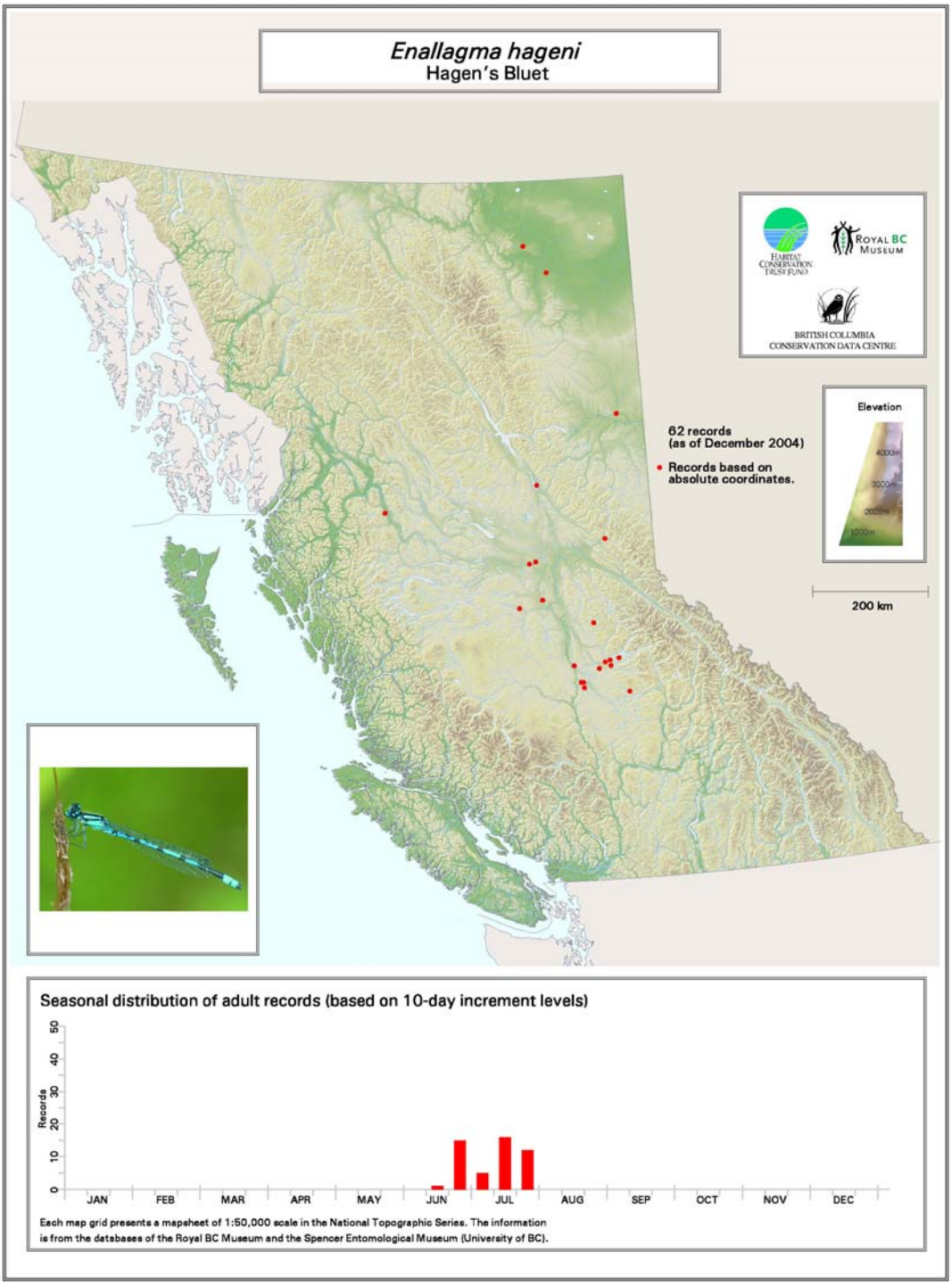
BC Distribution: From the central Cariboo area north to the Peace and Fort Nelson regions and west to the Bulkley Valley. Most often seen in the Cariboo and Prince George regions.

Biology: An uncommon inhabitant of marshy lakes and ponds (Wm01-02, Wm04-07, Wf01); tends to prefer more acid situations than *E. ebrium*. For example, specimens were collected in mossy fens near Gaitaga Lake, Mackenzie (Wf06-07).

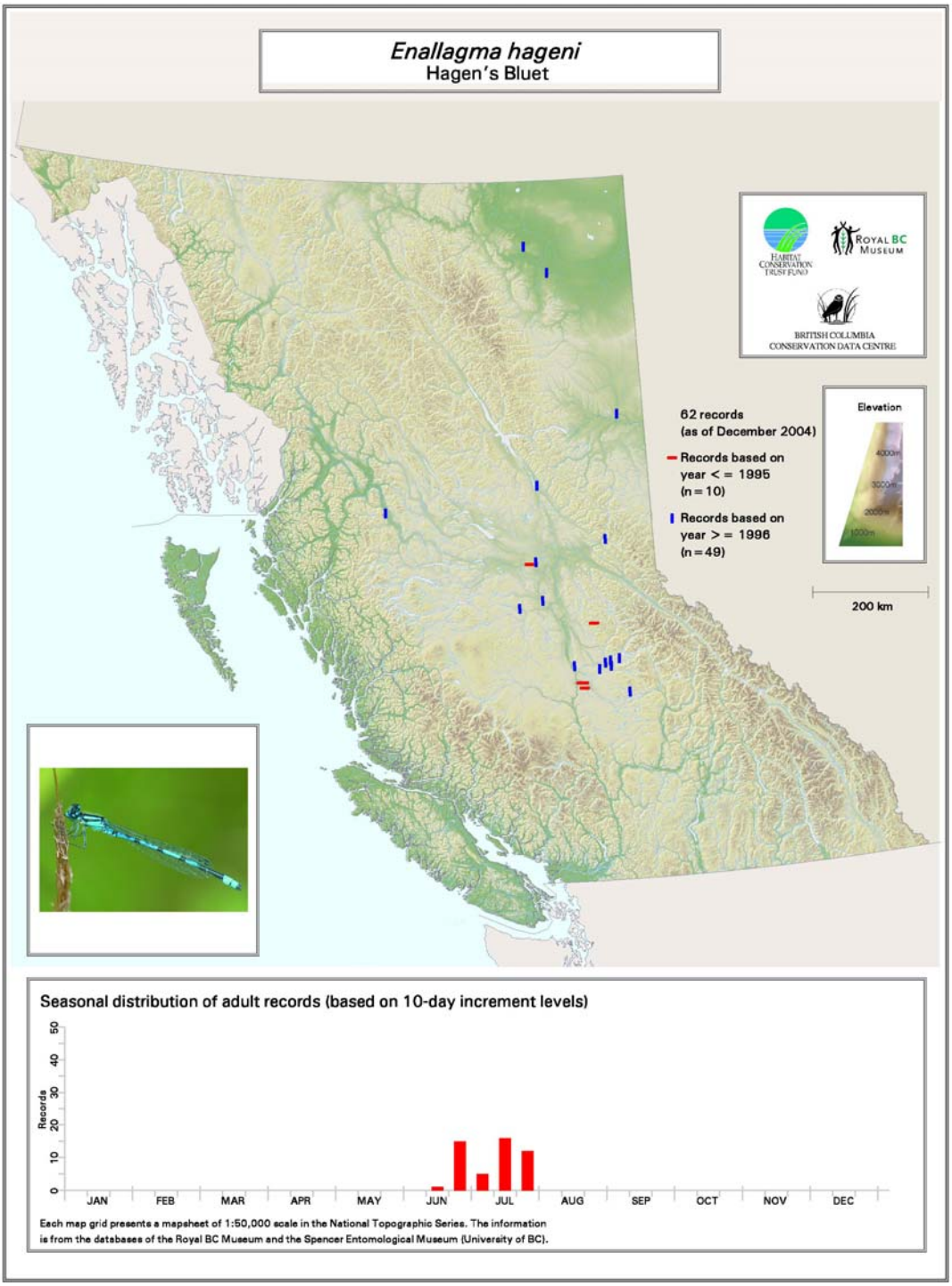
BC flight period: late May to early September; most records from early July to early August.

Management and protection considerations: In northern BC, *E. hageni* lives mainly in lakes used by fishermen and other recreational users. Disturbance by low-level recreation use is probably minimal in most areas studied, at least in the more remote lakes, although shoreline erosion from motorized craft may disturb breeding sites. Further inventory will document more localities close to more intense human activity. More precise knowledge of larval distribution along the shorelines of specific lakes in more-travelled areas would help decision-making regarding the health of *E. hageni* and other lacustrine species. Marina developments, pollution from powerboats, and popular swimming beaches all have potential impact on larval survival in these areas. Riparian forest damage by logging is also a potential disturbance.

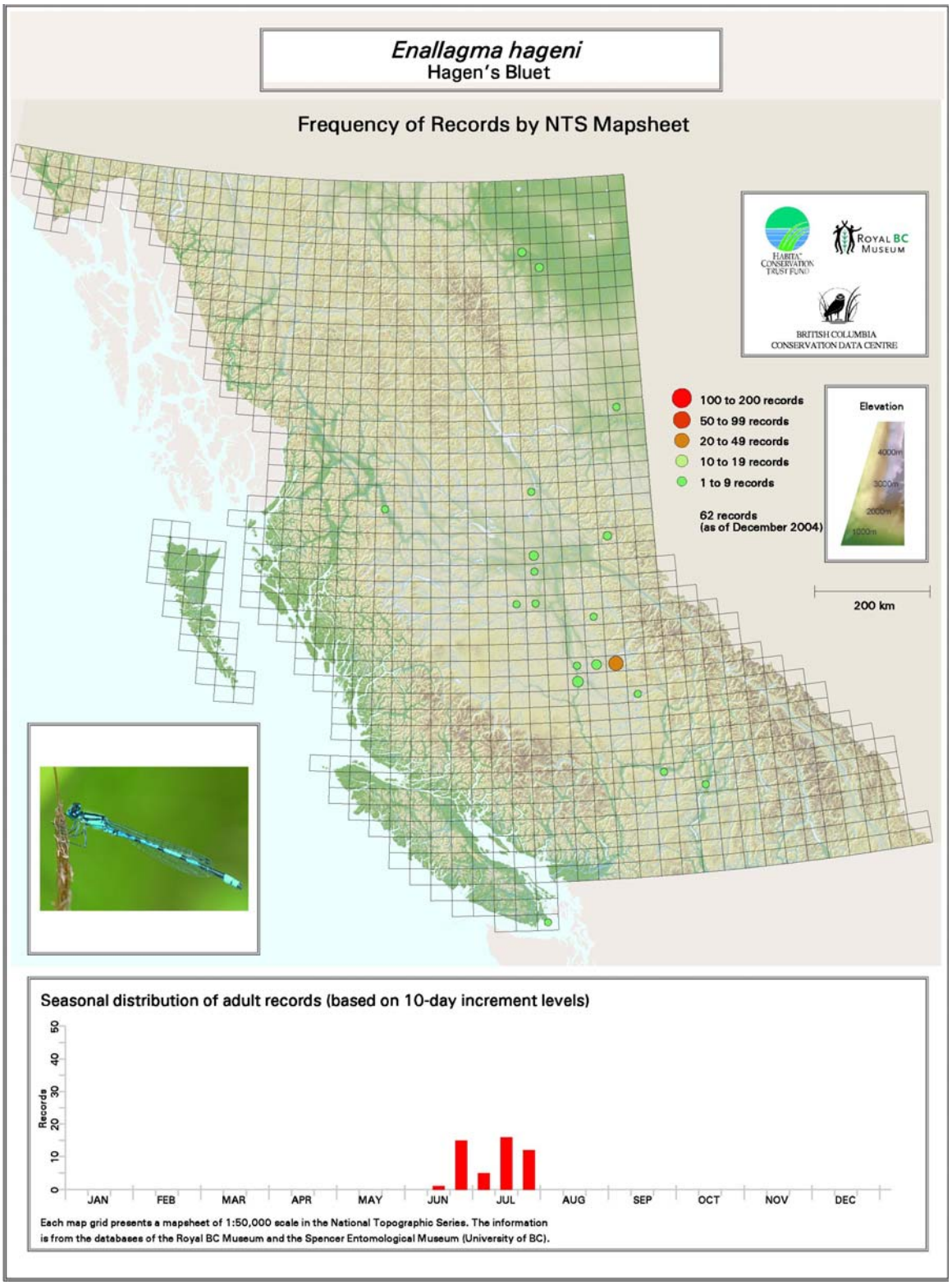
Enallagma hageni male. Photograph: George Doerksen, RBCM



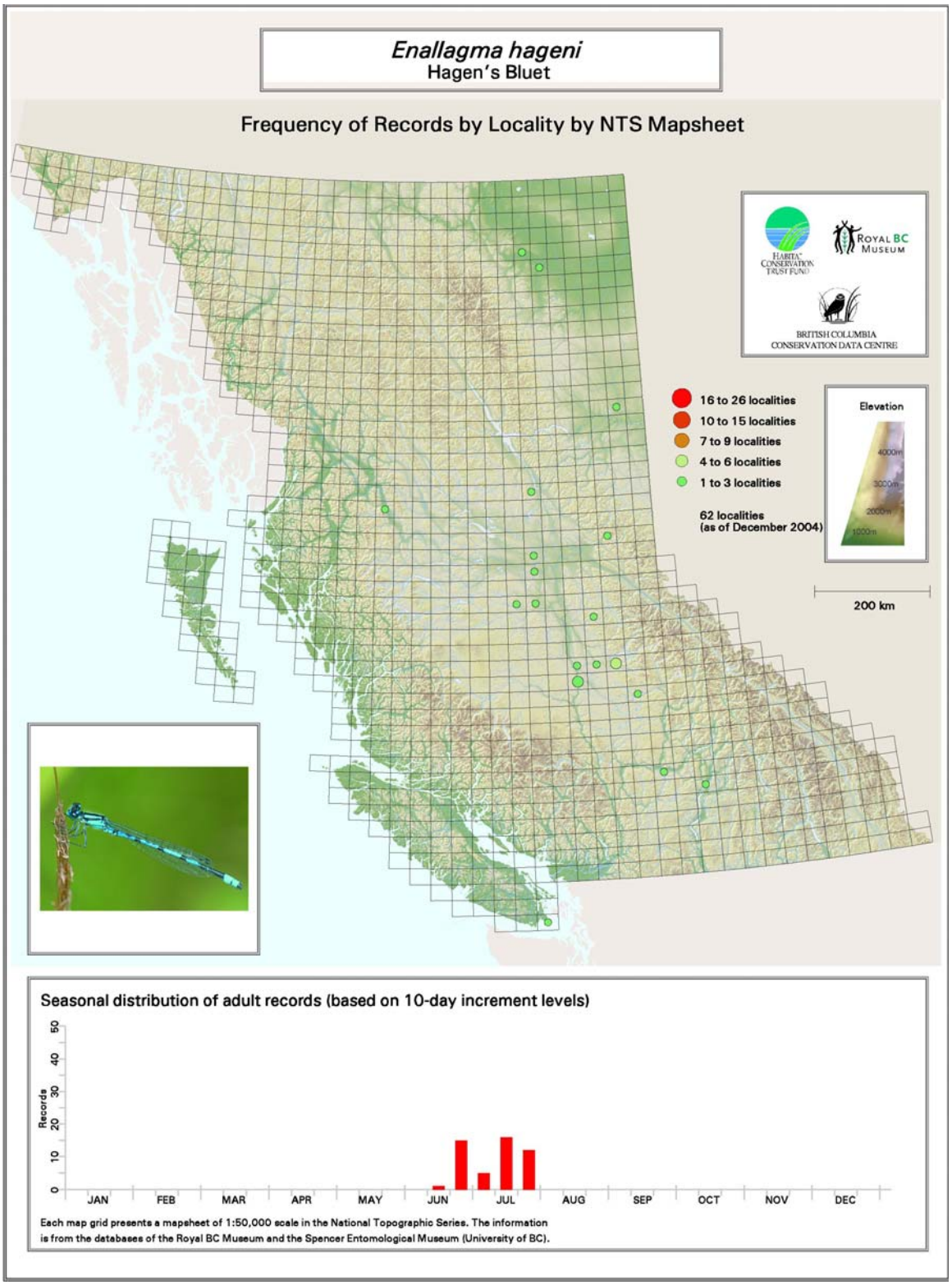
Enallagma hageni Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Enallagma hageni Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Enallagma hageni Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



Enallagma hageni Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Ischnura* (Forktails)**
Found almost everywhere dragonflies live, though mostly absent from boreal habitats; distribution in North America is decidedly southern. BC has four species, but only the two most widespread – *I. cervula* and *I. perparva* – are encountered often. *I. damula* is strictly northern and *I. erratica* lives only on the south coast. Male forktails in BC are mostly black, blue and green. The abdomen is black above and has a blue tip; the last segment bears a distinct forked projection on top, which gives the group its English name. Females may be the same colour as males or may have a tan, pink or orange thorax when immature; they may darken with extensive pruinescence as they age. Larvae are similar to those of bluets, but the gills usually have long, tapered tips.

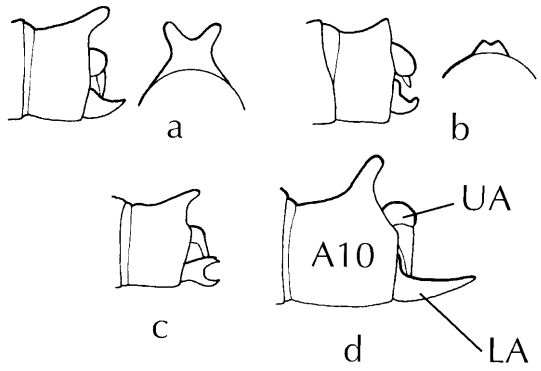
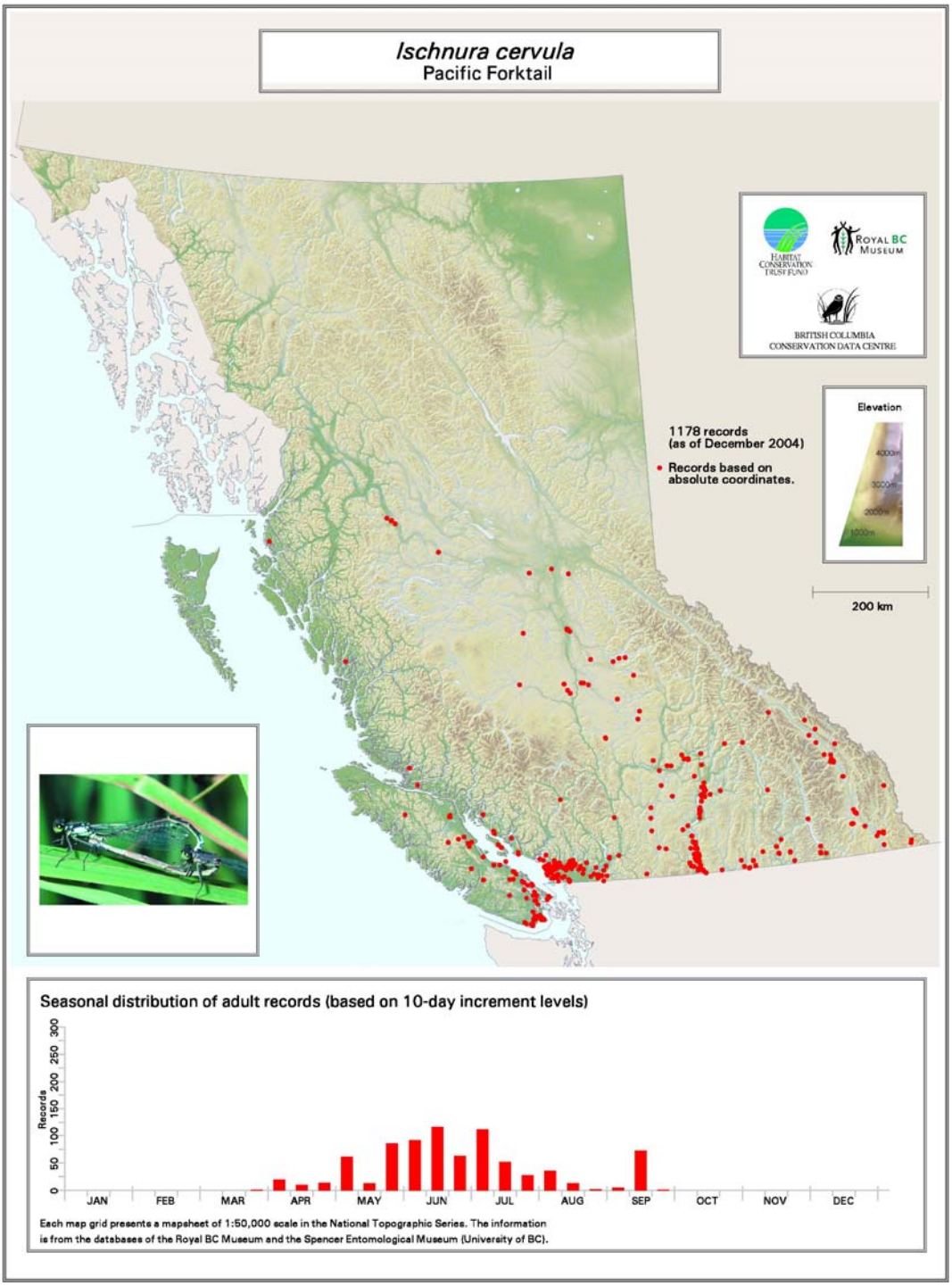


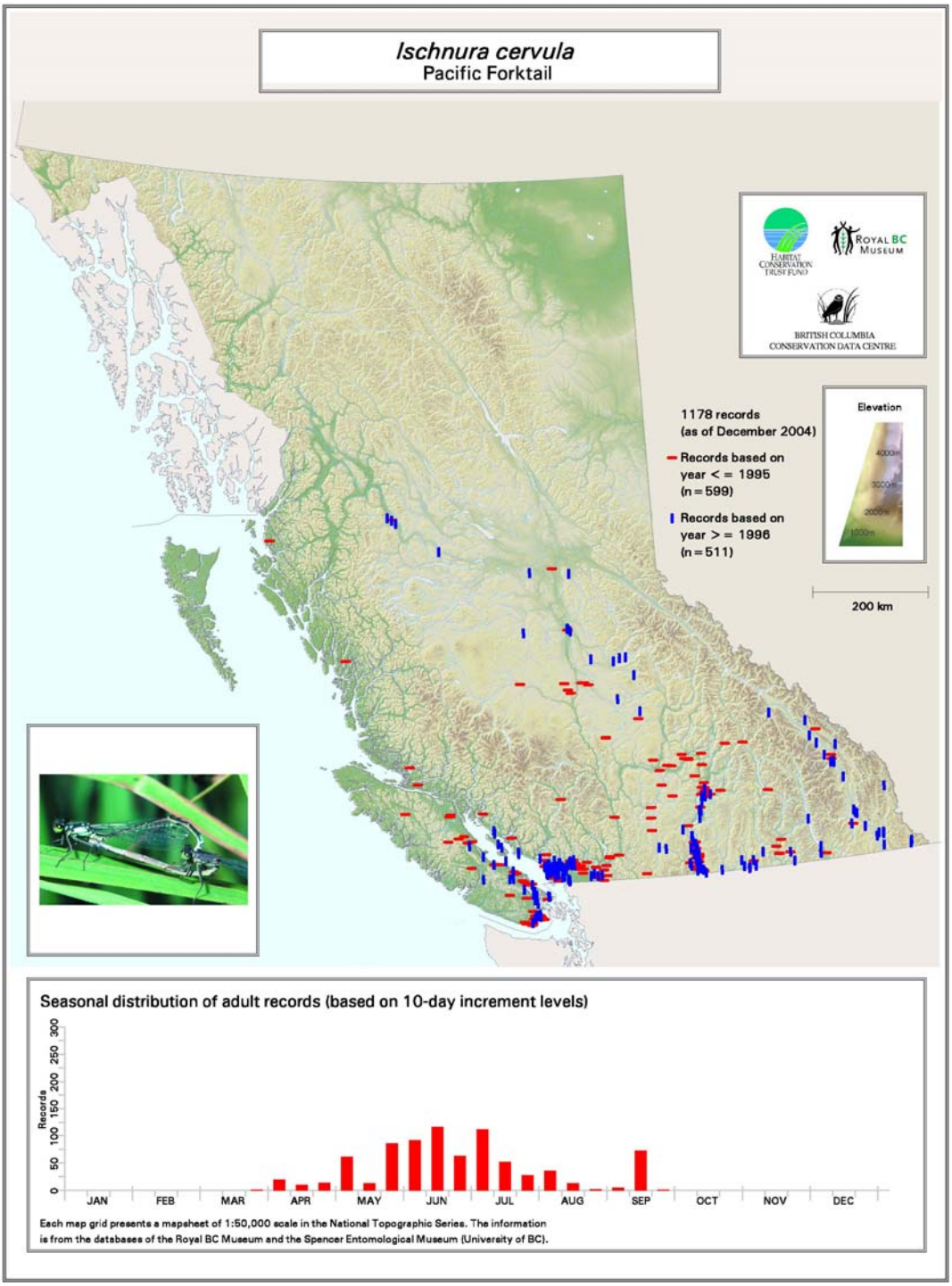
Figure 6. Forktail male appendages, side view; in a and b, the hind view of the top of abdominal segment 10 is on the right: a, Pacific; b, Plains; c, Western; d, Swift. A10 = abdominal segment 10; UA, LA = upper, lower appendages.

***Ischnura cervula* (Pacific Forktail)**
BC conservation rank: S5. Yellow List.
Description: Male's thorax has blue sides and a black top with two pairs of pale dots; appendages, fig. 6a. Female's thorax is sometimes coloured like the male's (dots elongated), but more often green or tan to pink with dark lines of variable thickness above; the abdomen has a blue tip. Most females darken with age; they often have a vulvar spine. Length: male 29 mm, female 30 mm.
Global Range: British Columbia and Alberta south to New Mexico and Baja California (Westfall and May 1996). Faunal element: Cordilleran (see Appendix 3).
BC Distribution: Widespread in the southern half of the province to about 55°N (BulkleyValley)
Biology: One of the most common damselflies of low and moderate elevations across southern BC. Most common around marshes and the marshy edges of small lakes and ponds (Wm01-02, Wm04-06); the only dragonfly that often flies among dense cattails and bulrushes. Prefers neutral and alkaline waters. It has one of the longest flight seasons of any dragonfly in BC, and is usually one of the first to appear in spring.
BC flight period: early April to late October; most records are from mid May to mid August.

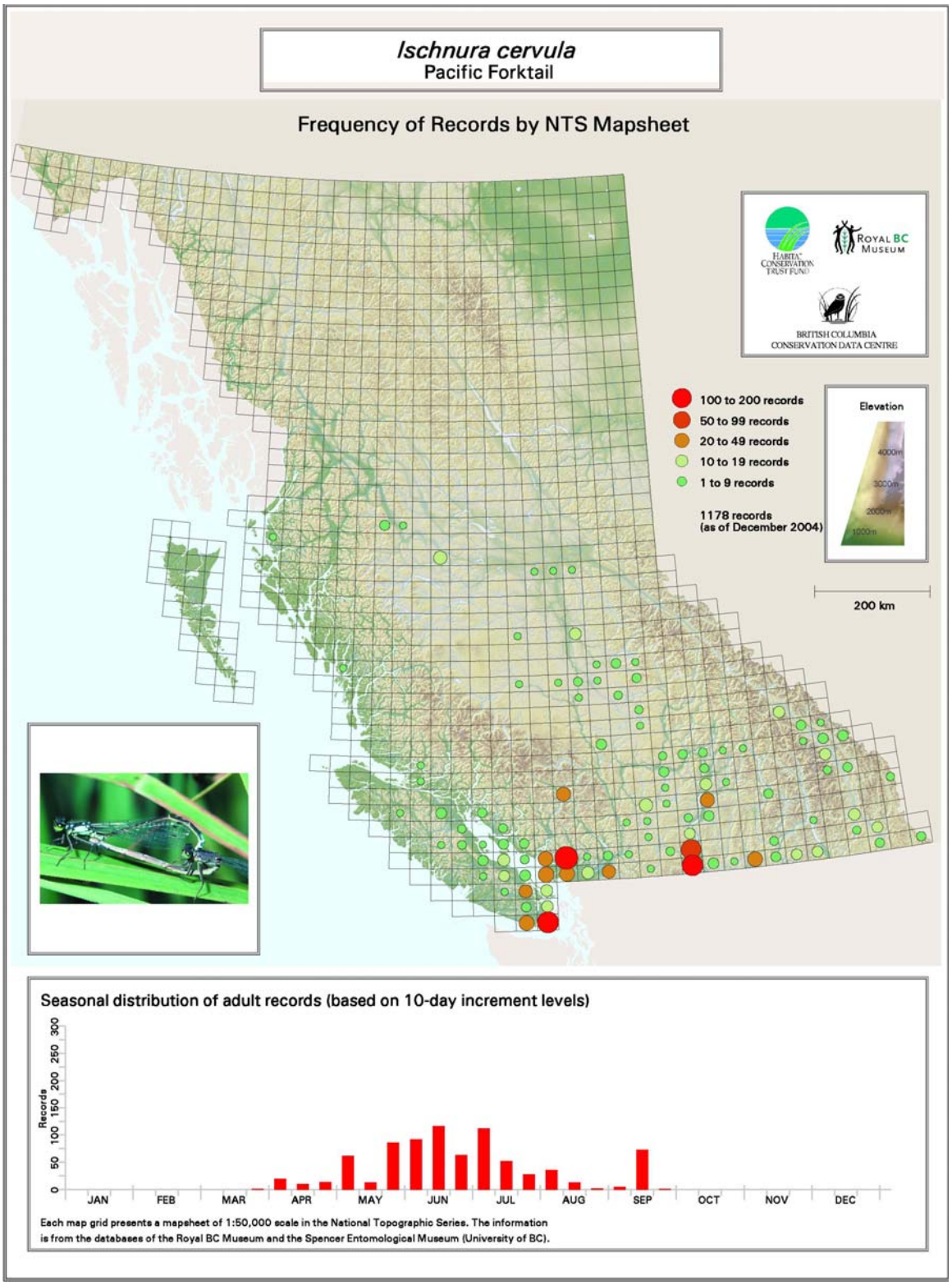
Ischnura cervula mating. Photograph: George Doerksen, RBCM



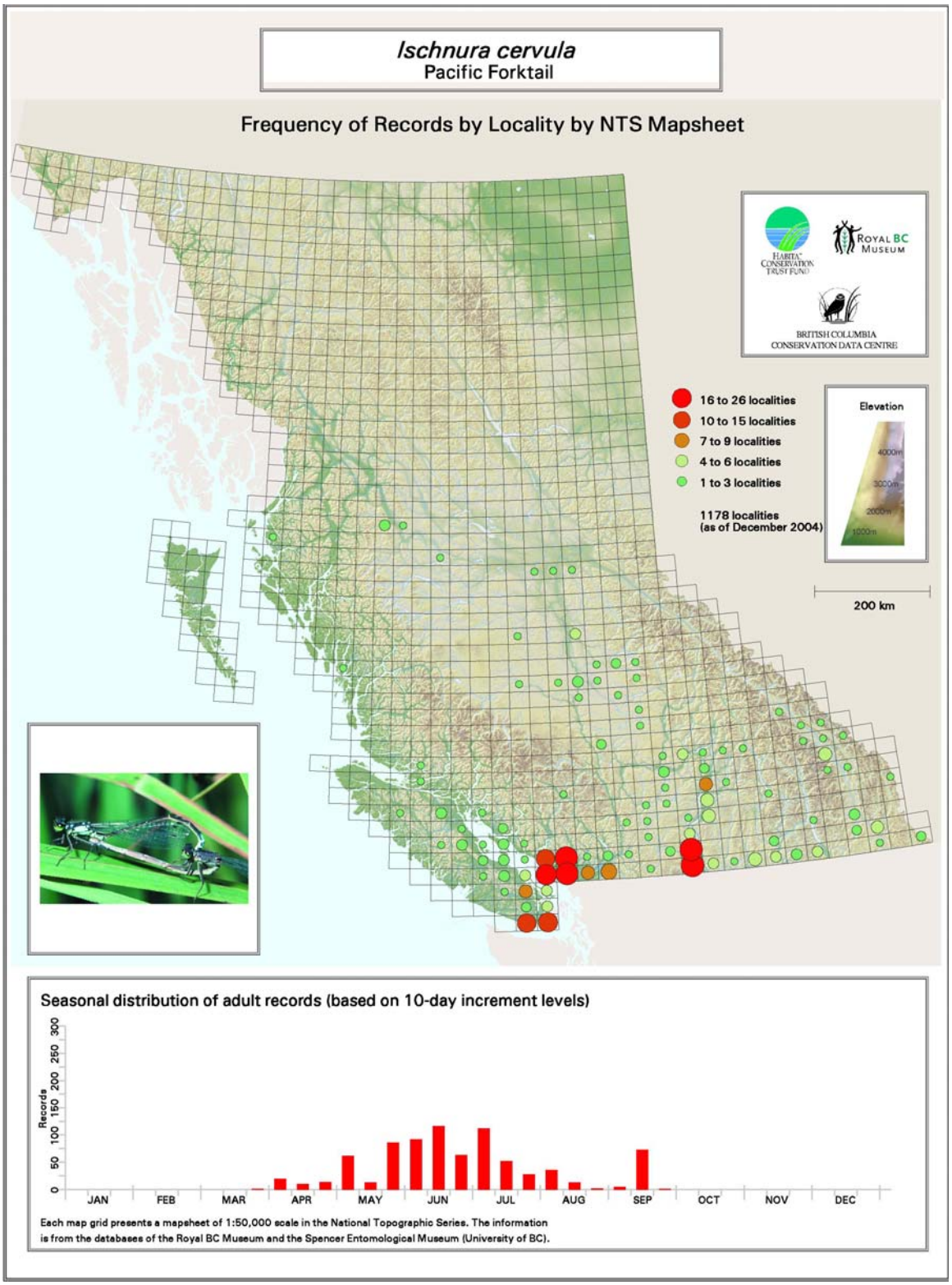
Ischnura cervula Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Ischnura cervula Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Ischnura cervula Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



Ischnura cervula Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

Ischnura damula* (Plains Forktail)

BC conservation rank: S1. Red List. For a long time known in BC only from Liard River Hot Springs, a rather fragile, though protected site. A second locality in the Kispiox Valley was recorded in 2002, but we have retained the S1 rank.

Description: Male's coloration is like that of *I. cervula*; appendages, fig. 6b. Female's thorax is often similar to the males, or has pale spots on top joined into stripes; it may also be tan to pink. The abdomen's tip is blue. Females are less prone than *I. cervula* to darken with pruinescence; they have a vulvar spine. Length: male 28 mm, female 27 mm.

Global Range: British Columbia and Yukon east to Manitoba, south to Texas and Arizona (Westfall and May 1996). Faunal element: Western (see Appendix 3).

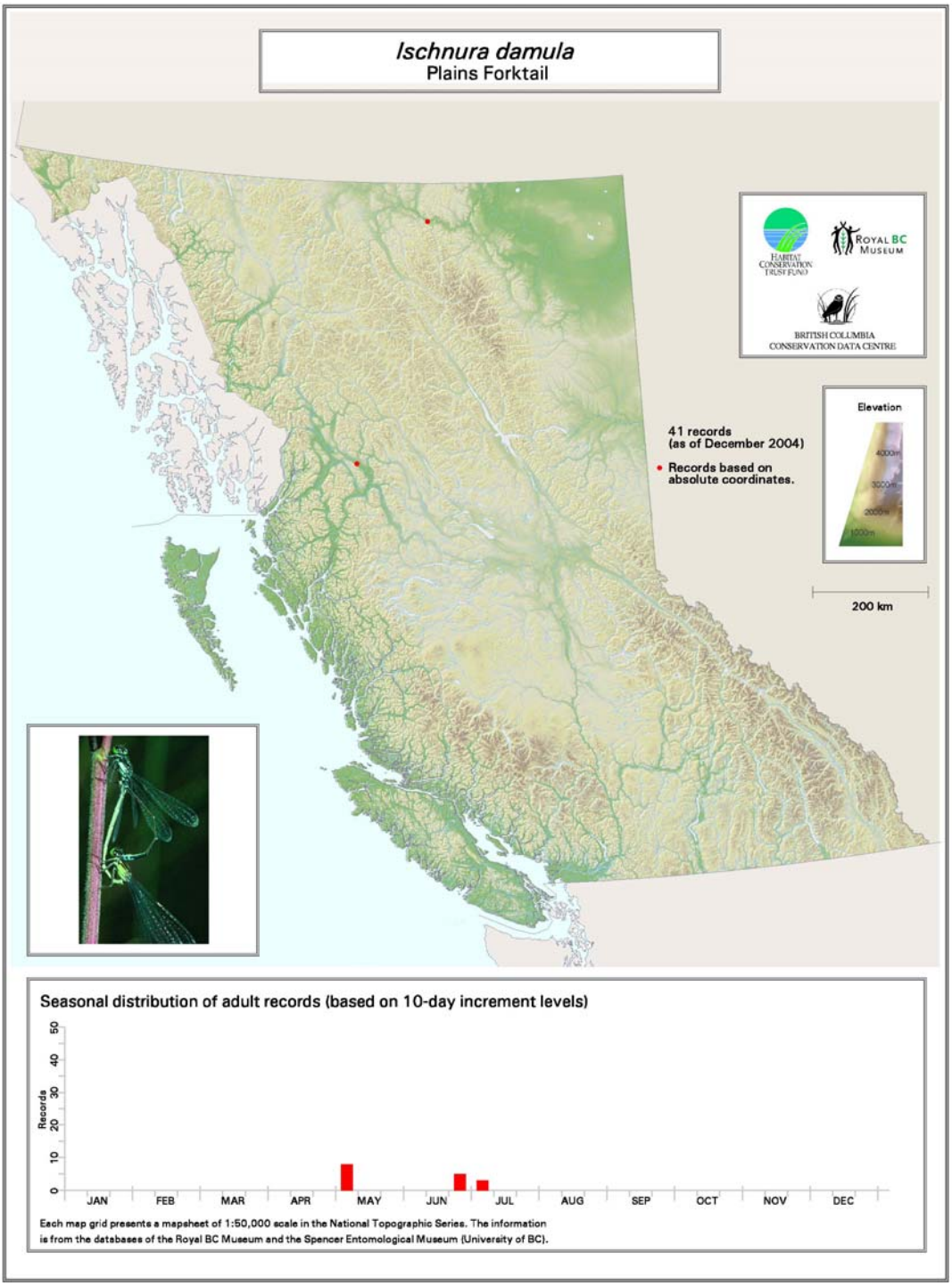
BC Distribution: In BC, found at Liard River Hot Springs on the Alaska Highway and at Elizabeth Lake in the Kispiox Valley.

Biology: The isolated population at Liard River Hot Springs is probably a relic of a more widespread distribution during the warm climatic period (Hypsithermal) about 6000 years ago. The recently collected, first Yukon specimens are also from warm springs. In Alberta, some *I. damula* localities are warmed by power plants, which mimic warm springs (Acorn 2004). Other sites are natural, non-spring habitats. At the second BC site in the Kispiox Valley specimens were not apparently associated with warm springs. Expected site associations are Wm01-02, Wm04, Wf01. Closely related to *I. cervula* and similar in appearance, but in BC, the ranges of the two species do not overlap.

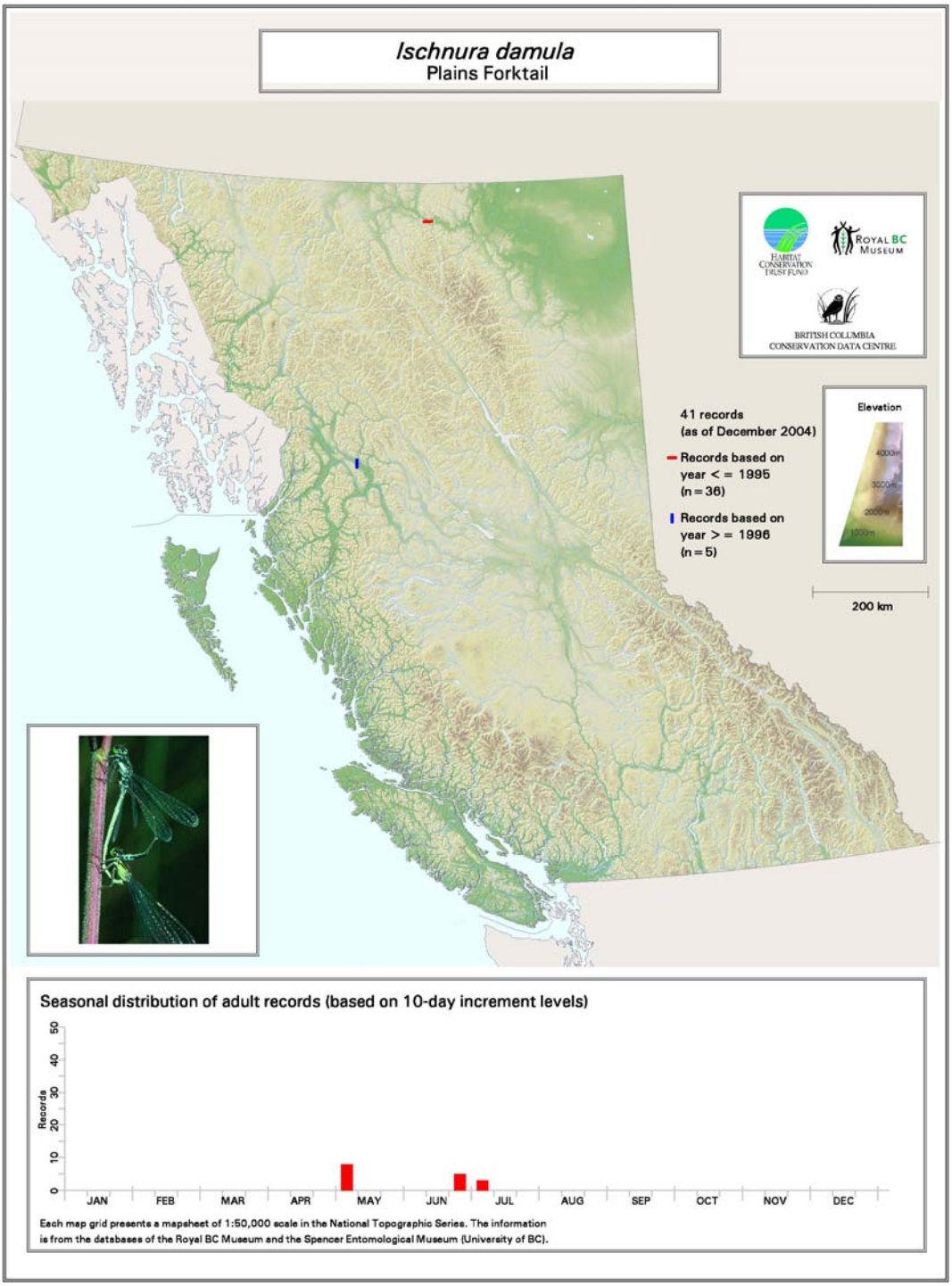
BC flight period: mid May to mid August; all records are from mid May to mid July.

Management and protection considerations: Liard River Hot Springs is protected as a provincial park, although any plans to modify the water flows (any more than they already are) for bathing purposes should be carefully considered in light of the rare flora and fauna present. The site often gets significant tourist traffic but boardwalks on some trails protect the habitat somewhat from trampling. Better population estimates of the damselfly at the springs are required. The site at Elizabeth Lake is a Ministry of Forests recreational site and campground; it is mostly used by fishermen. The exact breeding place was not discovered, but this and the size of the population should be clarified. The habitat should be noted as vulnerable by the managers of the site. Further inventory in the Northeast and central BC plateaus, especially at warm springs, should be undertaken to expand our knowledge of the species distribution.

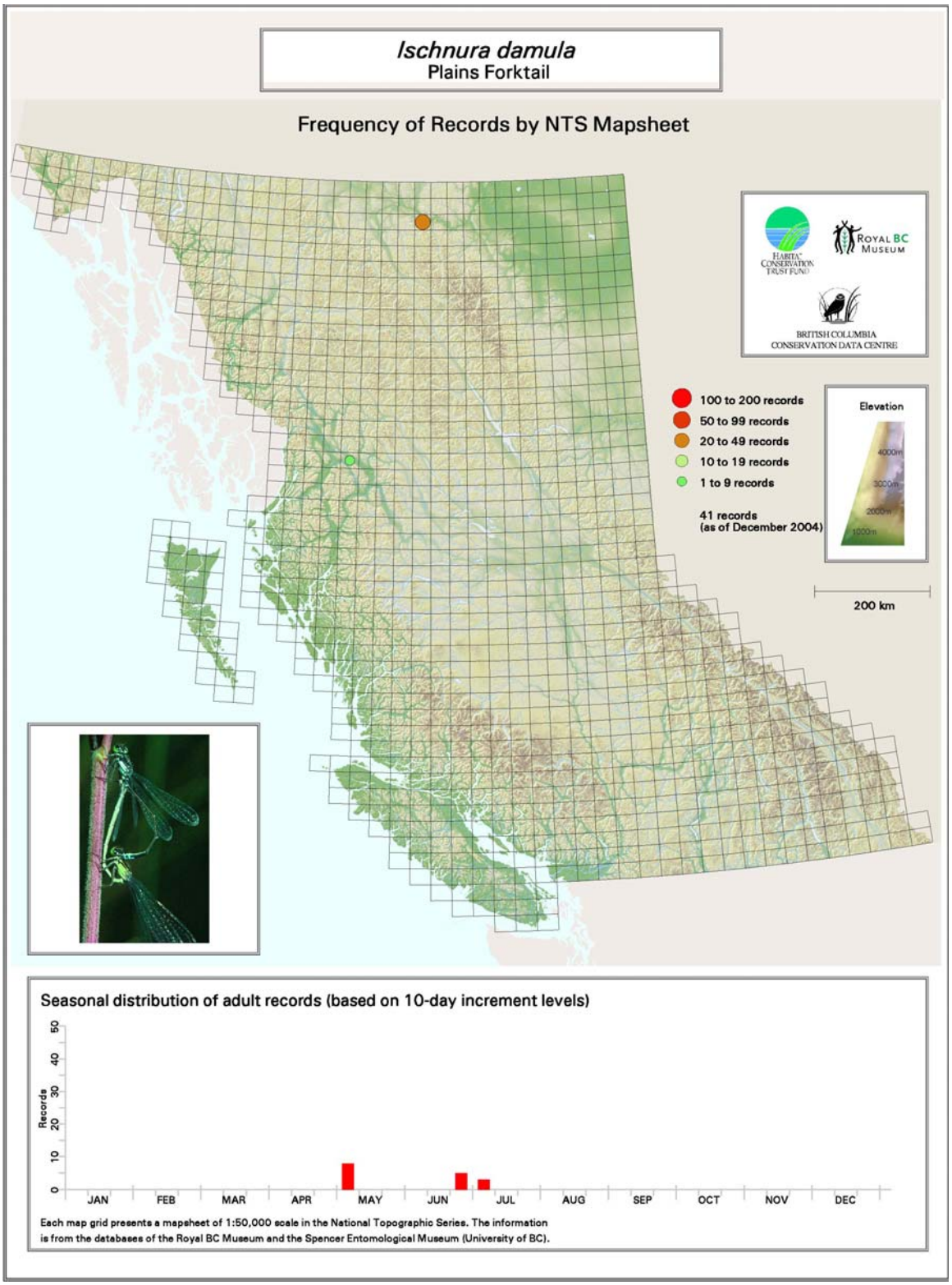
Ischnura damula male. Photograph: George Doerksen, RBCM



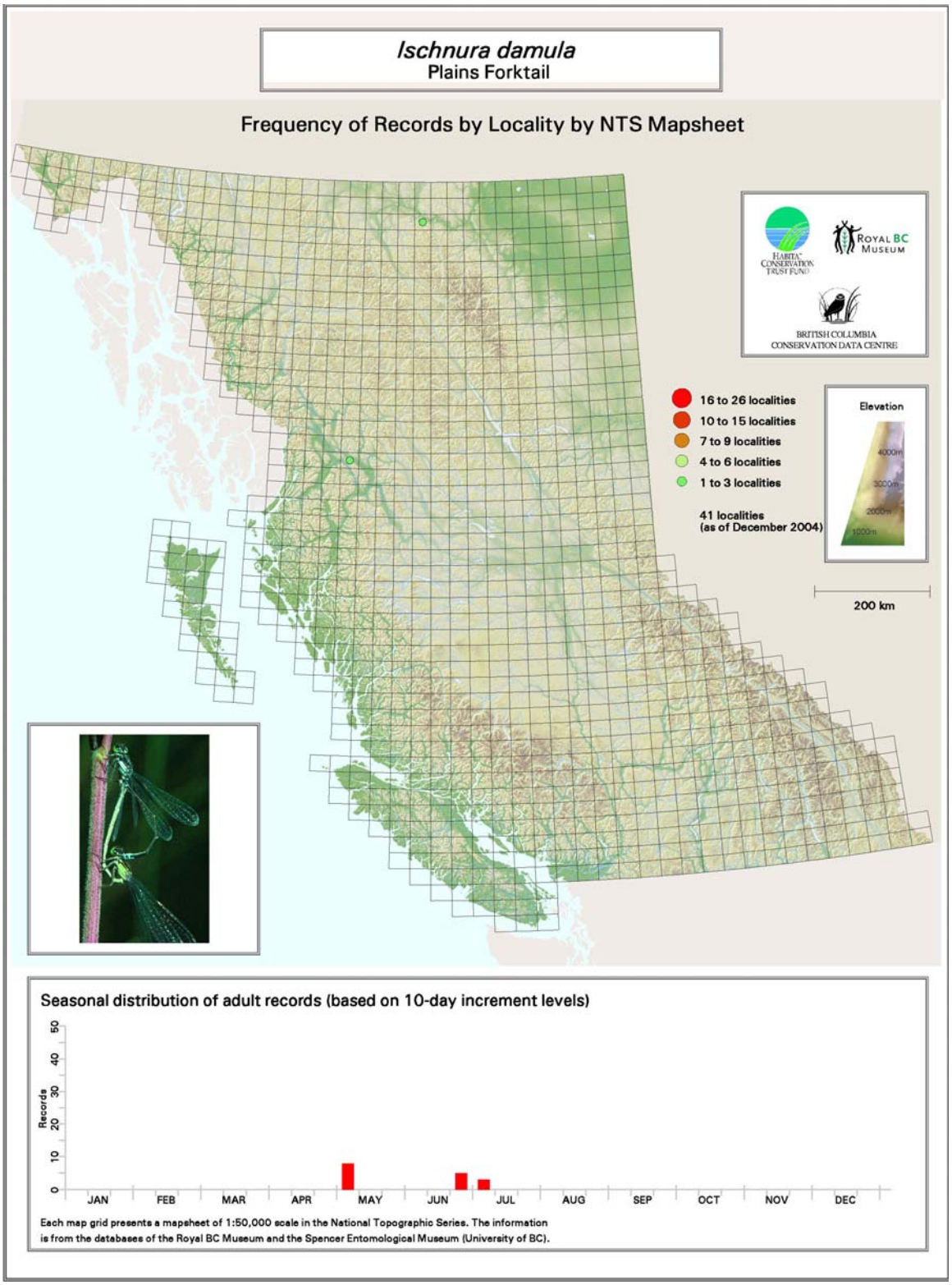
Ischnura damula Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Ischnura damula Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



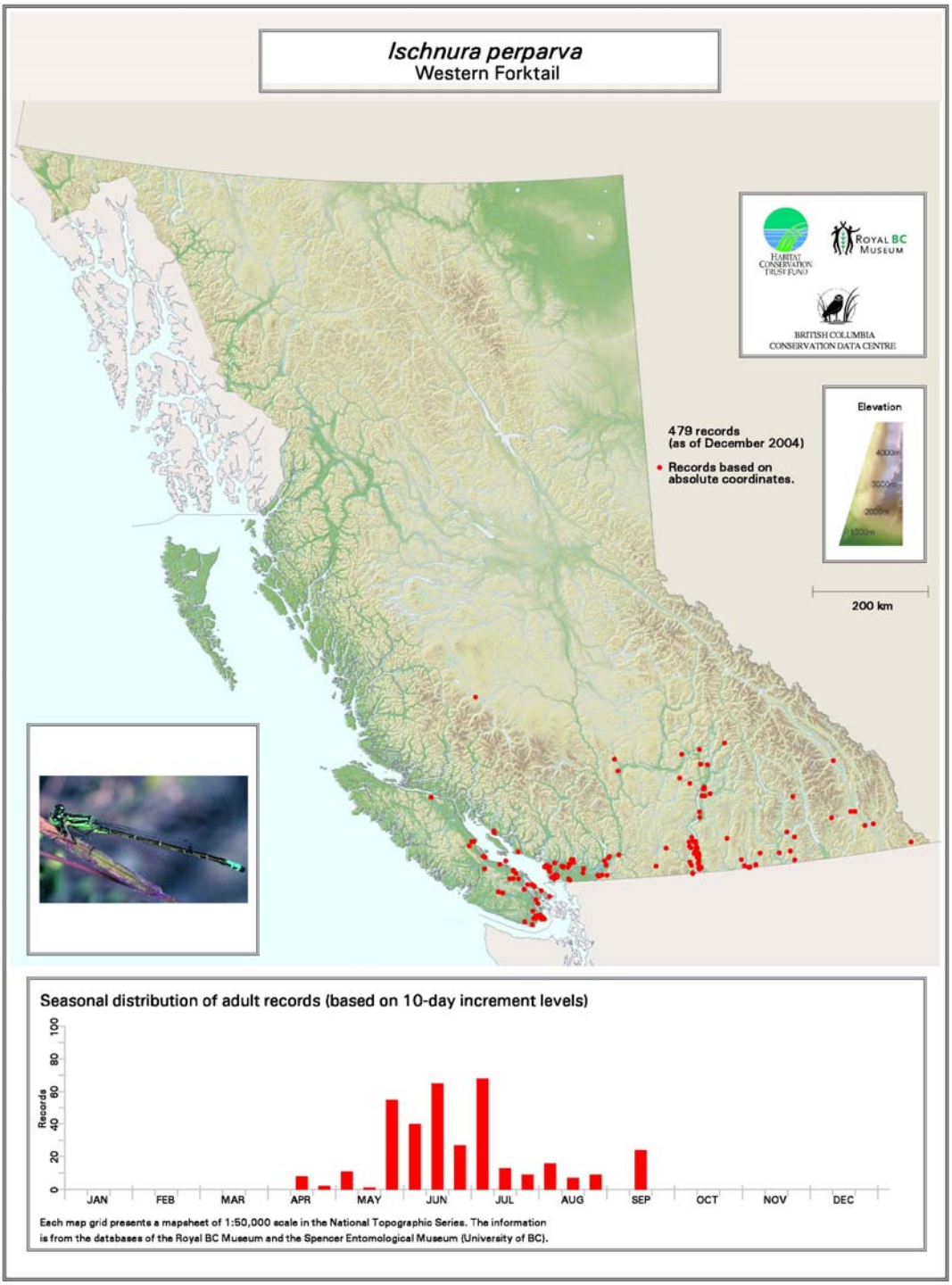
Ischnura damula Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



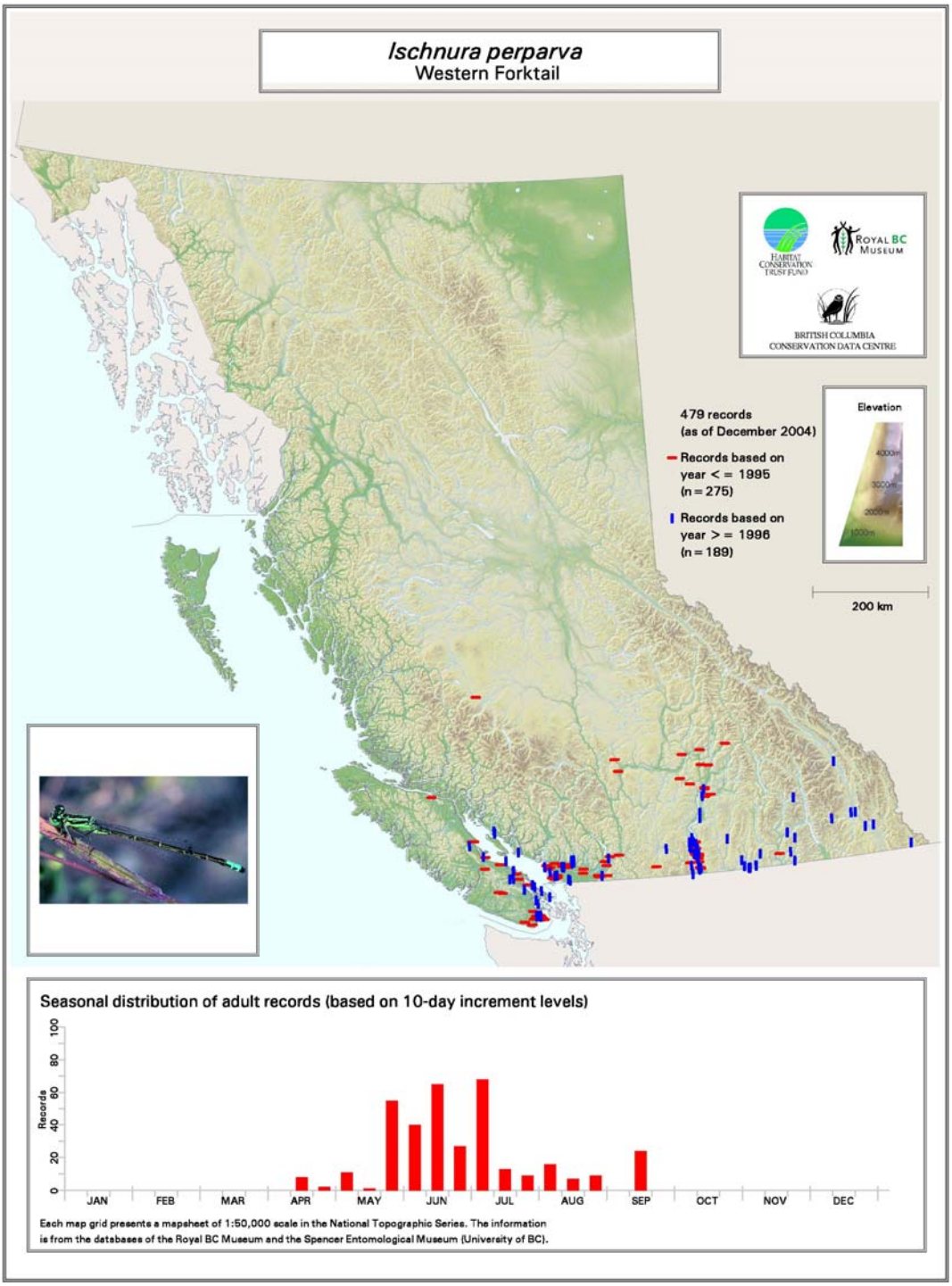
Ischnura damula Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Ischnura perparva* (Western Forktail)**
BC conservation rank: S5. Yellow List.
Description: Our smallest forktail. Male's thorax has green sides, and a dark top with green stripes; appendages fig 6.c. Immature female's thorax has orange sides and stripes on top; the abdomen is black with an orange base. Mature female's pale areas darken to olive, but eventually, the whole body is covered by grey-white pruinescence. Females have no vulvar spine. Length: male 26 mm, female 27 mm.
Global Range: British Columbia east to Manitoba, south to Oklahoma, New Mexico and California (Westfall and May 1996). Faunal element: Western (see Appendix 3).
BC Distribution: Southern third of BC to about 52°N, but mostly in the southern valleys south of 51ºN. The sole record in the northern study area is from Kleena Kleene in the western Chilcotin.
Biology: Common at low and moderate elevations, but generally less common than *I. cervula*. Inhabits ponds and marshy lakeshores (Wm01-02, Wm04-06), and is more common in slowly flowing streams than *I. cervula*. The stocky little females lay eggs alone, their pruinose bodies and green eyes making them easy to identify.
BC flight period: late April to early October; most records range from early June to late August.

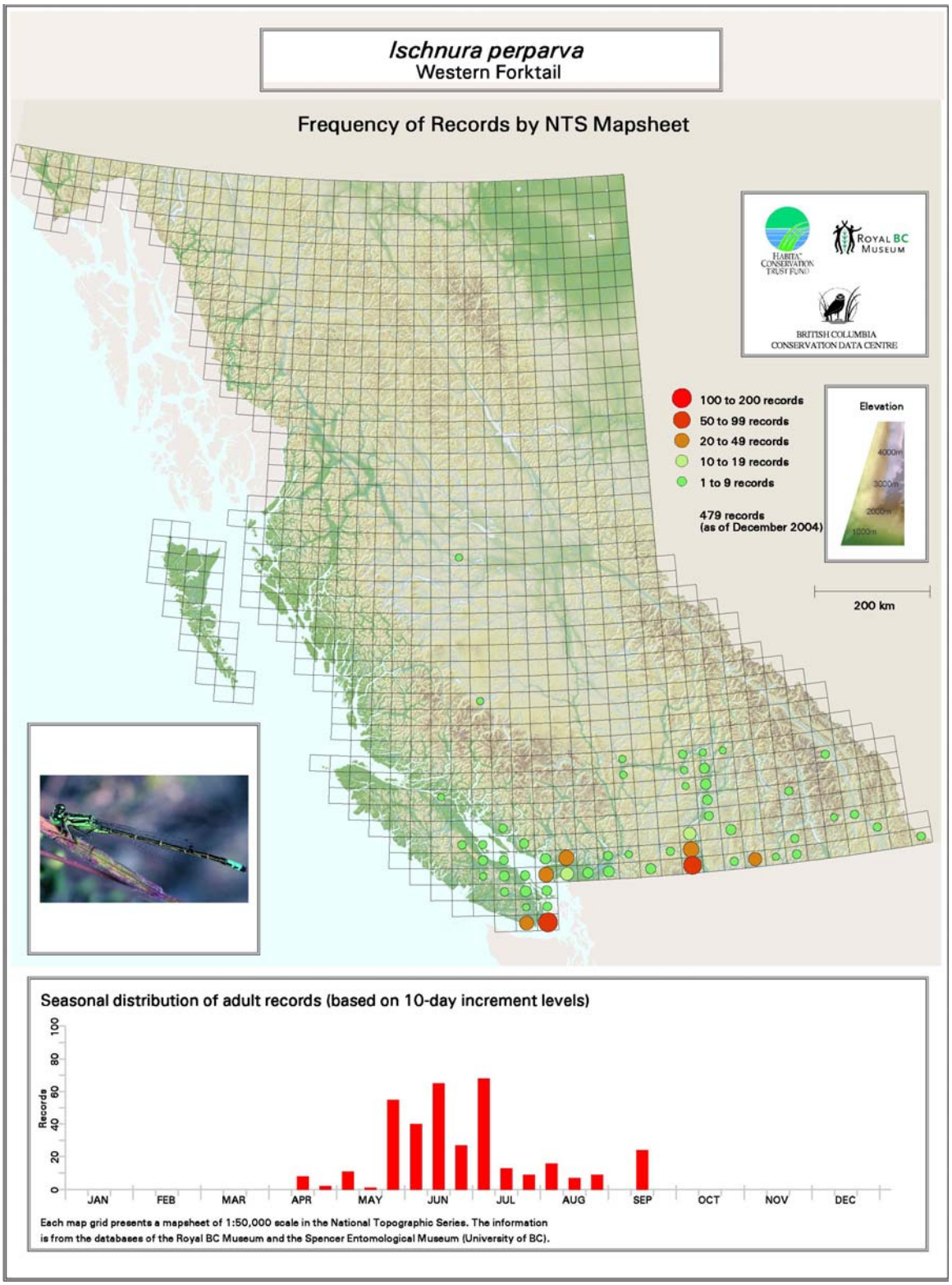
Ischnura perparva male. Photograph: George Doerksen, RBCM



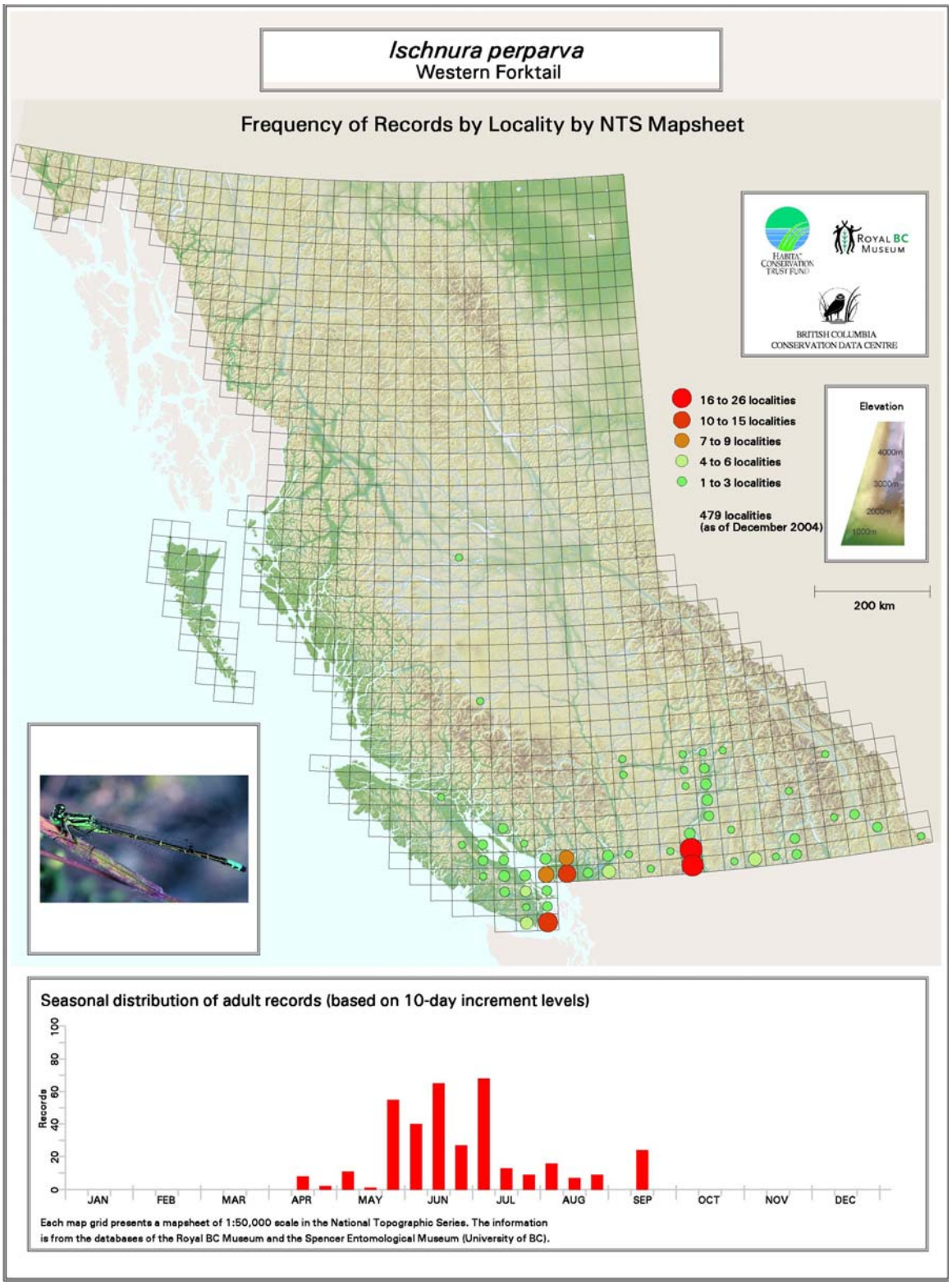
Ischnura perparva Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Ischnura perparva Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Ischnura perparva Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.

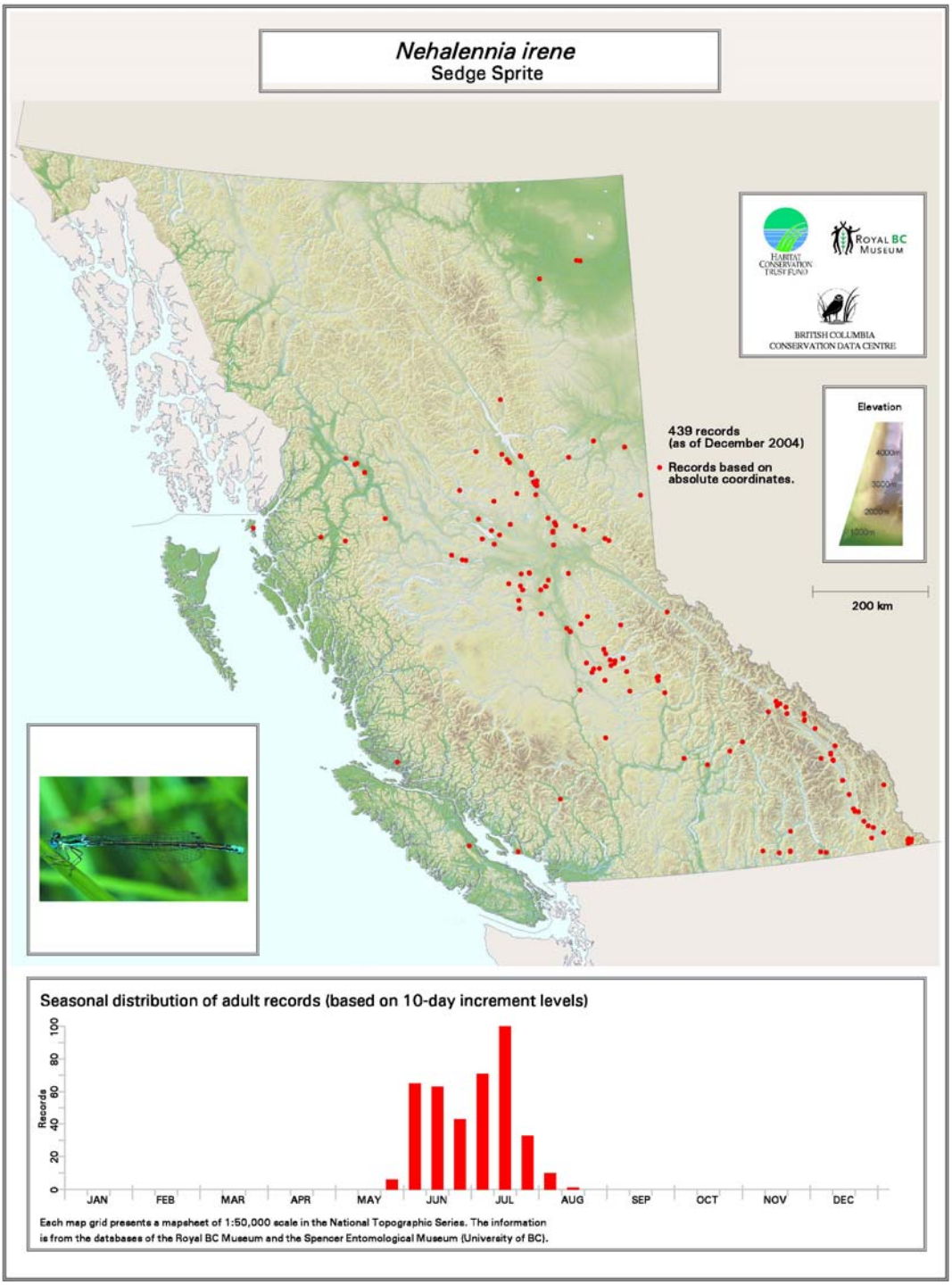


Ischnura perparva Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

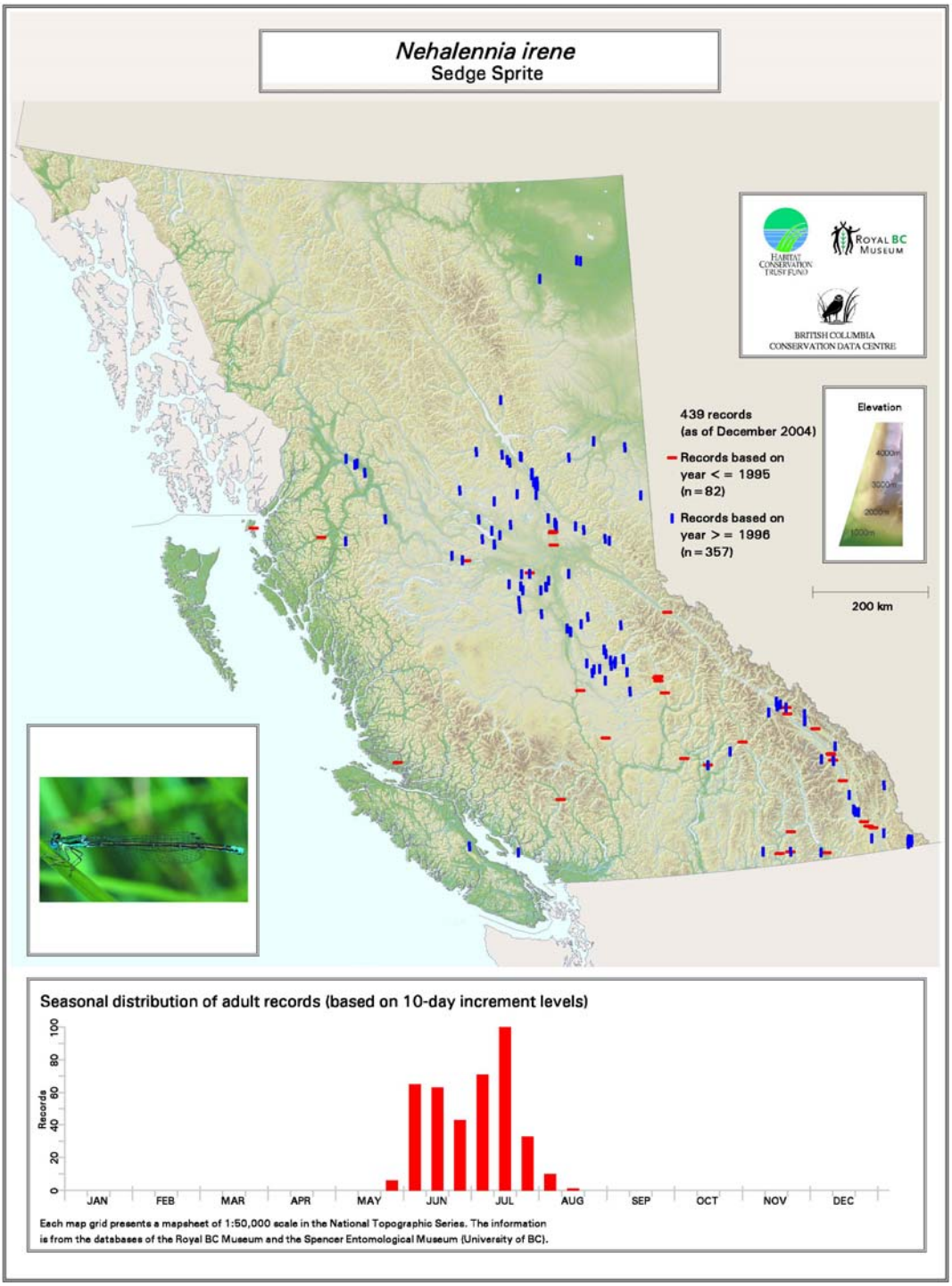
***Nehalennia* (Sprites)**
Small and delicate damselflies; five species live in the Americas and just one in Eurasia. The two Canadian species, unlike any others in the pond damsel family, are completely metallic green on top of the thorax; they also lack the pale spots behind the eyes that are common in many other members of the family.

***Nehalennia irene* (Sedge Sprite)**
BC conservation rank: S5. Yellow List. Changed from S4 to S5 in 2000 after northern surveys found it in many localities.
Description: The smallest and most delicate damselfly in BC. The abdomen is dark with a blue tip; the top of the thorax is metallic green. Length: male 26 mm, female 27 mm.
Global Range: British Columbia east to Newfoundland; south to South Carolina, Iowa, Wyoming and California (Westfall and May 1996). Faunal element: Southern Boreal (see Appendix 3).
BC Distribution: Widespread in the interior, north to the Yukon, but not recorded in the Northwest north of the Nass river. Rare on the coast.
Biology: Inconspicuous but common in suitable habitat; flies weakly in dense grasses and sedges. Most abundant in sedge meadows and lakes bordered by sedges (Wm01-02, Wm04; Wf01, 05-06). While laying eggs in floating plants, the female perches horizontally and the male, clasping her thorax with the tip of his abdomen, holds himself stiffly at a 45° angle.
BC flight period: late May to mid September; almost all records are from mid June to mid August.

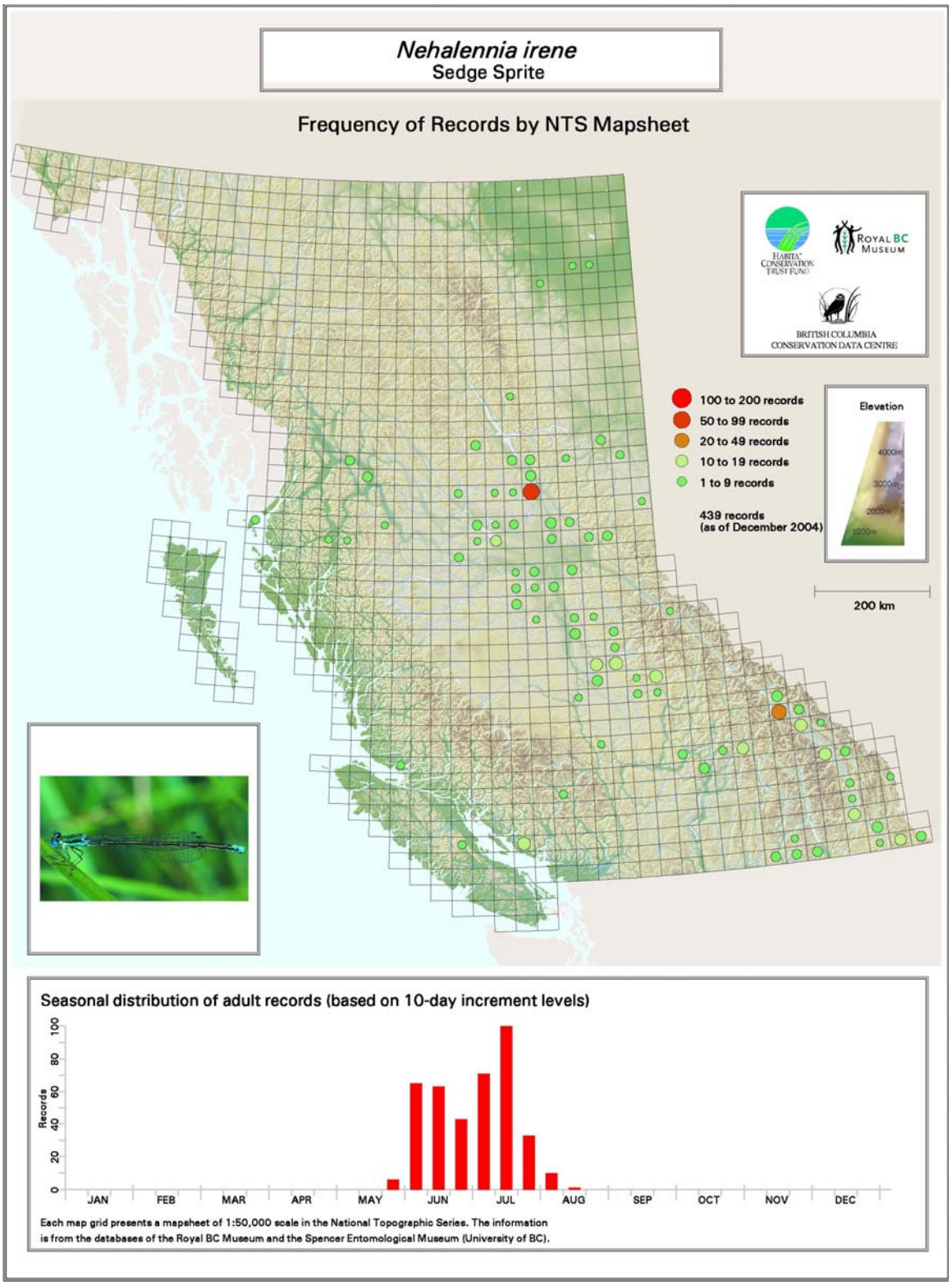
Nehalennia irene male. Photograph: George Doerksen. RBCM



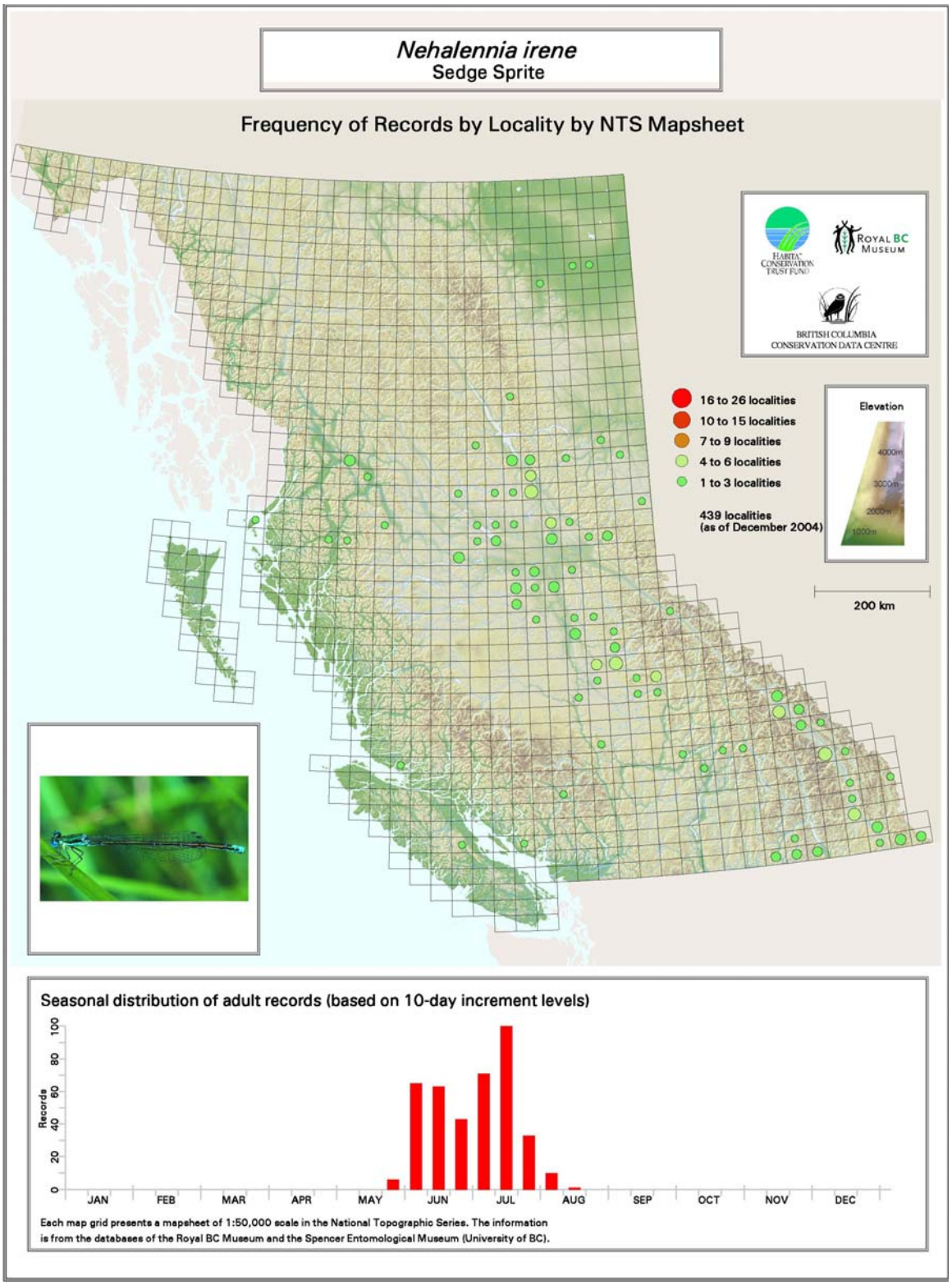
Nehalennia irene Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Nehalennia irene Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Nehalennia irene Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



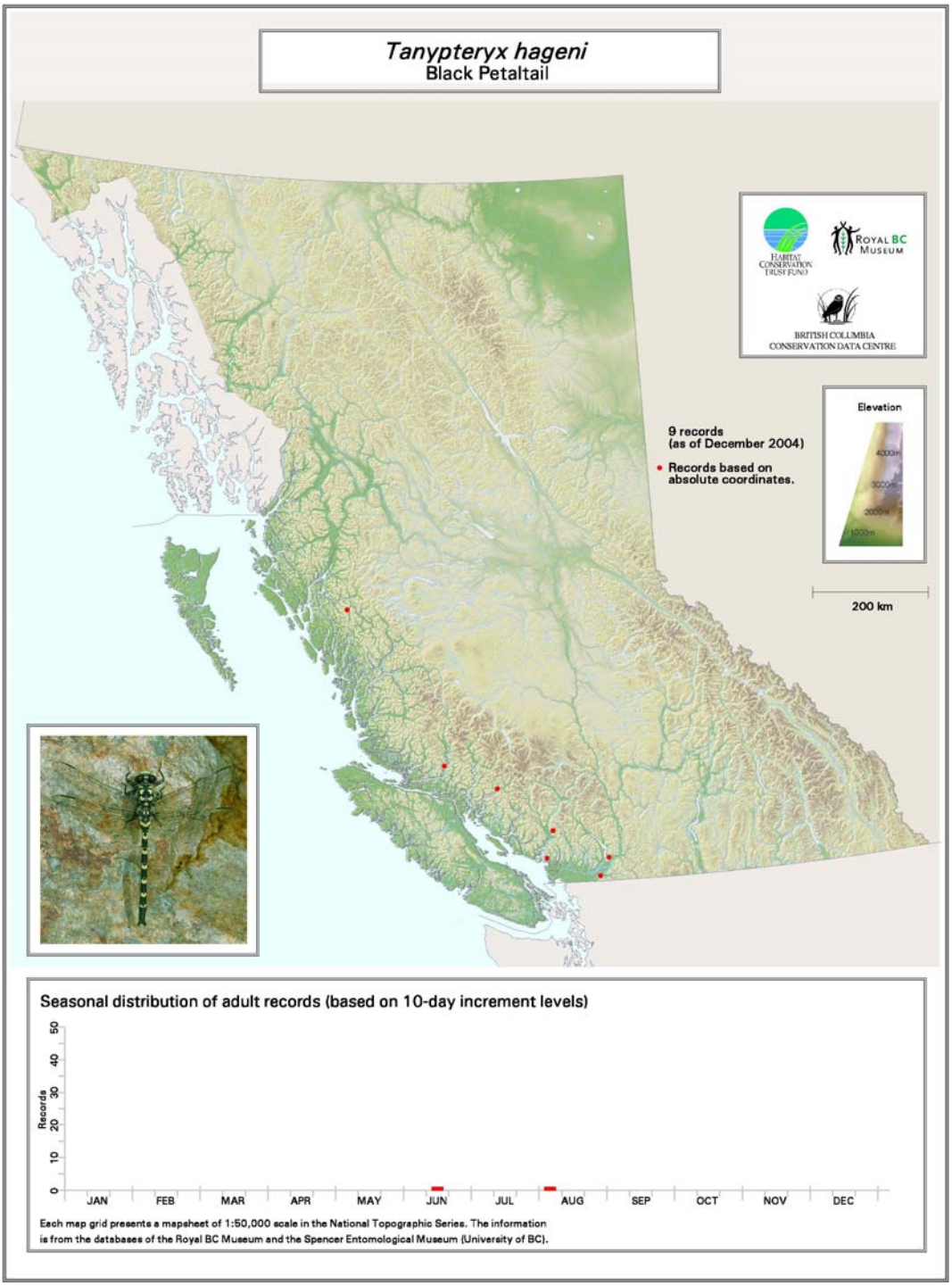
Nehalennia irene Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

Suborder Anisoptera (True Dragonflies)

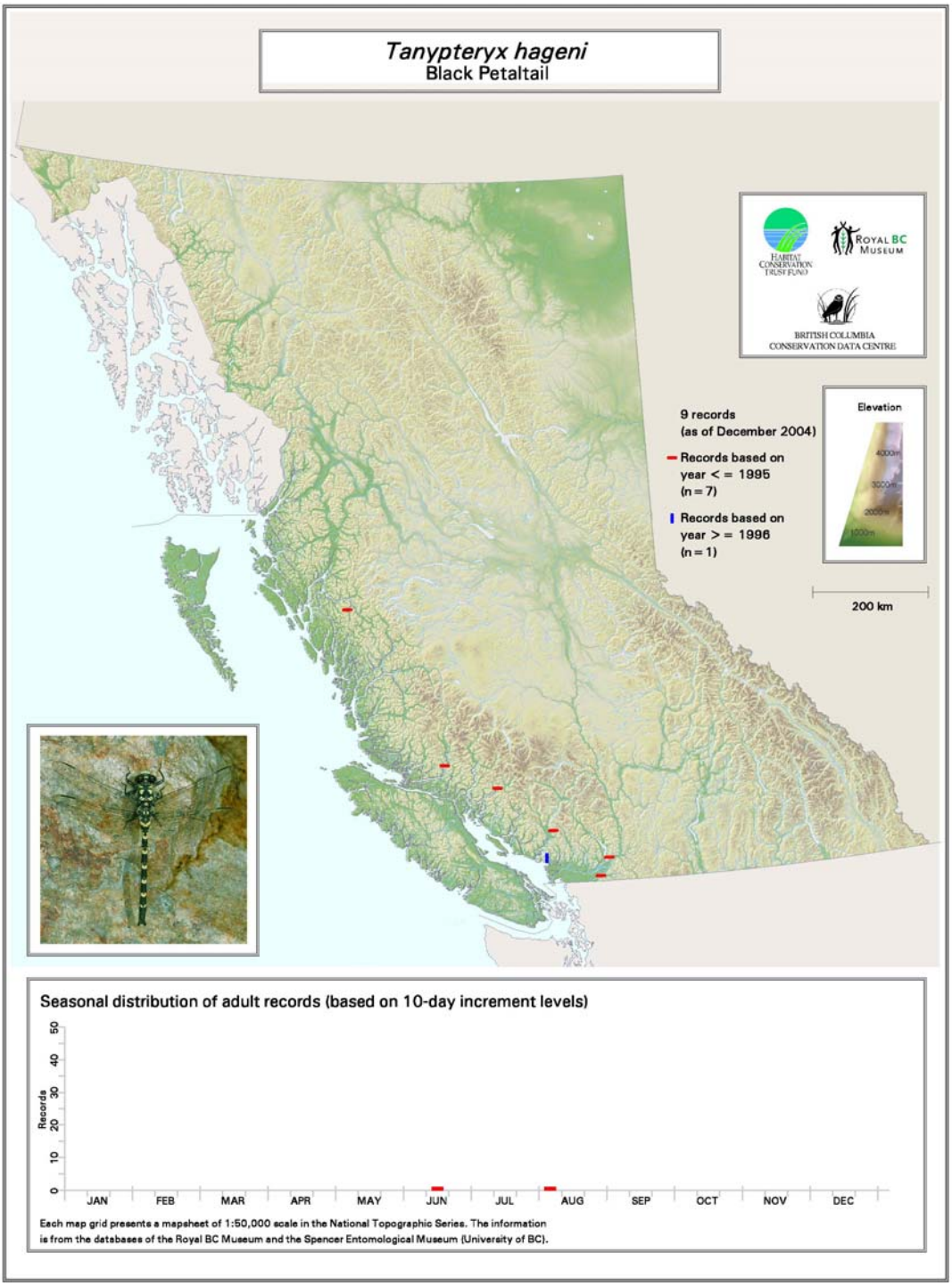
Family Petaluridae (Petaltails)
Abundant fossils show that the petaltails flourished in the Jurassic Period, at least 150 million years ago, well before the landmass that is now BC existed. Today, 11 species persist in widely scattered regions — New Zealand, Australia, Chile, Japan, the Appalachian Mountains and western North America. The eyes of petaltails are separated and the pterostigma is long and narrow; females have an ovipositor. Larvae live where water seeps and trickles over the ground, and many species make burrows; they are amphibious, spending much time out of water.

Tanypteryx hageni* (Black Petaltail)
BC conservation rank: S2S3. Blue List.
Description: The body is black with yellow spots, the face yellow with separated brown eyes. Male's upper appendages are flat and strongly angled outward. Female has a short, curved ovipositor. Length: male 56 mm, female 53 mm.
Global Range: British Columbia south to Nevada and California (Needham *et al*. 2000). Faunal element: Cordilleran (see Appendix 3).
BC Distribution: In Canada, found only on BC's mainland coast north to about 53°N.
Biology: Lives at mid to high elevations in the Cascade and southern Coast mountains, and at sea level on the central coast. Larvae burrow in mud and moss saturated by trickling water seeping from hillsides (e.g., Wf50); many burrows can be concentrated in a small area. Adults perch on tree trunks, logs, rocks and the ground. They can be tame and frequently land on people.
BC flight period: late June to early September; all records range from late June to mid August.
Management and protection considerations: The main conservation concerns for this species are related to development and industrial activity in its subalpine or coastal forest environment. Logging is perhaps the greatest threat; the fragile fen seepage habitats are easily damaged or destroyed. Ski developments in the coastal mountains have potential impacts on the small fen habitats that the larvae inhabit. On the other hand, potentially damaging development such as road construction can provide new breeding microhabitats for the species. For example, the only known larval colony in Canada is in an abandoned logging road cut in Cypress Provincial Park near Vancouver. Once the soil is colonized to some extent by mosses and liverworts, the roadside offers the open, sloping ground and constant water seepage that the species prefers.

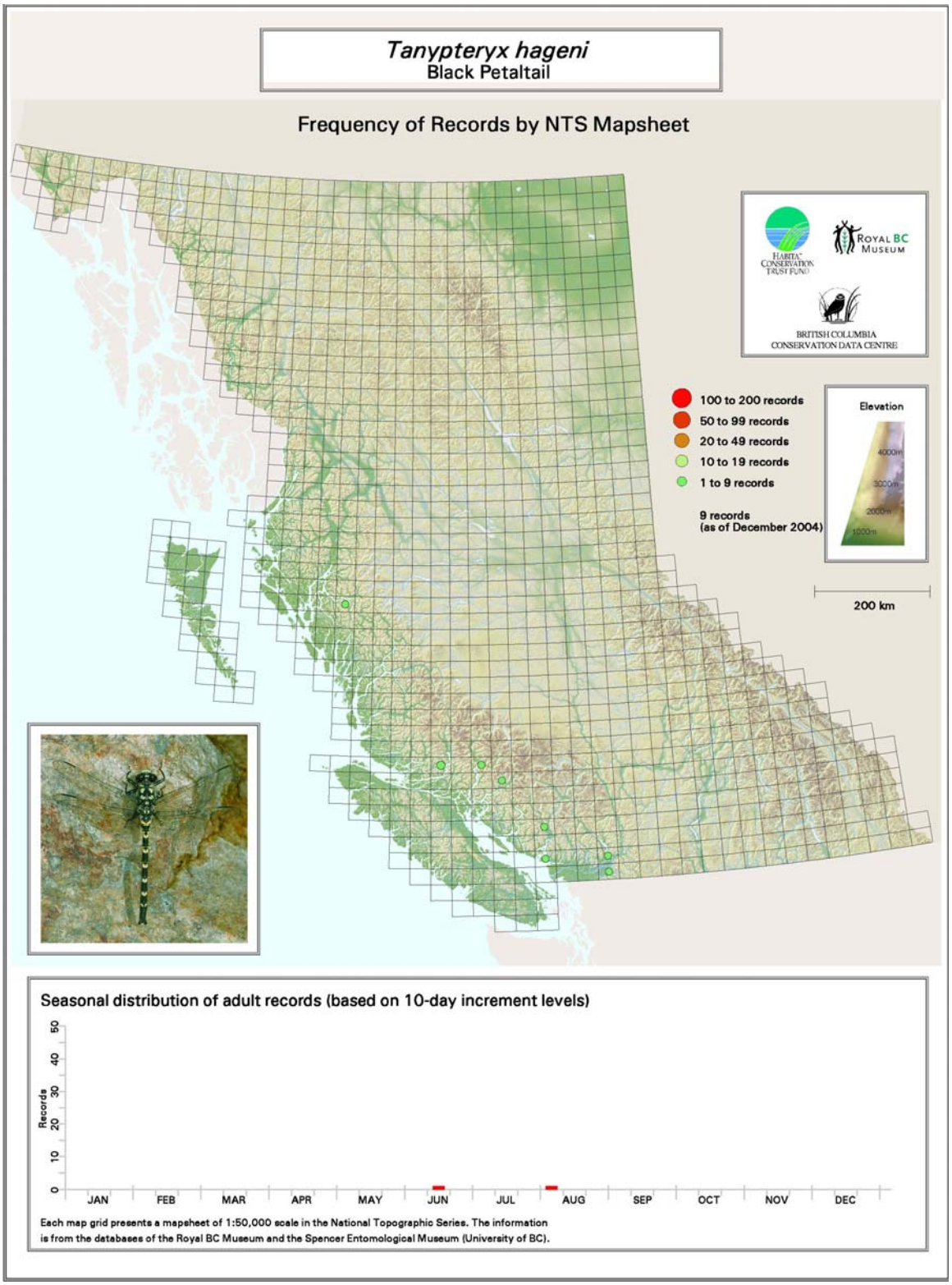
Tanypteryx hageni male. Photograph: Ian Lane



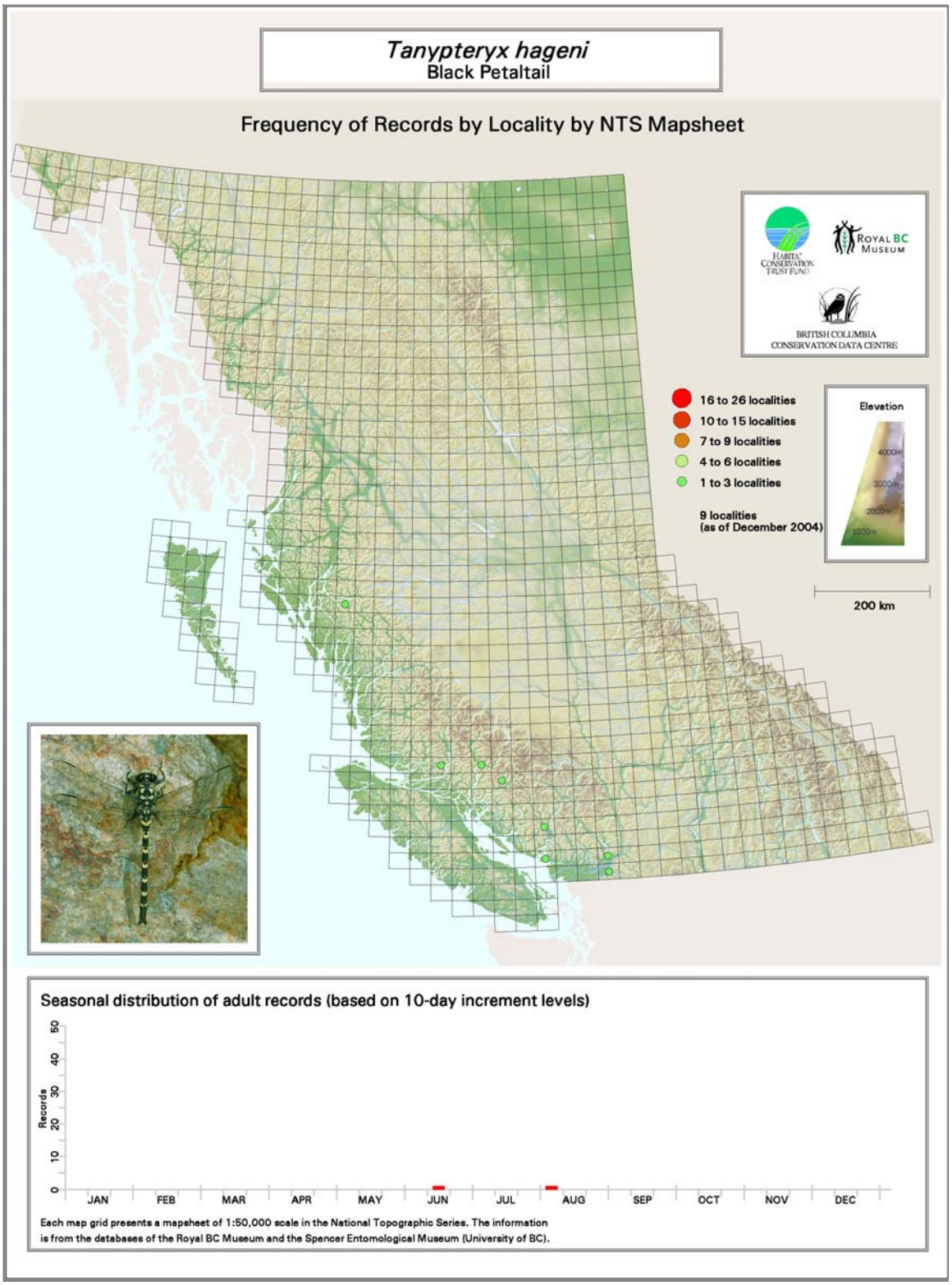
Tanypteryx hageni Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Tanypteryx hageni Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Tanypteryx hageni Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



Tanypteryx hageni Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

Family Aeshnidae (Darners)
Large, swift-flying dragonflies, usually marked with blue, green or yellow. Adults hunt tirelessly for insects over ponds, lakes and streams, and wander widely in search of prey. Most species rest in a vertical position, but a few sit flat on the ground. Females have a prominent ovipositor and lay eggs in water plants or floating wood above or below the water line. Larvae are slender and sleek, with flat labia lacking bristles; they are rapacious hunters among water plants.

***Aeshna* (Mosaic Darners)**
Mosaic Darners are common in BC; they fly everywhere dragonflies are found. Twelve of the 13 BC species are recorded in the North. The only darner not found north of 52º is *A. constricta*, a red-listed species of the southern interior valleys. Aeshna species are large and can usually be distinguished by their variations on a basic colour pattern. Generally, the body is brown, and each side of the thorax has a pair of blue, green or yellow stripes – their shape is important in identification (see fig. 7). Look also for the colour of the face and the line across its middle. Viewed from above, the forehead bears a distinctive T-shaped mark, called the "T-spot" (fig. 8). The abdominal spots on males are usually blue, and on females green, yellow or blue. Male upper appendages come in three types (fig. 9).

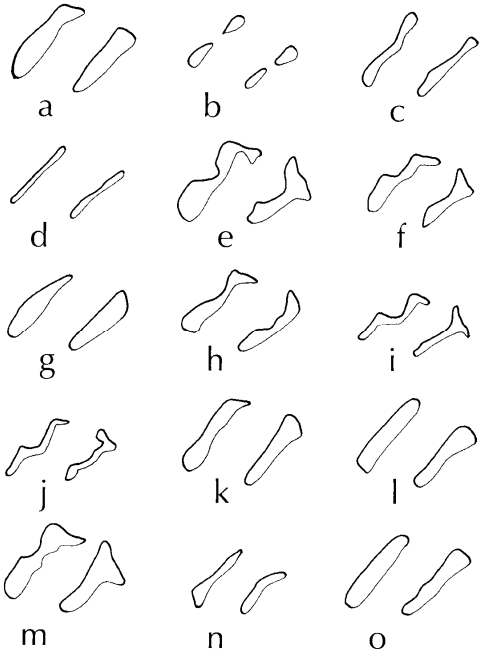


Figure 7. The shapes of the side stripes on the thorax of Mosaic Darners and Southern Darners (the front stripe is on the left): a, Black-tipped; b, Variable – spotted form; c, Variable – southeastern interior; d, Variable – interior form; e, Lake; f, Canada; g, Sedge; h, Subarctic; 1, Azure; j, Zigzag; k, Shadow; l, Paddle-tailed; m, Lance-tipped; n, California; o, Blue-eyed.

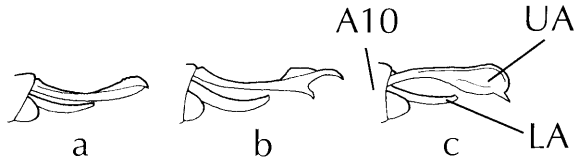


Figure 9. The three types of appendages of male Mosaic Darners and Southern Darners, side view: a, **simple** (most species; Canada is shown) broadens slightly toward a rounded or pointed tip; b, **forked** at the tip (Blue-eyed); c, **flattened** Lance-tipped, Paddle-tailed and Shadow) broadens and flattens toward the tip. A10 = abdominal segment 10; UA, LA = upper, lower

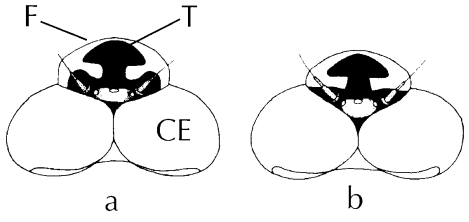
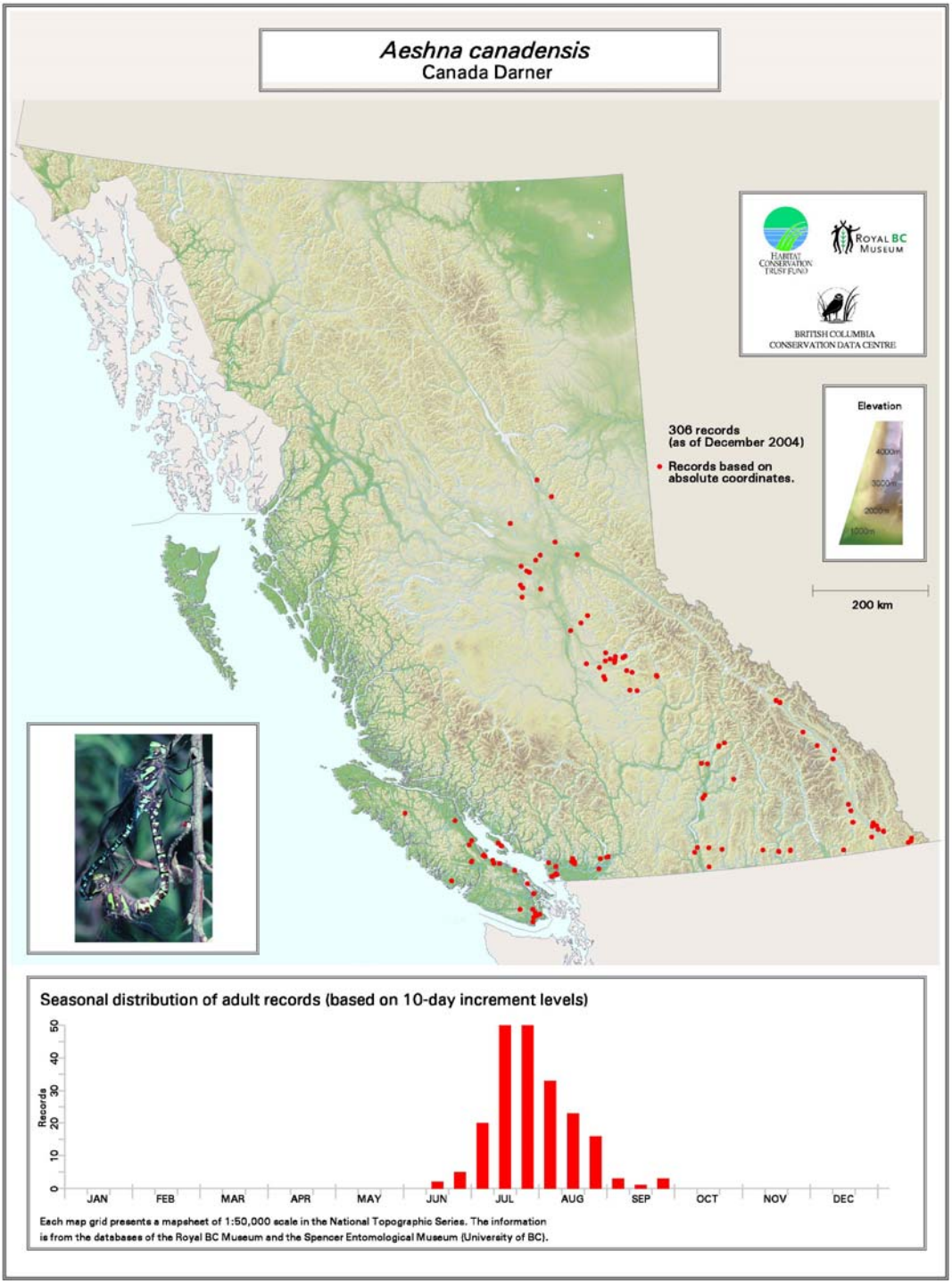


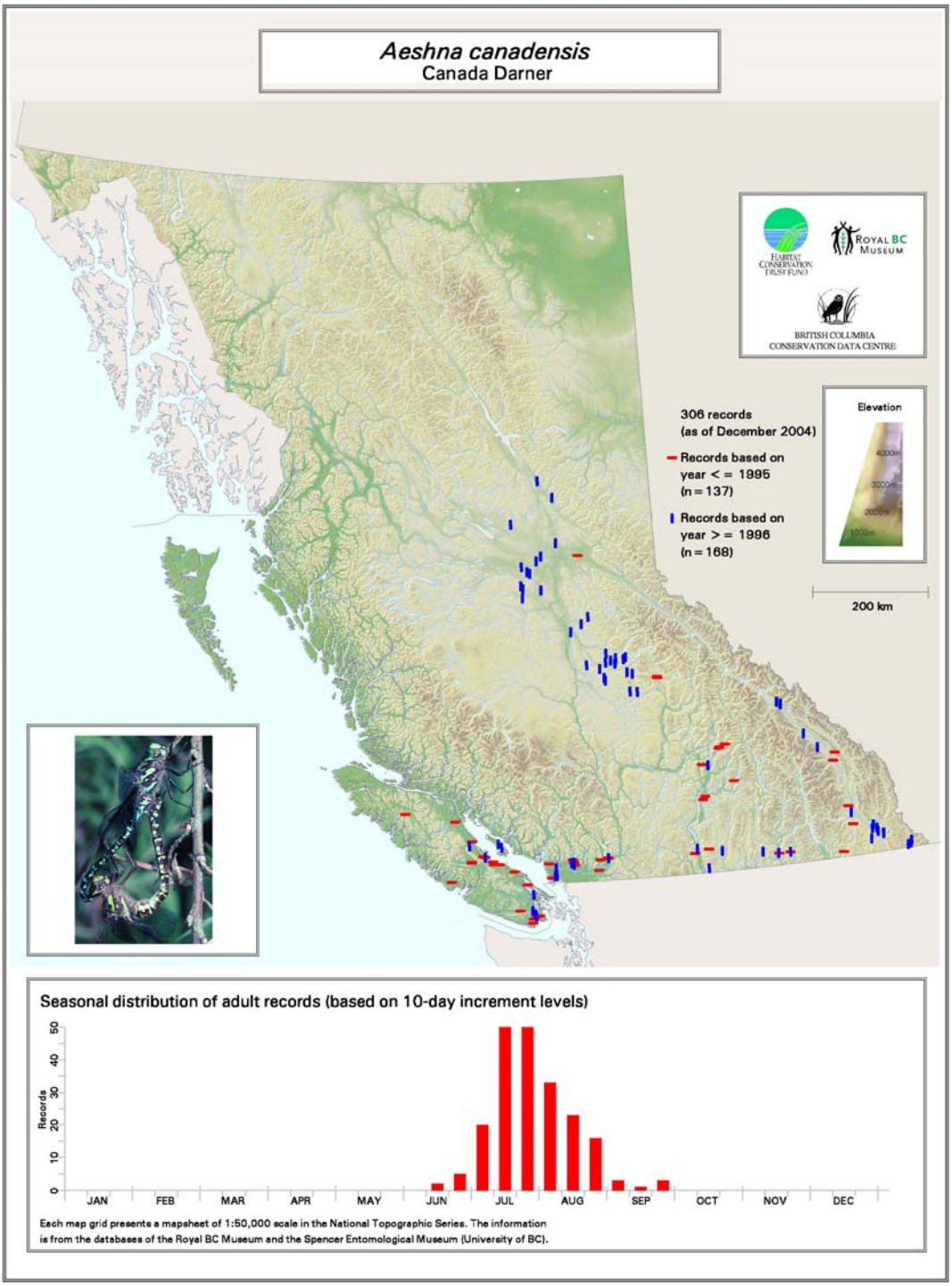
Figure 8. Mosaic Darner's T-spot, top view: a, Zigzag; b, Azure. CE = compound eye; F = face; T = T-spot.

***Aeshna canadensis* (Canada Darner)**
BC conservation rank: S5. Yellow List.
Description: Thorax stripes as in fig. 8f. The face is pale green; if a line is present, it is thin and pale brown. Blue spots mark the underside of the abdomen. Male's thorax stripes are blue to green; upper appendages simple (fig. 9a). Female has pale green (sometimes blue) markings. Length: male 68 mm, female 70 mm.
Global Range: Yukon and British Columbia east to Newfoundland (not recorded from Northwest Territories); south to Virginia, Arkansas, Nebraska, Montana and California (Needham *et al*. 2000). Faunal element: Transition (see Appendix 3).
BC Distribution: Widespread in southern and central BC; the most northerly record is near McLeod Lake (55ºN).
Biology: Not usually the predominant species at a locality, except on the south coast, where it can be abundant in some places. Most common in the south, uncommon in its northern range. Recorded in the Yukon, so may occur in BC's far North. Lives in peaty lakes, flooded beaver ponds, and sedge and cattail marshes at low and medium elevations (Wm01-02, Wm04-07; Wf01, 05-06).
BC flight period: mid June to late October; most records are from early July through to early September.

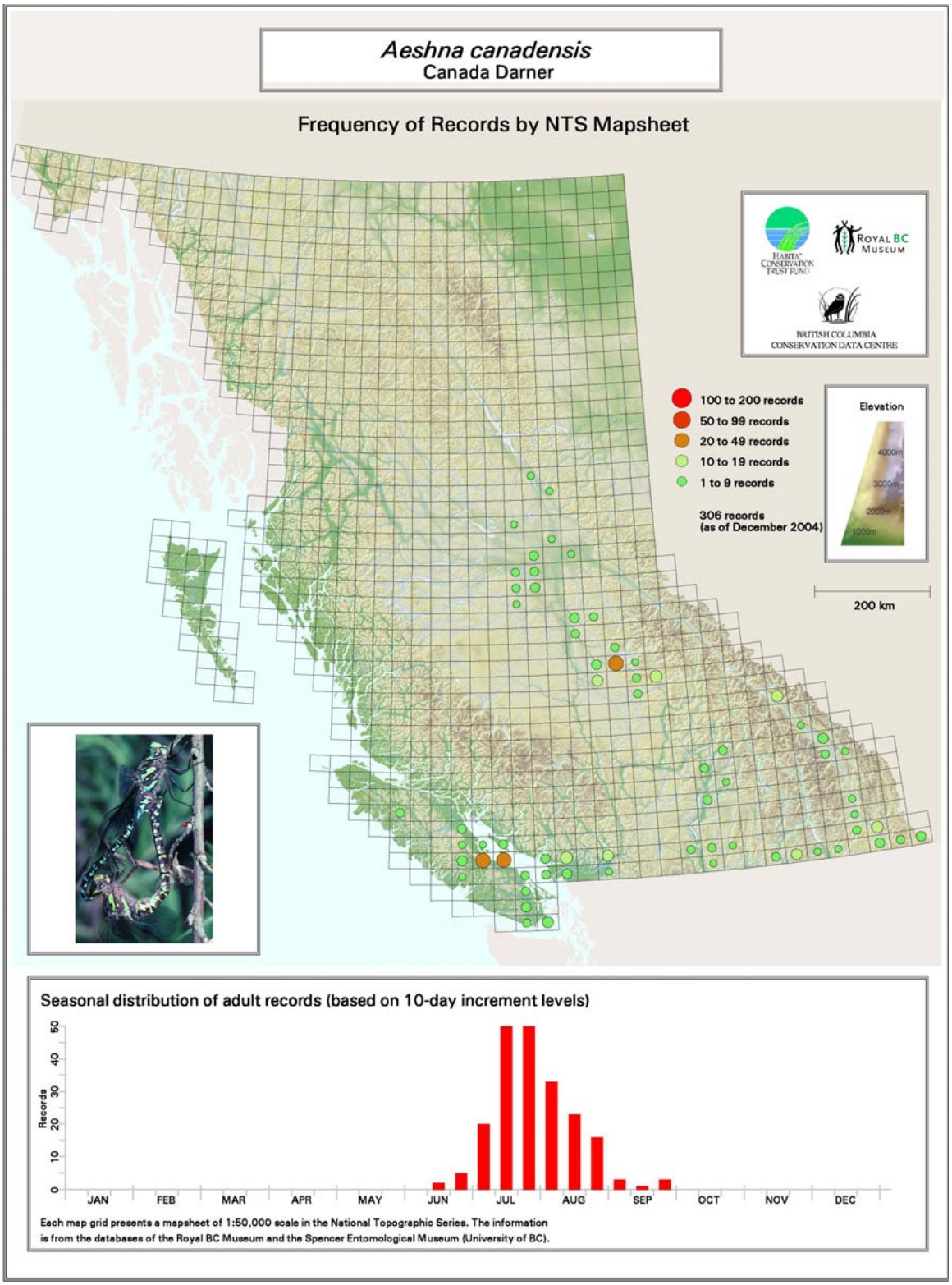
Aeshna canadensis mating. Photograph: George Doerksen, RBCM



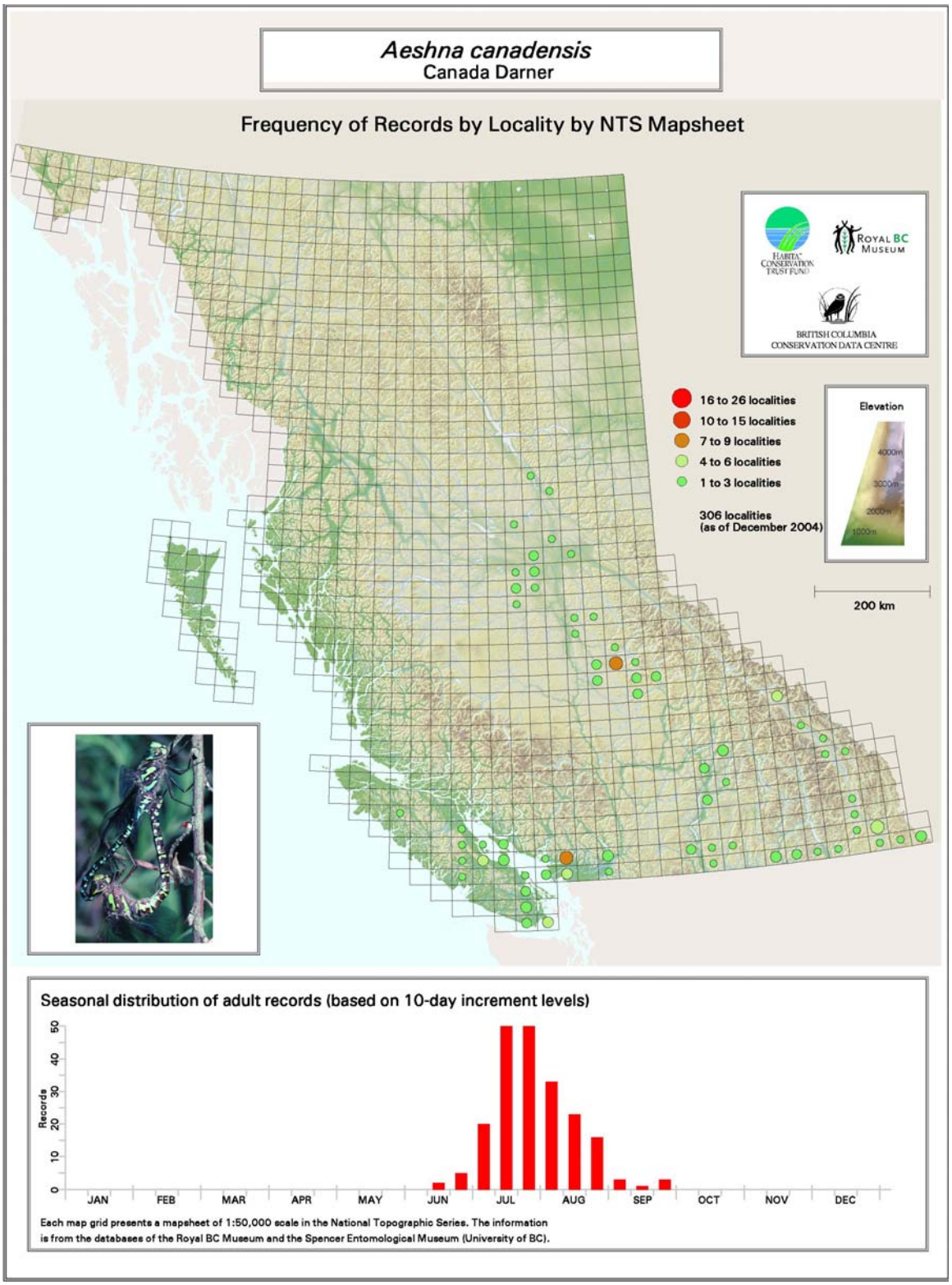
Aeshna canadensis Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Aeshna canadensis Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



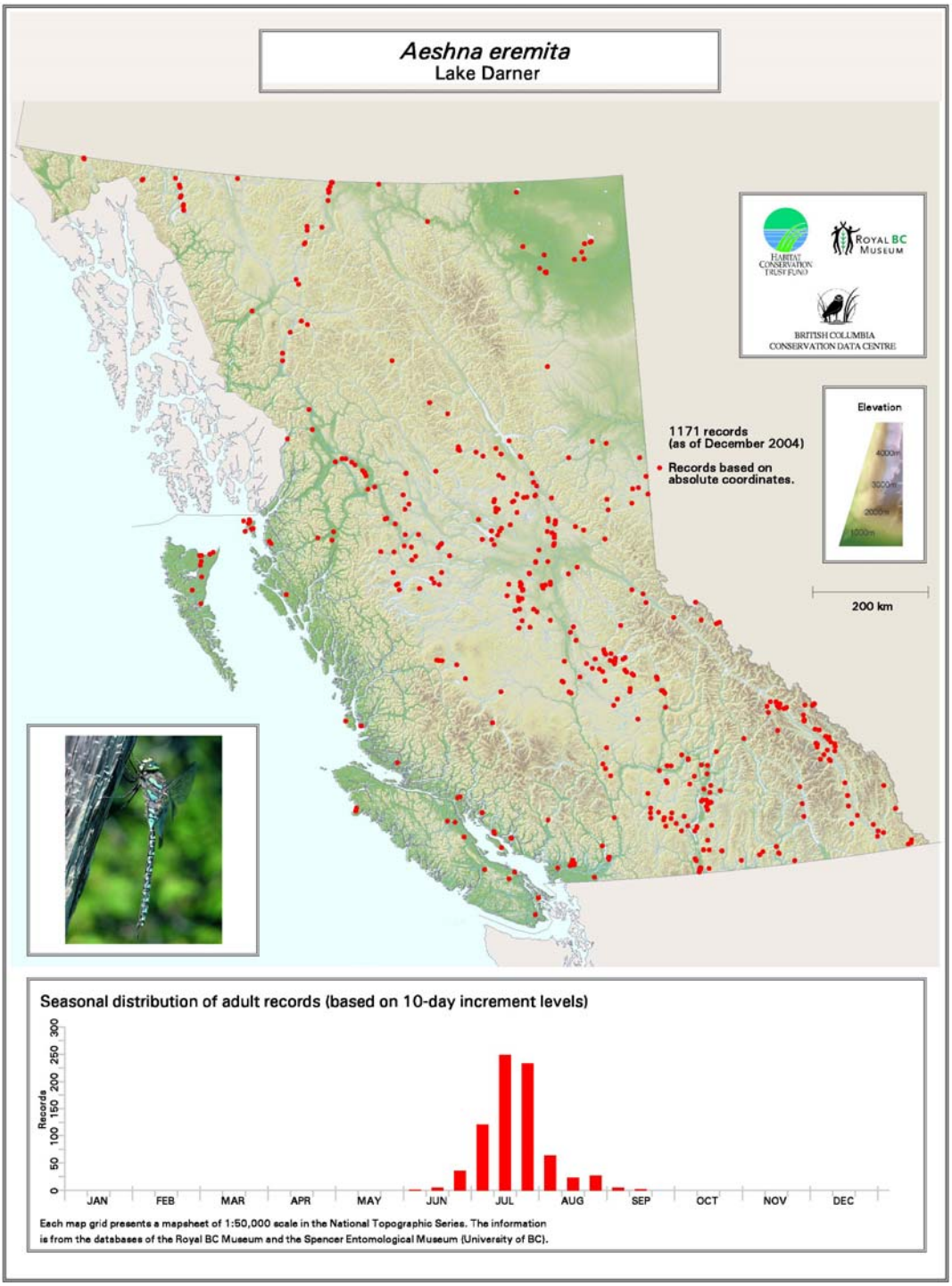
Aeshna canadensis Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



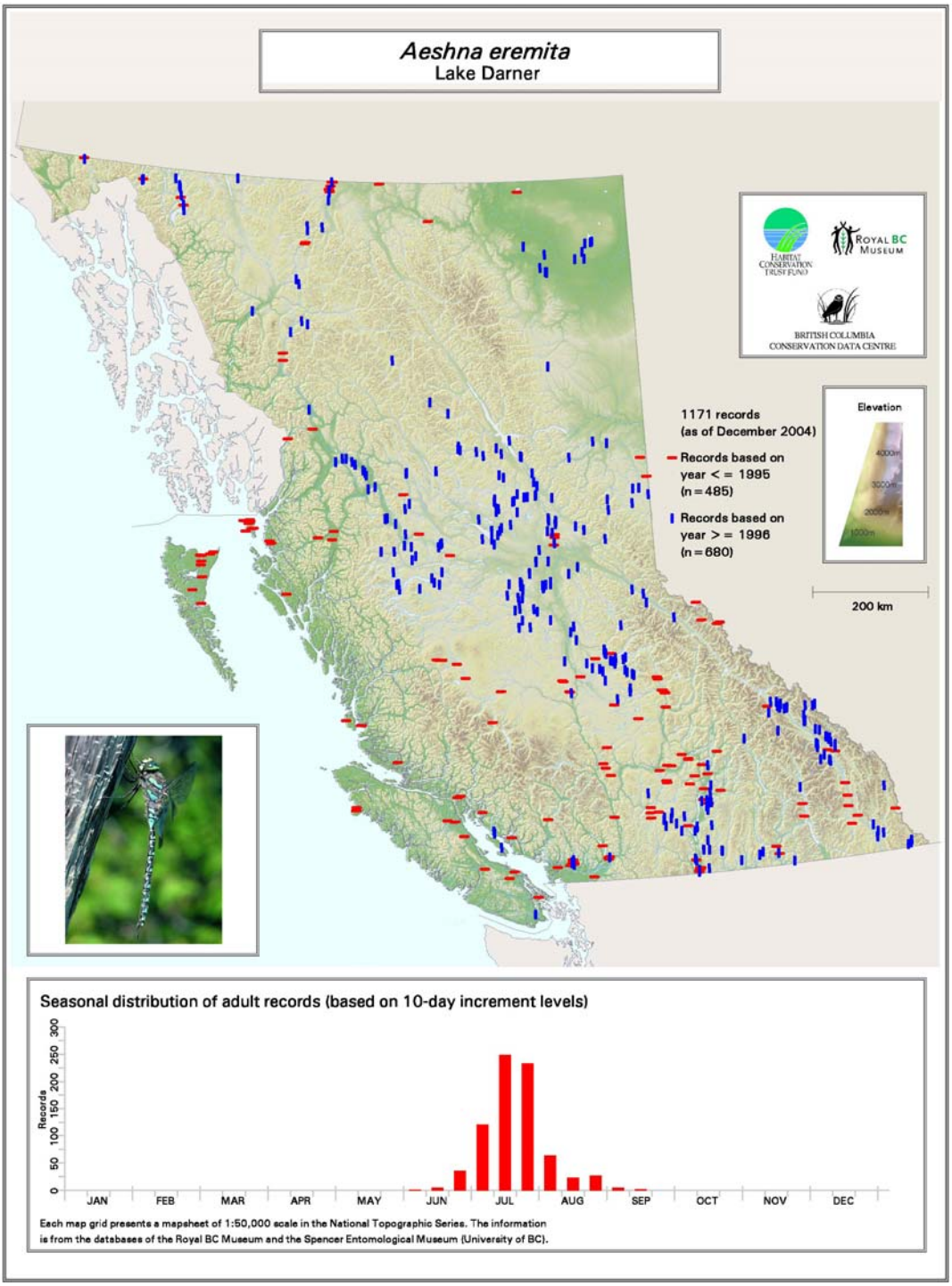
Aeshna canadensis Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Aeshna eremita* (Lake Darner)**
BC conservation rank: S5. Yellow List.
Description: Large; looks much like the Canada Darner, except its face is yellow-green with a black line and it lacks spots under the abdomen. Thorax stripes are blue to green; shape, fig. 7e. Pale areas on females are usually green or yellow-green, but sometimes blue. Male's upper appendages simple (fig. 9a). Length: male 75 mm, female 73 mm.
Global Range: Alaska east to Labrador and Newfoundland; south to New York, Michigan, North Dakota, Colorado, Utah and Washington (Needham *et al.* 2000). Faunal element: Widespread Boreal (see Appendix 3).
BC Distribution: Widespread.
Biology: The largest *Aeshna* in Canada and one of the most often encountered dragonflies in the northern forests of North America. In southern BC, it lives at all elevations, but is most common around forest lakes at mid and high elevations. Prefers lakeshores with little emergent vegetation (e.g., *Nuphar lutea* associations); it also occurs in deep fens and bogs (Wf01, 05-08; Wb13, 50-52), and around lakes and ponds surrounded by sedges (Wm01-02, Wm04-07). It may fly early in the morning and in the evening when the temperature is cool and the light is low. It likes perching on tree trunks. **BC flight period:** mid June to late October; most records are from early July to early September.

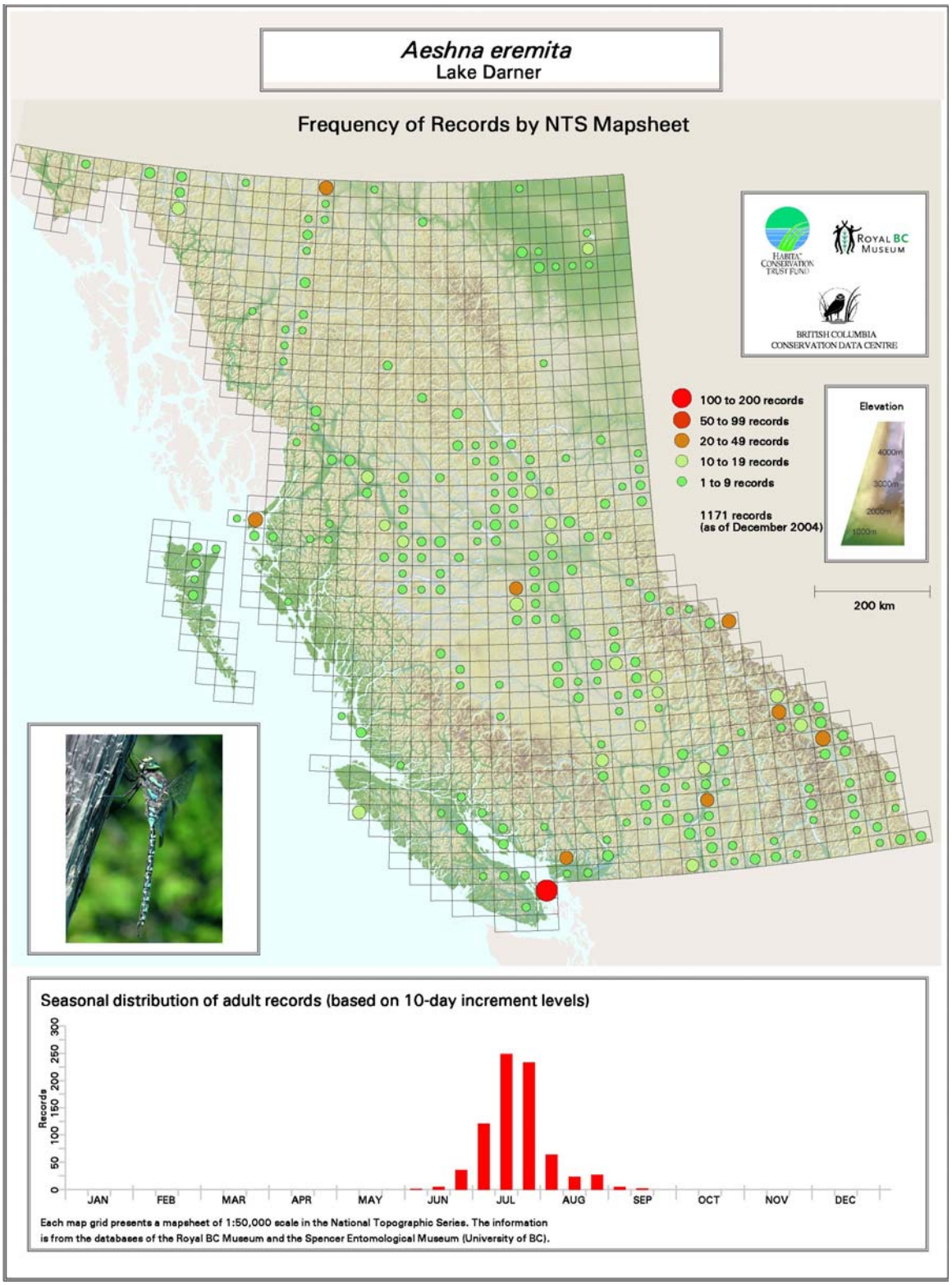
Aeshna eremita male. Photograph: Robert A. Cannings, RBCM



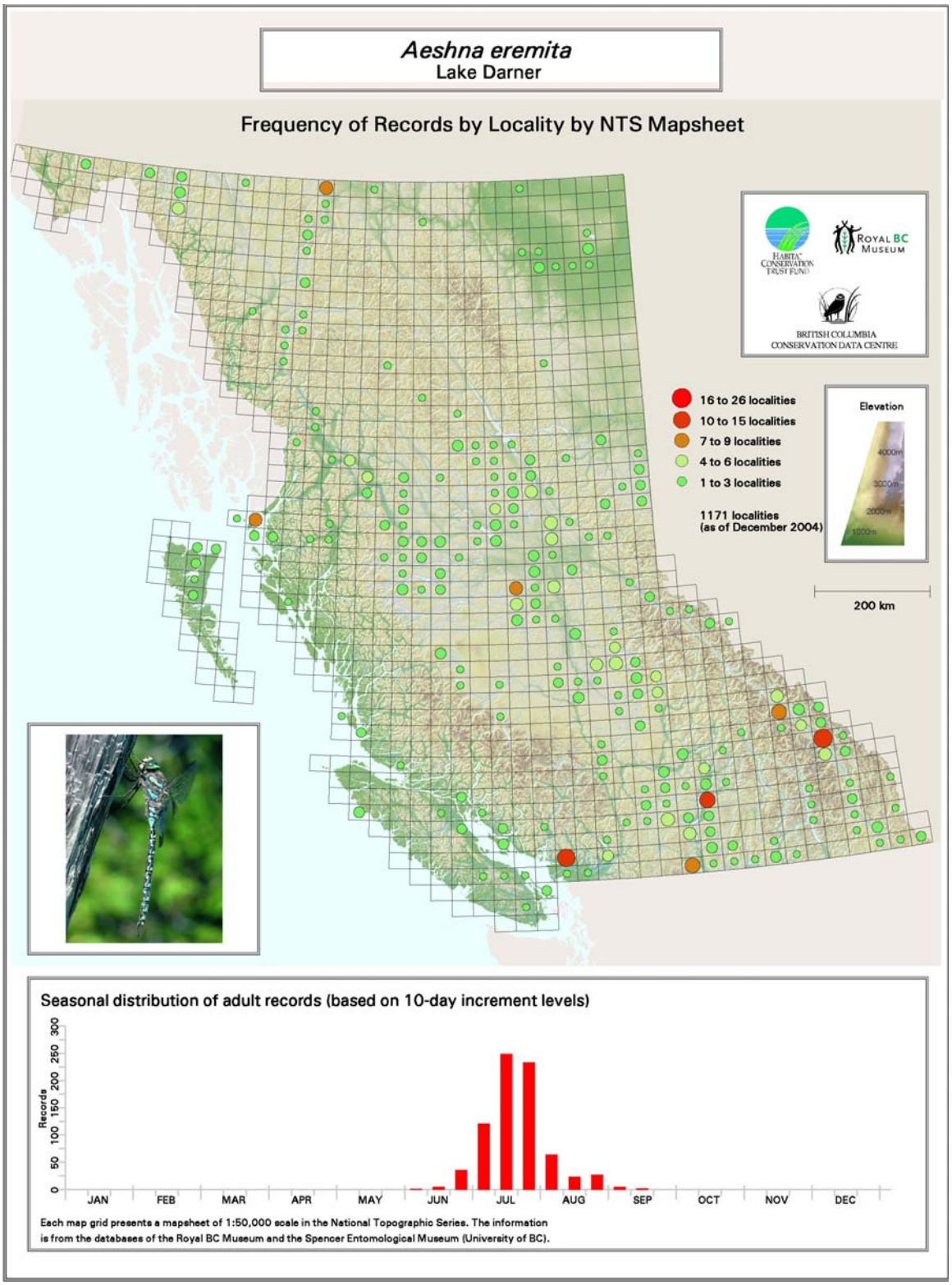
Aeshna eremita Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Aeshna eremita Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



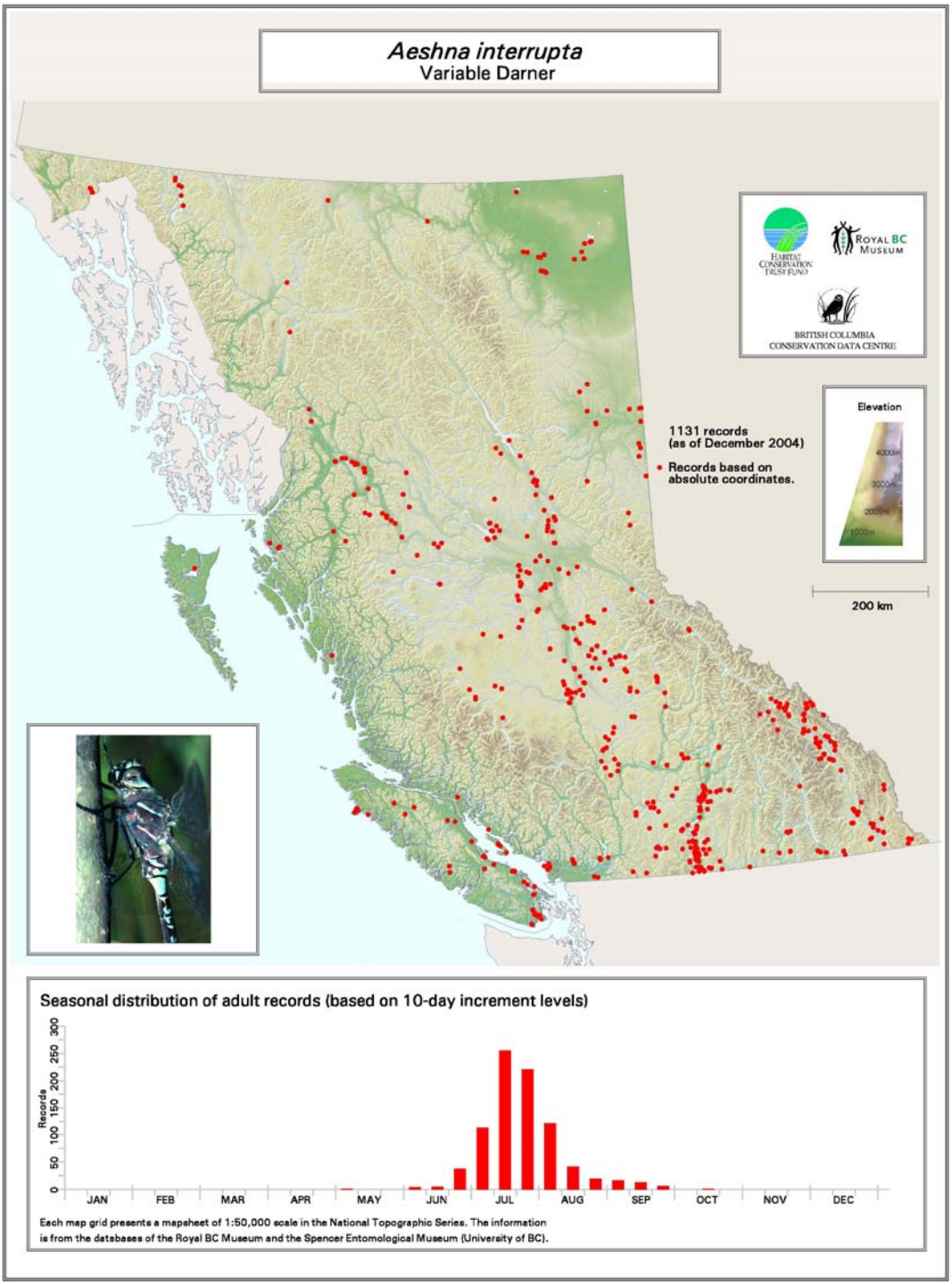
Aeshna eremita Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



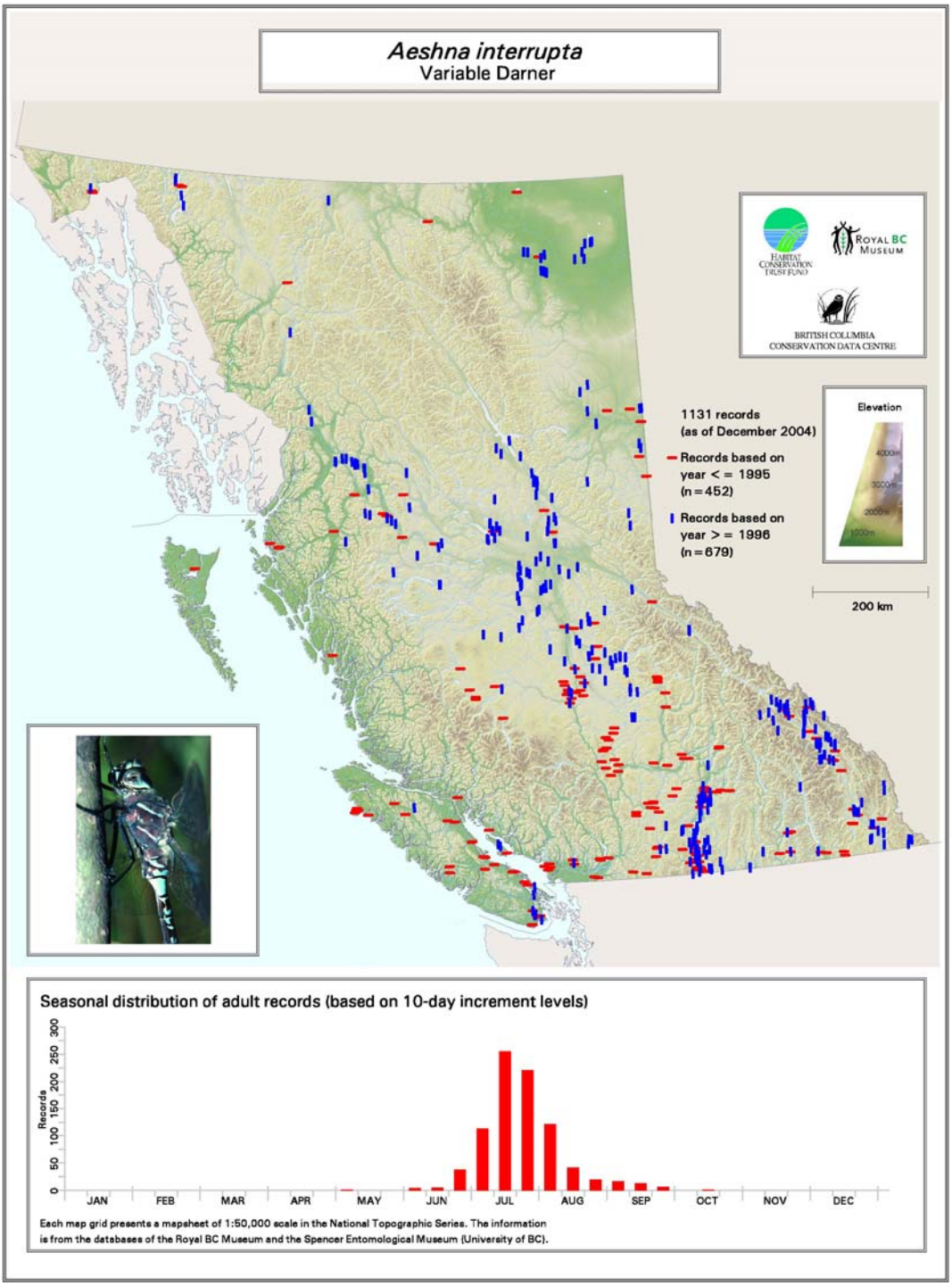
Aeshna eremita Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Aeshna interrupta* (Variable Darner)**
BC conservation rank: S5. Yellow List.
Description: The scientific name comes from the distinctly broken thorax stripes, usually on males found on BC's coast (fig. 7b); interior populations normally have complete narrow stripes (fig. 7c-d). This variation gives the species its English name. The stripes are usually yellow-green below and blue above. The face is green-yellow to pale blue with a black line. Pale areas on females are usually green or yellow, but some are blue. Male's appendages simple (fig. 9a). Length: male 70 mm, female 66 mm.
Global Range: Alaska east to Newfoundland; south to West Virginia, Wisconsin, Iowa, Nebraska, New Mexico and California (Needham *et al.* 2000). Faunal element: Southern Boreal (see Appendix 3).
BC Distribution: Widespread.
Biology: Common in BC. Lives in many habitats from northern and mountain peatlands (Wf01, 05-08; Wb13, 50-52) to cattail and bulrush marshes (Wm05-06) and temporary pools (e.g. Wm04, Wm06). This is the characteristic darner of grassland ponds (e.g., Wm06-07 and Gs01-03).
BC flight period: mid May to early November; most records range from early July to late September.

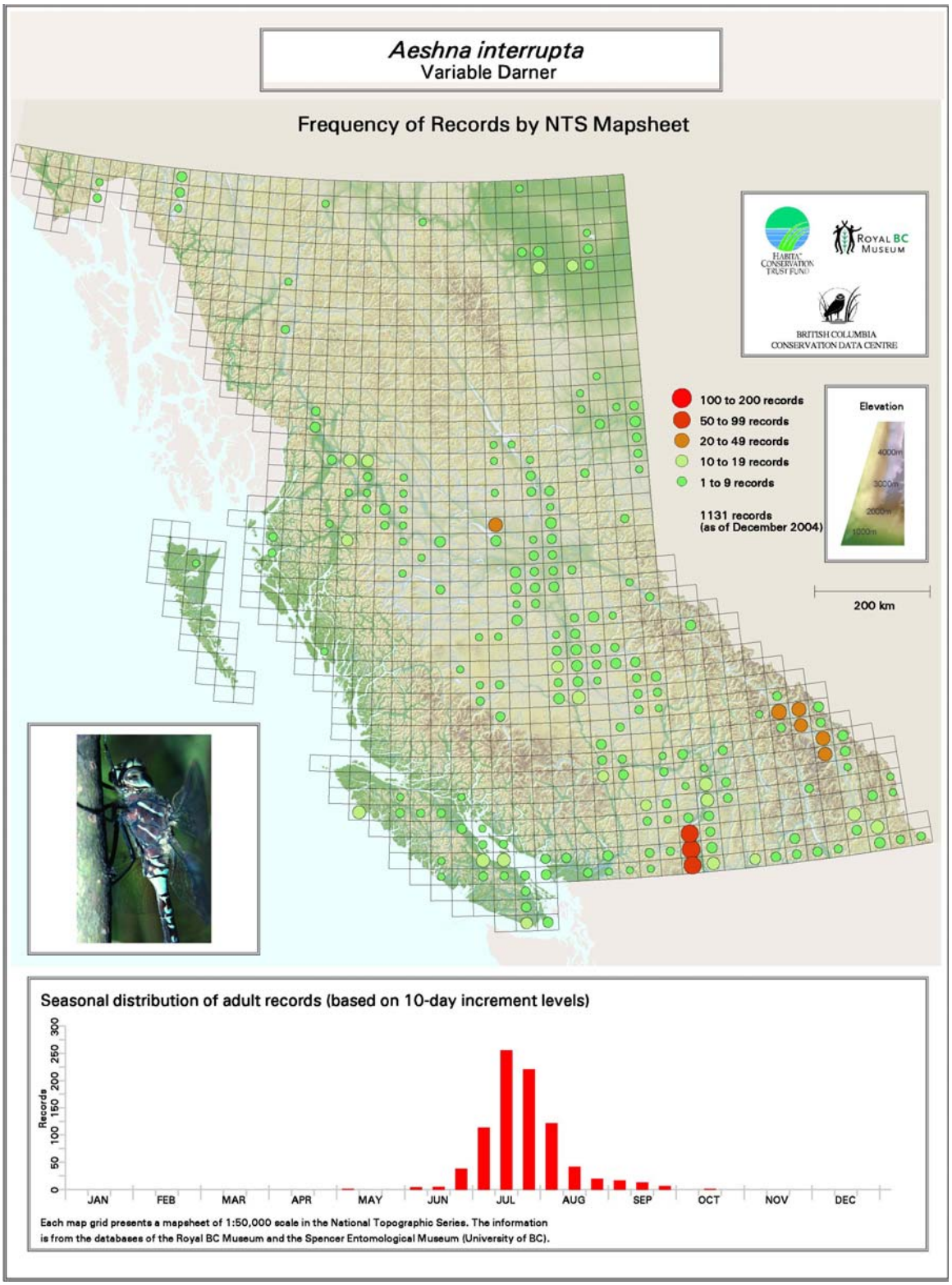
Aeshna interrupta male. Photograph: George Doerksen, RBCM



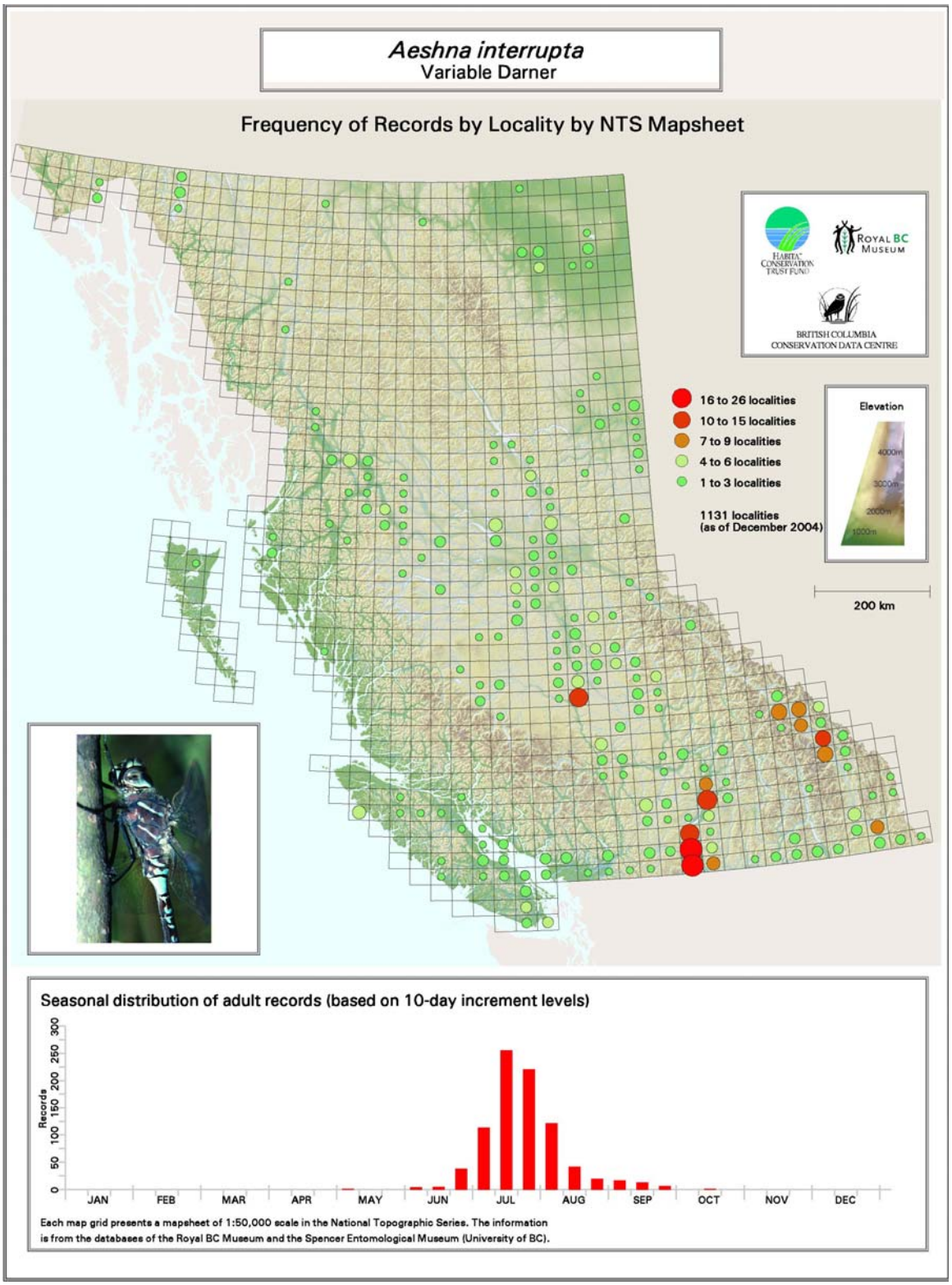
Aeshna interrupta Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Aeshna interrupta Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



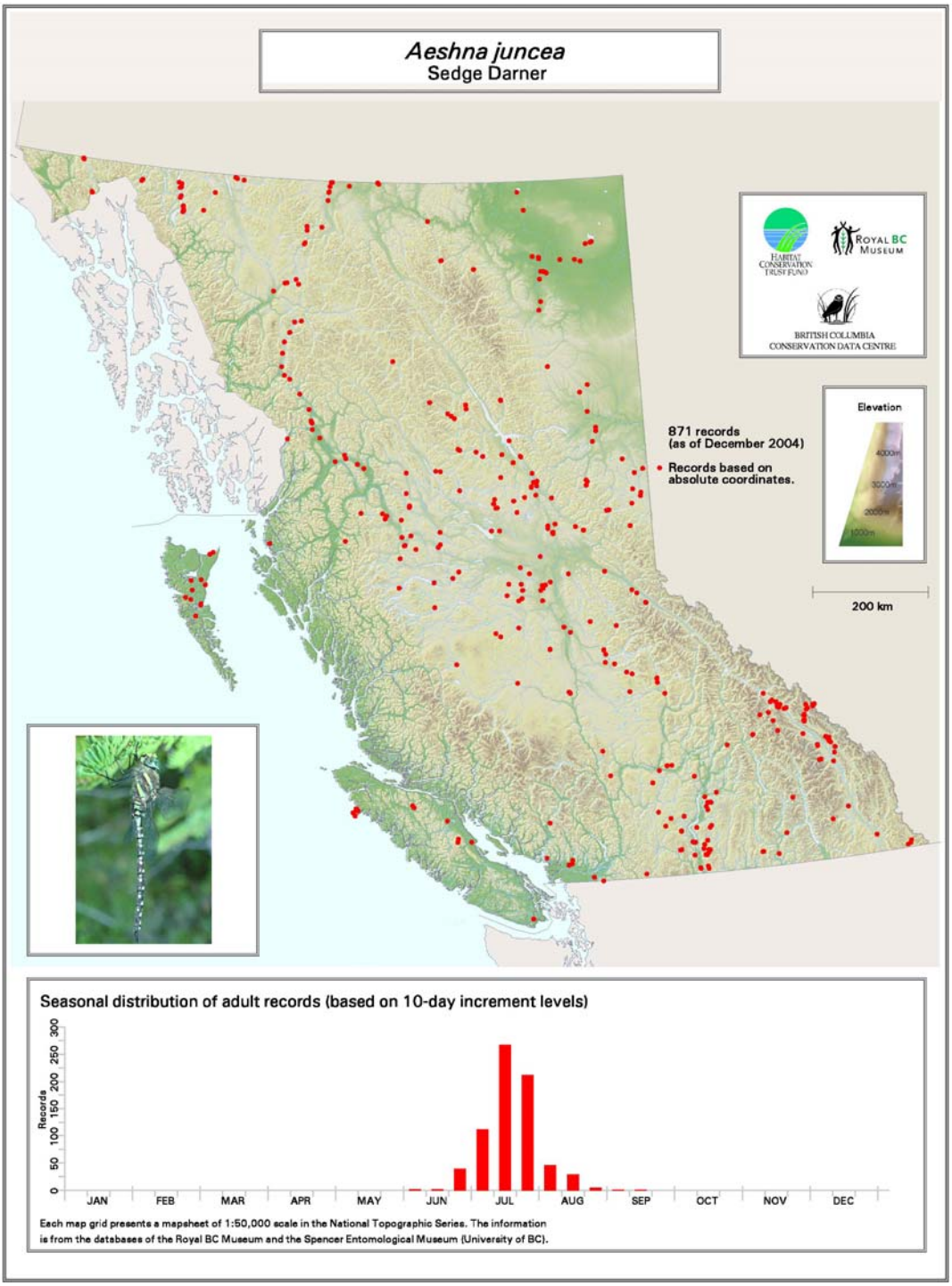
Aeshna interrupta Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



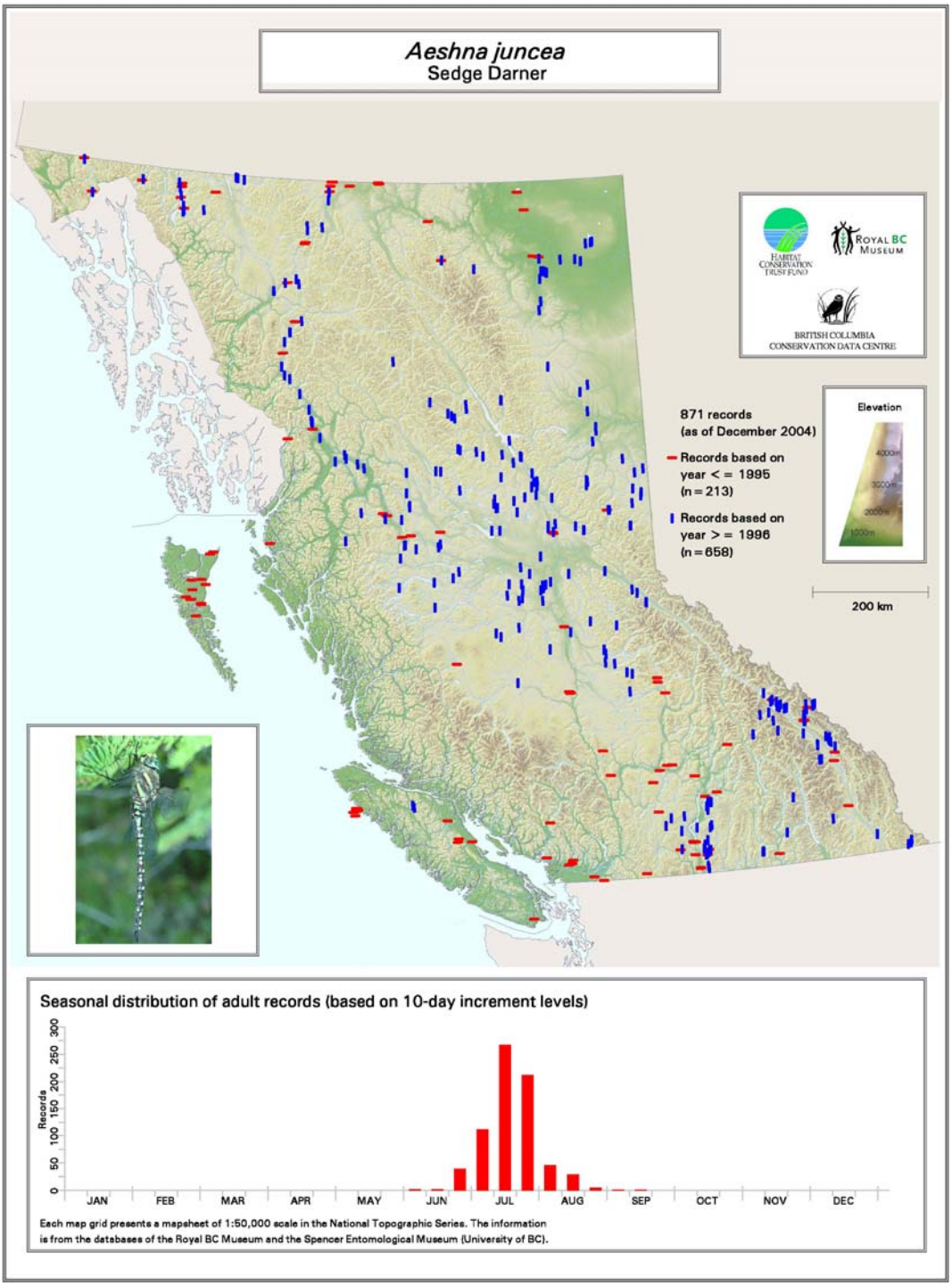
Aeshna interrupta Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Aeshna juncea* (Sedge Darner)**
BC conservation rank: S5. Yellow List.
Description: Thorax stripes are yellow-green below, blue above and bordered with black; shape, fig. 7g. The face is yellow to yellow-green with a black line. Pale spots mark the undersides of the abdominal segments. The pale areas on females are usually green or yellow-green, but on some they are blue. Male's upper appendages simple (fig. 9a). Length: male 66 mm, female 65 mm.
Global Range: Alaska east to Labrador and Newfoundland; south to New Hampshire, Michigan, Manitoba, Alberta and south along the mountains to New Mexico and Oregon (Needham *et al.* 2000). Faunal element: Widespread Boreal (see Appendix 3).
BC Distribution: Widespread.
Biology: Uncommon in BC's southern valleys, but more common at higher elevations and northward; it is one of the most common species in the northern half of the province. Lives in a variety of habitats, mainly containing acidic waters, but it is most abundant in peatlands dominated by extensive stands of sedges (Wf01, 05-08; Wb13, 50-52). Also along sedge lined lakeshores (Wm01-02), especially in the North.
BC flight period: mid June to early October; most records form early July to late August.

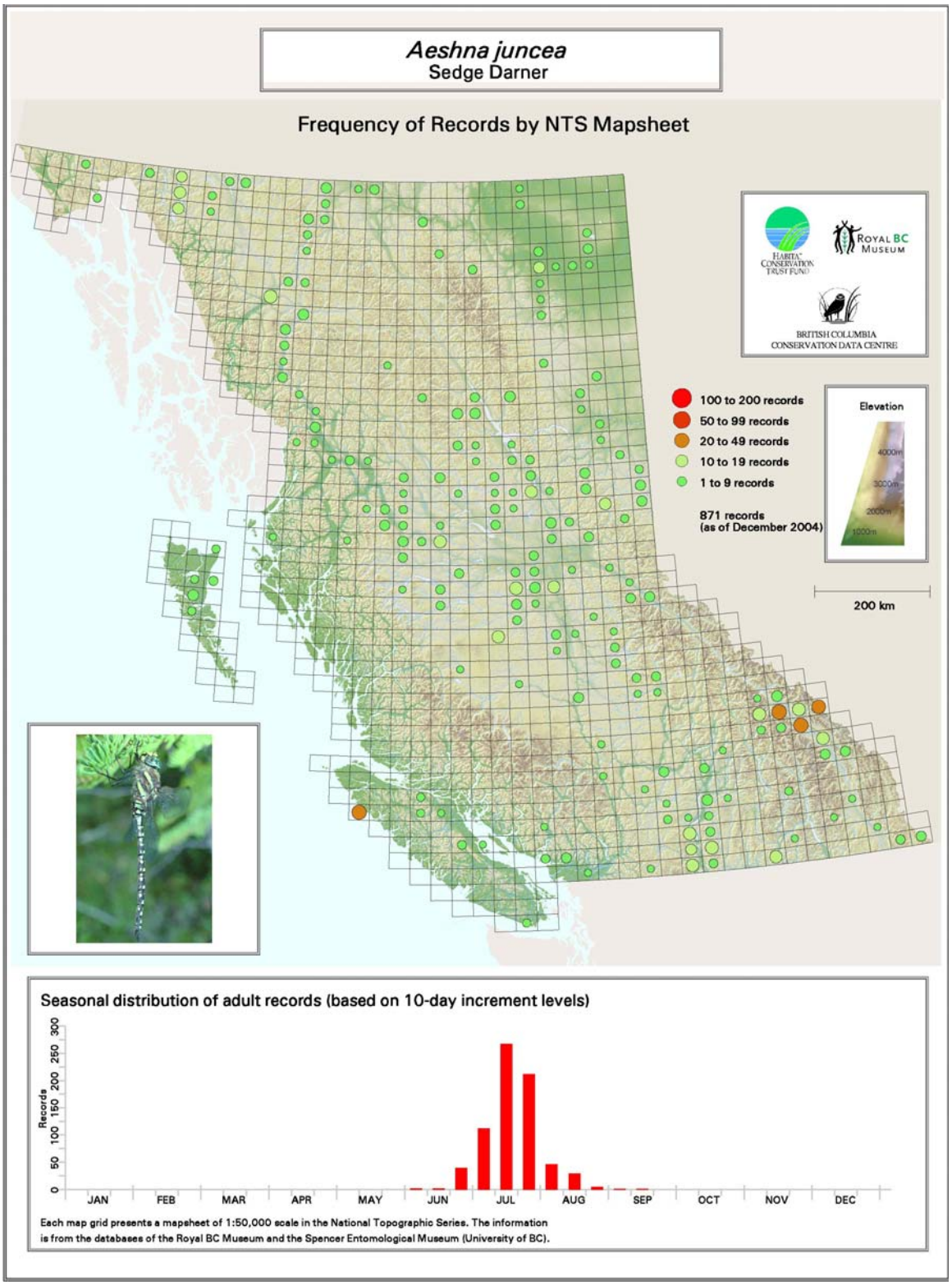
Aeshna juncea male. Photograph: Robert A. Cannings



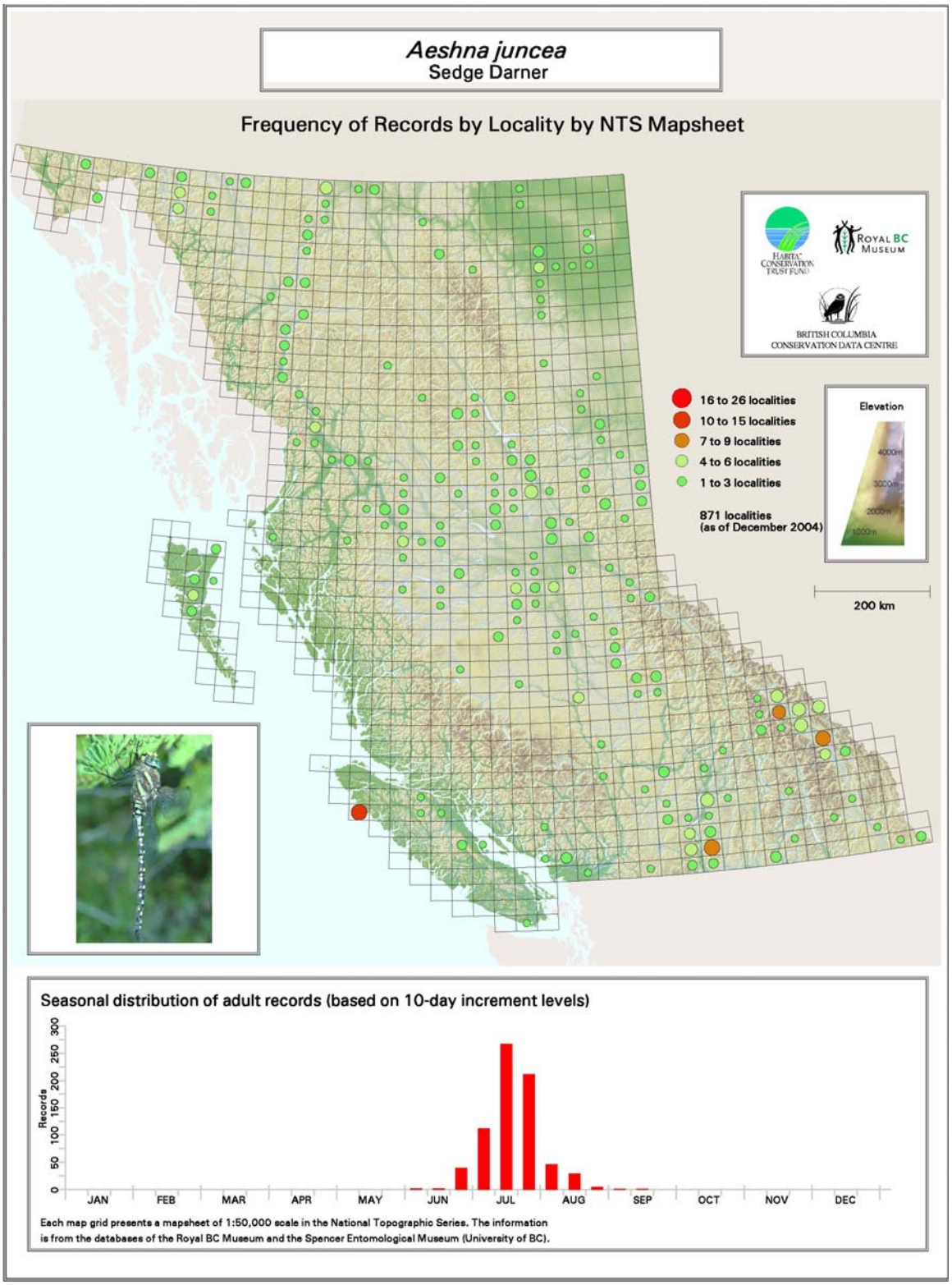
Aeshna juncea Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Aeshna juncea Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



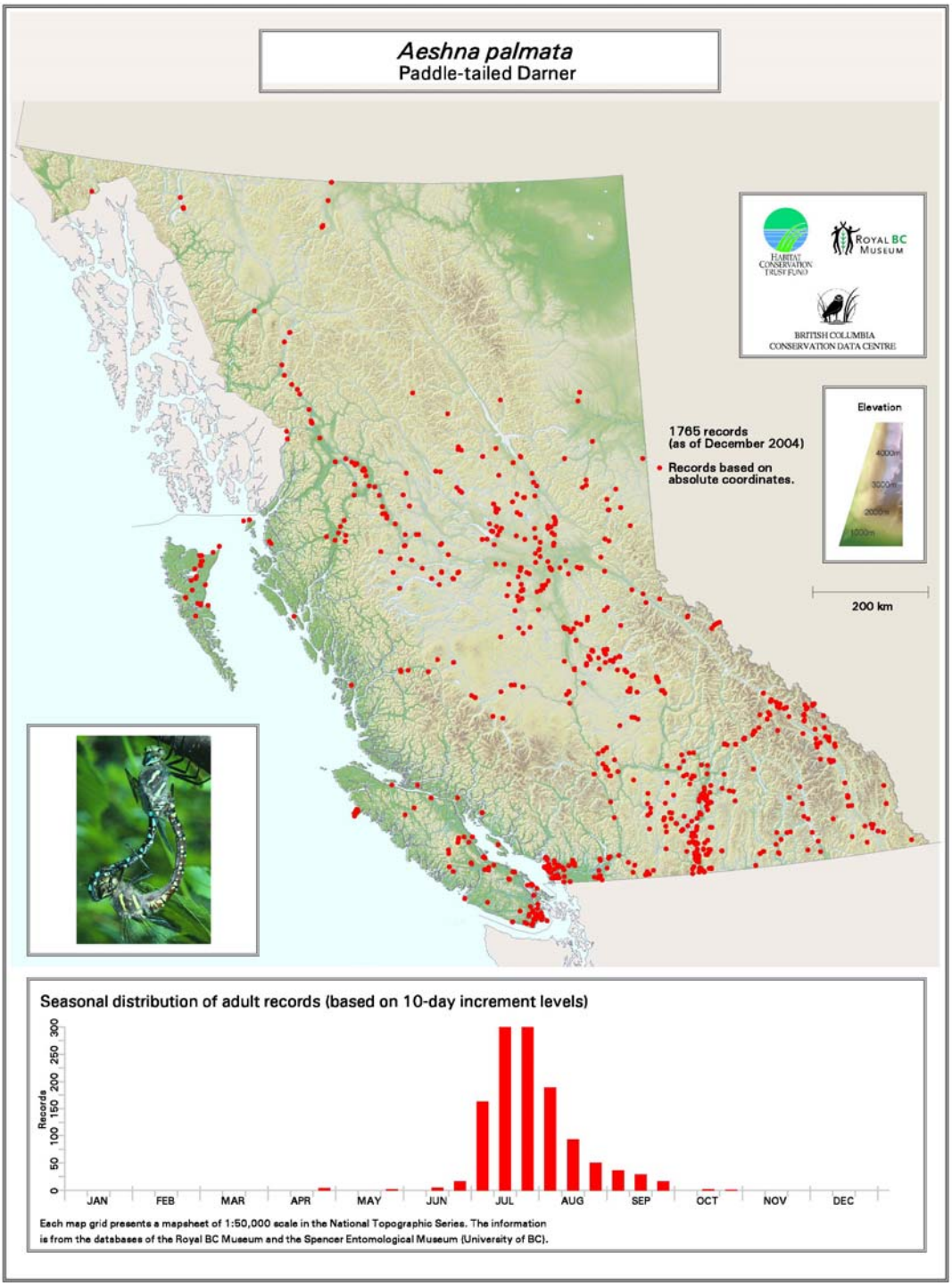
Aeshna juncea Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



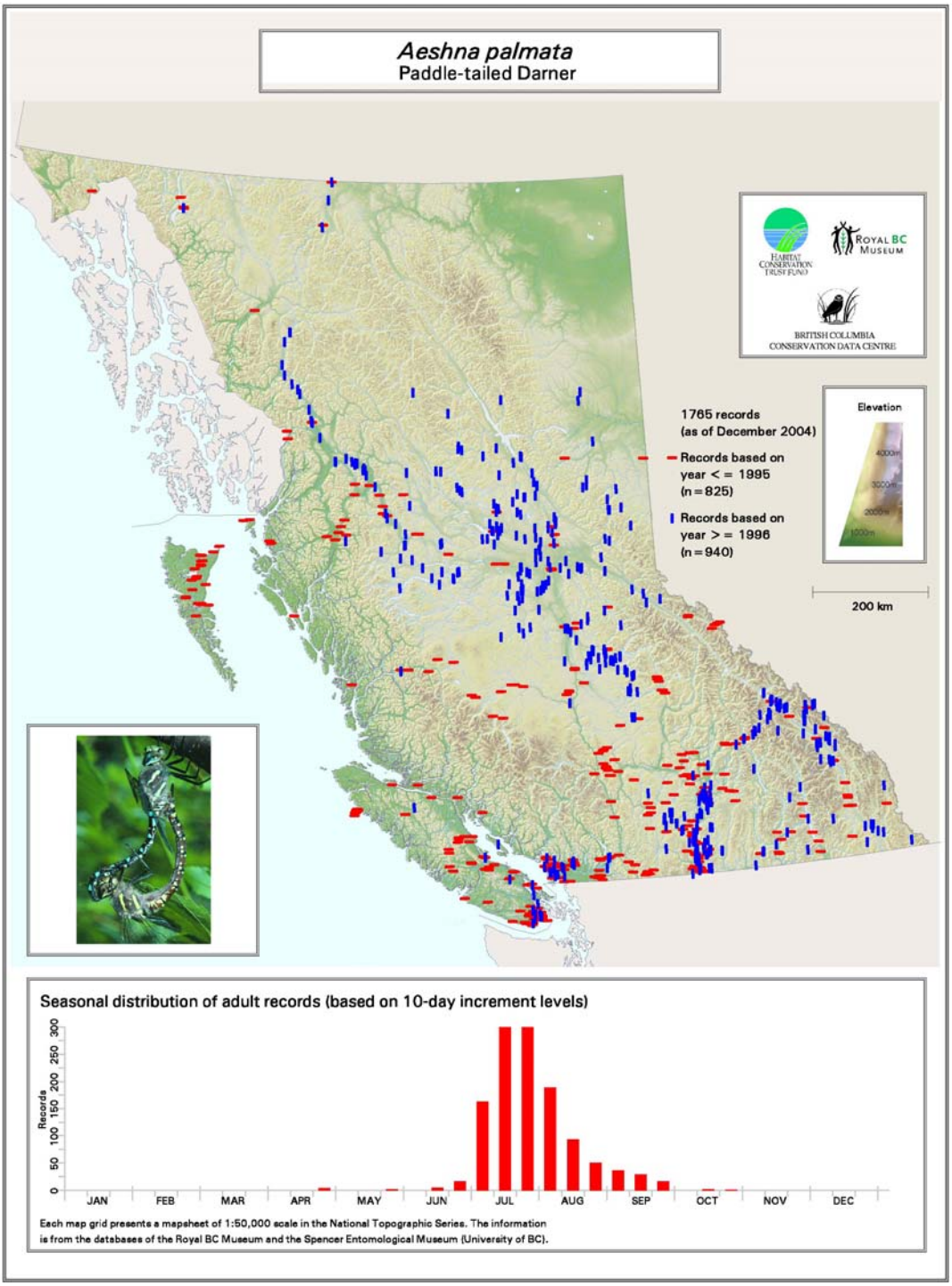
Aeshna juncea Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Aeshna palmata* (Paddle-tailed Darner)**
BC conservation rank: S5. Yellow List.
Description: The face is greenish yellow with a black line; the rear of the head is black. Thorax stripes are almost straight (fig. 7l). The abdomen has pale spots on top of segment 10, but none underneath on any segments. Compare with *A. umbrosa*, which does have these ventral spots. Male's stripes are yellow below and green to blue above, and its abdominal spots are blue. Females can be coloured like the male, but most have green-yellow thorax stripes and abdominal spots. Male's upper appendages flattened (fig. 9c). Length: male 72 mm, female 67 mm.
Global Range: Alaska east to the Rockies, but with outliers in the foothills and in the Cypress Hills of Alberta and Saskatchewan; south to Nebraska, New Mexico and California (Needham *et al.* 2000). Faunal element: Cordilleran (see Appendix 3).
BC Distribution: Widespread.
Biology: One of the most frequently encountered and abundant dragonflies in BC, though not as plentiful in the far north. Lives in a wide range of habitats, but typically in lakes and ponds in or near woodlands. (e.g. Wm01-02, Wm04-07; Wf01, 05-06; Wb50-52).
BC flight period: early May to early November; most collections are from early July to early October.

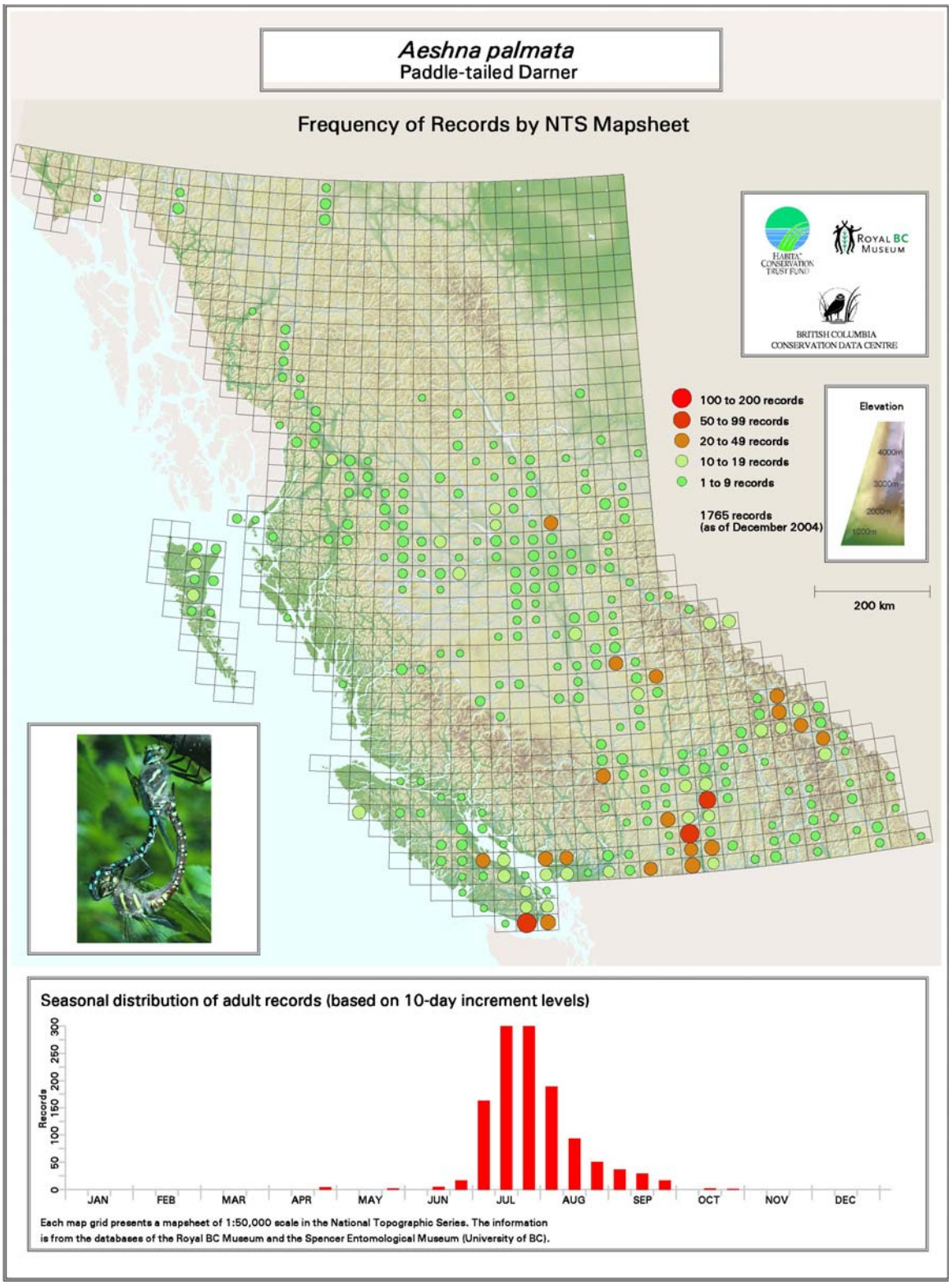
Aeshna palmata mating. Photograph: George Doerksen, RBCM



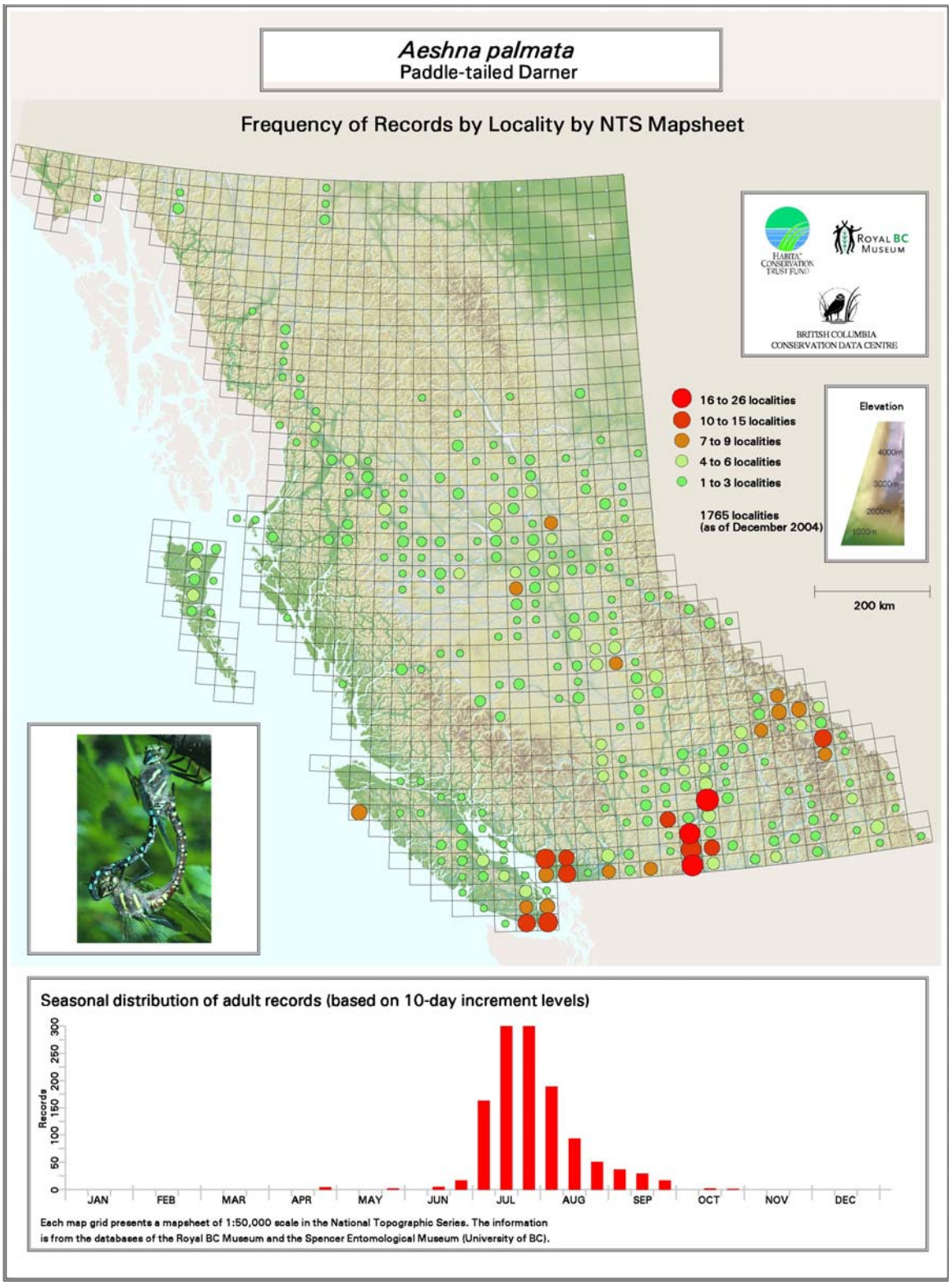
Aeshna palmata Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Aeshna palmata Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Aeshna palmata Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



Aeshna palmata Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Aeshna septentrionalis* (Azure Darner)**

BC conservation rank: S4. Yellow List. Modified from S3S4 after more collections since 2000 extended its known distribution in the North.

Description: Small, similar to *A. sitchensis*. Thorax stripes are pale blue or green; shape, fig. 7i. The face is blue or green; T-spot, fig. 8b. Male's abdomen has more blue than any other BC darner, the sky-blue spots usually fused to form irregular stripes; upper appendages simple (fig. 9a). Female has blue or yellow-green abdominal spots. Length: male 60 mm, female 57 mm.

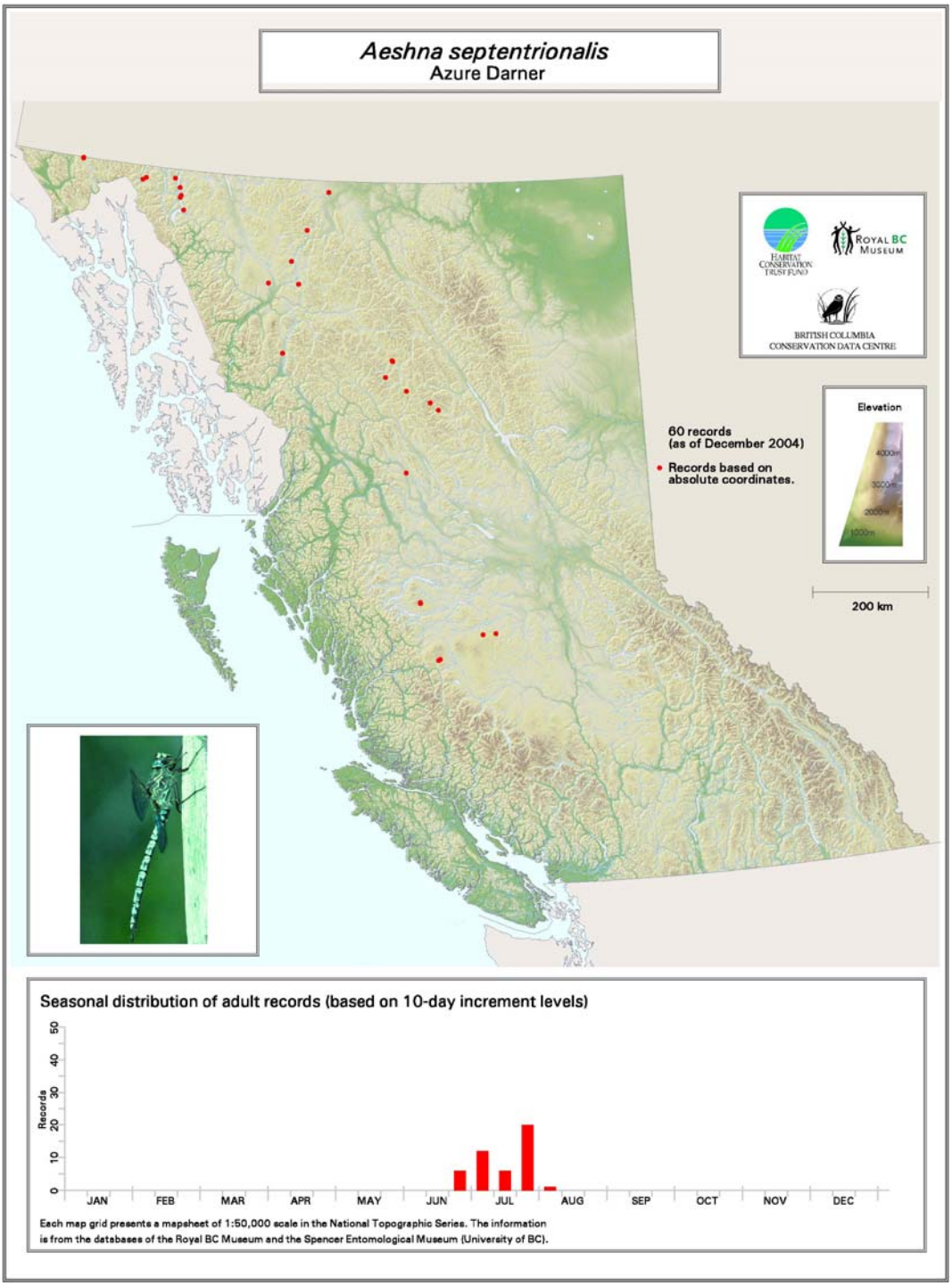
Global Range: Alaska east to Labrador and Newfoundland; south to New York in the Appalachian Mountains.(Needham *et al.* 2000). Faunal element: Northern Boreal (see Appendix 3).

BC Distribution: A northern species that ranges south only in the mountains and on northern plateaus to about 51°N in the Coast and Rocky mountains. Not known west of the Coast Range or from the Northeast.

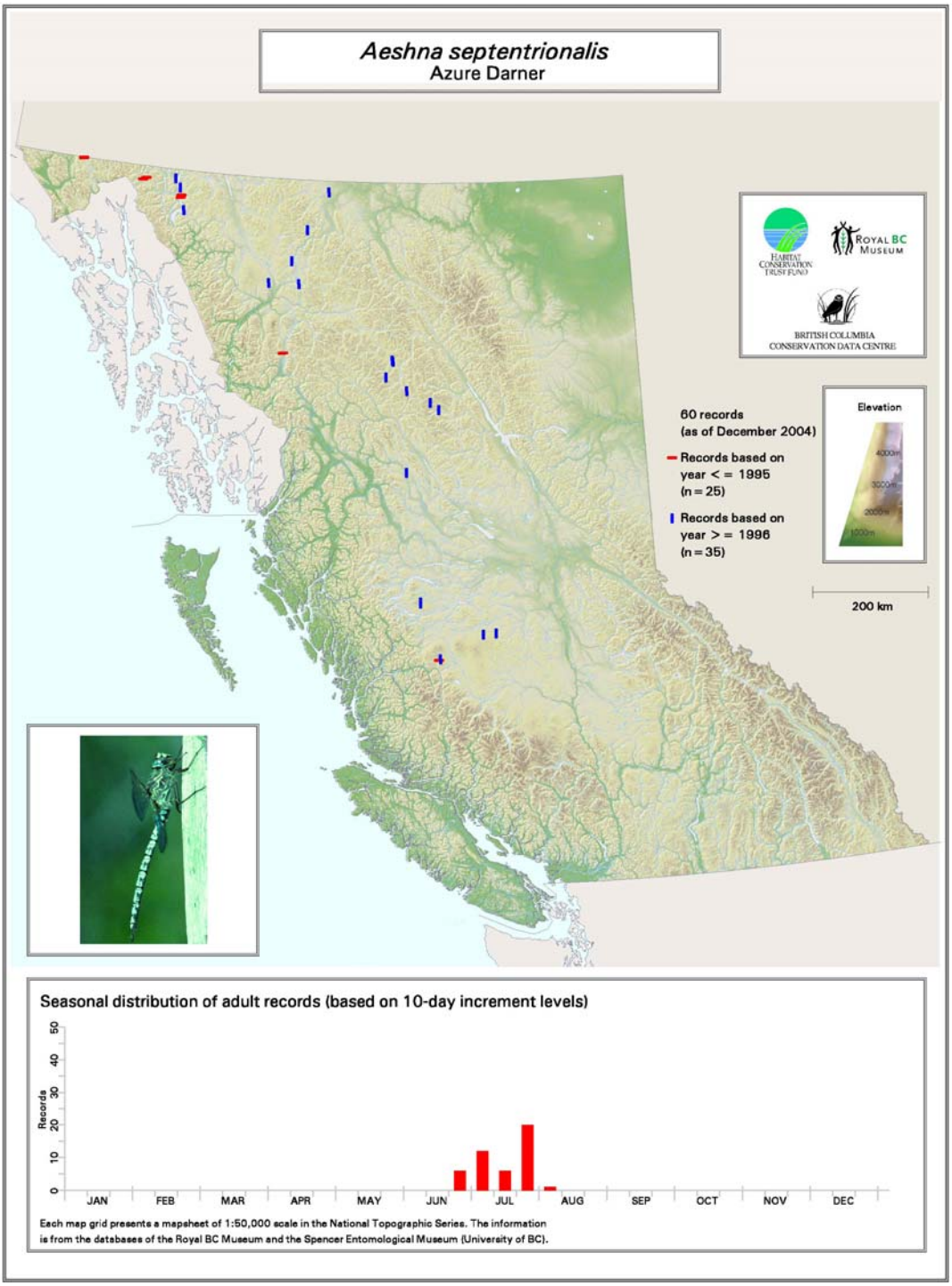
Biology: The most boreal of our darners. In BC it lives in subalpine peatlands with ponds (e.g., Mf05-08; Wb13). Perches low on tree trunks, or on stones, logs or moss.

BC flight period: early July to mid September; all records are from early July to mid August.

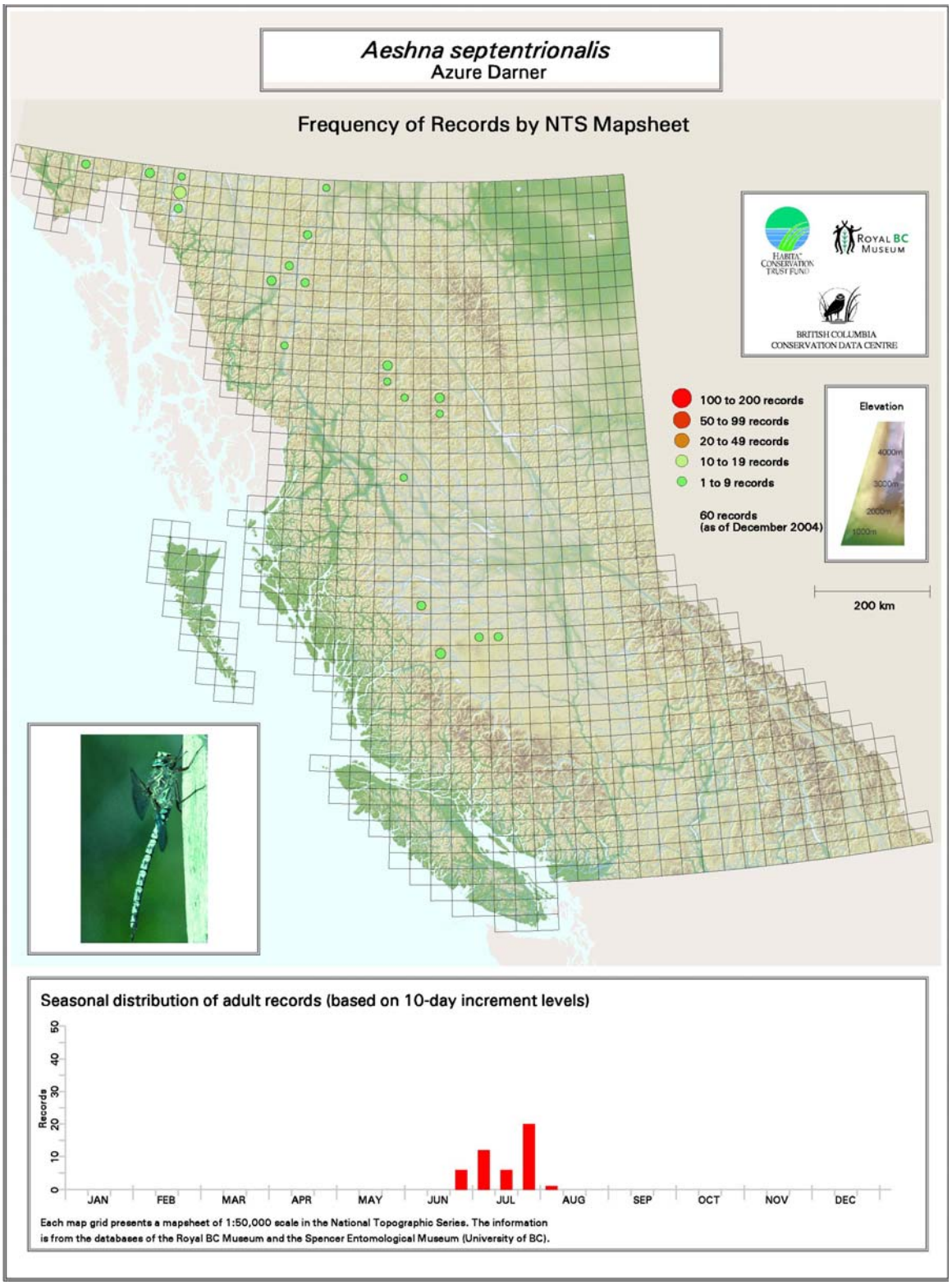
Aeshna septentrionalis male. Photograph: Robert A. Cannings



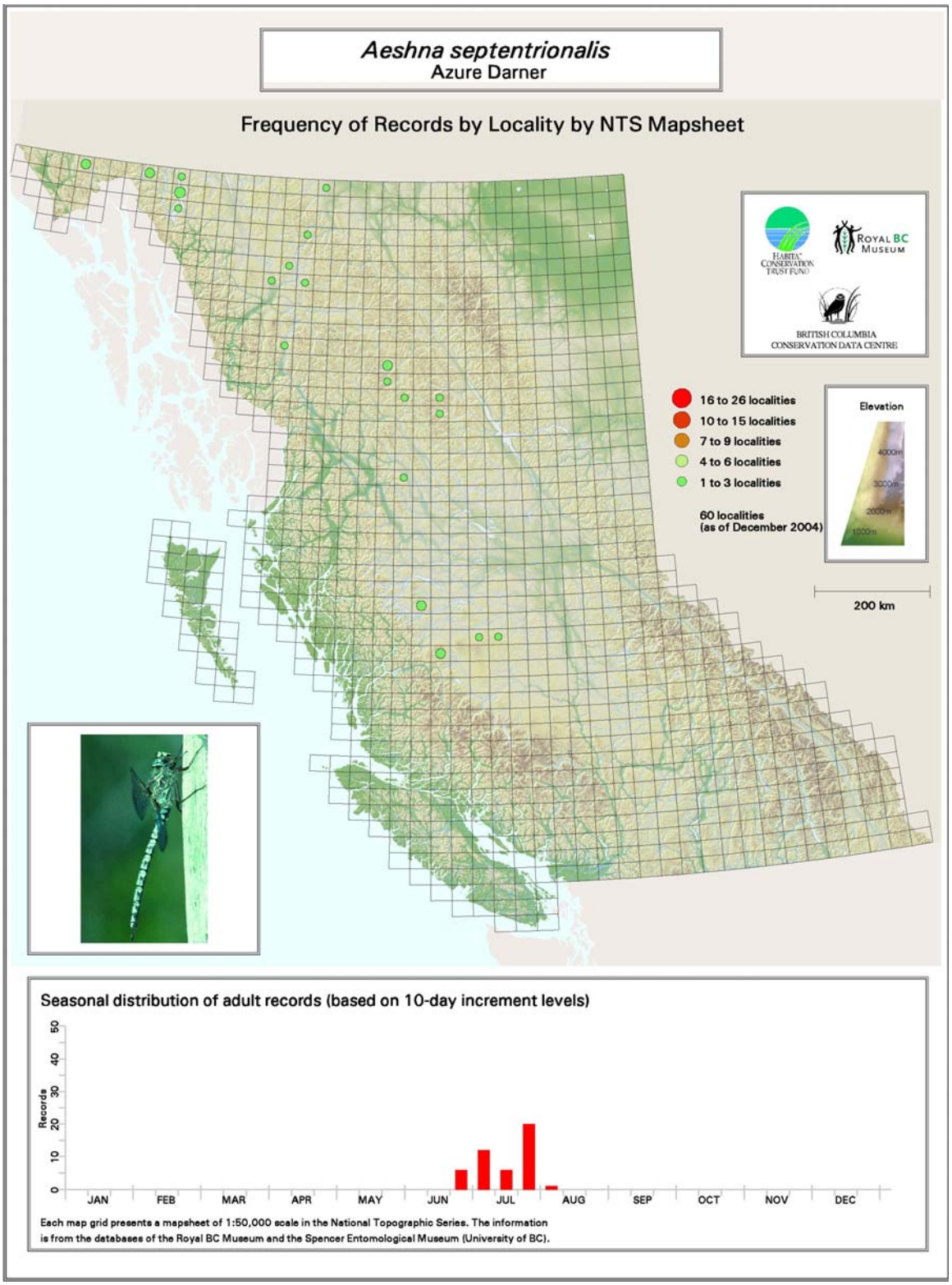
Aeshna septentrionalis Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Aeshna septentrionalis Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



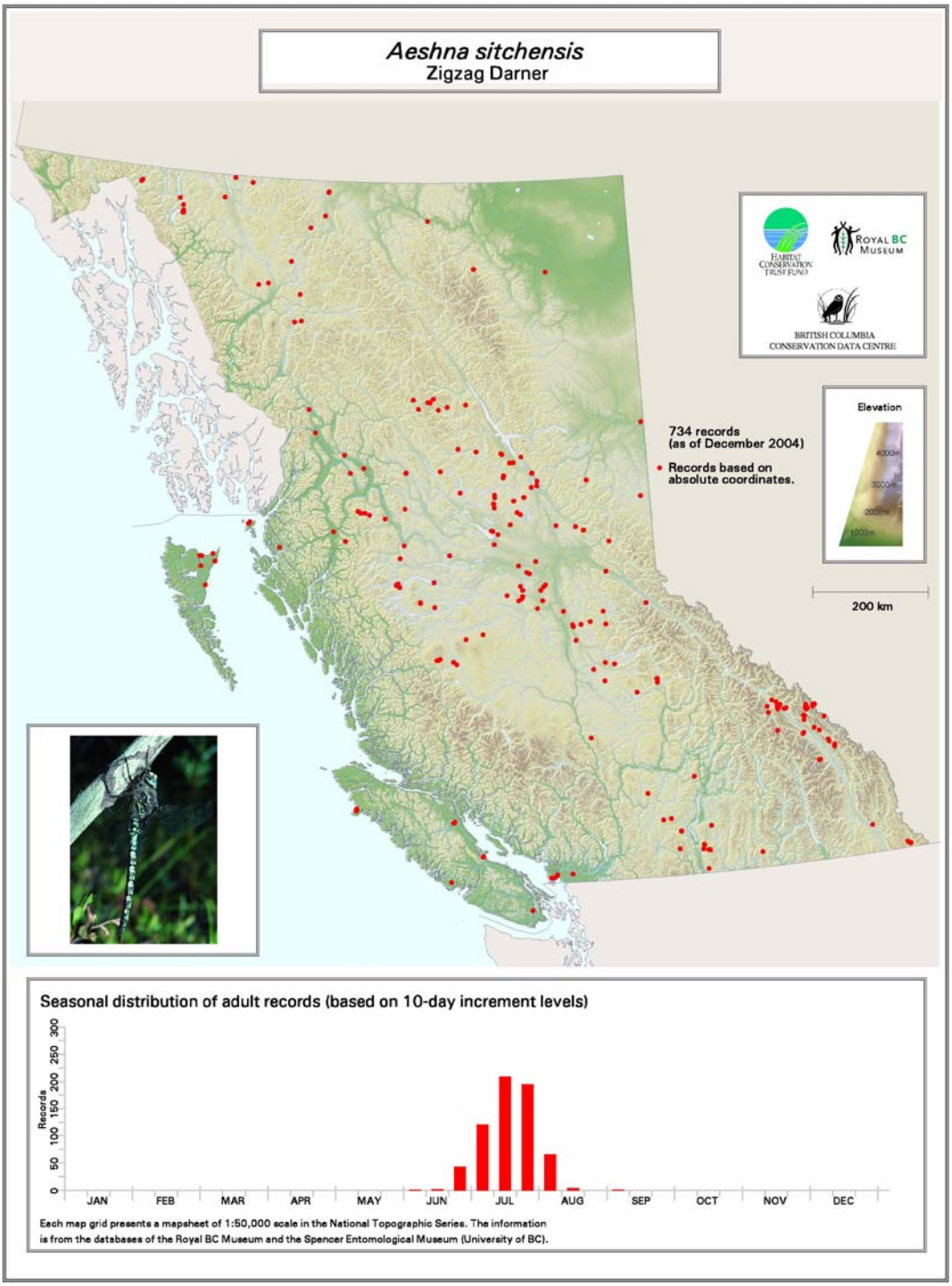
Aeshna septentrionalis Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



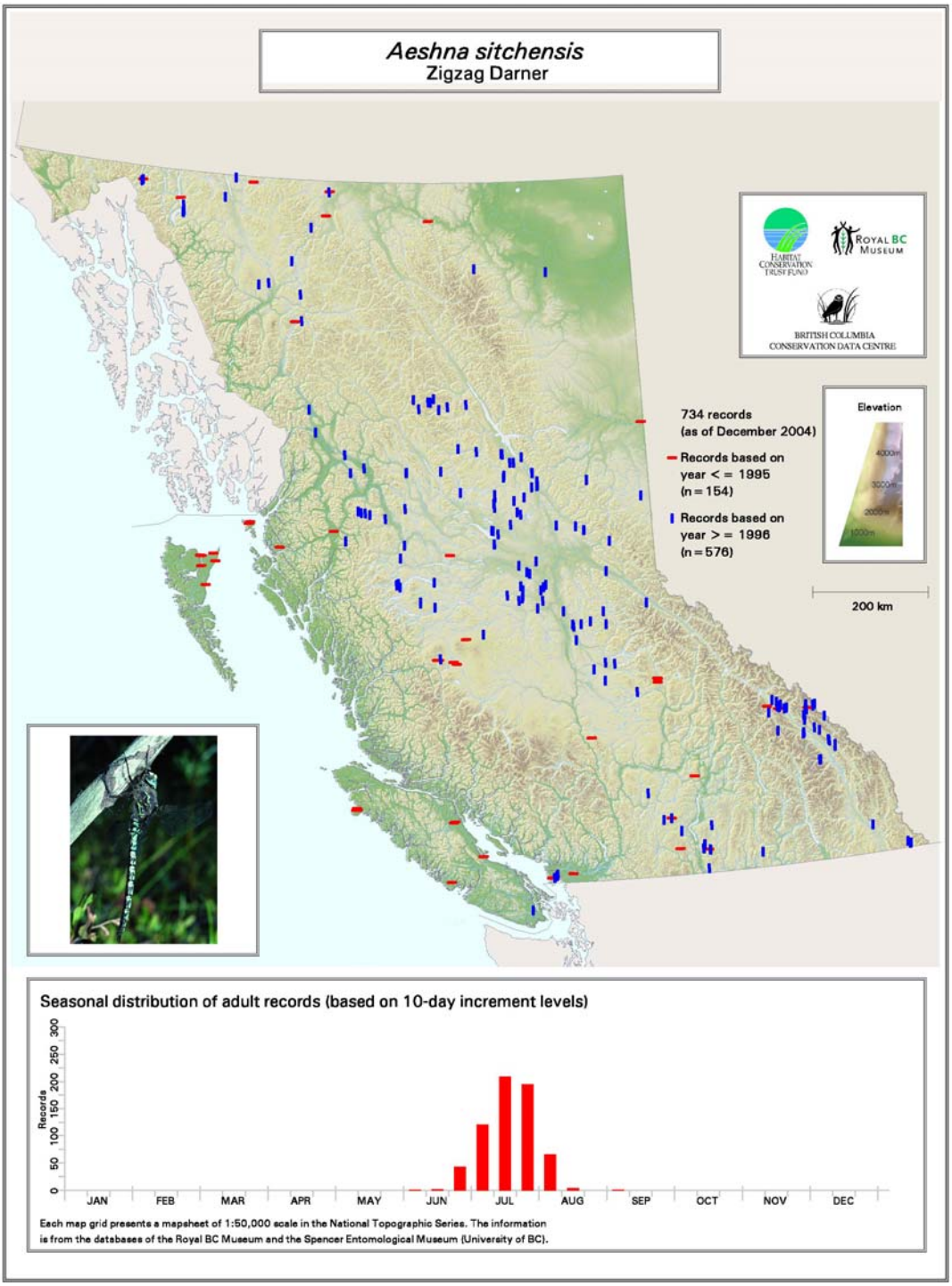
Aeshna septentrionalis Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Aeshna sitchensis* (Zigzag Darner)**
BC conservation rank: S5. Yellow List.
Description: Small, similar to *A. septentrionalis*, but its thorax stripes are yellow to blue, and the hind one is more zigzagged and less T-shaped (fig. 7j); the facial T-spot has a crescent-shaped base (fig. 8a). Male's abdomen has large blue spots, though smaller than those of *A. septentrionalis*. The face is yellow to green. Female's abdominal spots are blue or yellow-green. Male's upper appendages simple (fig. 9a). Length: male 59 mm, female 56 mm.
Global Range: Alaska east to Labrador and Newfoundland; south to Maine, Michigan, Minnesota, Montana, Wyoming, Utah and Washington (Needham *et al.* 2000). Faunal element: Widespread Boreal (see Appendix 3).
Range: Widespread.
Biology: Restricted to specific peatland conditions, where it can be abundant: bogs or fens where the surface is mossy and sparsely vegetated with short, evenly spaced sedges, and where open water, if present at all, is reduced to small, shallow, mud- or moss-bottomed ponds and puddles (07-08; Wb13, 50-52). Adults perch on the ground, rocks and logs, or vertically, low on tree trunks.
BC flight period: mid June to early October; the majority of collections range from early July to mid August.

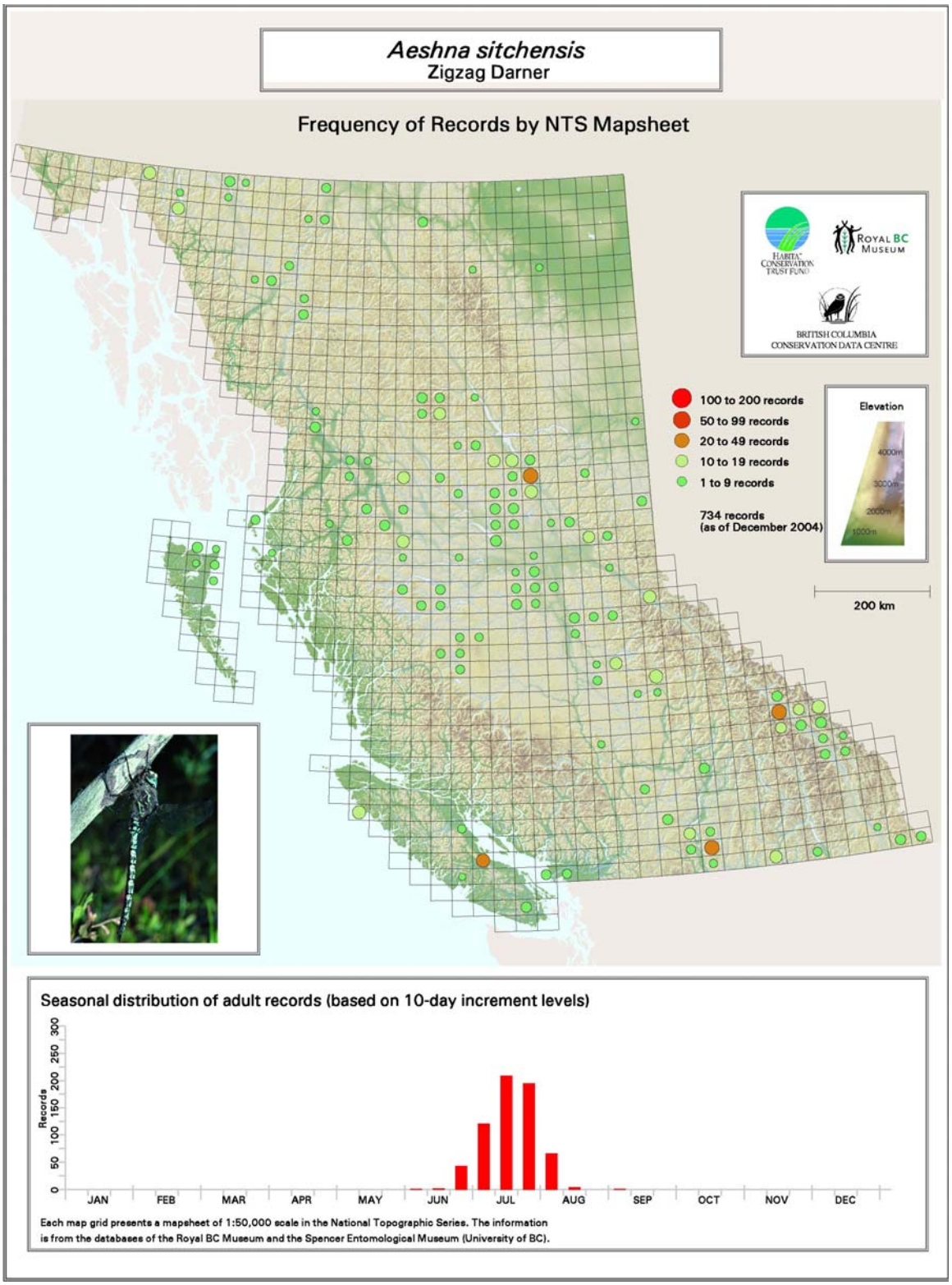
Aeshna sitchensis male. Photograph: Robert A. Cannings



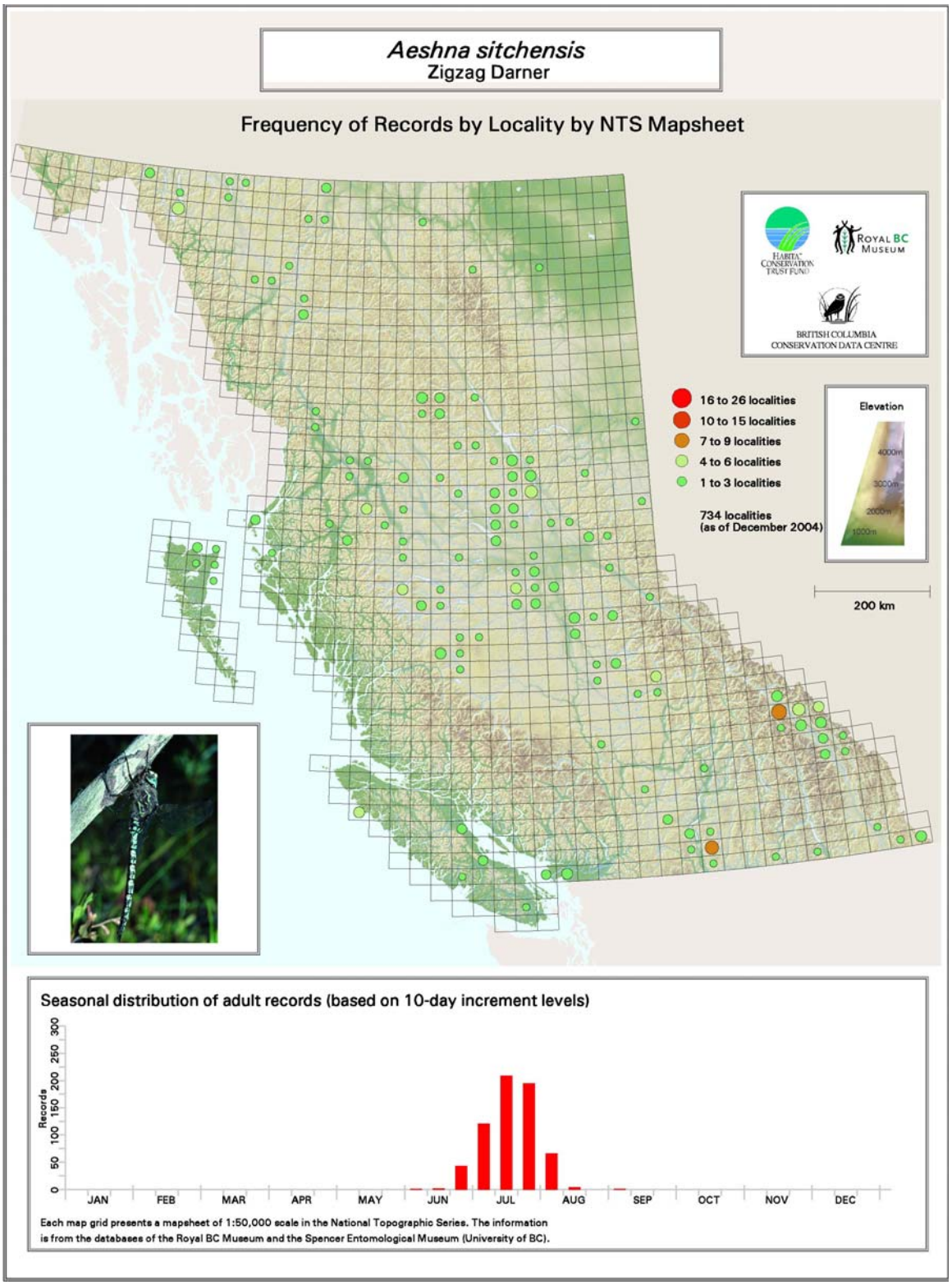
Aeshna sitchensis Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Aeshna sitchensis Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.

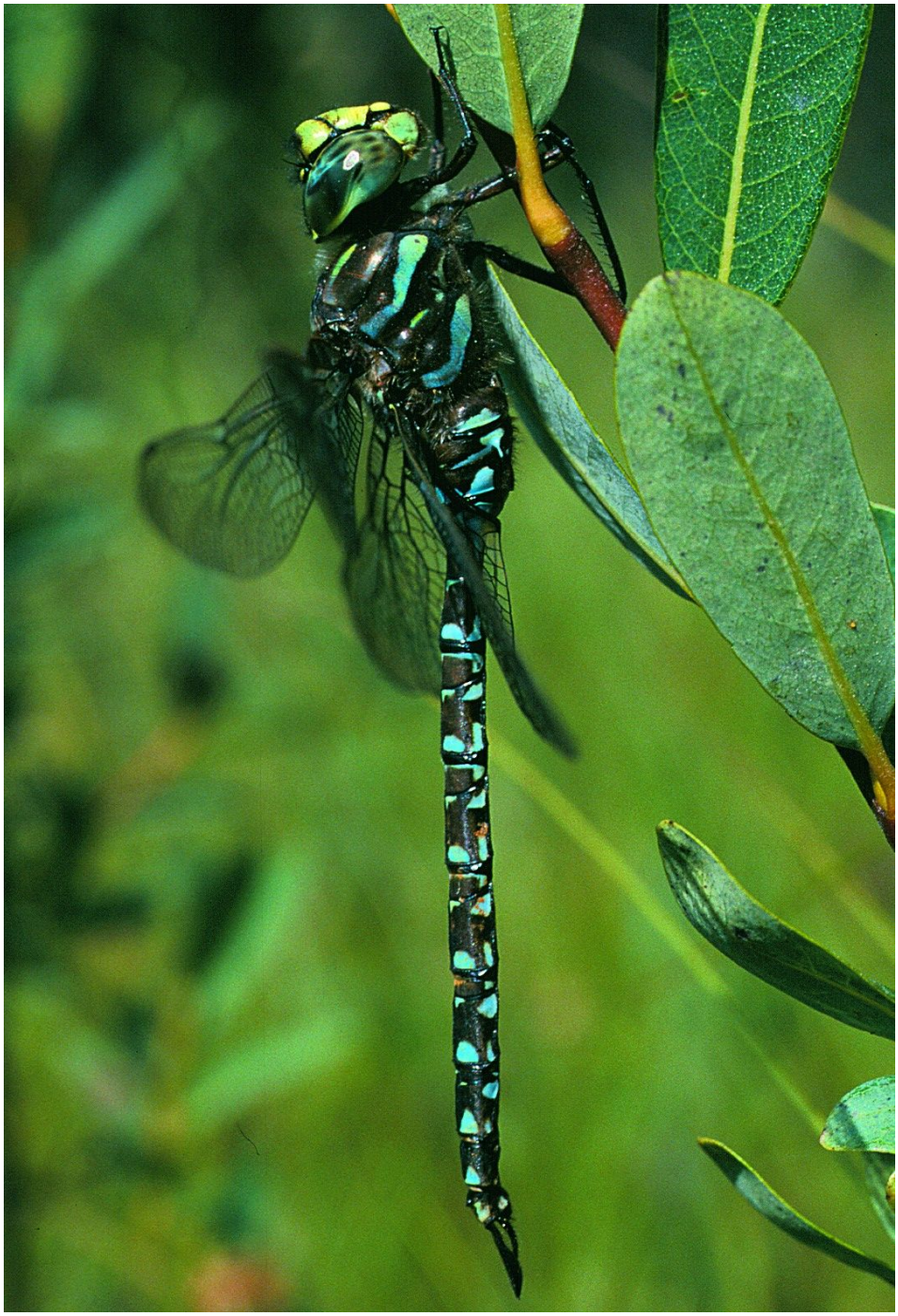


Aeshna sitchensis Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.

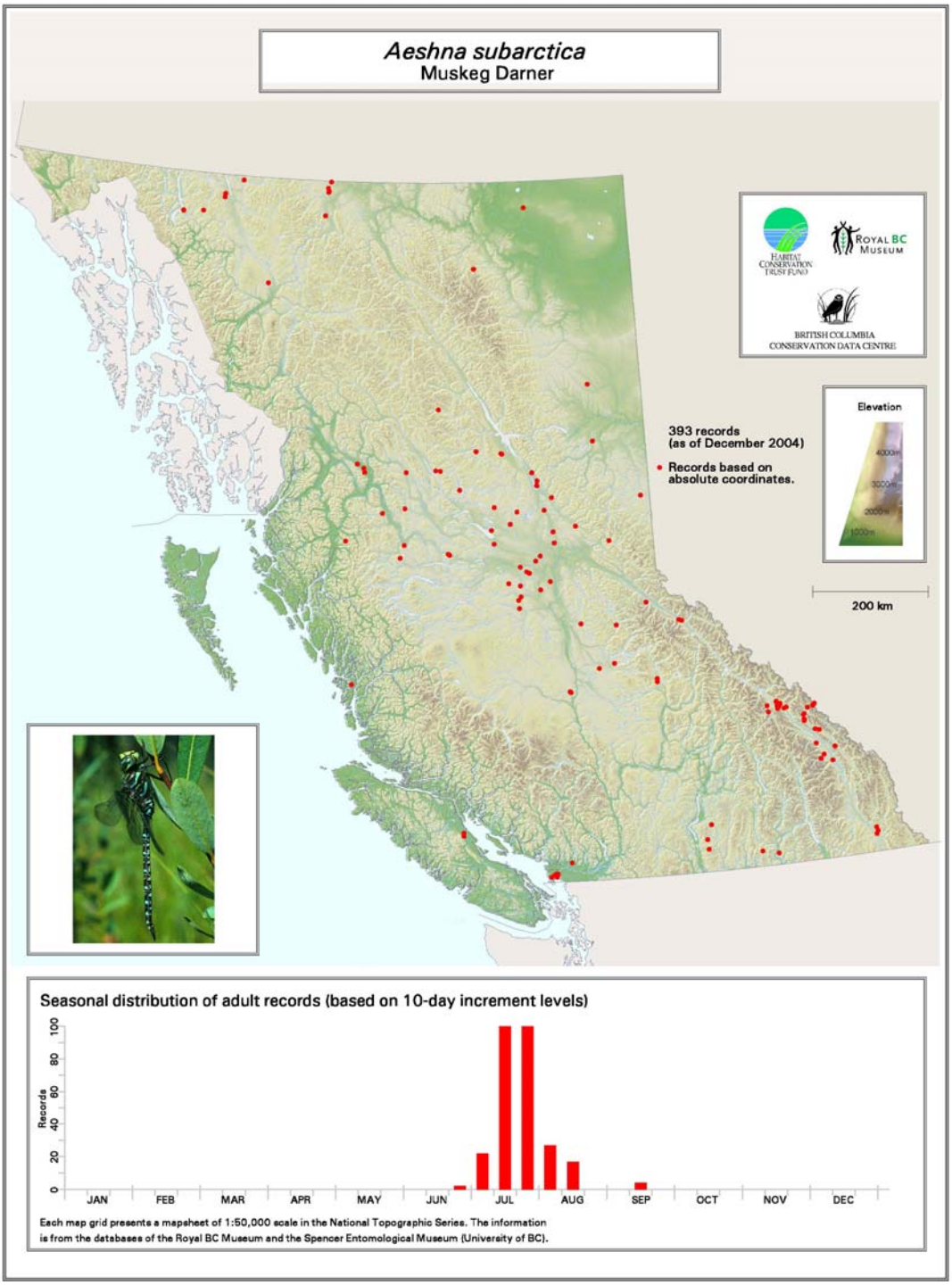


Aeshna sitchensis Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

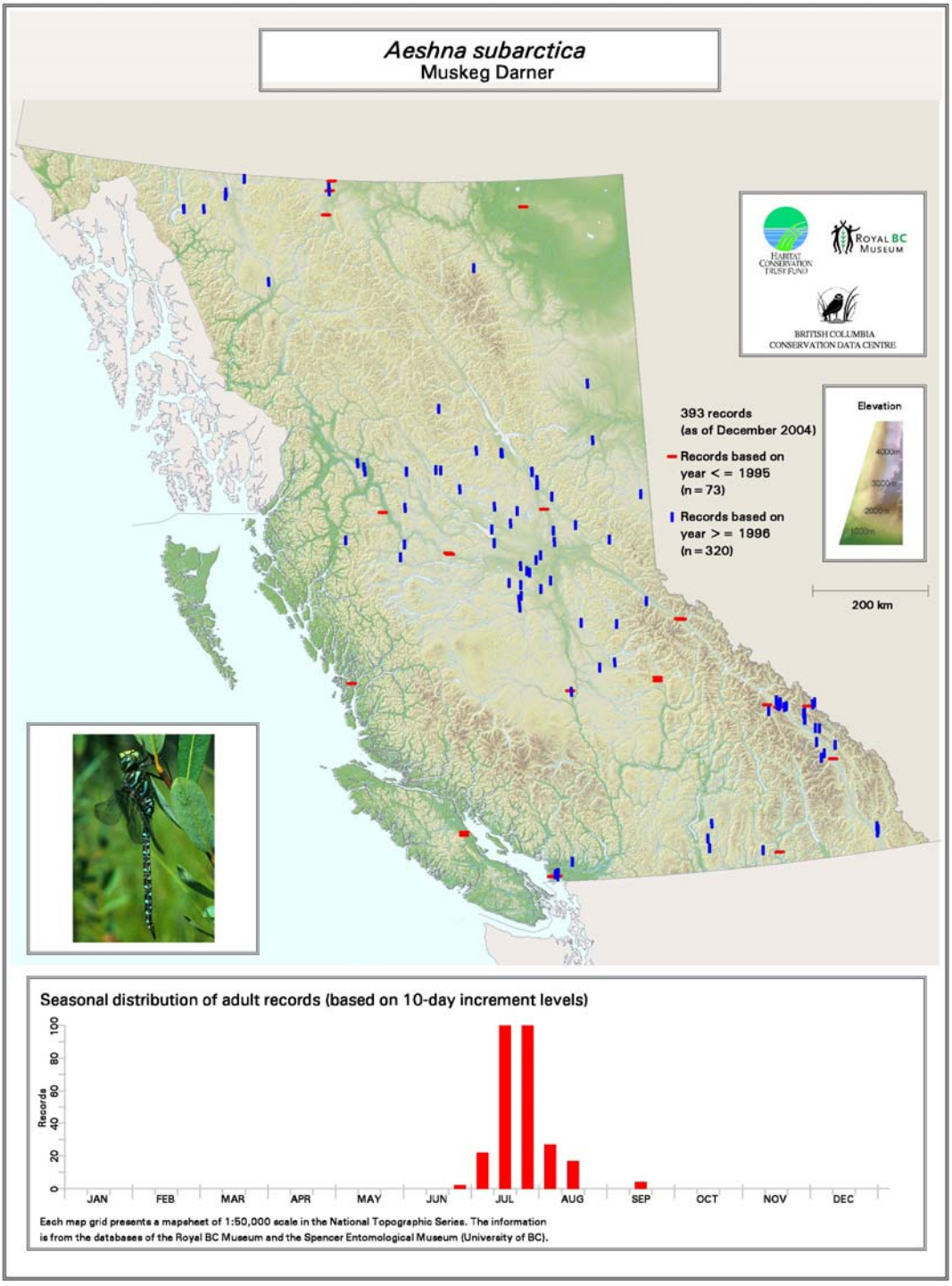
***Aeshna subarctica* (Subarctic Darner)**
BC conservation rank: S5. Yellow List.
Description: Similar to *A. juncea*, but can be distinguished by the thorax stripes, which are shaped differently (fig. 7h) and lack a black border. Male's upper appendages simple (fig. 9a). Length: male 68 mm, female 66 mm.
Global Range: Eurasia; Alaska east to Newfoundland; south to Massachusetts, Michigan, Wyoming and Oregon (Needham *et al*. 2000). Faunal element: Widespread Boreal; Holarctic (see Appendix 3).
BC Distribution: Widespread.
Biology: Especially common on the central plateaus; uncommon on the coast. Lives in peatland habitats – bogs and deep fens that are dominated by aquatic mosses (Wf05-08; Wb13, Wb50).
BC flight period: mid June to early October; almost all records fall between mid July and late August.



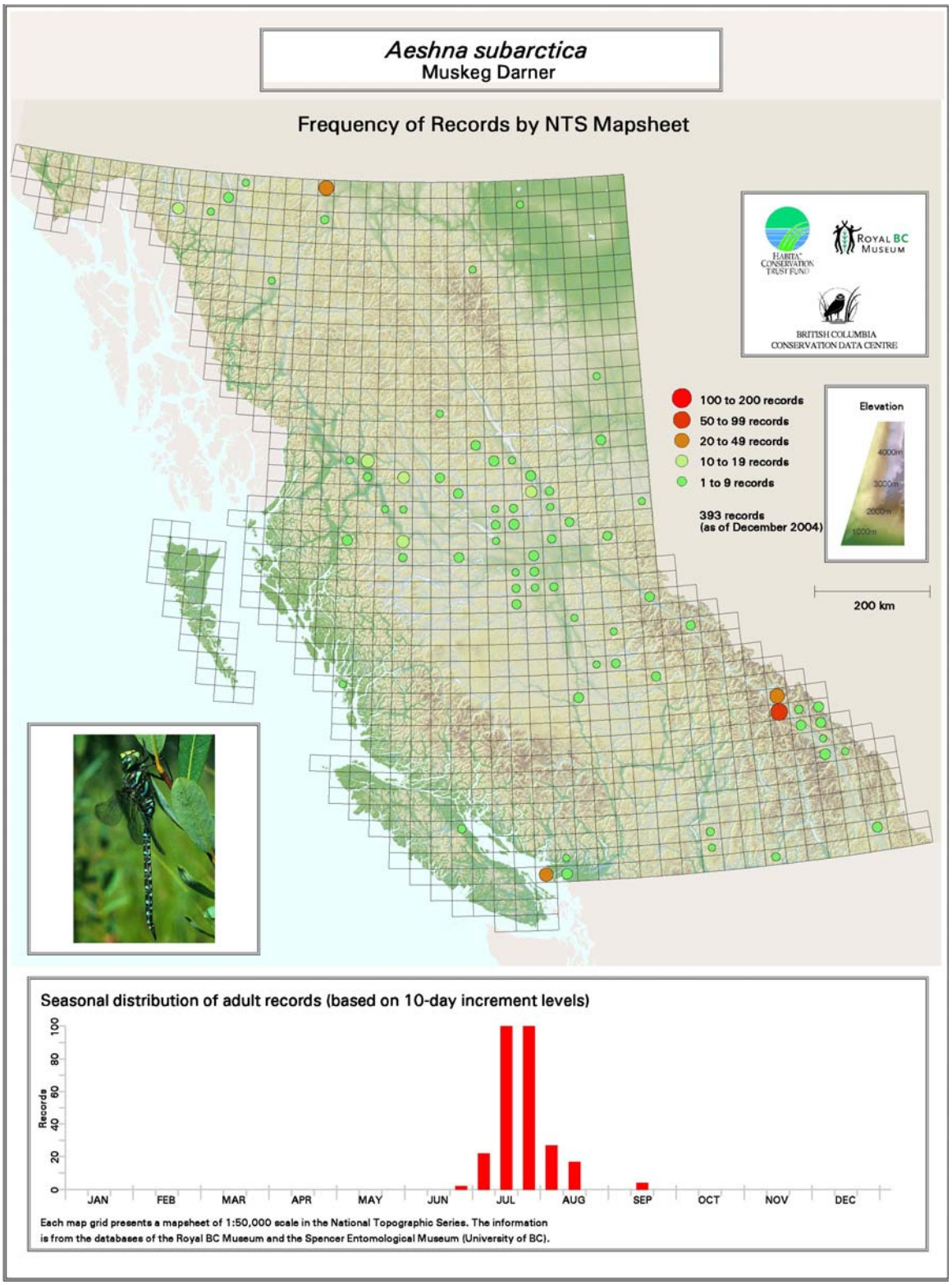
Aeshna subarctica male. Photograph: Robert A. Cannings, RBCM



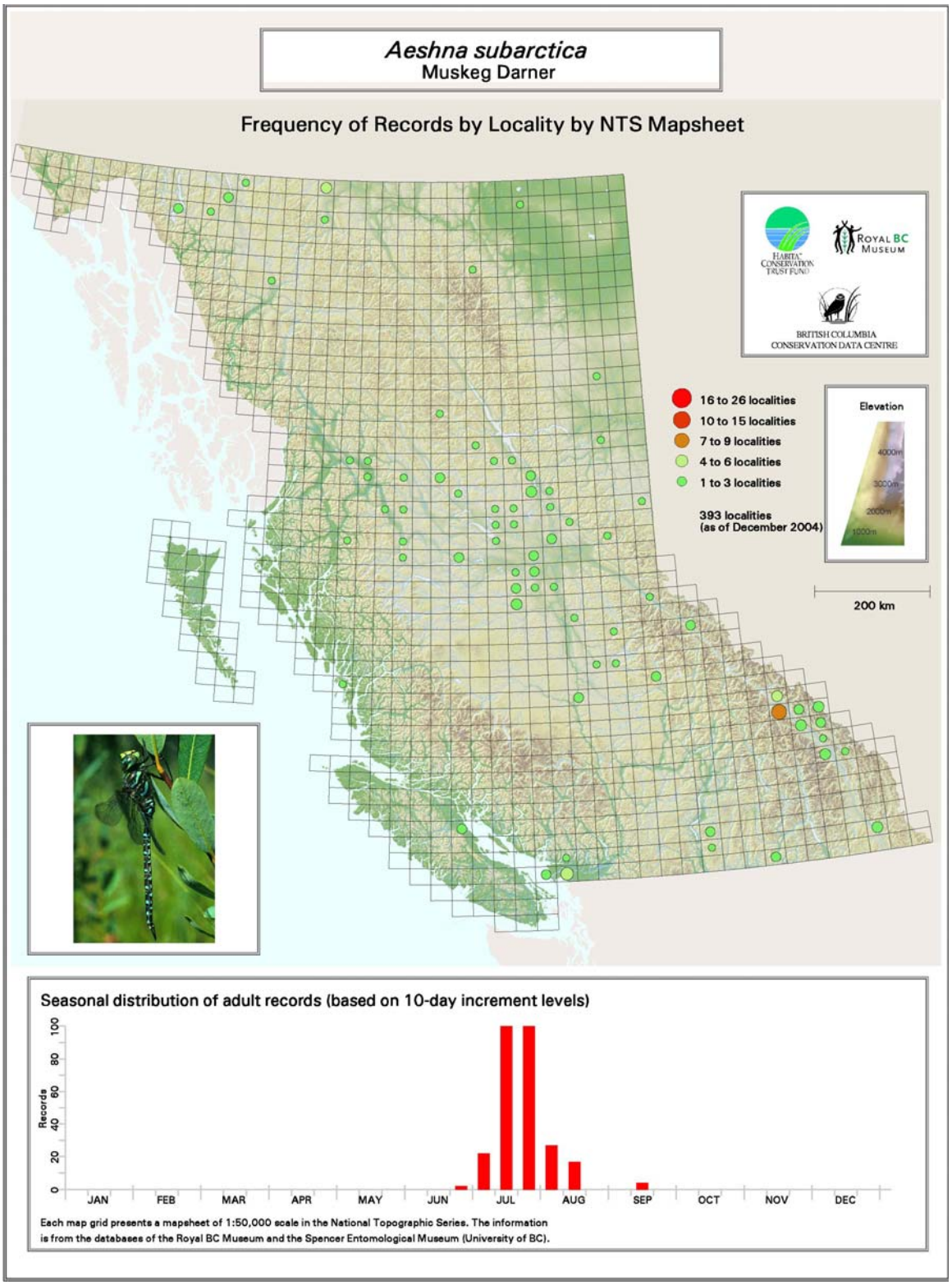
Aeshna subarctica Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Aeshna subarctica Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Aeshna subarctica Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



Aeshna subarctica Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

Aeshna tuberculifera **(Black-tipped Darner)**

BC conservation rank: S4. Yellow List. Northern surveys added greatly to the number of records of this uncommon species; the rank has been down-listed from S2S3 in 1995 to S3 in 2000 to S4 at present.

Description: Large and slender. Thorax stripes are green to blue; shape, fig. 7a. Its face is green, the face line thin and pale brown or absent. Segment 10 of the abdomen is all black, as the English name indicates. Female's abdomen has blue spots, like the male's. Male's upper appendages simple (fig. 9a) with a tubercle underneath near the base; female's appendages are large. Length: male 73 mm, female 75 mm.

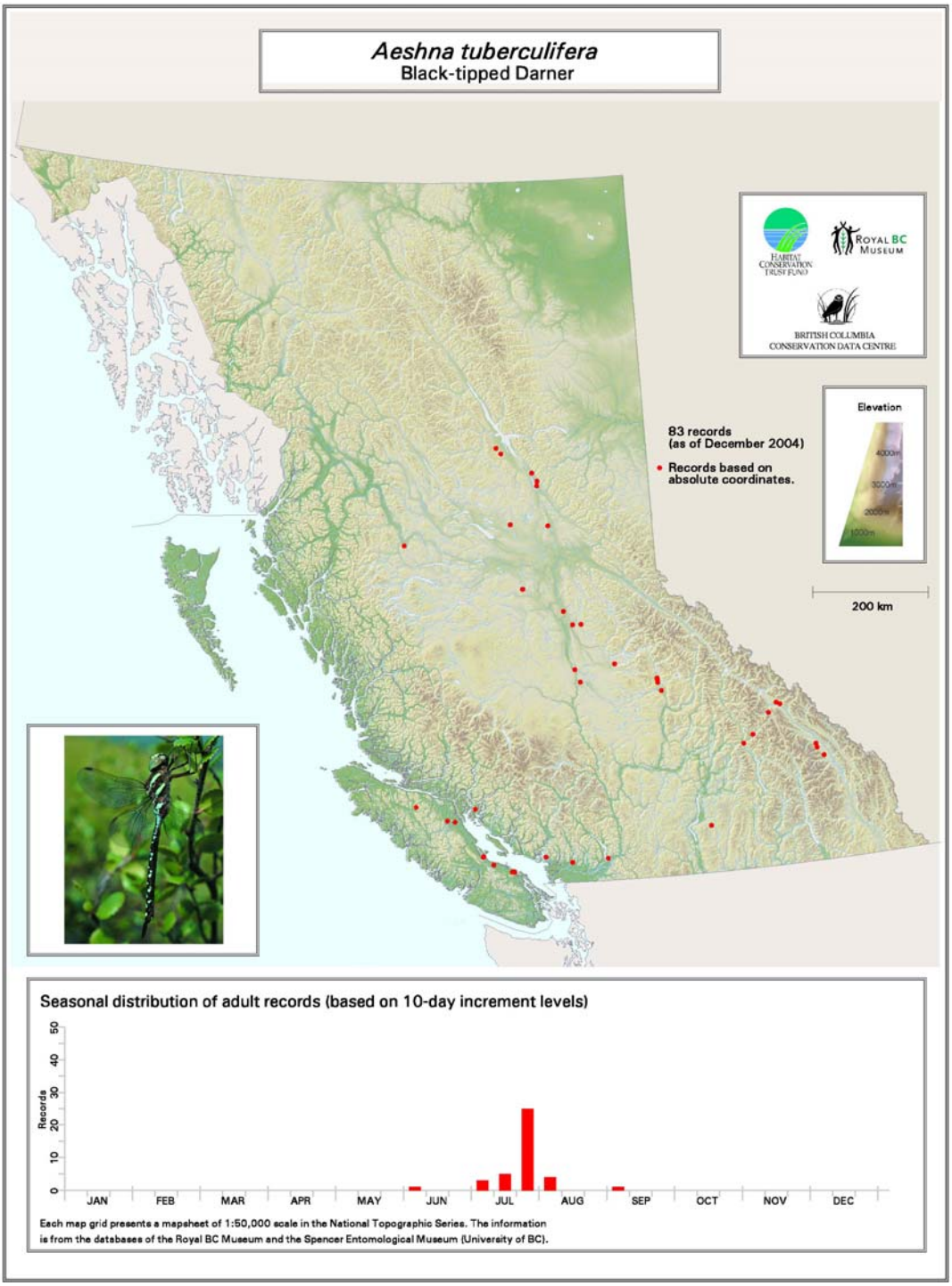
Global Range: British Columbia east to Nova Scotia; south to Virginia, Ohio, Iowa, Montana and Washington (Catling *et al.* 2005, Needham et al. 2000). Faunal element: Transition (see Appendix 3).

BC Distribution: Sparsely distributed across the moister regions of southern and central BC. north to Williston Lake.

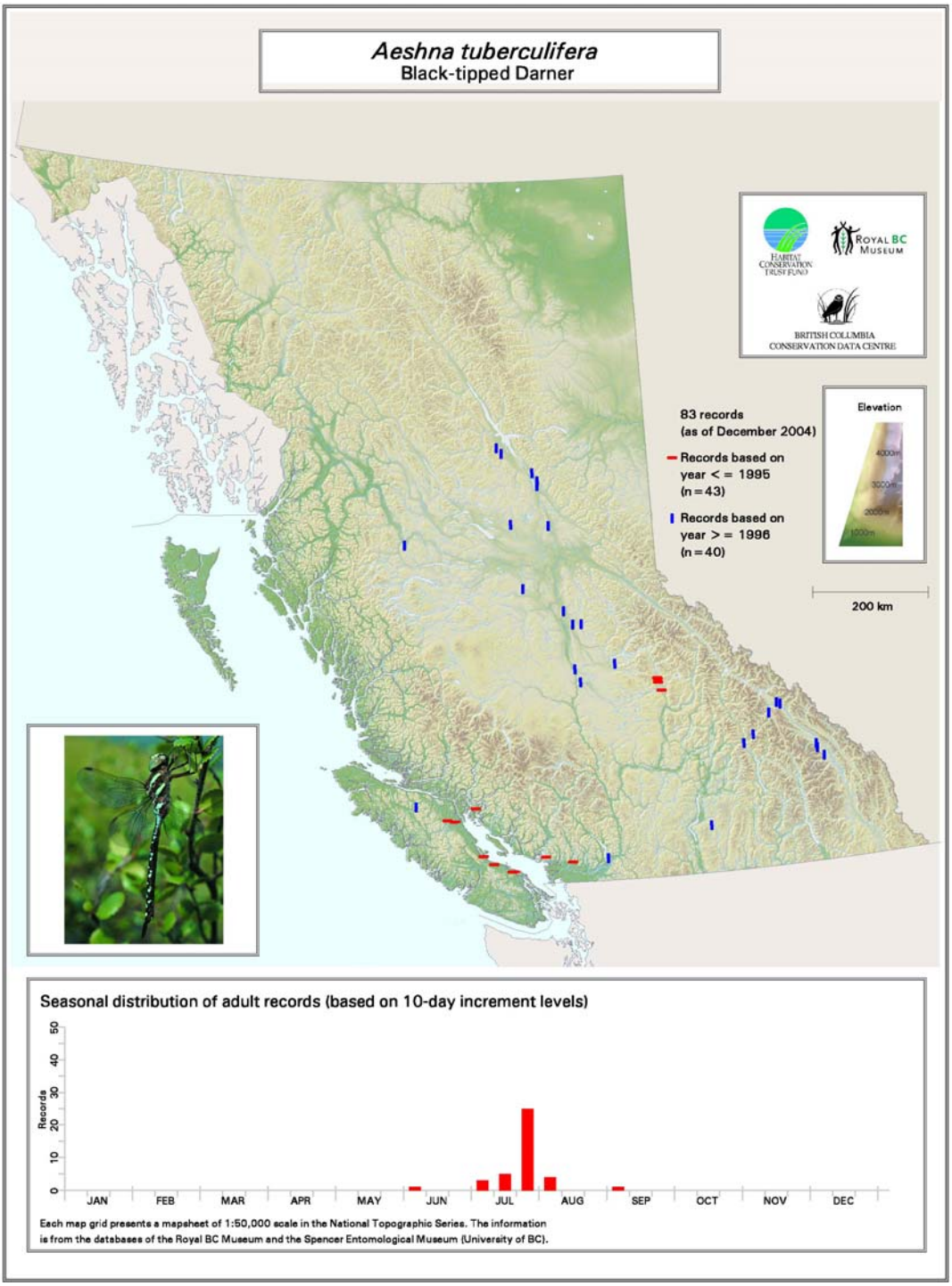
Biology: An uncommon dragonfly of peatland pools and peat-margined lakes (Wf05-08; Wb13, Wb50). Unlike most mosaic darners, females patrol like males and often lay eggs in vegetation above the waterline. Presumably, this behaviour reduces the amount of attention that males give them, allowing more time for uninterrupted egg-laying.

BC flight period: mid June to early October; most records are from mid July to mid August.

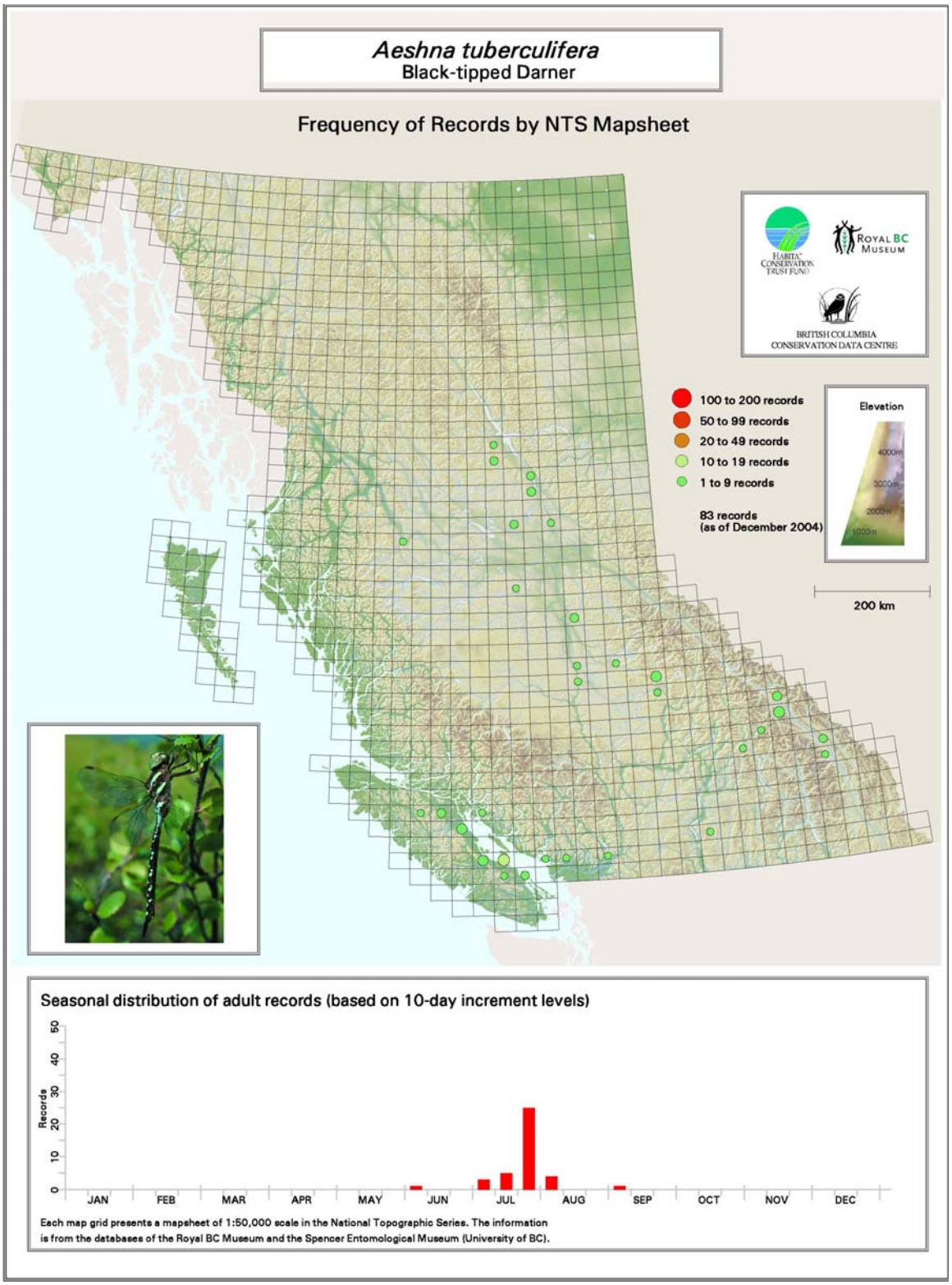
Aeshna tuberculifera male. Photograph: Robert A. Cannings, RBCM



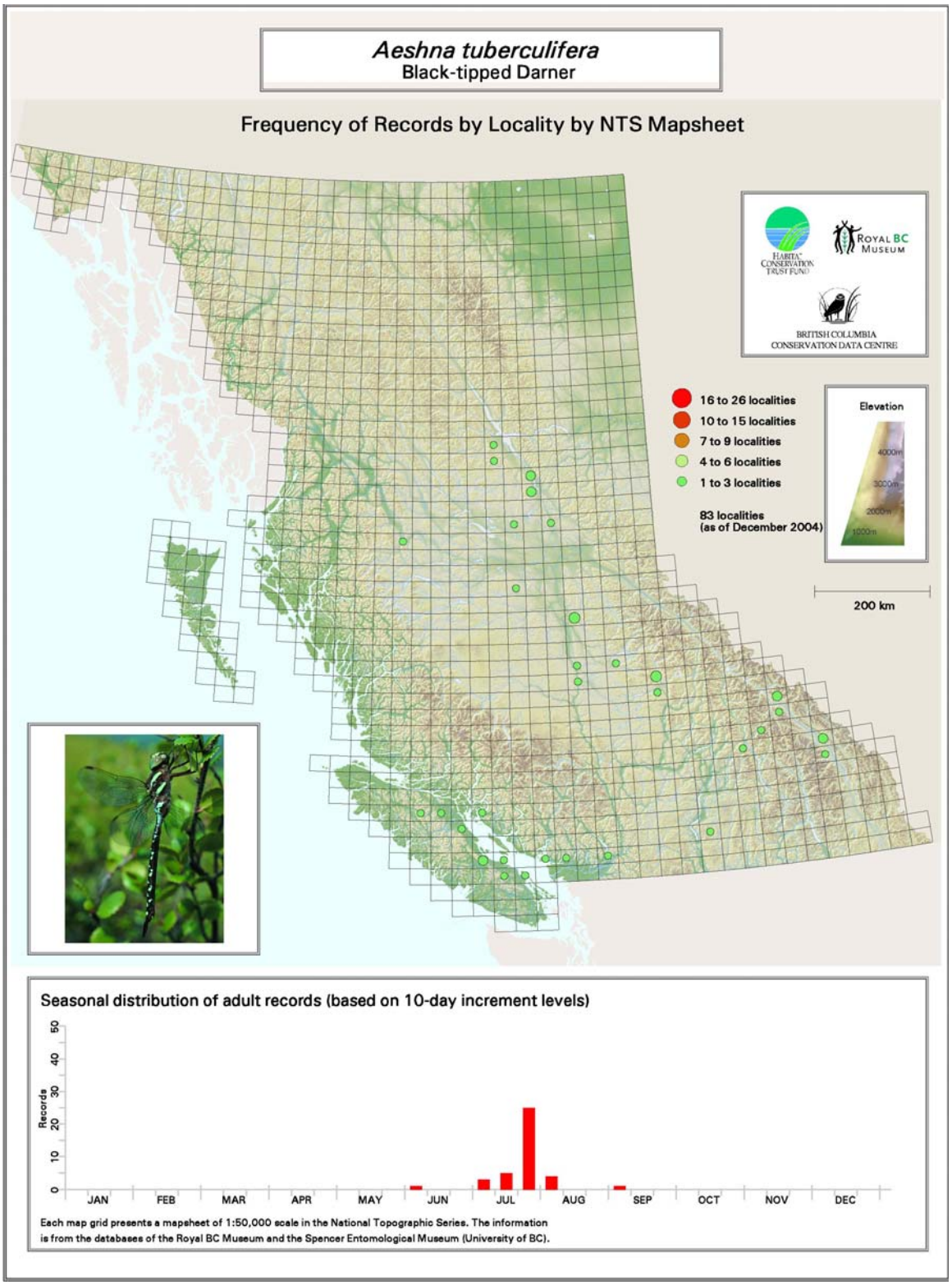
Aeshna tuberculifera Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Aeshna tuberculifera Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



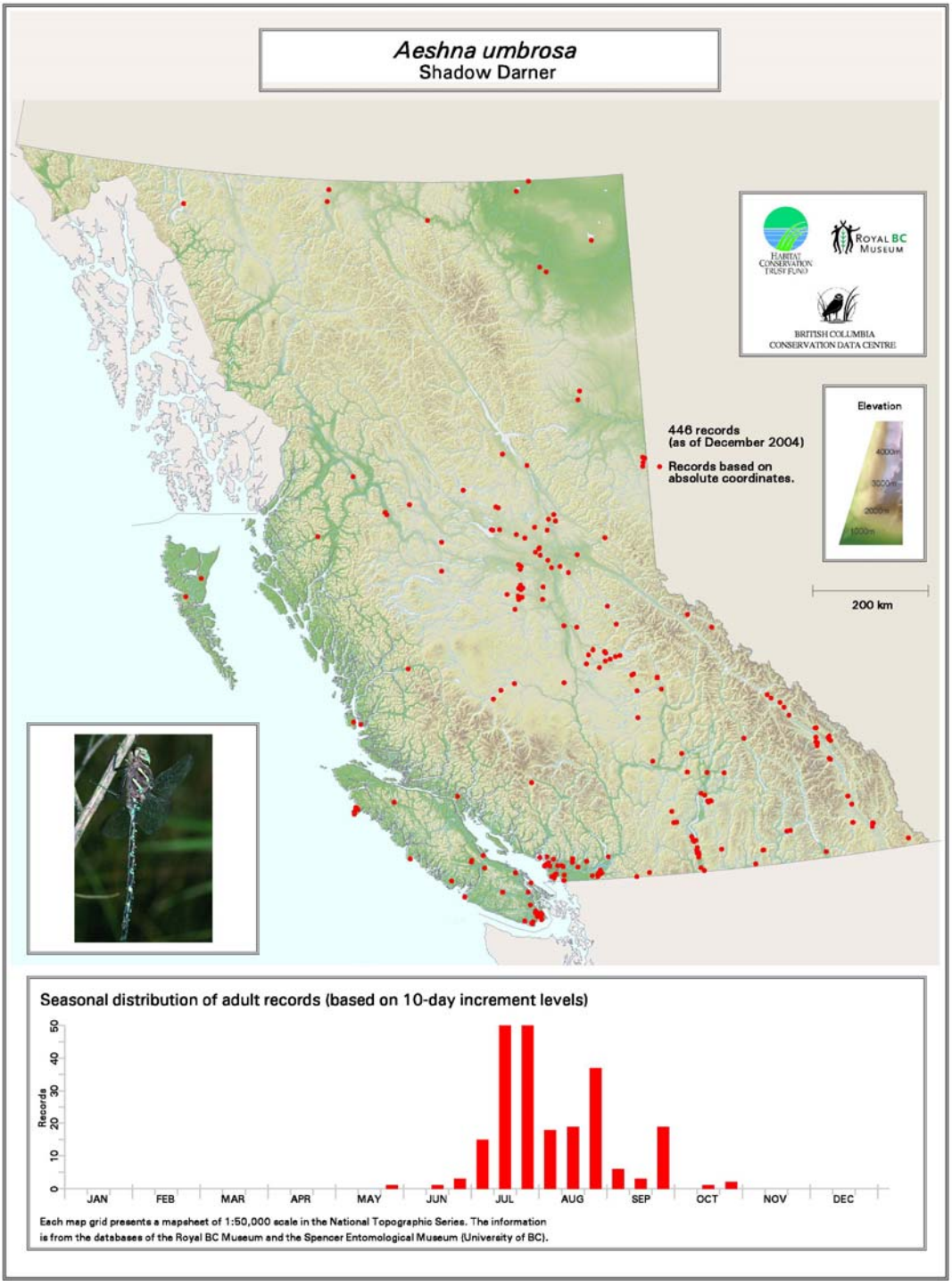
Aeshna tuberculifera Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



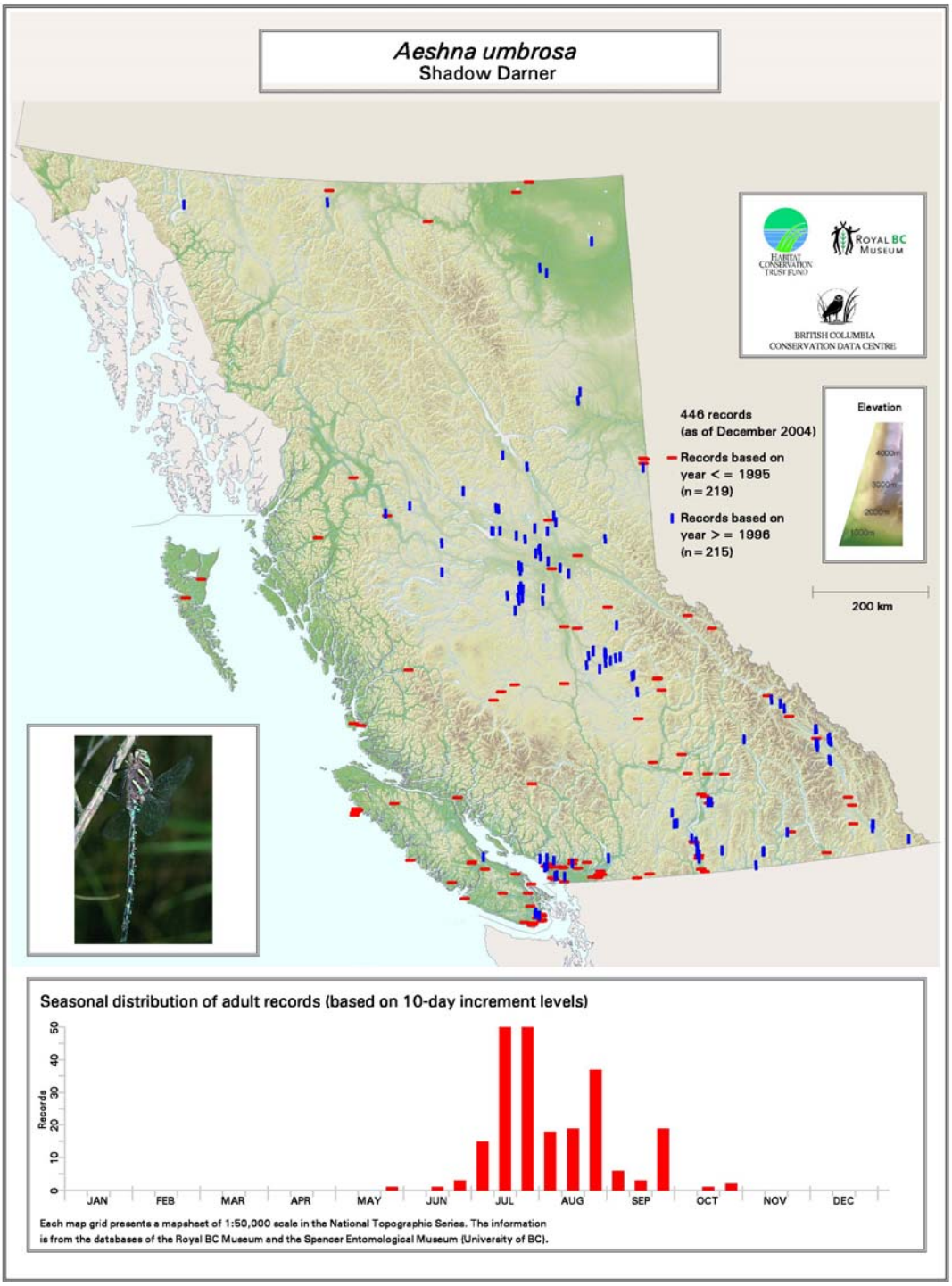
Aeshna tuberculifera Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Aeshna umbrosa* (Shadow Darner)**
BC conservation rank: S5. Yellow List.
Description: Similar to *A. palmata*, but darker and more slender. Thorax stripes are yellow to green, often blue above and outlined with dark brown; shape, fig. 7k. The face is pale green with a pale brown line or no line; the rear of the head is partly pale. Spots on top of the abdominal segments are green or blue; segment 10 is usually black on top. The underside of the abdomen has pale blue spots. The pale areas on females are green, yellow or, rarely, blue. Male's upper appendages flattened (fig. 9c). Length: male 70 mm, female 68 mm.
Global Range: Yukon and British Columbia east to Labrador and Newfoundland; south to Alabama, Oklahoma, New Mexico and California (Needham et al. 2000). Faunal element: Transition (see Appendix 3).
BC Distribution: Widespread.
Biology: More common in the south; uncommon in the far North. Partial to forest lakes and slow-moving streams; as its name suggests, it likes shady habitats (e.g., Wm01-02, Wm04-06; Wf01, Wf06; Wb50-52. Often found alongside *A. palmata*, its close and usually more common relative. The Shadow Darner is one of the latest flying species in BC, especially in the south.
BC flight period: early June to mid November; most records range from early July to early October.

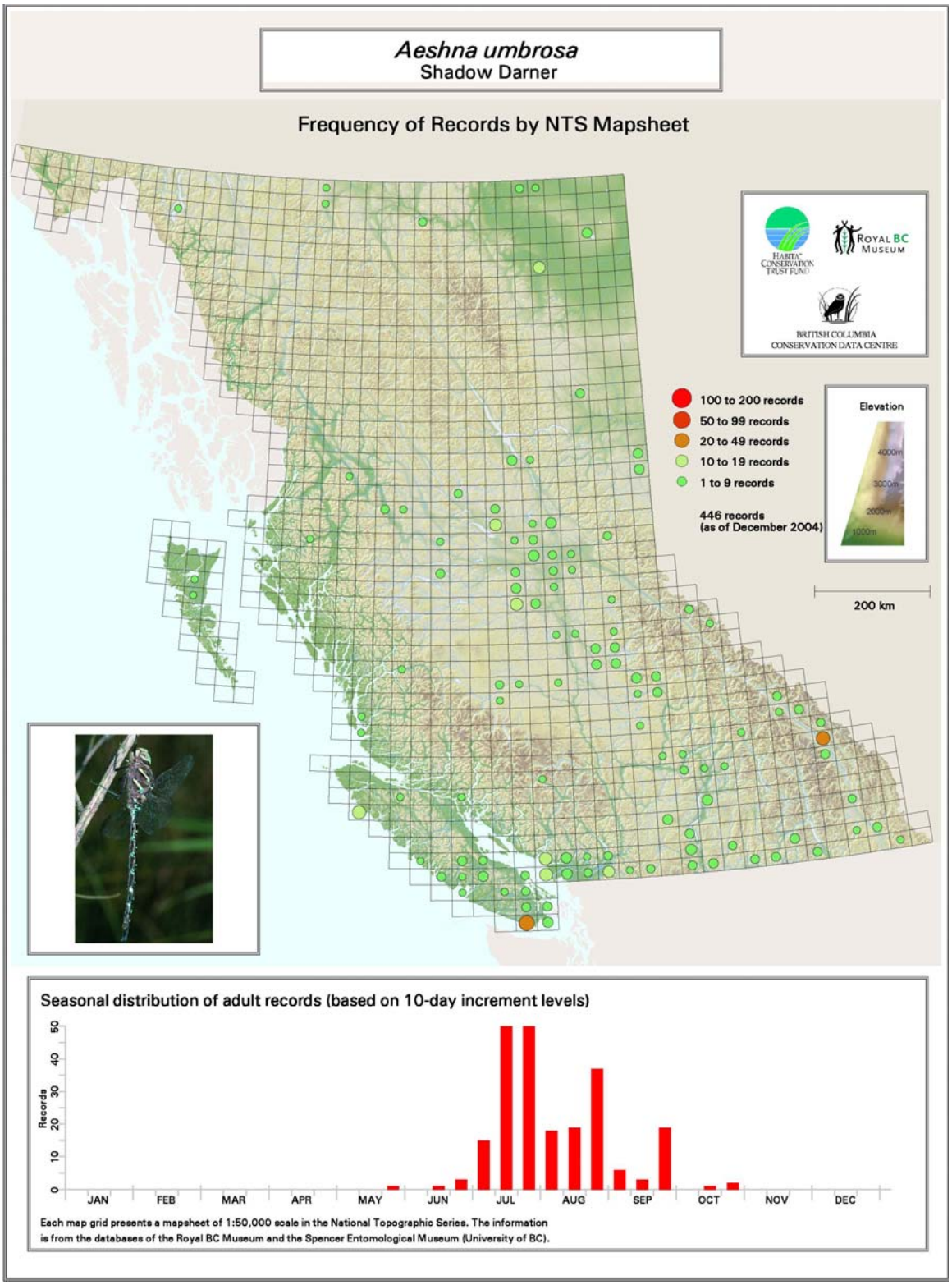
Aeshna umbrosa male. Photograph: George Doerksen, RBCM



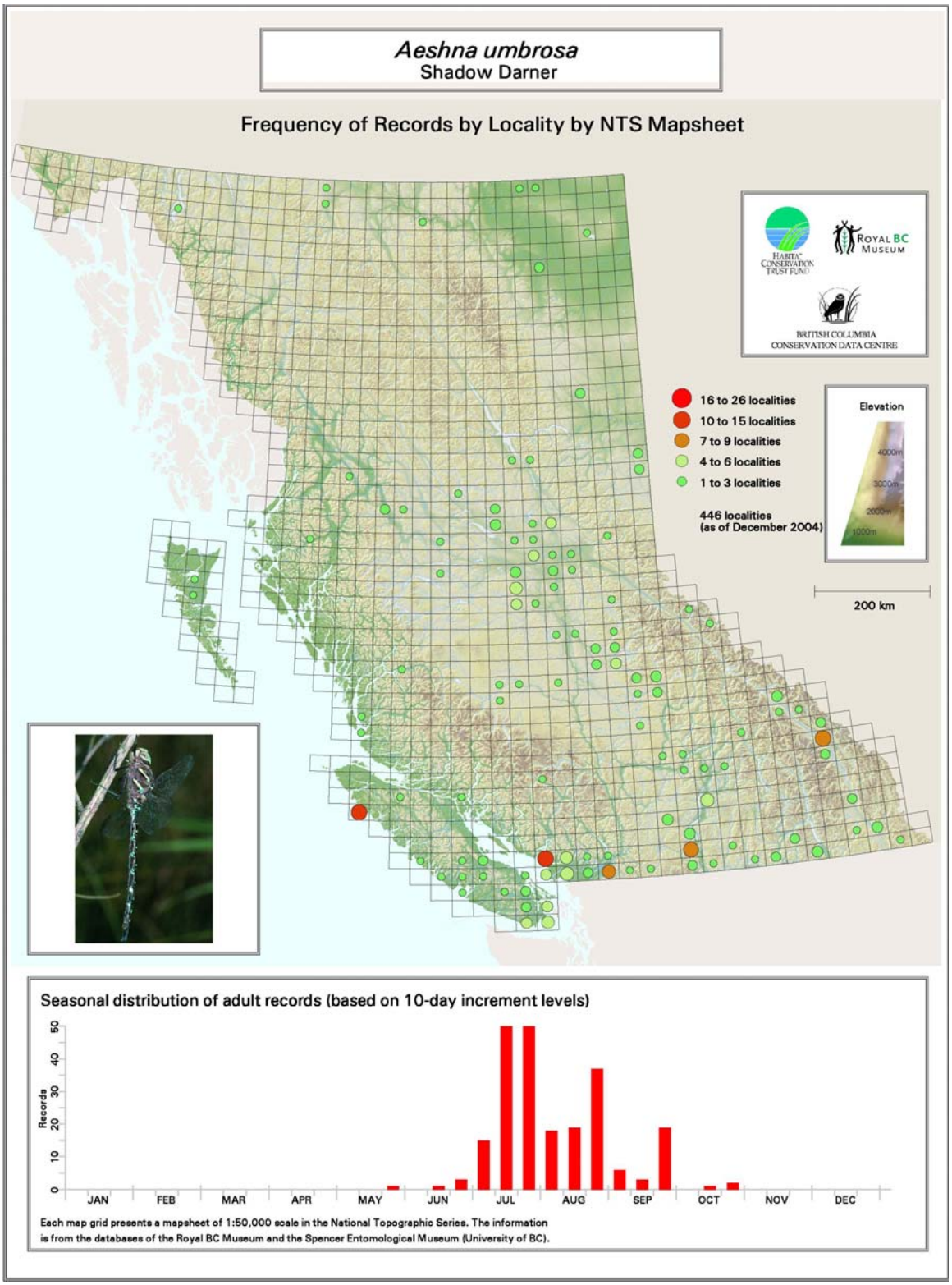
Aeshna umbrosa Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Aeshna umbrosa Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Aeshna umbrosa Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.

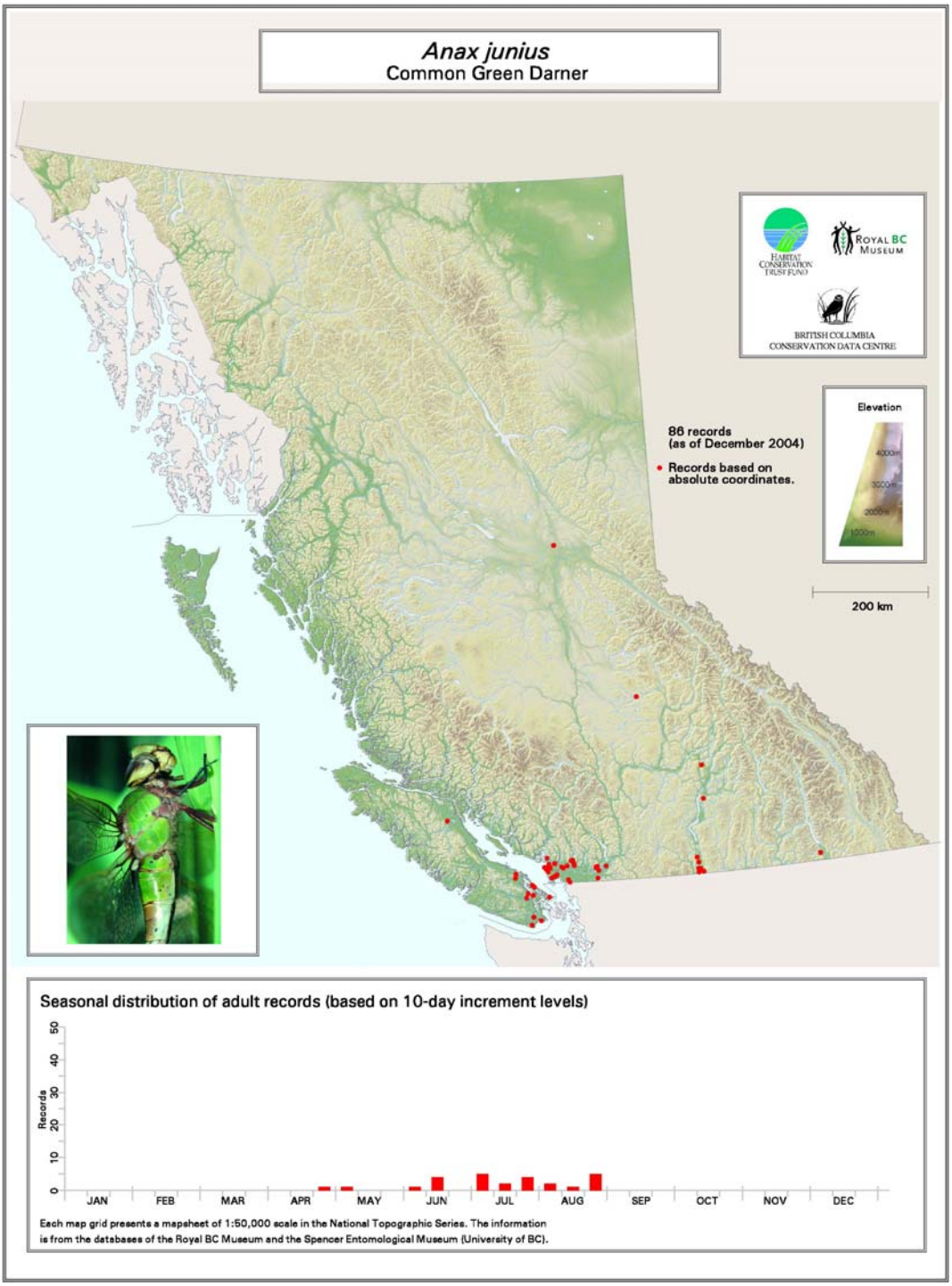


Aeshna umbrosa Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

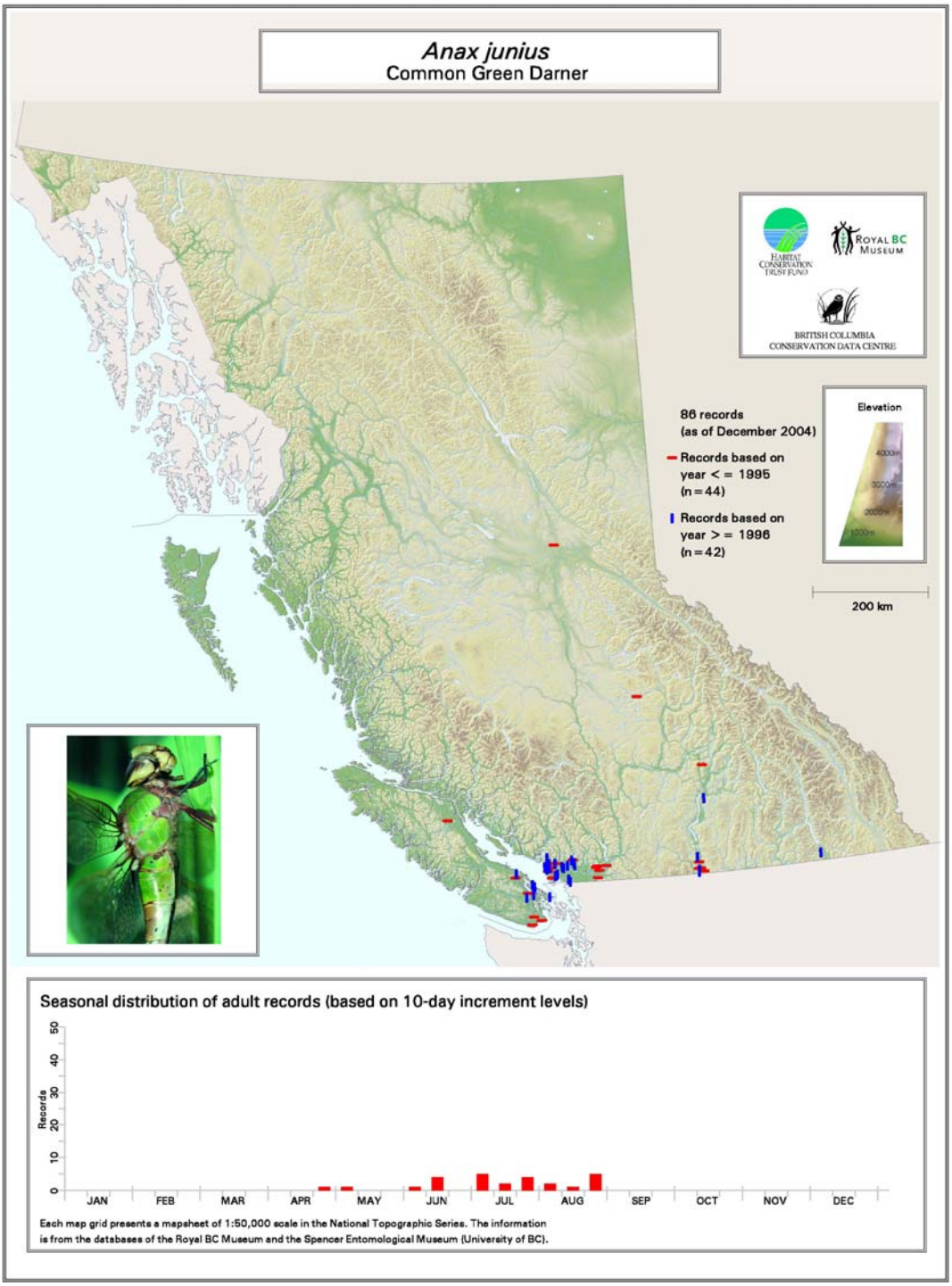
***Anax* (Green Darners)**
Four species of this cosmopolitan genus live in North America, but only one reaches BC from the south.

***Anax junius* (Common Green Darner)**
BC conservation rank: S5. Yellow List.
Description: One of our largest dragonflies, with a wingspan of almost 12 cm. The thorax is unmarked and green. Viewed from above, the forehead bears a black spot in a blue patch. The abdomen has a dark centre stripe; on immatures, the sides are reddish, but with age the male's become blue and the female's grey-green to violet. Length: male female 75 mm.
Global Range: Southern British Columbia east to Nova Scotia; south throughout all the U.S. states, northern Mexico and the Caribbean. (Needham *et al.* 2000). Faunal element: Austral (also in parts of Asia and Oceania) (see Appendix 3).
BC Distribution: Southern BC to the Prince George region.
Biology: Uncommon across southern BC, but common in some coastal localities. Develops in warm marshes and ponds at low elevations (Wm04-06). Southern Canada appears to have two populations — one seems to migrate north in the spring and lays eggs, their offspring developing rapidly and flying south in August and September; the other population is resident all year round, the adults taking flight in June and July.
BC flight period: late April to early October; all records range from early May to early September.

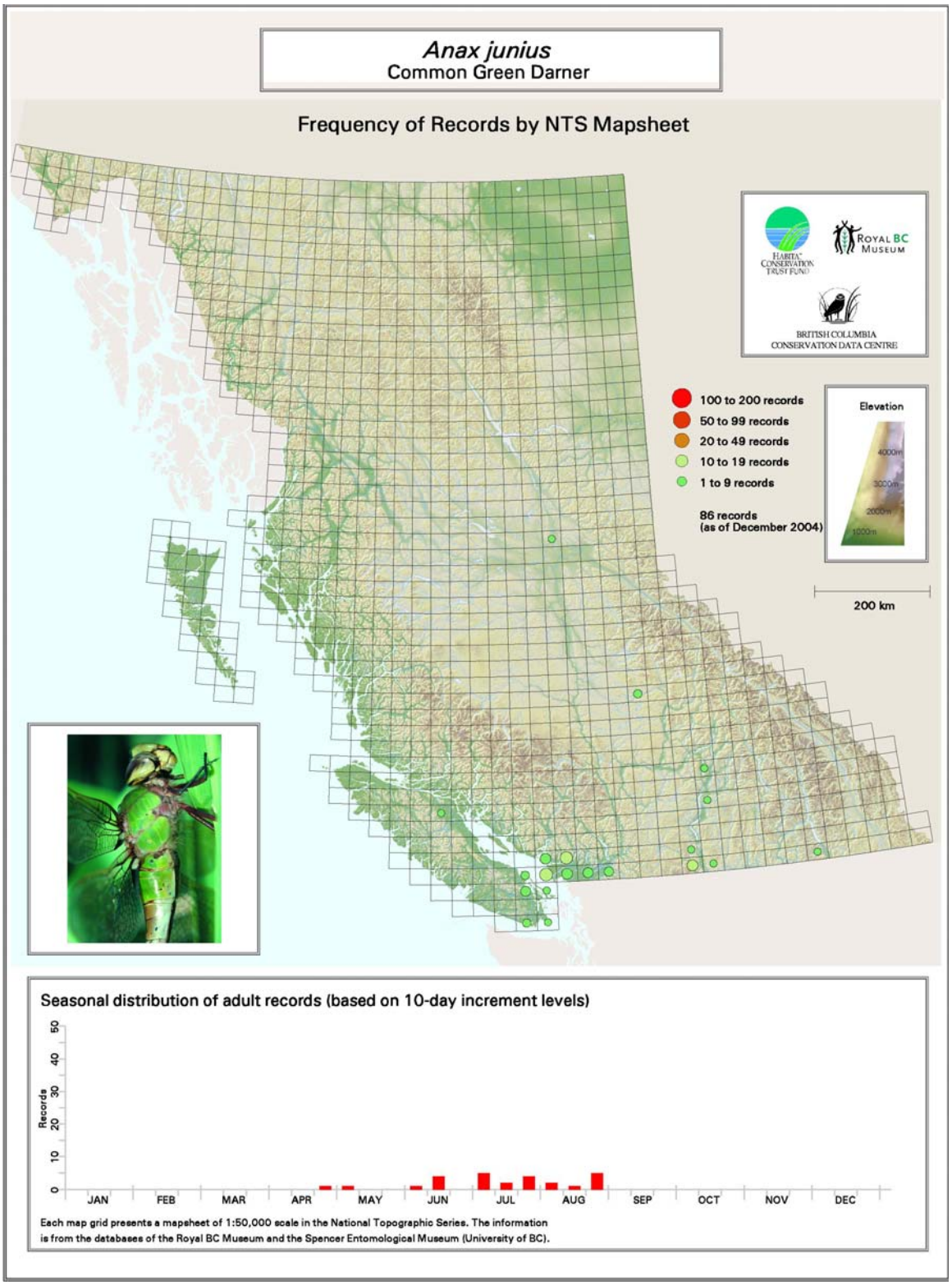
Anax junius feamle. Photograph: George Doerksen, RBCM



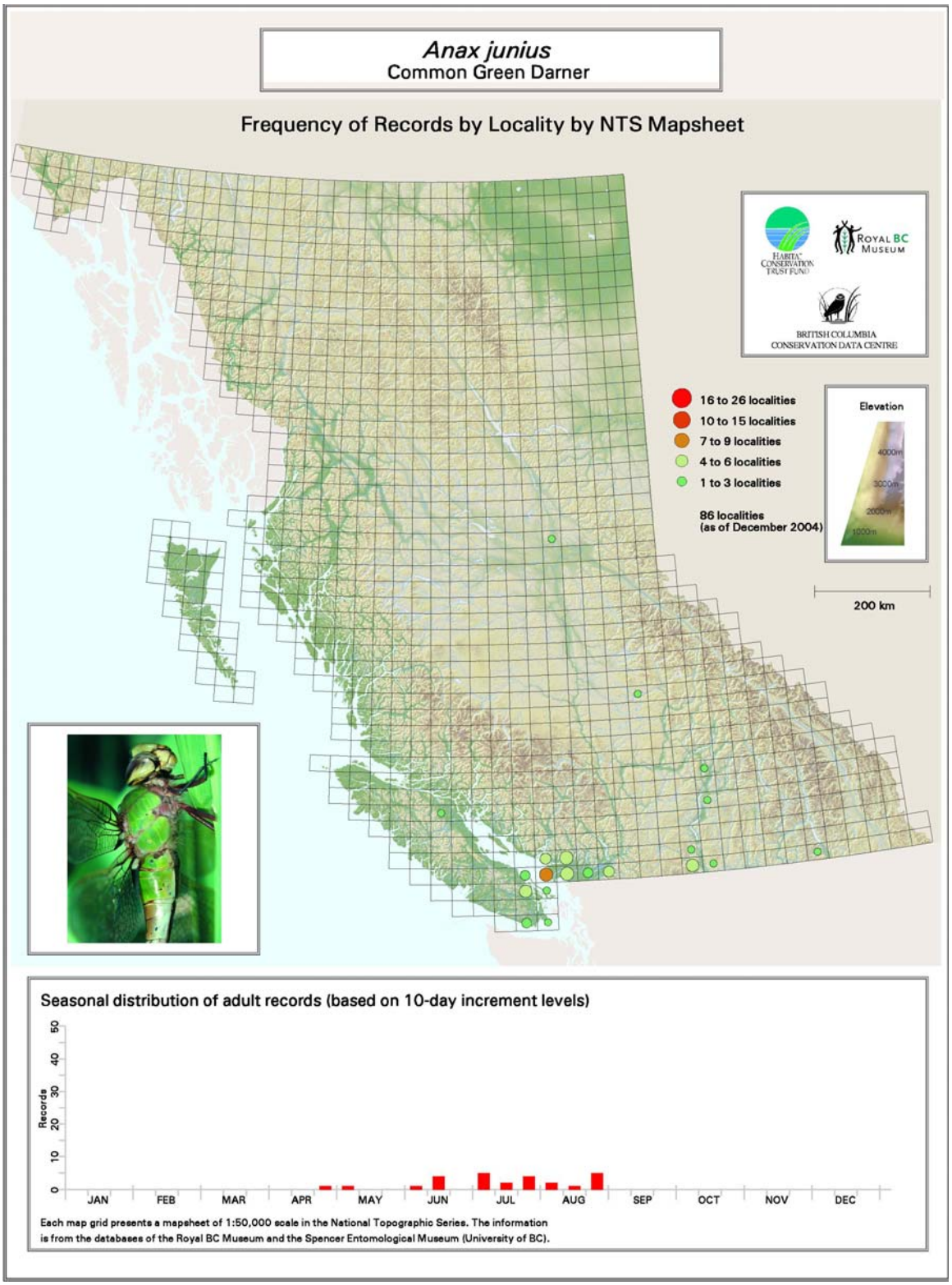
Anax junius Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Anax junius Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Anax junius Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.

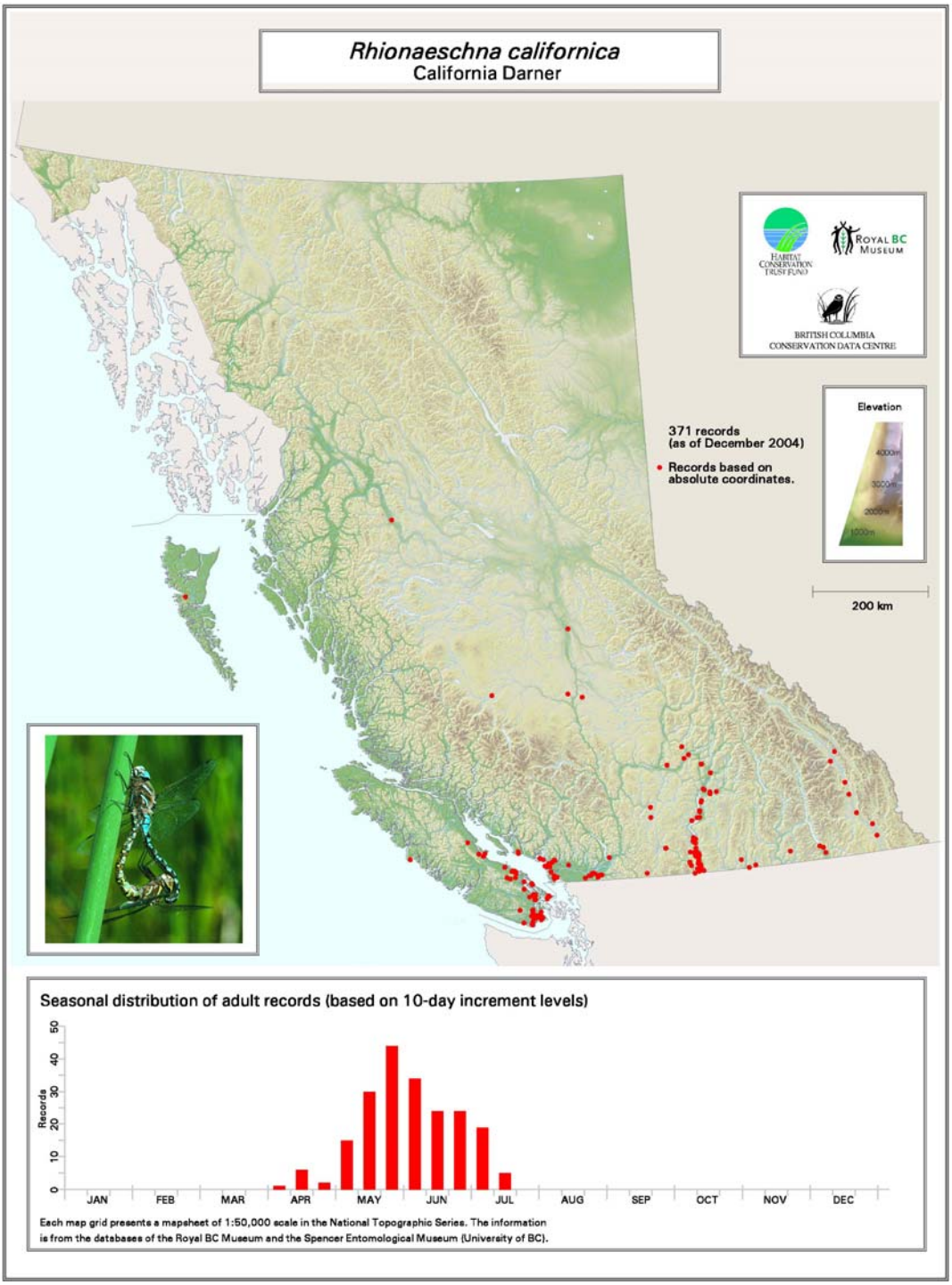


Anax junius Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

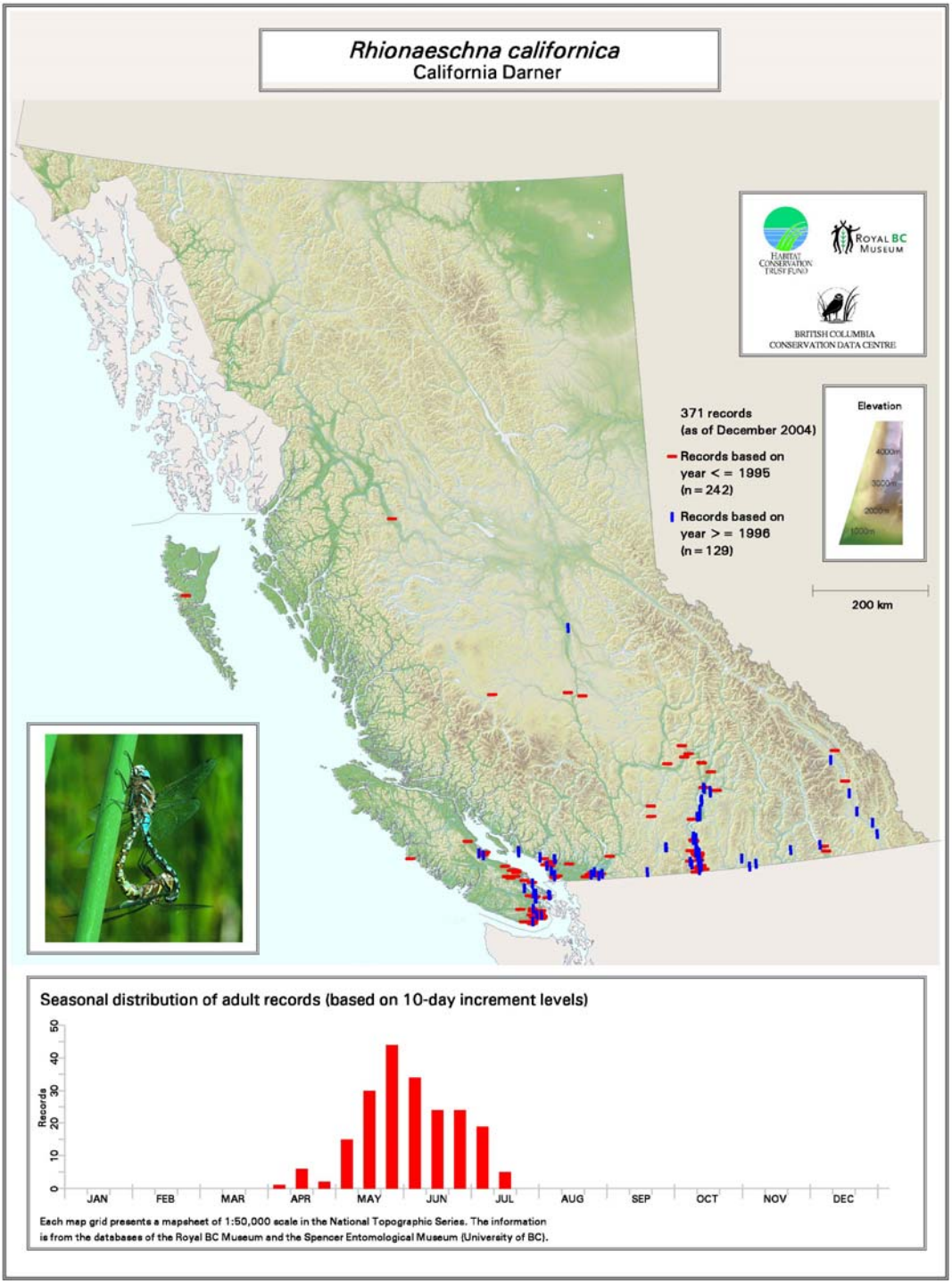
***Rhionaeschna* (Southern Darners)**
Similar to *Aeshna*, but recently separated as a distinct genus; both sexes have a tubercle on the underside of the first abdominal segment. Species of *Rhionaeschna* in BC have pale areas all blue in males and the lateral thoracic stripes are straight. Both species have southern and western affinities, unlike most of our darners, which are northern and transcontinental.

***Rhionaeschna californica* (California Darner)**
BC conservation rank: S5. Yellow List.
Description: Thorax stripes straight (fig. 7n) and bordered with black. The eyes are blue and the face is pale blue with a black line. Male's thorax stripes are pale blue; its upper appendages simple (fig. 9a). Female's thorax stripes and abdomen spots are pale blue or yellow. Length: male 60 mm, female 59 mm.
Global Range: British Columbia south in the mountains to Mexico; also recorded in South Dakota (Needham *et al.* 2000). Faunal element: Cordilleran (see Appendix 3).
BC Distribution: South of about 55°N (most northerly record is from the Bulkley Valley); rare north of the southern valleys (51ºN).
Biology: Common around ponds, lakes and marshes at low and medium elevations. (e.g.Gs01-03; Wm01, Wm04-07). For a darner, remarkable for its springtime flight season. At the most southerly locations, it may appear in April, with the earliest dragonflies; by early August it is uncommon, just when many darners are reaching their peak abundance.
BC flight period: mid April to mid August; all records lie between mid April and late July.

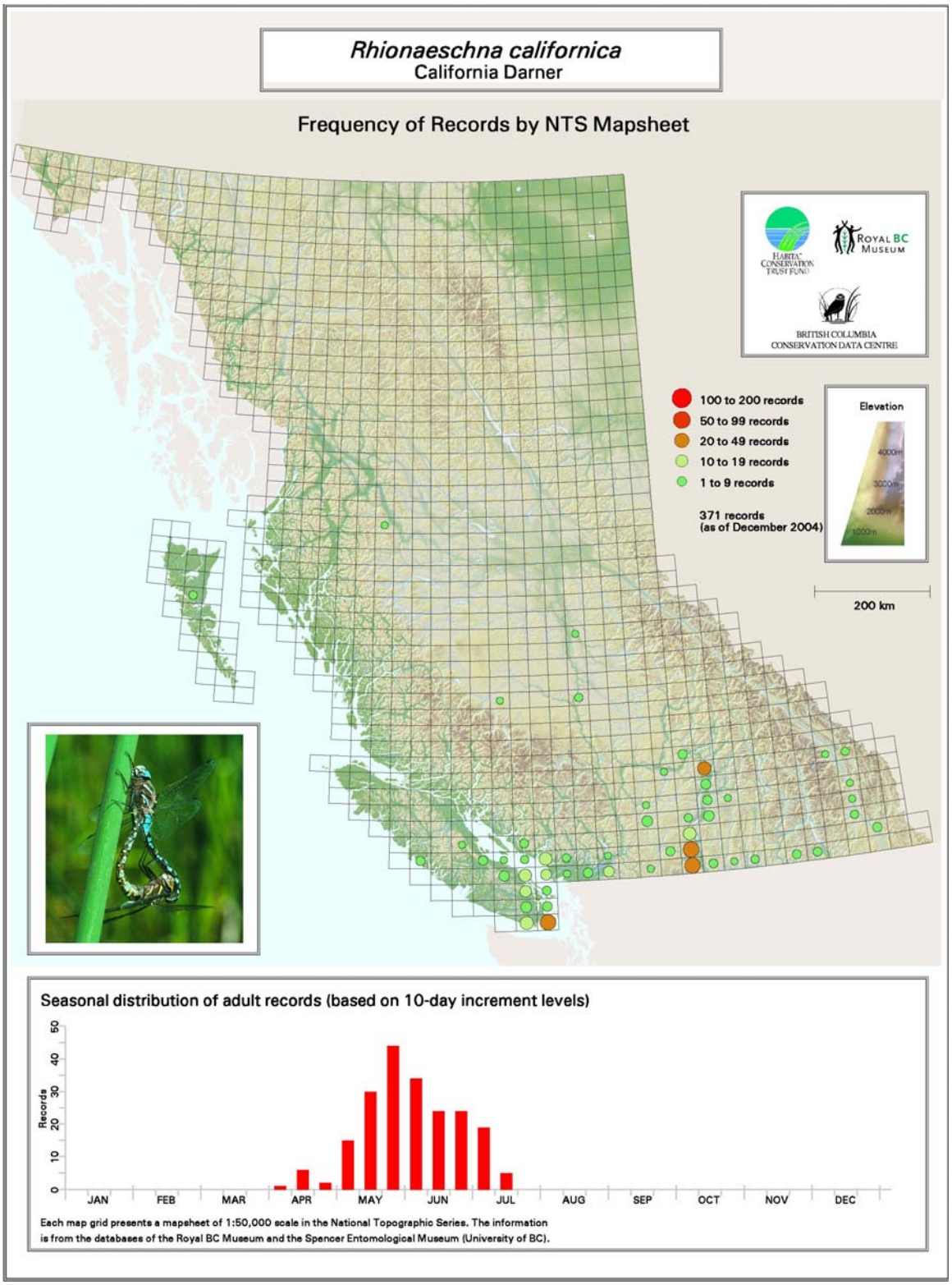
Rhionaeschna californica mating. Photograph: Ian Lane



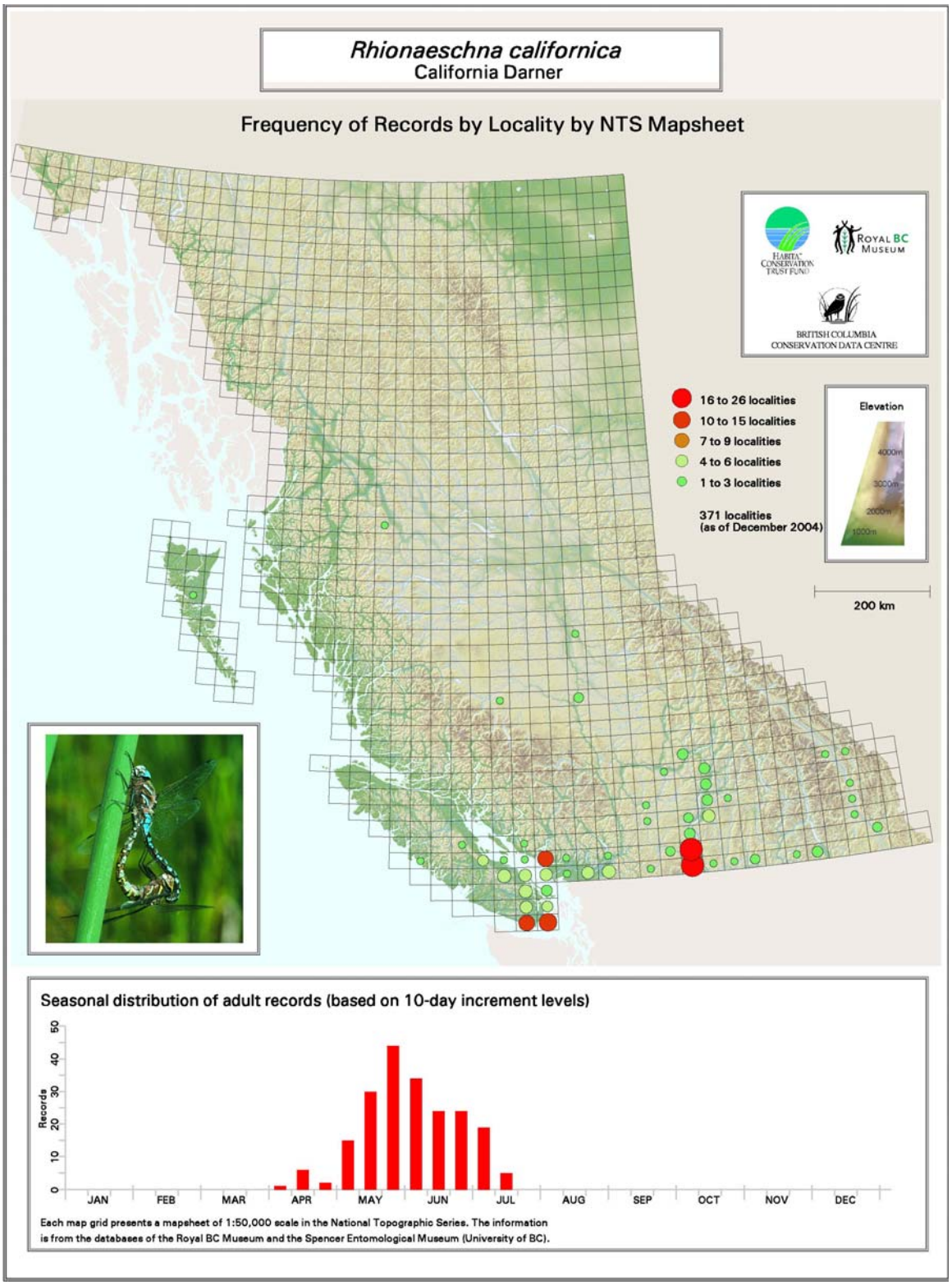
Rhionaeschna californica Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Rhionaeschna californica Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



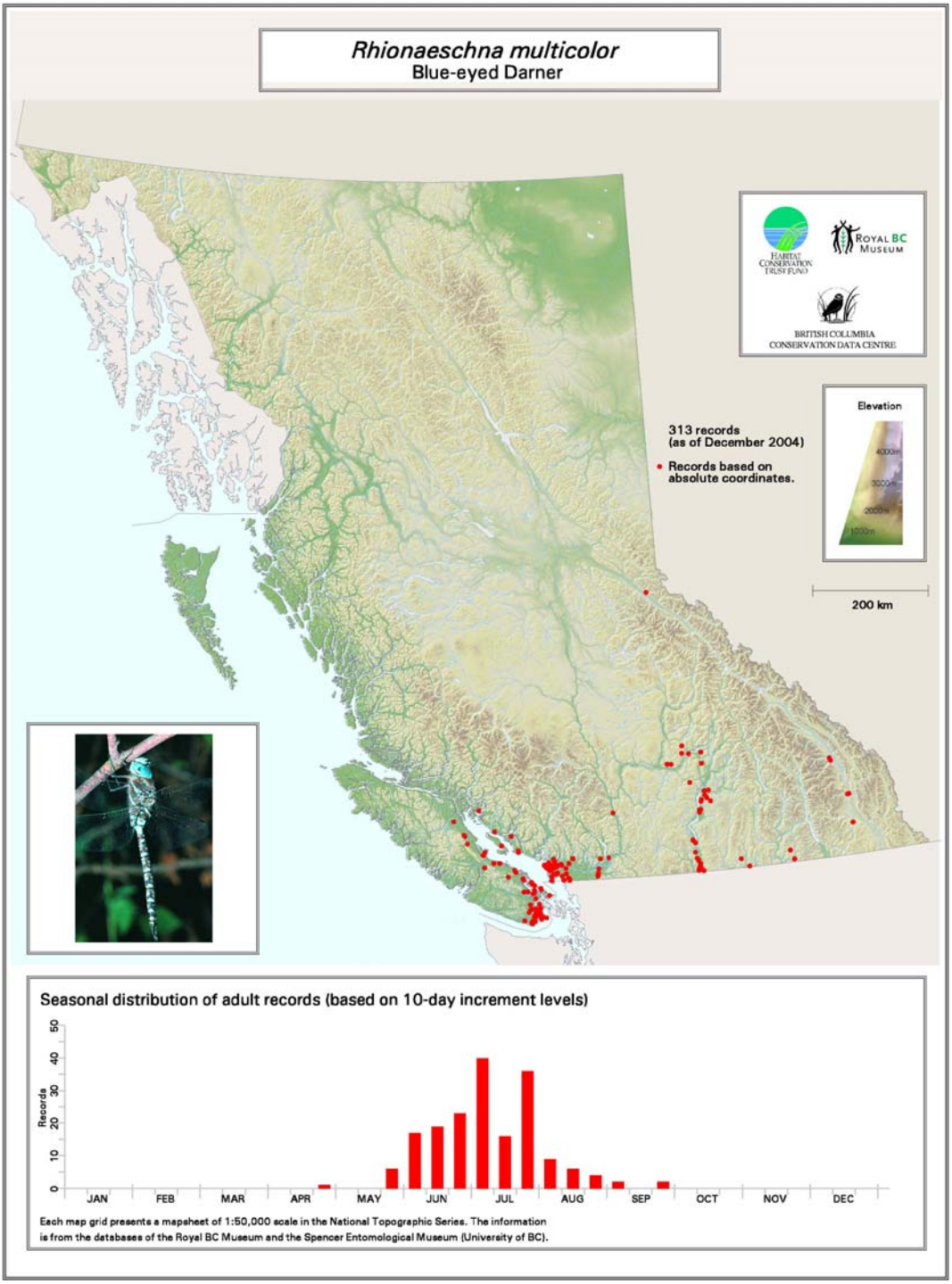
Rhionaeschna californica Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



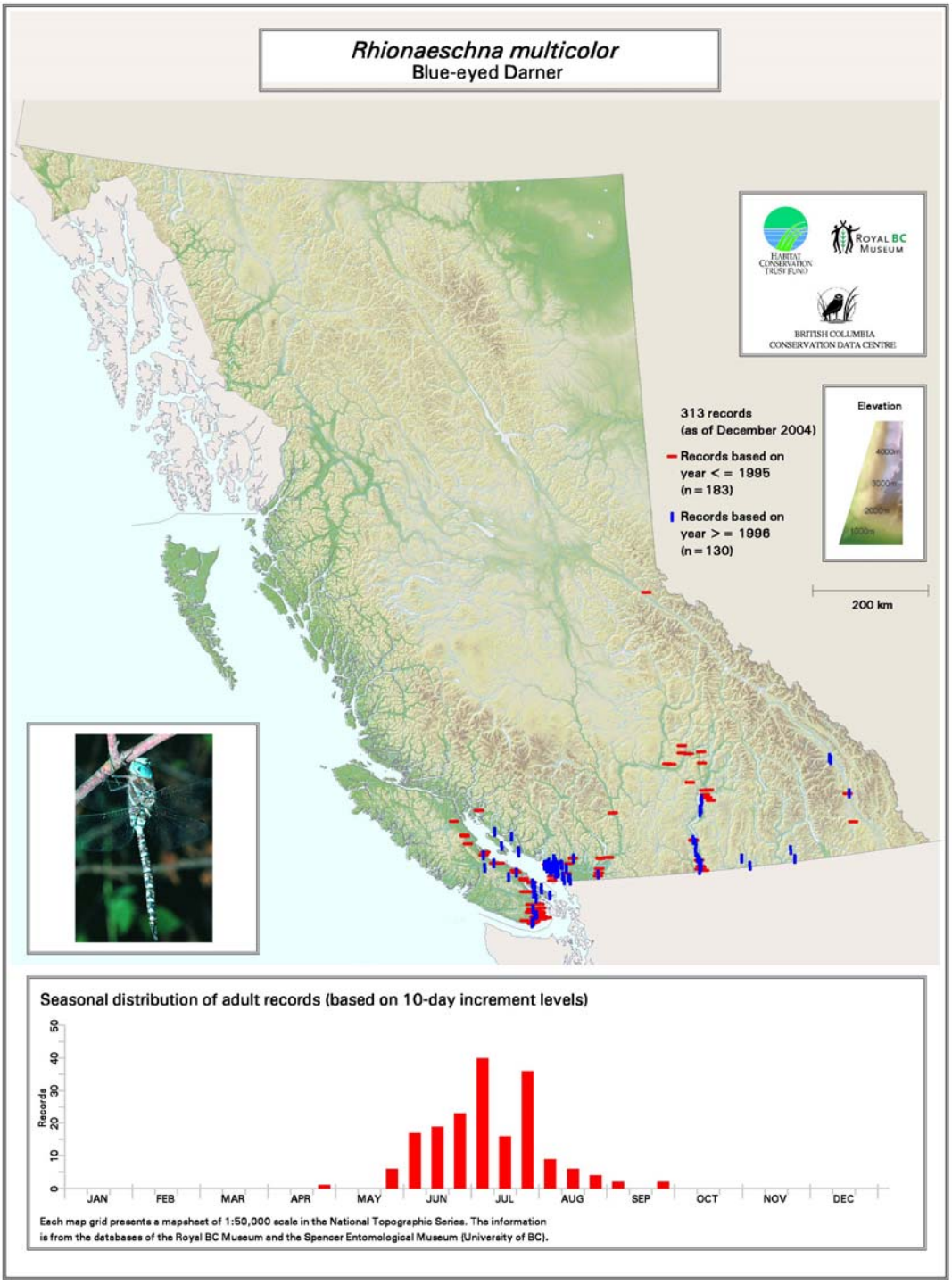
Rhionaeschna californica Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Rhionaeschna multicolor* (Blue-eyed Darner)**
BC conservation rank: S5. Yellow List.
Description: Thorax stripes straight (fig. 7o). Its face line, if it has one, is thin and pale brown. Male's face and eyes are sky-blue; the thorax stripes and abdomen spots are blue; upper appendages forked (fig. 9). Female's thorax stripes and abdomen spots are either blue or yellow. Length: male 69 mm, female 67 mm.
Global Range: British Columbia east to Alberta; south to Montana, Iowa, Oklahoma, Texas, Mexico and California. Also recorded in Massachusetts (Needham *et al.* 2000). Faunal element: Western (see Appendix 3).
BC Distribution: Widespread south of about 51°N; one record well to the north at McBride, the only one in the northern study area.
Biology: Common around marshes and marshy lakeshores and ponds (Wm04-06) in southern valleys.
BC flight period: **early May to mid October; almost all records fall between early June and mid September.**

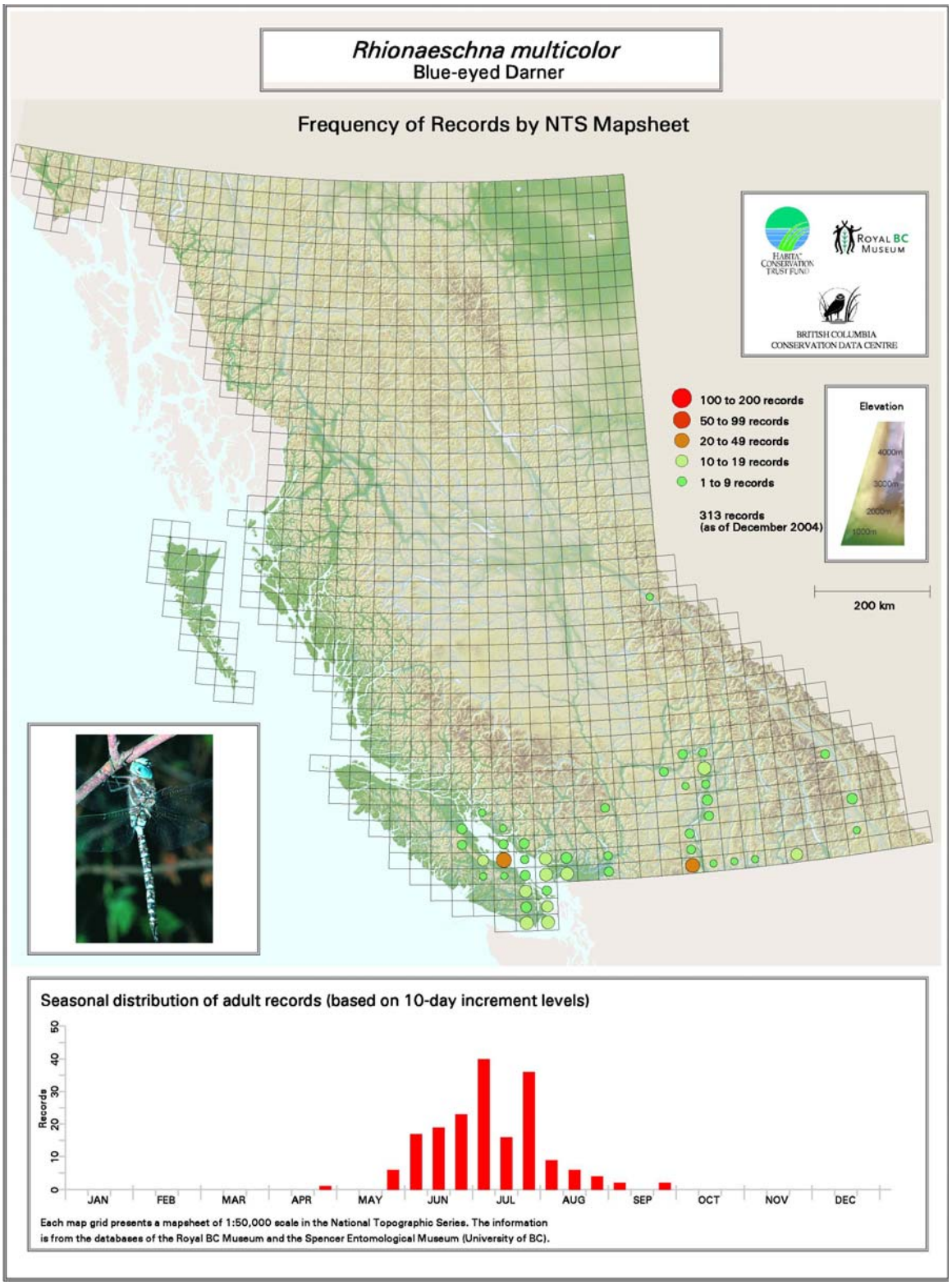
Rhionaeschna multicolor male. Photograph: George Doerksen, RBCM



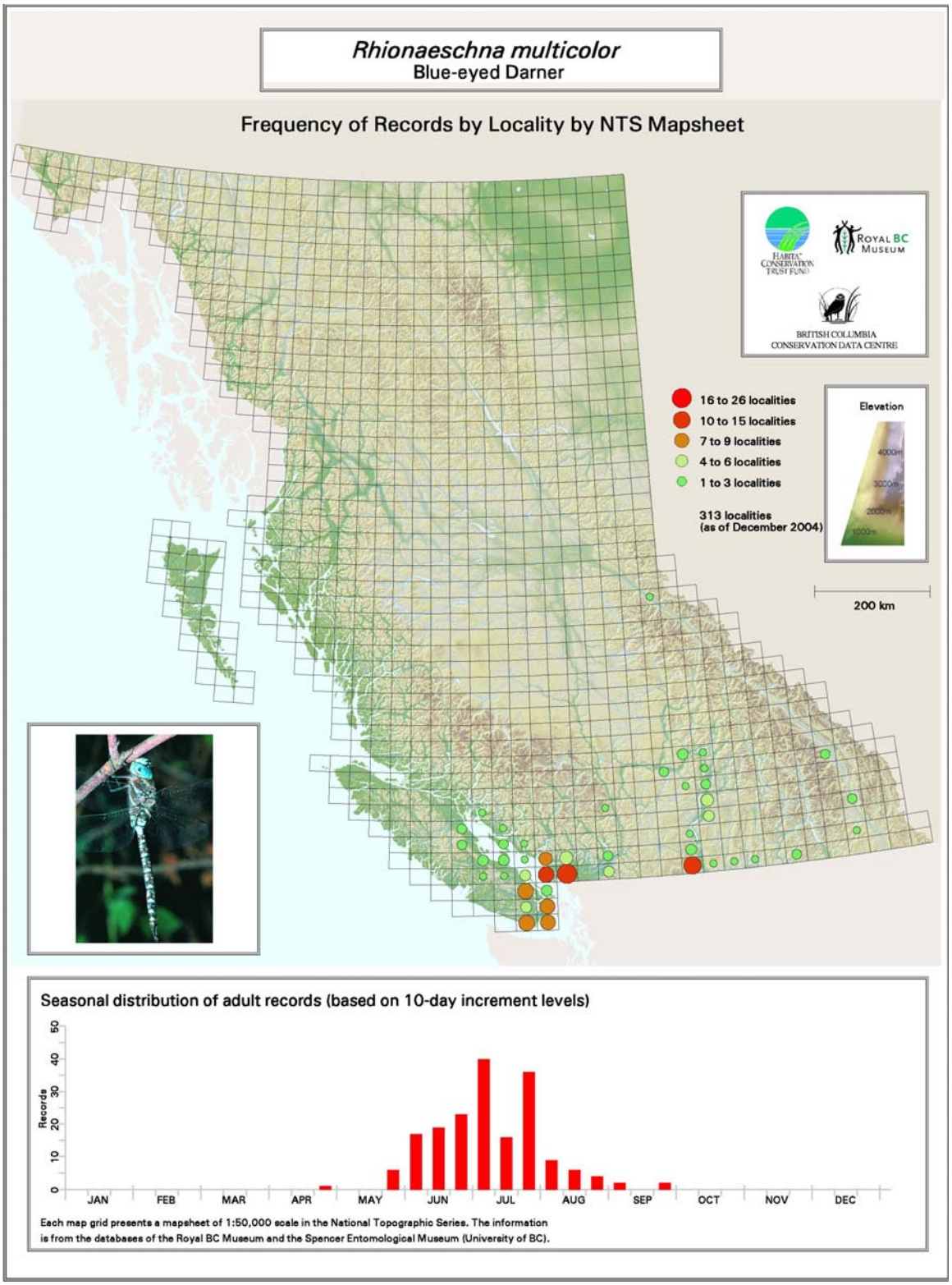
Rhionaeschna californica Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Rhionaeschna multicolor Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Rhionaeschna multicolor Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



Rhionaeschna multicolor Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

Family Gomphidae (Clubtails)
A large family, but poorly represented in our region. BC has only six species -- compared to some other families, clubtails are not common here, but they are easily recognizable by their widely separated eyes and their green or yellow bodies striped in brown and black. The tip of the abdomen, especially in males, is enlarged, giving them their English name. Females lack an ovipositor and drop their eggs directly into clear streams and along the sandy shallows of larger lakes; they lay their eggs without the protection of their mates. Larvae burrow in the bottom sediments of these water bodies.

***Ophiogomphus* (Snaketails)**
Most snaketails live in eastern North America. The three species in BC fly along clear, relatively warm streams and lakeshores; uncommon in settled areas, at least partly because the burrowing larvae are sensitive to changes in water flow and siltation, and they are especially affected by poor logging practices. The mature adult's thorax is green; younger adults are more yellow. The abdomen has white or yellow marks on the sides and yellow spots on top; this snake-like pattern gives the genus its English and scientific names (*ophio* is Greek for "snake" and *gomphos* means "bolt" or "arrow"). The hindwings have a three-celled anal loop (fig. 10a). Male's upper appendages are short and usually pointed in side view.

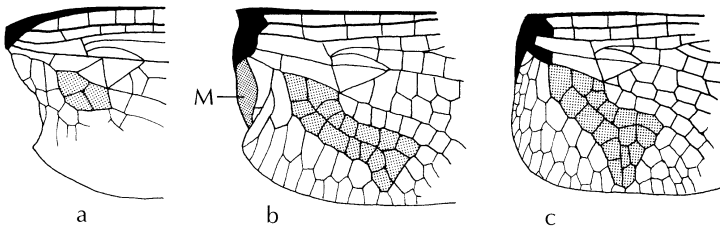
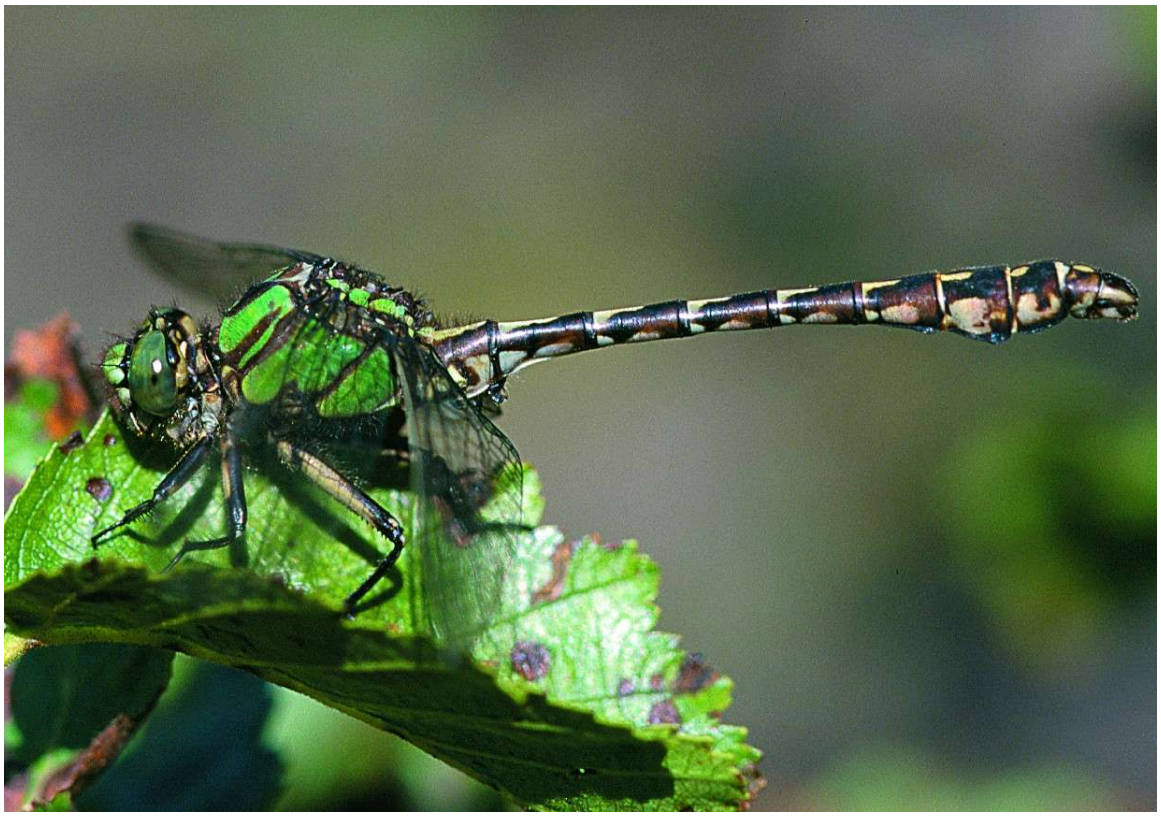
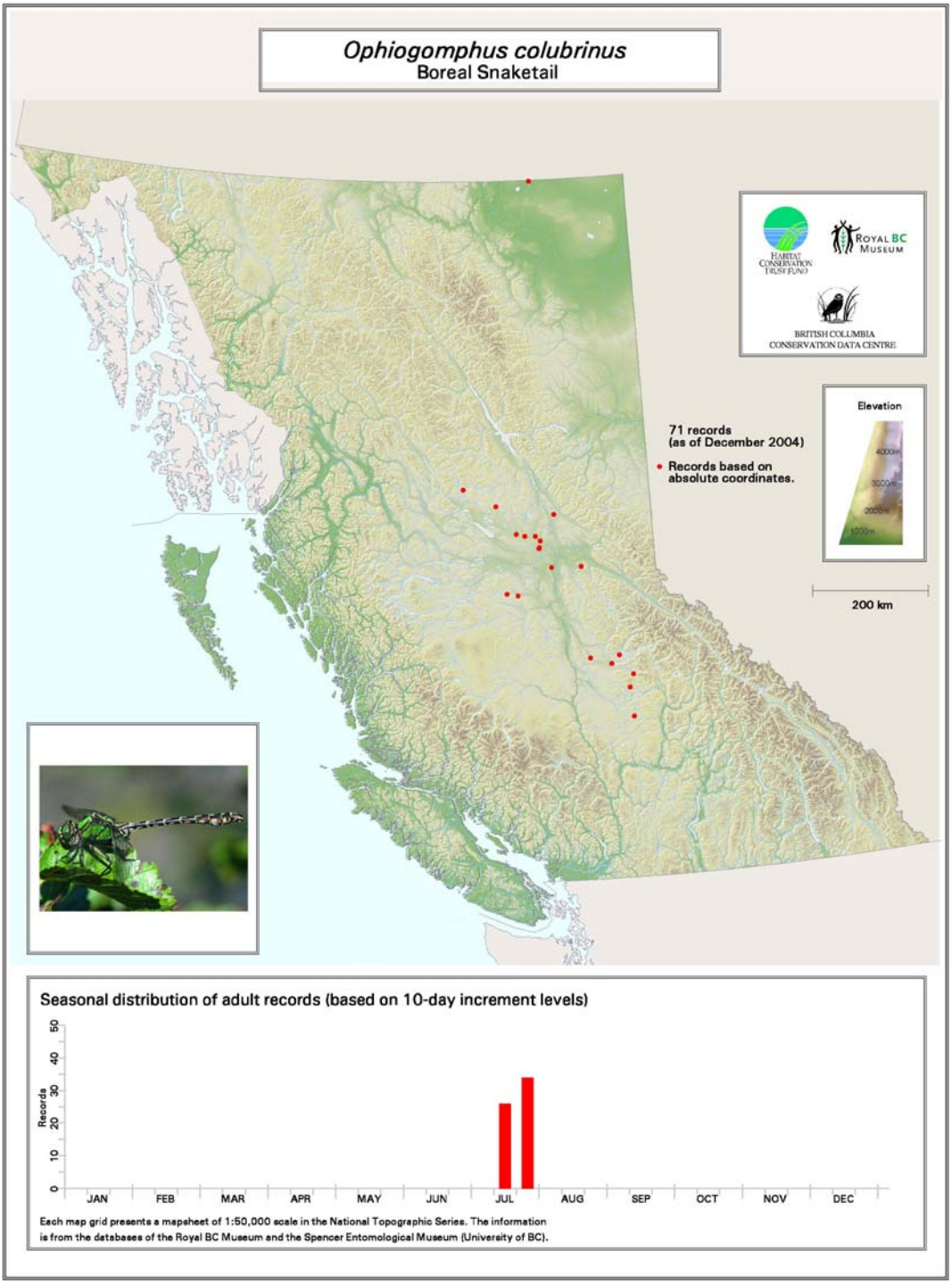


Figure 10. Anal loops: a, snaketails (represented by *Ophiogomphus severus*); b, emeralds (American Emerald); c, skimmers (Yellow-legged Meadowhawk). M = membranule.

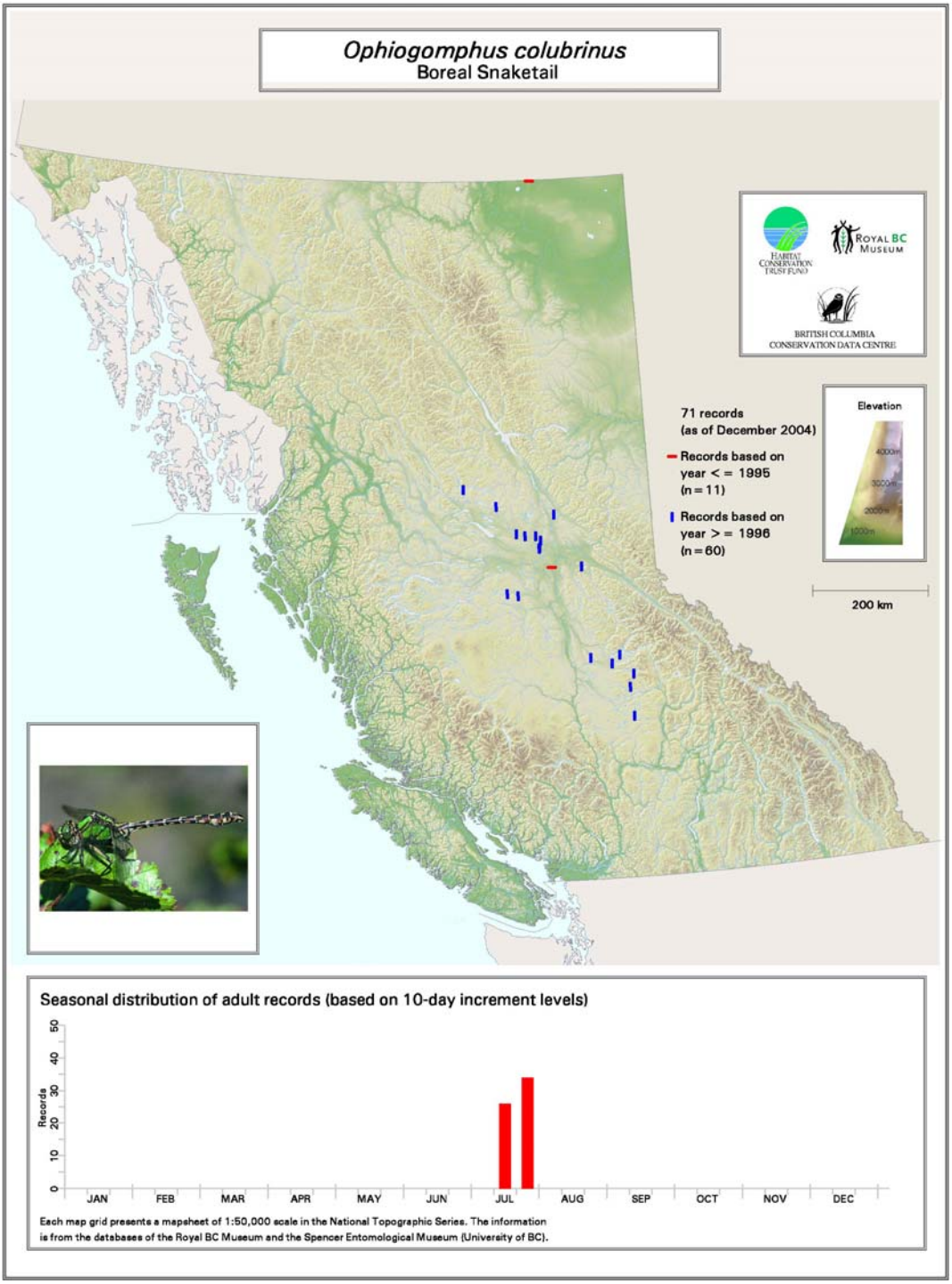
***Ophiogomphus colubrinus* (Boreal Snaketail)**
BC conservation rank: S4. Yellow List. First ranked as S3? in 1995, *O. colubrinus* is one species whose status was definitely changed by knowledge gained in northern surveys. Once its habitat preference was established, searches for suitable sites found it frequently.
Description: The face is green with black stripes. The thorax is bright green with brown stripes, including one on the side behind the forewing base. Length: male female 47 mm.
Global Range: British Columbia east to Newfoundland; south to New York, Michigan, and Wyoming (Needham *et al*. 2000). Faunal element: Southern Boreal (see Appendix 3).
BC Distribution: Widespread in northern and central BC, south to about 52ºN in the Cariboo, but not yet known from the dry Chilcotin. Probably more common in the far North than records suggest, especially east of the Rockies.
Biology: The most northern of all North American clubtails and the only transcontinental clubtail inhabiting boreal forests. Uncommon, but can be abundant in the right habitat – clear, warm streams flowing out of forest lakes. Larvae burrow in the sand and gravel on the stream bottom; adults perch on the ground or on streamside vegetation.
BC flight period: mid June to early September; records are from the last half of July and the first half of August.



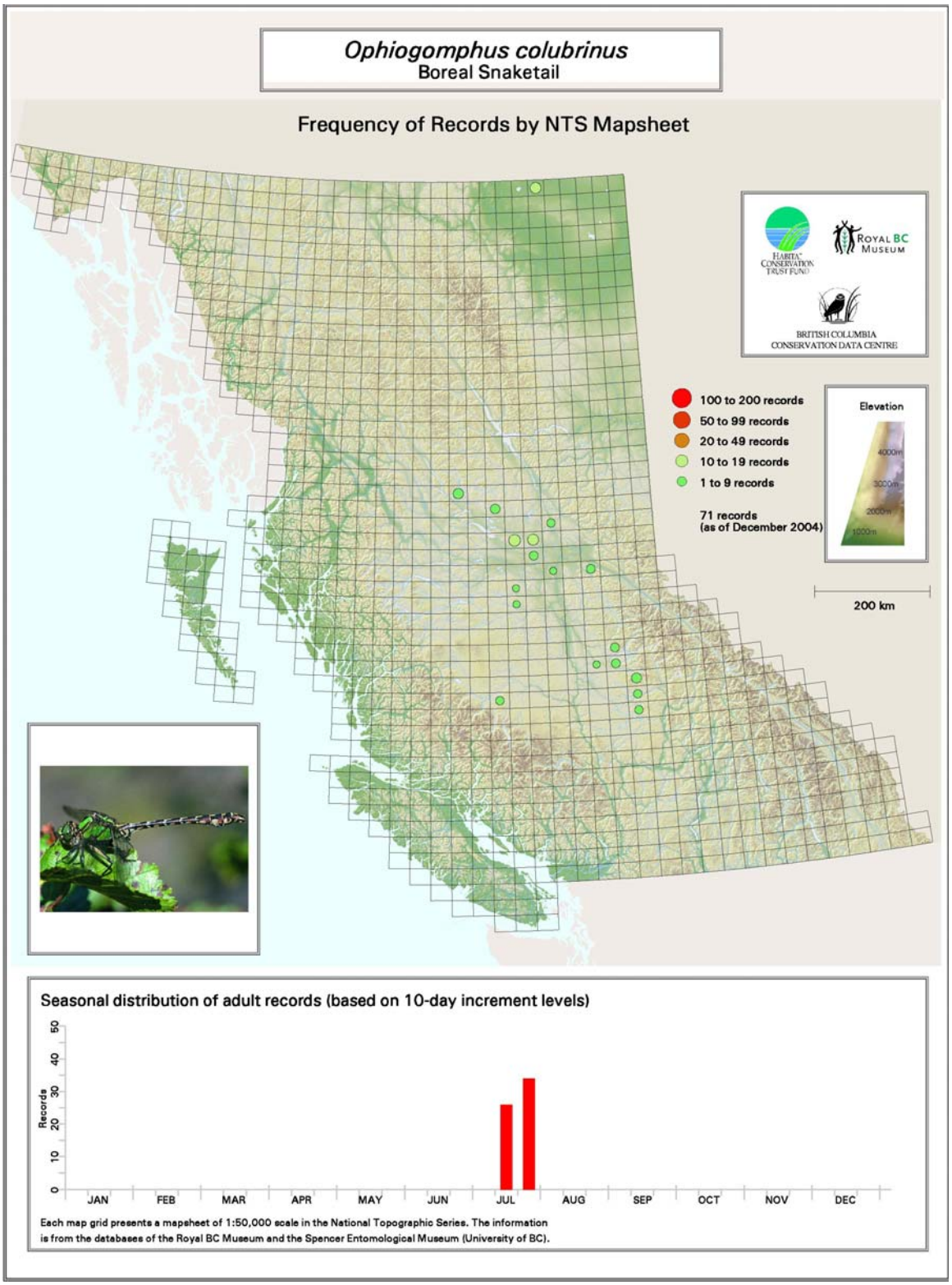
Ophiogomphus colubrinus male. Photograph: Robert A. Cannings, RBCM



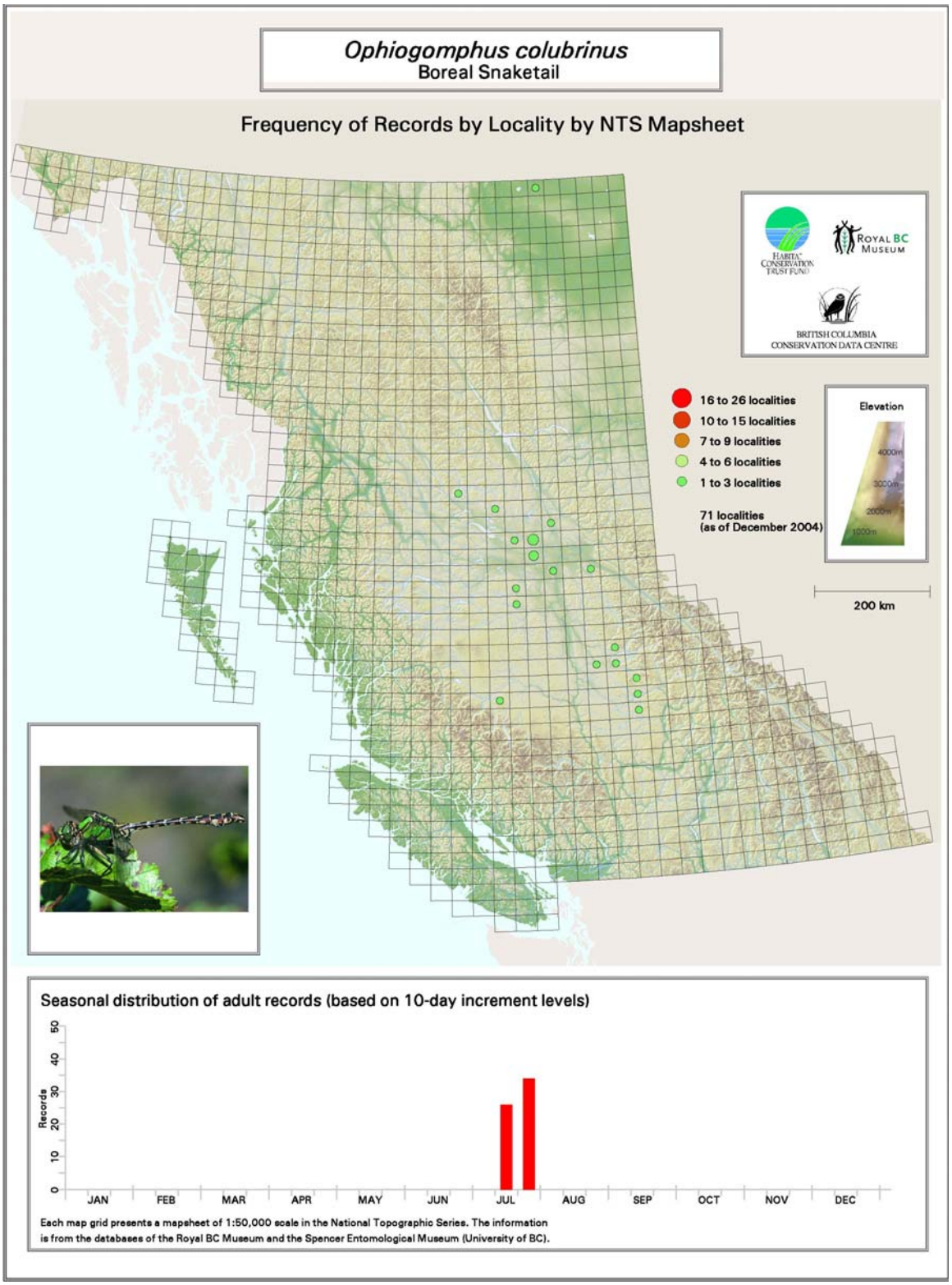
Ophiogomphus colubrinus Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Ophiogomphus colubrinus Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



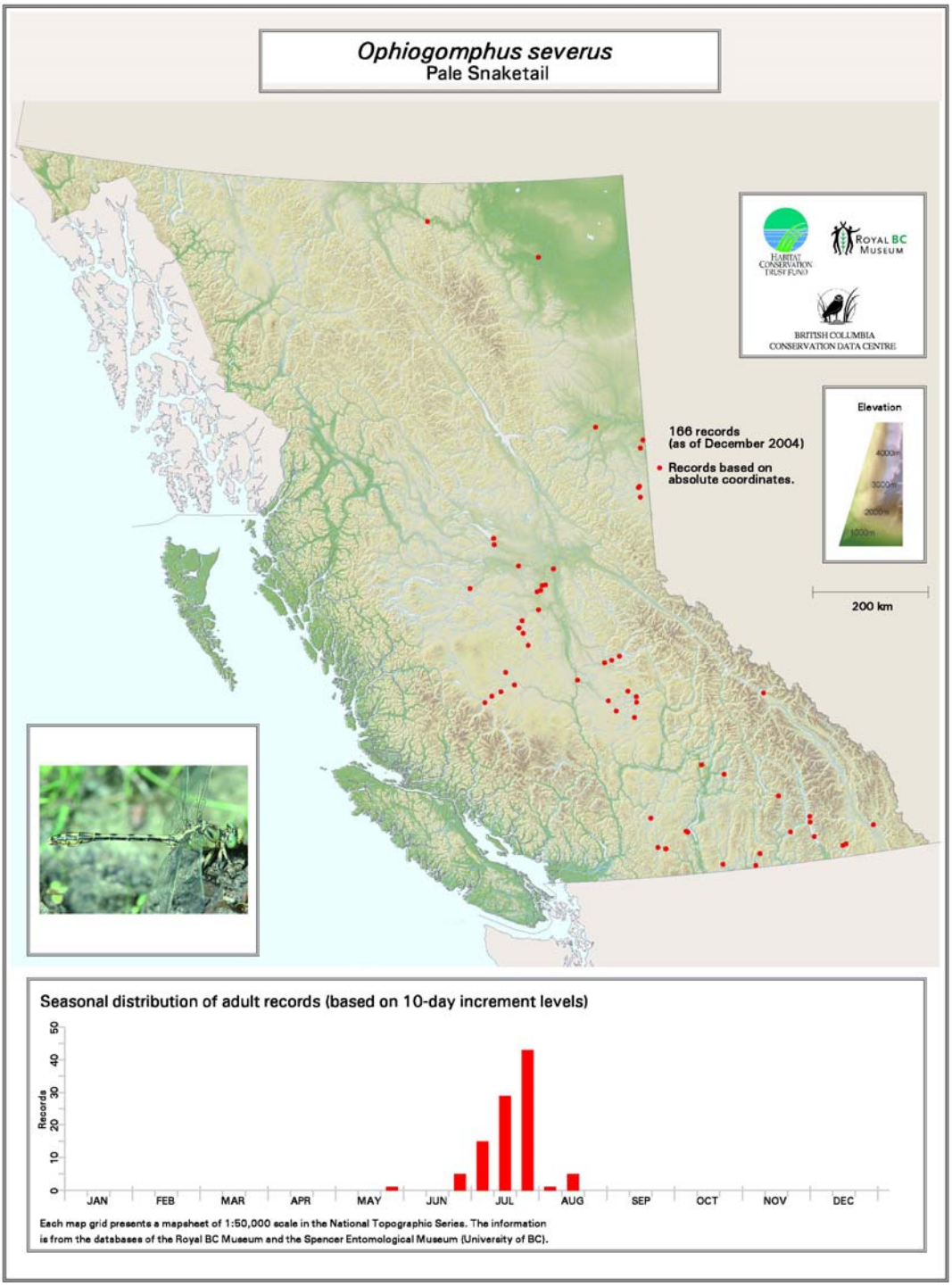
Ophiogomphus colubrinus Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



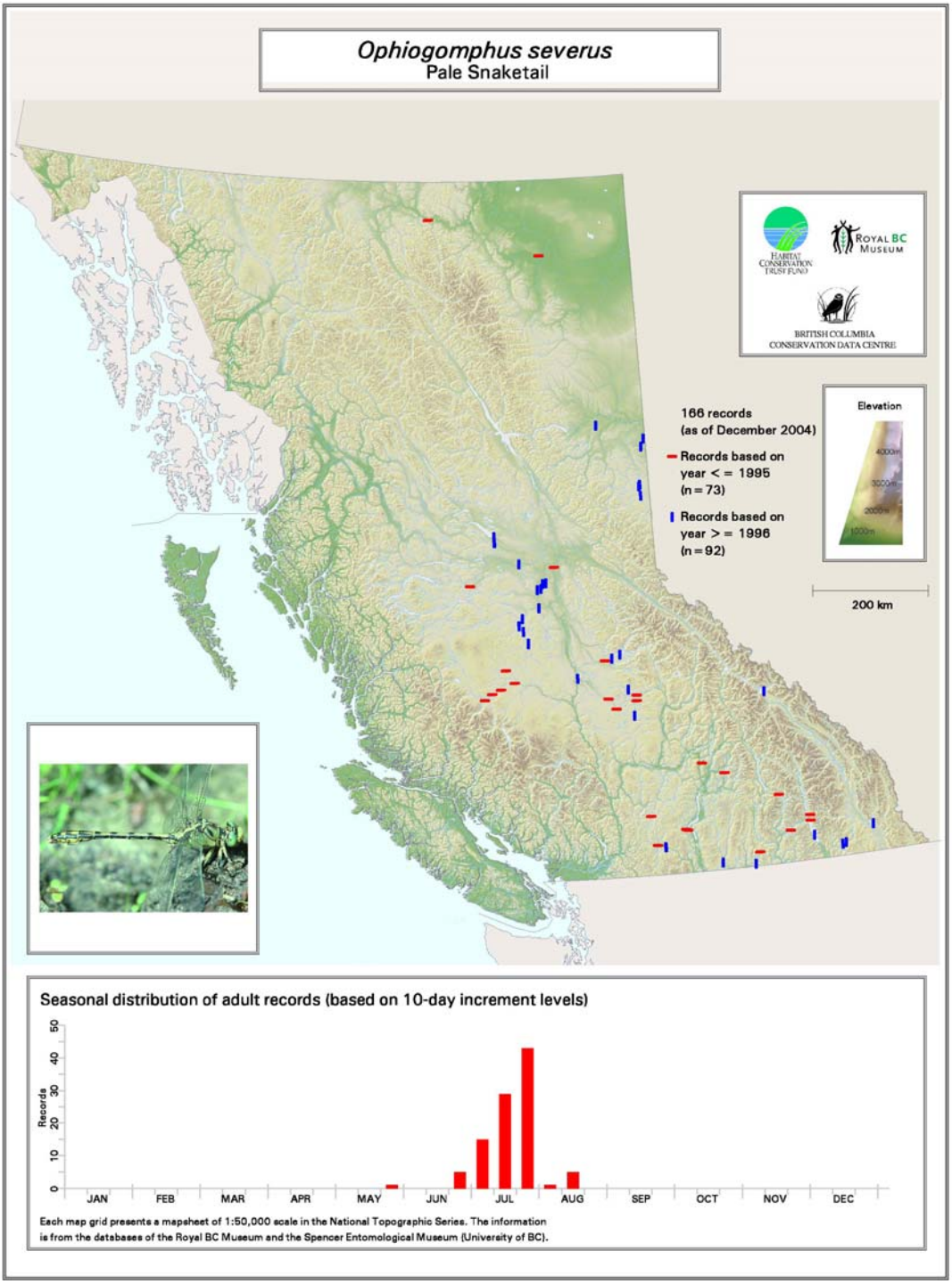
Ophiogomphus colubrinus Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Ophiogomphus severus* (Pale Snaketail)**
BC conservation rank: S5. Yellow List.
Description: The face is yellow with no stripes. The thorax is green-yellow to green with fine brown stripes on the sides and a prominent oval spot in front of the forewing base. The abdomen is dark brown, sometimes mostly yellow below, with large yellow spots on top. Length: male 51 mm, female 52 mm.
Global Range: British Columbia east to Saskatchewan; south to Arkansas, Kansas, New Mexico and California (Needham *et al.* 2000). Faunal element: Western (see Appendix 3).
Range: Western. Widespread in BC east of the Coast Mountains; unknown north of 55ºN west of the Rockies, but recorded at scattered localities in the Northeast.
Biology: Uncommon. Most records are from clear streams, but this species also develops in large, muddy rivers and in lakes, where it sometimes emerges on floating waterlily leaves (*Nuphar lutea* associations).
BC flight period: early June to mid September; most collections are from mid July to early August.

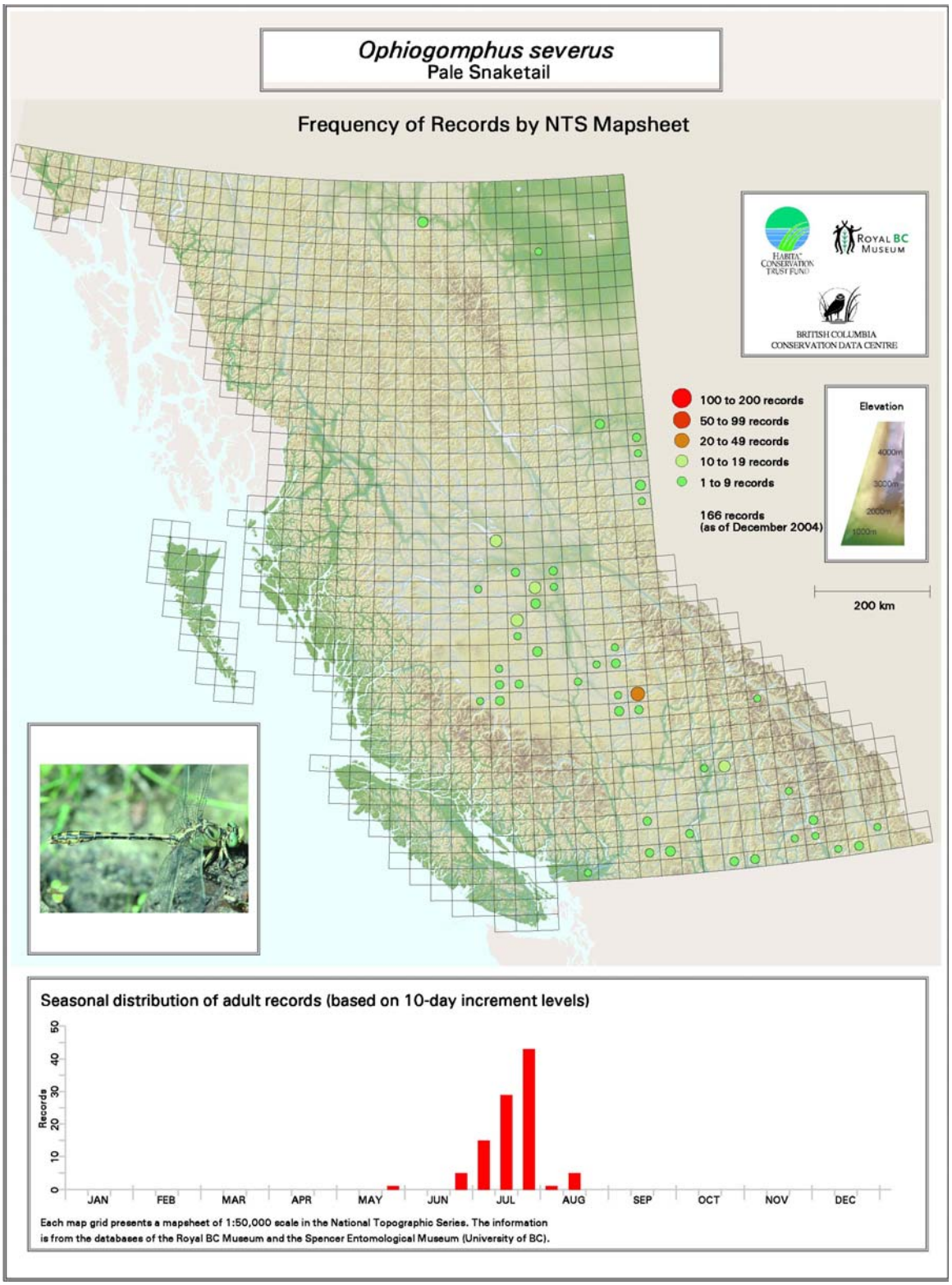
Ophiogomphus severus male. Photograph: George Doerksen, RBCM



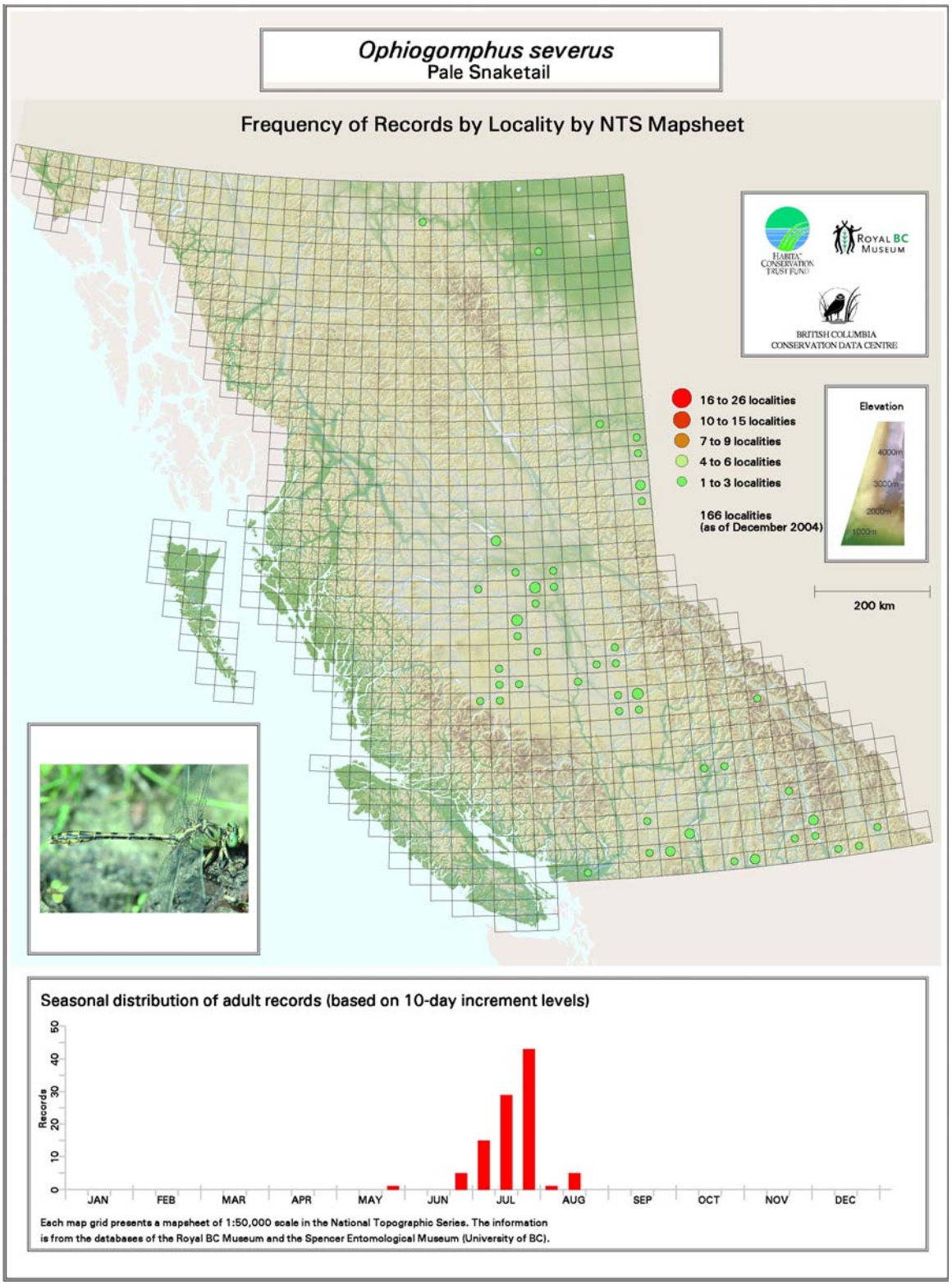
Ophiogomphus severus Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Ophiogomphus severus Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



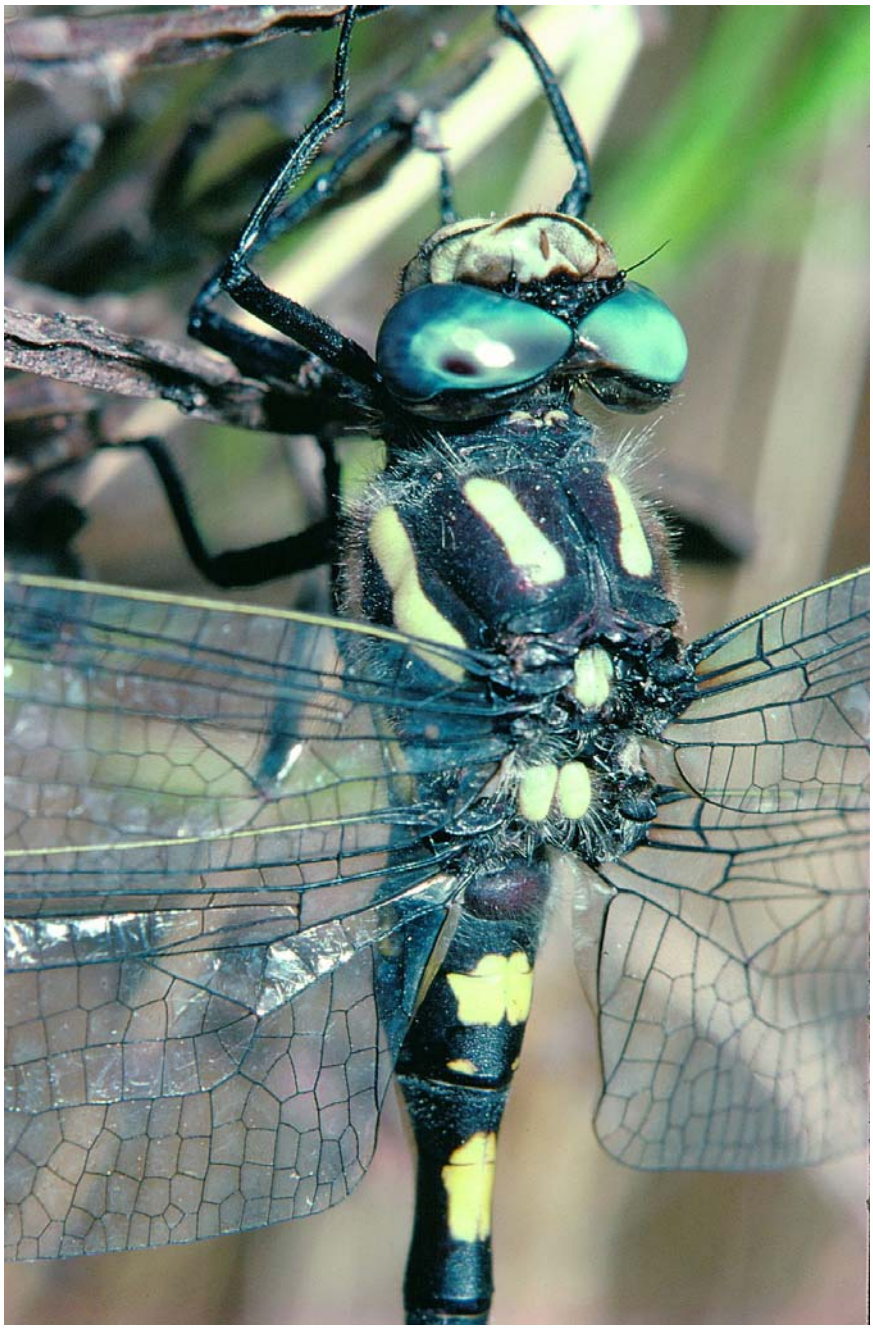
Ophiogomphus severus Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



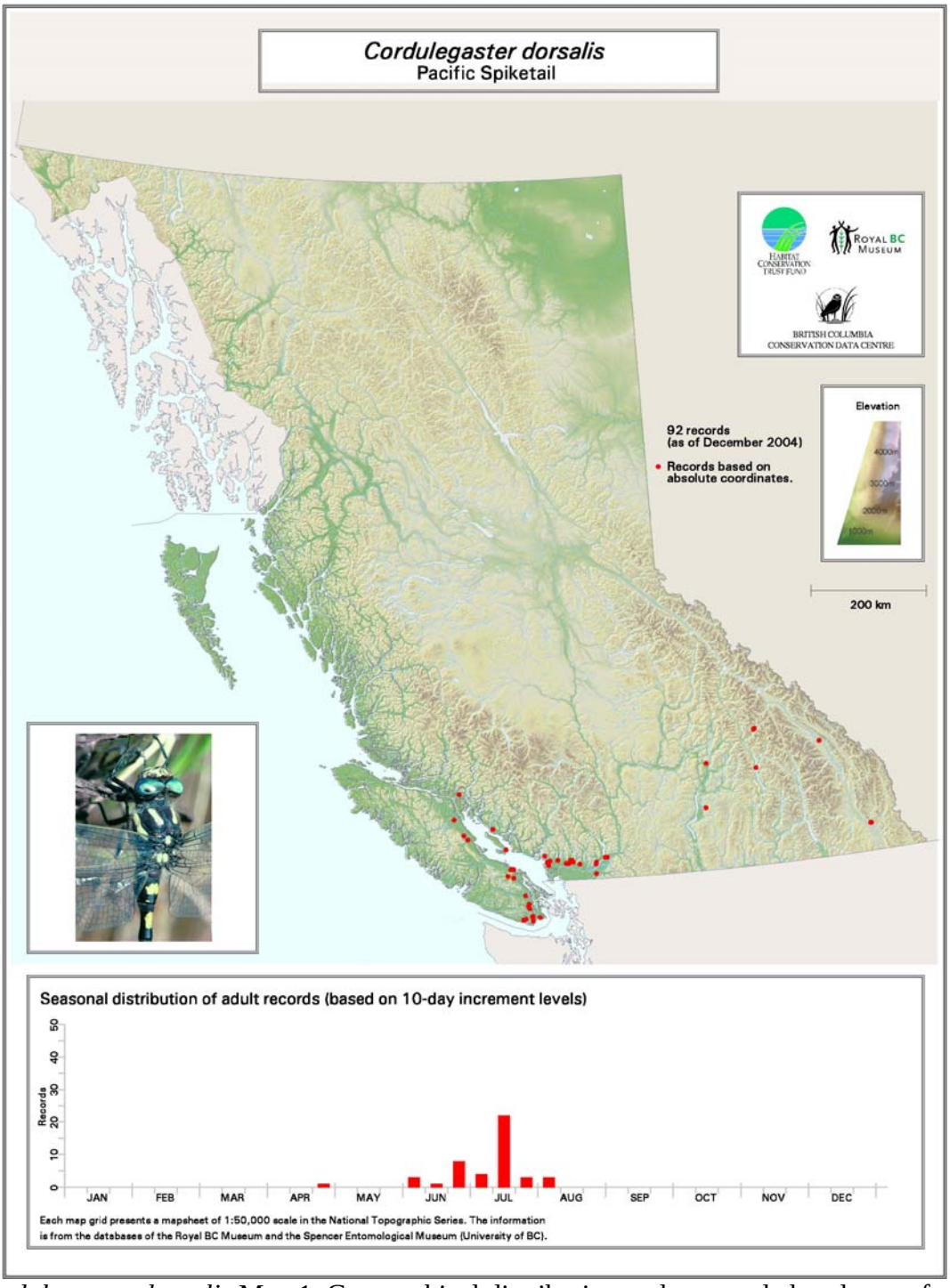
Ophiogomphus severus Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

Family Cordulegastridae (Spiketails)
Large black-and-yellow dragonflies with eyes meeting at a single point on top of the head. Spiketails live along streams where the males patrol steadily up and down for long distances. The English name comes from the female's long, spike-like ovipositor, used for placing eggs in streambeds. The large, squat, hairy larvae bury themselves in the sediment to await their prey.

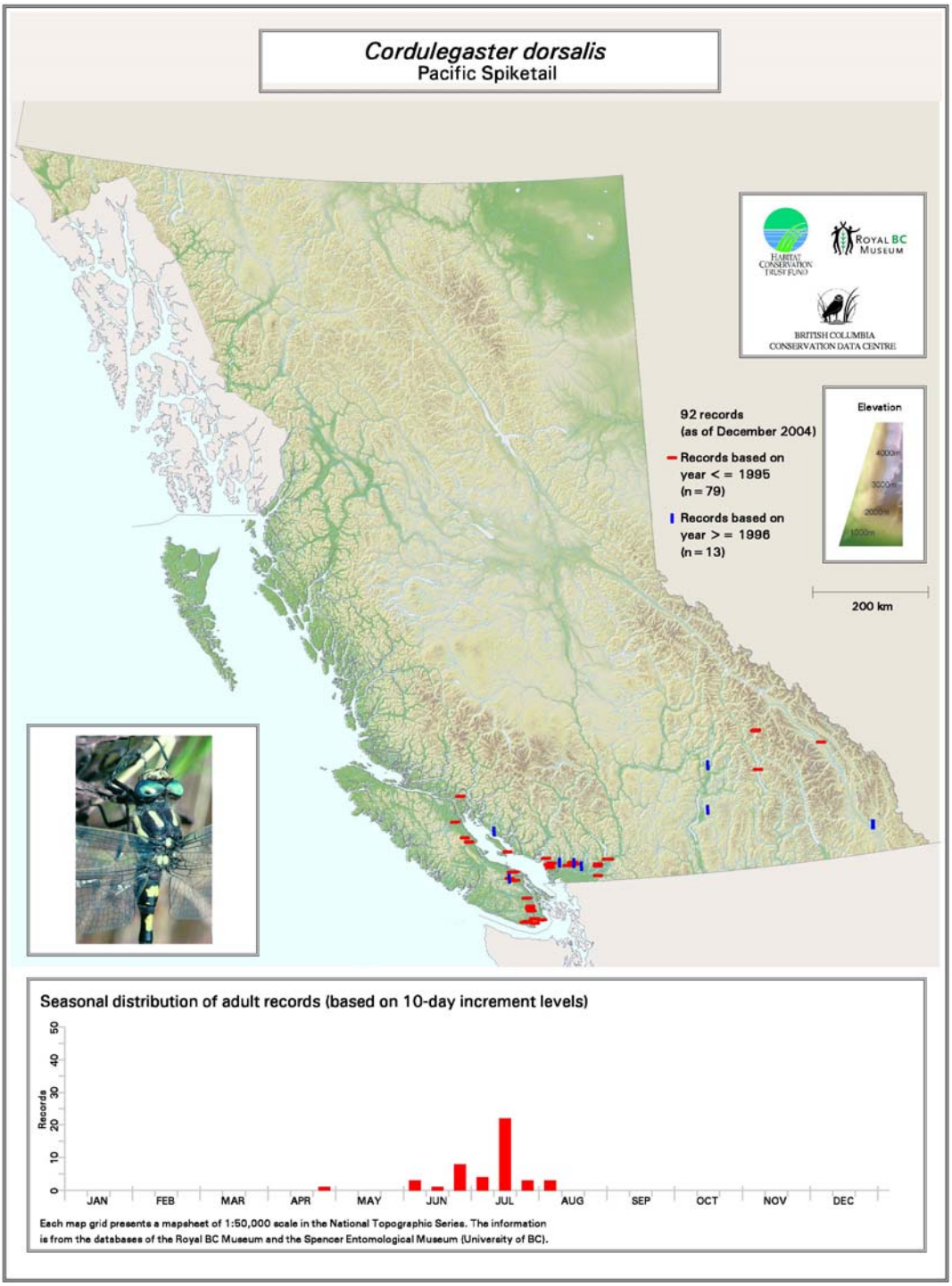
***Cordulegaster dorsalis* (Pacific Spiketail)**
BC conservation rank: S5. Yellow List.
Description: The face is yellow with a dark line; blue eyes barely meet at a point on top of the head. The body is black, with yellow stripes on the thorax and yellow spots on top of the abdomen. Length: male 75 mm, female 80 mm.
Global Range: Alaska and British Columbia south to Montana, Colorado, New Mexico and California (Needham *et al.* 2000). Faunal element: Cordilleran (see Appendix 3).
BC Distribution: Coastal valleys; southern interior to about 51°N. Its presence in the Alaska Panhandle suggests *Cordulegaster* occurs along the entire BC mainland coast.
Biology: One of our largest dragonflies. Fairly common along small coastal woodland streams flowing from lakes; rare east of the Coast Mountains in southern BC, and where it does occur, it flies along small warm streams, especially ones fed by springs. Egg-laying females hover vertically, moving up and down, shoving eggs into the sand and silt of the streambed. Perches vertically.
BC flight period: early May to early September; most are recorded between mid June and mid August.



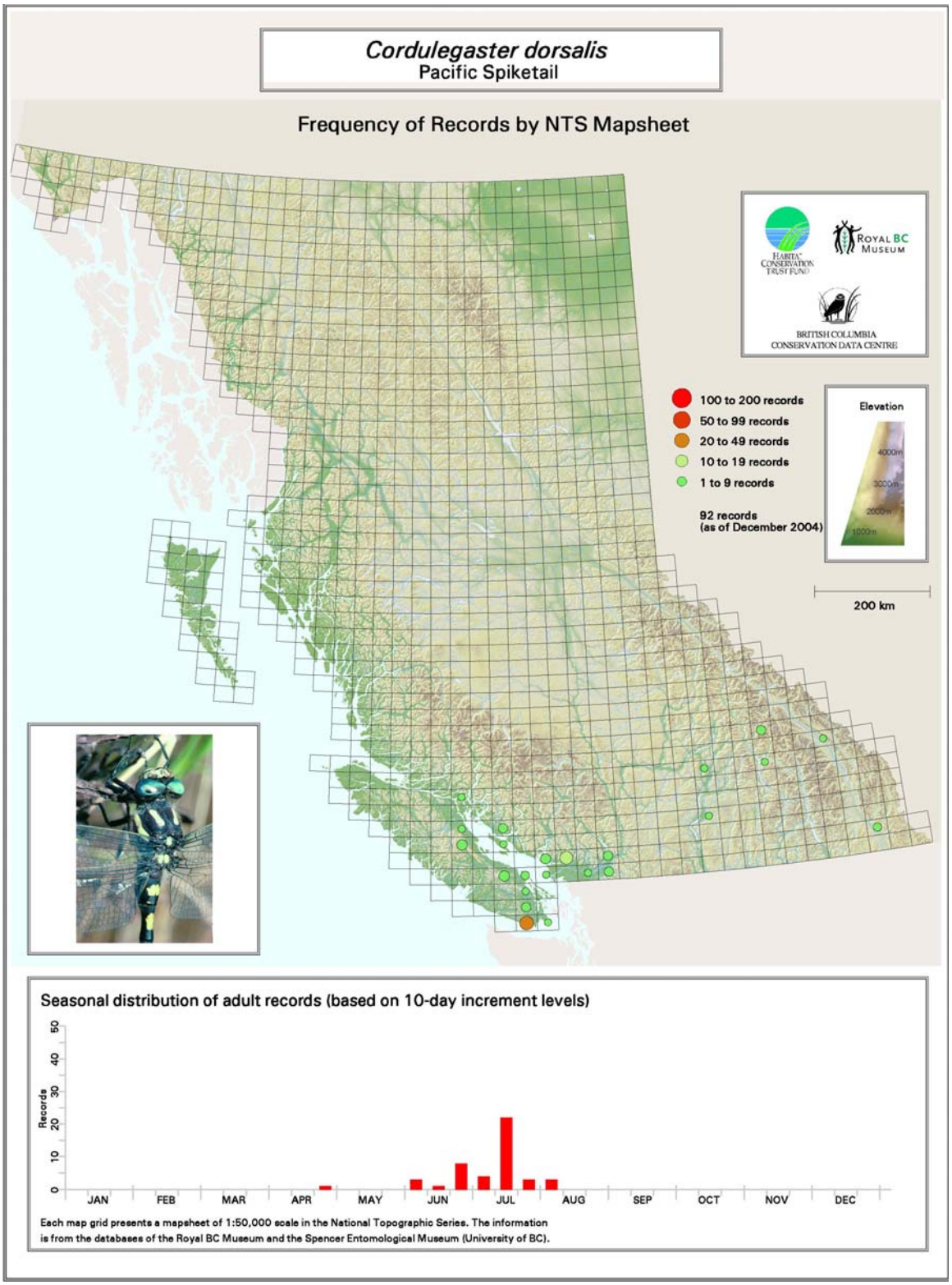
Cordulegaster dorsalis male. Photograph: George Doerksen, RBCM



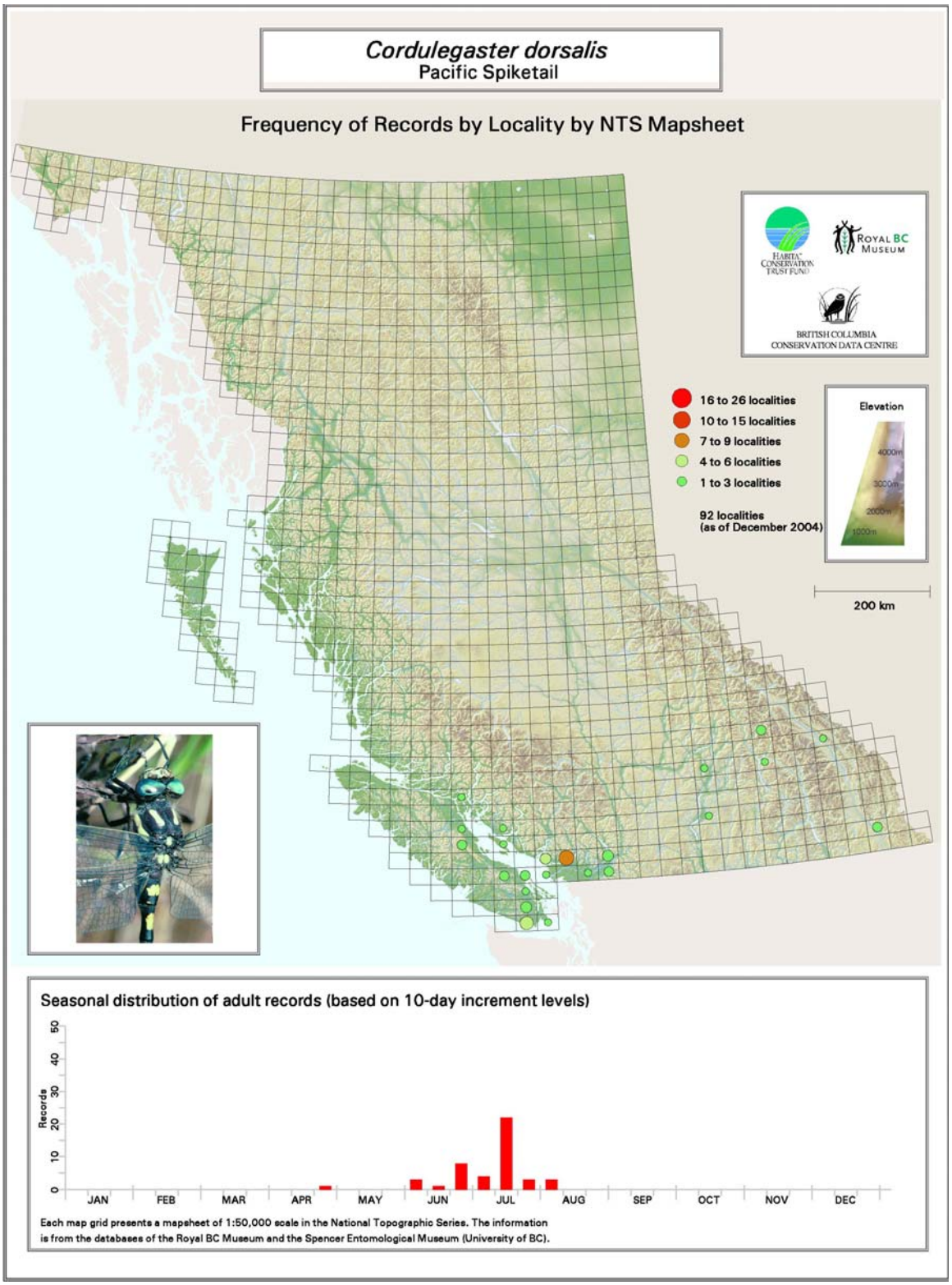
Cordulegaster dorsalis Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Cordulegaster dorsalis Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Cordulegaster dorsalis Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



Cordulegaster dorsalis Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

Family Corduliidae (Emeralds)
Medium-sized dragonflies most often seen around lakes, boggy streams and peatlands in the mountains or in the north. All 15 species in BC live in the northern study area; 13 have Boreal ranges. The eyes, often brilliant green, meet broadly on top of the head. The shape of the anal loop in the hindwing is distinctive (fig. 10b). Adults seldom perch during feeding and males frequently hover when patrolling for mates; when resting, they normally hang vertically or obliquely from vegetation. In flight, a male frequently arches its abdomen, which is often narrower at the base and tip. Larvae are usually squat and rather hairy; they sprawl in the mud and detritus in the bottom of the waters where they live.

***Cordulia* (Common Emeralds)**
The genus *Cordulia* is similar to *Somatochlora*, a much larger genus. There are only two species of Common Emeralds – ours and *C. aenea* (Downy Emerald) in Eurasia – but as the English genus name suggests, they are widespread and common.

***Cordulia shurtleffii* (American Emerald)**
BC conservation rank: S5. Yellow List.
Description: The face is dark with brilliant green eyes. The thorax is metallic green-bronze and, unlike those of many Striped Emeralds, has no pale marks on the sides. The abdomen is black after segment 4 and the male's is widest at segment 8. Male's appendages are forked in views from below and the side, fig. 11a. Female's vulvar lamina, fig. 11b. Length: male 45mm, female 46mm.
Global Range: Alaska east to Labrador and Newfoundland; south to Virginia, Michigan, Minnesota, Saskatchewan, and in the mountains to Colorado and California (*Needham et al.* 2000). Faunal element: Widespread Boreal (see Appendix 3).
BC Distribution: Widespread.
Biology: The most commonly seen emerald in our region. Flies early in the season, usually well before *Somatochlora* species appear, but both genera fly together later in the summer. Males patrol energetically and aggressively around forest lakes and peatland ponds, chasing off males of their own and other species.
BC flight period: late April to early September; the majority of records are from late May to early August.

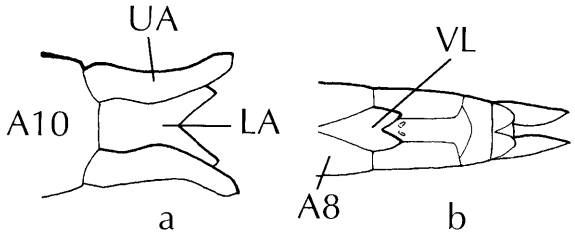
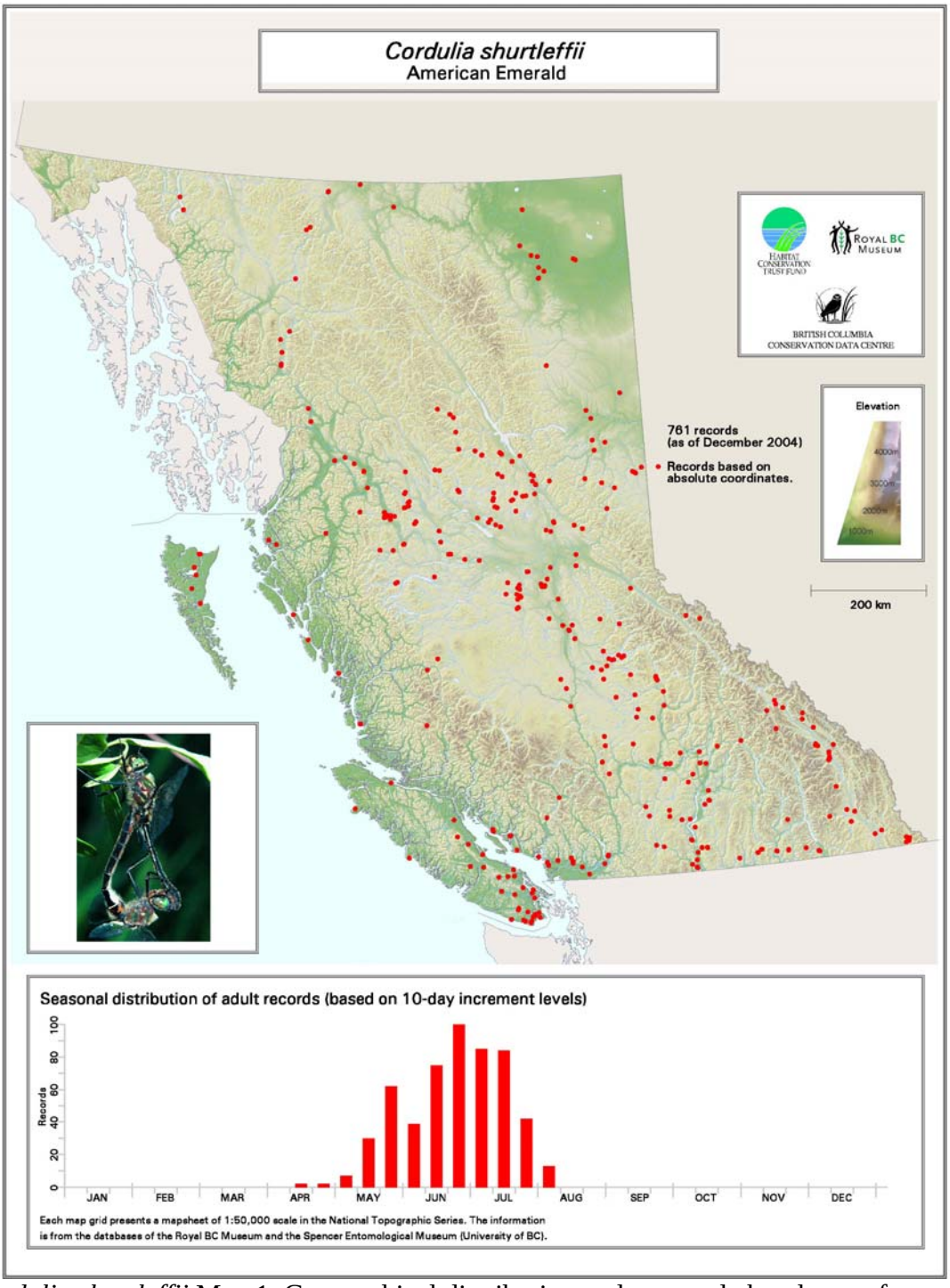
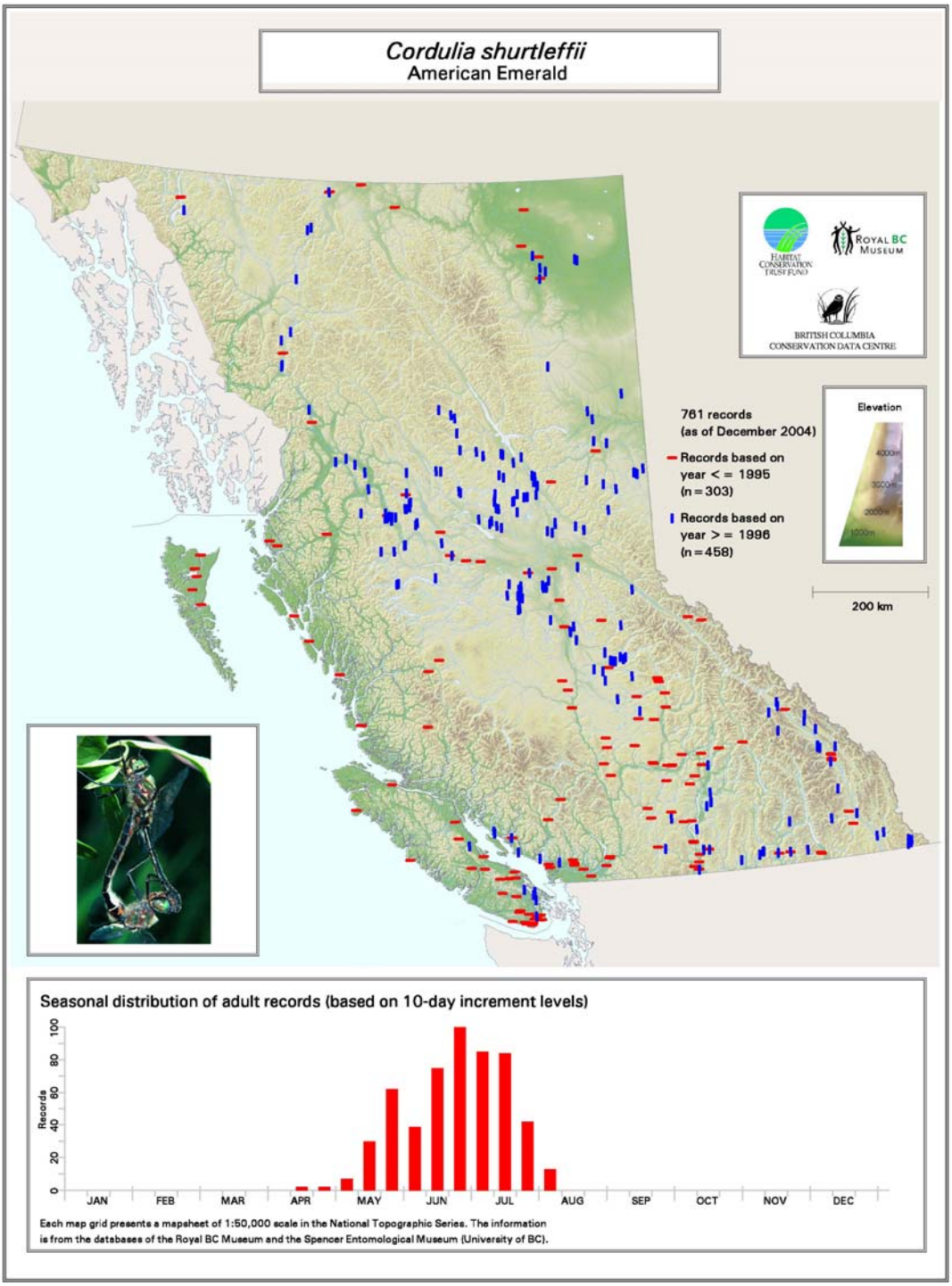


Figure 11. American Emerald: a, male appendages, view from above; b, female vulvar lamina, view from below. A8, A10 = abdominal segments 8, 10; UA, LA = upper, lower appendages. VL = vulvar lamina.

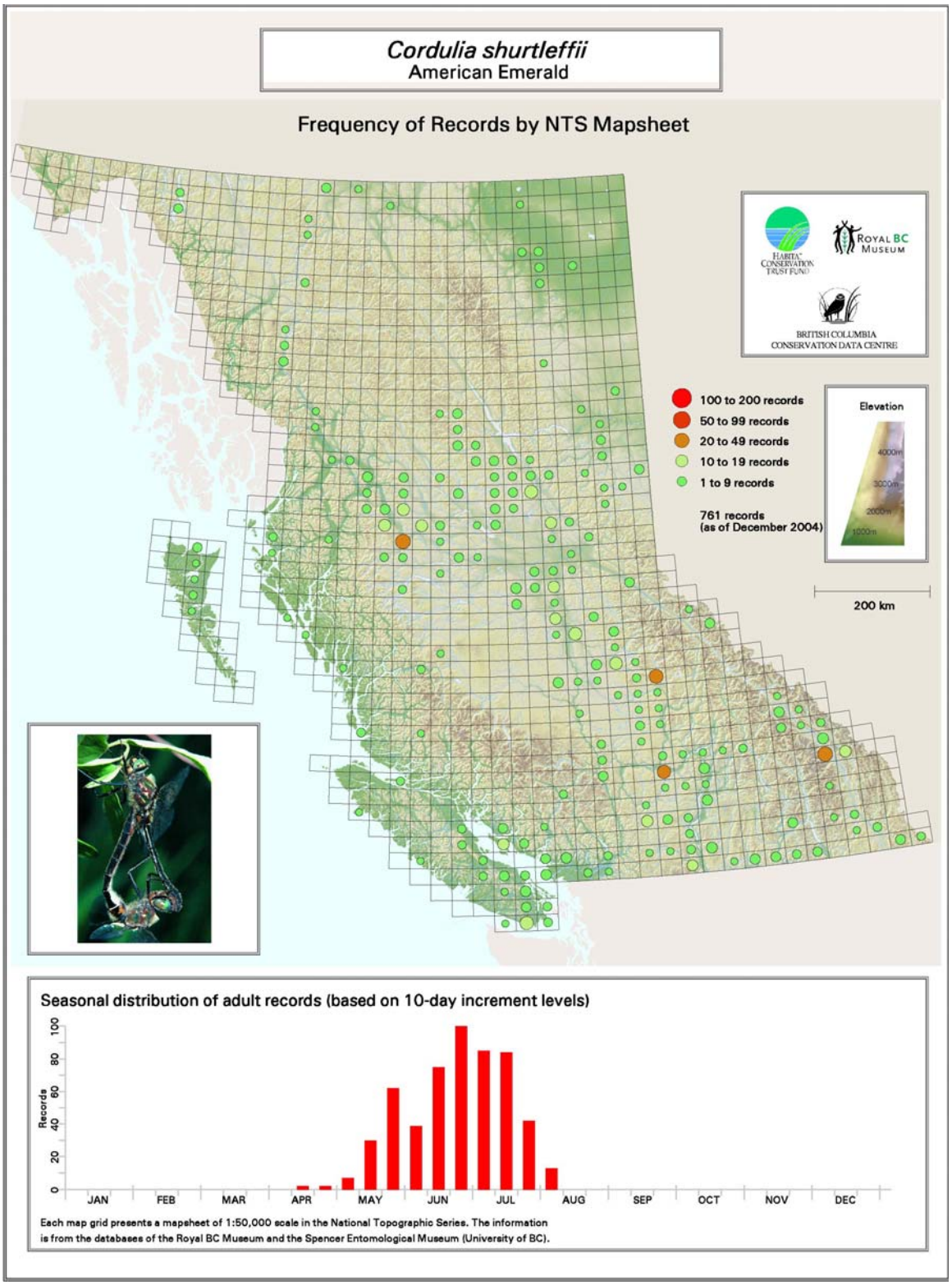
Cordulia shurtleffii mating. Photograph: George Doerksen, RBCM



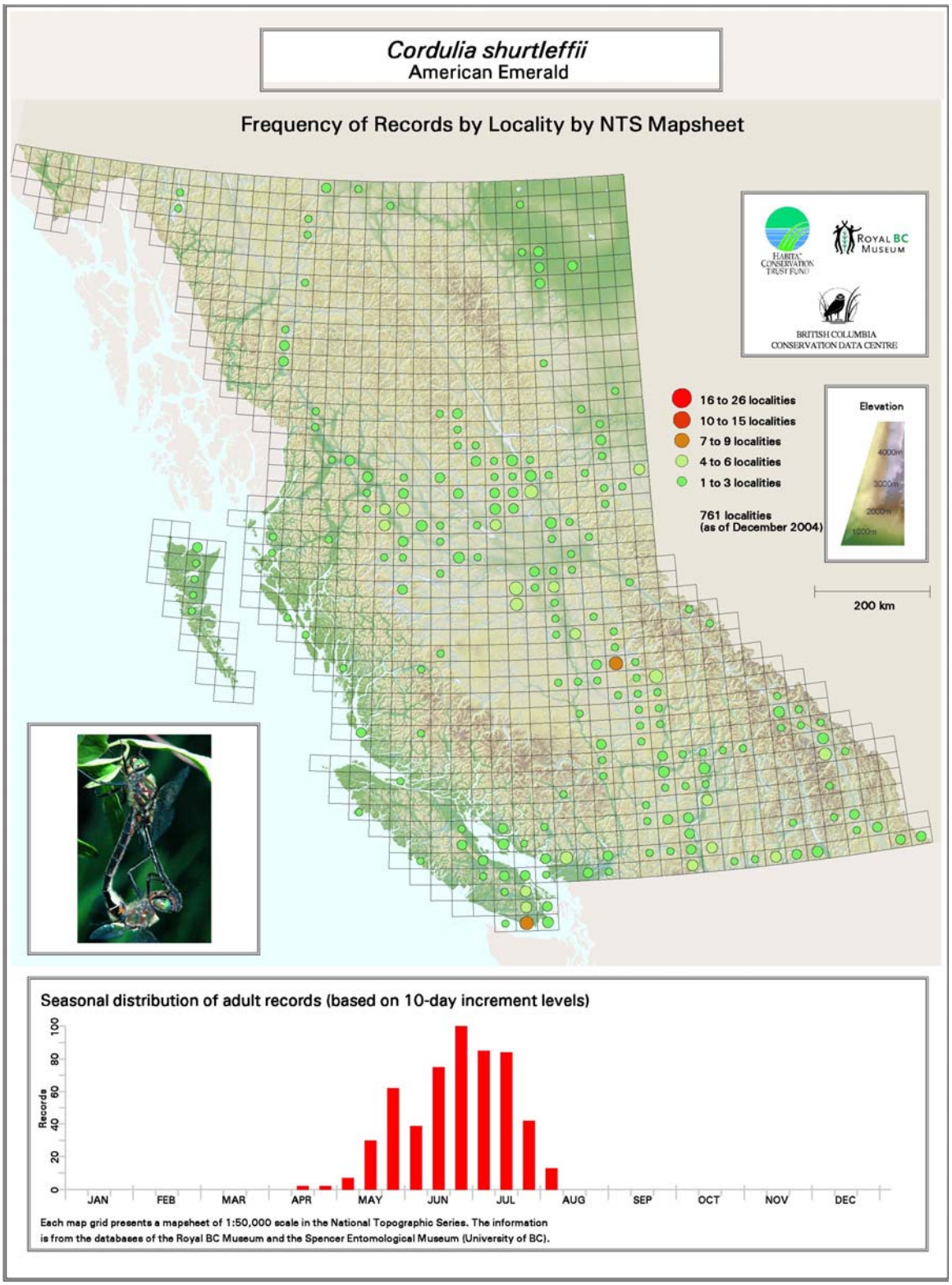
Cordulia shurtleffii Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Cordulia shurtleffii Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Cordulia shurtleffii Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



Cordulia shurtleffii Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Epitheca* (Baskettails)**

Baskettails live around the northern hemisphere. Rather than metallic green and black, like other emeralds, they have a brown thorax and a dark abdomen with yellow marks on the sides. The hindwings are marked with brown at the base. Females fly with the end of the abdomen curled upwards, the forked, finger-like vulvar lamina holding a ball of eggs as in a basket, which gives the group its English name. To lay the eggs, a female dips the egg mass into the water and it uncoils in long, gelatinous strands that float near the surface. Many females may contribute to communal egg masses. Larvae are less hairy and less coated with algae than those of our other emeralds; they have prominent dorsal and lateral spines on a broad abdomen. Some biologists place the North American species in the genus *Tetragoneuria*.

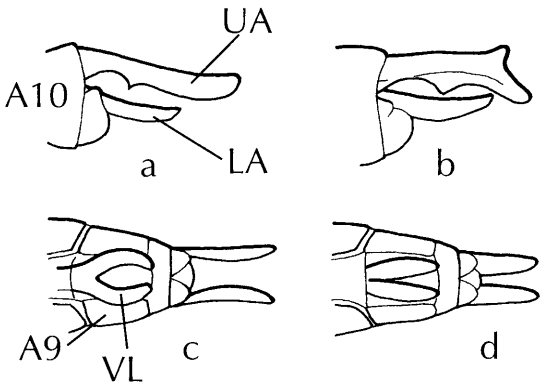


Figure 12. Identifying features for Baskettails. Above, male appendages, side view: a, Spiny; b, Beaverpond. Below, female vulvar lamina, view from below: c, Spiny; d, Beaverpond. A9, A10 = abdominal segment 9, 10; UA, LA = upper, lower appendages; VL = vulvar lamina.

***Epitheca canis* (Beaverpond Baskettail)**

BC conservation rank: S3. Blue List. Down-listed slightly in 2004 from S2S3 after northern surveys recorded the species at several localities in central BC.

Description: The face is orange-yellow with no T-spot. Male's appendages, fig. 12. Female's appendages are 2 mm long; vulvar lamina, fig 12d. Mature females have an extensive brown wash to their wings. Length: male female 45 mm.

Global Range: British Columbia to Nova Scotia, south to Virginia, Ohio, and California Needham *et al.* 2000). Faunal element: Transition (see Appendix 3).

BC Distribution: Scattered records from the extreme south coast to the Peace River drainage; no records from the dry southern valleys of the interior.

Biology: Rare inhabitant of marshy lakeshores, ponds (Wm01-02, Wm05-06; Wf01) and backwaters of slowly flowing streams (e.g. Wm01, Wf01). A spring and early summer species.

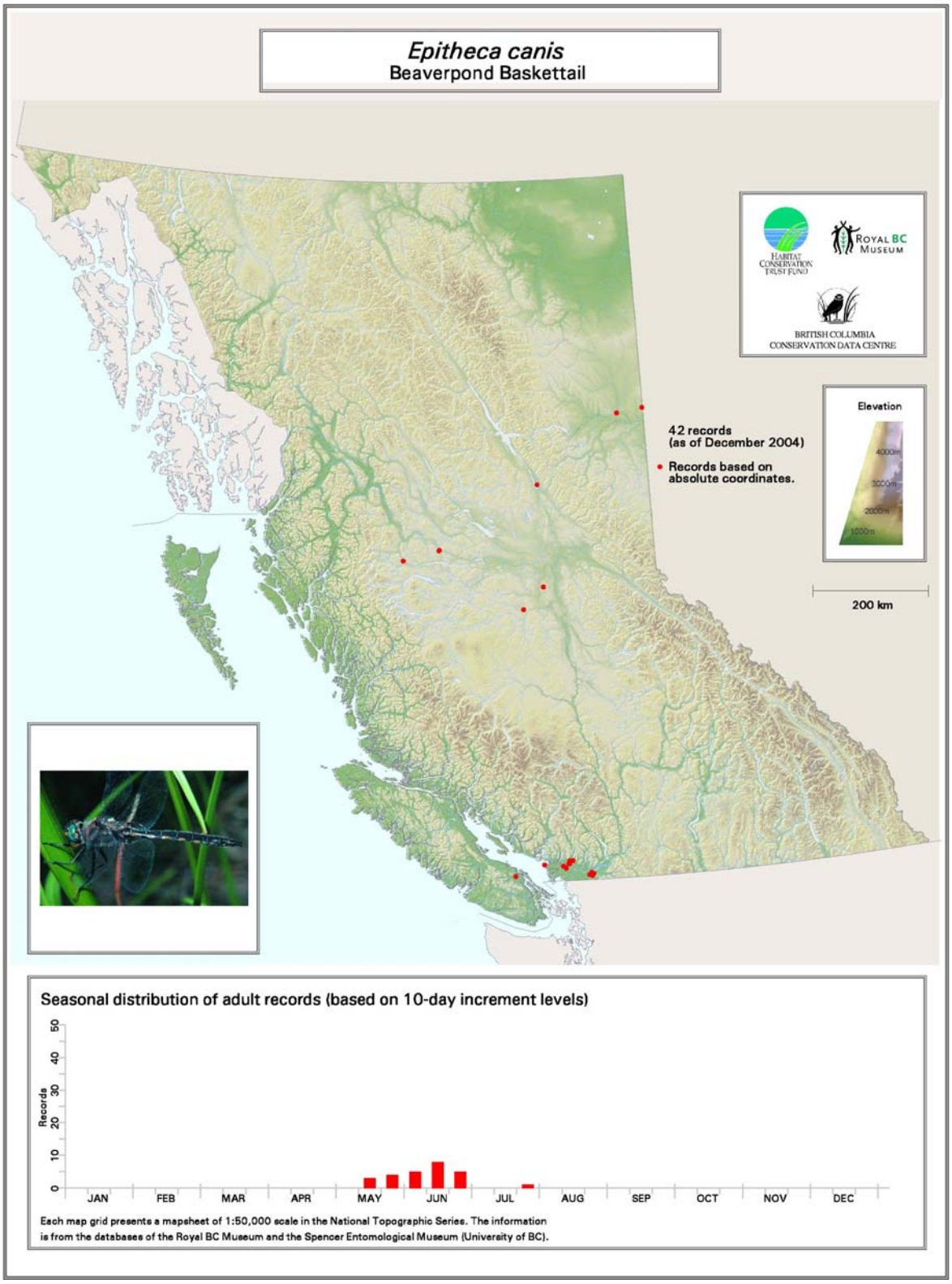
BC flight period: early May to mid August; most records are from June and early July.

Management and protection considerations: *E. canis* is still a rather enigmatic dragonfly in BC. Although at first glance, its preferred habitat is common and records are scattered over much of the province, the species is hard to find. This is largely because we know little about its biology and because it probably is truly scarce in most places.

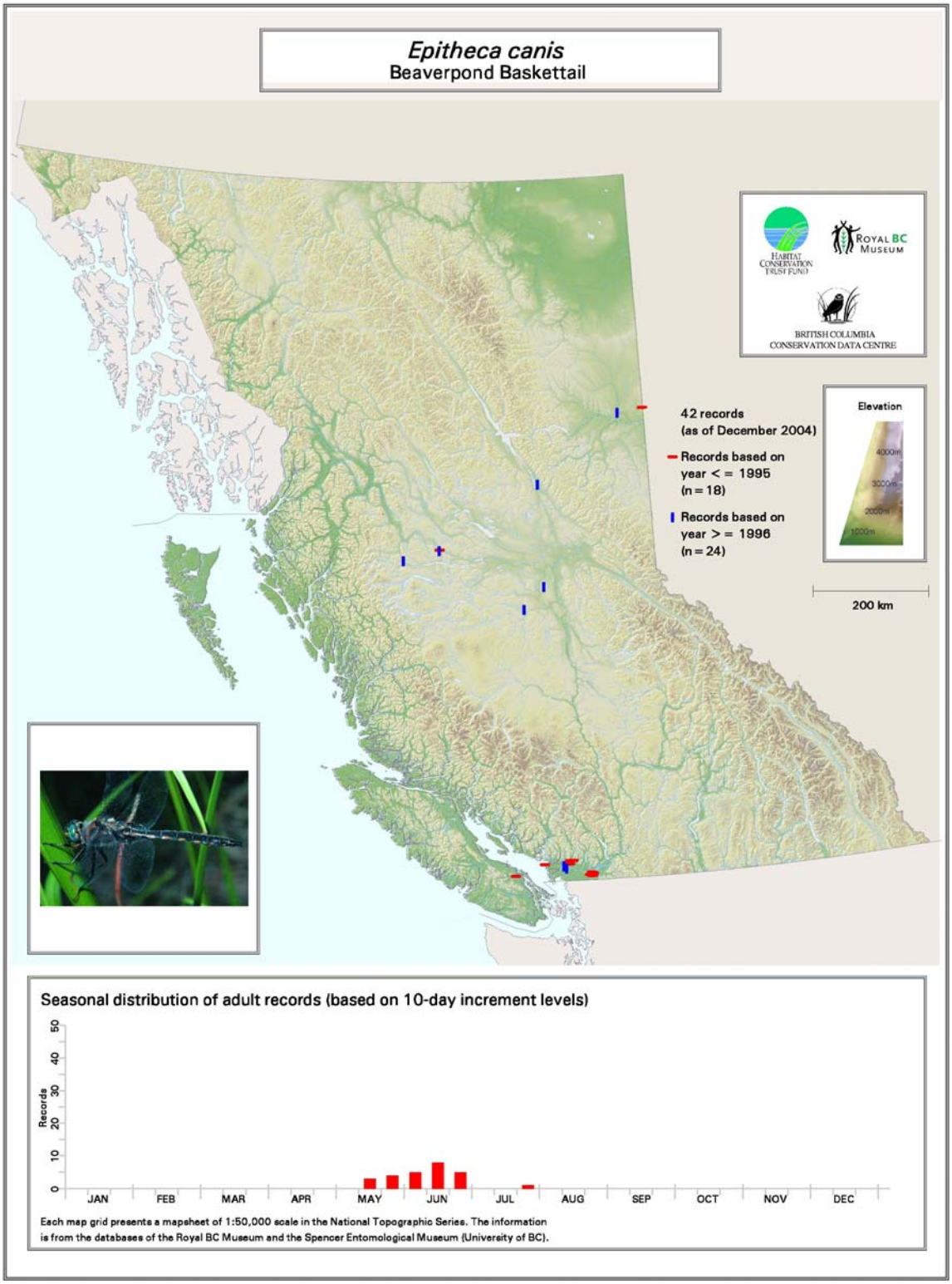
In northern BC, *E. canis* lives mainly in lakes used by fishermen and other recreational users. Disturbance by low-level recreation use is probably minimal in most areas studied, at least in the more remote lakes, although shoreline erosion from motorized craft may disturb breeding sites.

Further inventory will document more localities close to more intense human activity. More precise knowledge of larval distribution along the shorelines of specific lakes in more-travelled areas would help decision-making regarding the health of this dragonfly's populations. Marina developments and pollution from powerboats have potential impact on larval survival in these areas. On the positive side, most populations likely are not threatened -- most lakes are remote and used little, if at all, for intensive recreation. Ponds are also used as breeding habitat. Road development poses risks for particular sites, especially with regard to marsh filling and changes in drainage patterns. Development that may affect the hydrology of a catchment area should be managed to minimize impacts. Riparian forest damage by logging is also a potential disturbance. Samways and Steytler (1996) provide recommendations for the width of riparian buffers and vegetation heterogeneity for species assemblages. Although these recommendations treat different odonate assemblages than the ones described here, the life requirements of the dragonfly species are similar. Management practices that ensure the continued viability of wetlands should be followed.

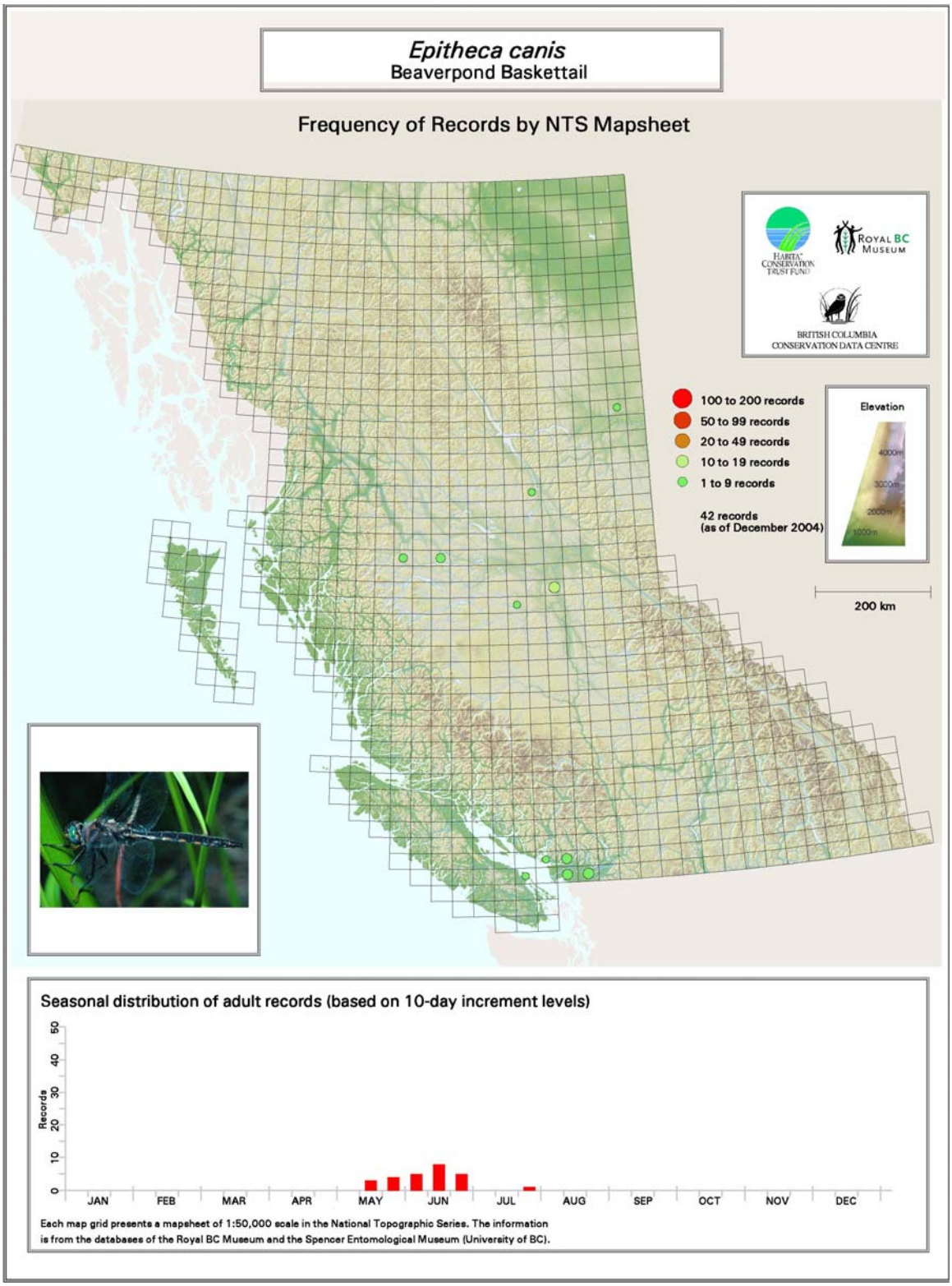
Epitheca canis male. Photograph: George Doerksen, RBCM



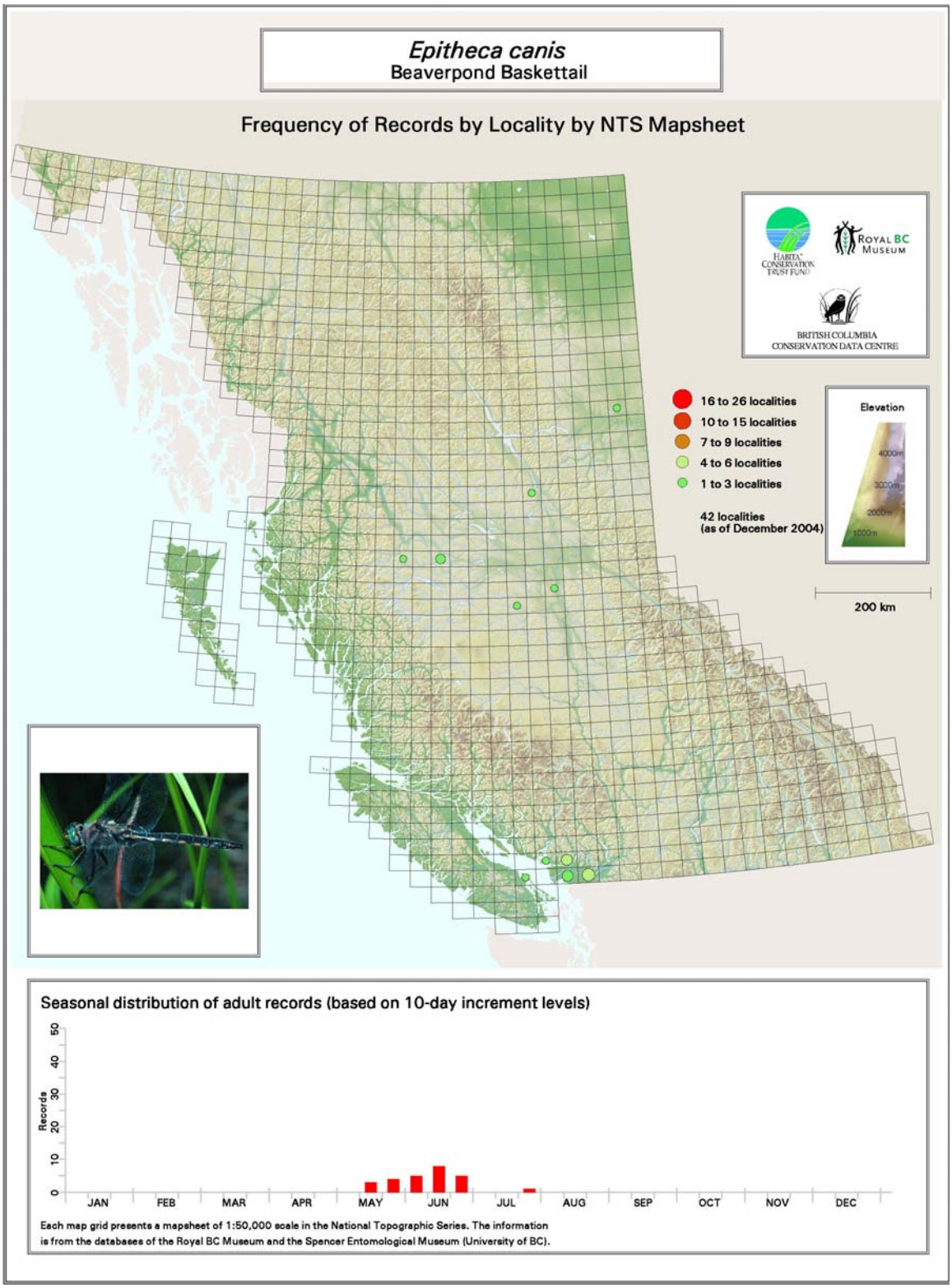
Epitheca canis Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Epitheca canis Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



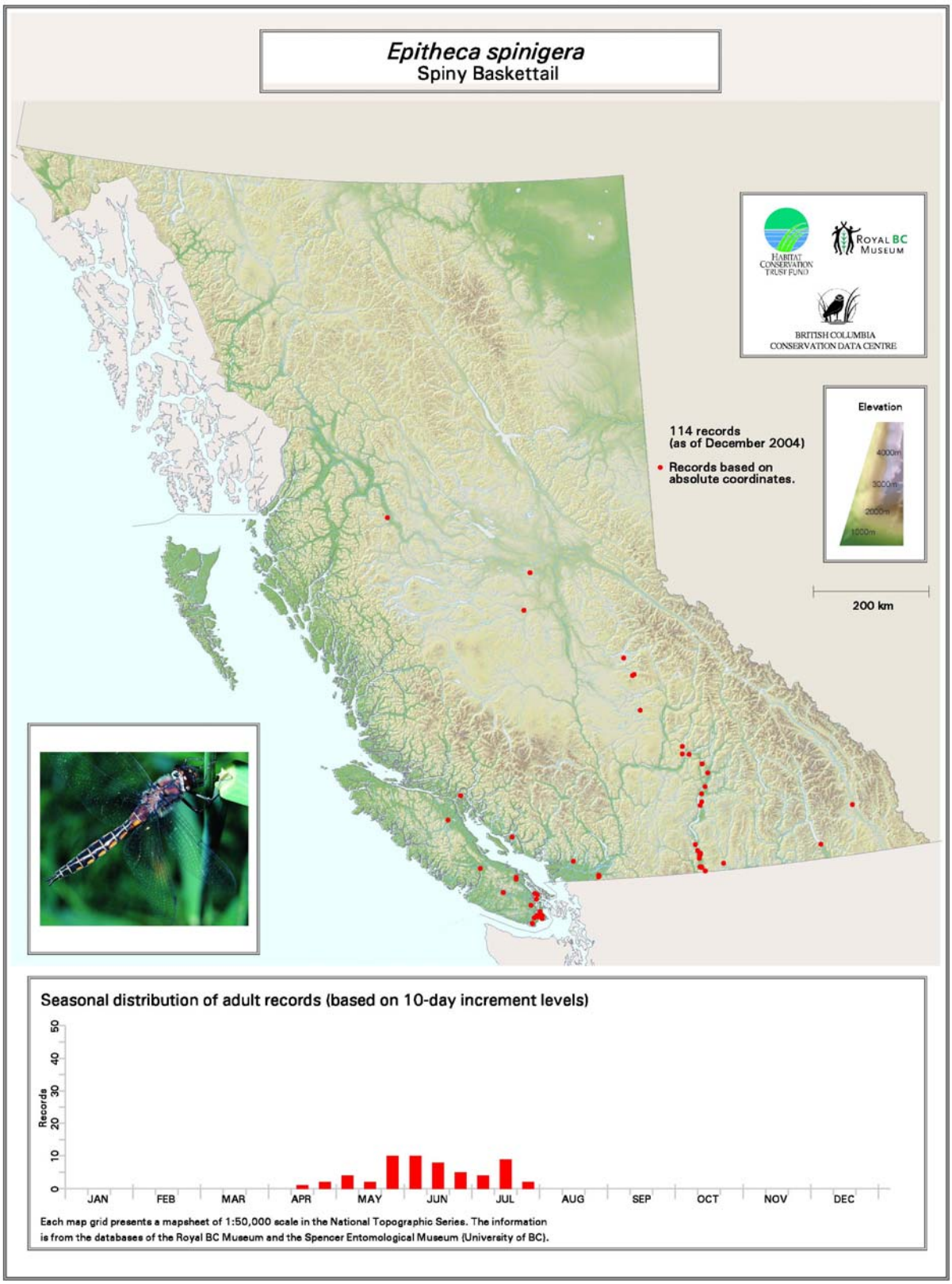
Epitheca canis Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



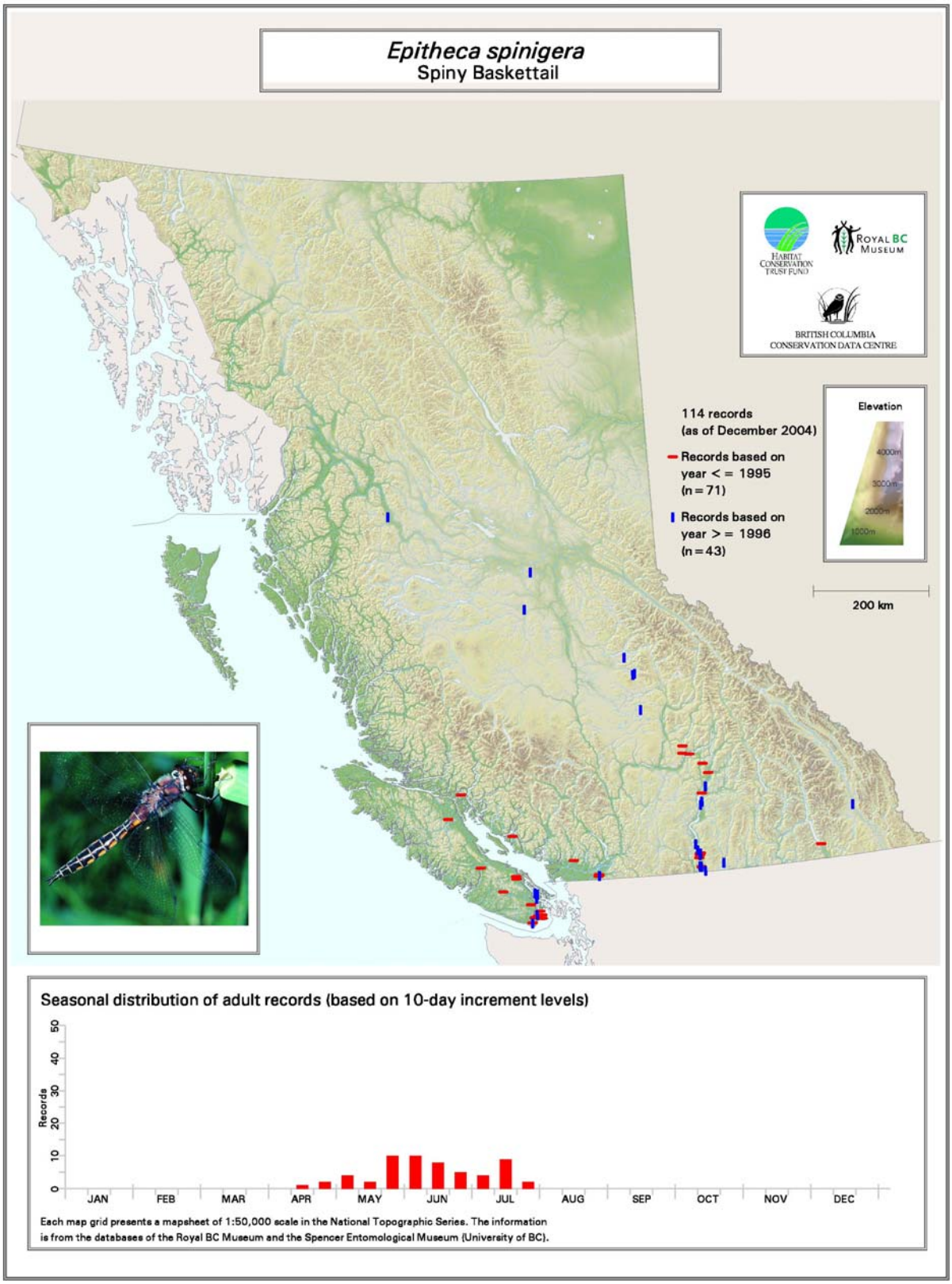
Epitheca canis Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Epitheca spinigera* (Spiny Baskettail)**
BC conservation rank: S5. Yellow List.
Description: The orange-yellow face has a dark T-spot. Male's appendages, fig 12a. Female's appendages are 3 mm long; vulvar lamina, fig. 12c. Length: male female 48 mm.
Global Range: British Columbia east to Nova Scotia; south to New Jersey, Kentucky, Iowa, Montana and California (Needham *et al.* 2000). Faunal element: Transition (see Appendix 3).
BC Distribution: Widespread on the south coast and southern interior valleys; scattered localities in the Cariboo-Chilcotin and north to Smithers.
Biology: Infrequently encountered in the southern valleys of the province, although at times it can be numerous. Breeds in lakes and ponds (Wm01-02; Wm05-06; Wf01), but often seen hunting well away from water. Flies early in the season.
BC flight period: late April to late August; mostly records are from early June to late July.

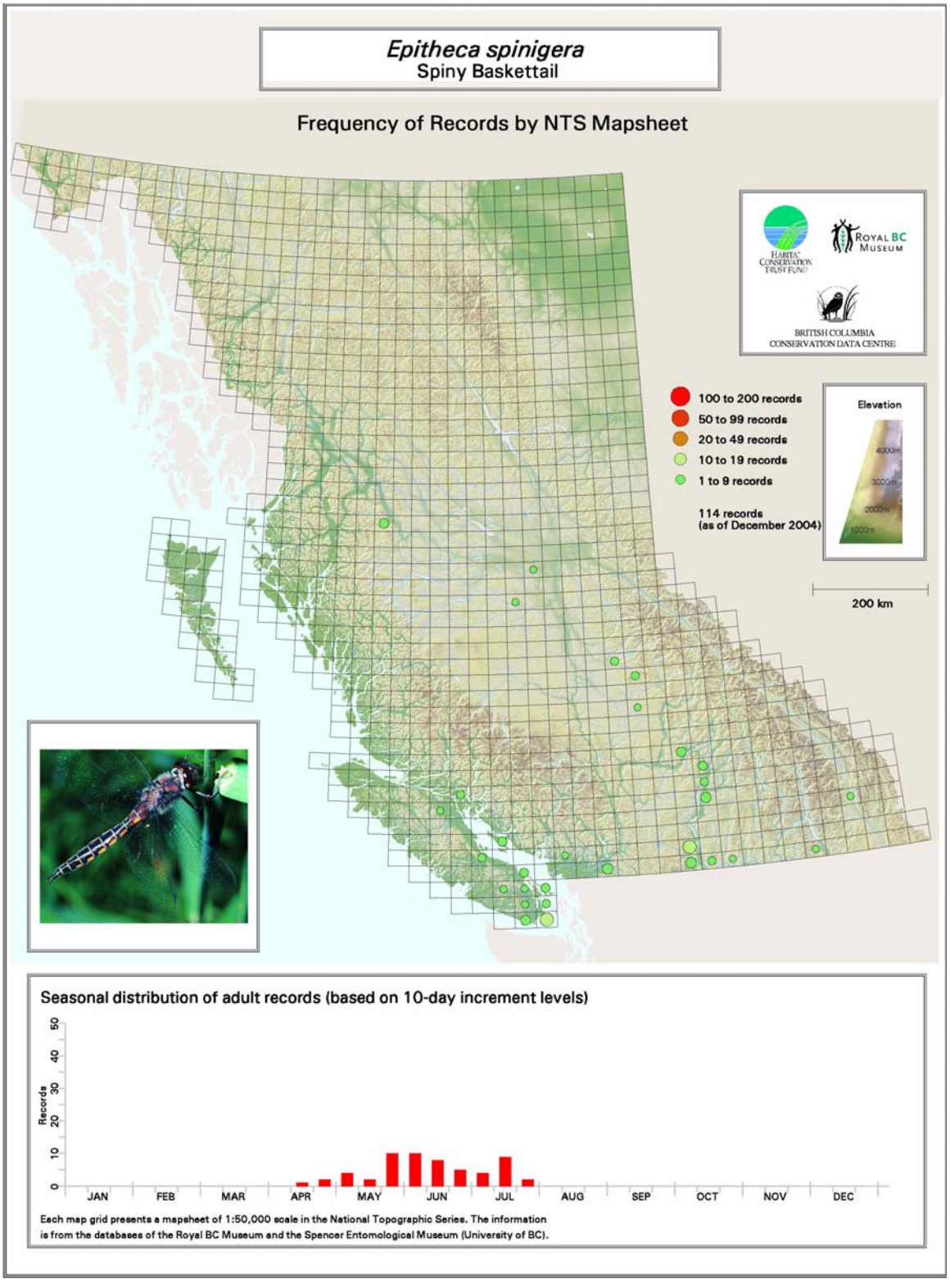
Epitheca spinigera male. Photograph: George Doerksen, RBCM



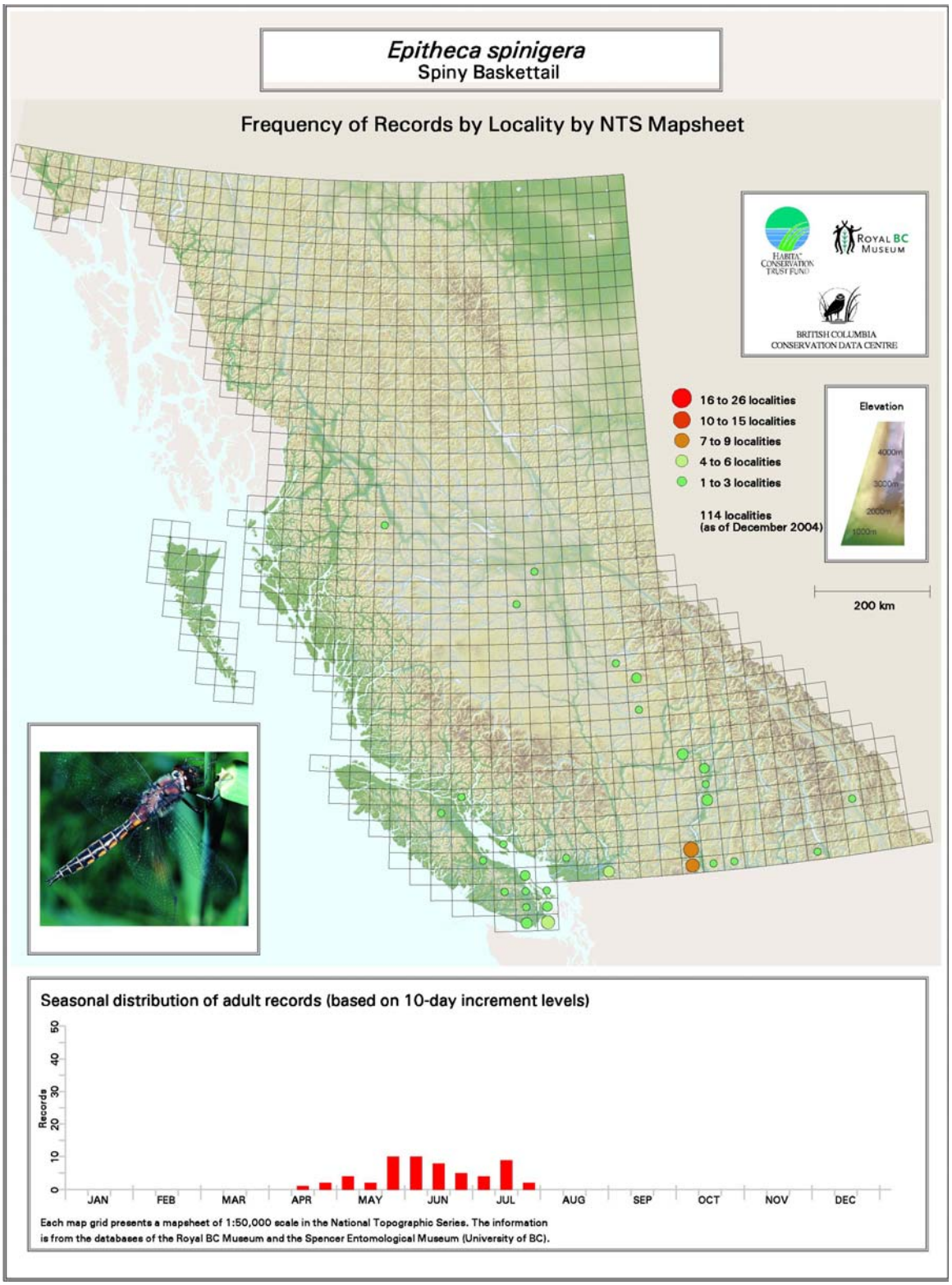
Epitheca spinigera Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Epitheca spinigera Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Epitheca spinigera Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



Epitheca spinigera Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Somatochlora* (Striped Emeralds)**
The scientific name comes from two Greek words: *soma*, meaning "body", and *khloros*, meaning "green". The English name refers to the yellow or white markings on the sides of the metallic green or bronzy thorax, but most of the distinctly striped species live in eastern North America; western species have spots, short bars or no marks at all. They all have brilliant green eyes. Most North American species are boreal and Appalachian; 12 of 26 occur in BC. Most live around northern or mountain lakes and peatlands.

Species can be hard to identify, especially the females. Look for pale marks on the side of the thorax and white rings between the segments of the abdomen. *S. albicincta, S. cingulata* and *S. hudsonica* have narrow, white abdominal rings. Examine the shapes of the male's upper appendages and the female's vulvar lamina. And look for a brown spot at the base of the hindwings – not the membranule, which can also be dark, but an additional spot (*S. franklini, S. septentrionalis* and *S. whitehousei* have it).

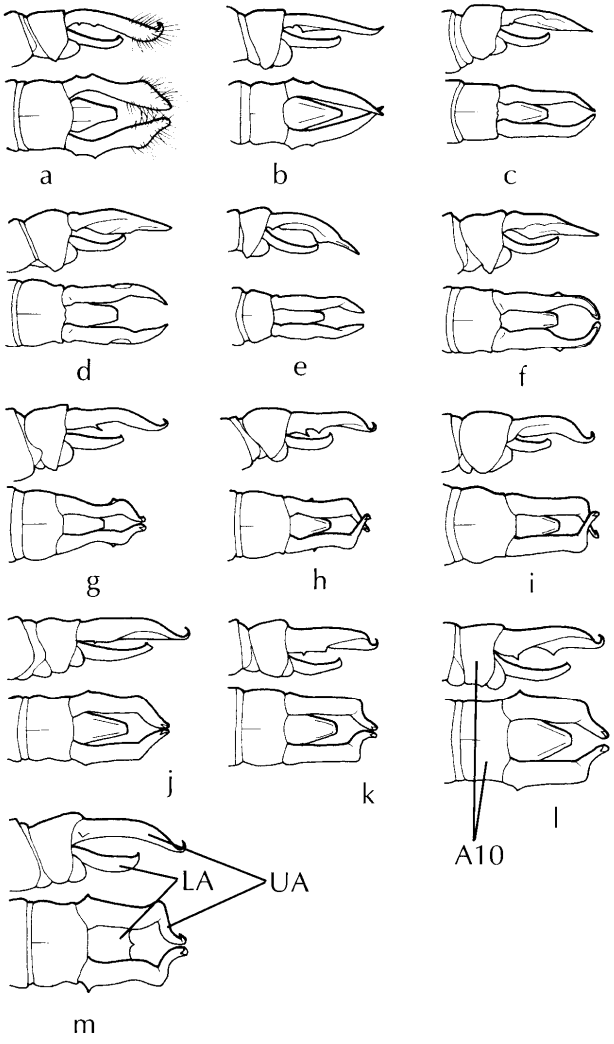


Figure 13. Striped emerald male appendages, (side view above, top view below): a, Brush-tipped; b, Ocellated; c, Delicate; d, Kennedy's; e, Forcipate; f, Mountain; g, Whitehouse's; h, Muskeg; i, Treeline; j, Quebec; k, Ringed; l, Hudsonian; m, Lake. A10 = abdominal segment 10; UA, LA = upper, lower appendages.

The upper appendages come in three main shapes: a-b, converging and the tips turned gently upward; c-f, pincer-like and the tips pointed downward with no curl at the tip; g-m, tips bent abruptly inward and strongly curled.

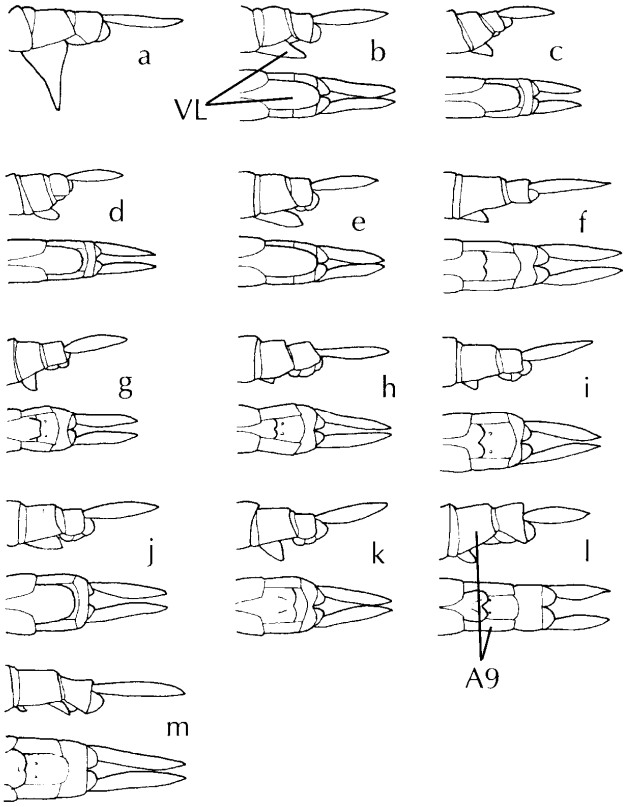
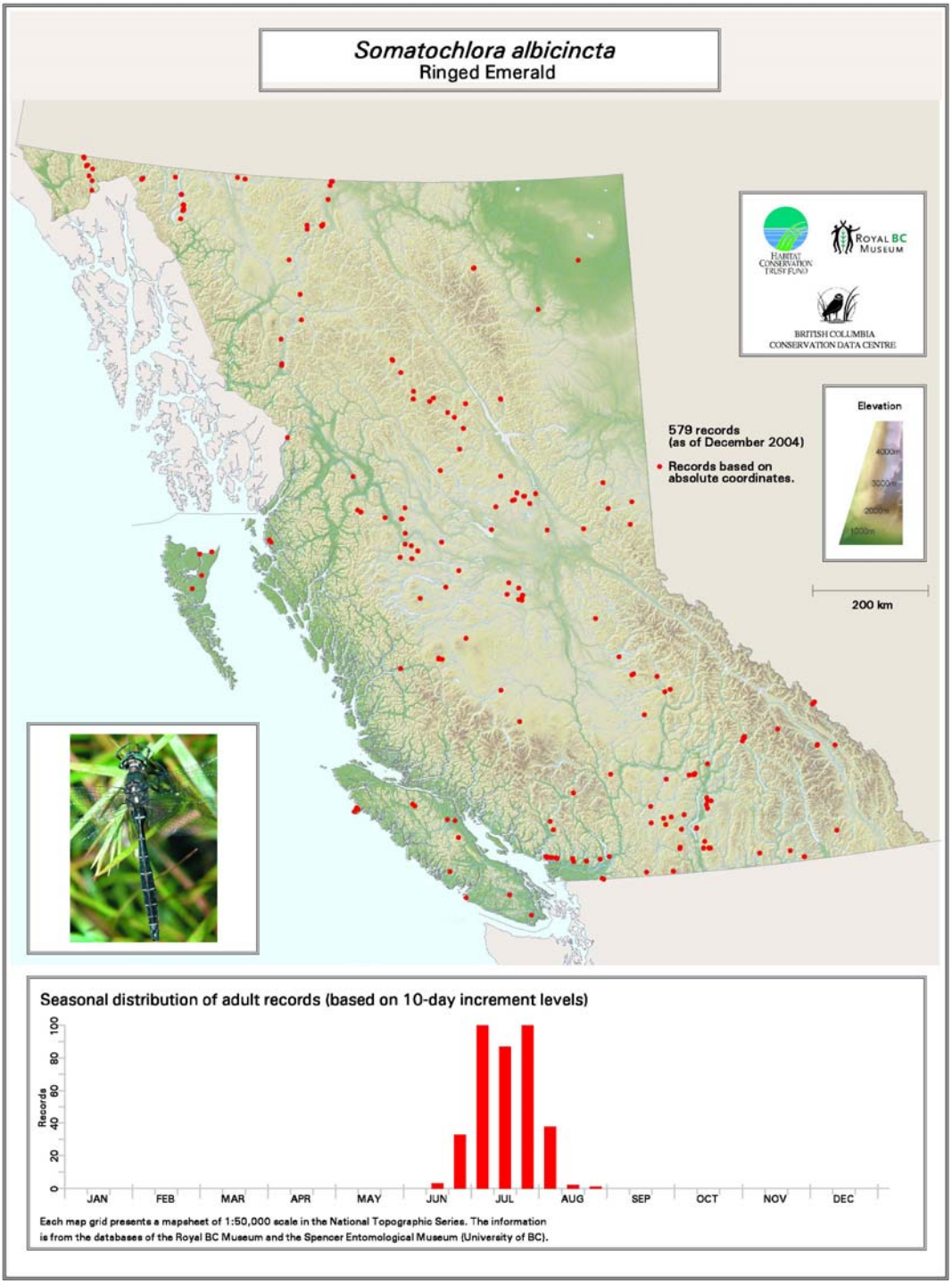


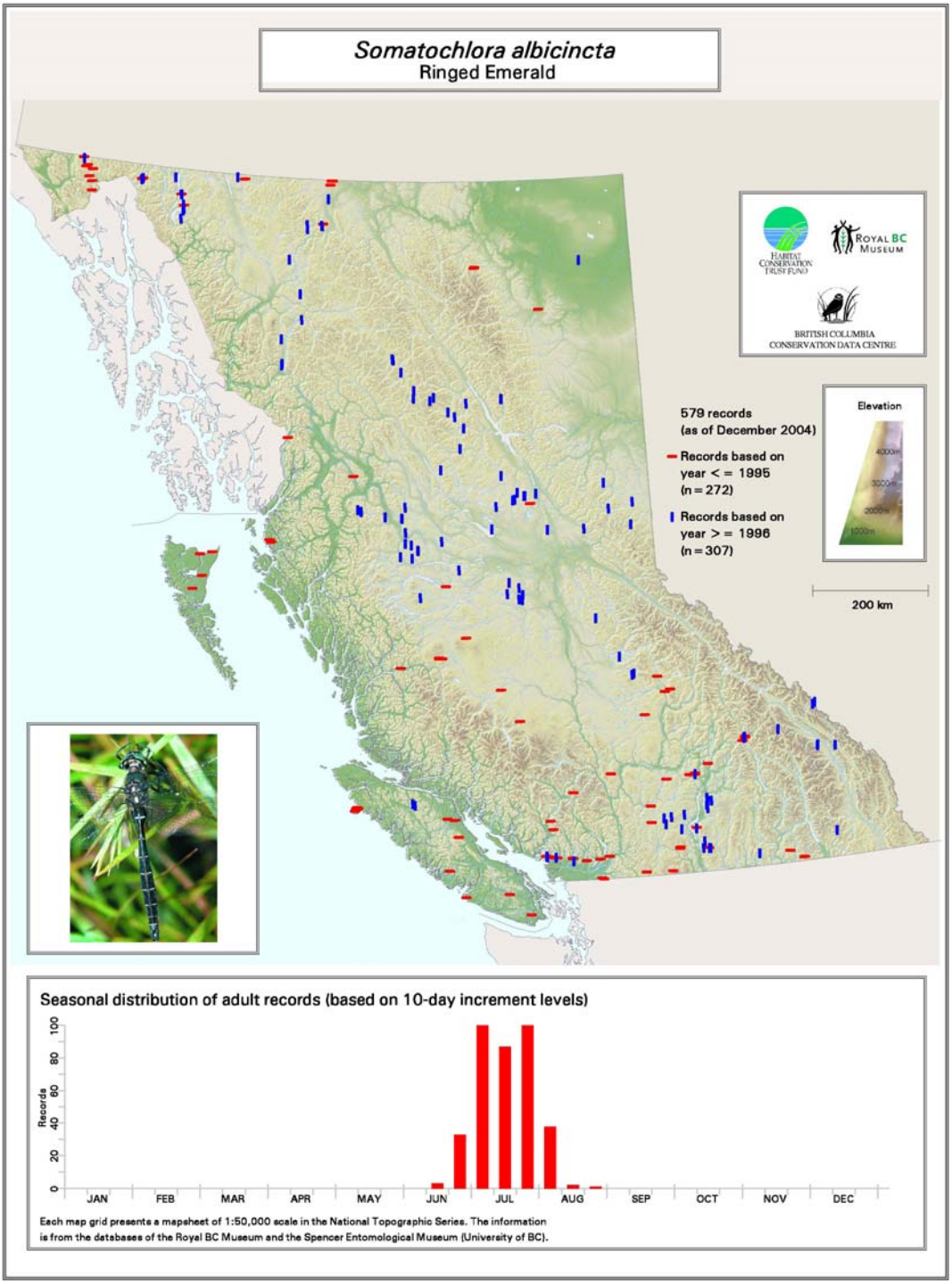
Figure 14. Female striped emeralds have a spout-like or flap-like vulvar lamina (side view above, top view below): a, (side view only) Ocellated; b, Brush-tipped; c, Delicate; d, Kennedy's; e, Forcipate; f, Mountain; g, Whitehouse's; h, Muskeg; i, Treeline; j, Quebec; k, Hudsonian; l, Ringed; m, Lake. A9 = abdominal segment 9; VL = vulvar lamina.

***Somatochlora albicincta* (Ringed Emerald)**
BC conservation rank: S5. Yellow List.
Description: Similar to *S. hudsonica*, but smaller. Male appendages, fig. 13k; female vulvar lamina, fig. 14l. The thorax sides are brassy green and marked with a white bar, its ends pointed. The English and scientific names refer to narrow white rings between the segments of the abdomen (*albicincta* means "girdled with white"); the top of segment 10 has a pair of pale spots. Length: male 50 mm, female 50 mm.
Global range: Alaska east to Labrador and Newfoundland; south to New Hampshire, New York, Lake Superior, and north of the Great Plains to the Rockies; south through British Columbia and Alberta to Montana and California (Needham *et al.* 2000). Faunal element: Widespread Boreal (see Appendix 3).
BC Distribution: Widespread; the only white-ringed emerald west of the Coast Mountains.
Biology: Patrols margins of firm-edged peatland ponds (Wf06, Wf10, Wf50; Wb50-52).
and slow streams, and the open, peaty margins of forest lakes. Its habitats usually contain relatively open, poorly vegetated, shallow water. Specimens on the BC coast are larger than usual; some on the Queen Charlotte Islands can be as large as *S. cingulata*.
BC flight period: mid June to mid October; most records from early July to mid-August.

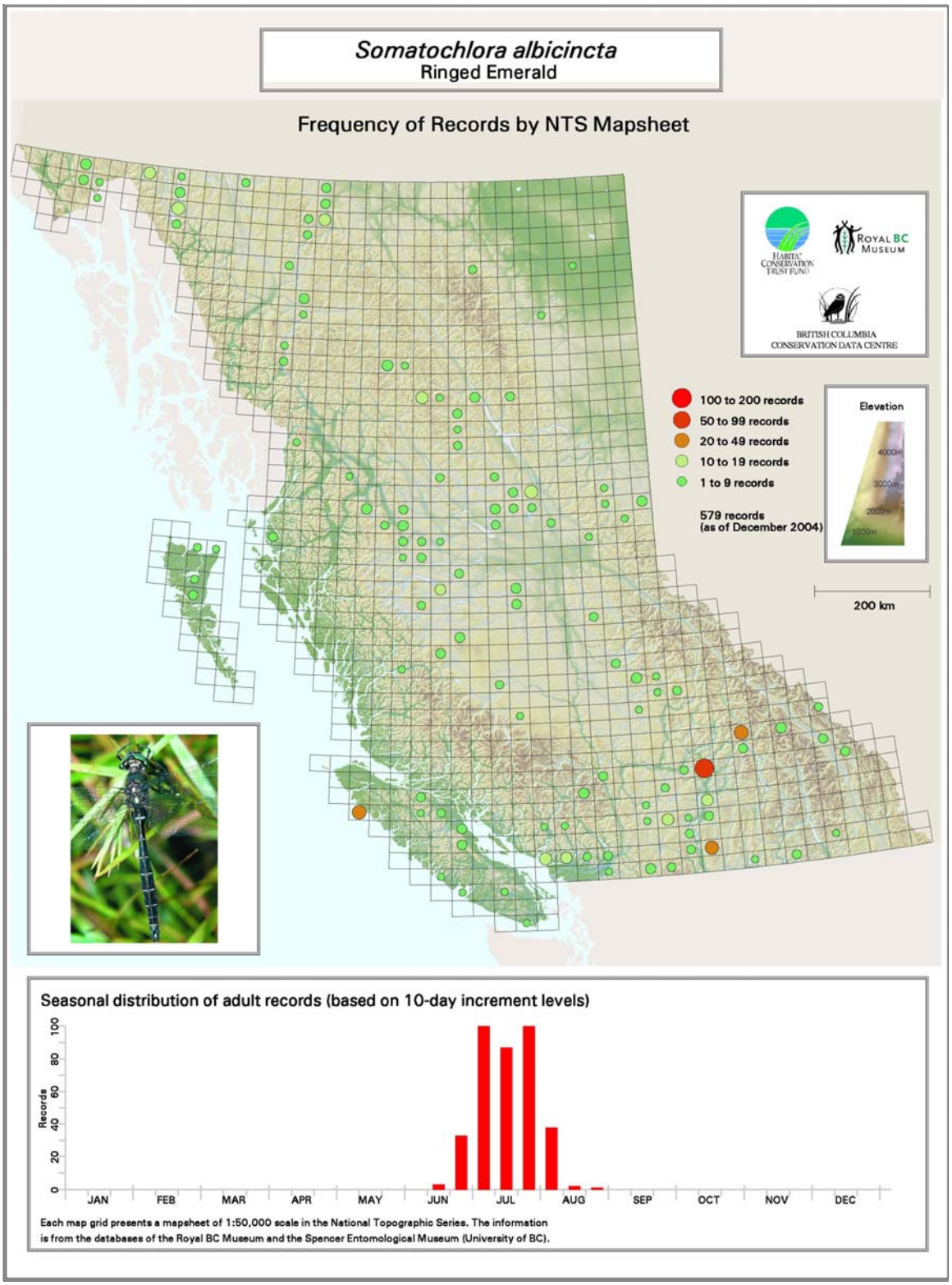
Somatochlora albicincta male. Photograph: George Doerksen, RBCM



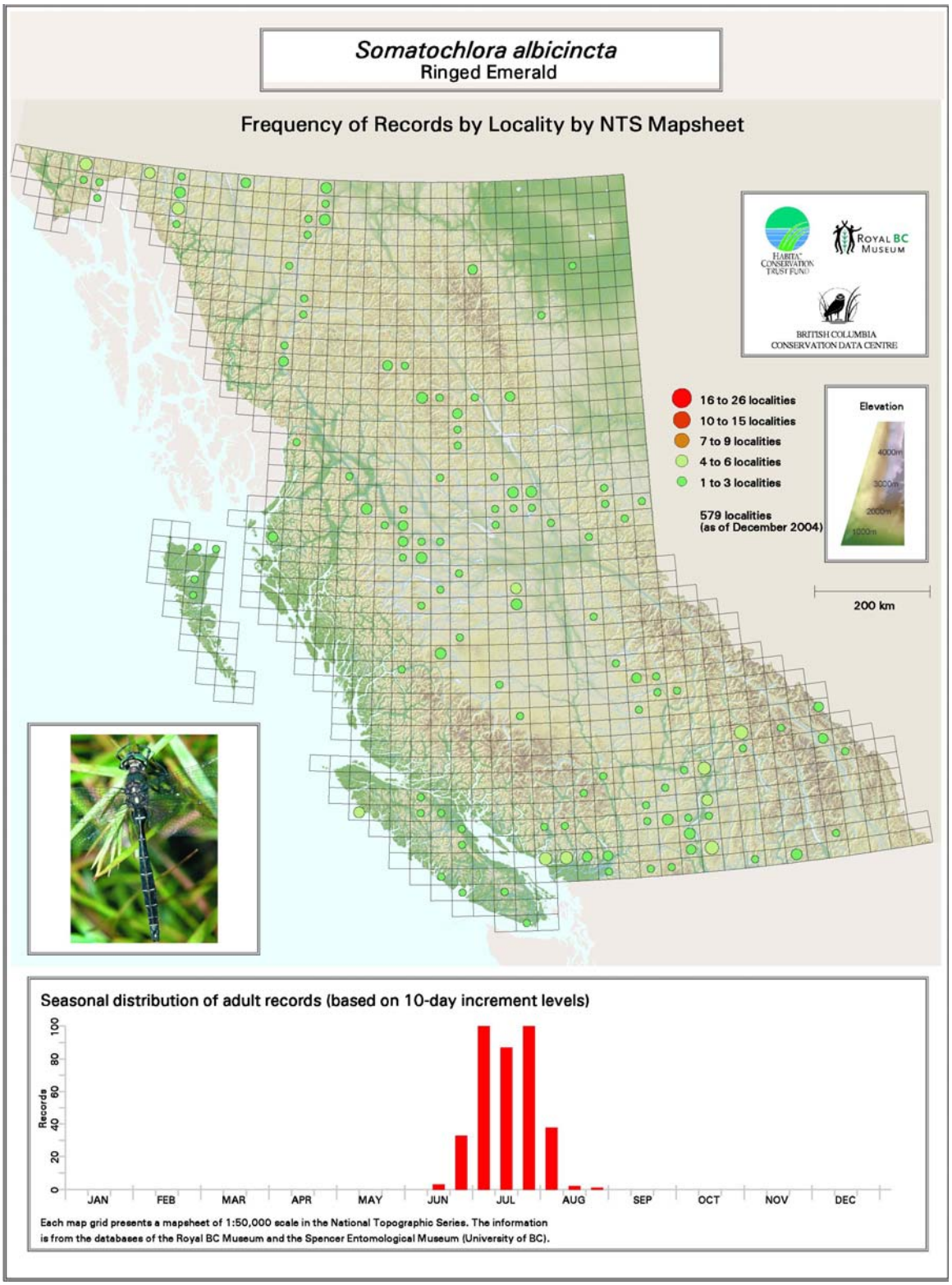
Somatochlora albicincta Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Somatochlora albicincta Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Somatochlora albicincta Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.

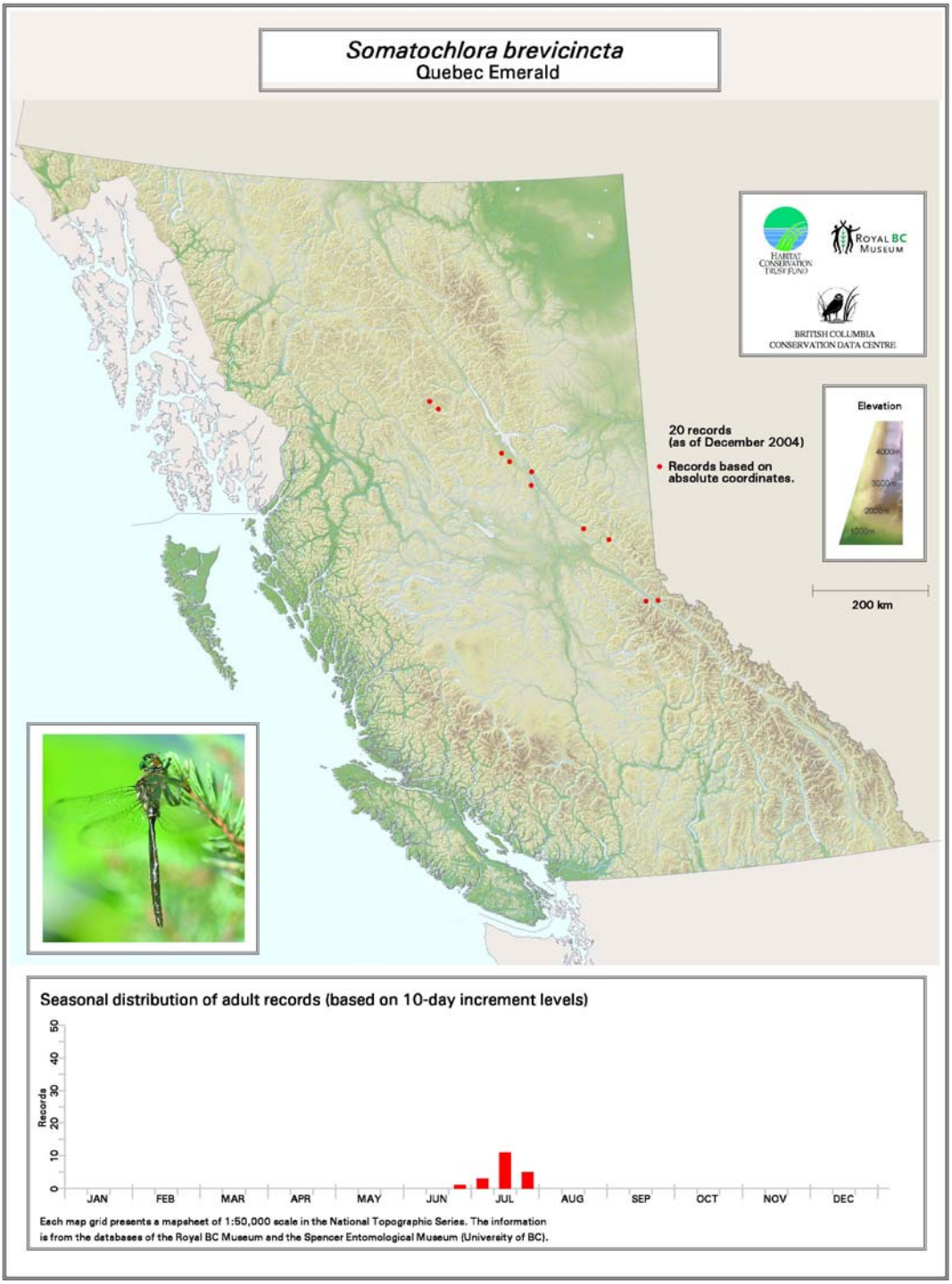


Somatochlora albicincta Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

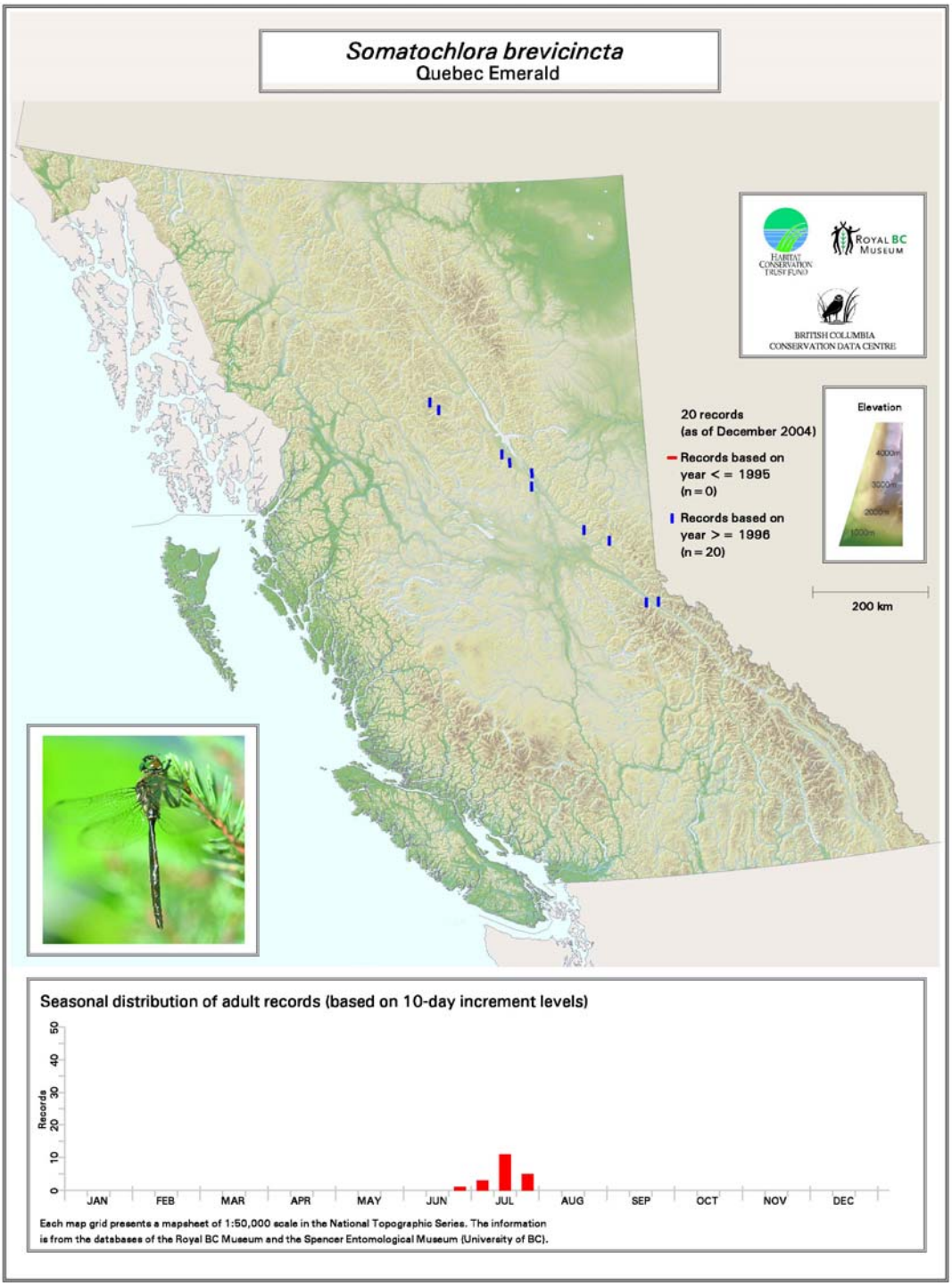
***Somatochlora brevicincta* (Quebec Emerald)**
BC conservation rank: S3. Blue List. Down-listed from the S1 originally given the species when it was first discovered in the province (four localities in 2000, ten by 2001, but not collected subsequently in the surveys).
Description: Similar to *S. albicincta*, but its abdomen lacks rings or they are reduced to small spots on the sides between segments 3 to 7; and the top of segment 10 is black. The thorax sides are brassy green with a white bar, its ends pointed. Female has reddish hairs on the hind margin of its head. Male's appendages, fig. 13j; vulvar lamina, fig. 14j. Length: male 48 mm, female 45 mm.
Global range: Quebec east to Newfoundland, south to Nova Scotia and Maine; British Columbia (Catling *et al.* 2005). Undoubtedly ranges across the Canadian boreal forest, but not yet recorded from Alberta to Ontario. Faunal element: Southern Boreal (see Appendix 3).
BC Distribution: Central Rocky and Cariboo mountains near McBride north to Williston Lake (northern Rock Mountain trench); central BC plateau west of Williston Lake.
Biology: Rare. First discovered in BC in 2000, several thousand kilometres west of Quebec (where it was originally discovered) and the rest of its range in the Atlantic provinces and Maine. In BC, this species prefers mossy fens, especially patterned ones (Wf 08) with shallow pools (flarks) dominated by short sedges. It flies with *S. whitehousei* in these habitats, but is much less abundant.
BC flight period: mid June to early September; the few records are from July and early August.
Management and protection considerations: Even in ideal habitat sites, *S. brevicincta* is rare. It is difficult to separate from its more common congeners on the wing, and at a place such as the patterned fen on Bell Mountain near McBride, where several were captured in 2000, 20 or so *S. whitehousei* had to be netted for each *S. brevicincta* counted.

Like other rare or uncommon northern *Somatochlora* species, *S. brevicincta* lives in habitats that are widespread, but difficult to sample because of their remoteness from roads. For this reason, it may be probably relatively more abundant than records indicate, although the known distribution restricted to areas not far from the western slopes of the Rockies is curious. Nevertheless, it was certainly recorded in only a fraction of the patterned fens sampled. These fen habitats are sensitive to changes in drainage created by road building and other construction, siltation resulting from logging and other disturbances. In general, peatland pools should be managed to maintain water quality and water table stability. Development that may affect the hydrology of a catchment area should be managed to minimize impacts.

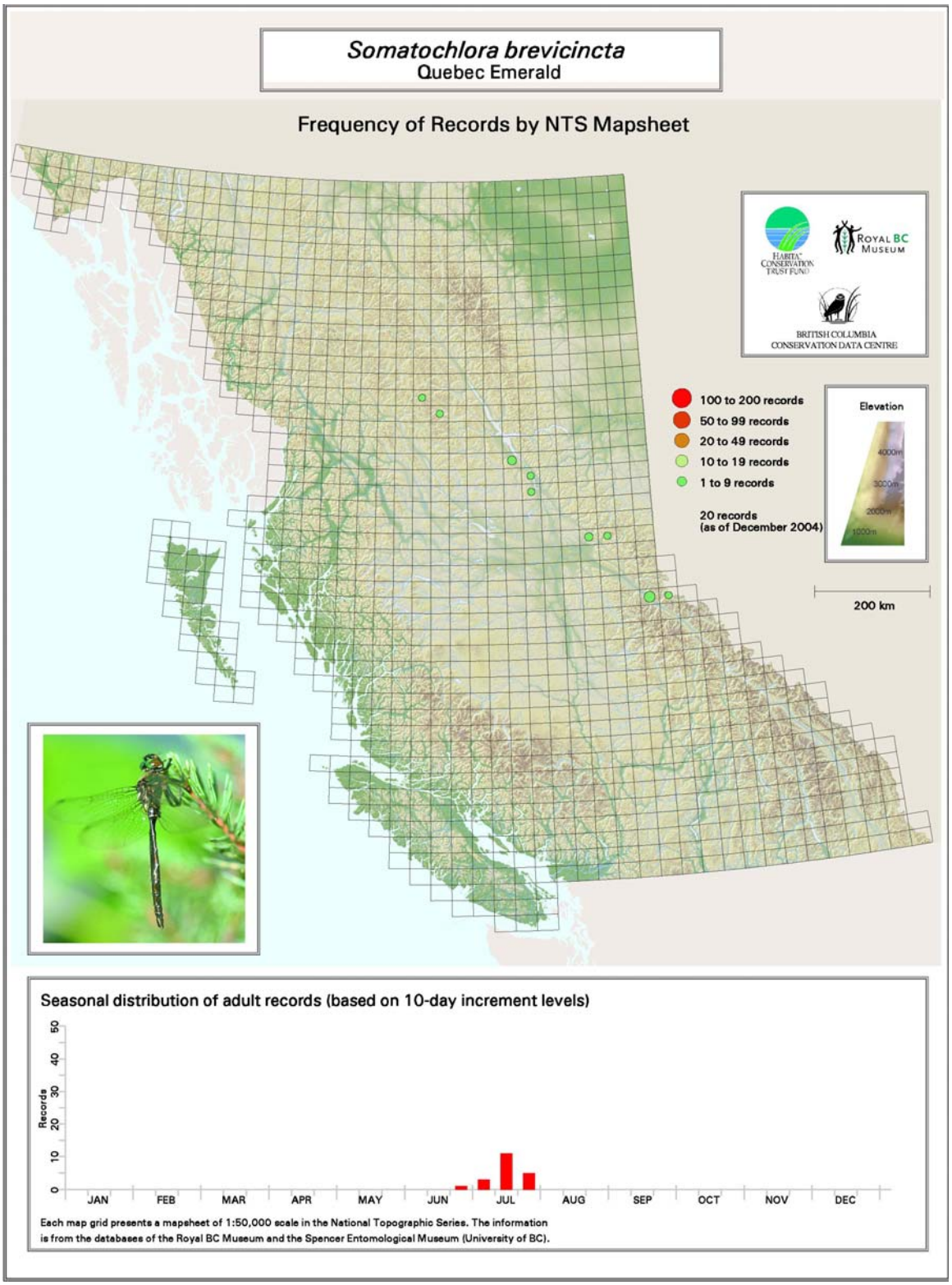
Somatochlora brevicincta male. Photograph: Sid Dunkle



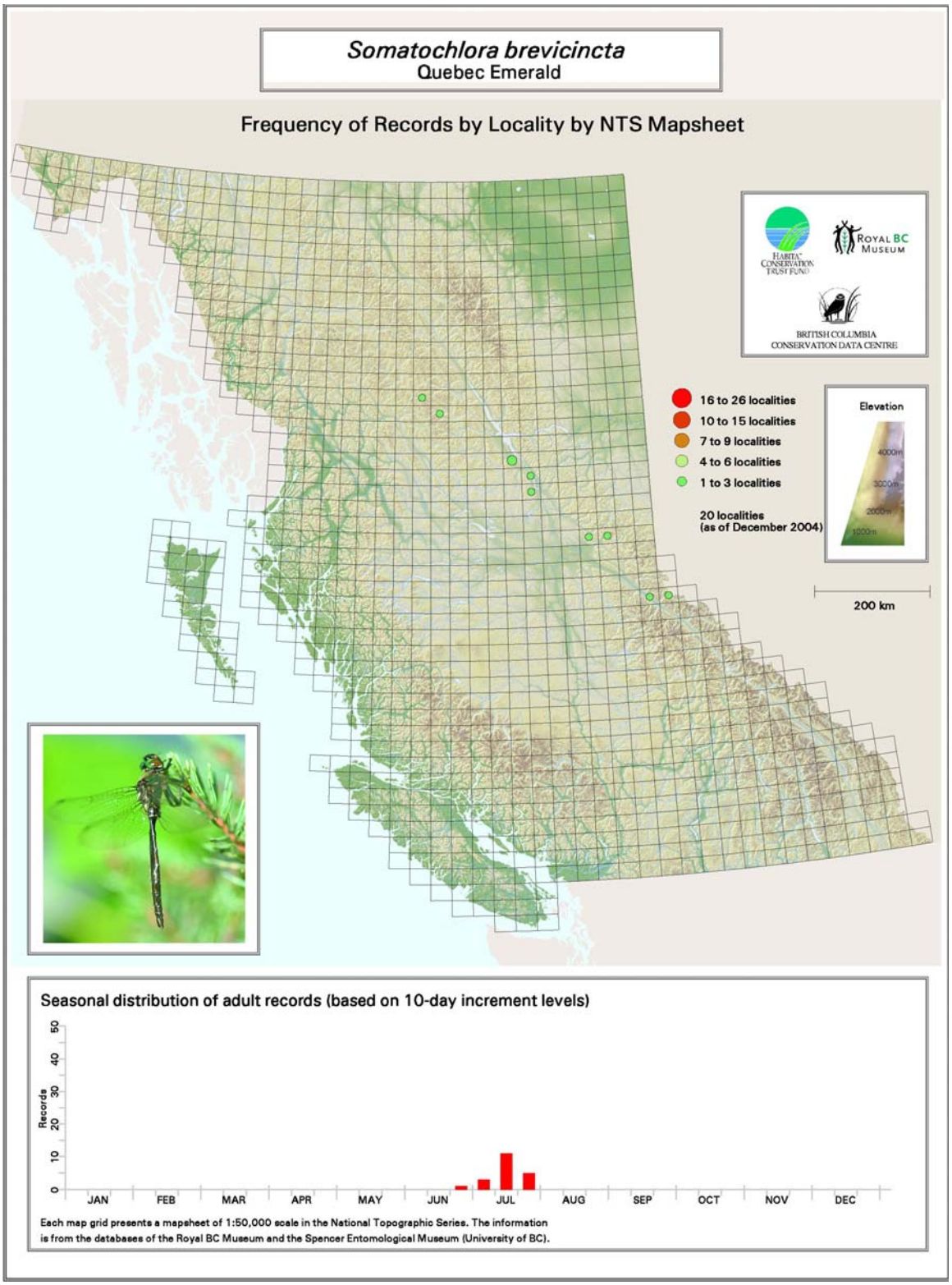
Somatochlora brevicincta Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Somatochlora brevicincta Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



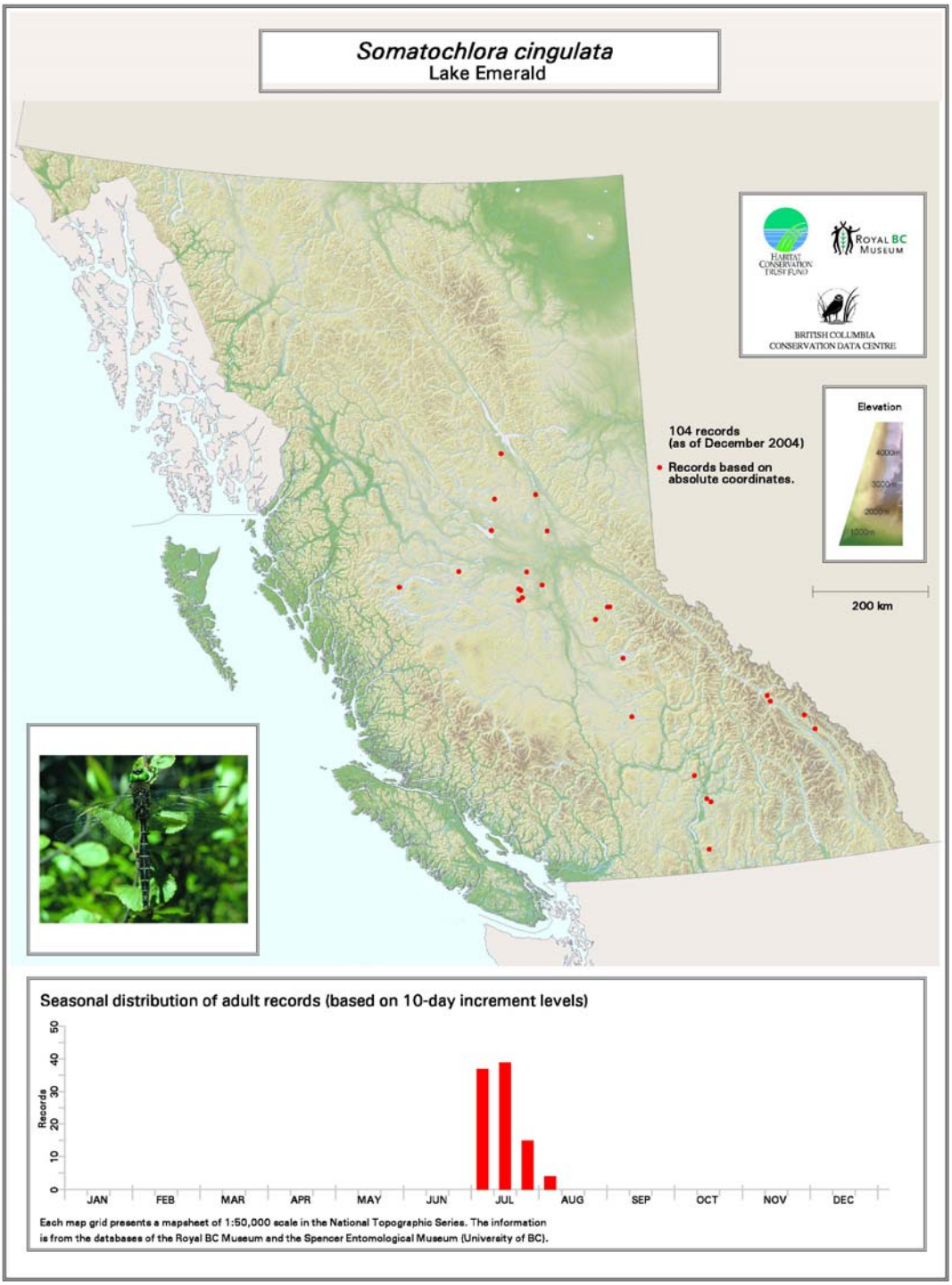
Somatochlora brevicincta Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



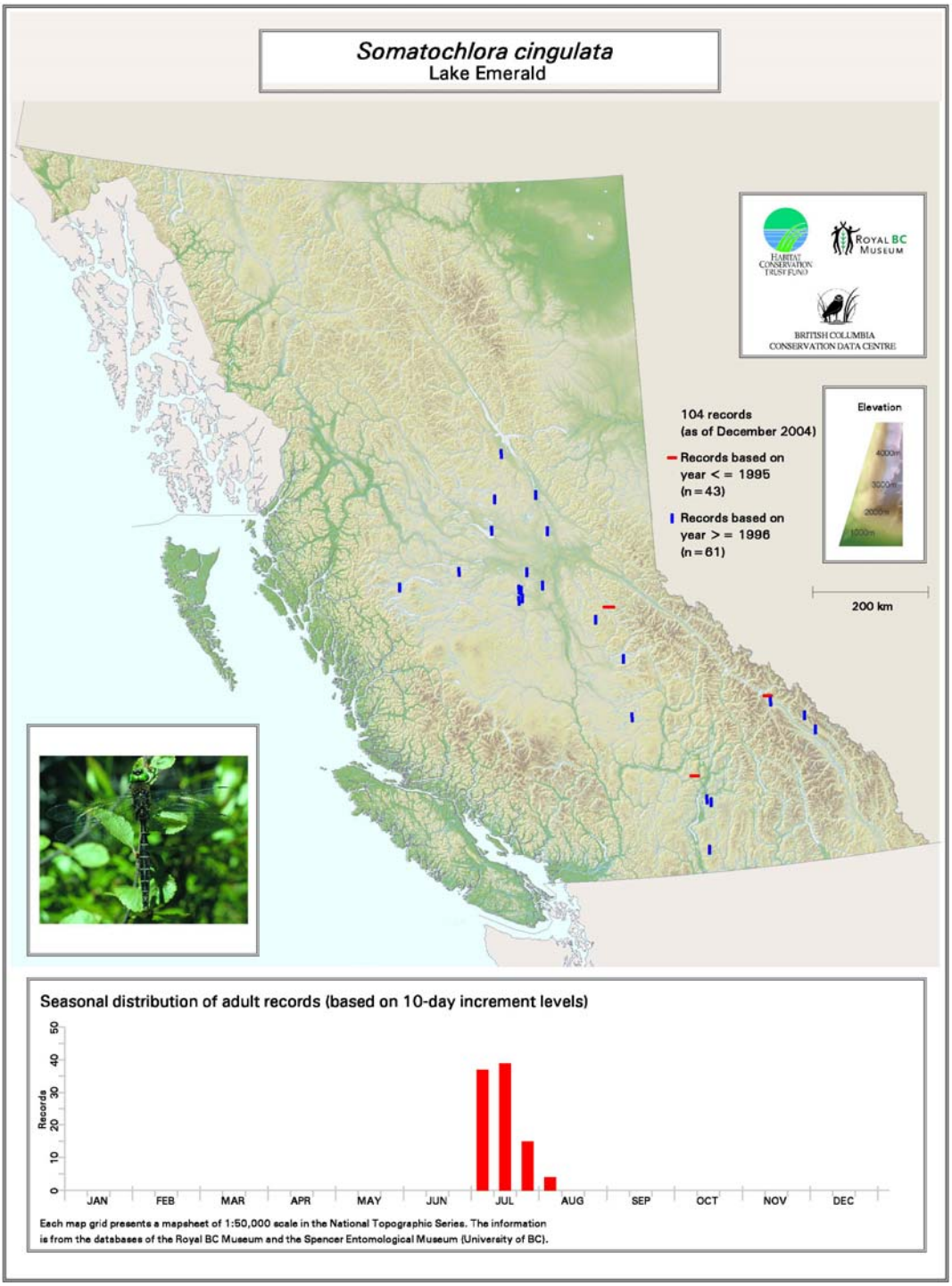
Somatochlora brevicincta Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Somatochlora cingulata* (Lake Emerald)**
BC conservation rank: S4. Yellow List. This species has been down-listed twice from the original S2S3 given it in 1995 as our understanding of its status improved during the northern surveys.
Description: The largest emerald in our region, as big as a small darner. Similar to *S. albicincta* and *S. hudsonica*, but larger. The thorax sides are dark brassy green-brown without marks; the abdomen has narrow white rings. Male's appendages, fig. 13m; vulvar lamina, fig. 14m. Length: male 60 mm, female 58 mm.
Global Range: Ranges across the southern boreal forests from Newfoundland and Labrador to central British Columbia; south to Massachusetts, Minnesota, and Wyoming (Needham *et al.* 2000). Faunal element: Southern Boreal (see Appendix 3).
BC Distribution: Southern and central BC east of the Coast Mountains; north to Williston Lake.
Biology: Often hard to find, but can be common around midday in its preferred habitat: mountain and plateau fishing lakes, usually edged with sedges and peat and dotted with floating waterlilies (*Nuphar lutea* -- *Utricularia macrorhiza* communities; Wm01-02, Wm06; Wf01). Adults are often difficult to observe and catch, for they usually fly rapidly over open water several metres from shore. However, in some situations they patrol right along the lake margin.
BC flight period: late June to early September; most records from mid July to early August.

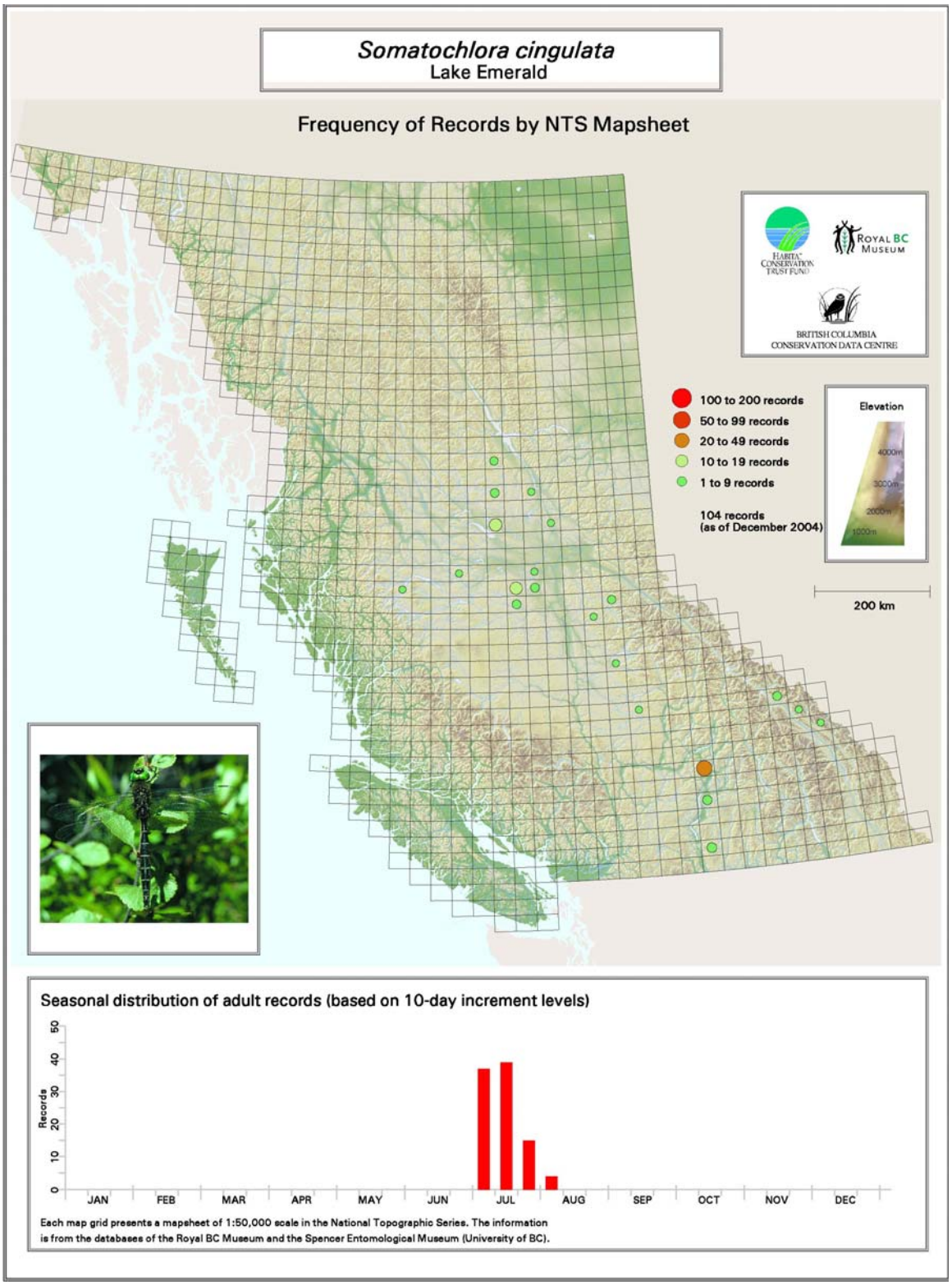
Somatochlora cingulata male. Photograph: Robert A. Cannings, RBCM



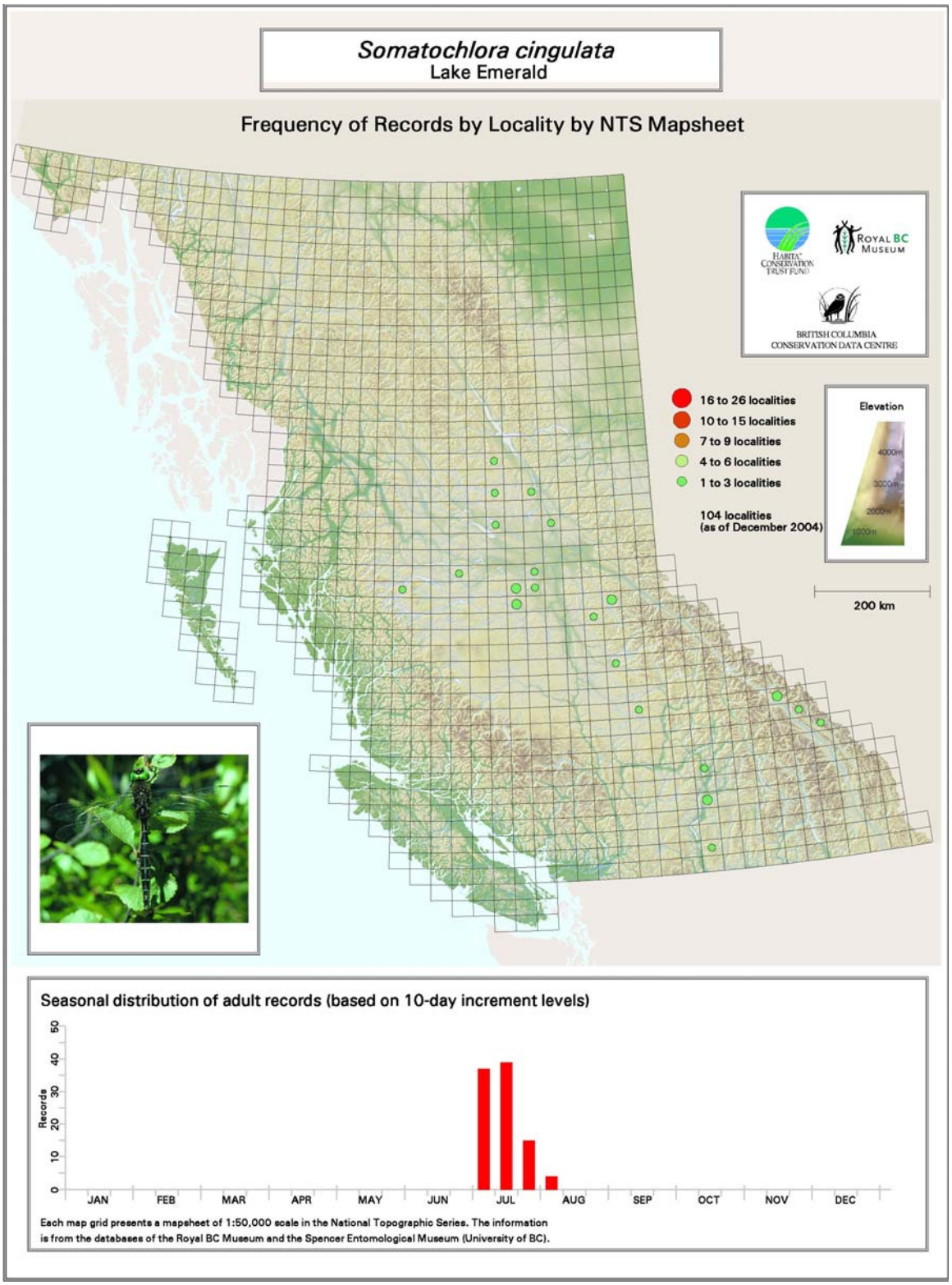
Somatochlora cingulata Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Somatochlora cingulata Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



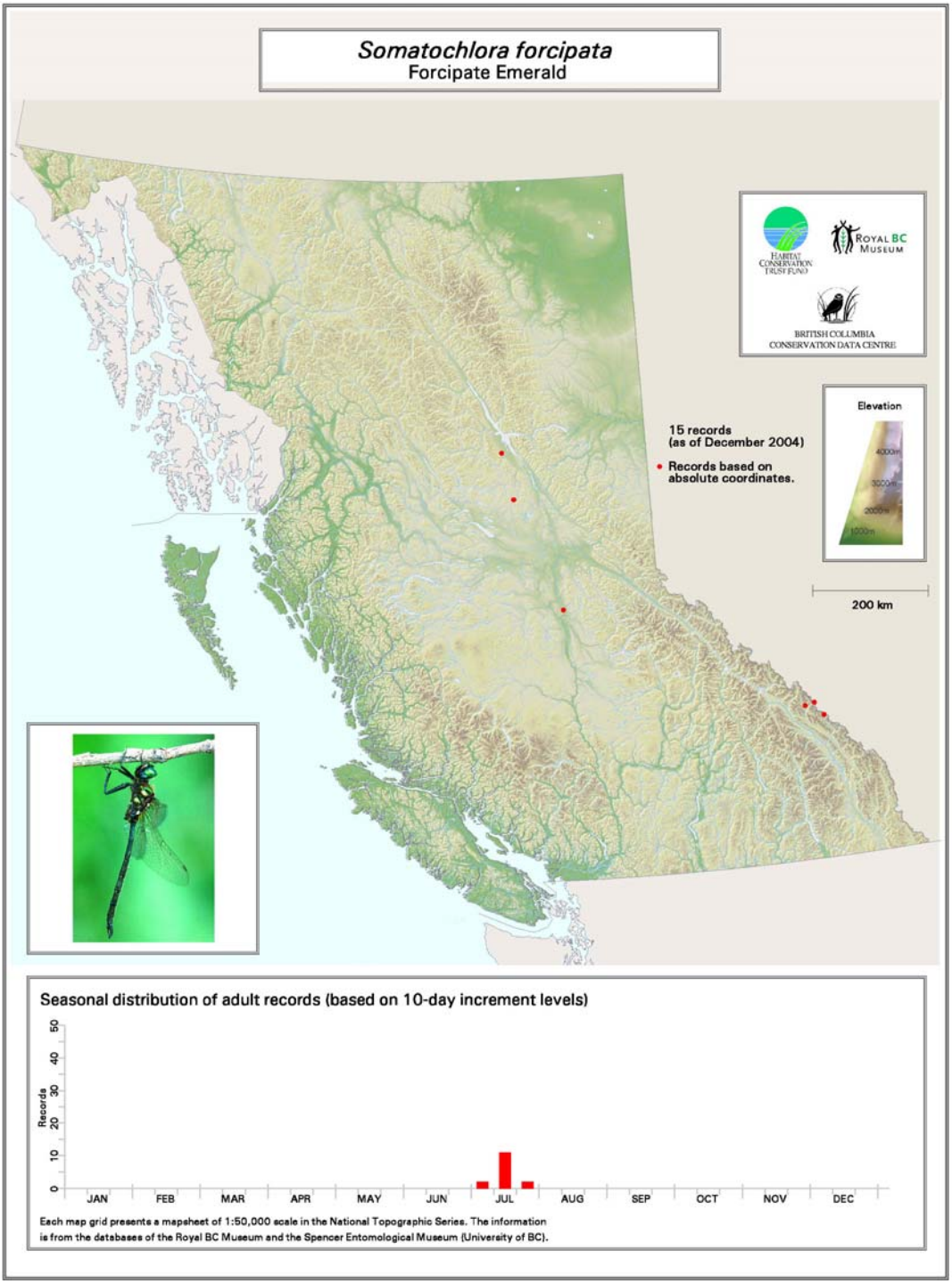
Somatochlora cingulata Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



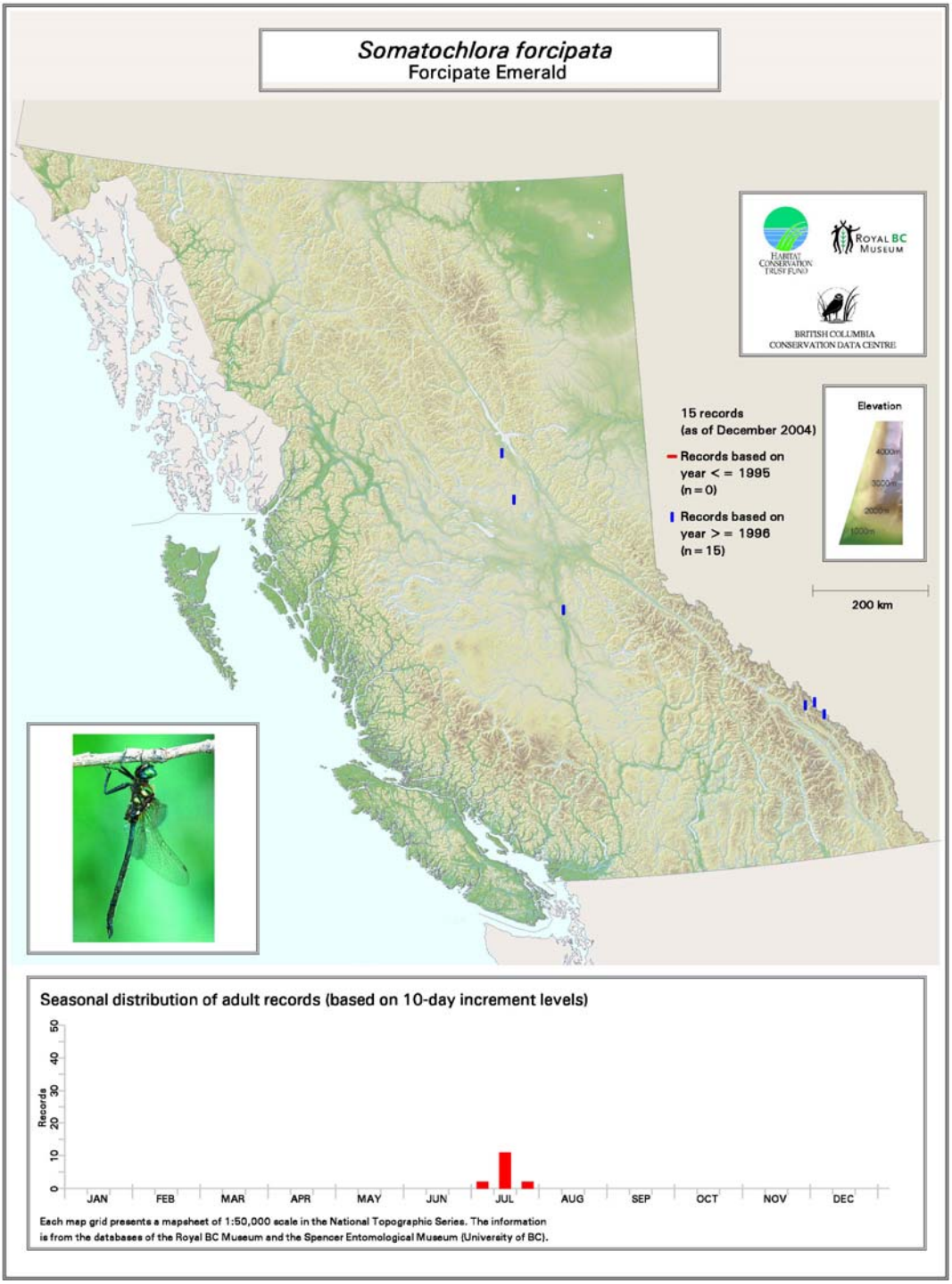
Somatochlora cingulata Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Somatochlora forcipata* (Forcipate Emerald)**
BC conservation rank: S2S3. Blue List. This species has been down-listed from S1S2 given it in 2000; the number of known localities doubled from three to six between 2000 and 2002.
Description: Similar to *S. semicircularis* but more slender. The thorax sides have two whitish oval spots. The abdomen has small, dull-yellow spots (on segments 5 to 8 on males, and 3 to 7 on females), which are usually absent on *S. semicircularis*. Male's appendages, fig. 13e; vulvar lamina, fig. 14e. Length: male 48 mm, female 49 mm.
Global Distribution: In eastern North America this species ranges from Manitoba and Labrador south to Minnesota and West Virginia (Needham et al. 2000); in the west it is known from only seven localities in the Rocky Mountains of Alberta (one record) and British Columbia (six localities). Faunal element: Transition (see Appendix 3).
BC Distribution: From Kootenay National Park in the southern Rocky Mountains to Williston Lake; central BC plateaus.
Biology: Rare; first discovered in BC in 1998. Lives around shallow spring-fed streamlets trickling through subalpine hillside fens (e.g., WF03-04) or in small pools associated with flowing groundwater in such situations. Females lay eggs in moss and algal mats. Patrolling males often fly in shady glades in open spruce forests.
BC flight period: mid June to early September; all records from mid July to early August.
Management and protection considerations: Because of its attachment to cool, flowing groundwater, this species may be particularly sensitive to changes in local hydrology. There is also a danger that its small breeding sites may be overlooked as wetlands are modified in logging road construction and other development. These sites appear to be rare, at least along the road corridors sampled in this study, but further inventory is recommended to confirm this impression. In general, known localities in forest fen habitats should be managed to maintain water table quality. Development that may affect the hydrology of a catchment area should be managed to minimize impacts.

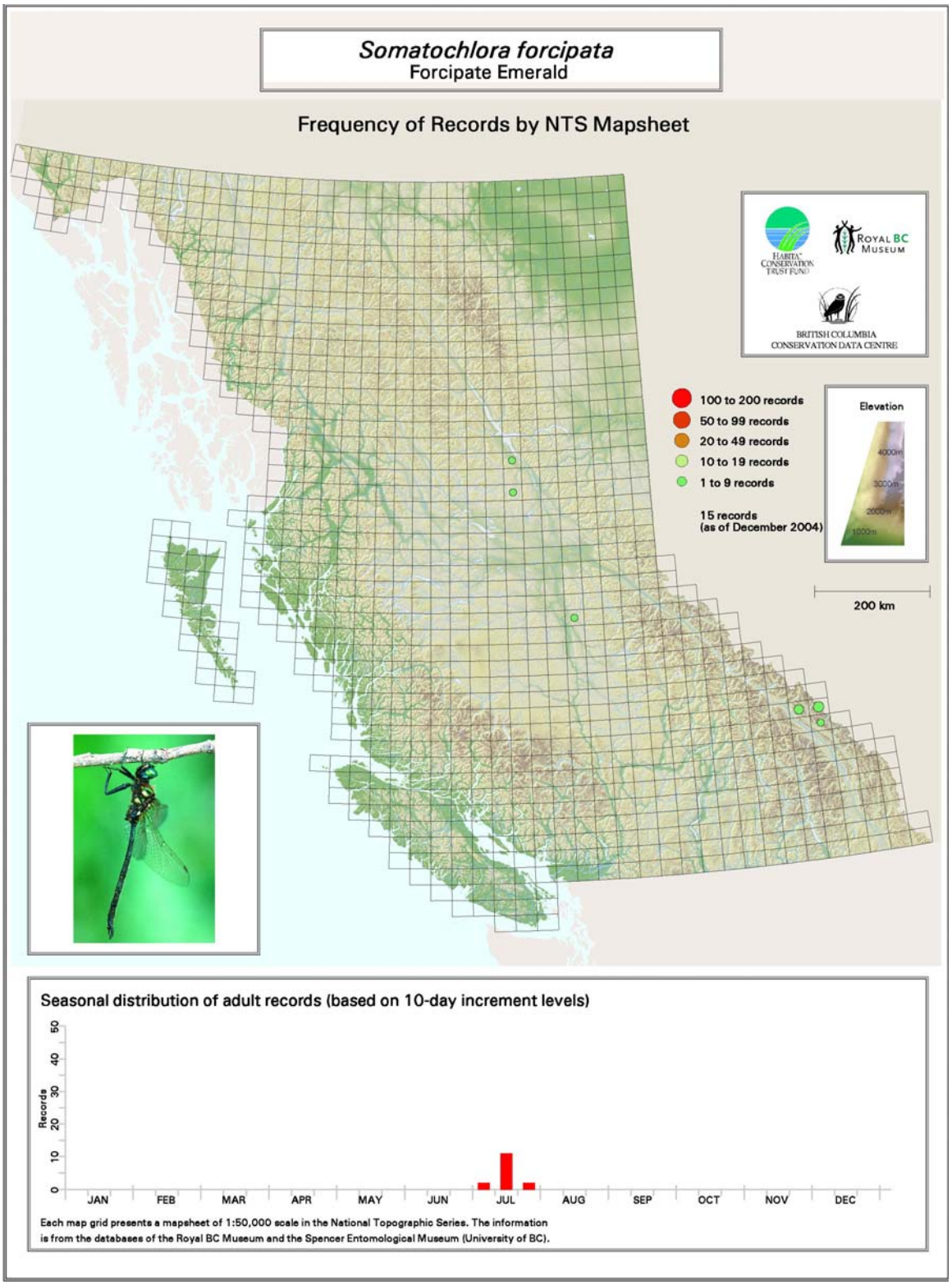
Somatochlora forcipata male. Photograph: Blair Nikula



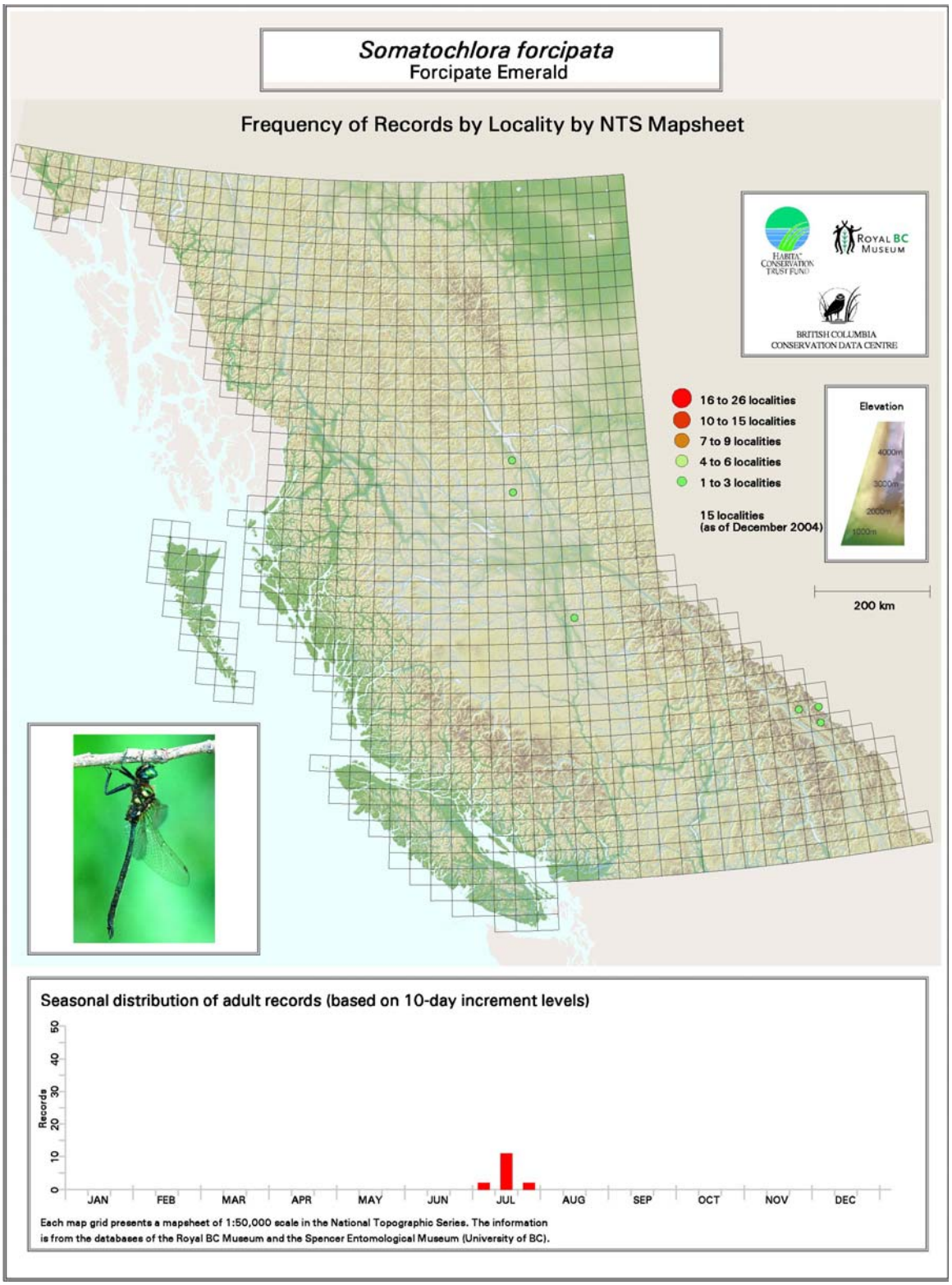
Somatochlora forcipata Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Somatochlora forcipata Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Somatochlora forcipata Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



Somatochlora forcipata Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Somatochlora franklini* (Delicate Emerald)**
BC conservation rank: S5. Yellow List.
Description: Named for its slender body – obvious in males. The long, narrow abdomen is widest at segment 9; the side of the thorax has one pale spot, often obscured with age. The wings are short, just 3/4 the length of abdomen, and the hindwings have a dark spot at the base. Male's appendages, fig. 13c; vulvar lamina, fig. 14c. Length: male 50 mm, female 45 mm.
Global Distribution: Alaska east to Labrador and Newfoundland; south to New Hampshire, New York, Michigan, Minnesota and north of the Great Plains to the mountains of British Columbia and Alberta (Needham *et al.* 2000). Faunal element: Widespread Boreal (see Appendix 3).
BC Distribution: East of Coast Range from about 51°N in the mountains of southcentral BC to valleys and plateaus in the far North.
Biology: A northerner, becoming scarcer in the southern parts of its range, where it lives at higher elevations. Usually flies with *Aeshna sitchensis*, but rarer than the darner, at least in the south. Can be common in the right habitat. Prefers shallow, moss-bottomed bogs and fens evenly vegetated with sedges or horsetails (Wf07-Wf10). or flooded fens with moss, shrubs, sedges and forbs (e.g. Wf 02); in these habitats, open patches of water are usually not visible from a distance. Males hover frequently, pivoting while stationary.
BC flight period: mid June to early September; most records from early July to early August.

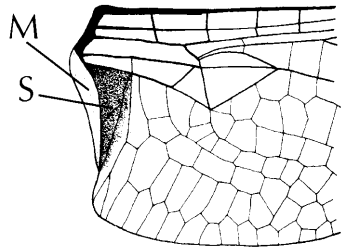
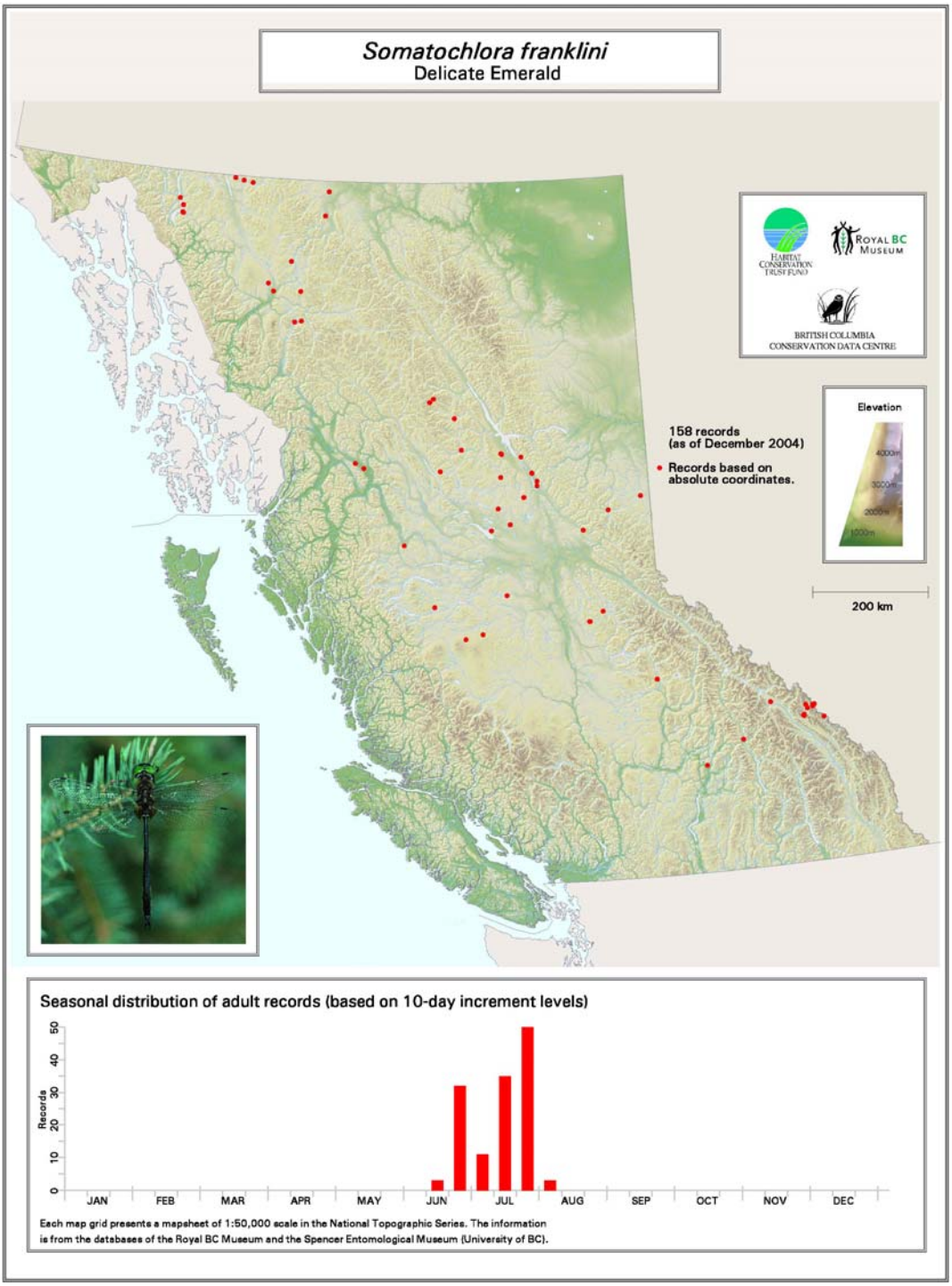
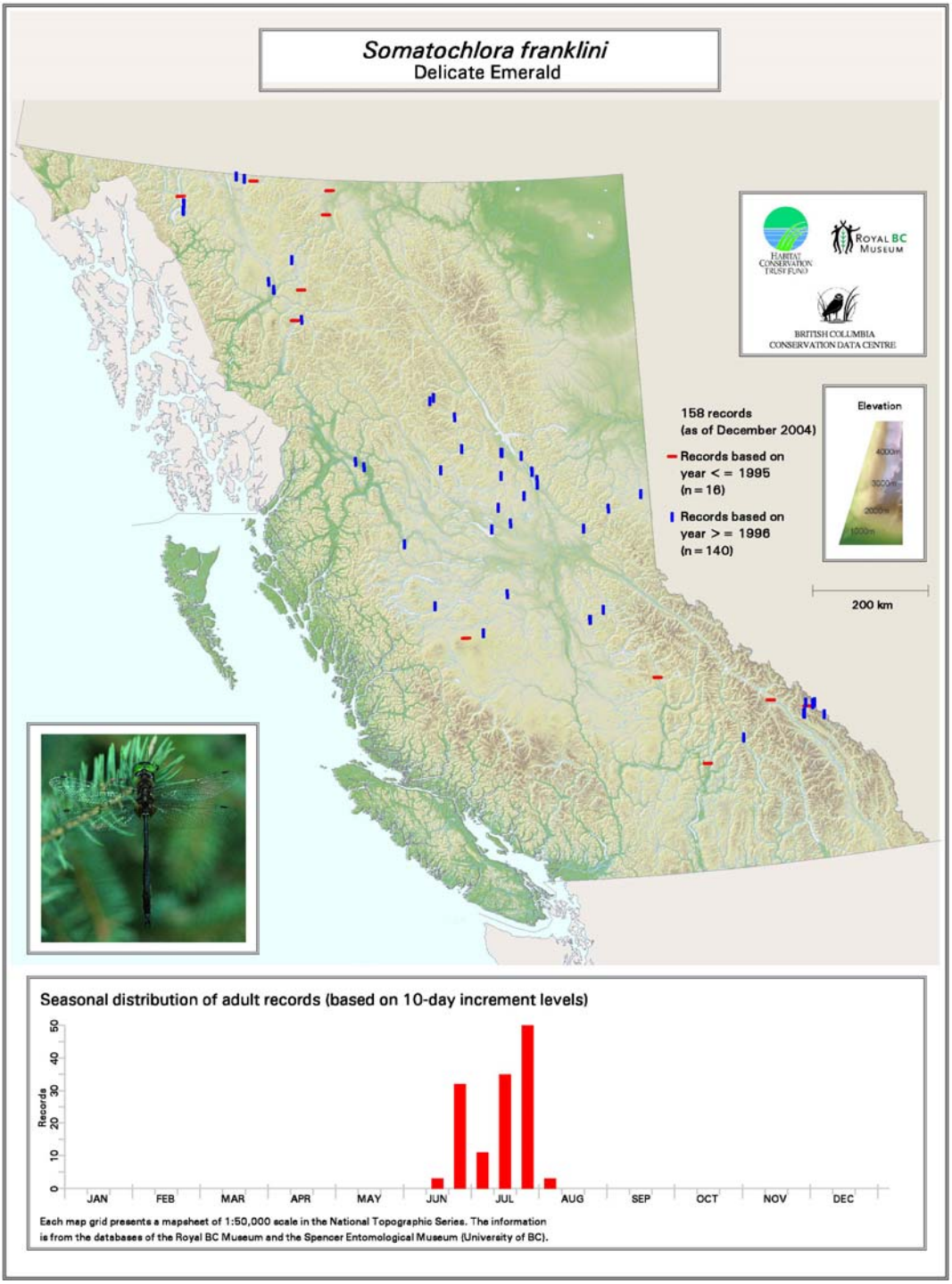


Figure 15. The hindwing of a Delicate Emerald. M = membranule; S = spot. Muskeg and Whitehouse's emeralds have a similar spot.

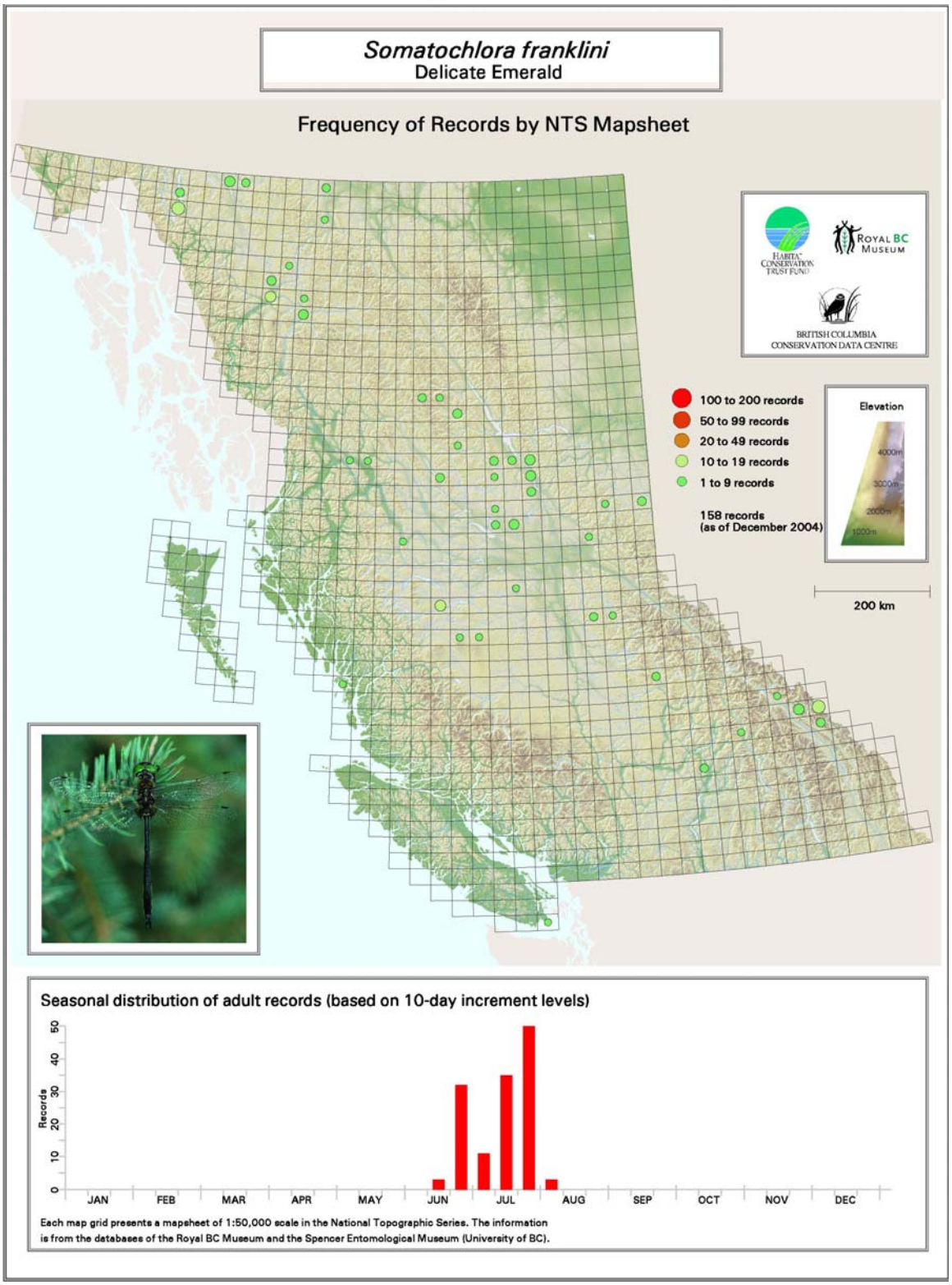
Somatochlora franklini male. Photograph: Robert A. Cannings, RBCM



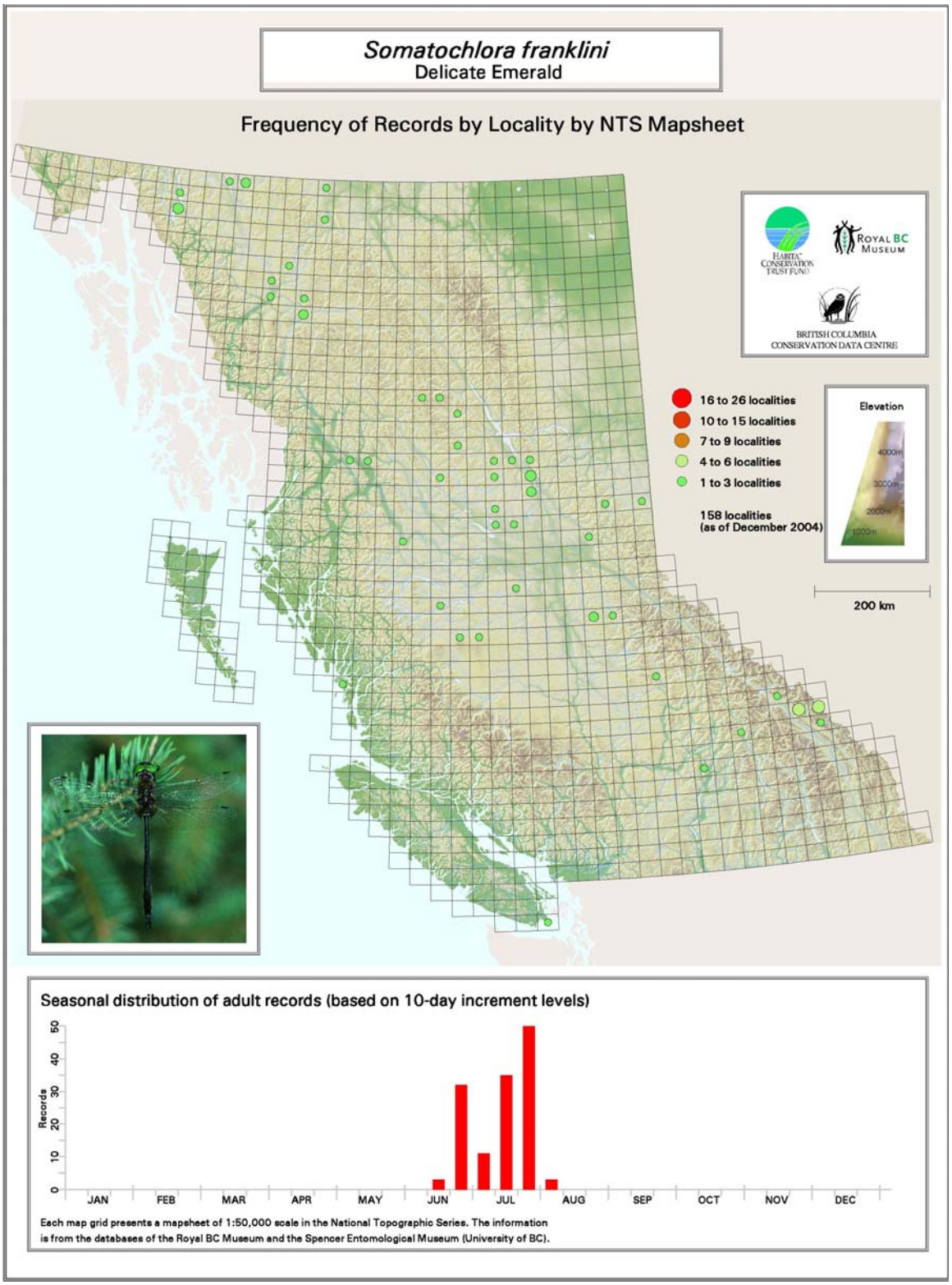
Somatochlora franklini Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Somatochlora franklini Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



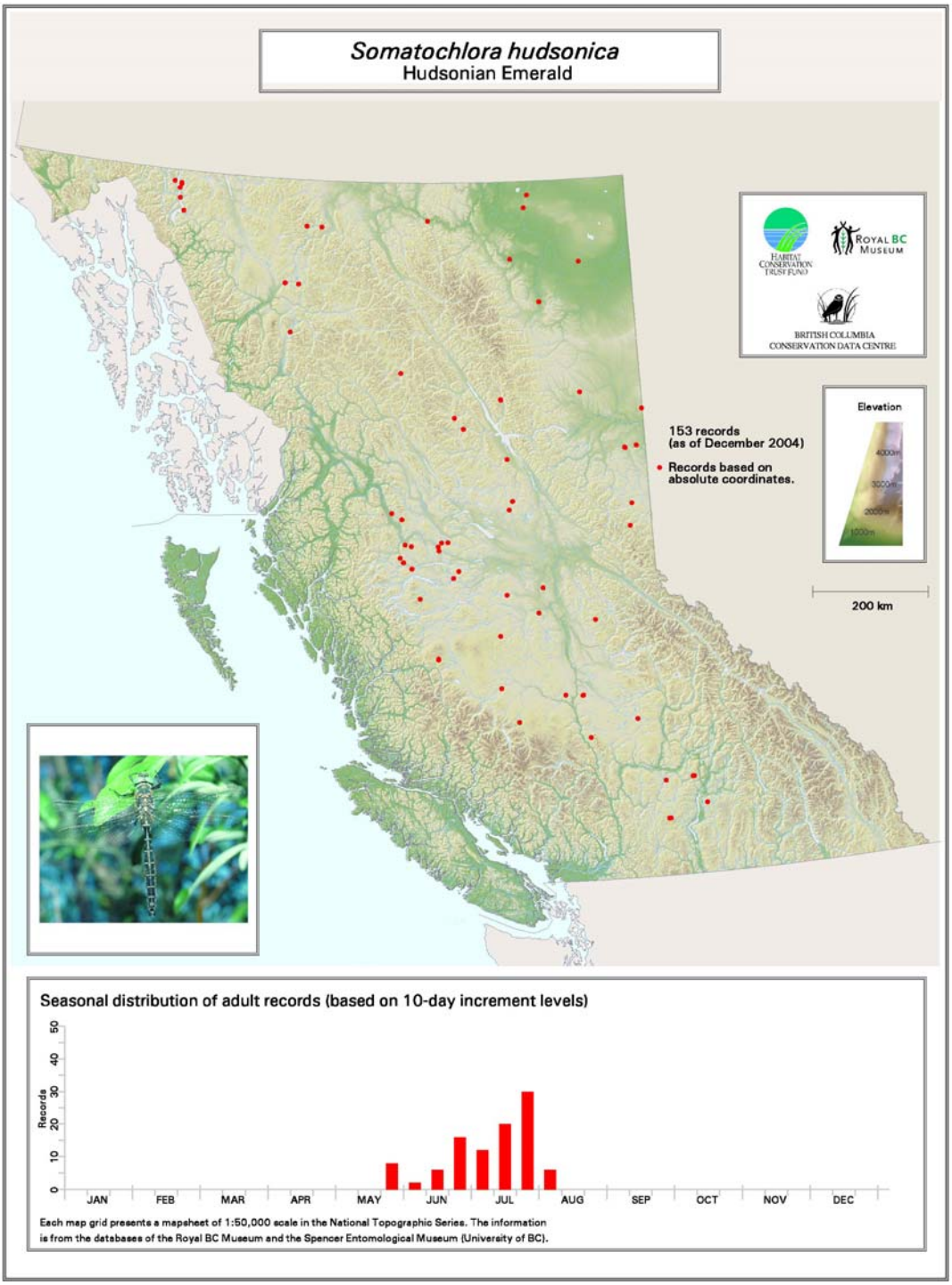
Somatochlora franklini Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



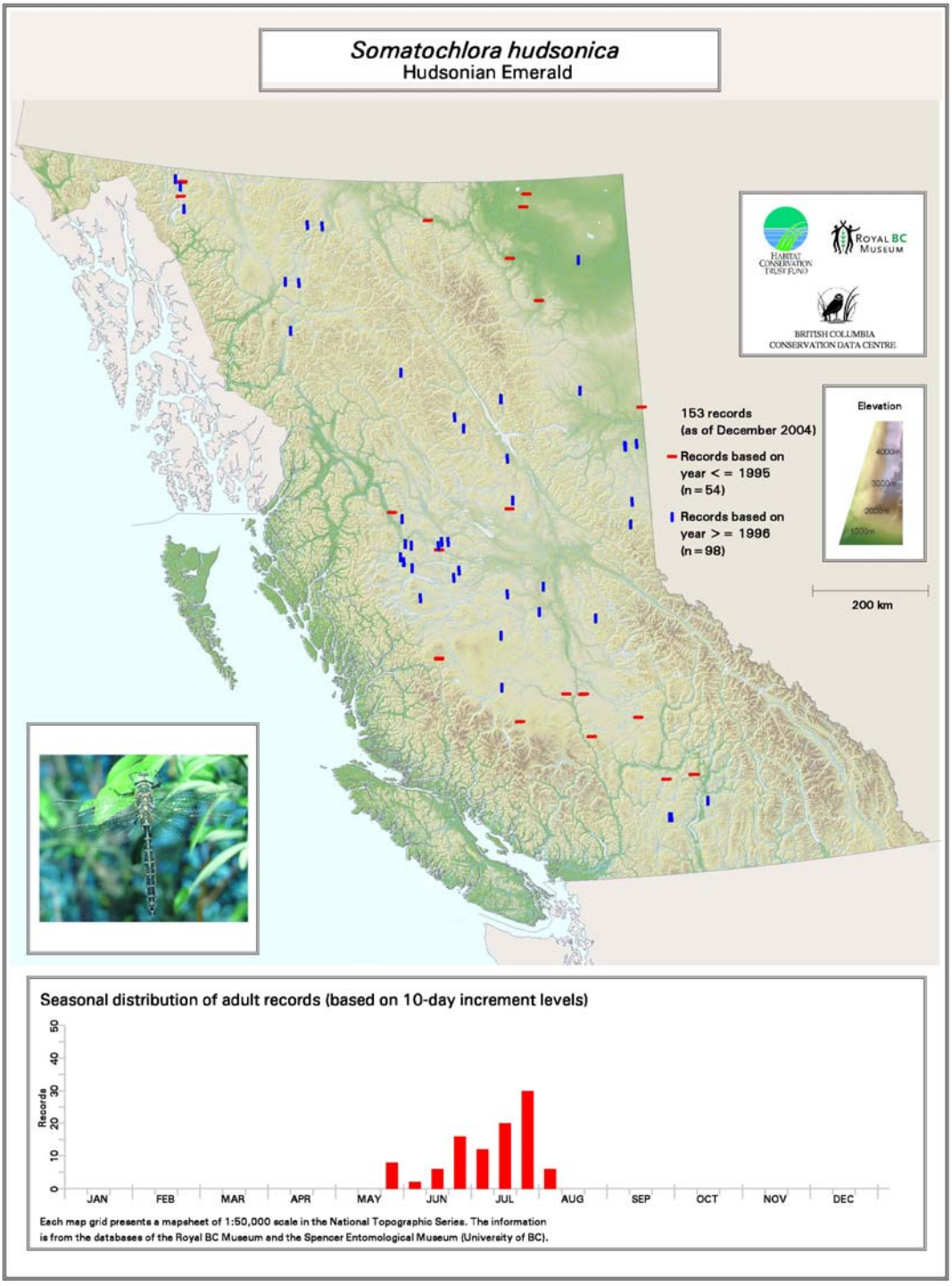
Somatochlora franklini Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Somatochlora hudsonica* (Hudsonian Emerald)**
BC conservation rank: S5. Yellow List.
Description: Very similar to *S. albicincta,* but larger. The thorax sides are brassy green with one tan, blunt-tipped bar that can be indistinct. The abdomen has narrow white rings. Male's appendages, fig. 13l; vulvar lamina, fig. 14l. Length: male 52 mm, female 52 mm.
Global Range: Alaska east through the Northwest Territories to northwestern Ontario; south, at high elevations in the Rocky Mountains, to Colorado. Faunal element: Western Boreal (see Appendix 3).
BC Distribution: Widespread east of the Coast Mountains; not recorded in the Columbia-Kootenay region, but known from the Alberta Rockies.
Biology: Uncommon in most of its BC range, especially in the south, where it lives at higher elevations. Breeds in deep, sedge-bordered lakes and ponds (Wm01-02, Wm06; Wf01)and in peatland ponds(Wf01, Wf06). The males patrol the outer edge of the emergent vegetation.
BC flight period: early June to mid September; collections range from early June to mid August.

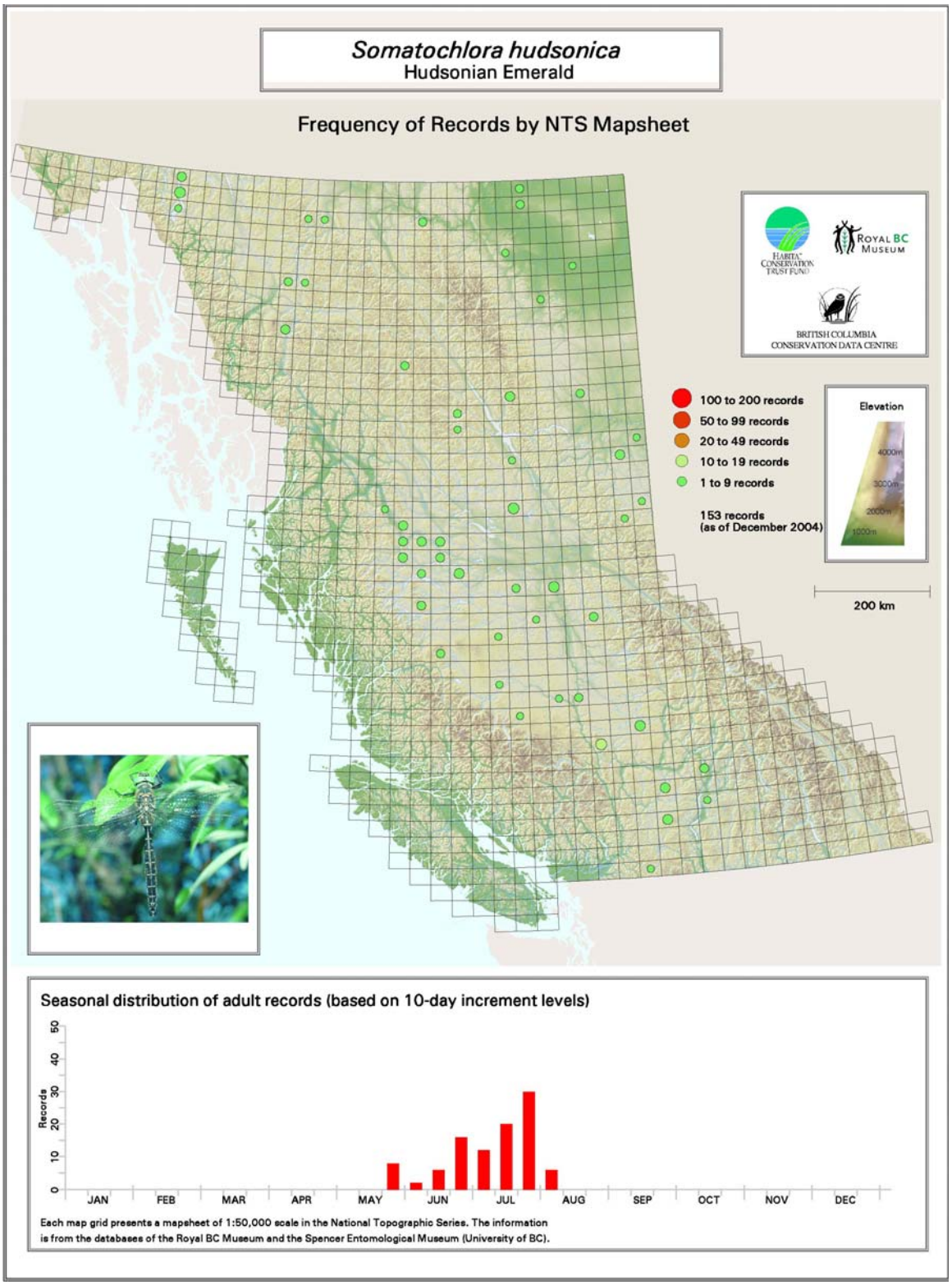
Somatochlora hudsonica male. Photograph: Robert A. Cannings



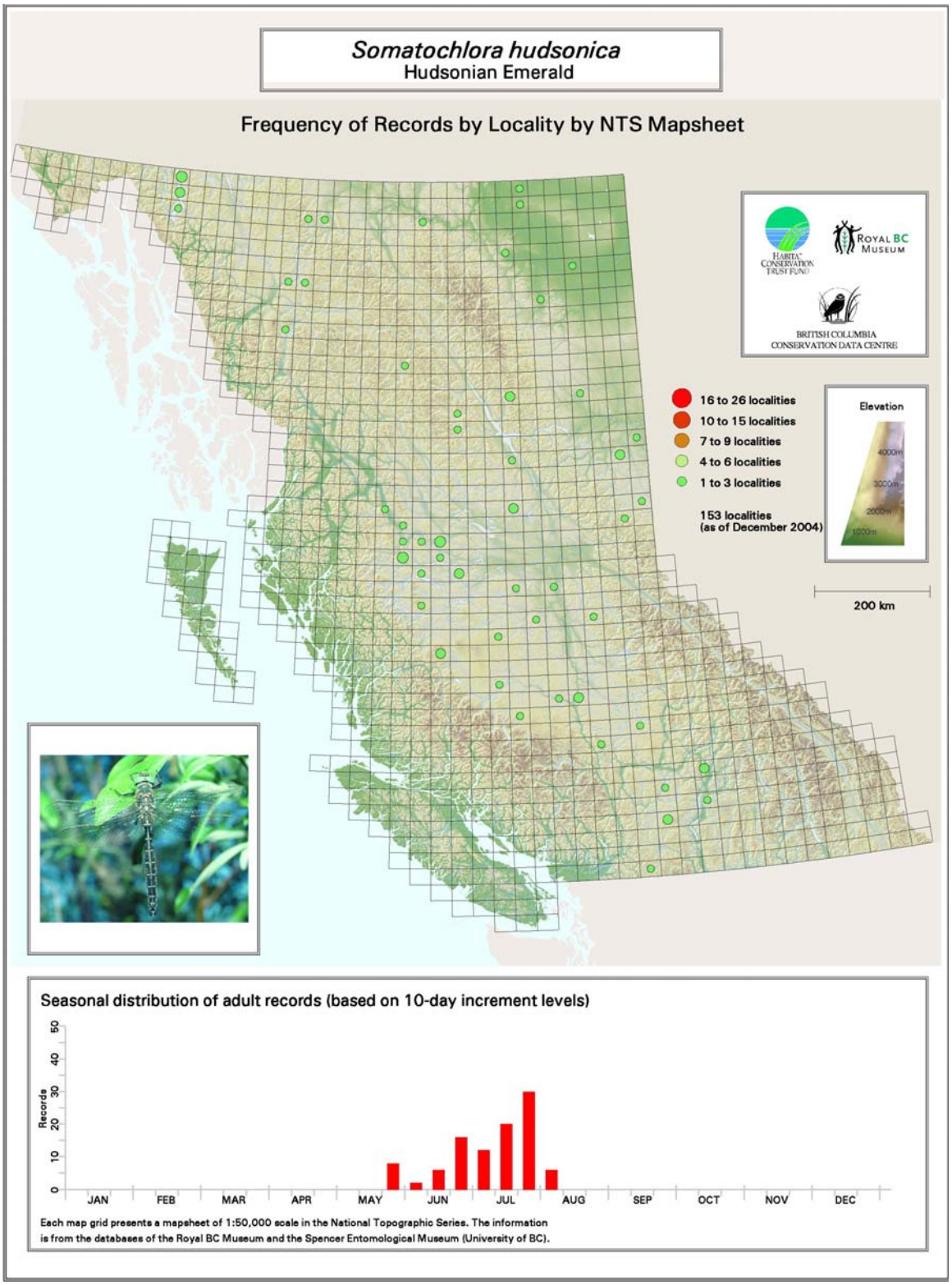
Somatochlora hudsonica Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Somatochlora hudsonica Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



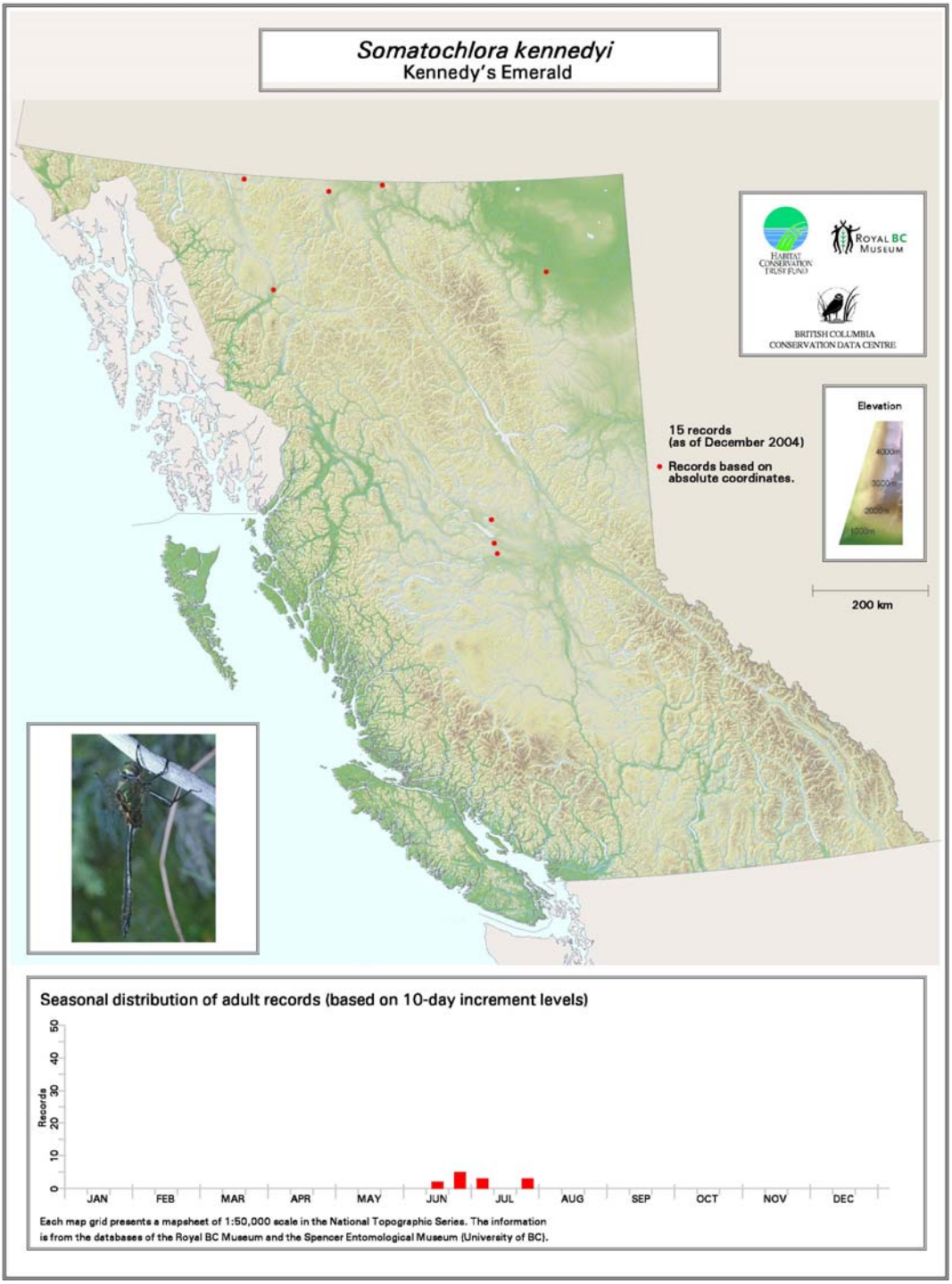
Somatochlora hudsonica Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



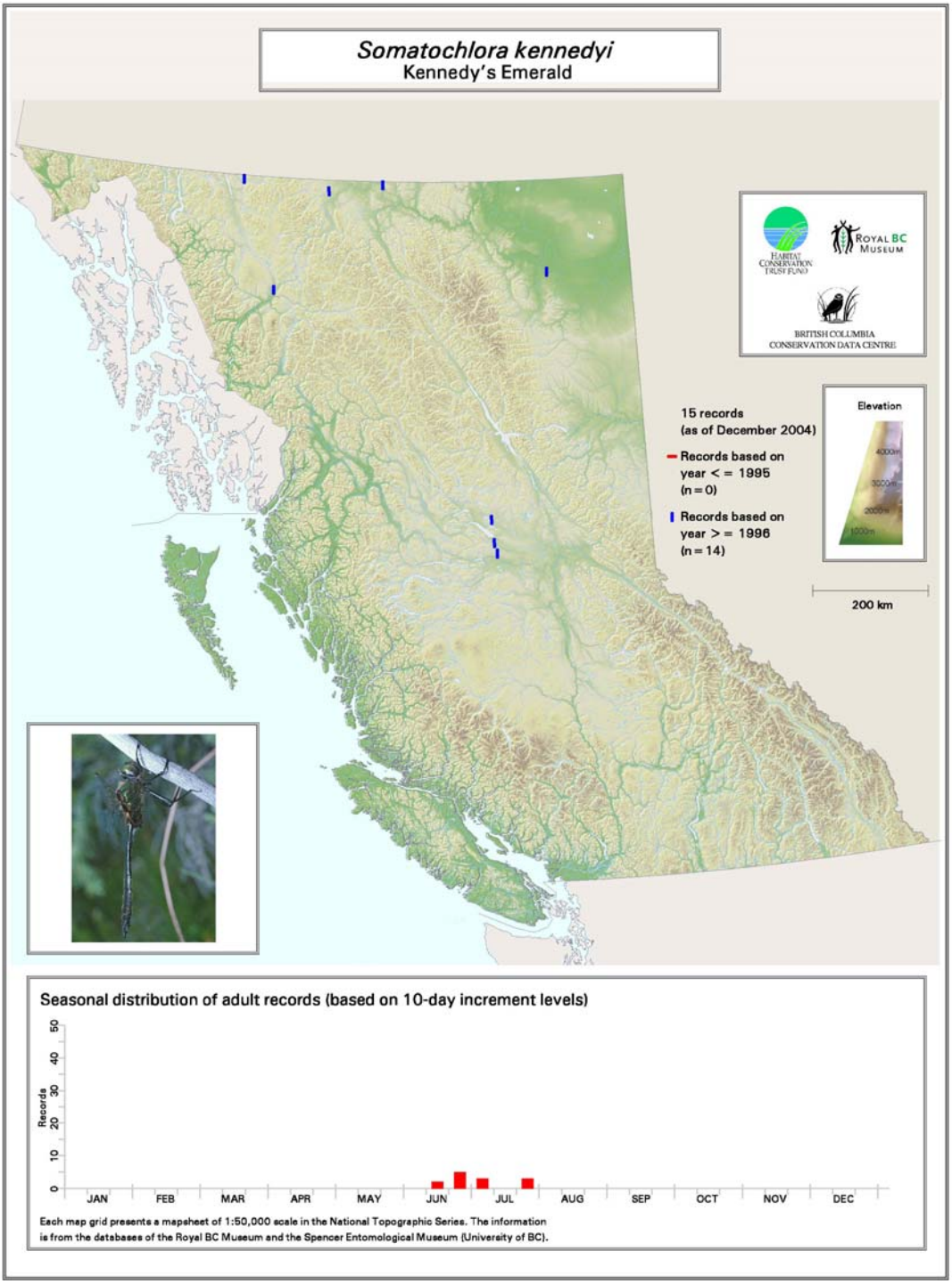
Somatochlora hudsonica Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Somatochlora kennedyi* (Kennedy's Emerald)**
BC conservation rank: S3S4. Blue List. Modified from the 2000 rank of S1S2 in 2004 to account for the addition of a number of widespread records throughout the North.
Description: Variable coloration on the thorax; often lacks conspicuous spots, but may have extensive yellow-brown markings on the sides of the thorax. There are usually no spots on the abdomen sides after segment 3. The abdomen is long, the male's widest at segment 6. Male's appendages, fig. 13d. Female's vulvar lamina is yellow, scoop-shaped (fig. 14d). Length: male 44 mm, female 43 mm.
Global Range: Alaska and Yukon east to Labrador and Nova Scotia, south to New York, Ohio, Wisconsin, Saskatchewan and British Columbia (Needham *et al*. 2000). Faunal element: Southern Boreal (see Appendix 3).
BC Distribution: Scattered localities across the northern half of the province from Fort St. James in the South to the Yukon boundary in the North.
Biology: Rare in northern BC. Found in sedge fens or bogs where females lay eggs in in flooded moss mats or in shallow, open pools underlain by aquatic moss (e.g., Wb13; Wf01-02, Wf06-07). Named for the American dragonfly researcher, Clarence Kennedy.
BC flight period: mid June to late August; the few records range from late June to early August.
Management and protection considerations: Like other rare or uncommon northern *Somatochlora* species, *S. kennedyi* lives in habitats that are common and widespread, but difficult to sample because of their remoteness from roads. It apparently lives in a wider range of peatland types than do *S. brevicincta* and *S. forcipata*. For these reasons, it is probably relatively more abundant than records indicate. Nevertheless, these habitats are sensitive to changes in drainage created by road building and other construction, siltation resulting from logging and other disturbances. In general, peatland pools and peat-margined lakes should be managed to maintain water and littoral habitat quality. Development that may affect the hydrology of a catchment area should be managed to minimize impacts.

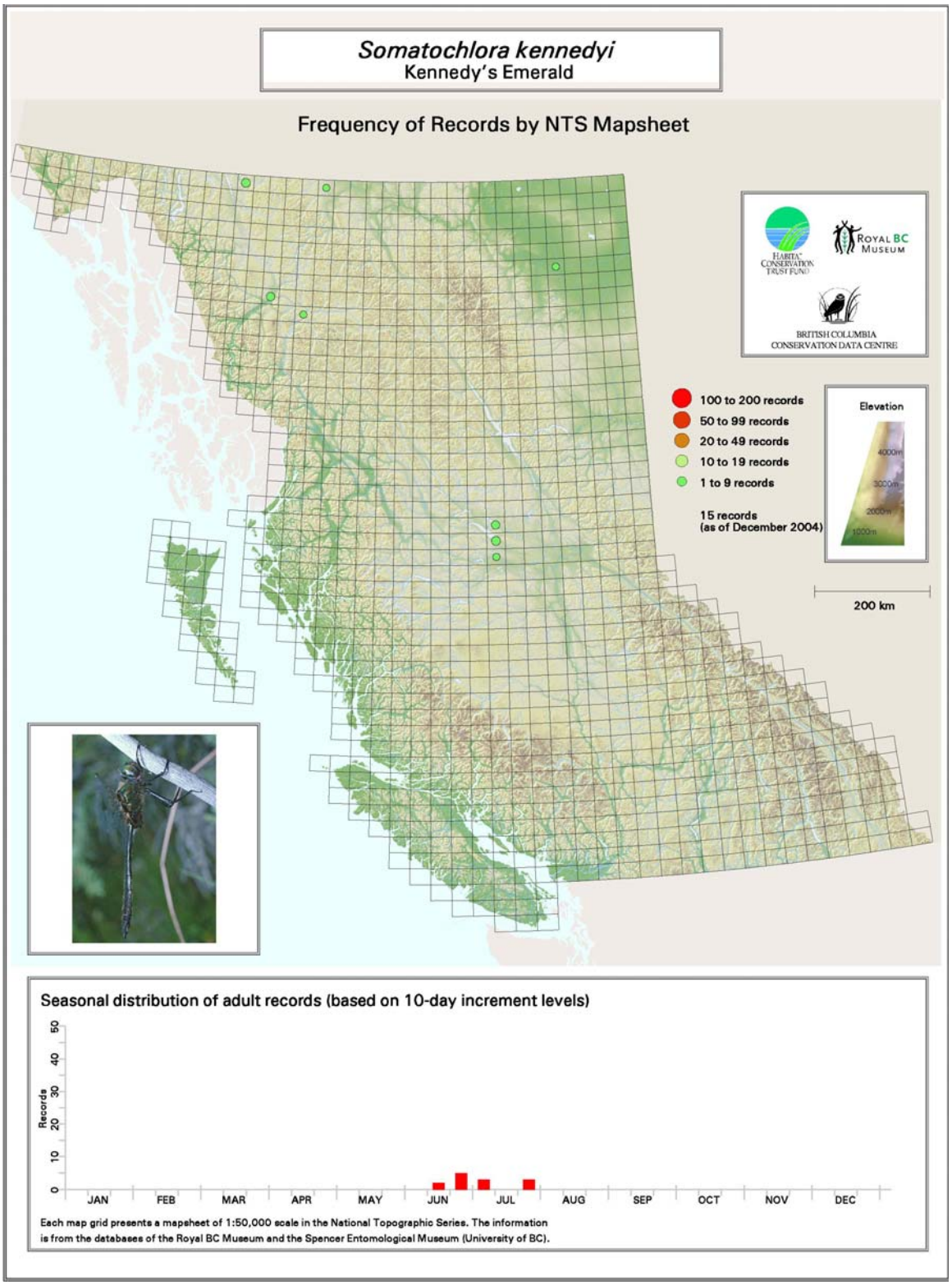
Somatochlora kennedyi male. Photograph: Robert A. Cannings



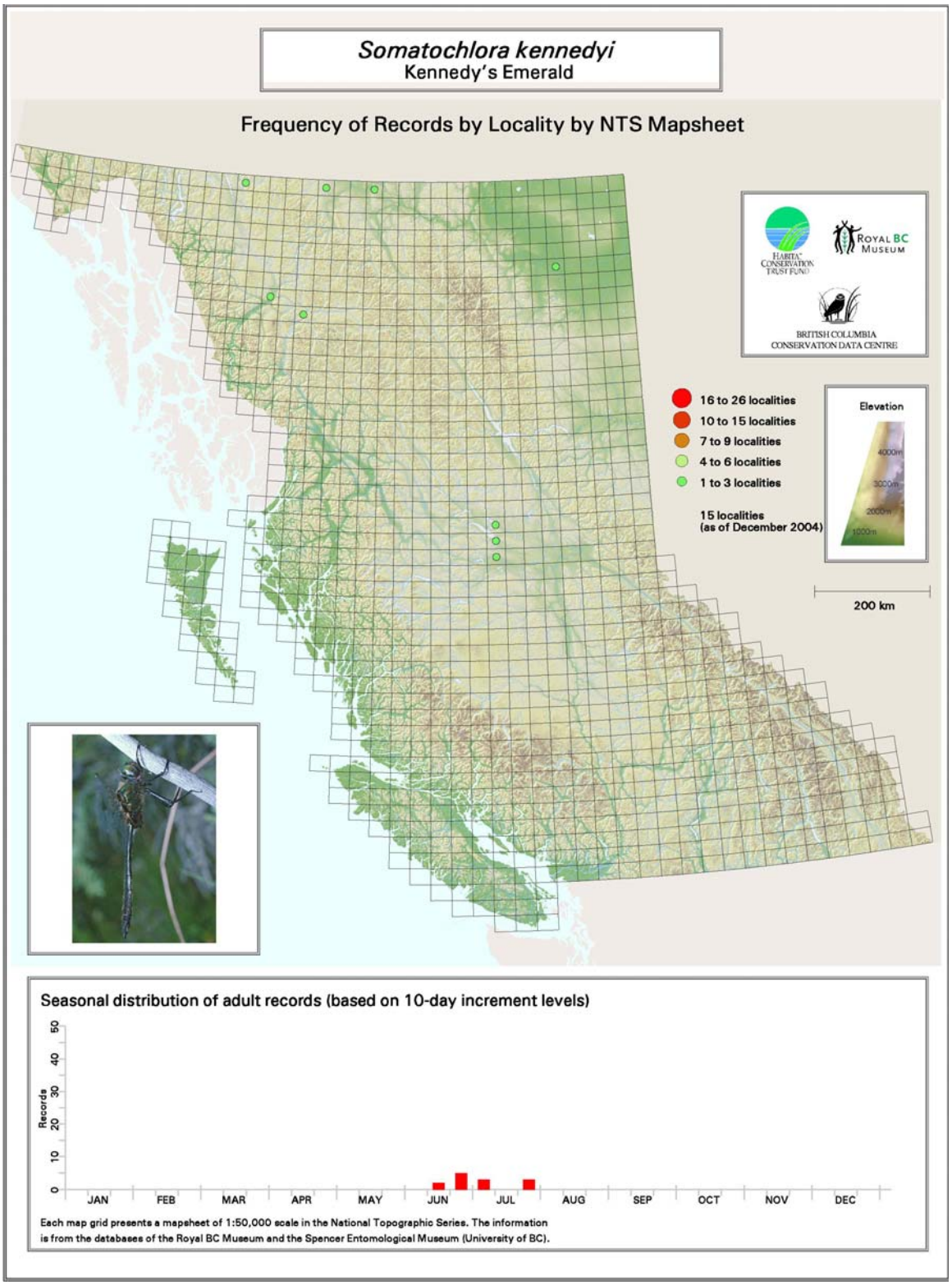
Somatochlora kennedyi Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Somatochlora kennedyi Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



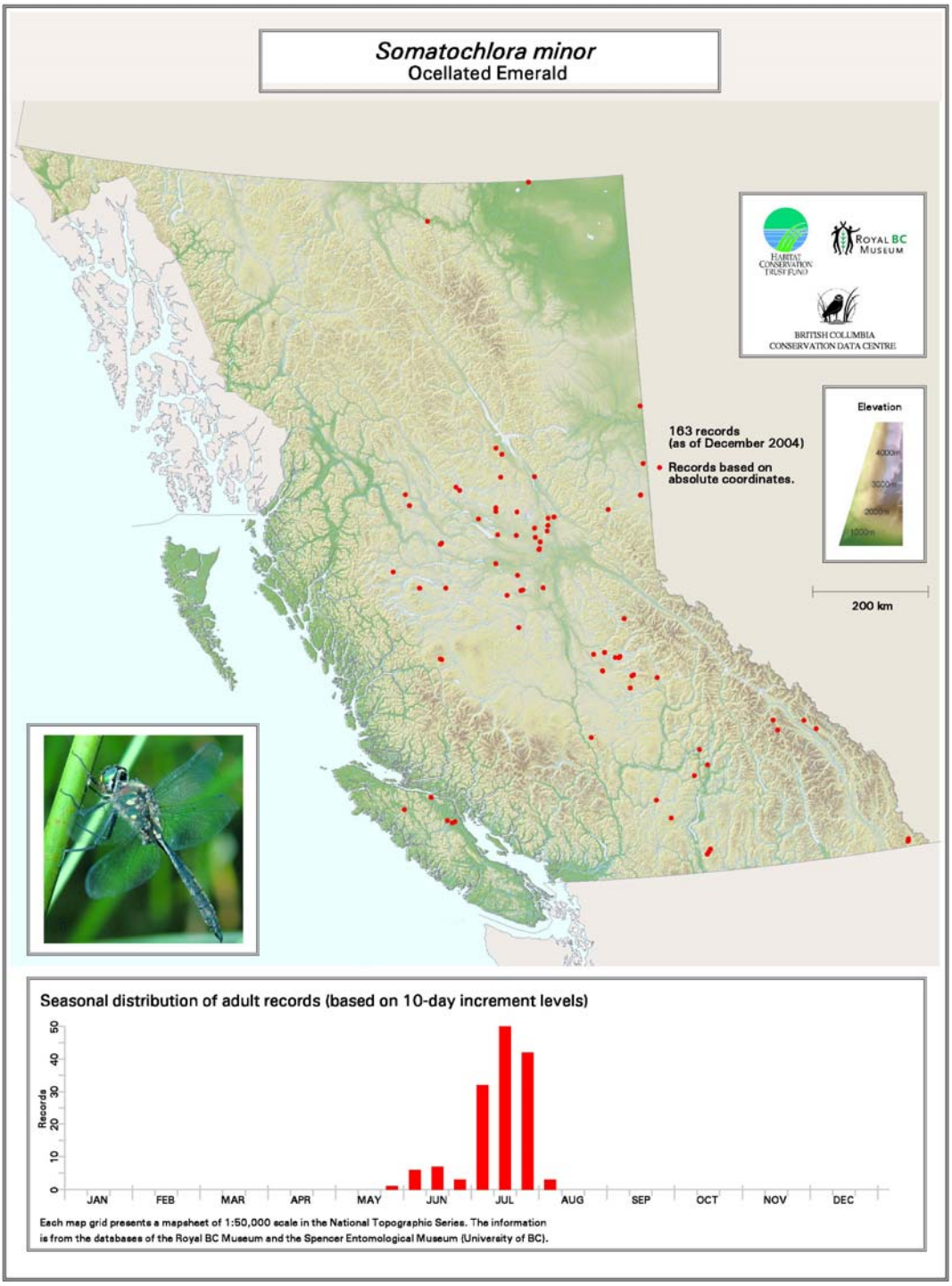
Somatochlora kennedyi Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



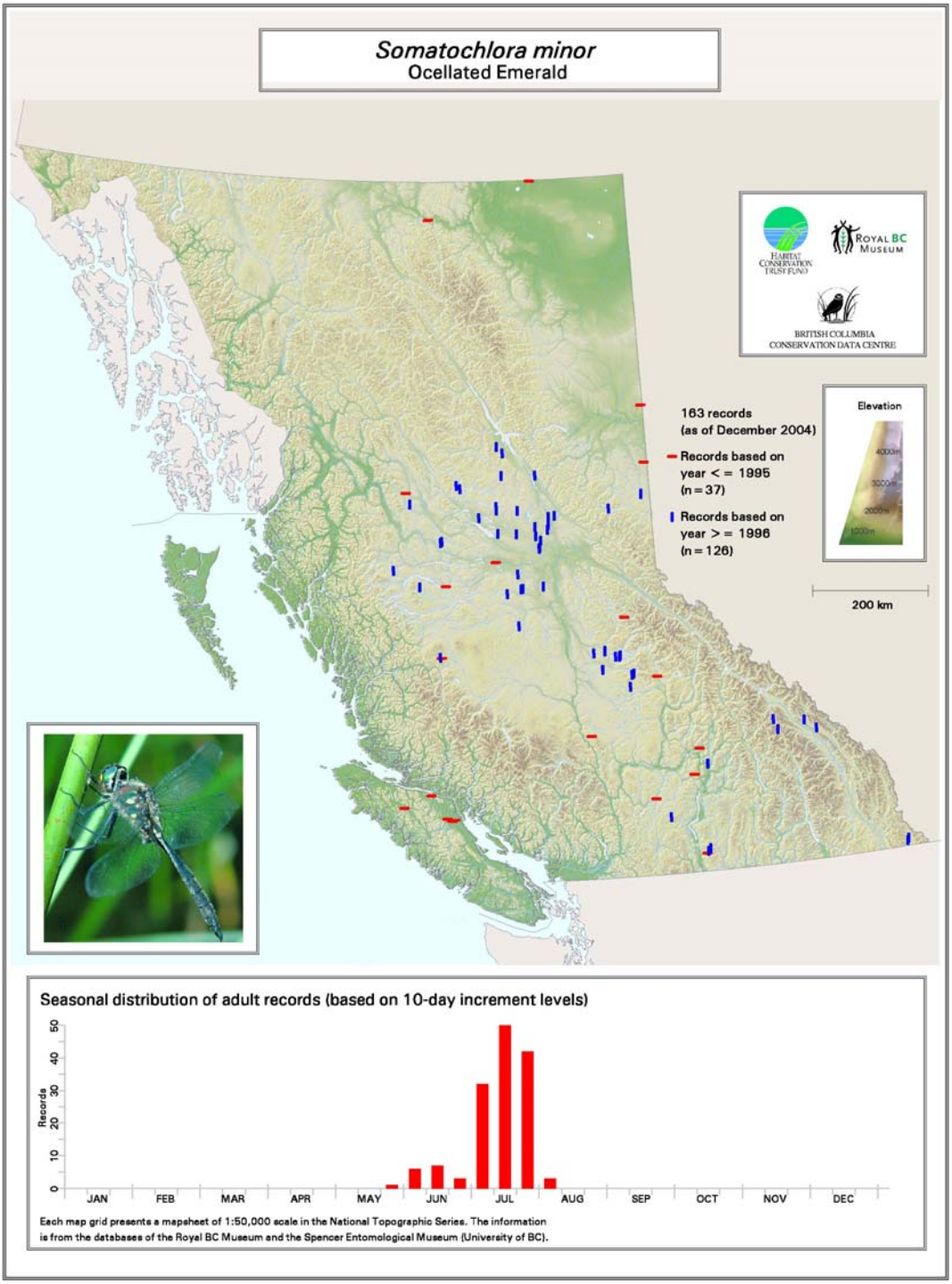
Somatochlora kennedyi Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Somatochlora minor* (Ocellated Emerald)**
BC conservation rank: S5. Yellow List.
Description: The English name refers to two yellow eye-like spots on each side of the thorax. Otherwise, this species is scarcely marked, though the short, dark abdomen has some pale spots at the base. Male's appendages, fig. 13b. Female's vulvar lamina is long, perpendicular to abdomen vulvar lamina (fig. 14a). Length: male 43 mm, female 46 mm.
Global Range: Yukon and British Columbia east to Labrador and Newfoundland; south to Connecticut, Michigan, Minnesota, Montana, Colorado and Oregon (Needham *et al*. 2000). Faunal element: Southern Boreal (see Appendix 3).
BC Distribution: Throughout BC, but not recorded in the Northwest north of about 56ºN; on the coast, known only from northern Vancouver Island.
Biology: Uncommon inhabitant of warm streams, both gently and rapidly flowing ones, in peatlands and forests (e.g., Wf01, Wf04-05). The stream bottom can contain any material from rocks to soft mud and organic matter. Females have a more conspicuous vulvar lamina than other emeralds; they use this spout-like egg-laying device to tap eggs into the water or into moss on stream banks.
BC flight period: early June to mid September; the bulk of the records lie between mid July and early August.

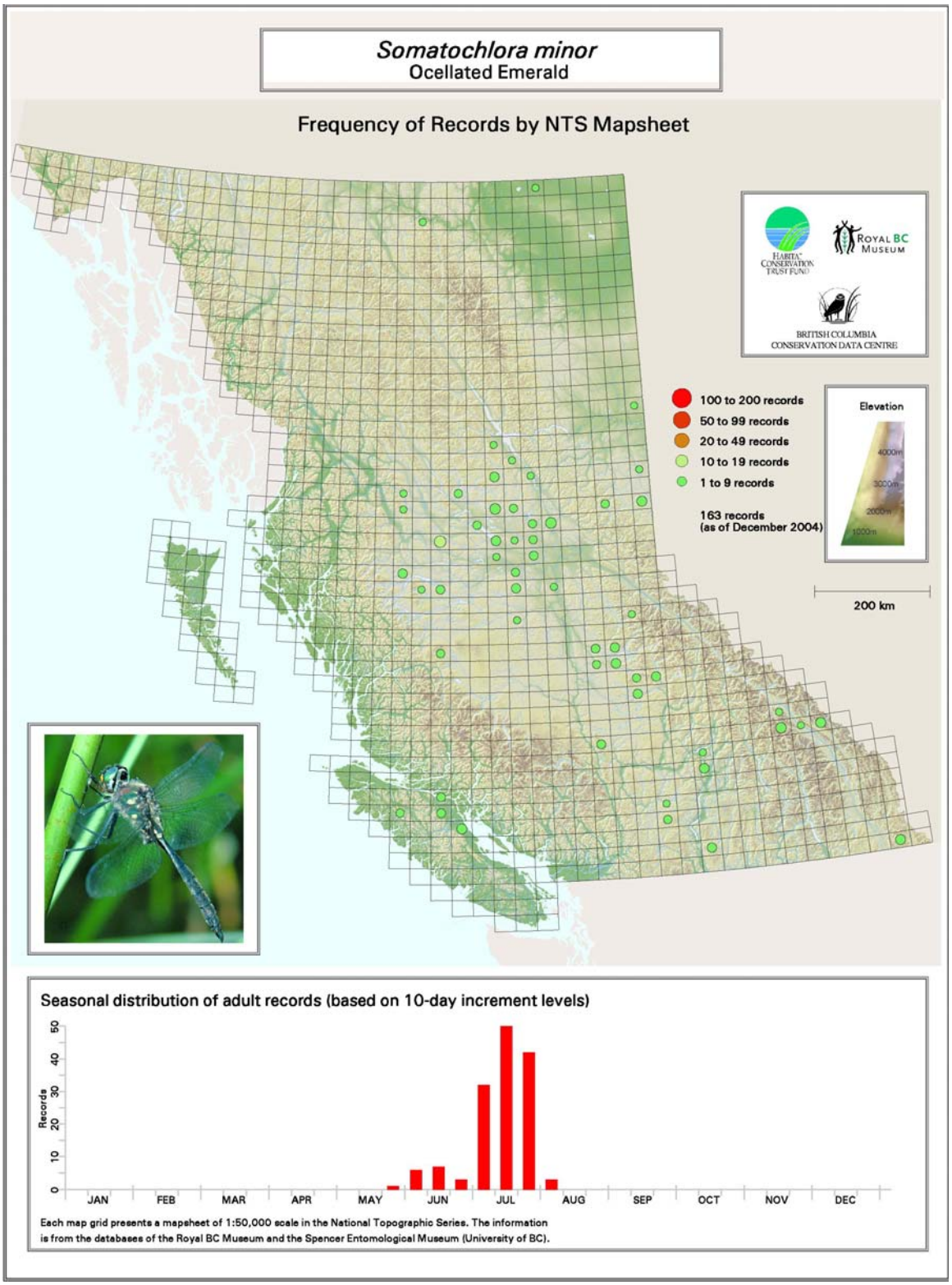
Somatochlora minor male. Photograph: George Doerksen, RBCM



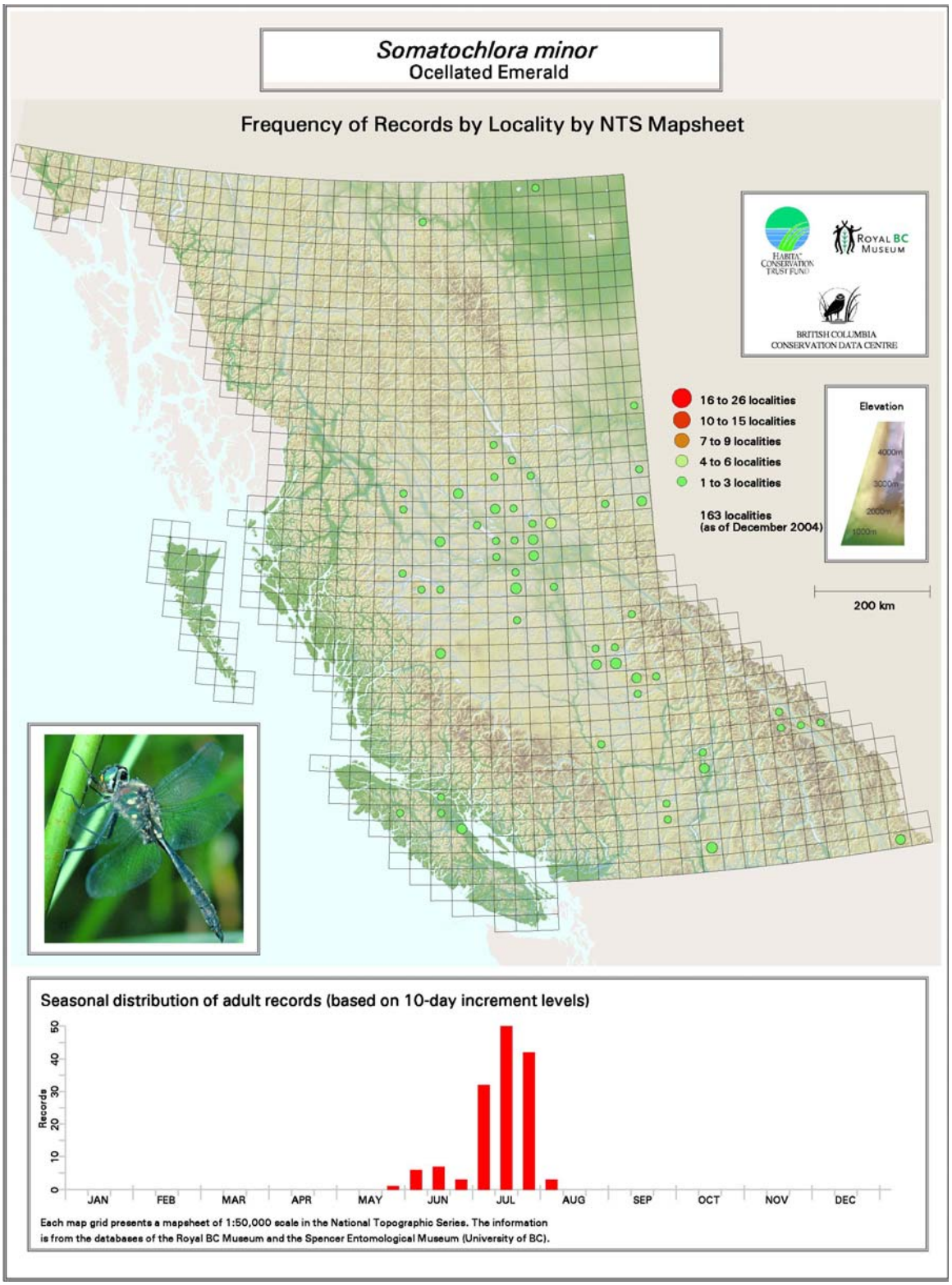
Somatochlora minor Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Somatochlora minor Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



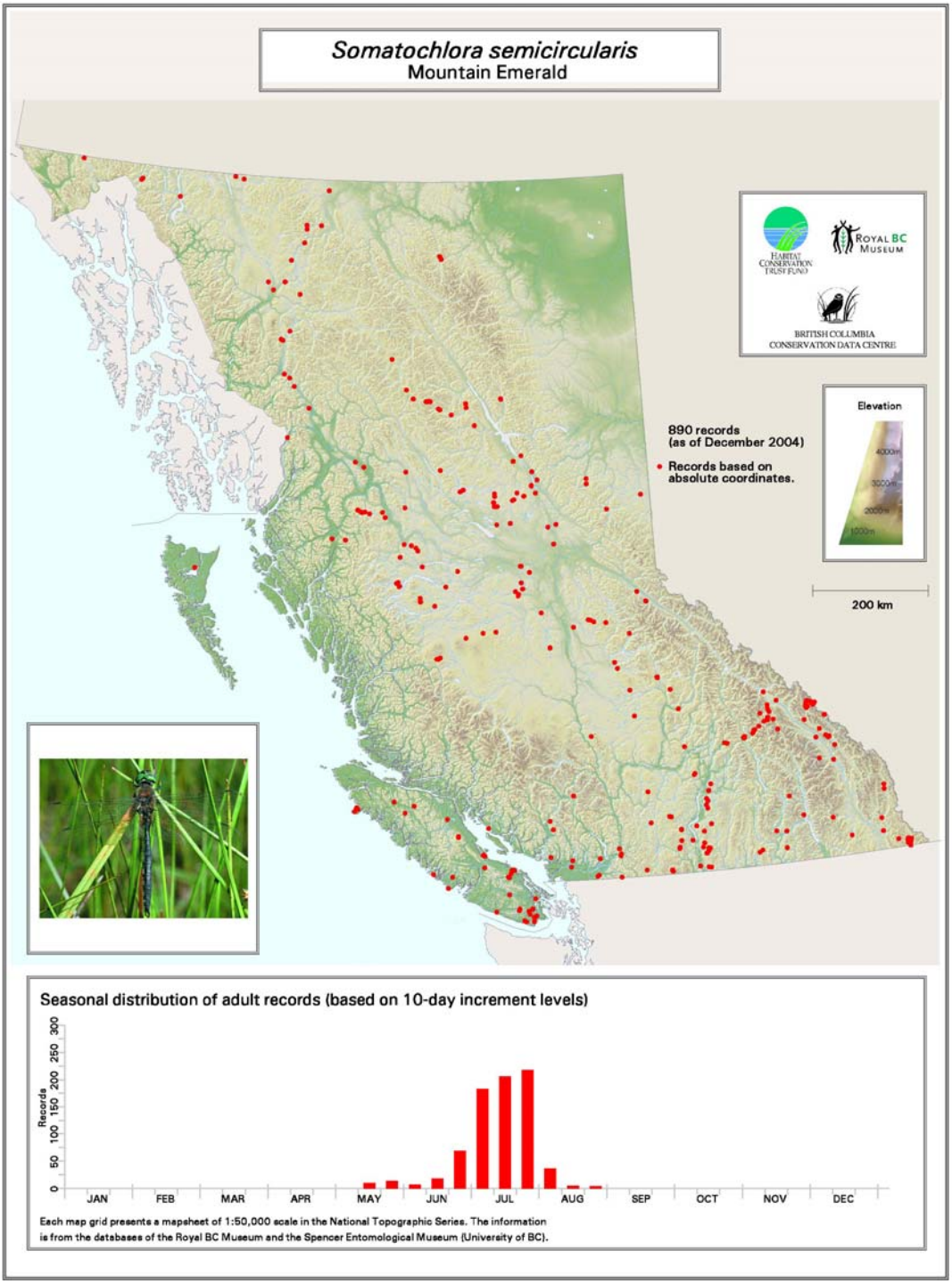
Somatochlora minor Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



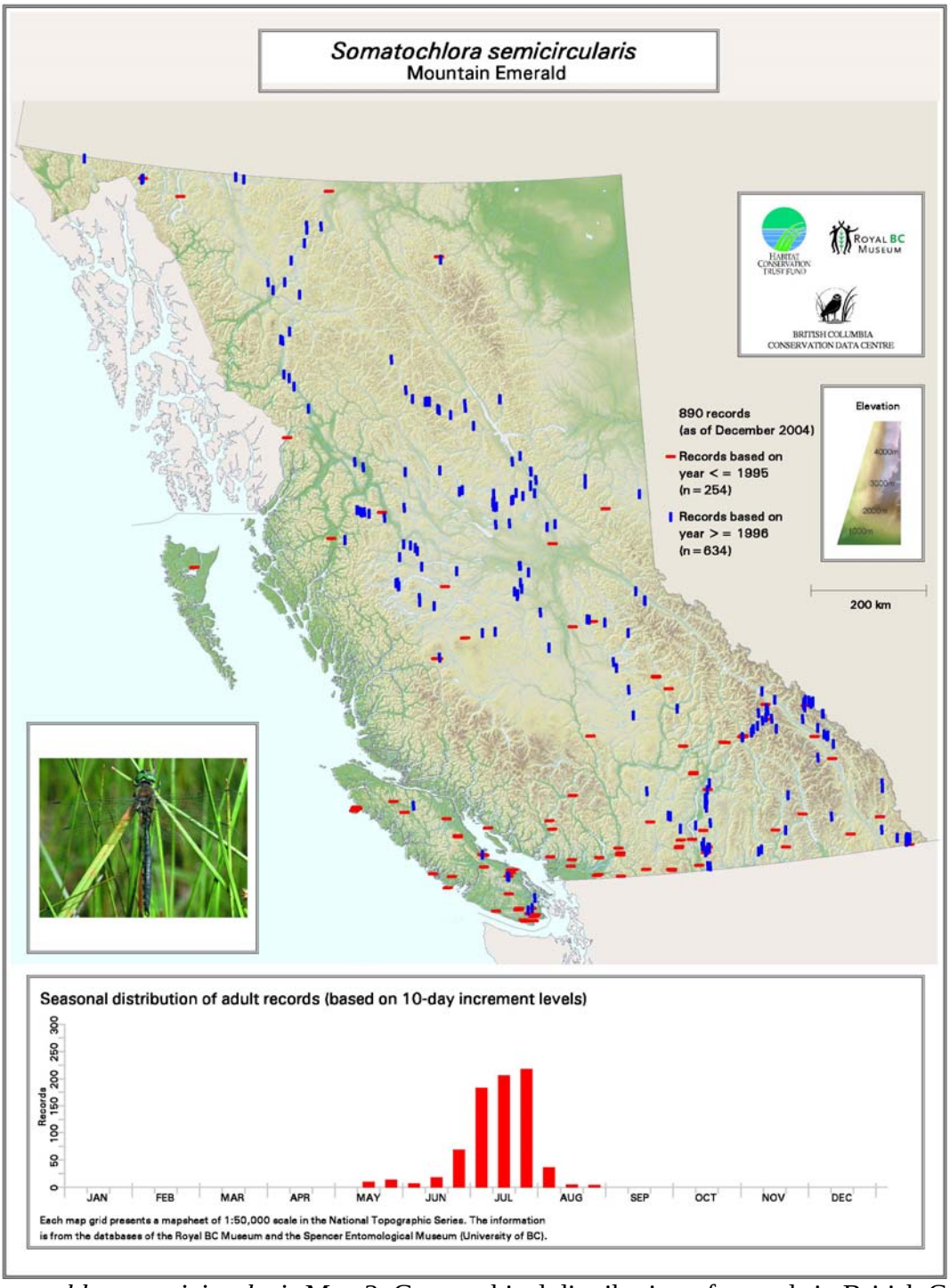
Somatochlora minor Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Somatochlora semicircularis* (Mountain Emerald)**
BC conservation rank: S5. Yellow List.
Description: The sides of the thorax are metallic green with two oval yellow spots, the larger in front. The abdomen sides sometimes have small, dull yellow spots on segments 5 to 8. Male's appendages, fig. 13f (the shape gives this species its scientific name, *semicircularis*). Female's vulvar lamina, fig. 14f. Length: male female 50 mm.
Global range: Alaska east to Yukon, south through British Columbia and western Alberta to New Mexico and California (Needham *et al*. 2000). Faunal element: Cordilleran (see Appendix 3). *S. semicircularis* is the only species in the family belonging to the Cordilleran faunal element
BC Distribution: Widespread; not known from lower elevations east of the Rocky Mountains.
Biology: The most abundant *Somatochlora* in BC, much more common in the south than in the north. Thrives in marshes and peatlands in sedge-lined lakes and ponds (Wf01 is the classic site association; also Wf05-08, Wm01-02), especially where the plants are tall and dense; males patrol and hover over these sedge beds.
BC flight period: late May to early October; most records are from early July through mid August.

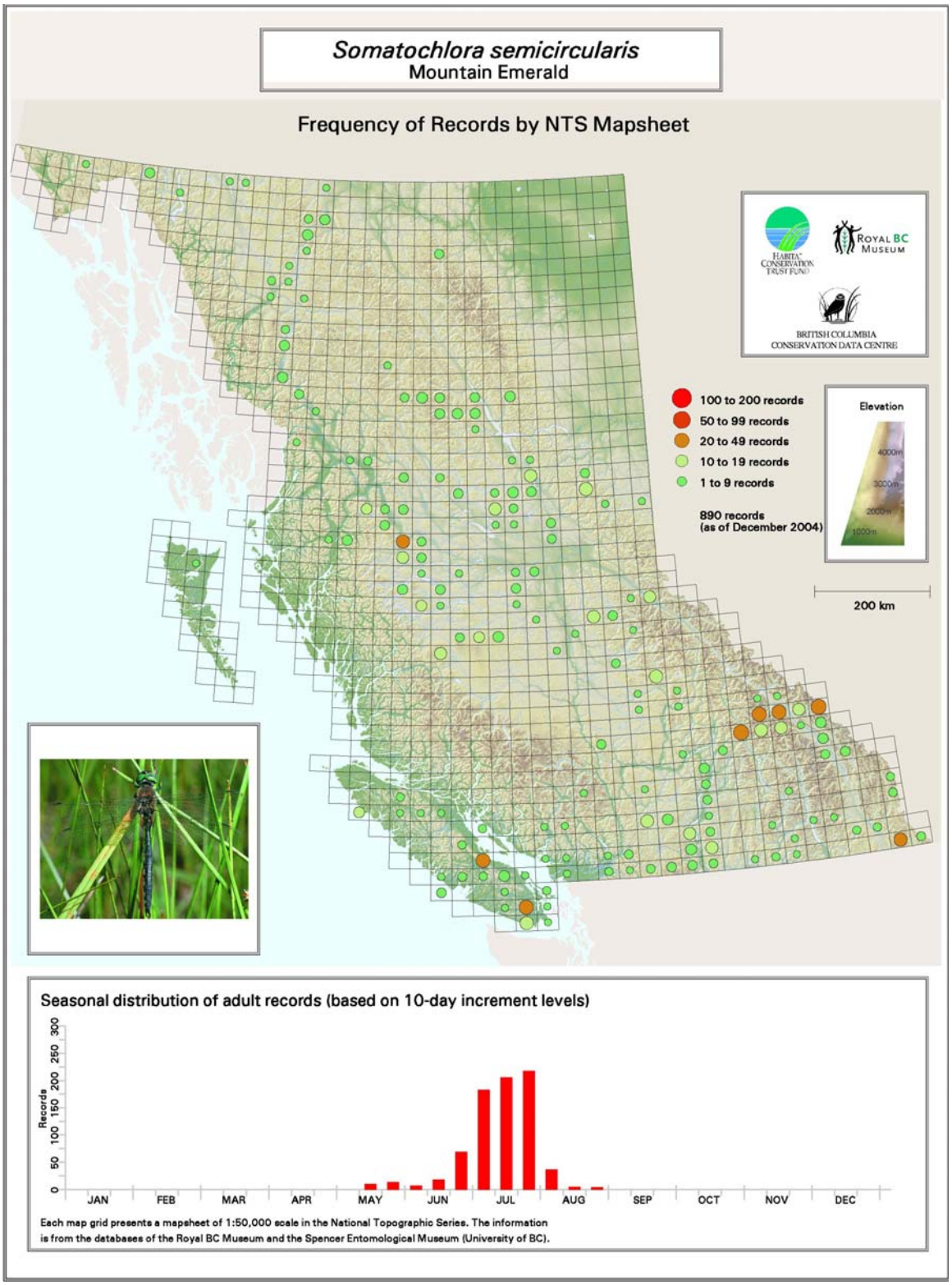
Somatochlora semicircularis male. Photograph: Robert A. Cannings



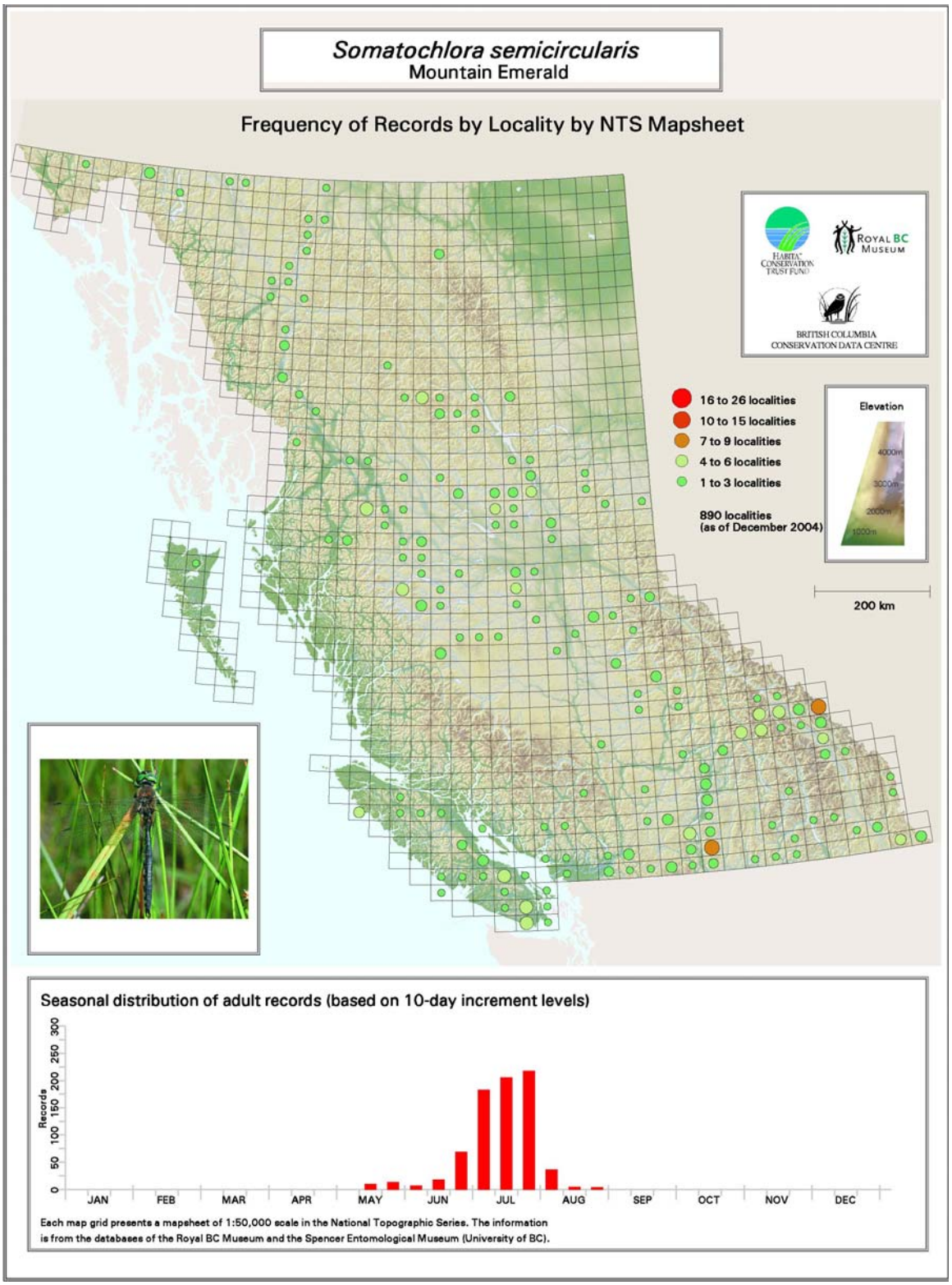
Somatochlora semicircularis Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Somatochlora semicircularis Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



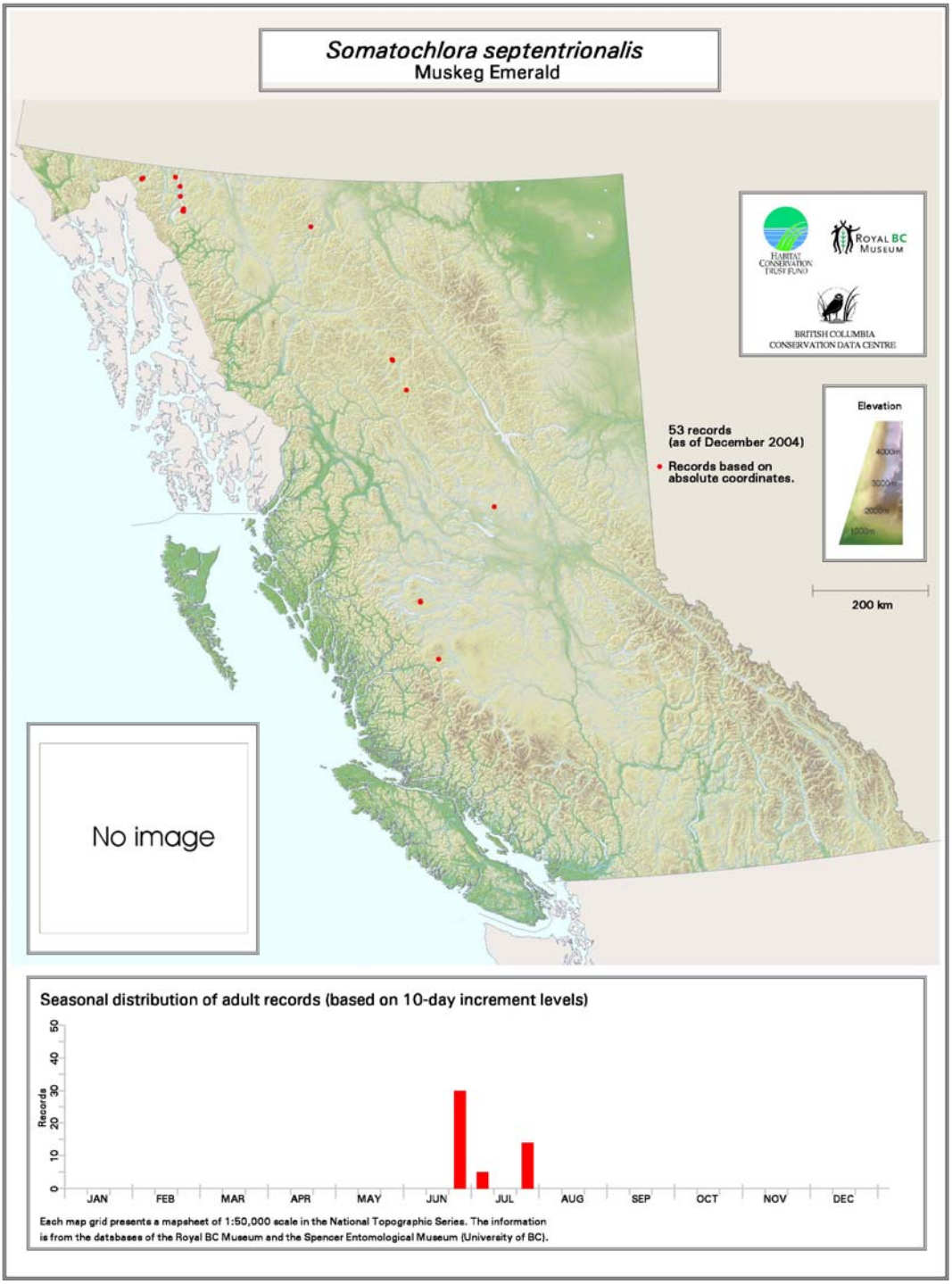
Somatochlora semicircularis Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



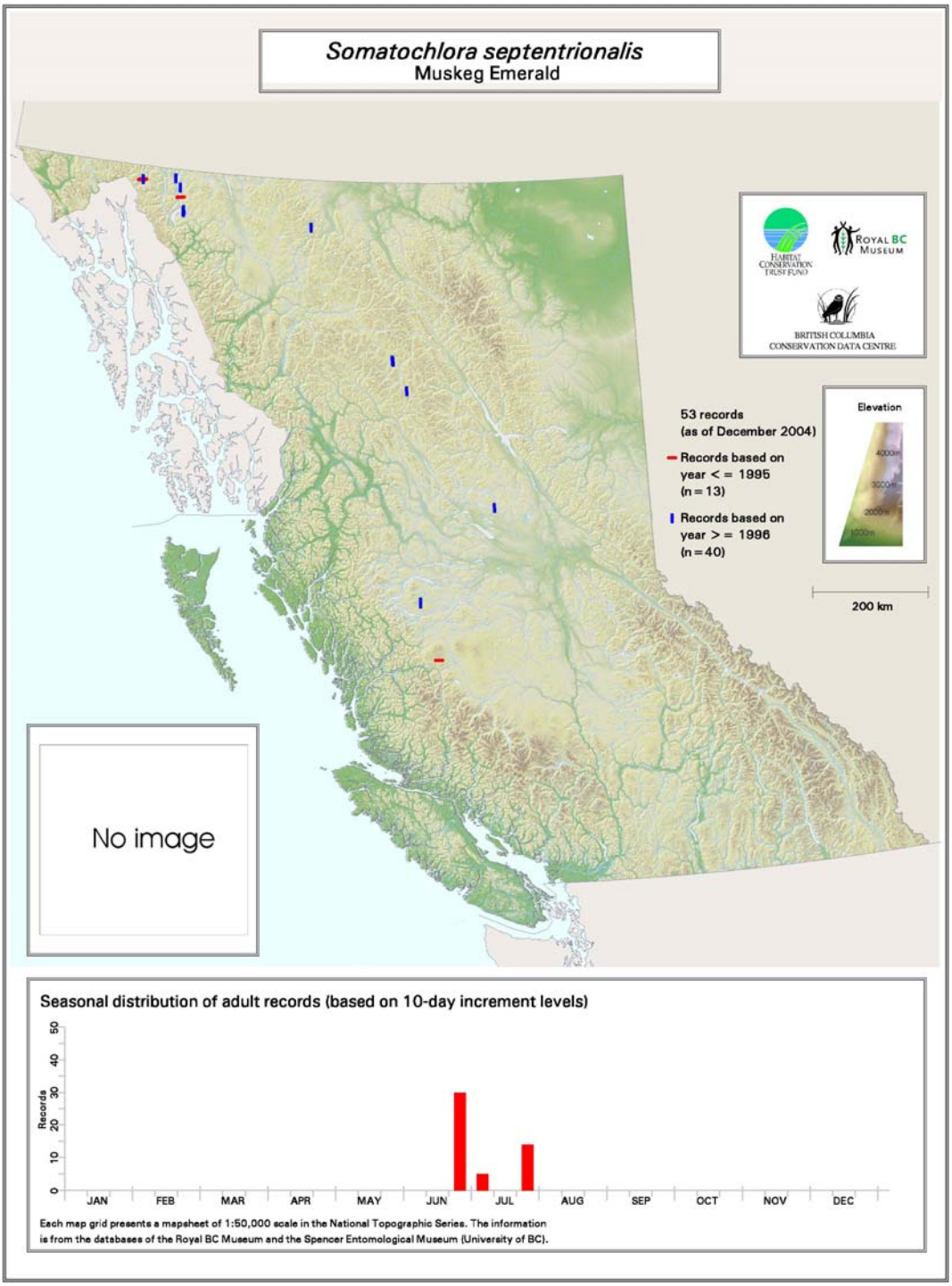
Somatochlora semicircularis Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Somatochlora septentrionalis* (Muskeg Emerald)**
BC conservation rank: S4. Yellow List. Changed from S3S4 to S3? in 2000 and downgraded to S4 in 2004, this species has been shown to be more widespread than known before the northern surveys.
Description: Similar to *S. whitehousei*, but less common. Both have a dark spot at the base of each hindwing. Both have brassy green thorax sides with a short, indistinct yellow-brown stripe below the base of the forewing (sometimes an indistinct yellowish patch below the base of the hindwing). The difference is in the shapes of the male's appendages (fig. 13h) and female's vulvar lamina (fig. 14h). Length: male 43 mm, female 44 mm.
Global Range: Yukon and British Columbia east to Newfoundland and Labrador; south to Nova Scotia and the northern parts of Quebec, Ontario and the prairie provinces (Needham *et al*. 2000). Faunal element: Northern Boreal (see Appendix 3).
BC Distribution: From the Yukon south to about 54°N on the central plateaus and about 52°N in the Coast Mountains. Most common in the extreme Northwest (Atlin); not known from the Rocky Mountains.
Biology: Rare. Lives in bogs and fens (Wb12-13; Wf07-08) where males patrol shallow ponds and pools. Typically, these pools are set in sphagnum and other mosses and are characterized by soft, mucky margins and scattered sedges. Males fly irregularly over the open water and around the pool edges, hovering infrequently.
BC flight period: mid June to late August; records from early July to early August.

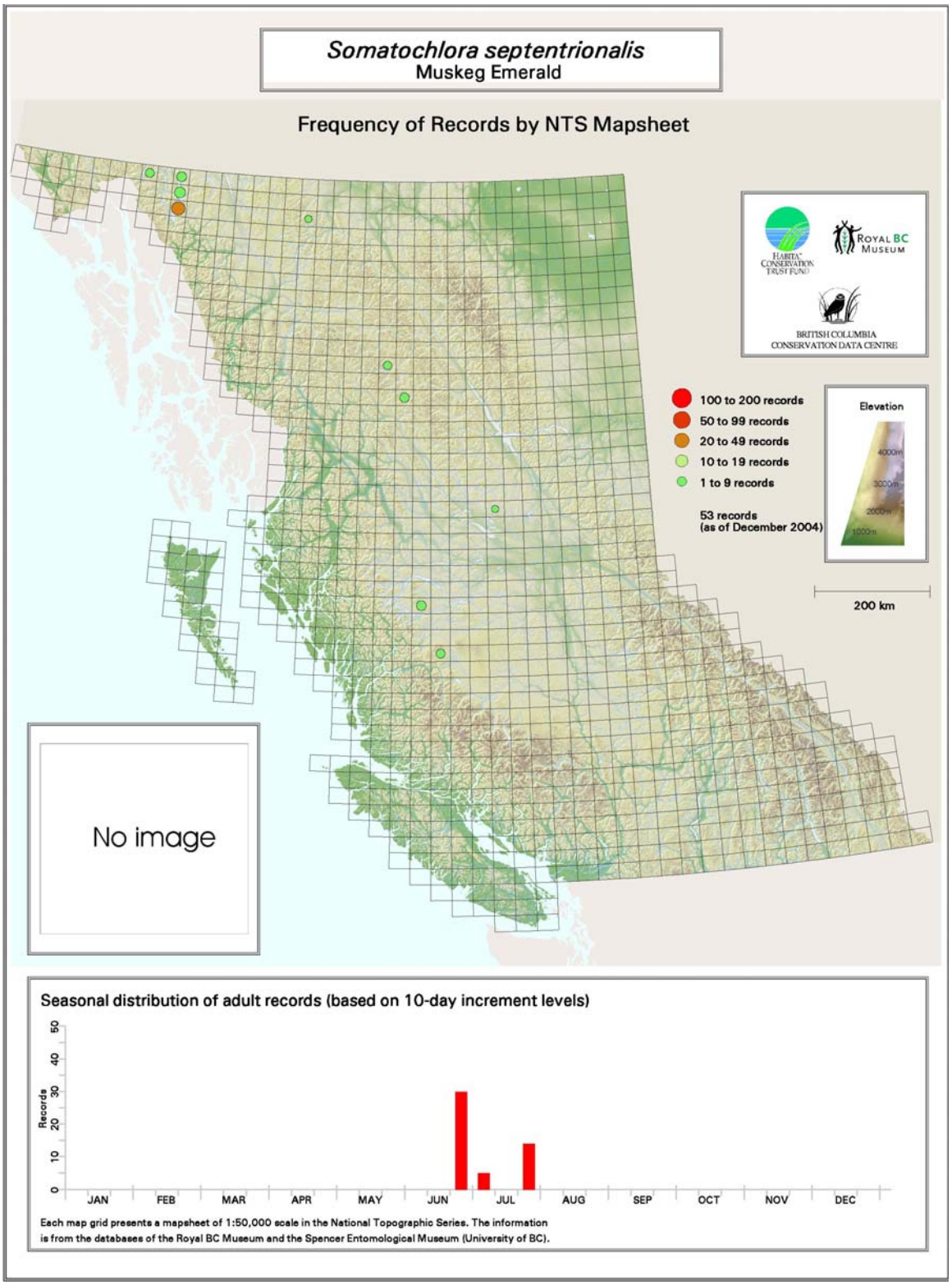
Photograph unavailable



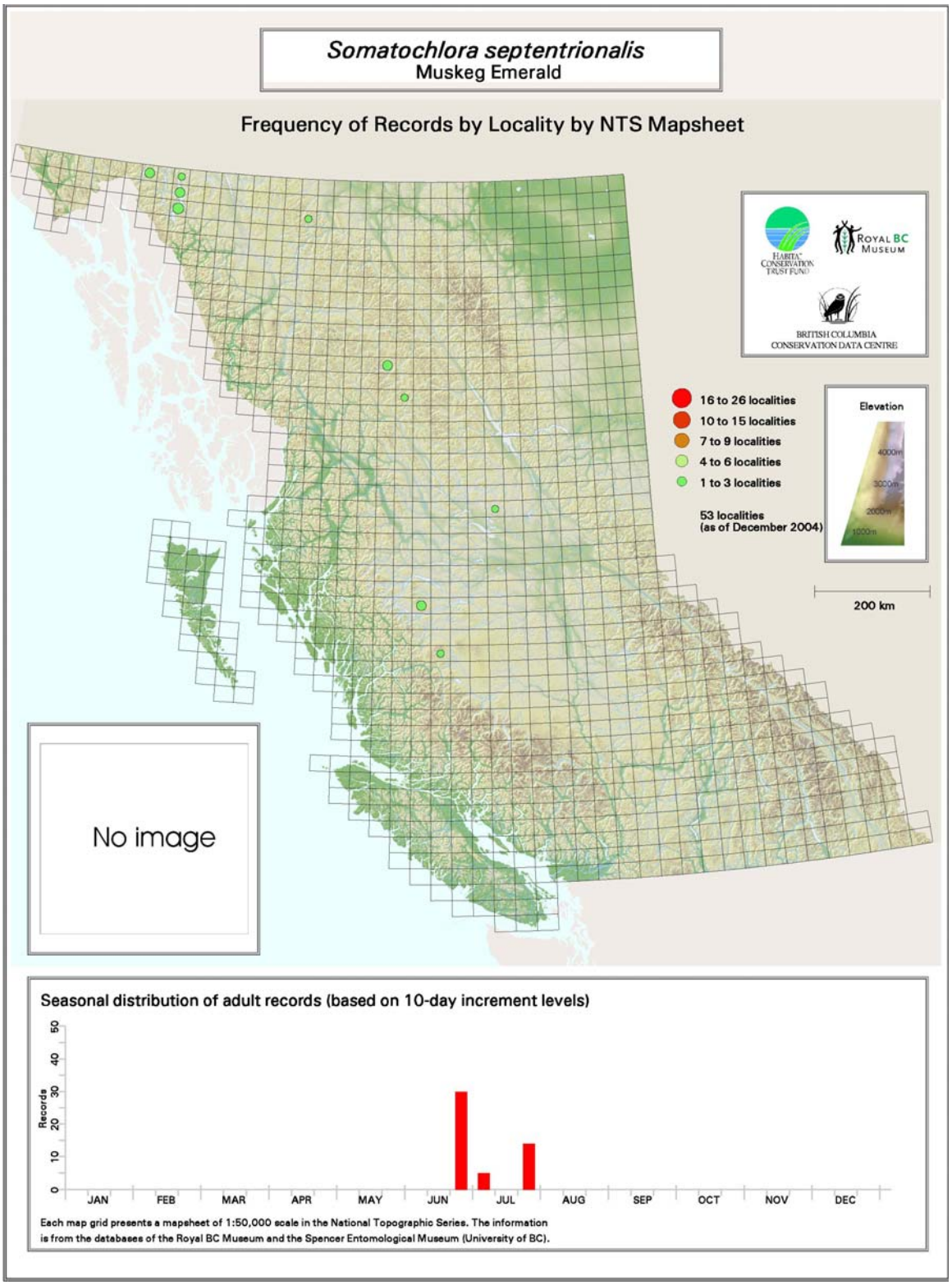
Somatochlora septentrionalis Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Somatochlora septentrionalis Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



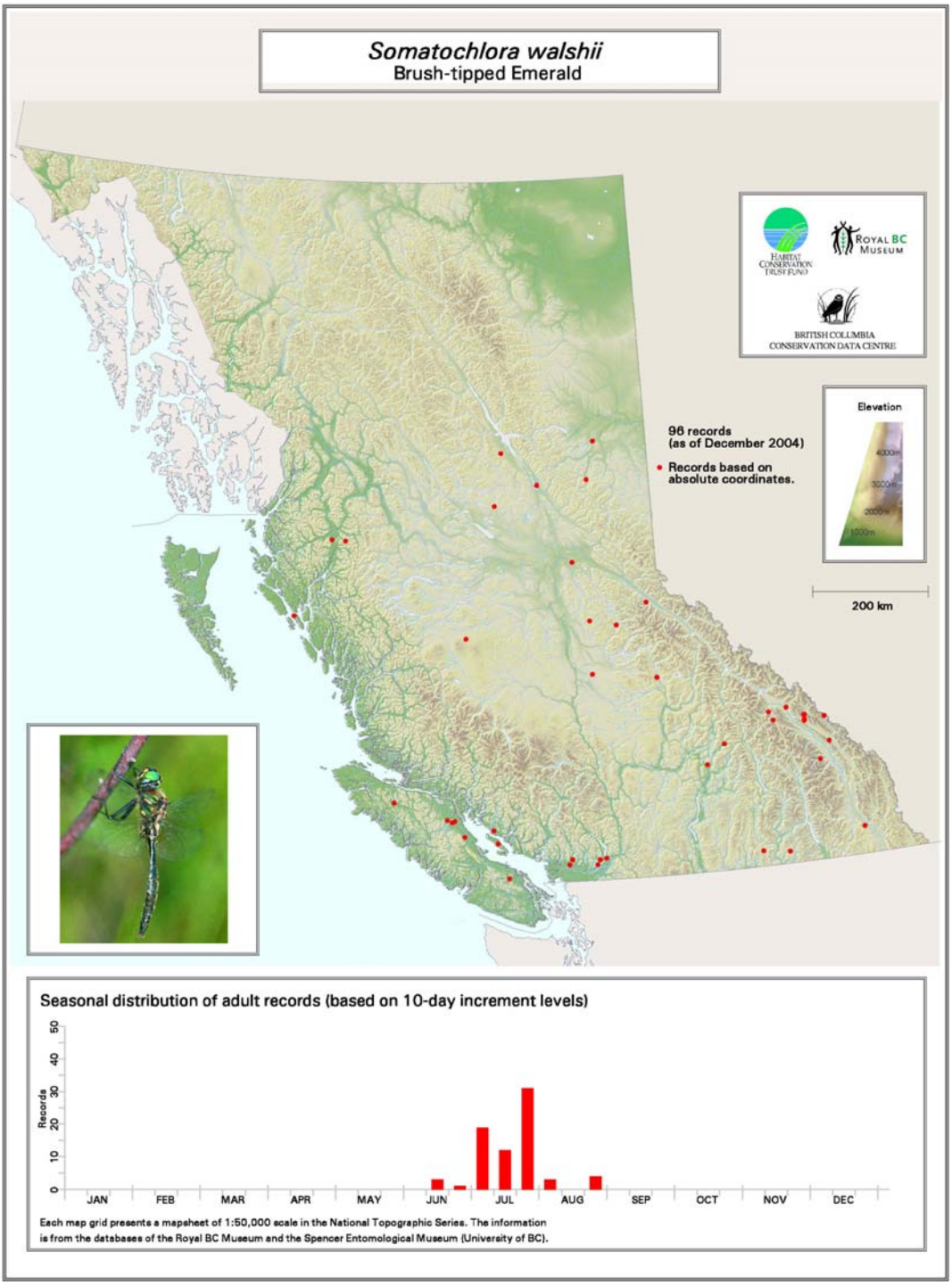
Somatochlora septentrionalis Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



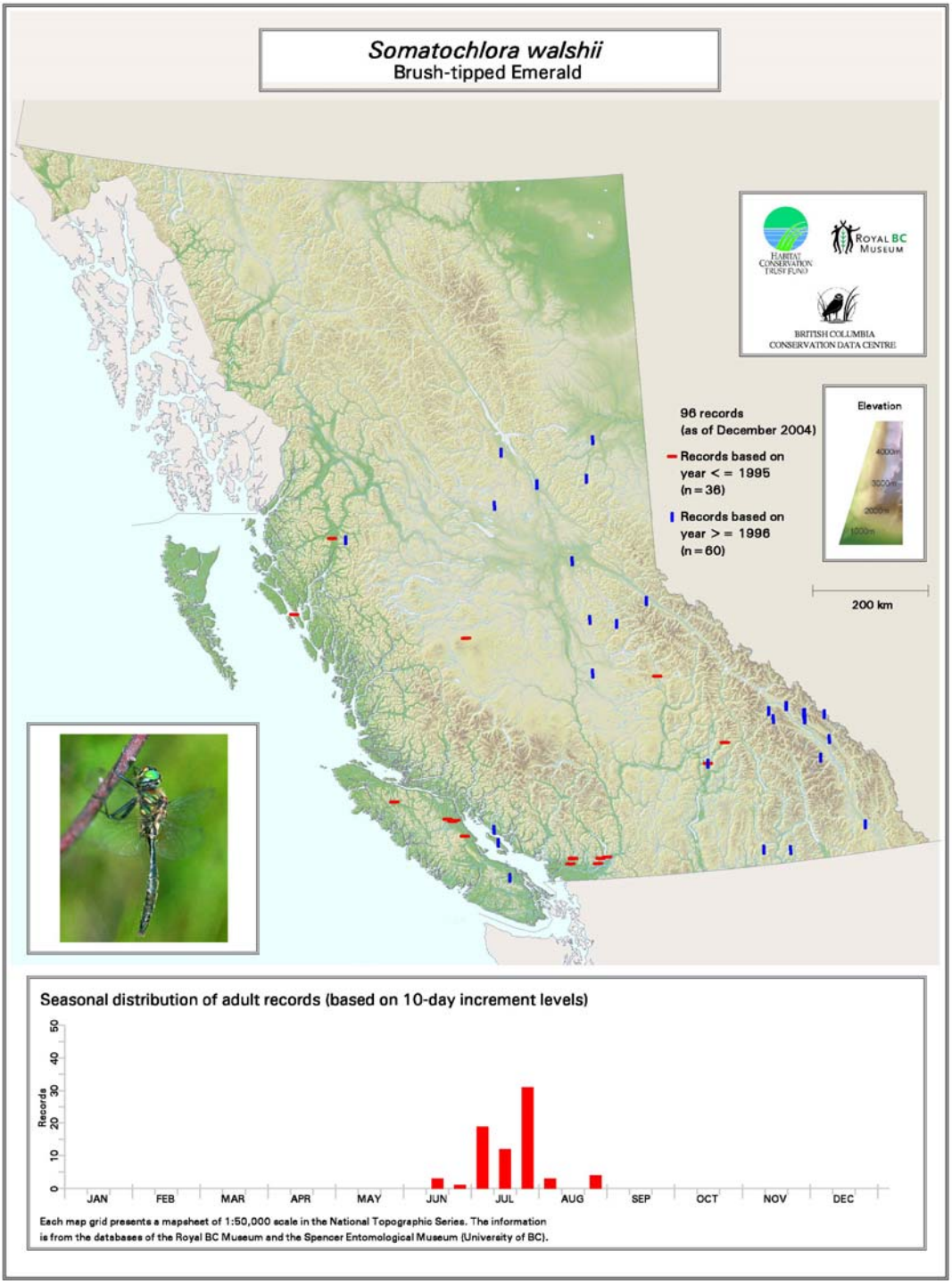
Somatochlora septentrionalis Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Somatochlora walshii* (Brush-tipped Emerald)**
BC conservation rank: S4. Yellow List.
Description: The side of the thorax has two pale marks, a short stripe at the front and an oval spot behind. The short, dark abdomen has small yellow spots on the sides of segments 5 to 7, at least. Male's appendages, fig. 13a; they have distinctive tufts of hair at the tips. Female's vulvar lamina is dark; shape, fig. 14b. Length: male 44 mm, female 47 mm.
Global Range: British Columbia east to Newfoundland; south to New Jersey, Michigan, Minnesota, Montana and Oregon (Needham *et al*. 2000). Faunal element: Southern Boreal (see Appendix 3).
BC Distribution: Throughout the southern two-thirds of BC north to the Skeena and Peace river basins.
Biology: Uncommon. Breeds in sedge meadows or fens (Wm01; Wf01, Wf05-06; Ws06) typically with small slow streams flowing through them.
BC flight period: late June to mid September; most records are from mid July to early August.

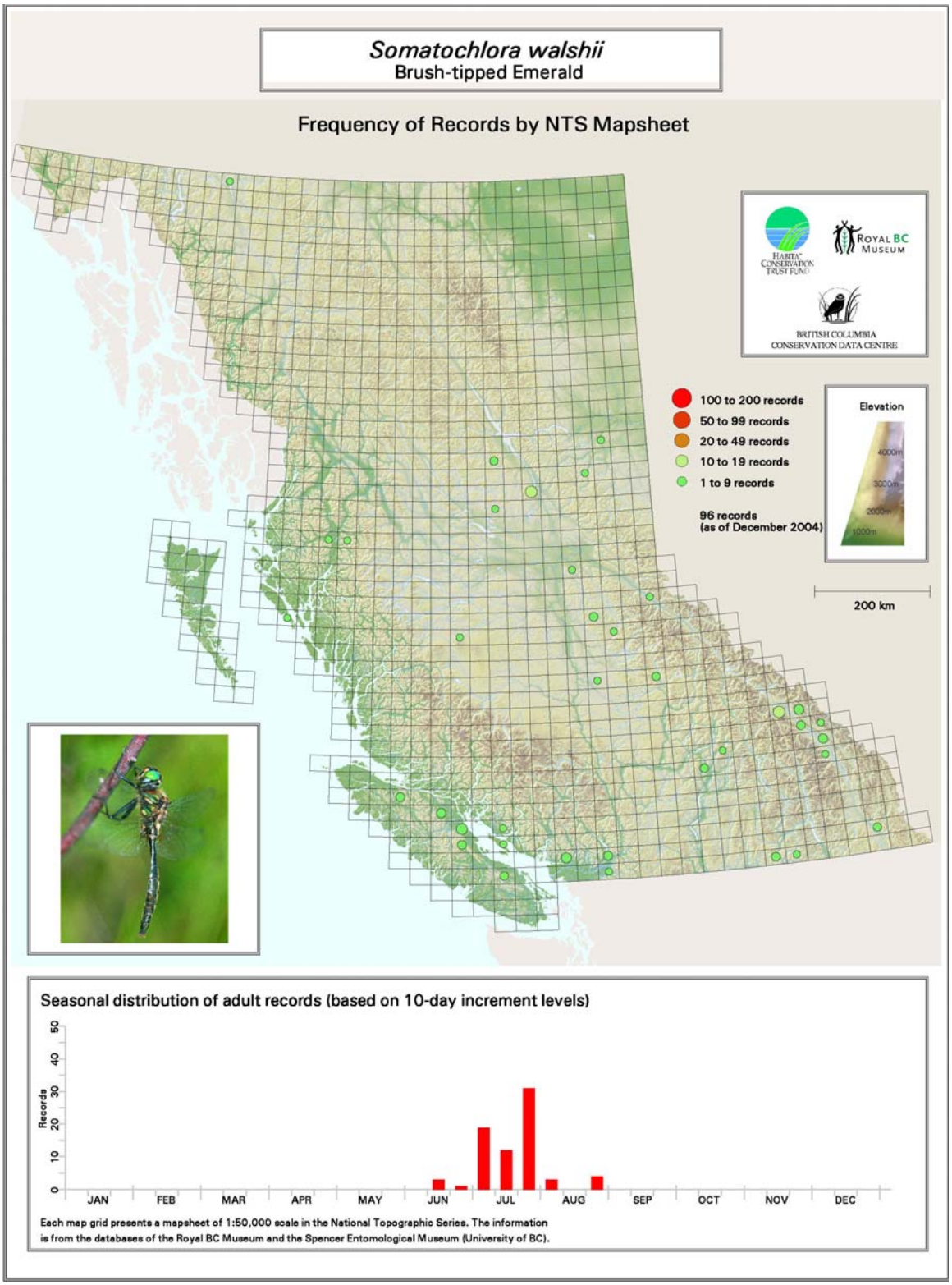
Somatochlora walshii male. Photograph: George Doerksen, RBCM



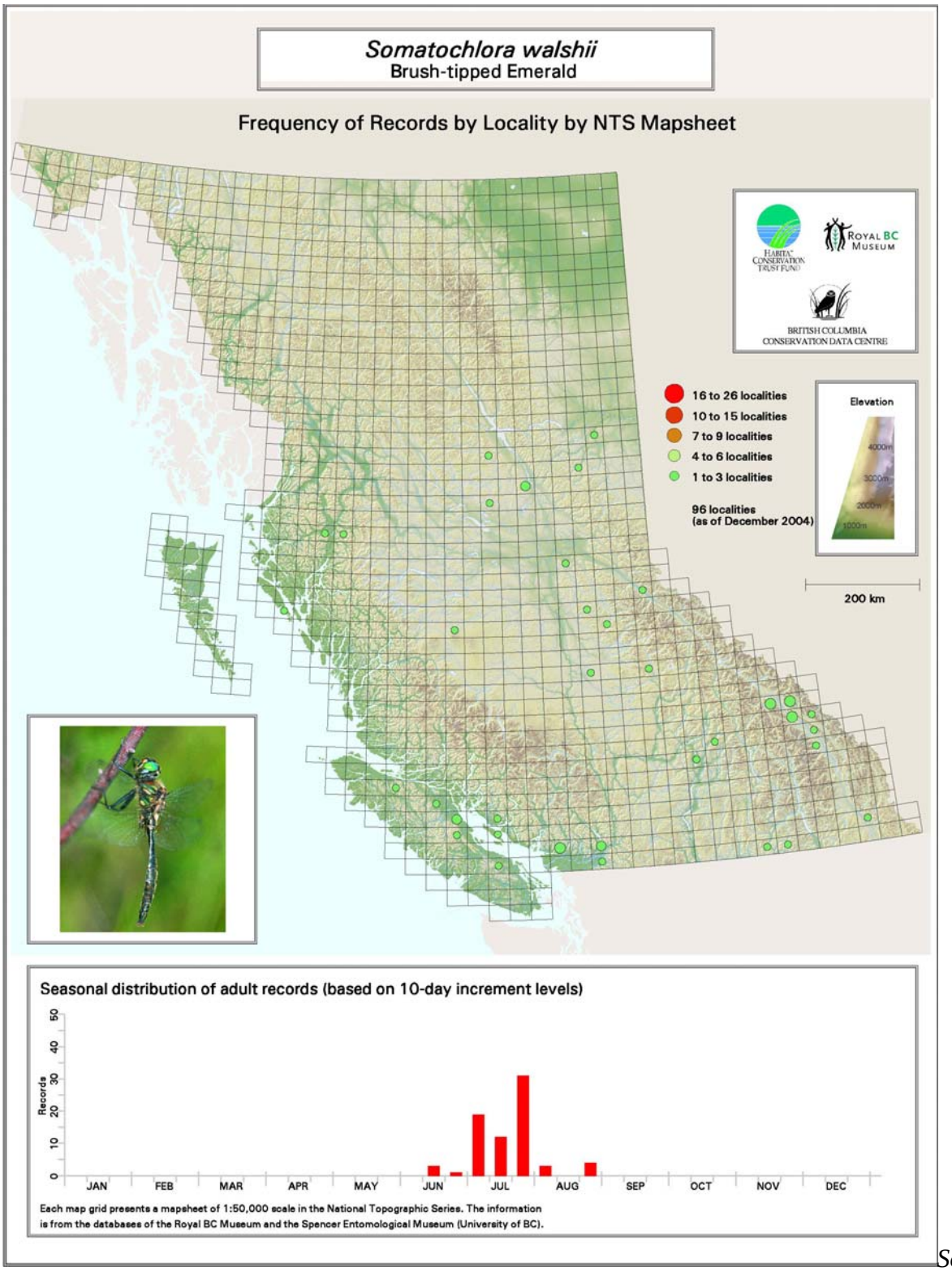
Somatochlora walshii Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Somatochlora walshii Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



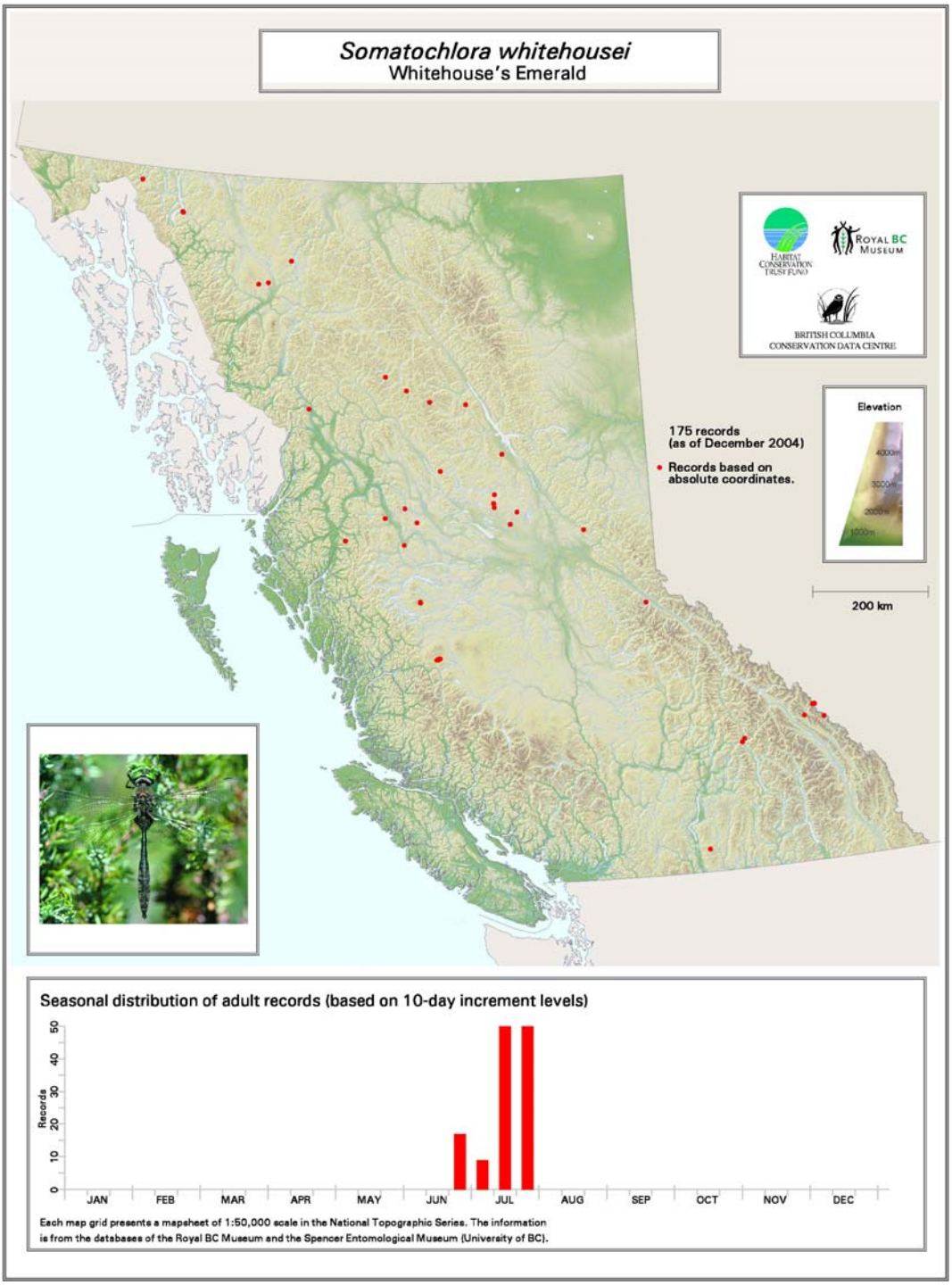
Somatochlora walshii Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



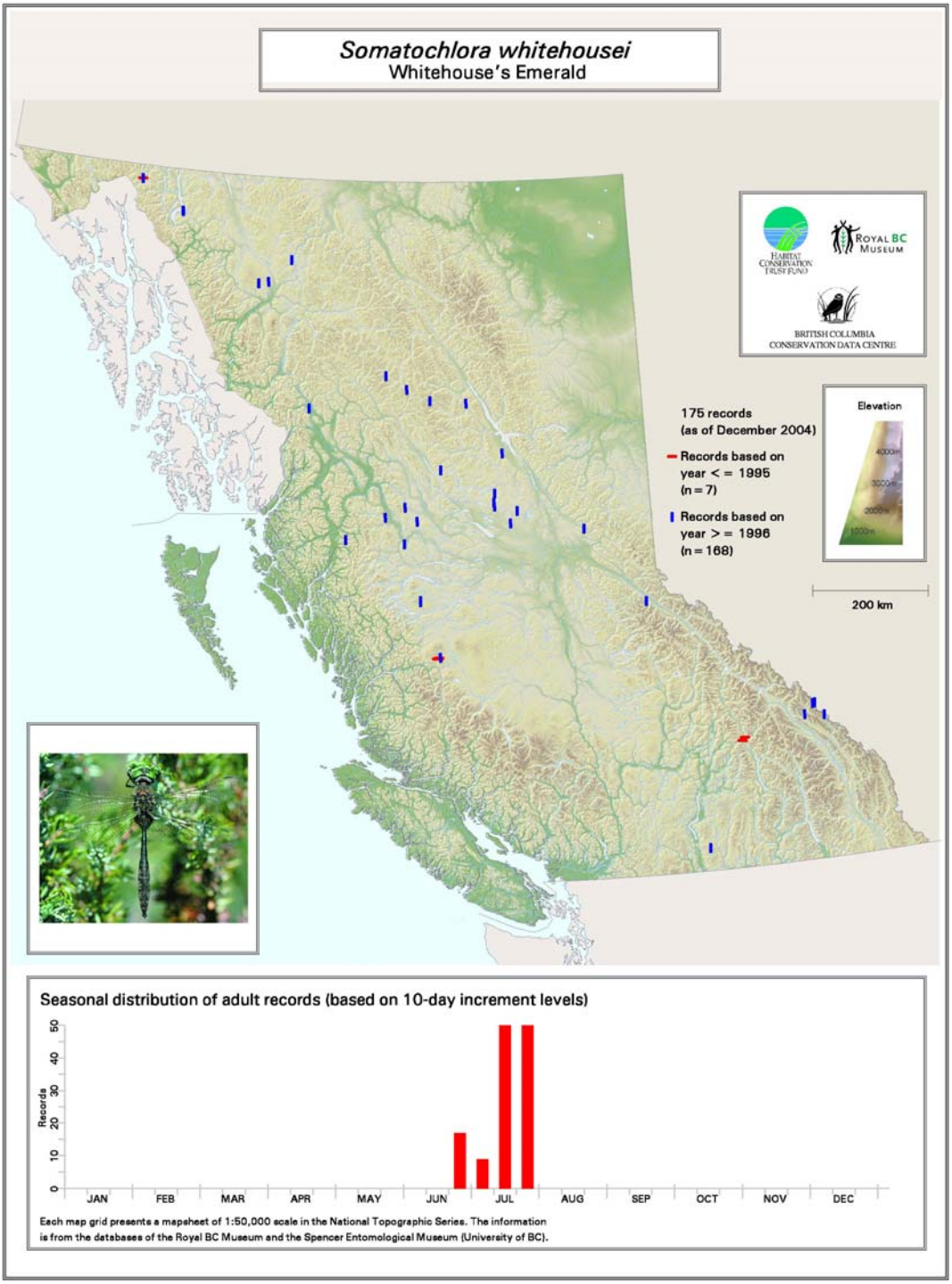
Somatochlora walshii Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Somatochlora whitehousei* (Whitehouse's Emerald)**
BC conservation rank: S4. Yellow List.
Description: Similar to *S. septentrionalis*, but much more common. Both have a dark spot at the base of each hindwing (see fig. 15). Both have brassy green thorax sides with a short, indistinct yellow-brown stripe below the base of the forewing (sometimes an indistinct yellowish patch below the base of the hindwing). The main difference is in the shapes of the male appendages (fig. 13g) and vulvar lamina (fig. 14g). Length: male female 47 mm.
Global Range: Yukon and British Columbia east to Labrador and Newfoundland (Needham *et al*. 2000). Faunal element: Widespread Boreal (see Appendix 3).
BC Distribution: Widespread east of the Coast Mountains from the southern plateaus and Rocky Mountains to the Yukon border. Very rare south of 51ºN. Not yet known from the Northeast.
Biology: Uncommon overall, but often abundant in suitable habitats. Prefers level, shallow, mossy fens and bogs dominated by short sedges and buckbean (Wf07-08). Males patrol across and around pools or small shallow puddles. Named for Francis Whitehouse, a BC banker and student of dragonflies.
BC flight period: early June to early September; recorded from early July to early August.

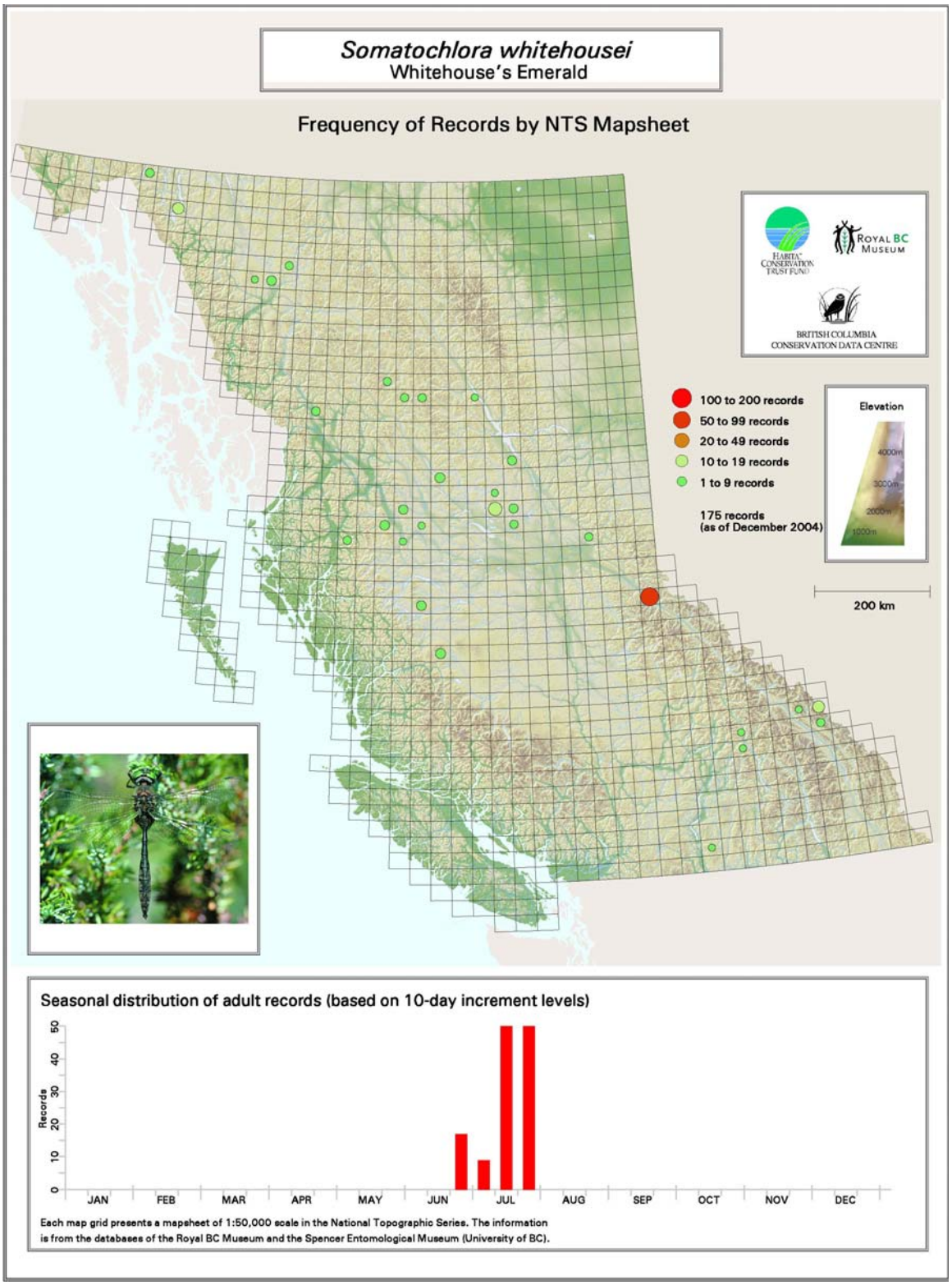
Somatochlora whitehousei male. Photograph: Robert A. Cannings, RBCM



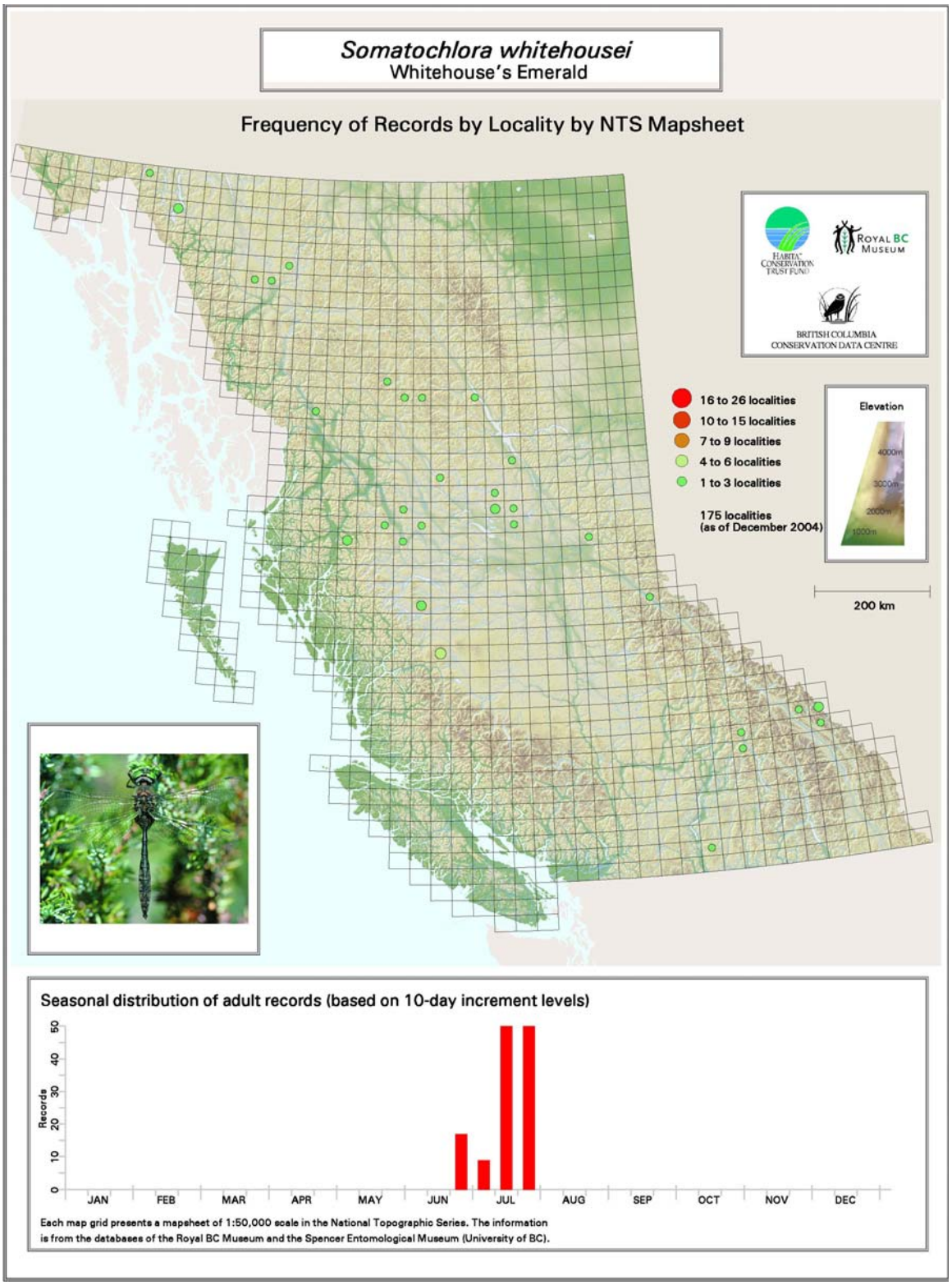
Somatochlora whitehousei Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Somatochlora whitehousei Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Somatochlora whitehousei Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



Somatochlora whitehousei Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

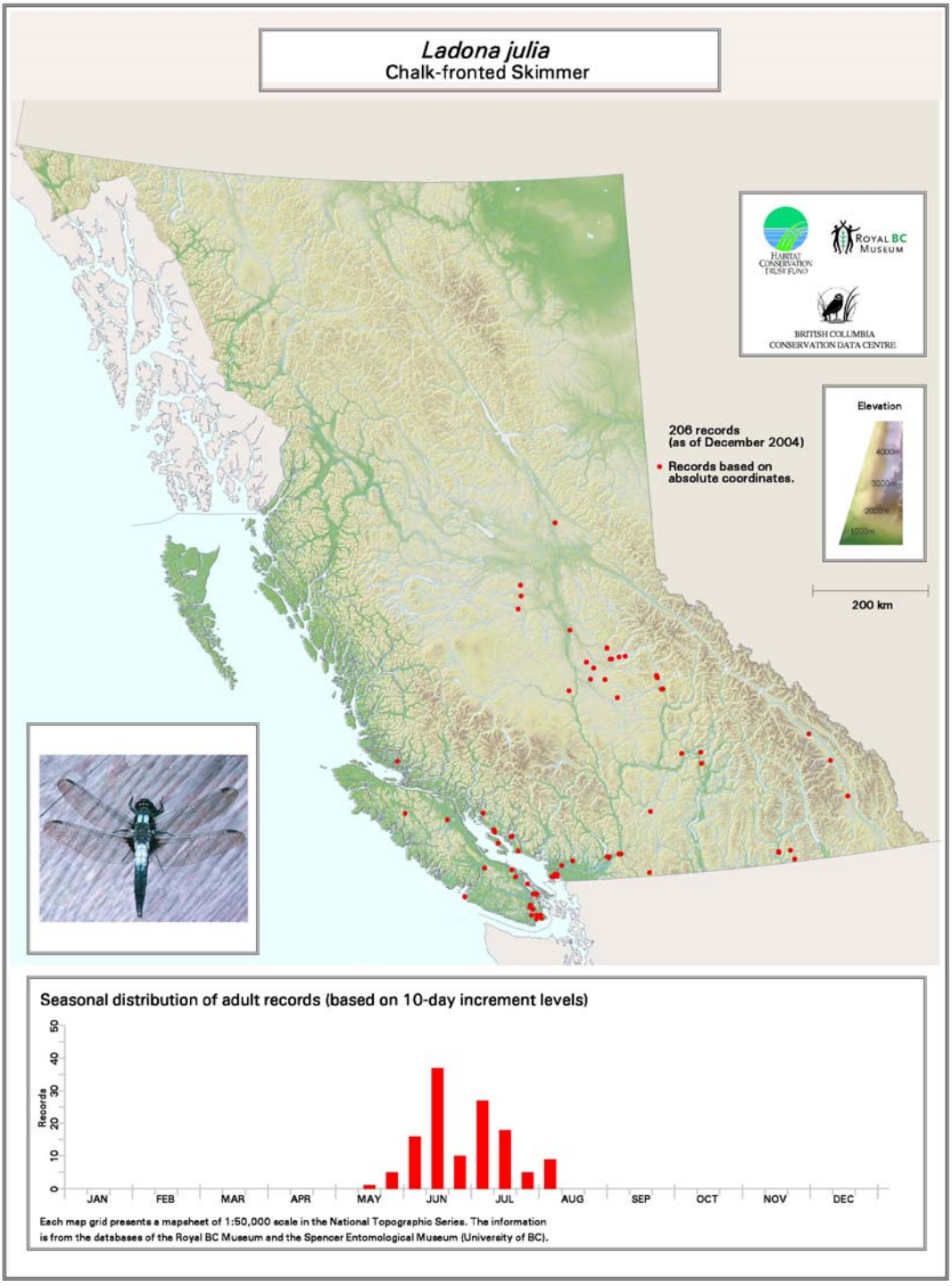
Family Libellulidae (Skimmers)
The largest dragonfly family in our region – 23 species in five genera live here and 2 species in two other genera are visitors. They come in many sizes and colours, many with bold wing markings or coloured veins. Their eyes meet broadly on top of the head. The anal loop in the hindwing is distinctive: foot-shaped with a long toe (fig. 10c). Most common around ponds, marshy lakeshores and sluggish streams, the adults dart about and most species spend a lot of time perched horizontally in the sun. Females lay eggs alone or in the company of guarding males. Most dip the tip of their abdomen into the water when releasing the eggs, but some will tap or splash the eggs into wet mud or moss, or simply flick them into a dry pond basin. Some larvae, like those of the emeralds, move sluggishly or squat on the bottom mud; others climb in vegetation.

***Ladona* (Corporals)**
A small genus closely related to, and often included in, *Libellula. Ladona* has six species, three of them in North America. They are medium-sized brown dragonflies with dark marks or patches at the bases of the wings and patterned pruinescence in mature males. Adults typically perch on the ground, on rocks and on logs rather than on vegetation, as most *Libellula* species usually do.

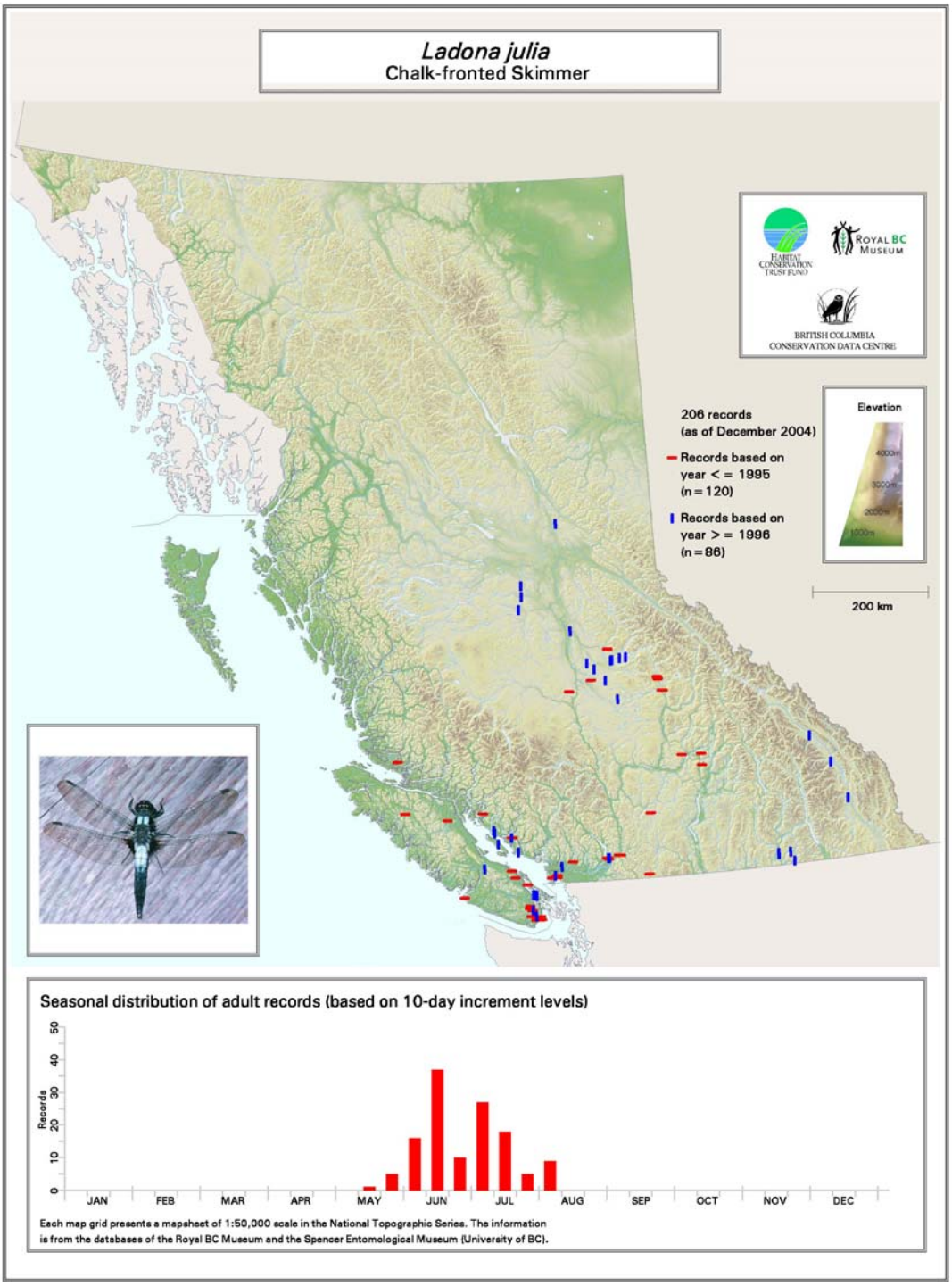
***Ladona julia* (Chalk-fronted Corporal)**
BC conservation rank: S5. Yellow List.
Description: Mostly brown. Named “corporal” because immatures have a pair of pale stripes on the top of the thorax; they also have a dark stripe on top of the abdomen. Mature adults are “chalk-fronted” with distinctive pale pruinescence on the front of the thorax, as well as the base of abdomen – white on males, grey on females. The wings are clear except for small, dark marks at the bases; those on the hindwings are triangular. Length: male 42 mm, female 40 mm.
Global range: Southern British Columbia east to Nova Scotia; south to West Virginia and California. Faunal element: Transition (see Appendix 3).
BC Distribution: Widespread in the southern half of the province.
Biology: Found around peaty forest ponds (e.g., in fens such as Wf07) and swampy lake bays (e.g. *Nuphar lutea – Utricularia macrorhiza* association); favours slightly acidic waters, where it can be surprisingly abundant. It often rests on rocks, logs, floating waterlily leaves or the bare ground and can be tame.

BC flight period: late May to early September; mostly recorded from mid June to late July.

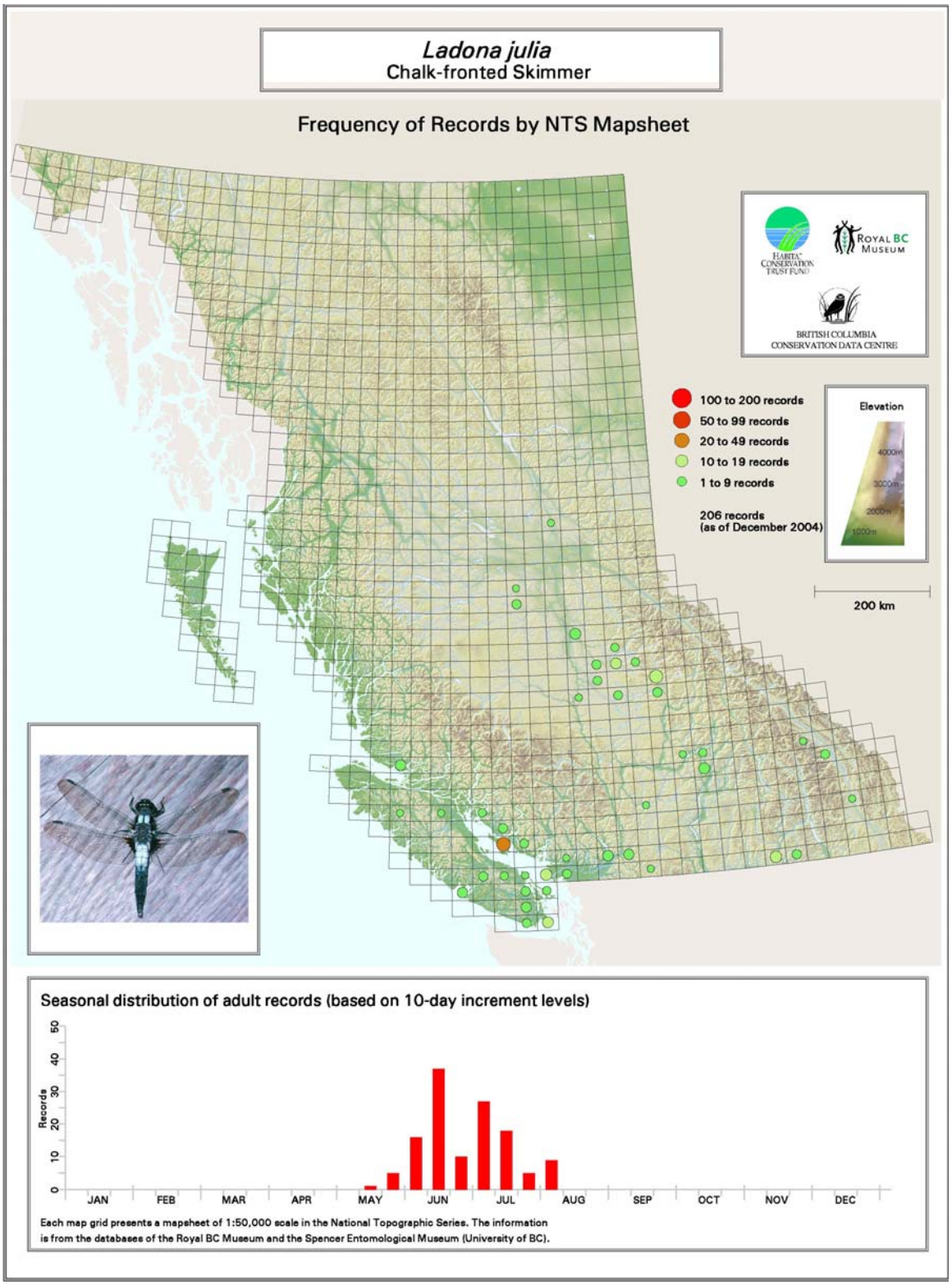
Ladona julia male. Photograph: George Doerksen, RBCM



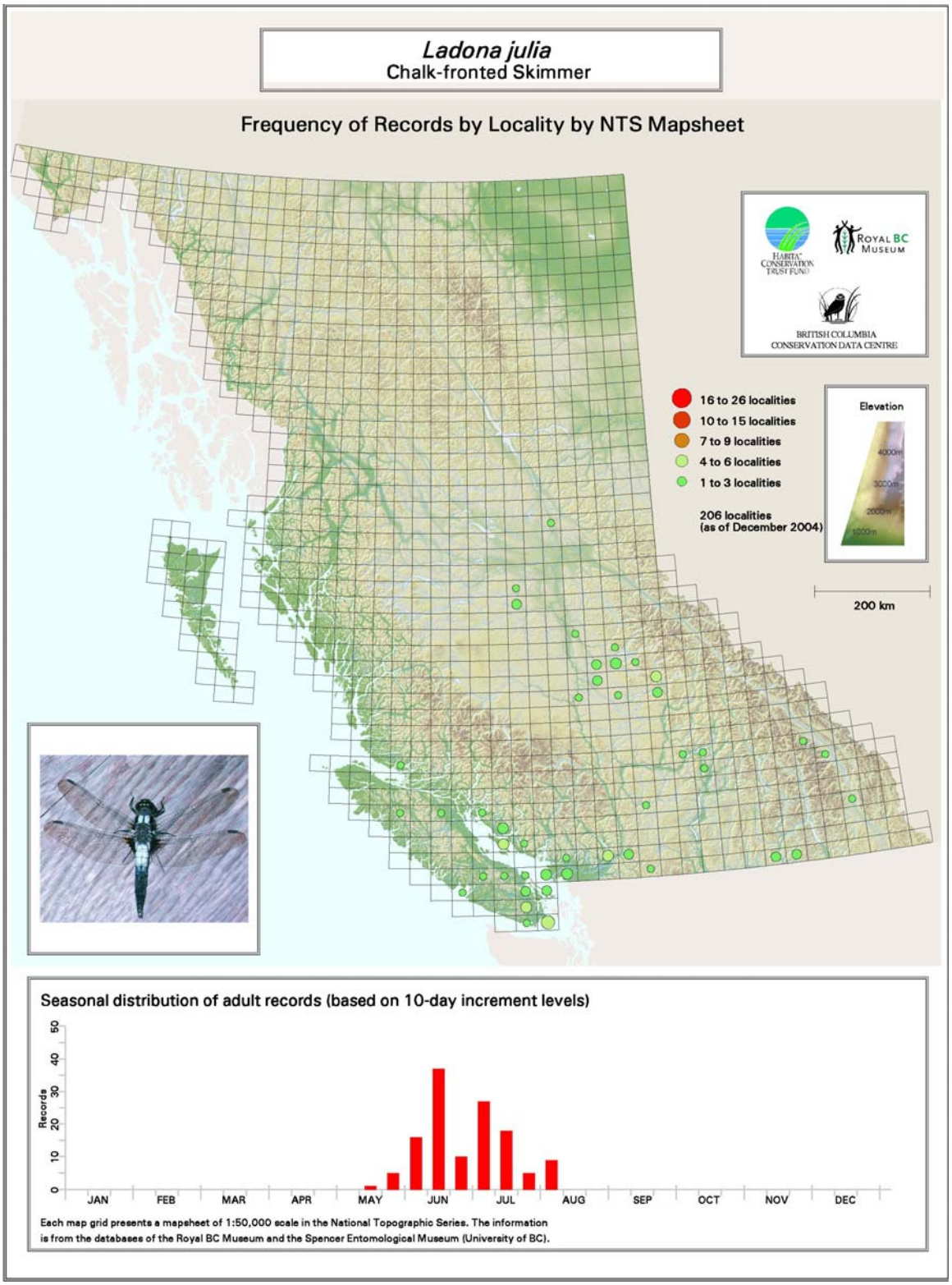
Ladona julia Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Ladona julia Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Ladona julia Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



Ladona julia Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Leucorrhinia* (Whitefaces)**

Small black dragonflies with white faces. The thorax and abdomen are usually marked, males with red and females with yellow (or sometimes red); some pruinescence develops with age. The hindwings have a distinctive small, triangular dark patch at the base and the legs are black. Five of the six species in our region are northern in distribution and most prevalent in the mountains or in the north around the marshy shores of lakes in the late spring or early summer. The Dot-tailed Whiteface is different, preferring cattail marshes and ponds in warm valley bottoms. Whitefaces perch on the ground, logs, lily pads or low vegetation. Males usually hover nearby while females lay eggs. Species can be tricky to separate; look for size, the colour pattern on the abdomen, and the details of the female's vulvar lamina and the male's hamules.

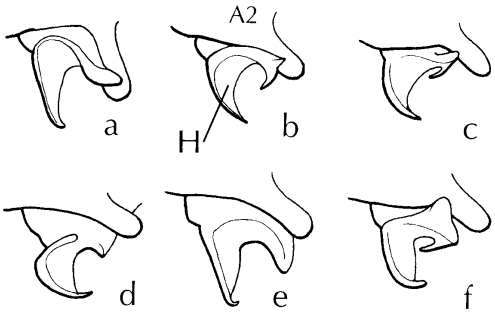
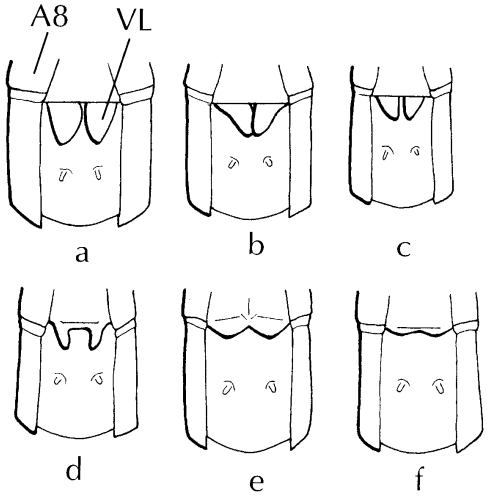


Figure 16. Whitefaces, male hamules, side view: a, Boreal; b, Hudsonian; c, Canada; d, Red-waisted; e, Crimson-ringed; f, Dot-tailed. A2 = abdominal segment 2; H = hamule.

Figure 17. Whitefaces, female vulvar lamina, view from below: a, Boreal; b, Hudsonian; c, Canada; d, Dot-tailed; e, Red-waisted; f, Crimson-ringed. A8 = abdominal segment 8; VL = vulvar lamina.



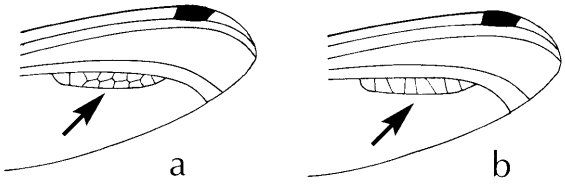
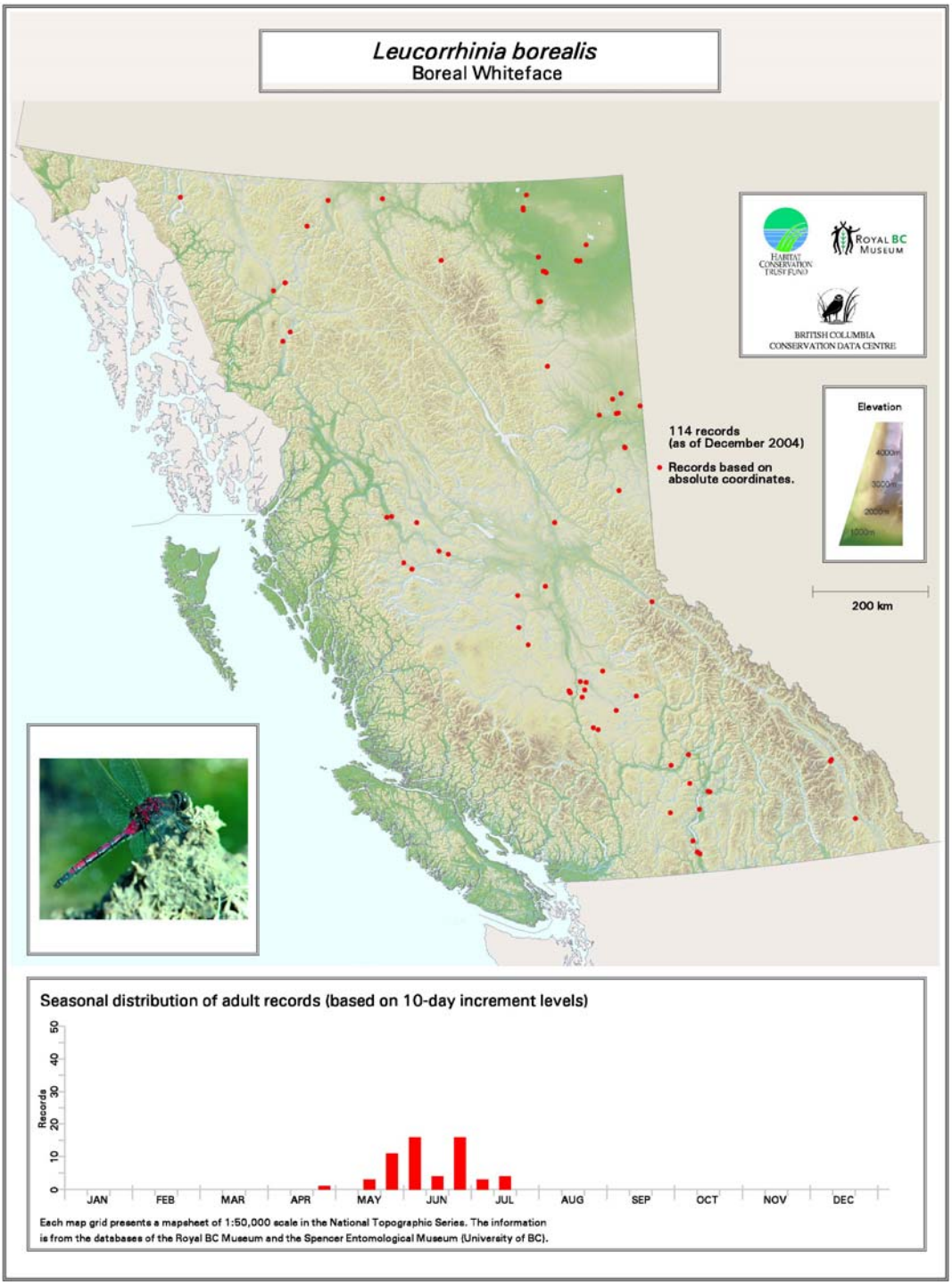


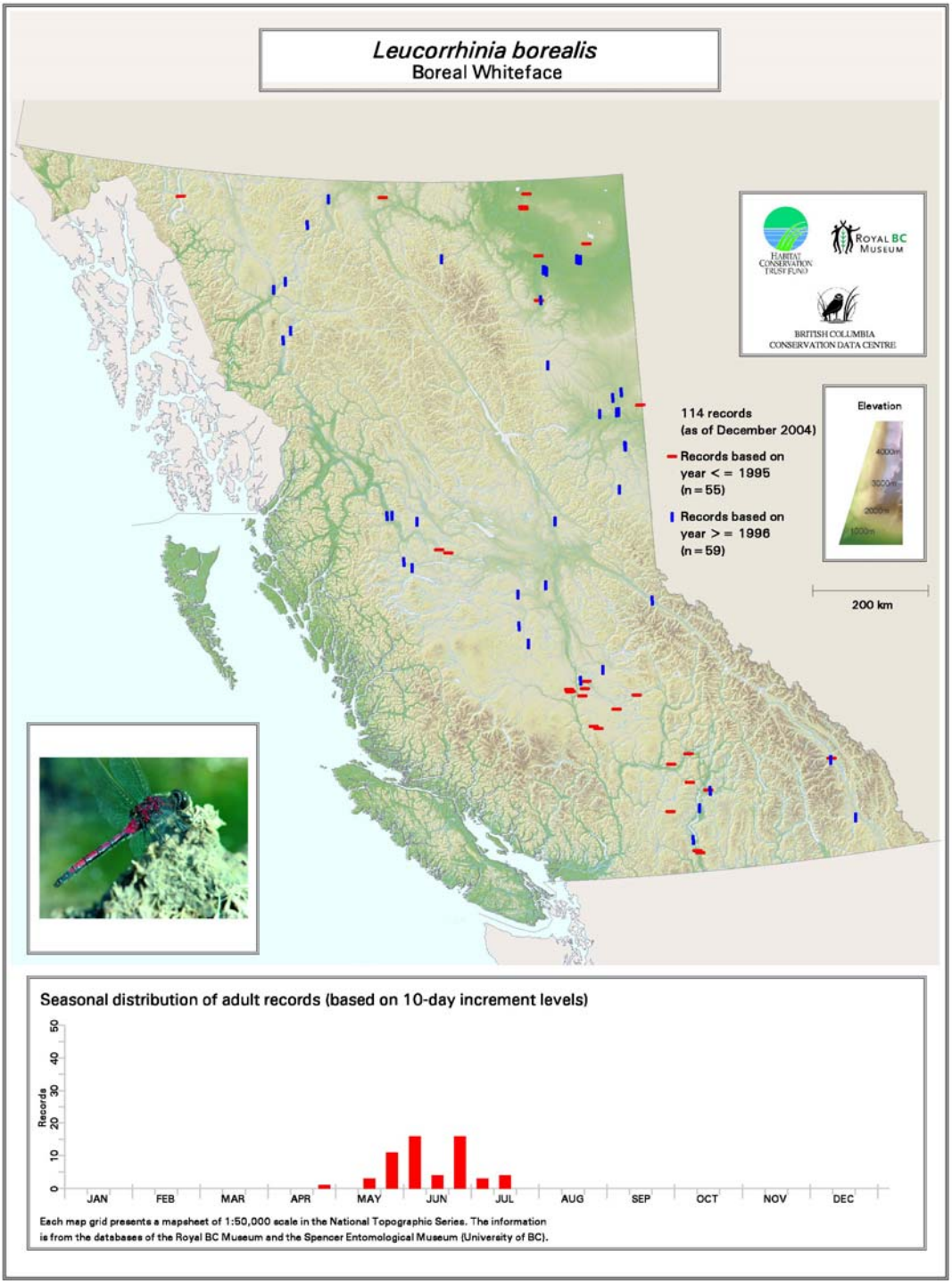
Figure 18. Comparing the ends of the forewings of: a, Crimson-ringed; b, Red-waisted whitefaces.

***Leucorrhinia borealis* (Boreal Whiteface)**
BC conservation rank: S5. Yellow List.
Description: Similar to the more common *L. hudsonica*, but larger and with bigger abdominal spots, including one on segment 8 in males. The spot on segment 7 reaches the end of the segment. The yellow markings of immatures turn red with age. Hamule, fig. 16a; vulvar lamina, fig. 17a. Length: male 39 mm, female 37 mm.
Global range: Alaska and Yukon east to northwestern Ontario south to Minnesota, North Dakota, Saskatchewan, Montana, Colorado, Utah and Washington (Needham *et al*. 2000). Faunal element: Western Boreal (see Appendix 3).
BC Distribution: Widespread east of the Coast Mountains.
Biology: Our largest whiteface, uncommon in the southern part of its range, but more frequent in northern BC (especially east of the Rockies). Prefers deep sedge marshes Wm01-02, but lives in a variety of fens and ponds (Wm04-06; Wf01, Wf05). Primarily a species of marshes at the northern reaches of the Great Plains, where it often swarms in large numbers. The flight season is early and short.
BC flight period: early May to early August; almost all records are from late May to late July.

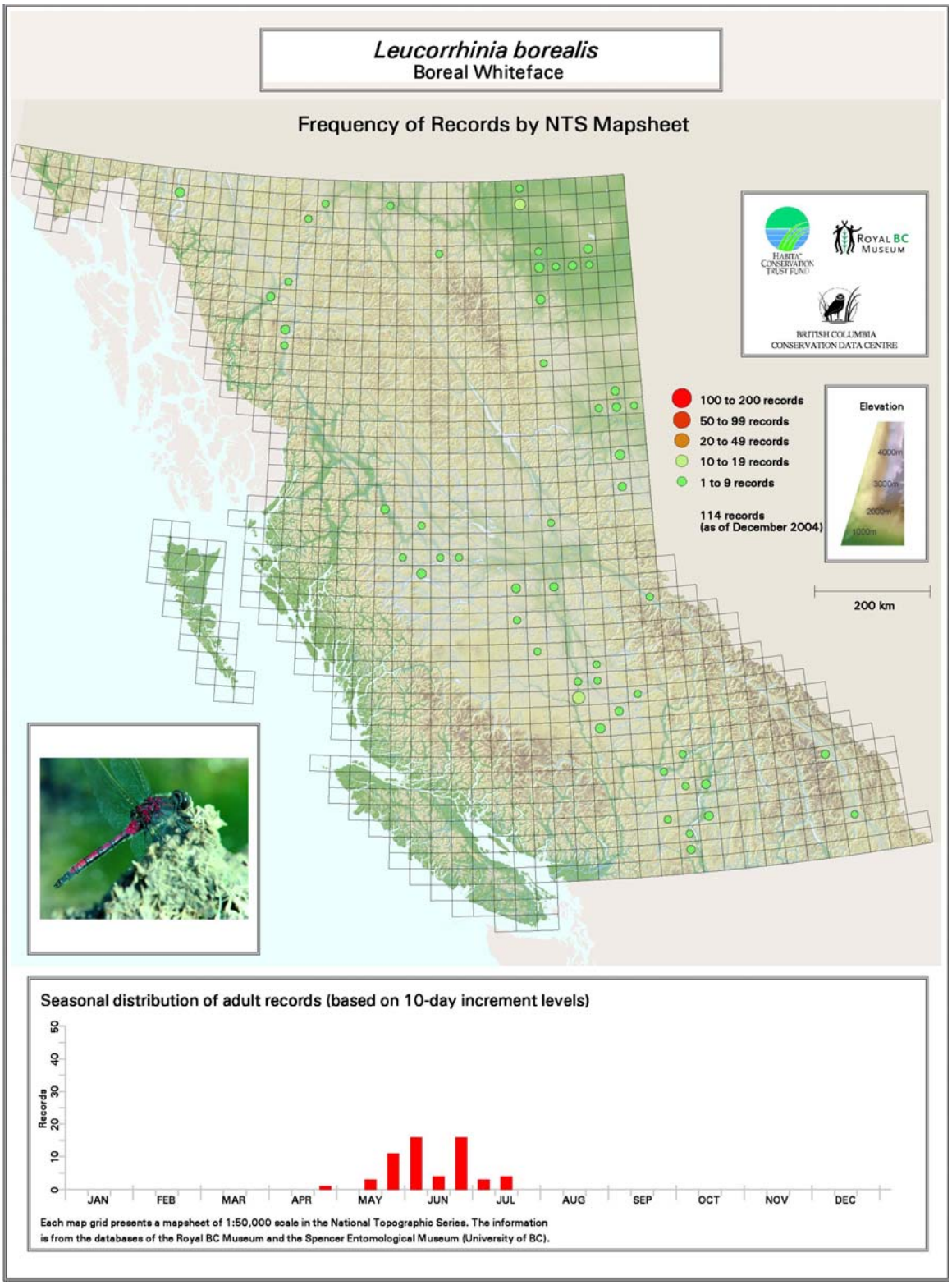
Leucorrhinia borealis male. Photograph: George Doerksen, RBCM



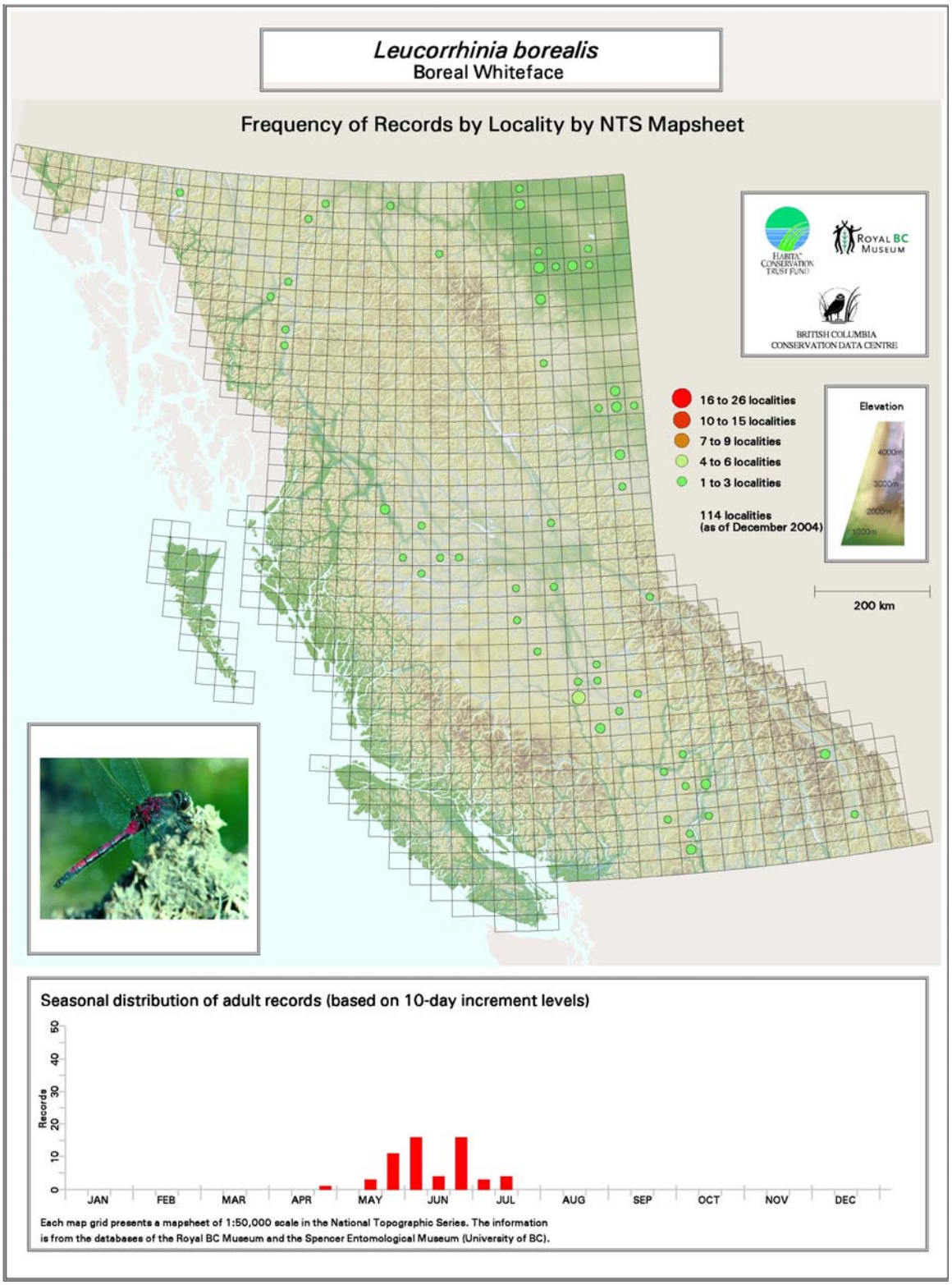
Leucorrhinia borealis Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Leucorrhinia borealis Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



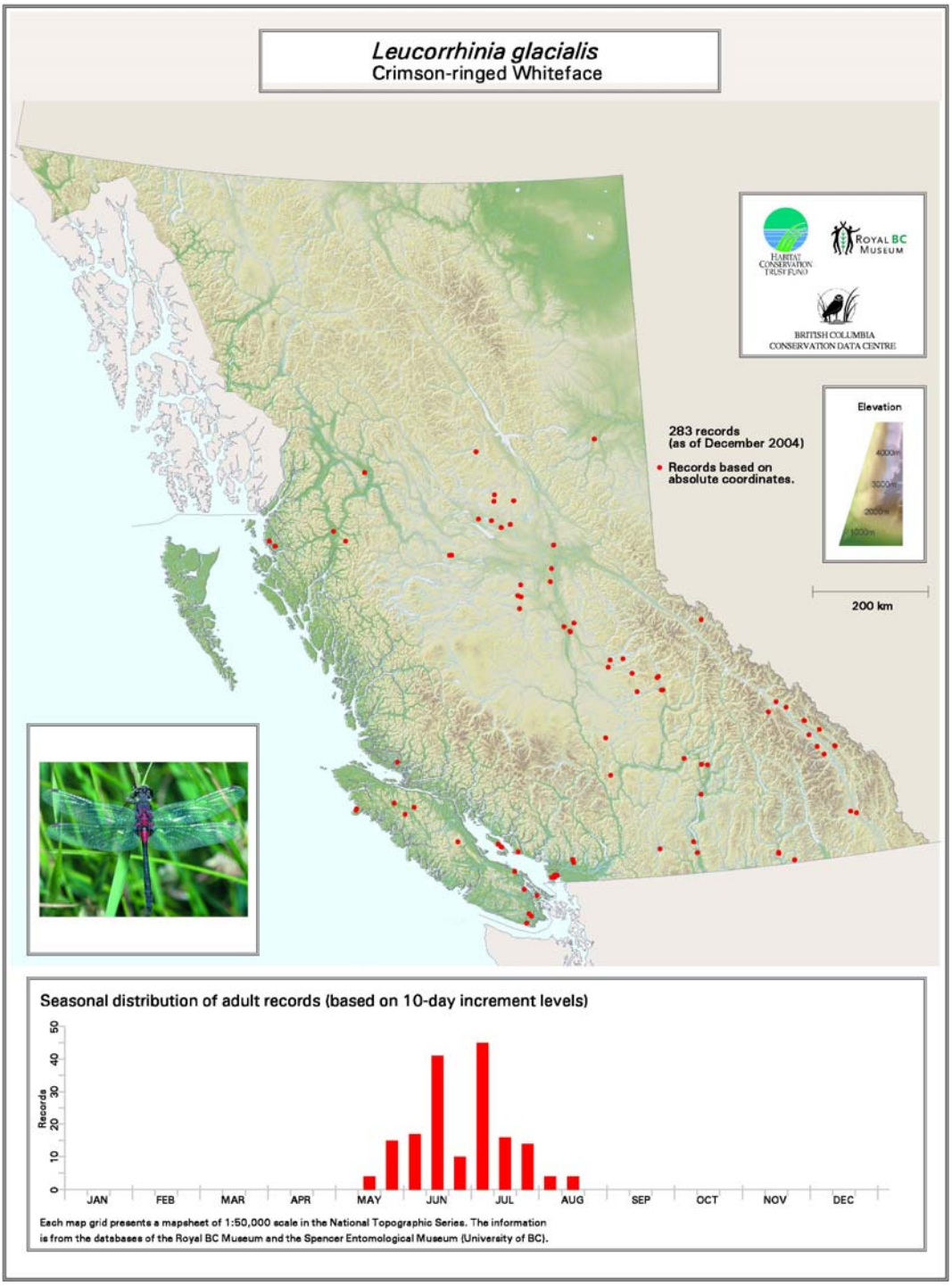
Leucorrhinia borealis Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



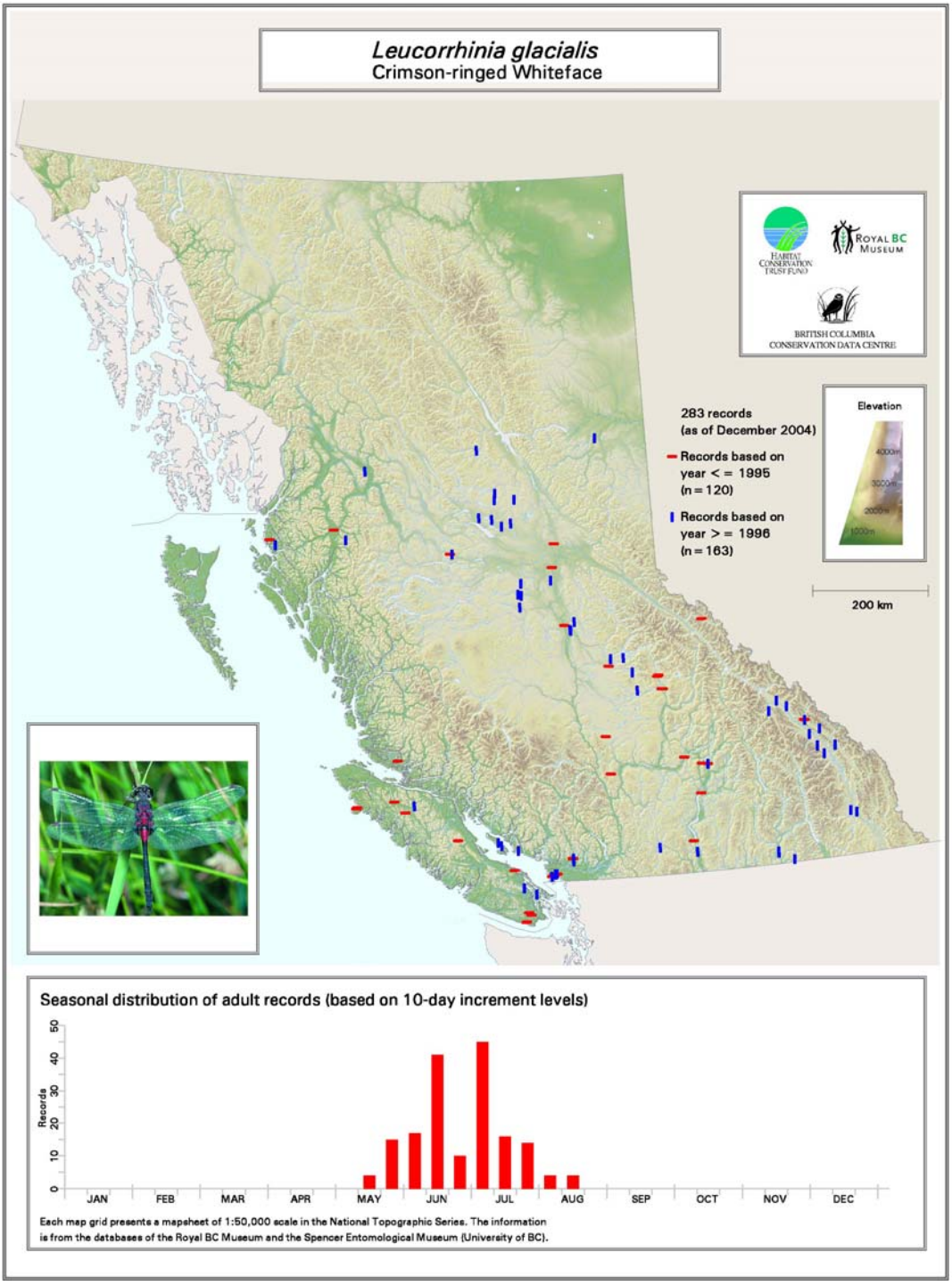
Leucorrhinia borealis Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Leucorrhinia glacialis* (Crimson-ringed Whiteface)**
BC conservation rank: S5. Yellow List.
Description: Can be confused with *L. proxima*, but its wings have two rows of cells (where shown in fig. 18a). Male's abdomen is mostly black, with red only at the base and without spots on top of the middle segments (though some have thin streaks). Young females have yellow marks on top of segments 1 to 7, sometimes turning red with maturity. Hamule, fig. 16e; vulvar lamina, fig. 17f. Length: male 36 mm, female 35 mm.
Global range: Southeastern Alaska and British Columbia east to Labrador and Newfoundland; south in the western mountains to California, Nevada and Wyoming, and in the east to Minnesota, Pennsylvania, West Virginia and Maryland (Needham *et al*. 2000). Faunal element: Transition (see Appendix 3).
BC Distribution: Widespread in southern and central BC, north to about 56ºN.
Biology: Lives around marshy lakes and ponds, especially peaty ones, in forests and mountains. (e.g., *Nuphar lutea* associations; Wm01-02, Wm04-06; Wf01, 05-08, Wf10).
Can be abundant in these places, but in general is not as common as *L. proxima*.
BC flight period: mid May to early September; all records range from late May to late August.

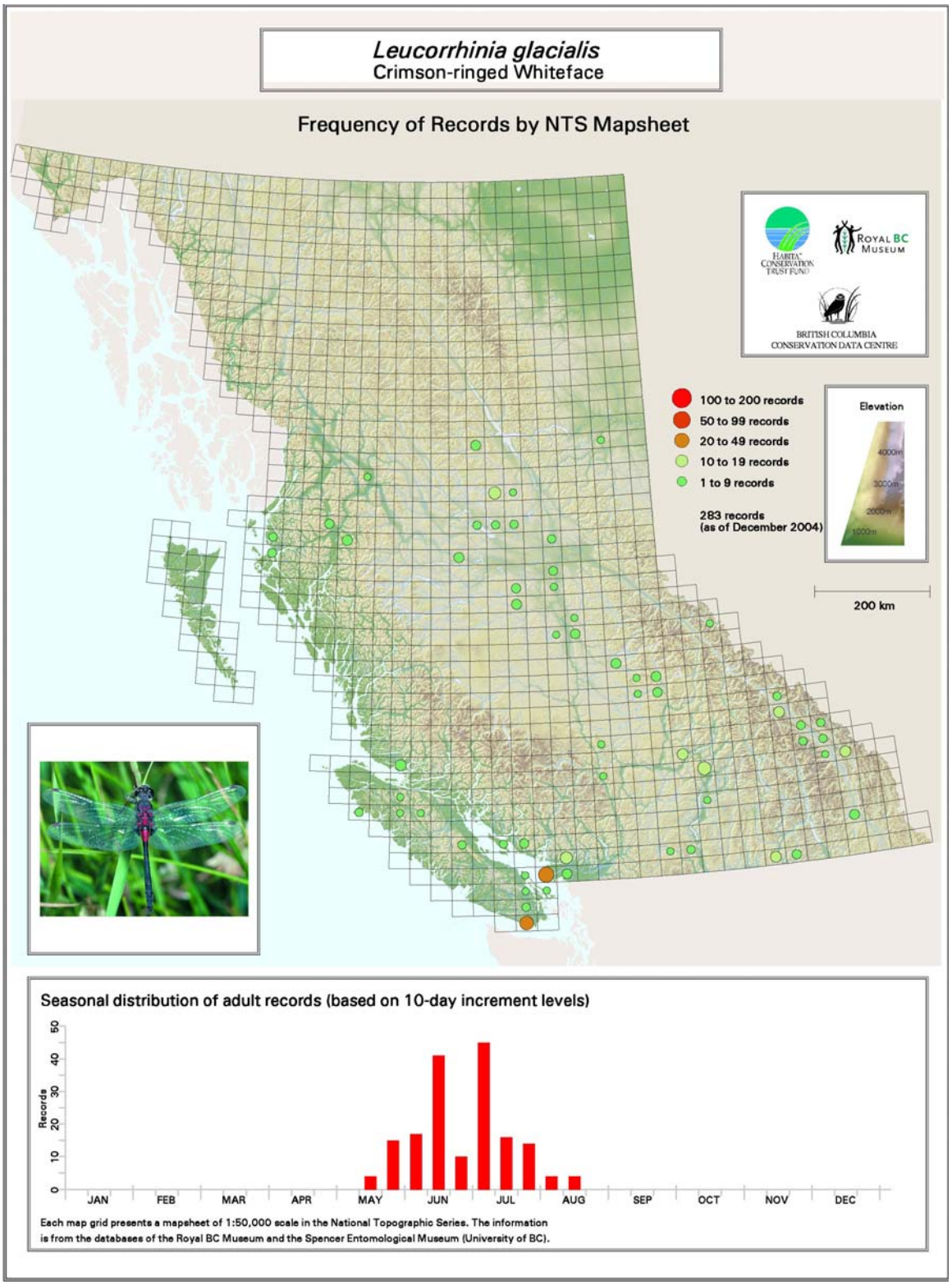
Leucorrhinia glacialis male. Photograph: George Doerksen, RBCM



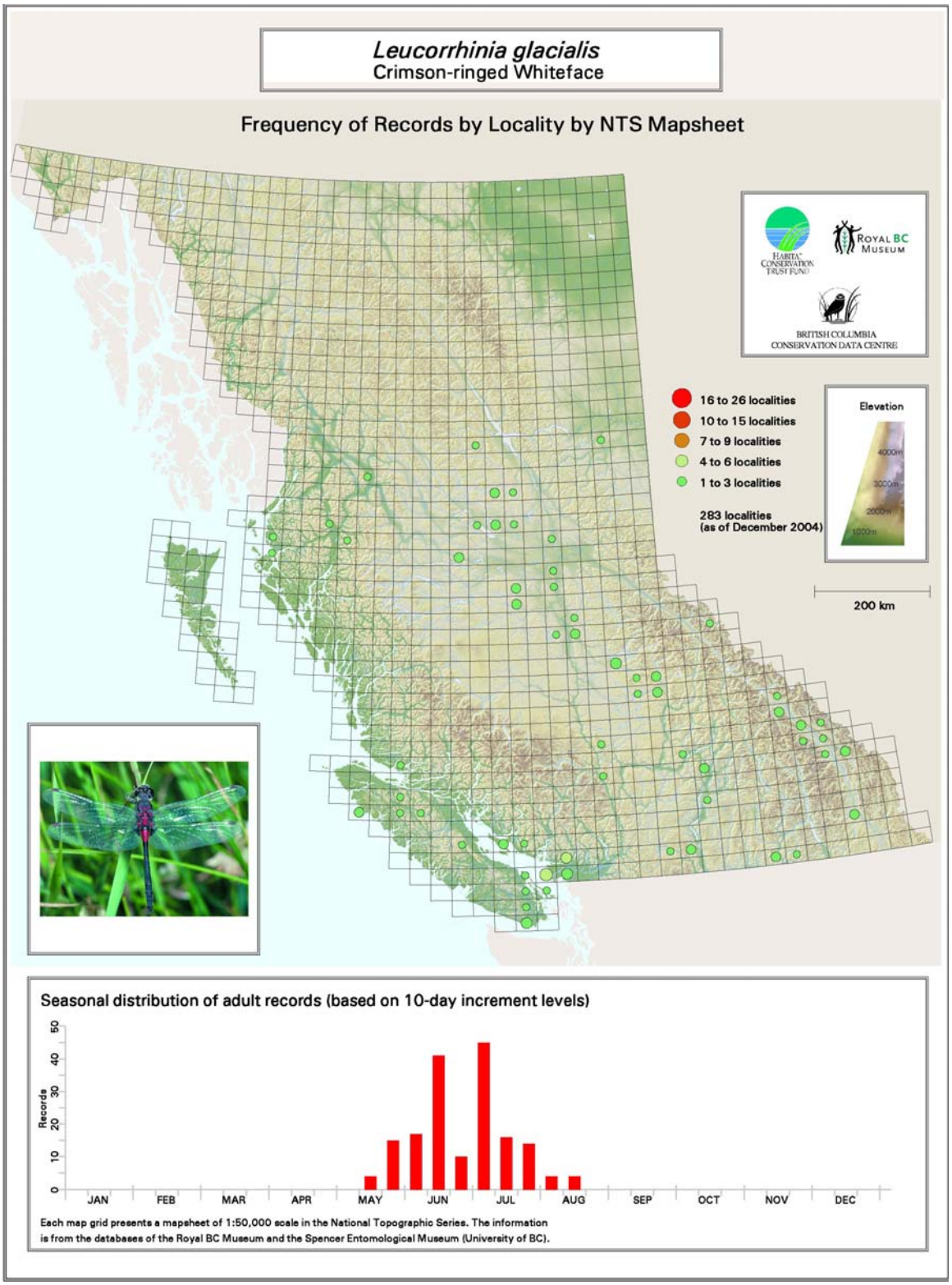
Leucorrhinia glacialis Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Leucorrhinia glacialis Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



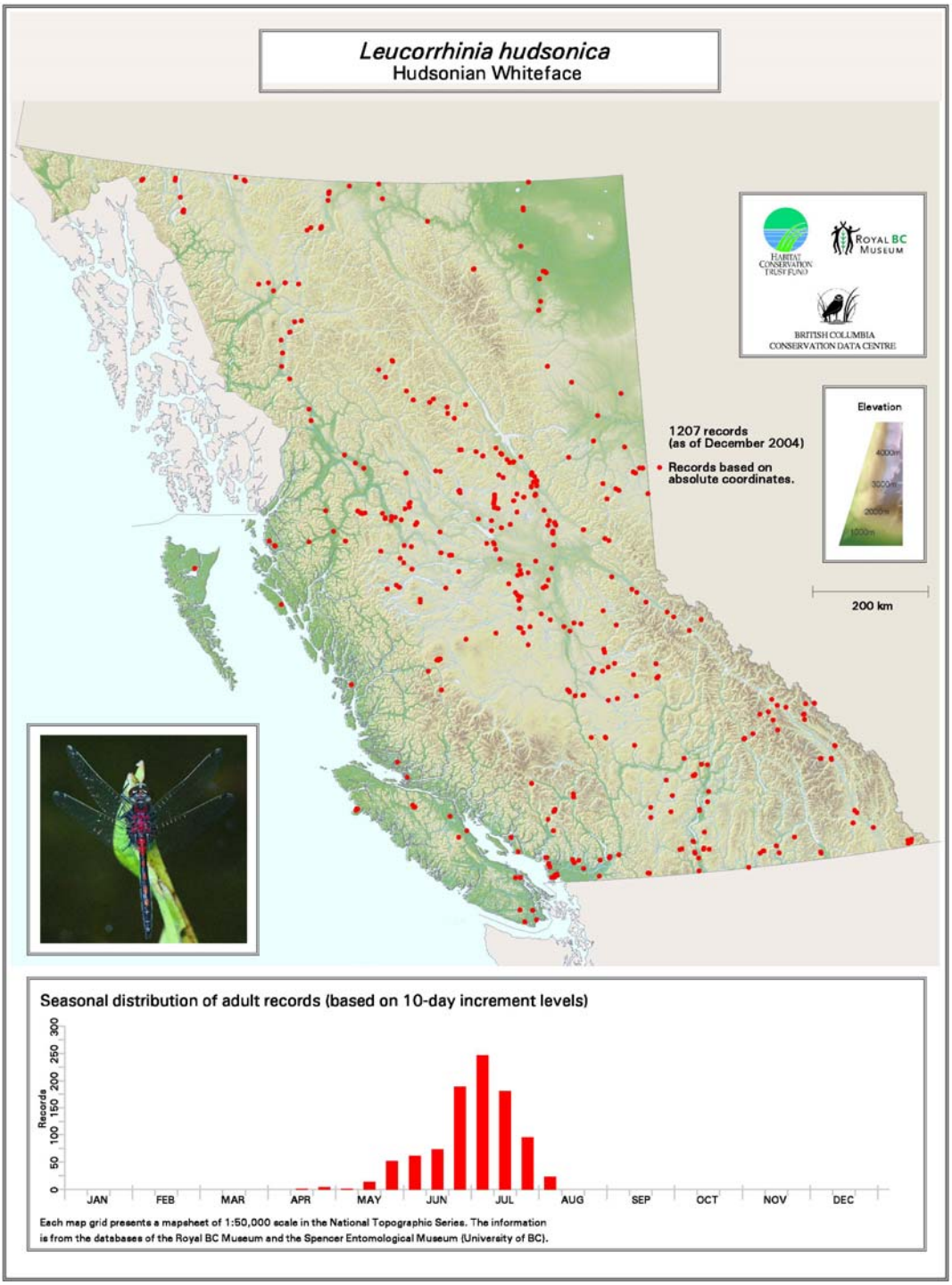
Leucorrhinia glacialis Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



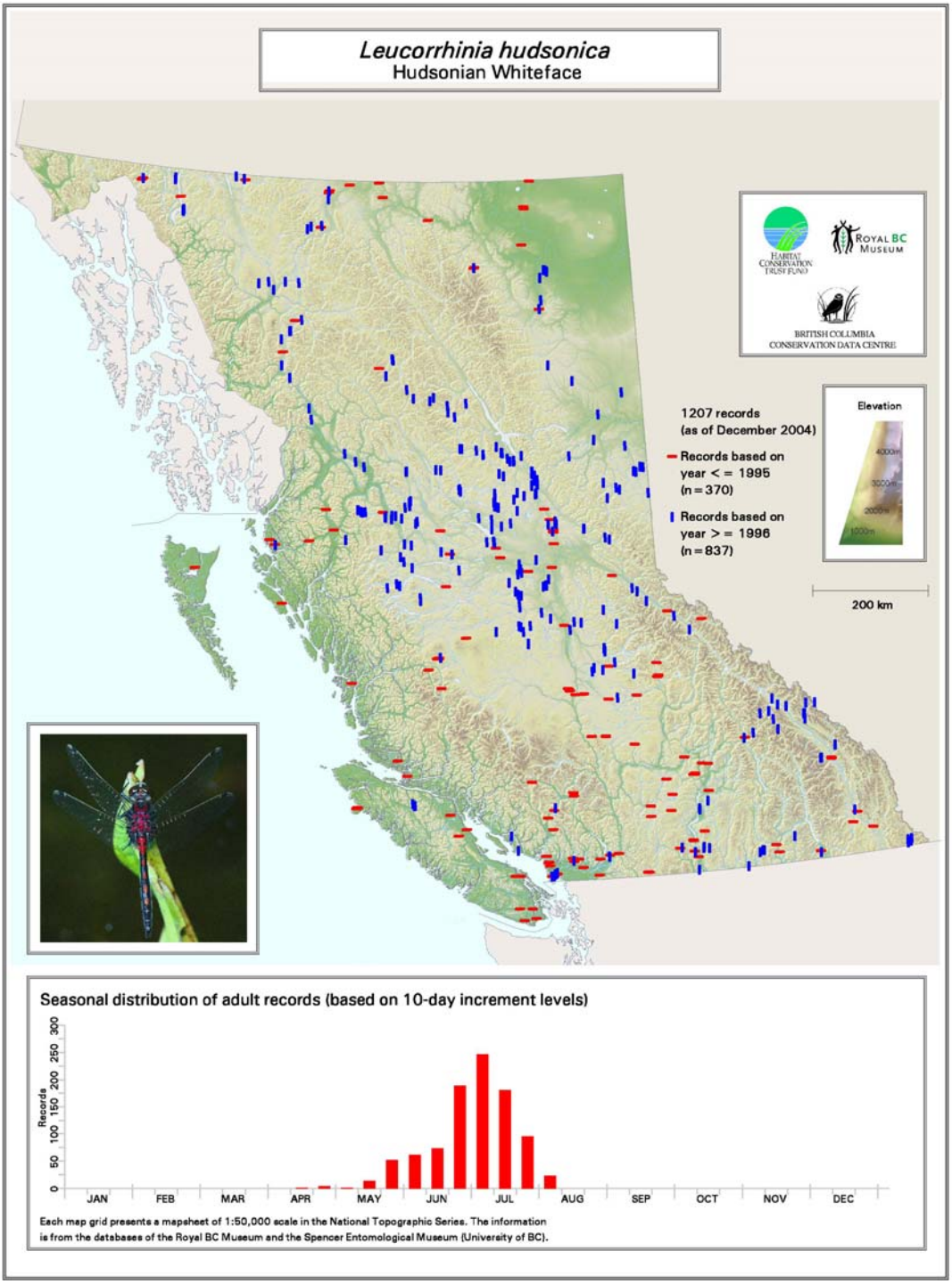
Leucorrhinia glacialis Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Leucorrhinia hudsonica* (Hudsonian Whiteface)**
BC conservation rank: S5. Yellow List.
Description: Similar to the Boreal Whiteface, but smaller and with less red or yellow on its abdomen. Male has strong red spots on top of segments 1 to 7, the one on 7 longer than its width; female's spots can be yellow or red. Hamule, fig. 16b; vulvar lamina, fig. 17b. Length: male 29 mm, female 28 mm.
Global Range: Alaska east to Labrador and Newfoundland; south to California, Nebraska, and Virginia (Needham *et al.* 2000). Faunal element: Widespread Boreal (see Appendix 3).
BC Distribution: Widespread.
Biology: The most widespread whiteface in our region and one of the province's most common skimmers. Most abundant at boggy lakeshores and peatlands in the mountains and the north. (e.g., Wm01-02, Wm04-06; Wf01, 05-08; Wb13, 50-52).
BC flight period: late April to early September; most records are from late may to mid August.

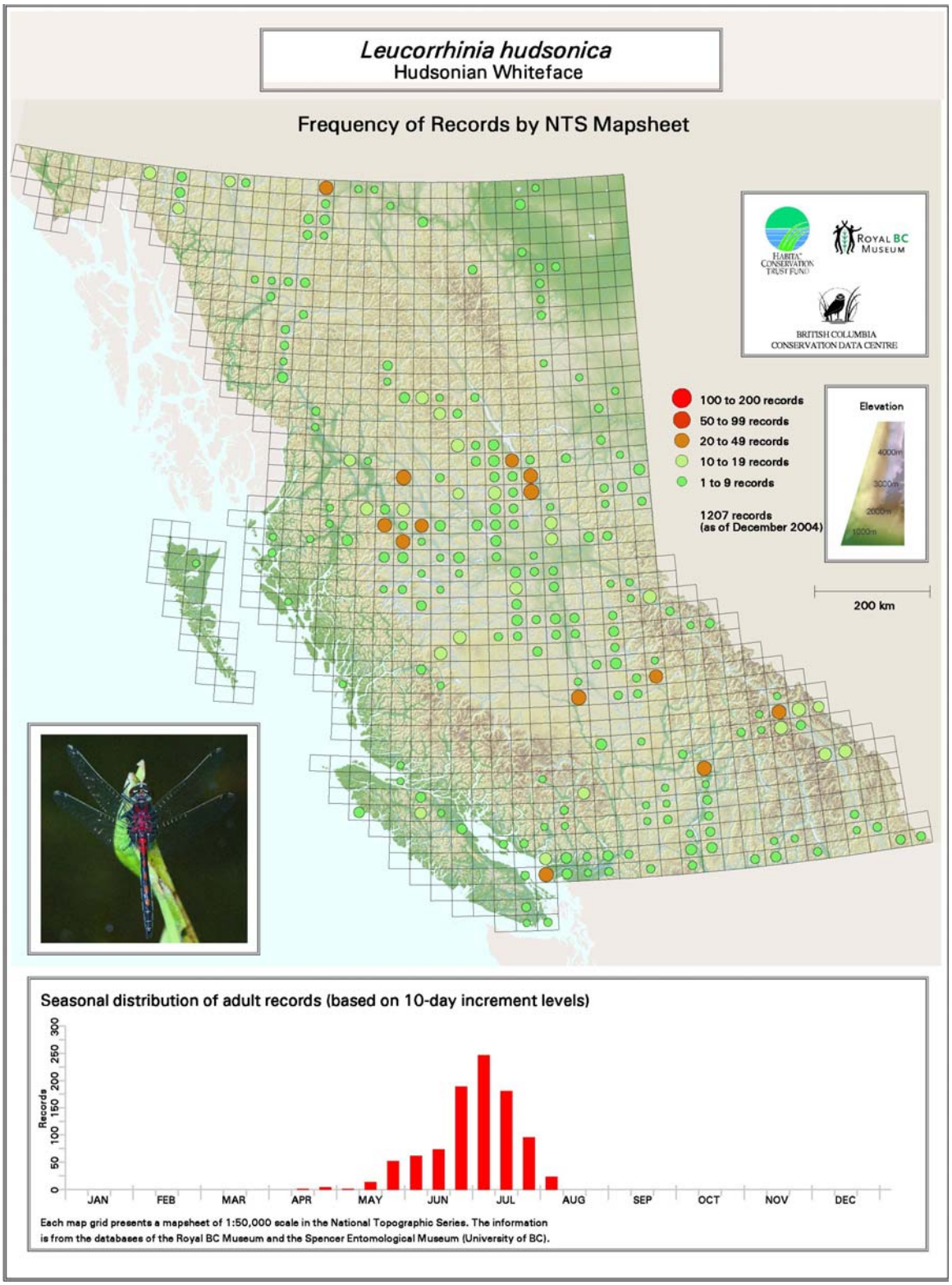
Leucorrhinia hudsonica male. Photograph: George Doerksen, RBCM



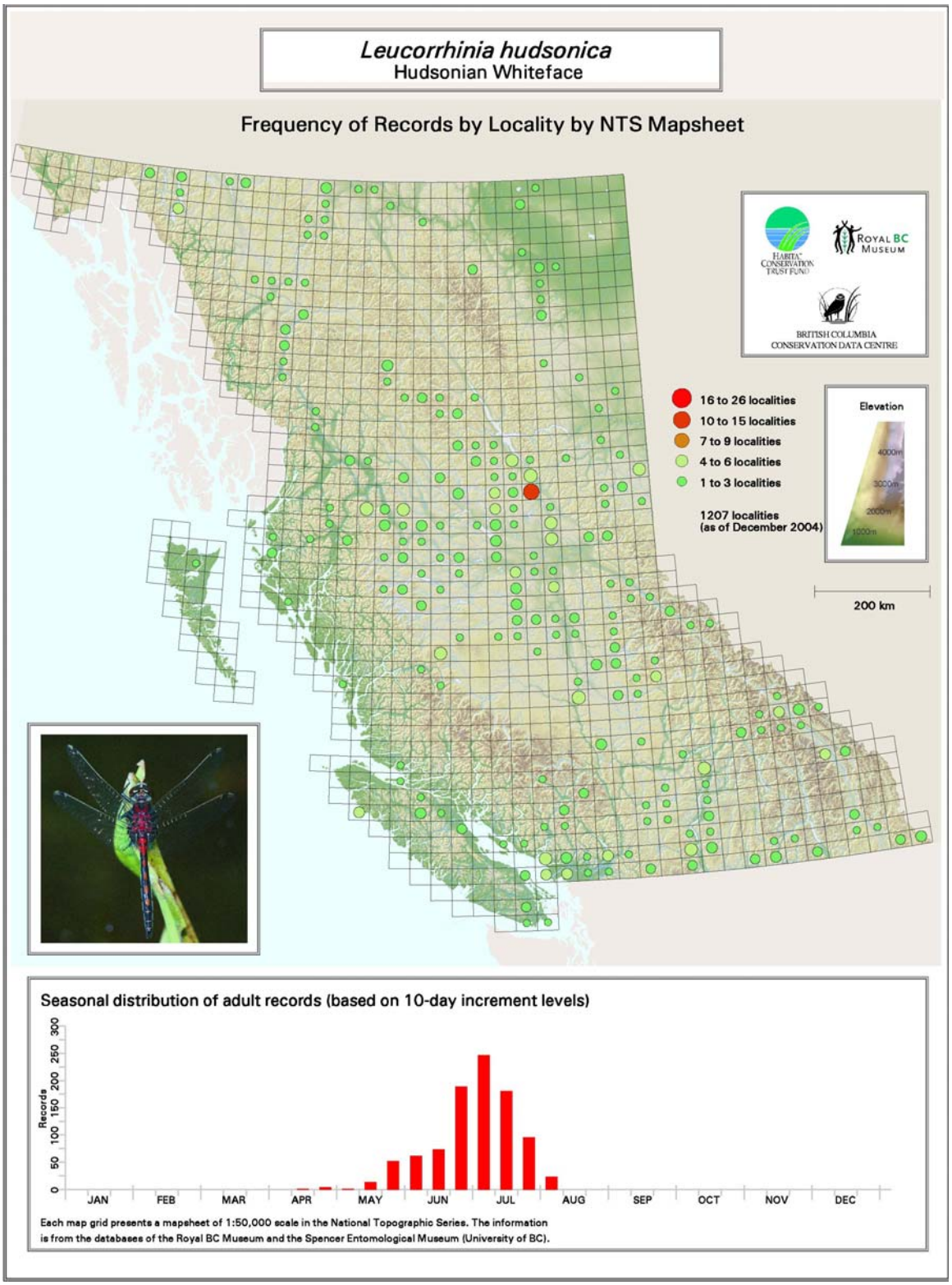
Leucorrhinia hudsonica Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Leucorrhinia hudsonica Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



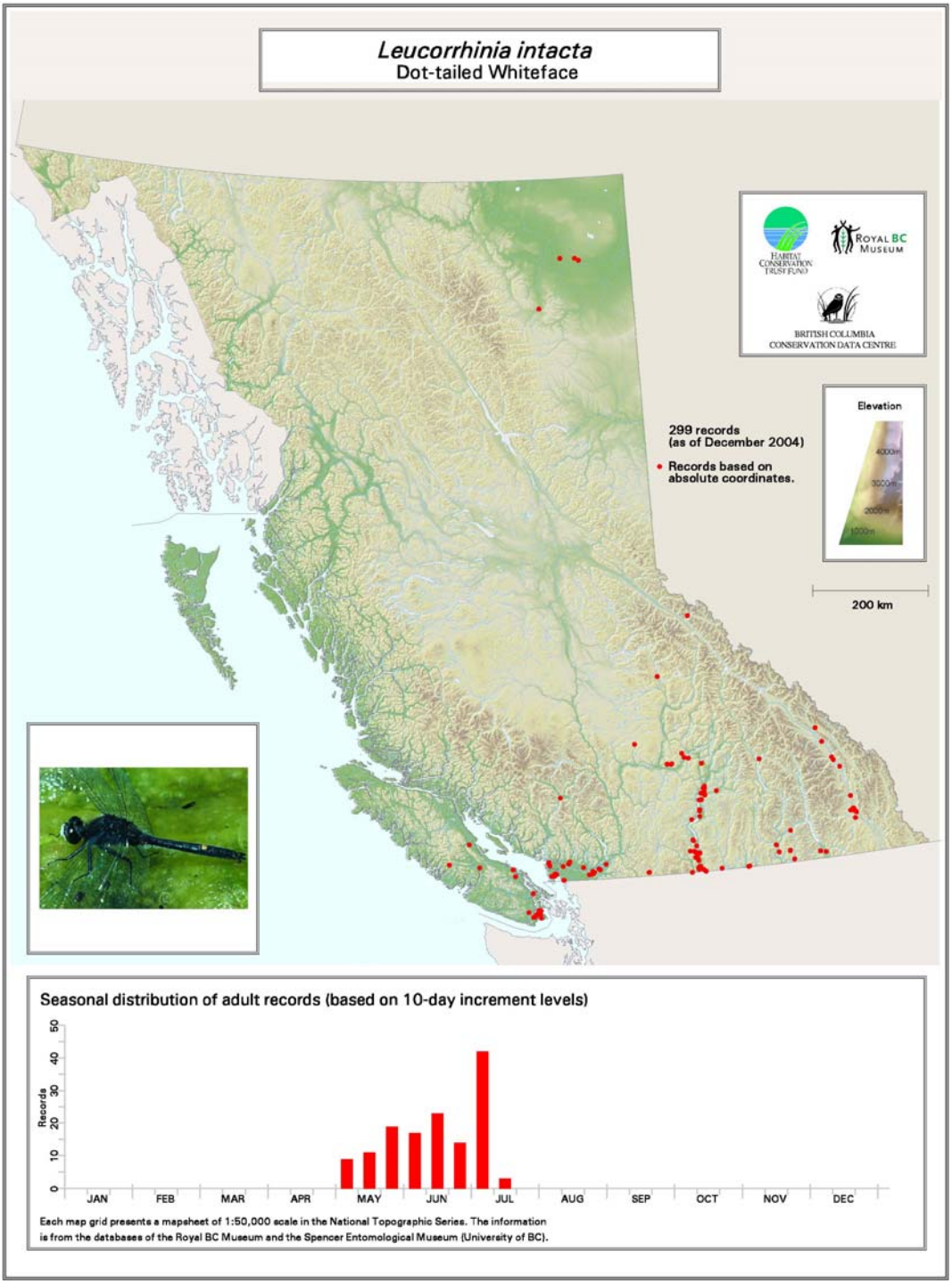
Leucorrhinia hudsonica Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



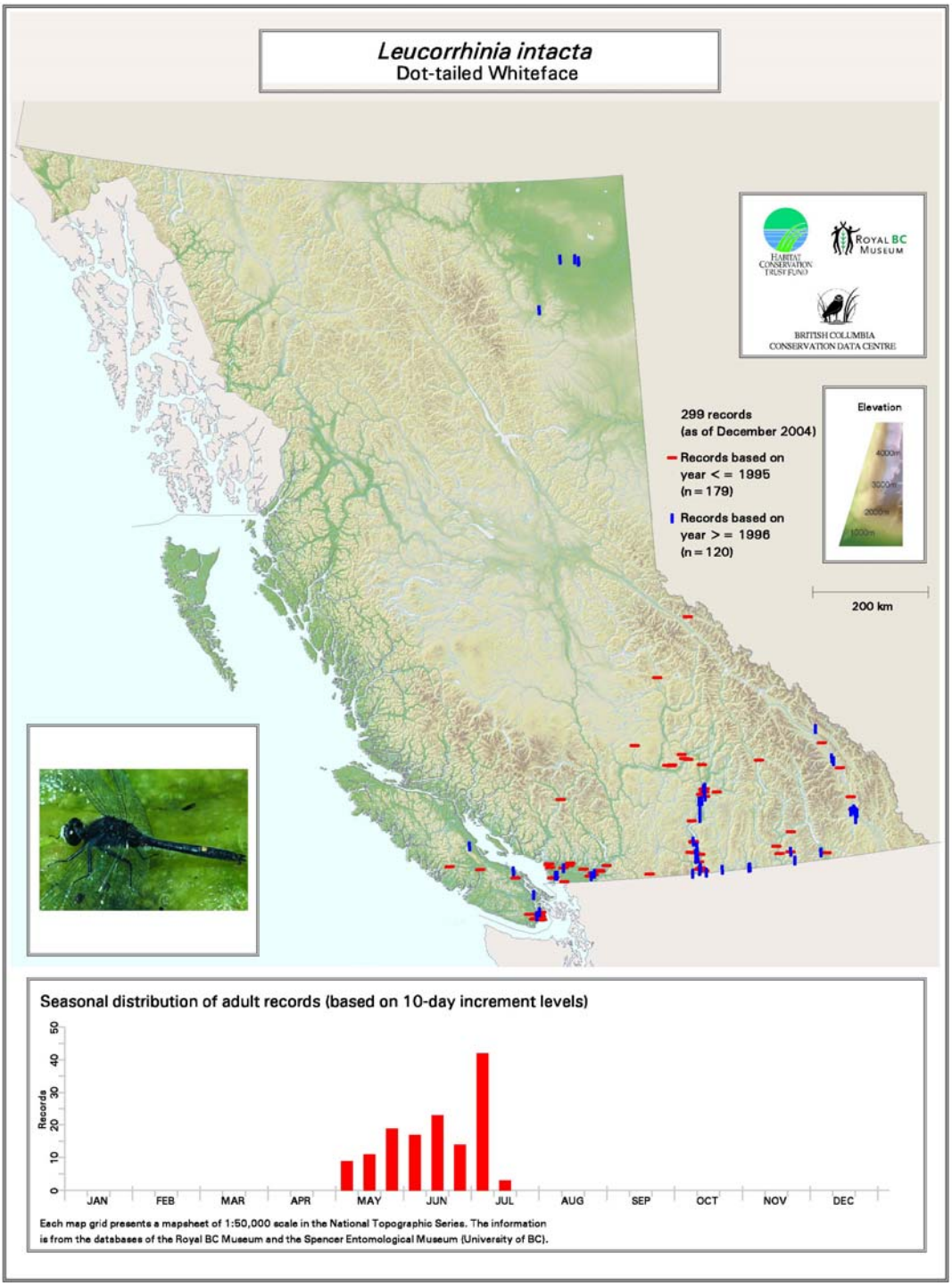
Leucorrhinia hudsonica Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Leucorrhinia intacta* (Dot-tailed Whiteface)**
BC conservation rank: S5. Yellow List.
Description: Distinguished by a yellow spot – actually a pair of dots – on abdominal segment 7. On mature males, this spot stands out against the dark abdomen. Immature males, many mature females and very few mature males have yellow on other segments; occasionally, these marks may be red on mature females. The male's lower appendage is forked, the tips widespread. Hamule, fig. 16f; vulvar lamina, fig. 17d. Length: male, female 34mm.
Global Range: British Columbia east to Nova Scotia; south to California, Kansas, Tennessee and Virginia (Needham *et al.* 2000). Faunal element: Transition (see Appendix 3).
BC Distribution: Mostly found in southern valleys; east of the Rocky Mountains it occurs as far north as the Fort Nelson area.
Biology: Most at home in warm, non-acidic lowland waters, unlike the other whitefaces in our region. Common in ponds (it likes organically rich places, such as farmyard ponds) and the marshy corners of lakes in the south. Typical site associations are *Typha* and *Schoenoplectus* marshes (Wm05-06).
BC flight period: early May to late August; all records are from mid May to late July.

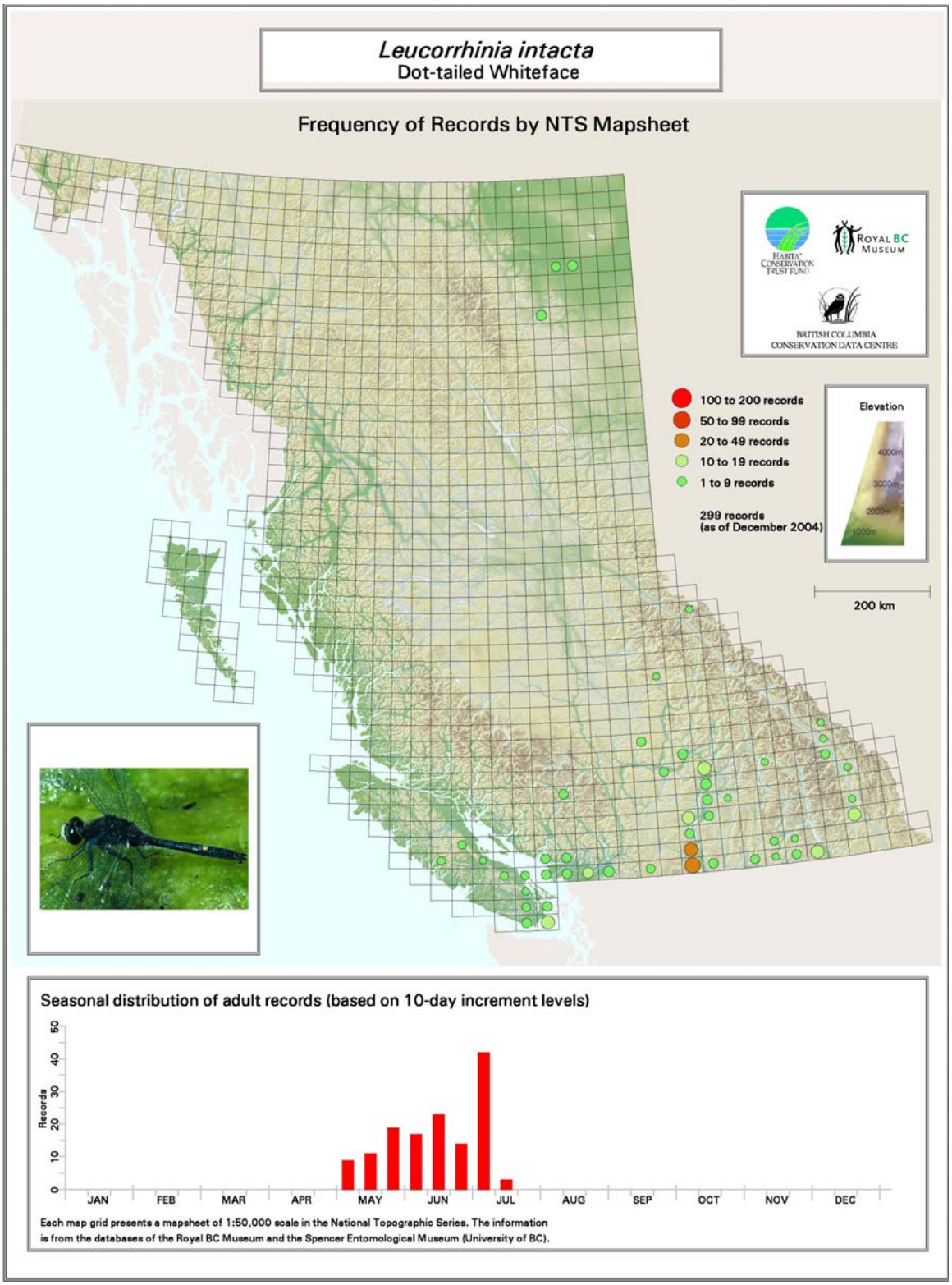
Leucorrhinia intacta male. Photograph: George Doerksen, RBCM



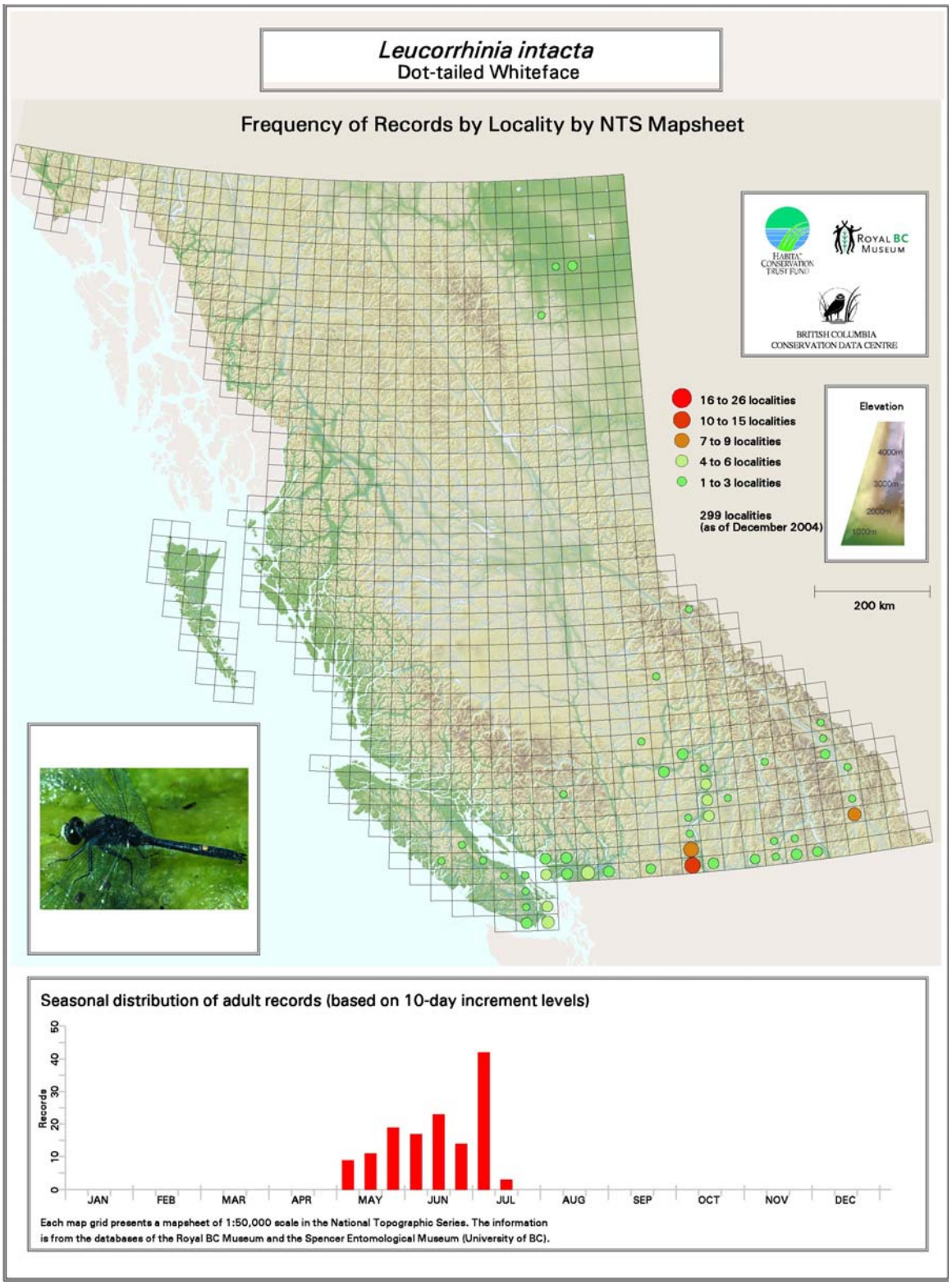
Leucorrhinia intacta Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Leucorrhinia intacta Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Leucorrhinia intacta Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.

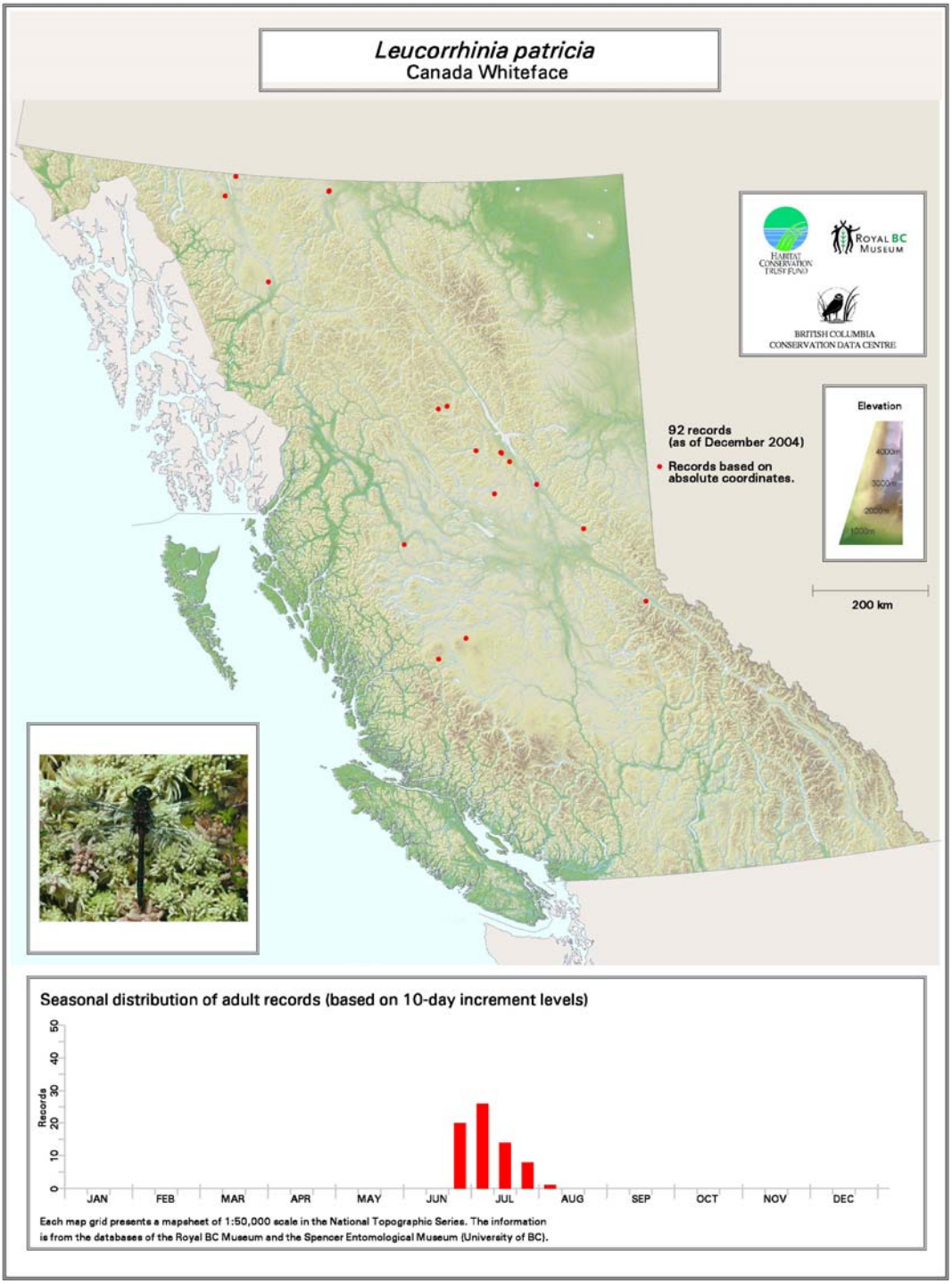


Leucorrhinia intacta Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

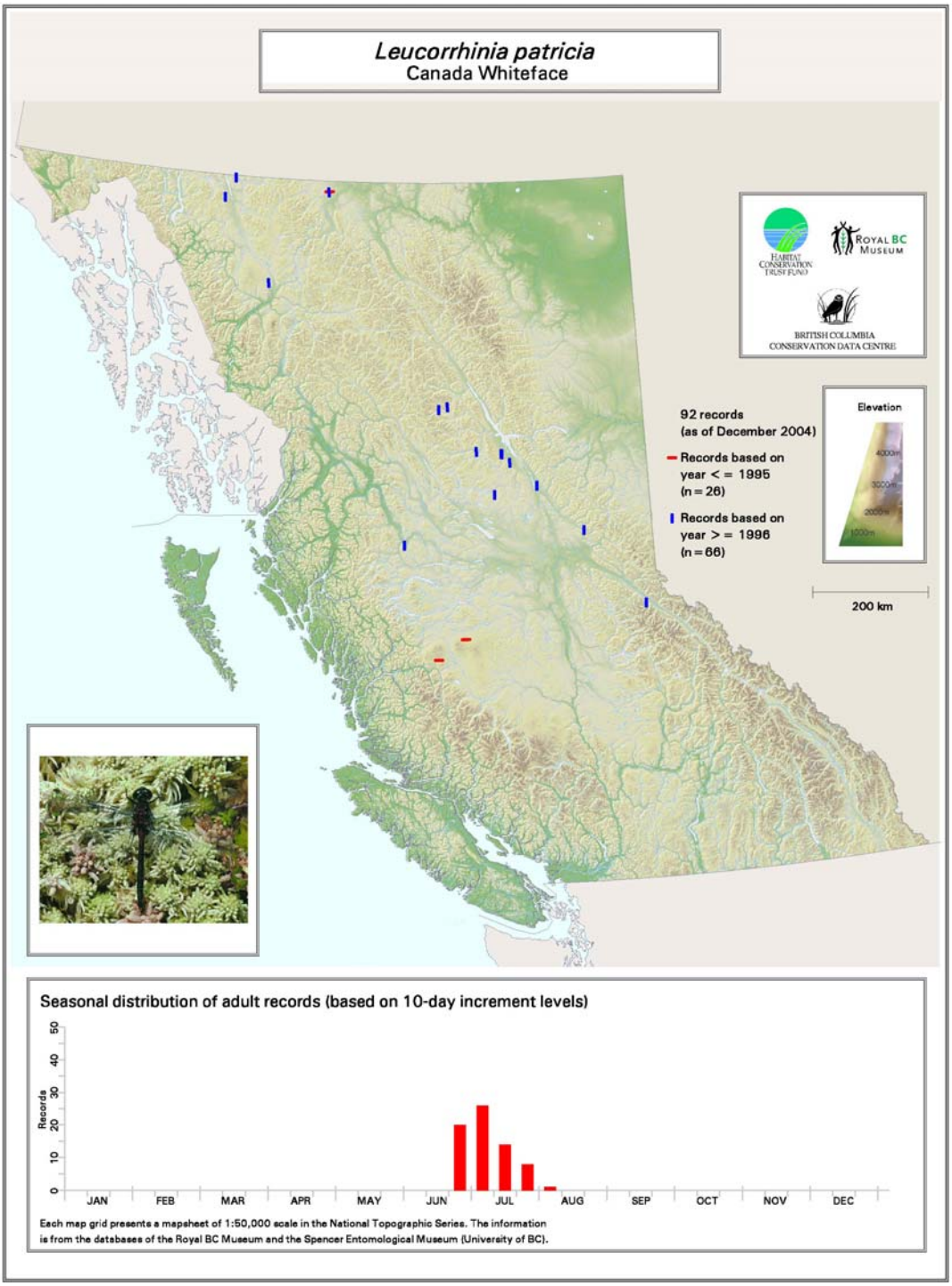
***Leucorrhinia patricia* (Canada Whiteface)**
BC conservation rank: S4. Yellow List. Northern surveys have increased the number of records of this uncommon, peatland obligate; consequently in 2004 it was removed from the Blue List where it was originally placed.
Description: Tiny and slender with a mostly black abdomen. The top of the male's abdomen is usually unmarked behind segment 3; if any marks are present, they are red streaks on segments 1 to 5. Females have larger yellow marks on segments 1 to 6 (and sometimes a streak on segment 7). Hamule, fig. 16c; vulvar lamina, fig. 17c. Length: male 27 mm, female 25 mm.

Global range: Alaska, Yukon and Northwest Territories east to Nova Scotia, south to southern Quebec, northern Ontario, the northern Prairie Provinces and central British Columbia (Catling *et al*. 2005)
BC Distribution: Central and northern BC, but not found west of the Coast Mountains. The southernmost record is from Heckman Pass in the western Chilcotin where Highway 20 passes through the Coast Mountains. There are no records east of the Rockies in BC as yet, but *L. patricia* will undoubtedly be found there.
Biology: Flies alongside its close relative, the larger and redder Hudsonian Whiteface, but is much less common. Rare in the southern parts of its range. Restricted to peatland waters with mats of aquatic moss floating on or near the surface (e.g., Wf06-08; Wb13). BC flight period: mid June to late August; all records lie between early July and mid August.

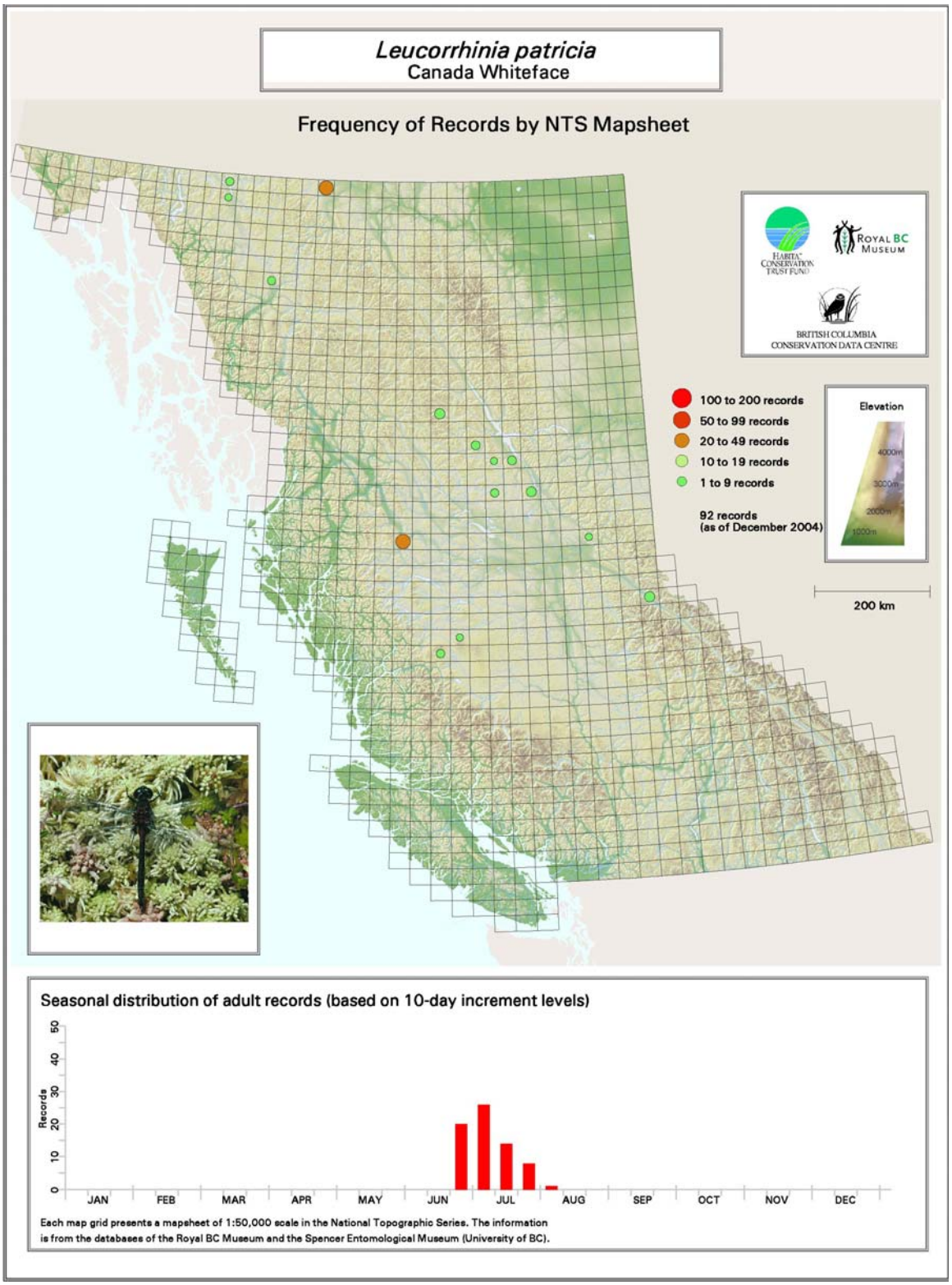
Leucorrhinia patricia male. Photograph: Robert A. Cannings, RBCM



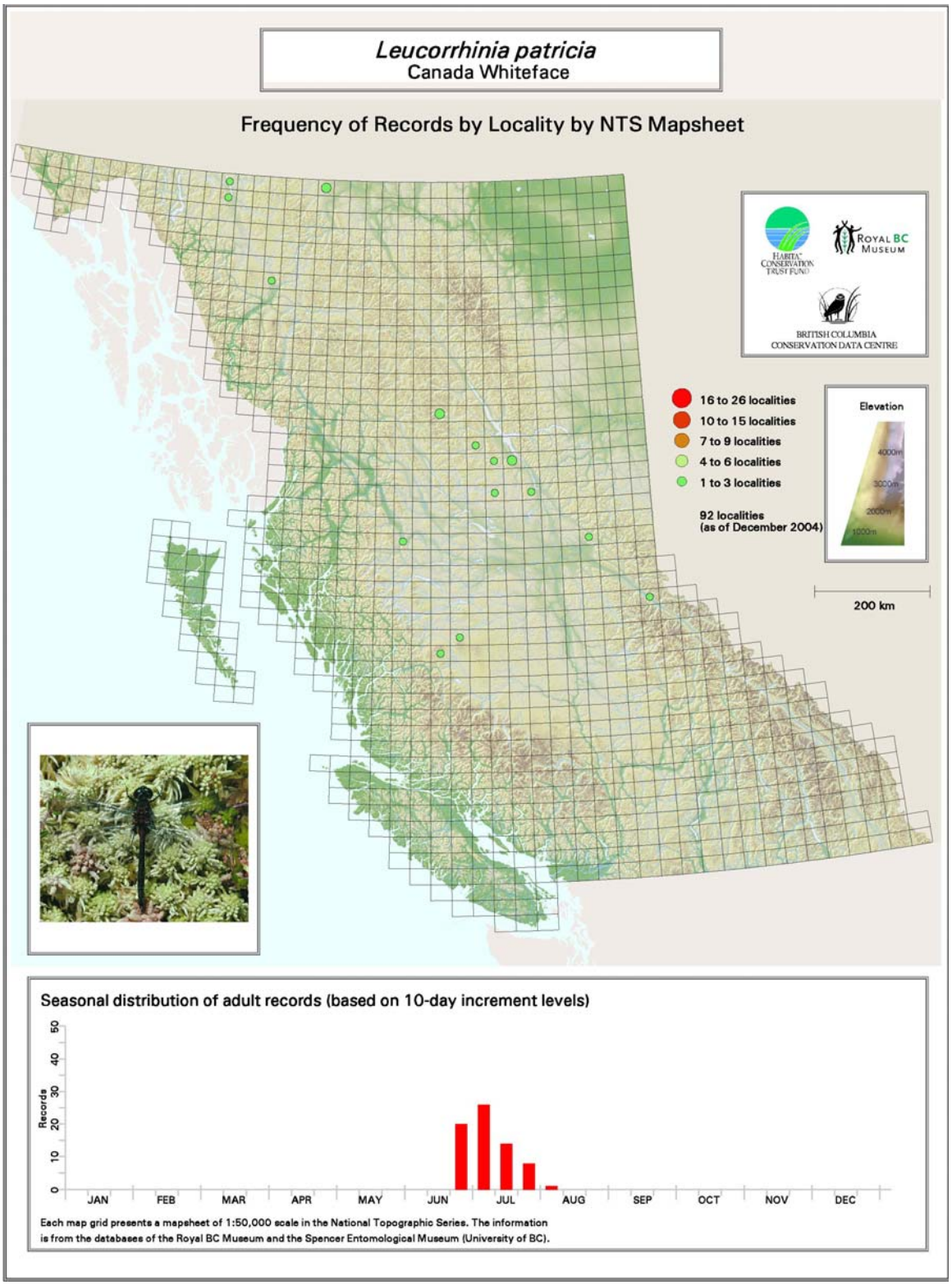
Leucorrhinia patricia Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Leucorrhinia patricia Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Leucorrhinia patricia Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.

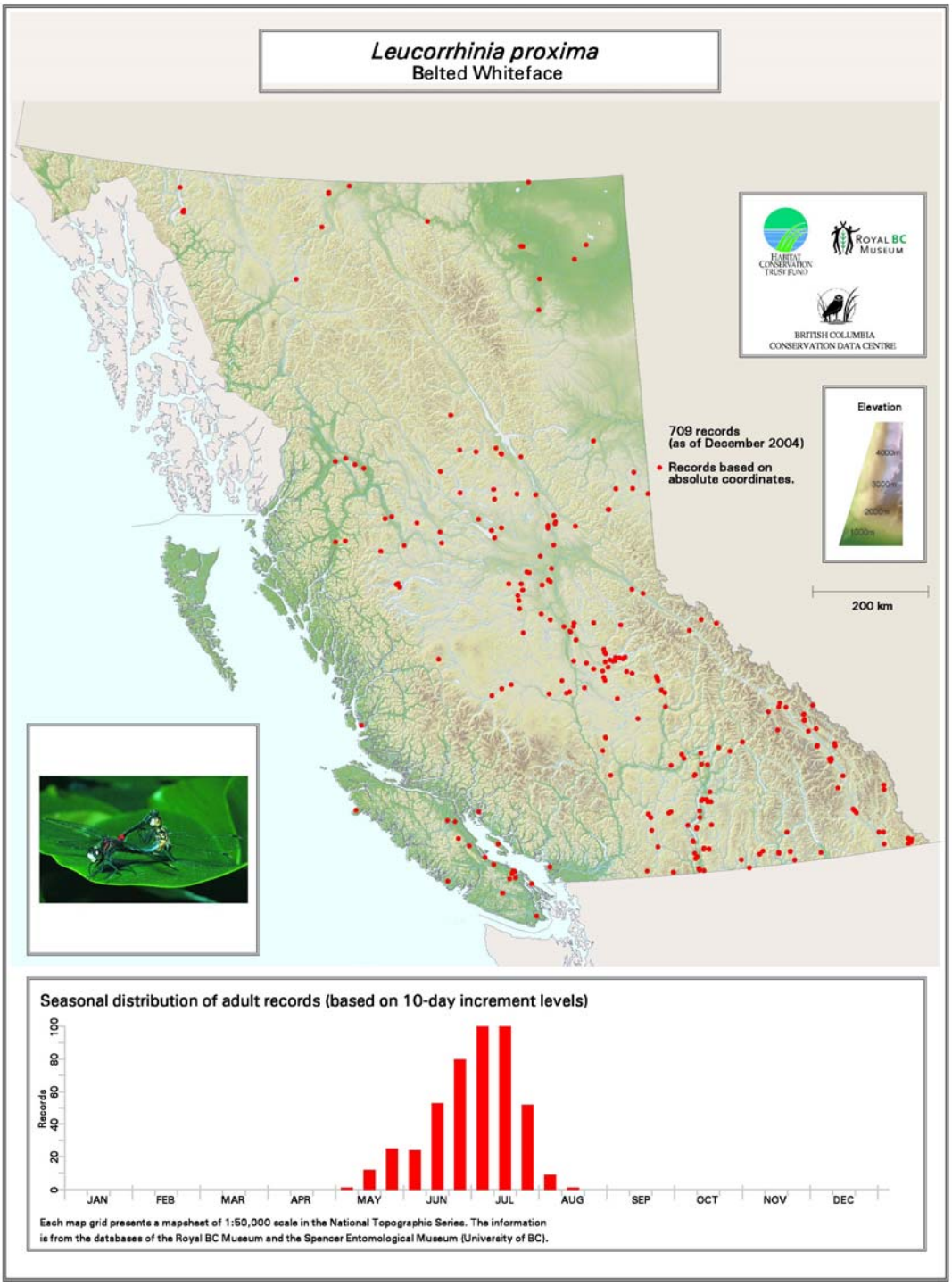


Leucorrhinia patricia Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

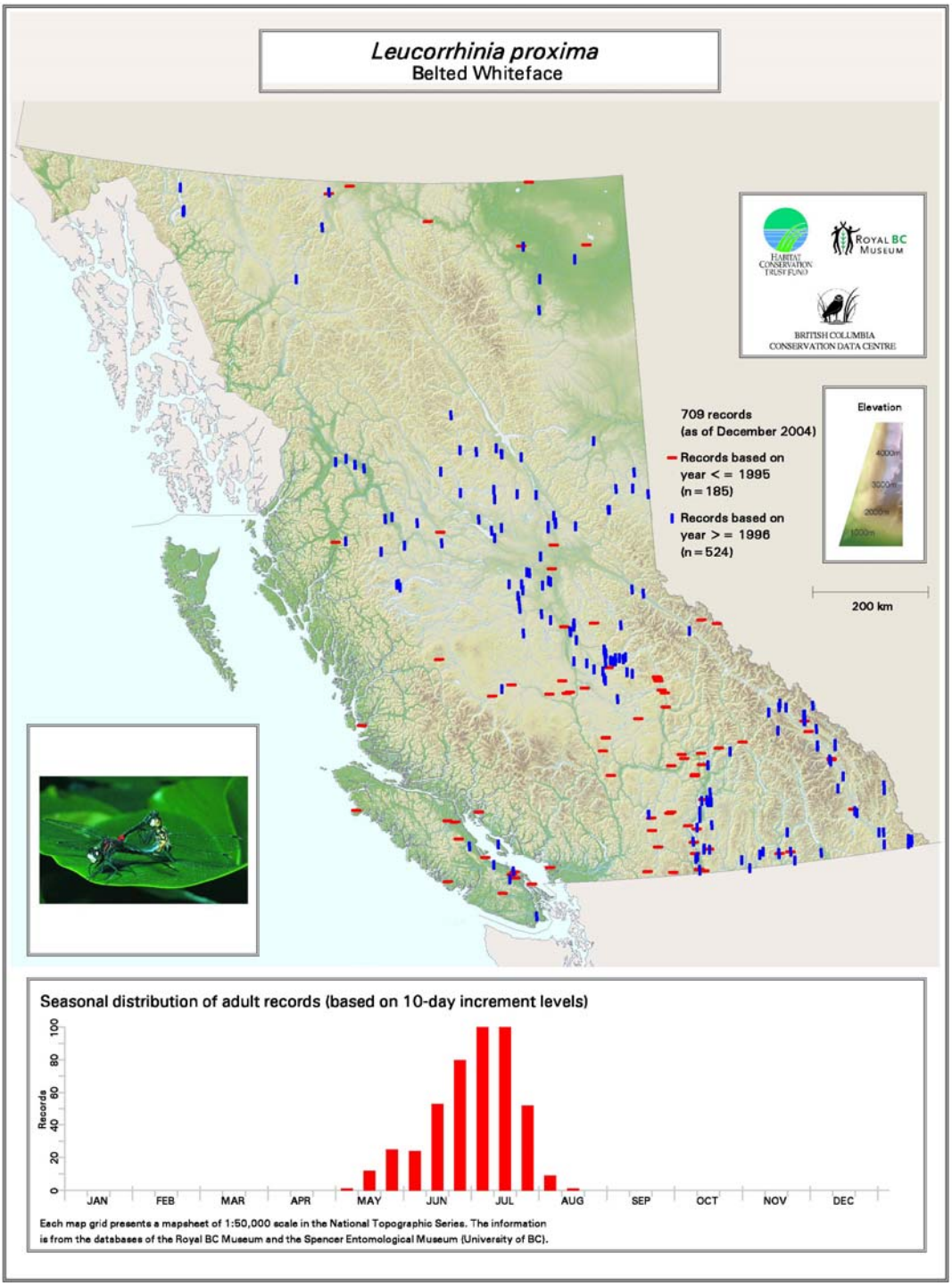
***Leucorrhinia proxima* (Belted Whiteface)**
BC conservation rank: S5. Yellow List.
Description: Similar to *L. glacialis*, but all or some of the wings have one row of cells (where shown in fig. 21b). Male's abdomen is mostly black, with red only at the base and without spots on top of the middle segments (though some have thin streaks). Young females have yellow marks on top of segments 1 to 7, sometimes turning red with maturity. Hamule, fig. 16d; vulvar lamina, fig. 17e. Length: male 36 mm, female 35 mm.
Global Range: Yukon east to Newfoundland; south to California, Colorado and Virginia (Needham *et al.* 2000). Faunal element: Southern Boreal (see Appendix 3).
BC Distribution: Widespread.
Biology: Common in BC; after *L. hudsonica*, this is the most widely distributed whiteface in our region. Often abundant around mountain and northern lakes, ponds and peatlands (Wm01-02, Wm04-06; Wf01, Wf05-08; Wb13, 50-52).

BC flight period: mid May to early September; most records are from late May to mid August.

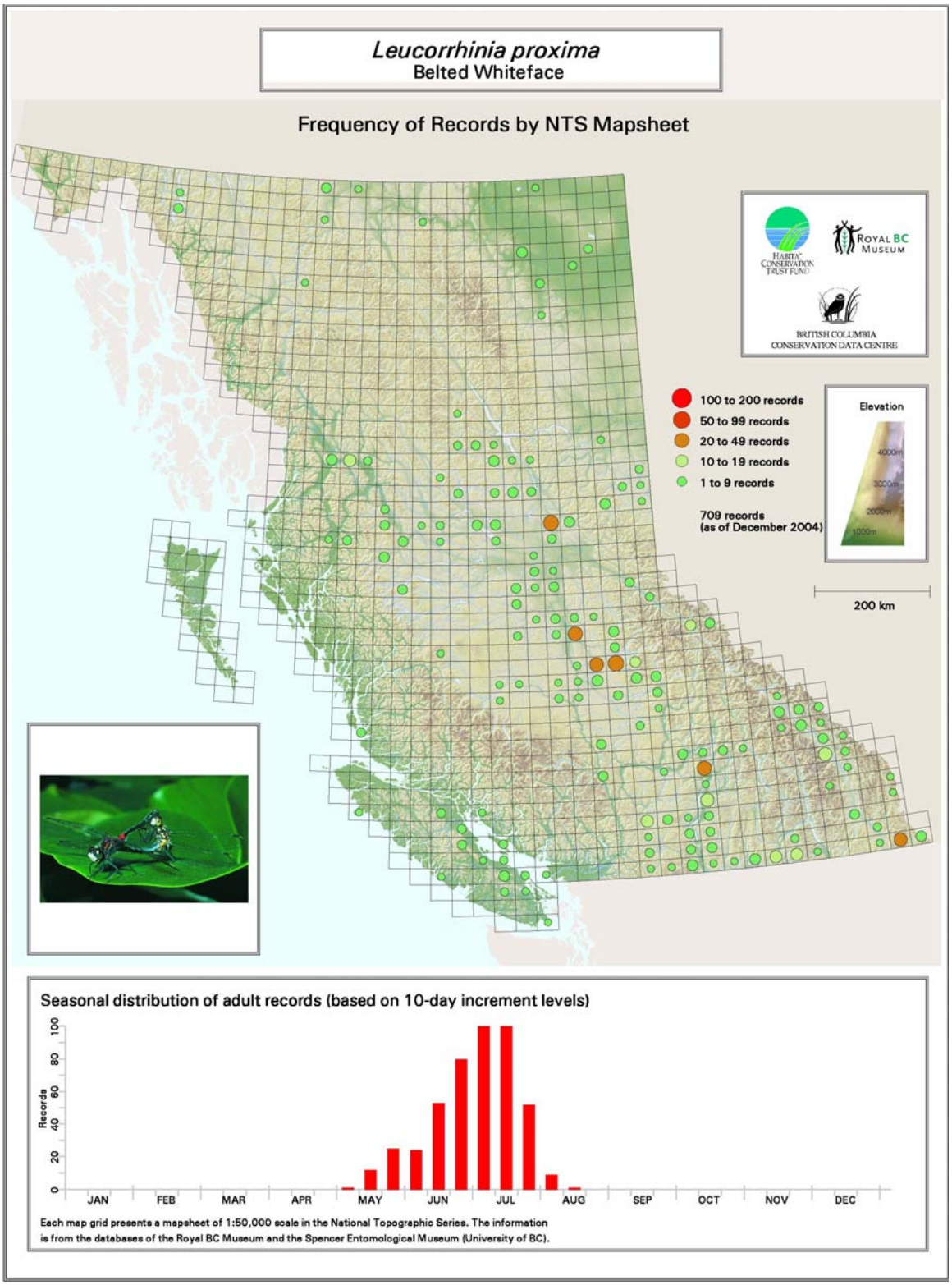
Leucorrhinia proxima mating. Photograph: George Doerksen, RBCM



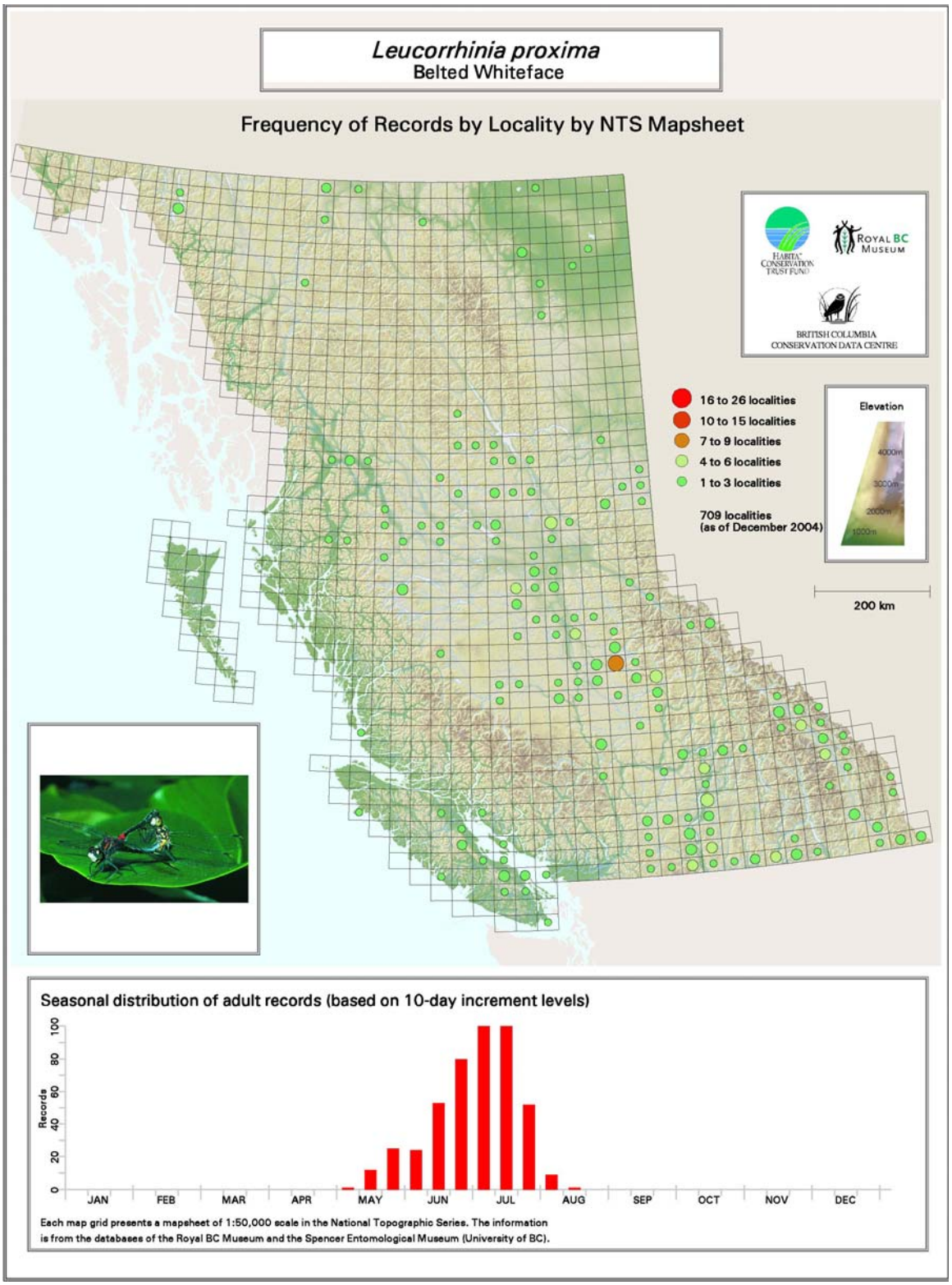
Leucorrhinia proxima Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Leucorrhinia proxima Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Leucorrhinia proxima Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.

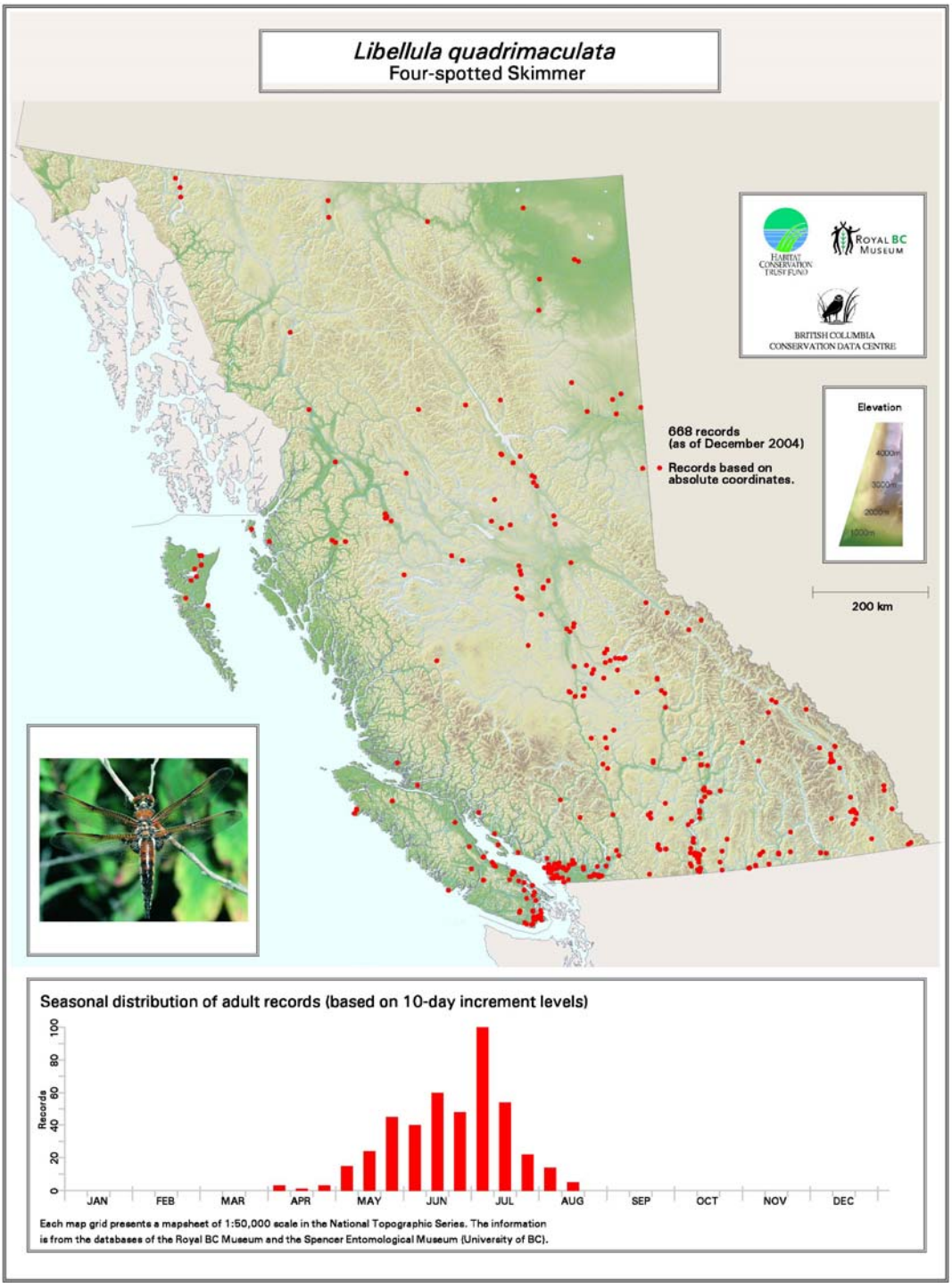


Leucorrhinia proxima Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

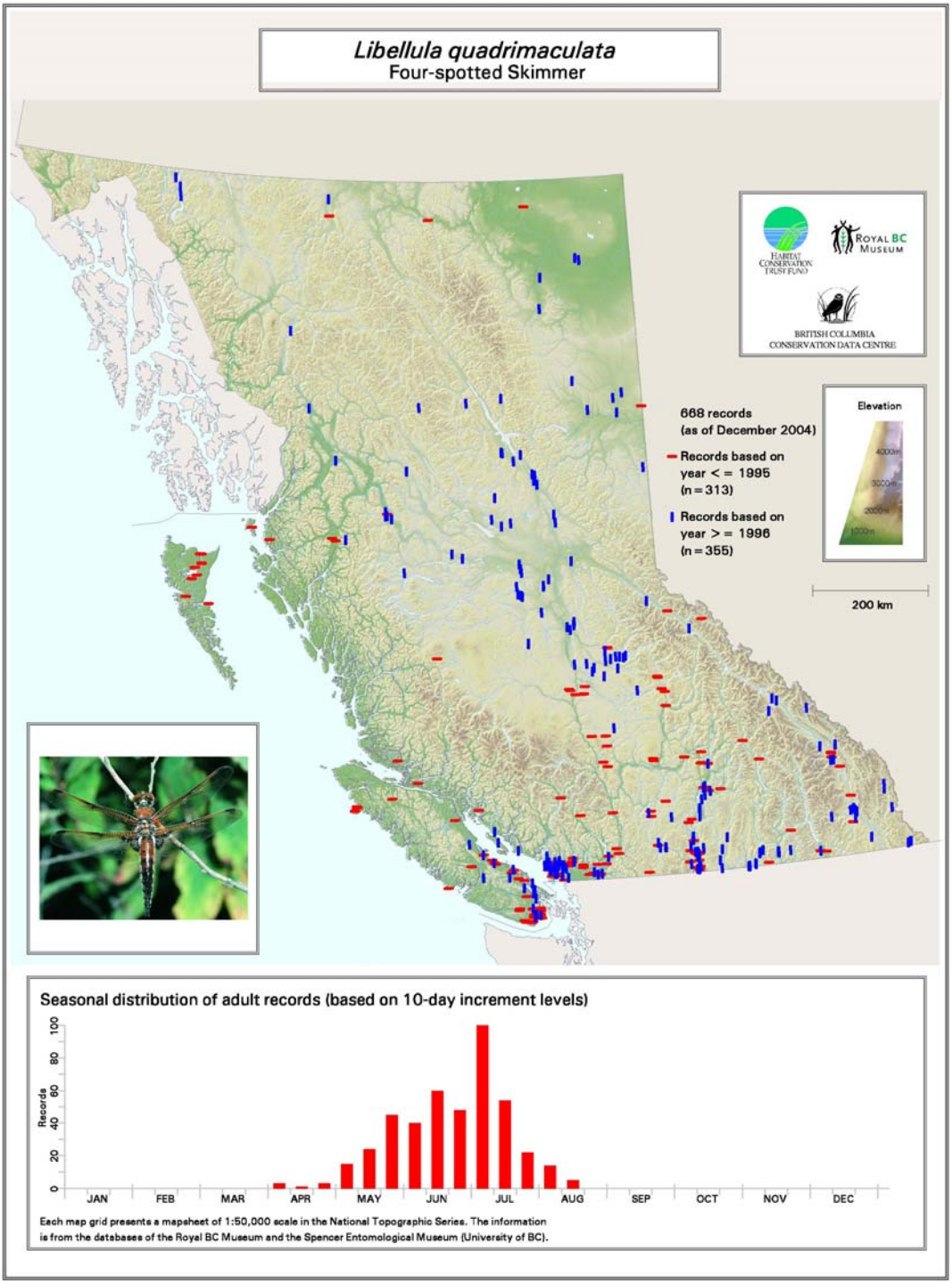
***Libellula* (King Skimmers)**
Three striking king skimmers live in BC, but only one lives in the North – *Libellula quadrimaculata*. Many species have banded or spotted wings, and in some species, males sport abdomens covered with white or bluish pruinescence. Showy and aggressive, king skimmers perch, hover and skim over the waters of ponds, lakeshores and sluggish streams. During egg laying, a female taps the water with the end of her abdomen; she flies alone or is guarded by her mate hovering nearby. Females of most species have small flaps on the sides of segment 8 that help them splash water along with their eggs, often depositing them on the shore.segment 8 that help them splash water along with their eggs, often depositing them on the shore.

***Libellula quadrimaculata* (Four-spotted Skimmer)**
BC conservation rank: S5. Yellow List.
Description: Grey-brown to yellow-brown, except for the black end of the abdomen. The thorax has yellow and black marks on the sides; the abdomen has narrow yellow side stripes. Each wing has a small dark spot at the midpoint of the front edge, and the hindwings have a dark triangular patch at the base. A golden stripe on the front edge of each wing can be prominent or vague. Length: male female 43mm.
Global Range: One of the most widespread dragonflies on the globe. Alaska, Yukon and Northwest Territories to Labrador and Newfoundland, south to Pennsylvania, Texas and Arizona. Also northern Europe and Asia (Needham *et al.* 2000). Faunal element: Widespread (H) (see Appendix 3).
BC Distribution: Throughout the province.
Biology: Lives in marshy-edged waters, from mountain and northern bogs, fens (Wf01, Wf05-08; Wb13, Wb50-52) and marshes (Wm01-02) to warm alkaline ponds (Wm07; Gs01-03) and marshes (Wm04-06) in southern valleys; most common in acidic waters. One of the earliest dragonflies in the spring.
BC flight period: mid April to early October; most records range from mid May to late August

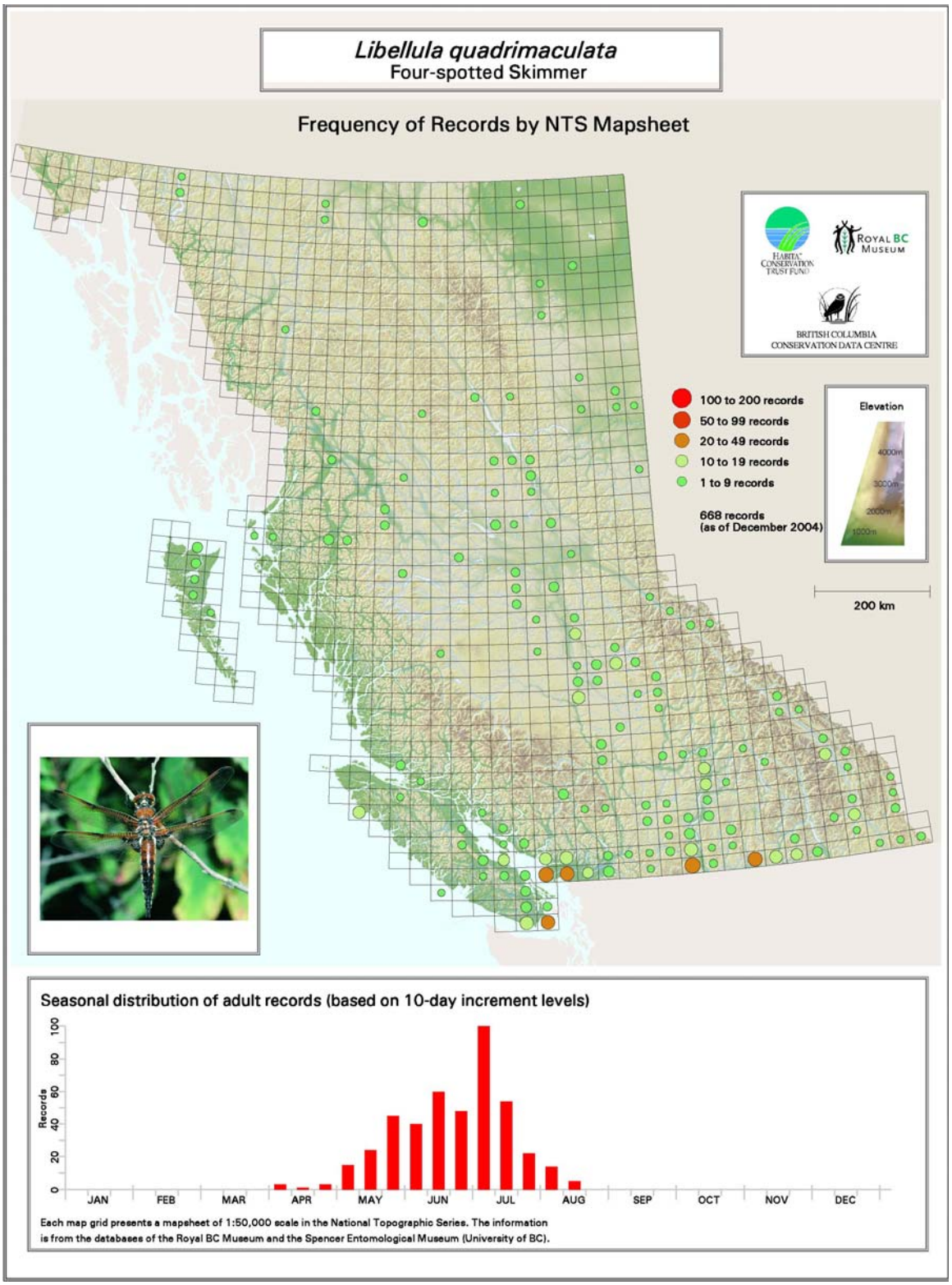
Libellula quadrimaculata male. Photograph: George Doerksen, RBCM



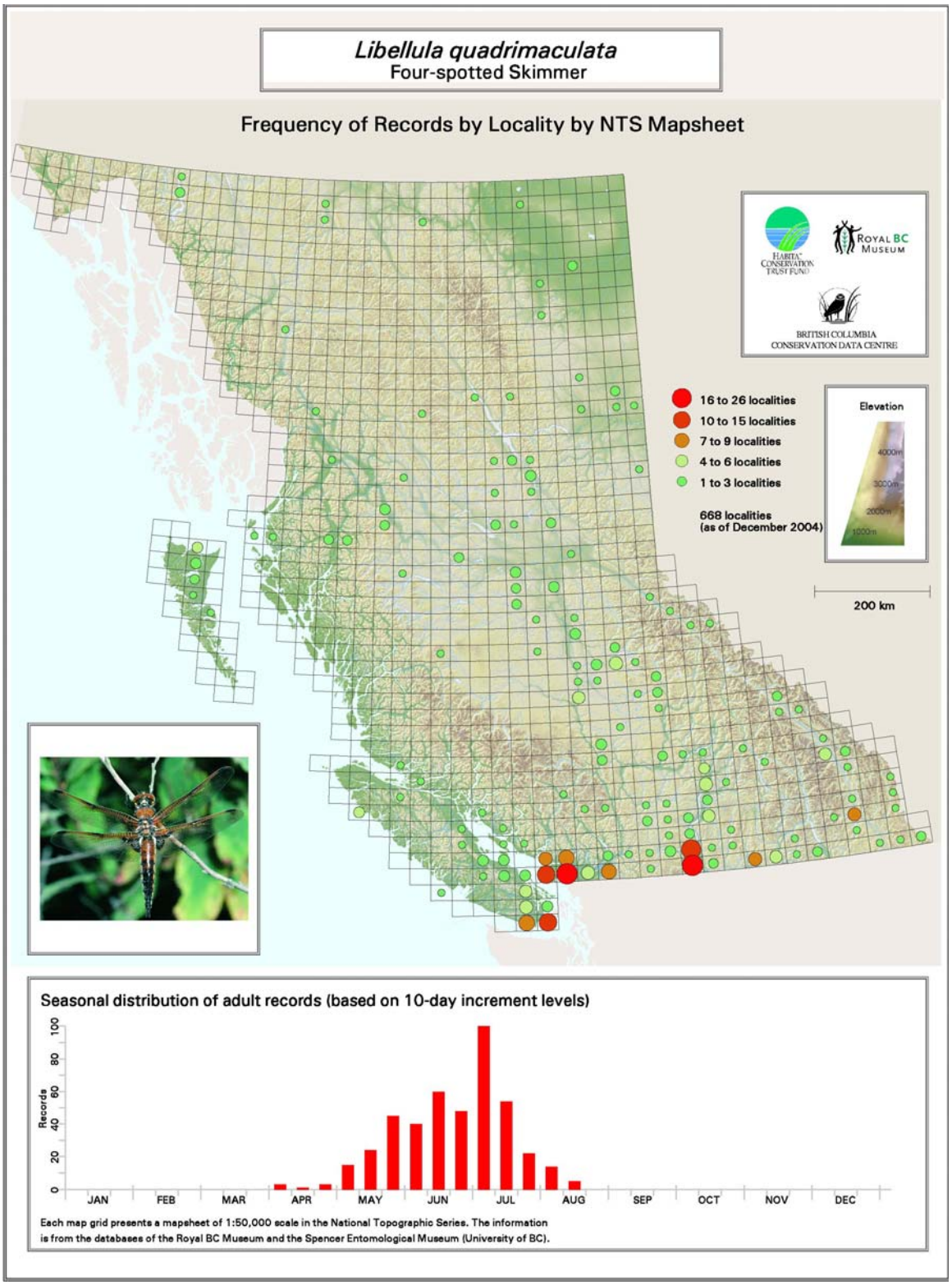
Libellula quadrimaculata Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Libellula quadrimaculata Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Libellula quadrimaculata Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



Libellula quadrimaculata Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Sympetrum* (Meadowhawks)**

Small to medium-sized dragonflies that are mostly yellow when young and mostly red when mature; one common species is black. Females are usually yellow or tan, but can be red like males. You can watch most species easily at close range, because the adults are not powerful flyers and perch often. They are frequently abundant around ponds and lakes and adjacent meadows, especially in the late summer and fall. Many species will perch on the ground; *Sympetrum* means "with (or on) the rocks". Species can be difficult to distinguish. Look for the colour of the face, legs and wing veins; the patterns on the sides of the thorax and abdomen; and the details of the genitalia (the male's hamules and the female's vulvar lamina).

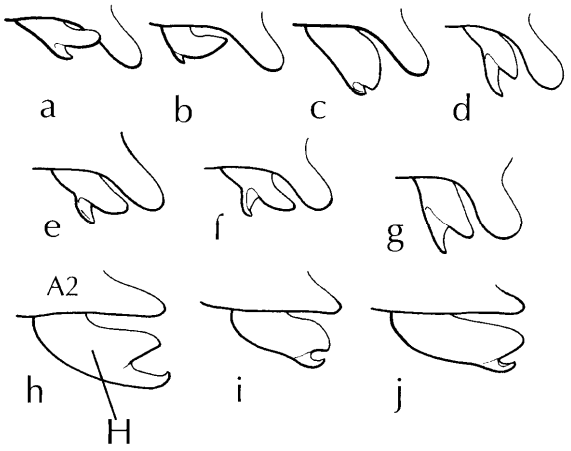


Figure 19. Meadowhawks, male hamules, side view: a, Cardinal; b, Variegated; c, Red-veined; d, Yellow-legged; e, Saffron-winged; f, Western; g, Black; h, Cherry-faced; i, White-faced; j, Striped; k, Hudsonian; l, Ringed; m, Lake. A2 = abdominal segment 2; H = hamule.

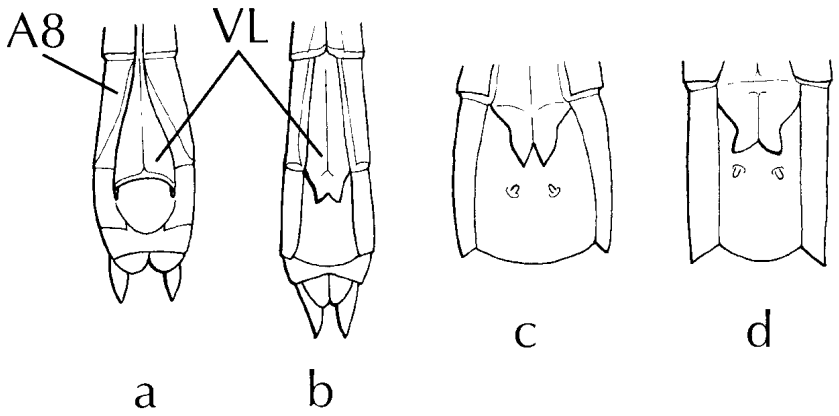
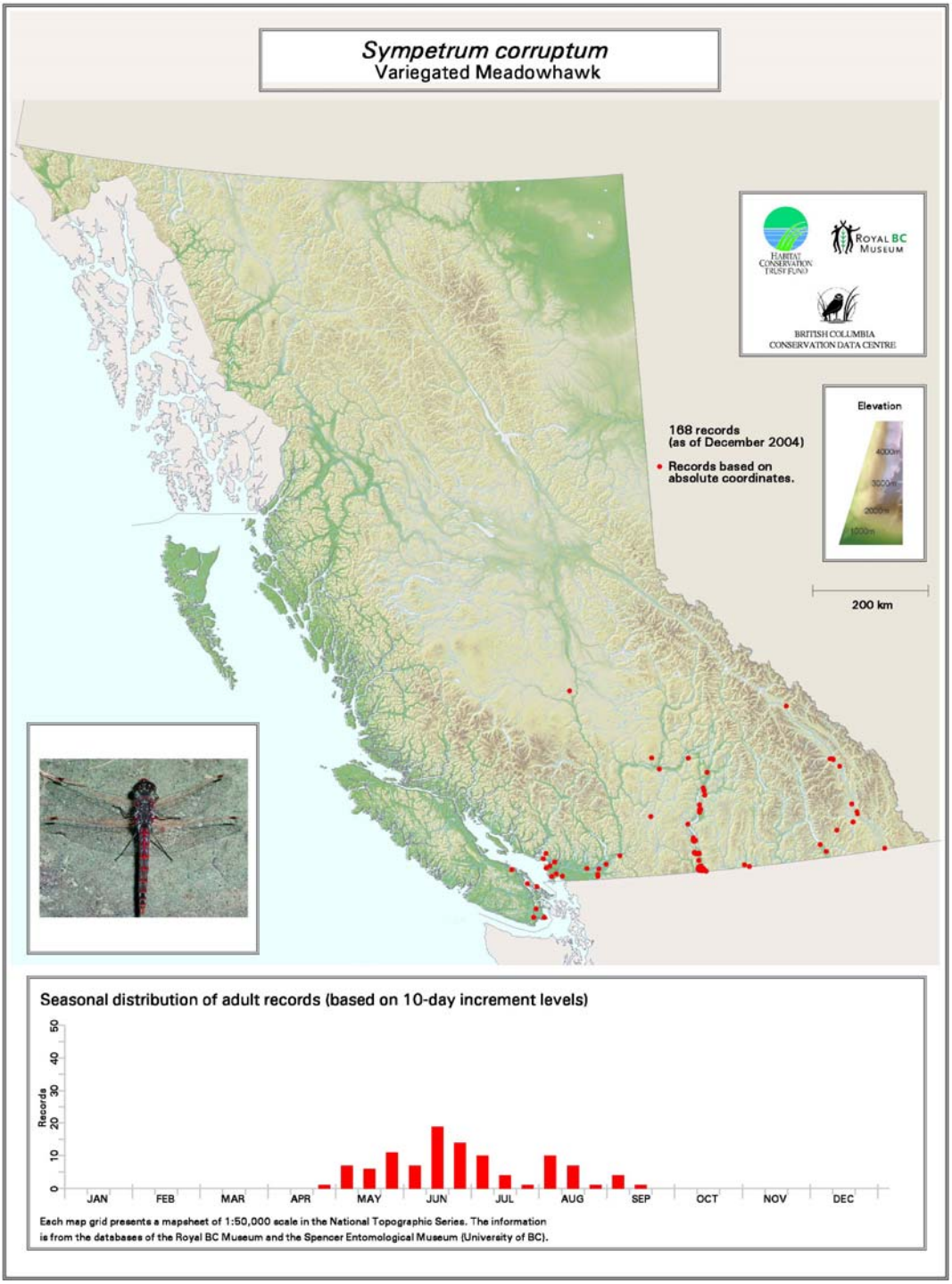


Figure 20. Meadowhawks, female vulvar laminae: a, Yellow-legged; b, Striped; c, White-faced; d, Cherry-faced. A8 = abdominal segment 8; VL = vulvar lamina.

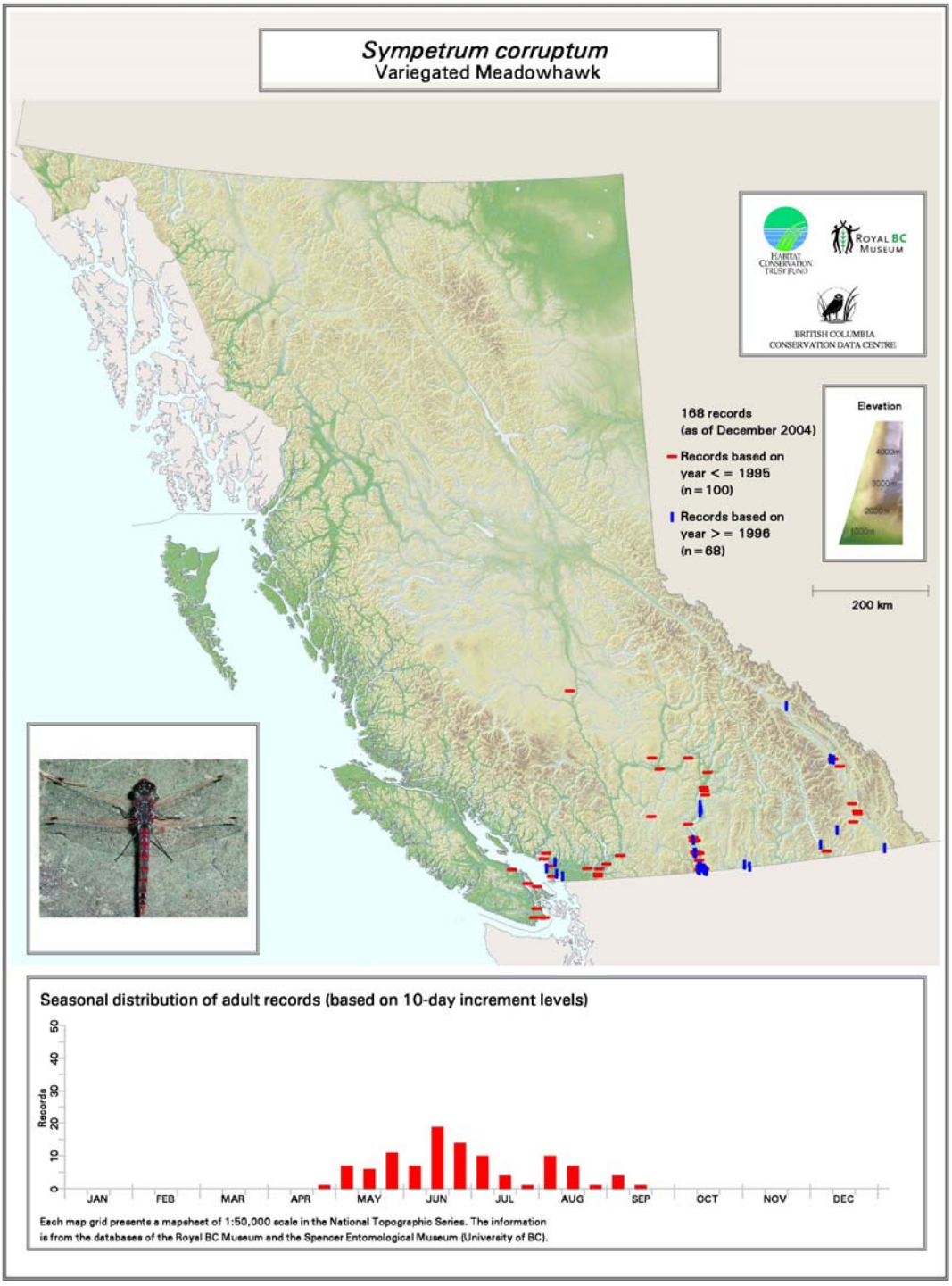
***Sympetrum corruptum* (Variegated Meadowhawk)**
BC conservation rank: S5. Yellow List.
Description: The face is tan, but the male's turns orange-red with age. The thorax has two pale stripes on each side, which on mature males shrink to yellow spots at the lower ends. The abdomen is grey-brown and orange or red with white spots on the sides bordered above by a black line. The wings are clear with pink to orange veins. The legs are black, often with yellow sides. Hamule, fig. 19b; vulvar lamina short with shallow lobes. Length: male 40 mm, female 41 mm.
Global Range: British Columbia east to Prince Edward Island and south to Mexico. It is also found in northeastern Asia (Needham *et al.* 2000). Faunal element: Western (see Appendix 3).
BC Distribution: Widespread in the south, north about 52°N. The only record in the northern study area is right at the southern boundary near Williams Lake.
Biology: Uncommon in BC; mostly living in the southern lowlands. Breeds in a variety of waters, often temporary ones, from rich marshes (Wm04-06) to alkaline ponds (Wm07, GS01-03) and sand-bottomed beach lagoons (*Salix exigua*, Fl06); usually absent from peatlands. Emergence is long and irregular, and perhaps represents two generations – one in spring and another in late summer. This species wanders widely and some fly southward in the early fall.

BC flight period: early May to early October; most records are from mid may to mid September.

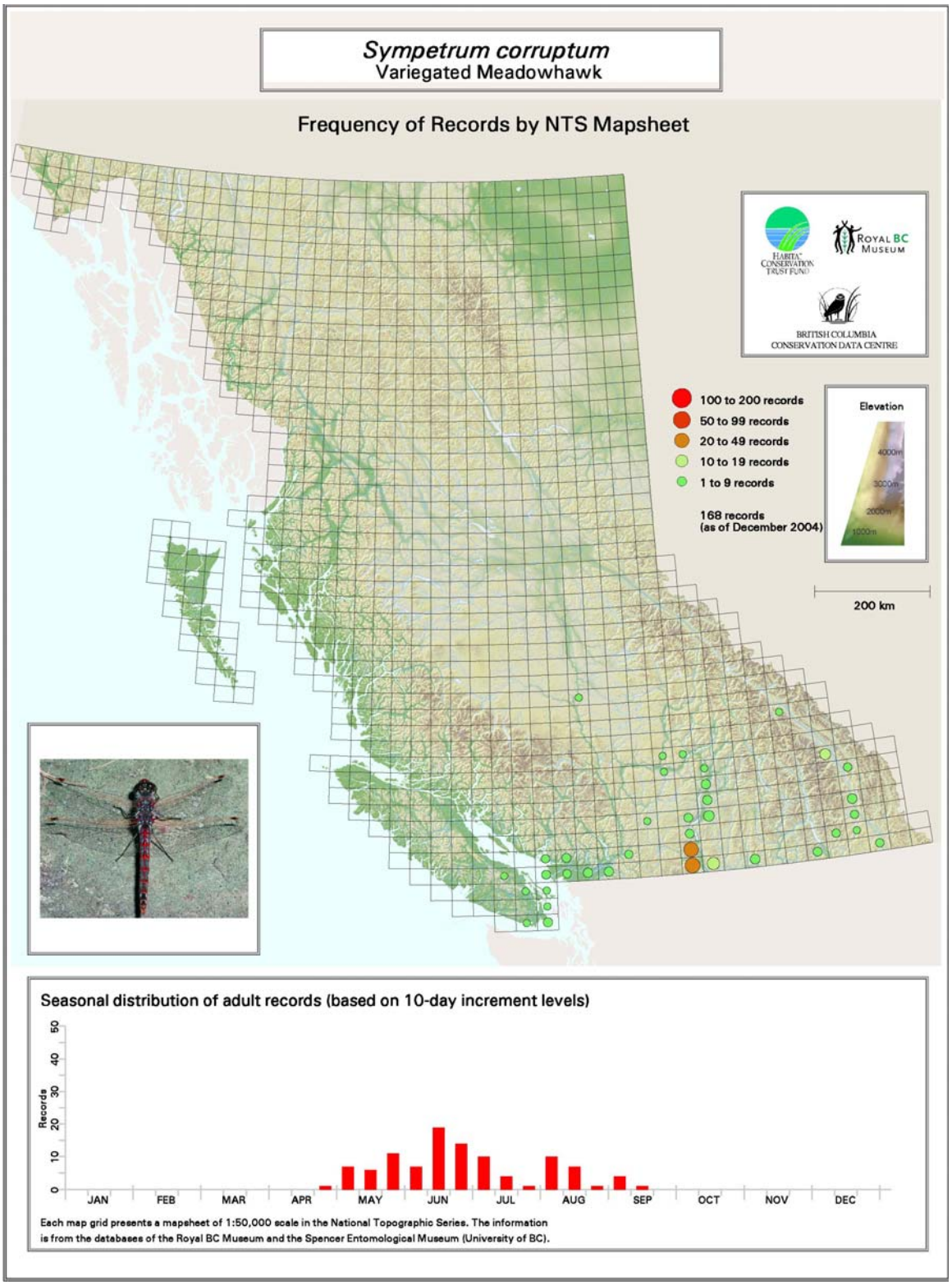
Sympetrum corruptum male. Photograph: George Doerksen, RBCM



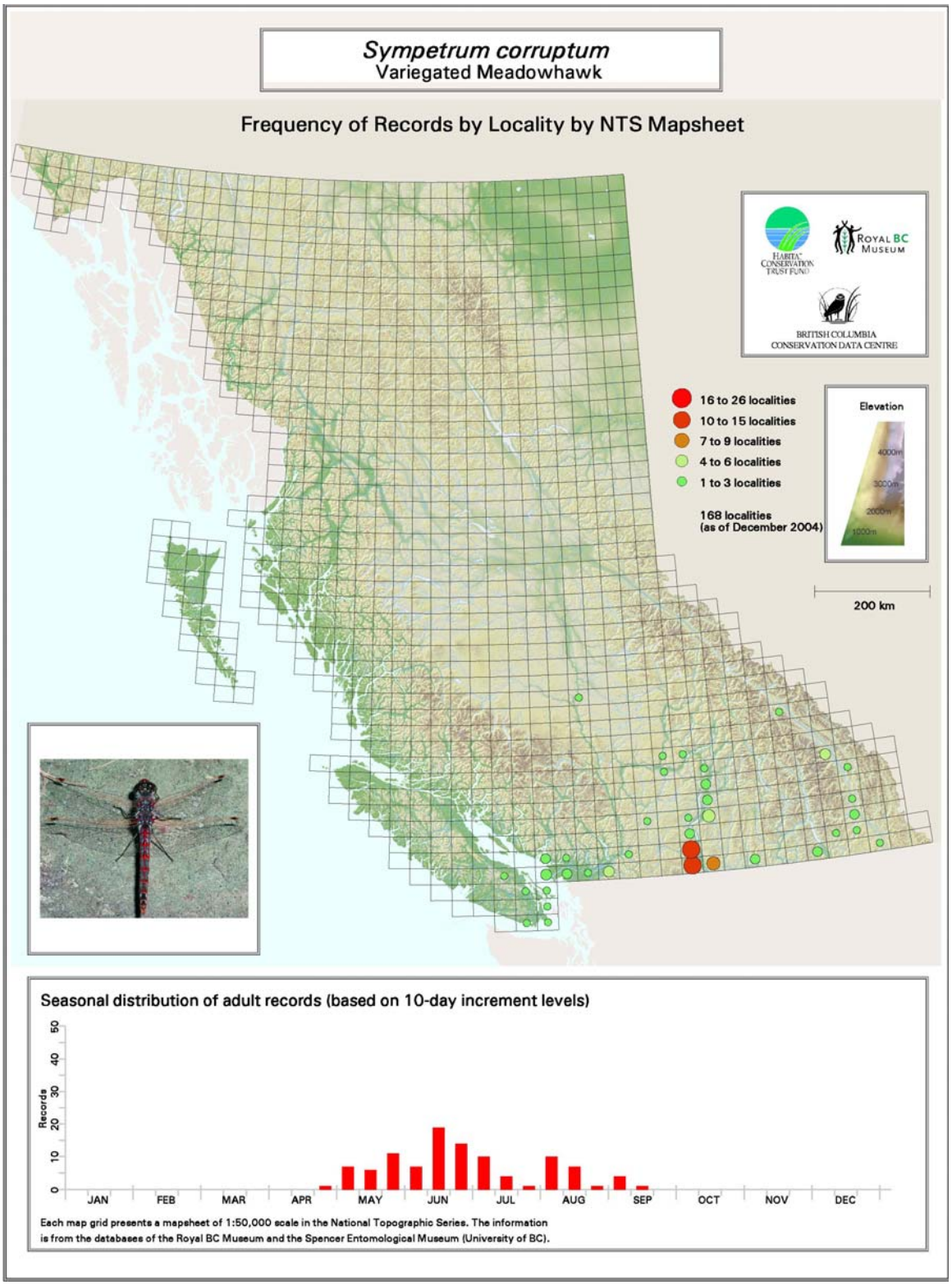
Sympetrum corruptum Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Sympetrum corruptum Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Sympetrum corruptum Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.

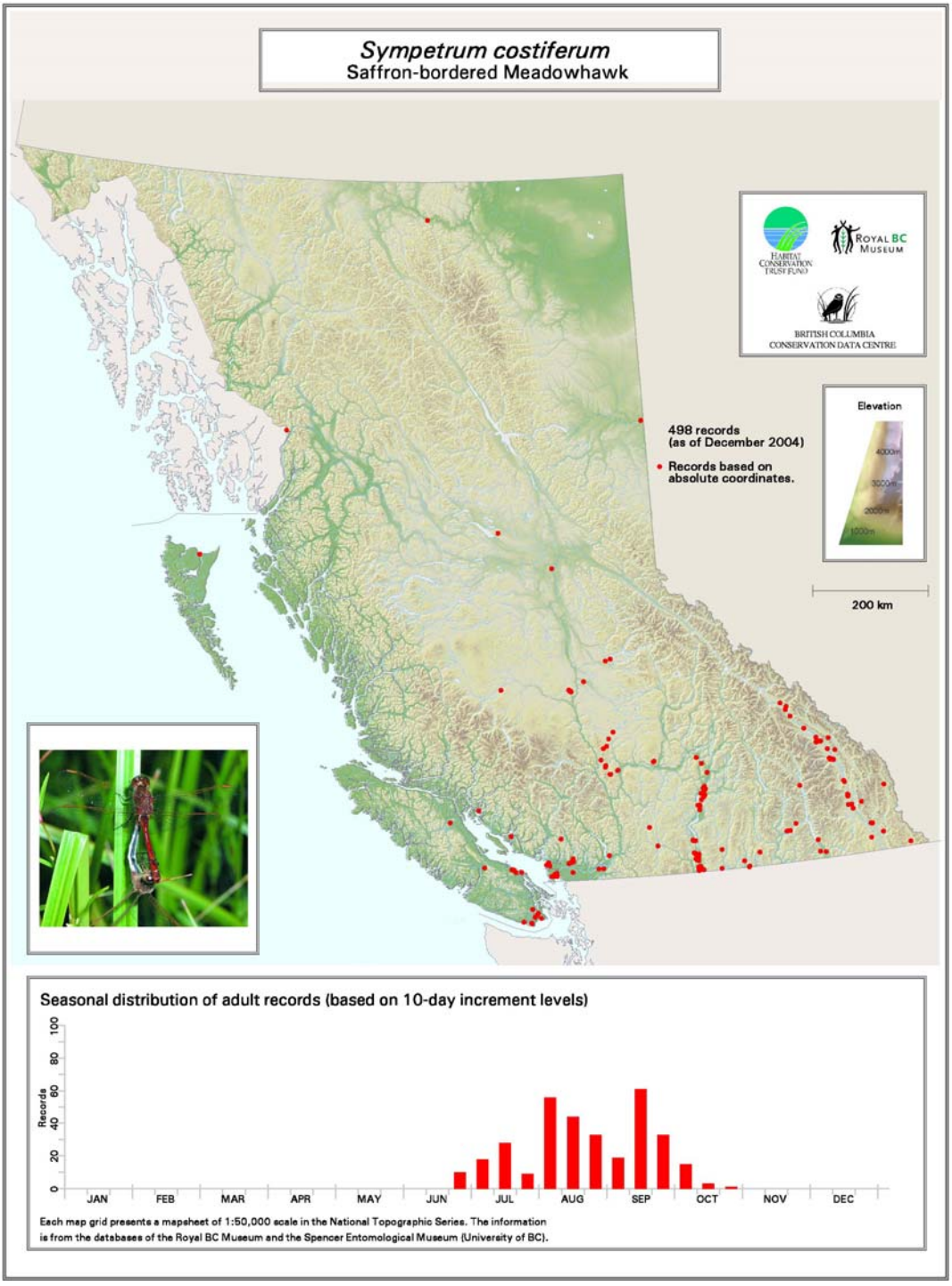


Sympetrum corruptum Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

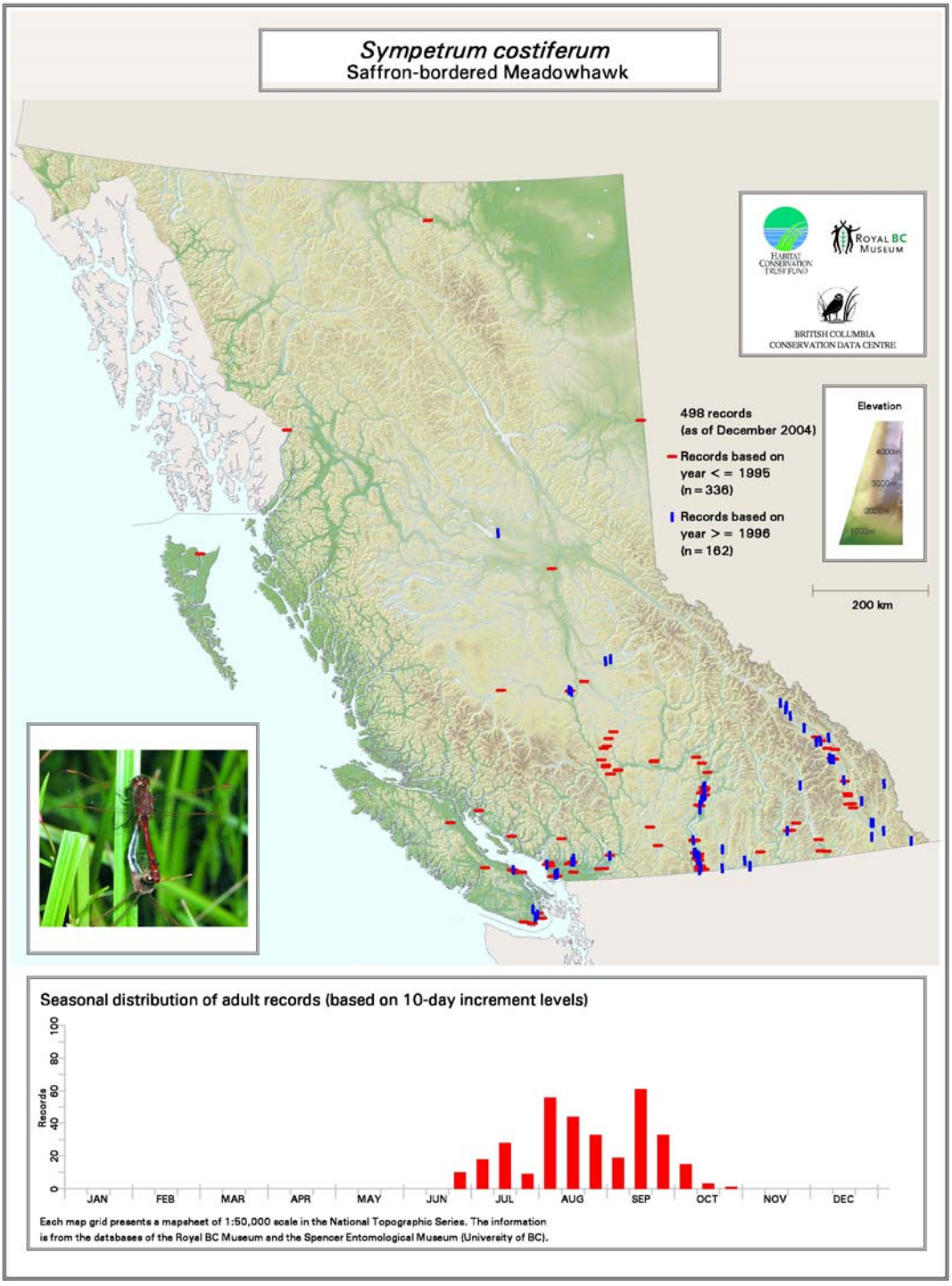
***Sympetrum costiferum* (Saffron-winged Meadowhawk)**
BC conservation rank: S5. Yellow List.
Description: The wings have yellow veins and a yellow stripe along their front edges. The stripe is especially obvious on immatures, which are all yellow, except for thin dark lines on the sides of the thorax, black marks on the legs (sometimes the legs are all dark) and a narrow black line on each side of the abdomen. As they age, males and some females turn dark red, the lines on the sides of the thorax disappear and the yellow wing stripe usually fades; other females turn brown. Hamule, fig. 19e; vulvar lamina a short, unlobed trough. Length: male female 36 mm.
Global Rank: British Columbia, east to Newfoundland; south to New Jersey and California (Needham *et al*. 2000). Faunal element: Transition (see Appendix 3).
BC Distribution: Widespread across the province but few records north of the Cariboo-Chilcotin regions.
Biology: Common, at least in southern lowlands. Inhabits ponds and lakes (e.g., Wm01-02, Wm04-06), especially in the open, including alkaline ponds in grasslands (Wm07, GS01-03). Walker and Corbet (1975) state that it is the *Sympetrum* most tolerant of alkaline conditions and it often favours the reedy edges of sandy or gravelly ponds.

BC flight period: early June to early November; almost all records are from early July to mid October.

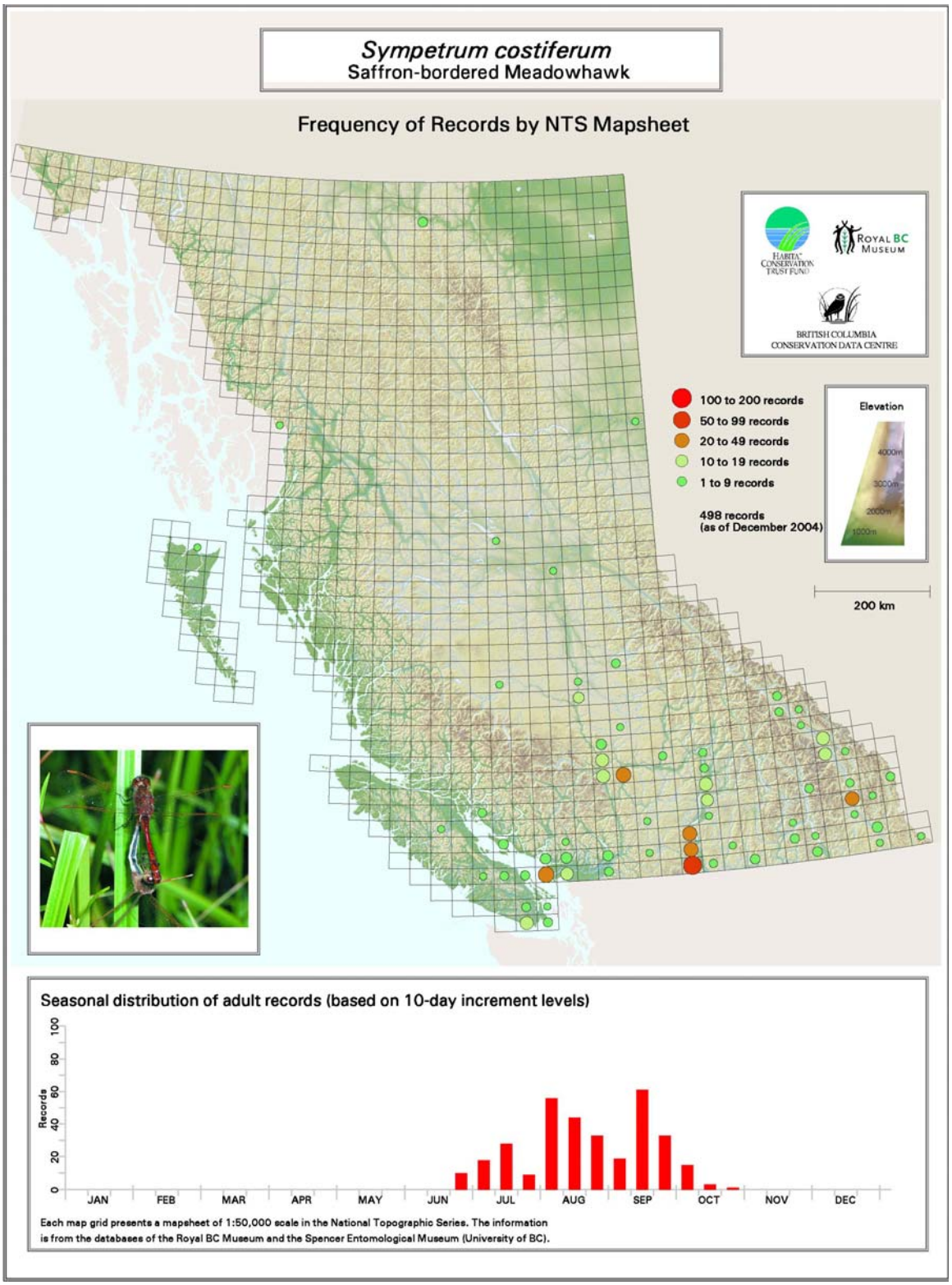
Sympetrum costiferum mating. Photograph: George Doerksen, RBCM



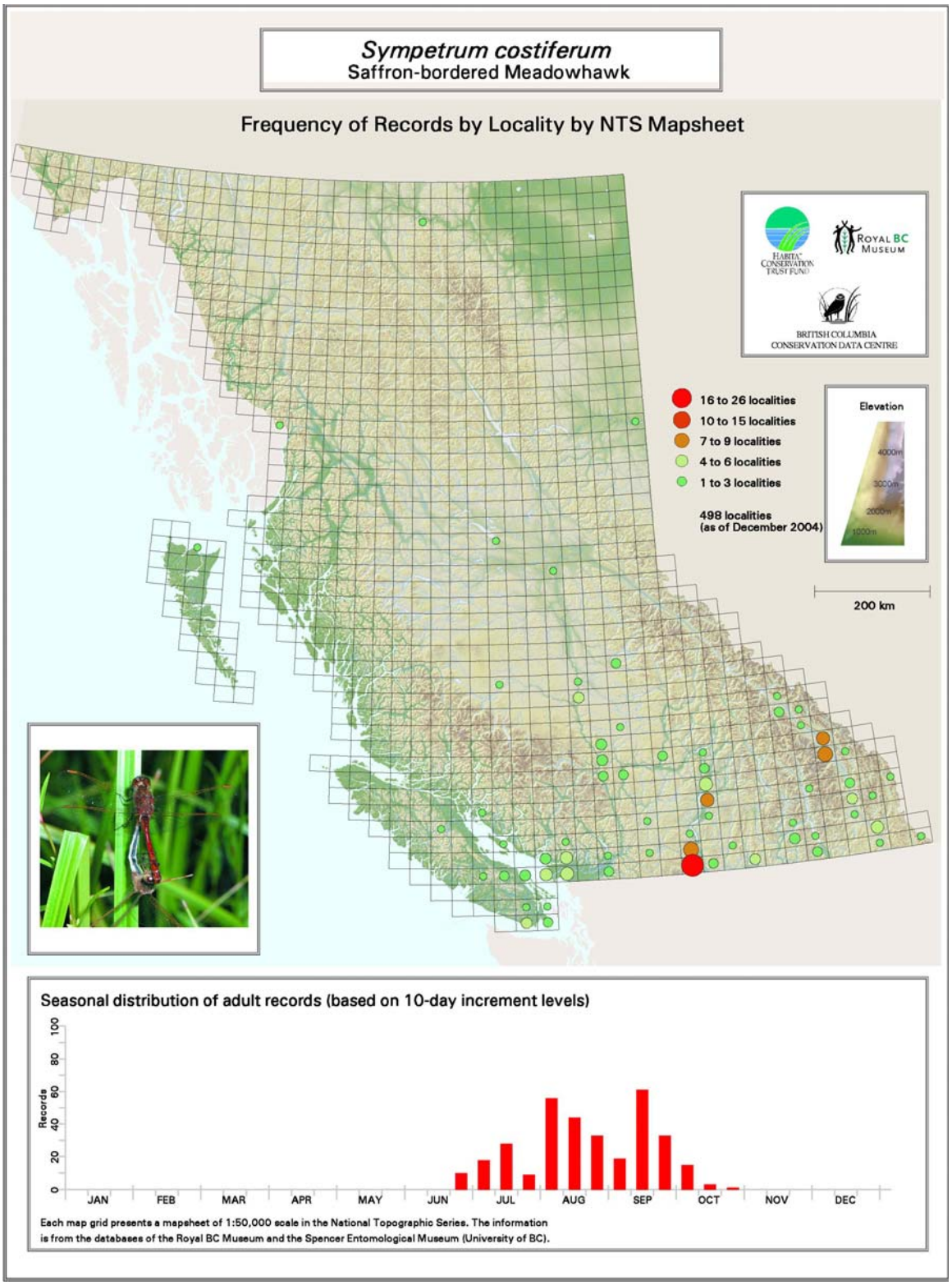
Sympetrum costiferum Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Sympetrum costiferum Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Sympetrum costiferum Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



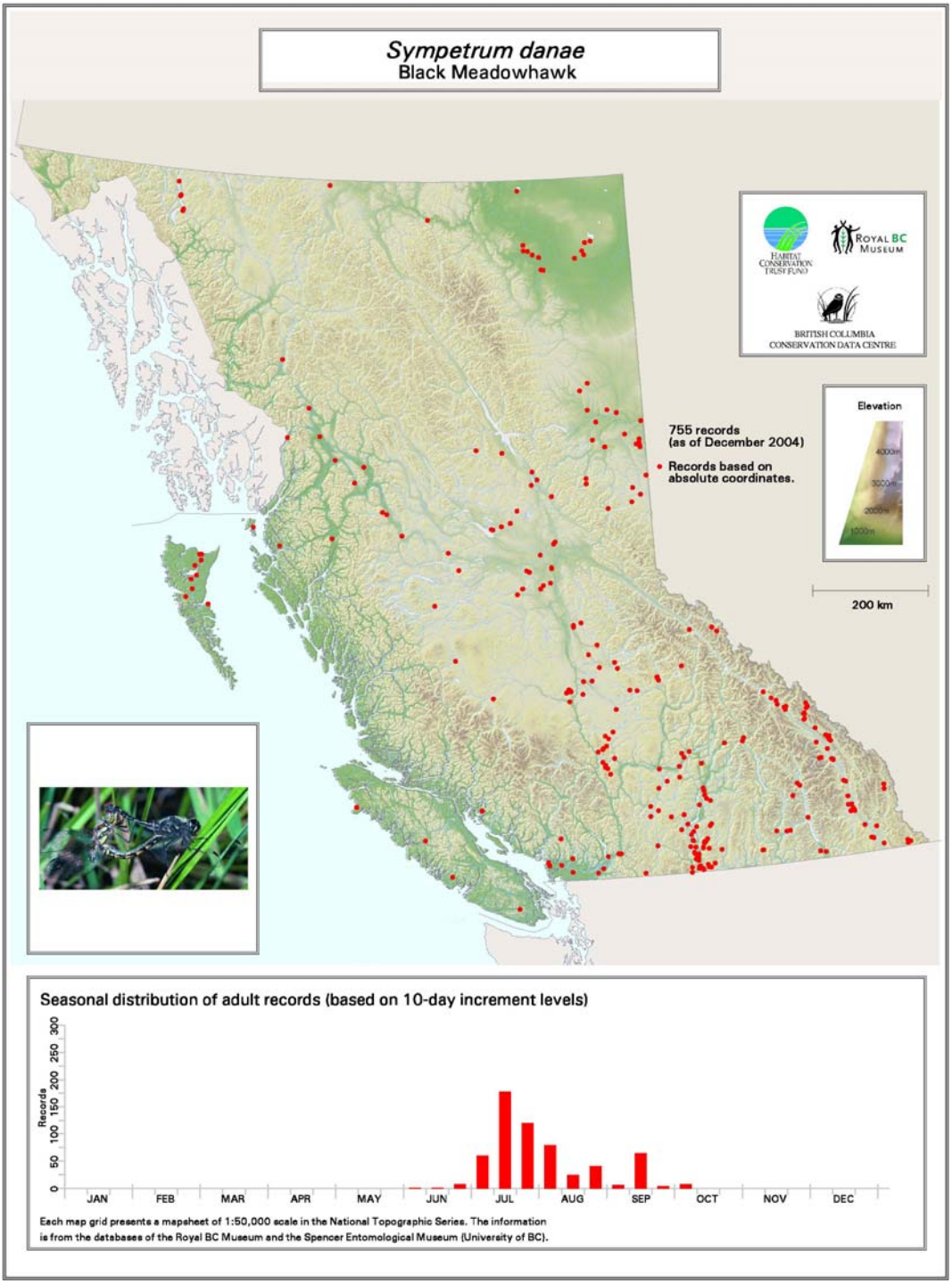
Sympetrum costiferum Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Sympetrum danae* (Black Meadowhawk)**
BC conservation rank: S5. Yellow List.
Description: The only meadowhawk in our region with no red on it: mature males are almost all black; females also turn mostly black, but usually not as much as males. Immatures have yellow lines and spots on the sides of the thorax; the abdomen is black with pairs of yellow spots on the top. Hamule, fig. 19g; vulvar lamina spout-like. Length: male 32 mm, female 31 mm.
Global Range: Alaska east to Labrador and Newfoundland; south through New York, west to Kentucky and California. It is also found in northern Europe and Asia to Japan and Kamchatka (Needham *et al.* 2000). Faunal element: Widespread Boreal (H) (see Appendix 3).

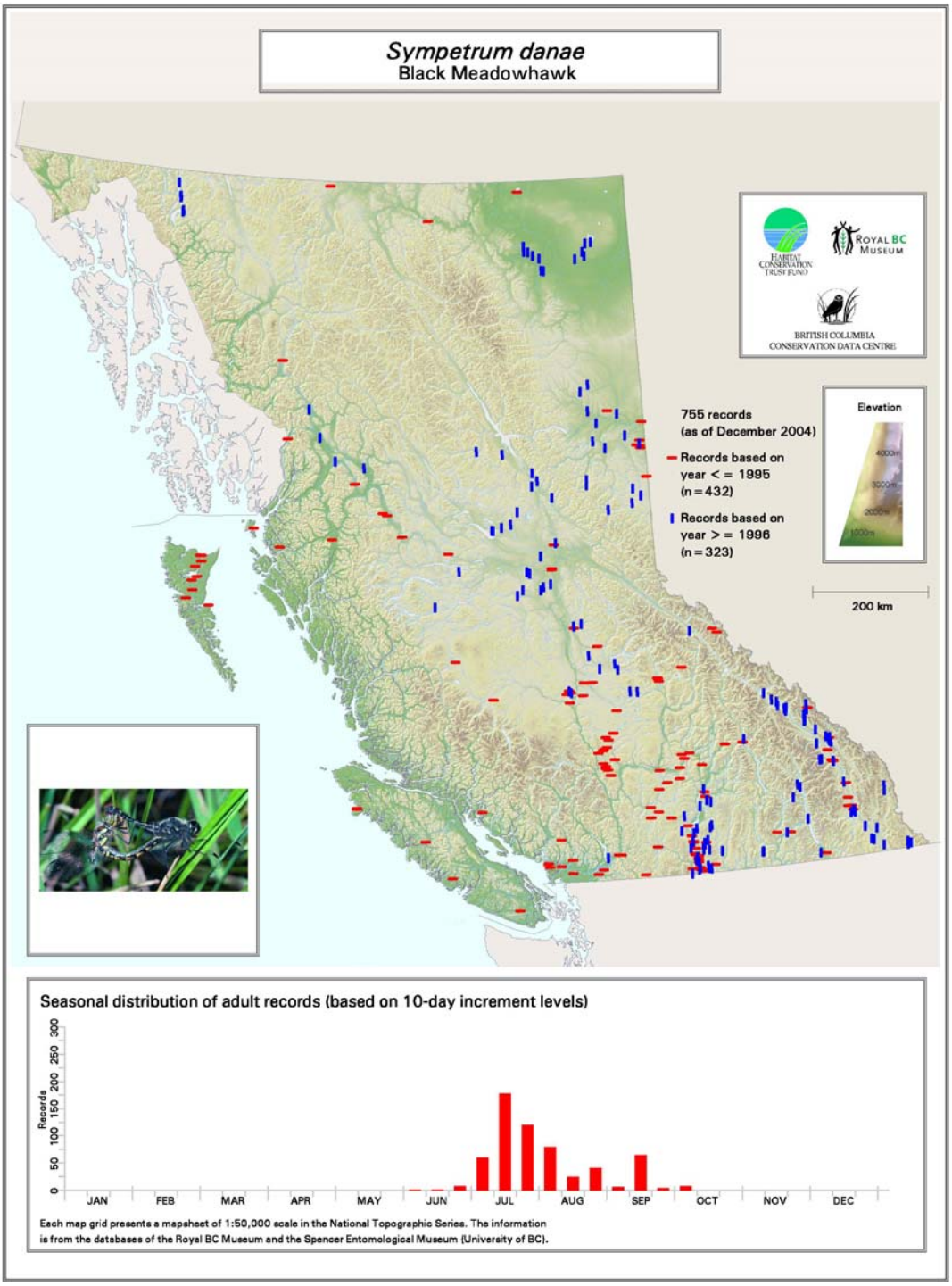
BC Distribution: Widespread across the province.
Biology: Lives in a wide range of habitats from mountain and northern peatland pools to warm lowland marshes and ponds that dry up in summer (Wm04-07). Especially common in peatlands (Wf01, 05-08; Wb13, 50-52).

BC flight period: mid June to late October; most records are from mid July to late September.

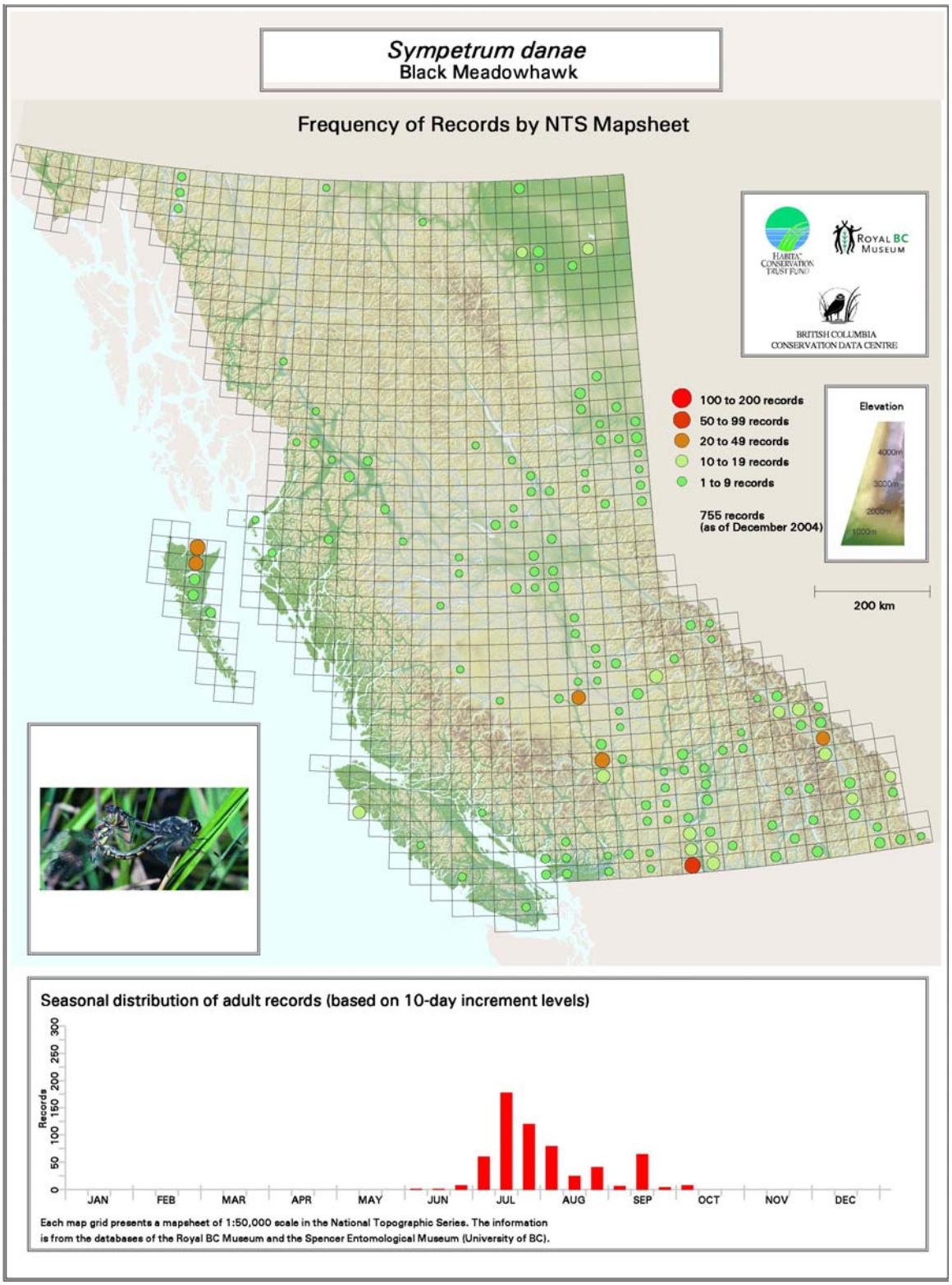
Sympetrum danae mating. Photograph: George Doerksen, RBCM



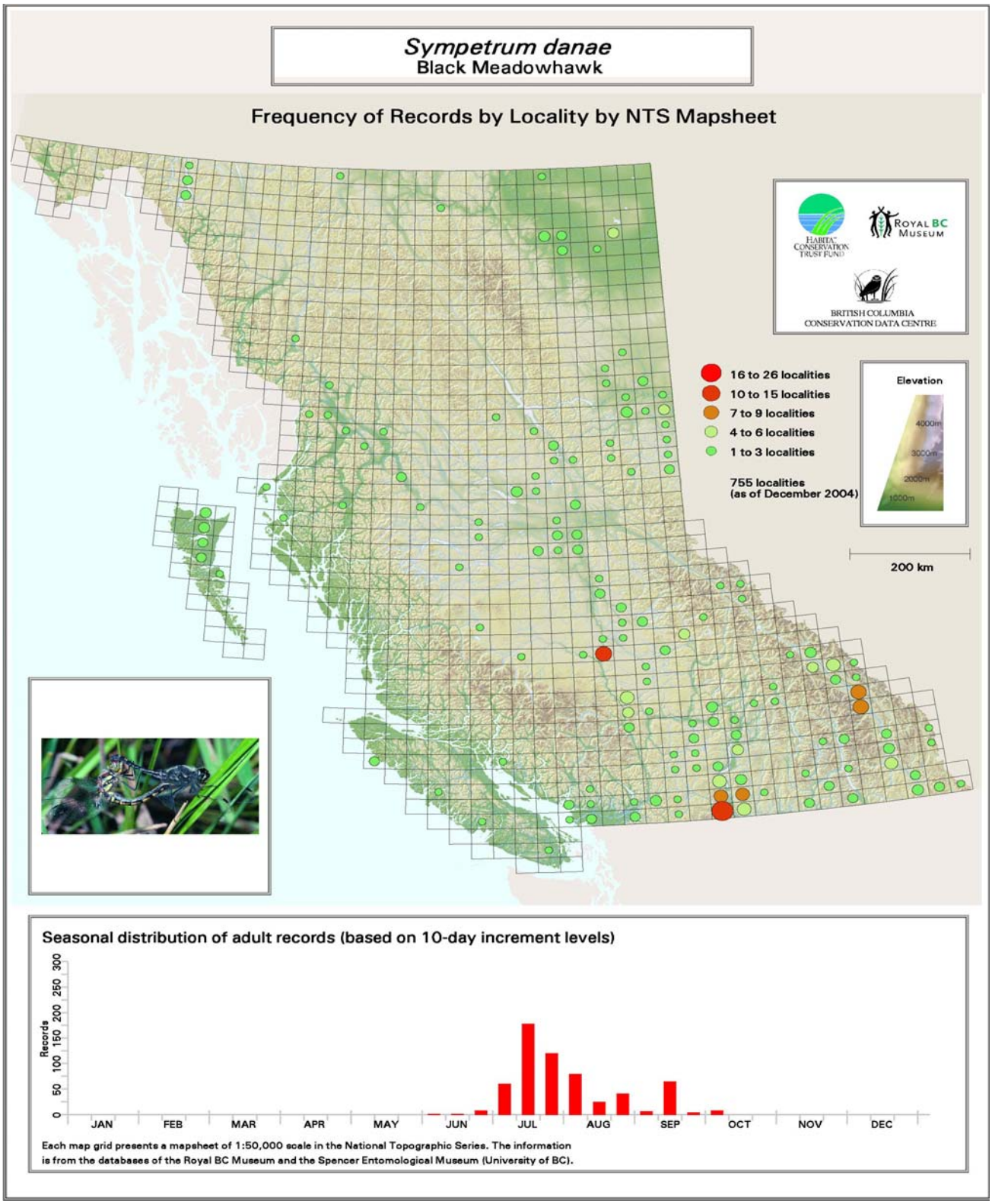
Sympetrum danae Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Sympetrum danae Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



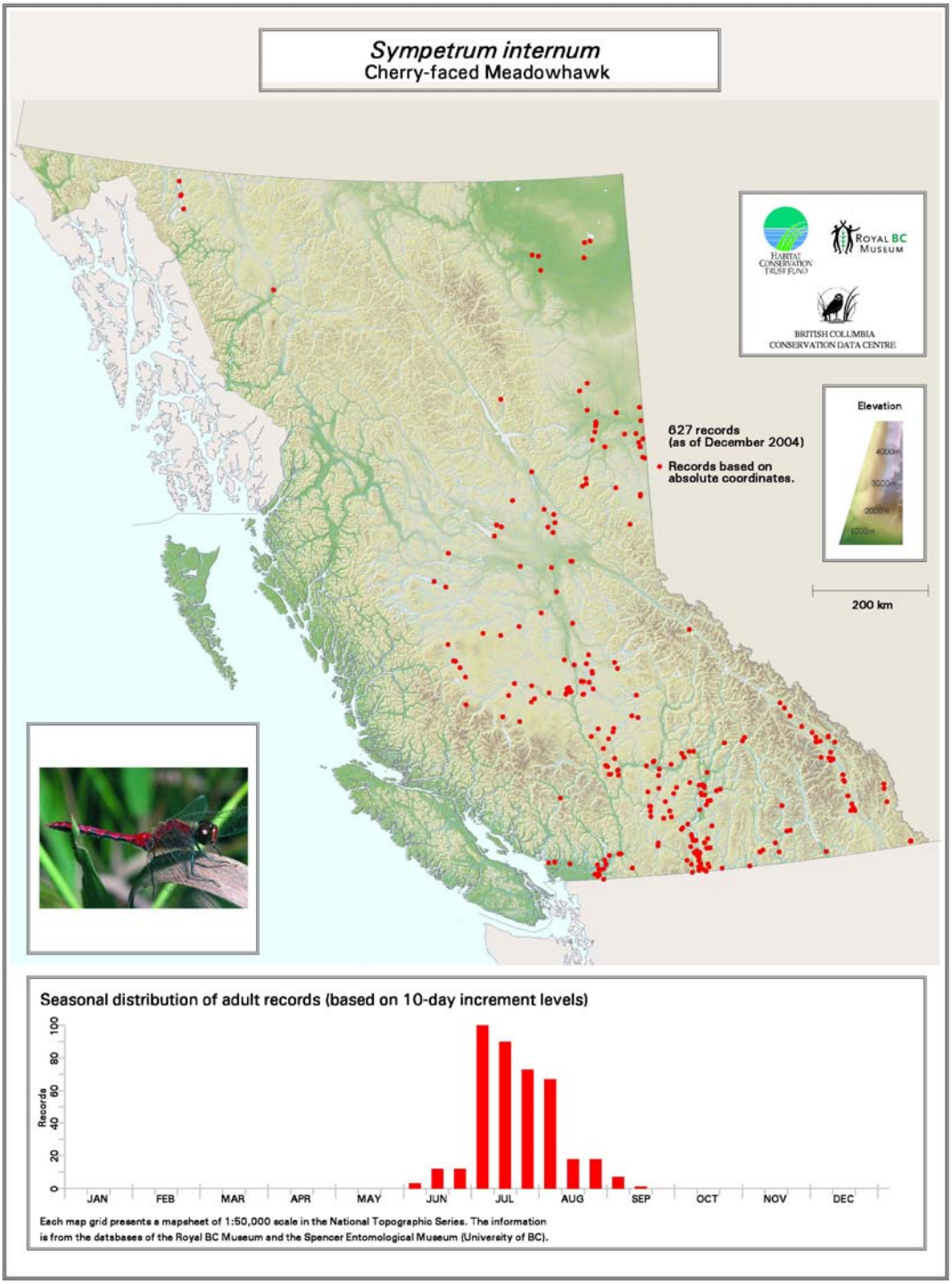
Sympetrum danae Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.


Sympetrum danae
Black Meadowhawk
Frequency of Records by Locality by NTS Mapsheet
HABITAT CONSERVATION TRUST FUND
ROYAL BC MUSEUM
BRITISH COLUMBIA CONSERVATION DATA CENTRE
16 to 26 localities
10 to 15 localities
7 to 9 localities
4 to 6 localities
1 to 3 localities
755 localities
(as of December 2004)
Elevation
4000m
3000m
2000m
1000m
200 km
Seasonal distribution of adult records (based on 10-day increment levels)
Records
0
50
100
150
200
250
300
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
Each map grid presents a mapsheet of 1:50,000 scale in the National Topographic Series. The information is from the databases of the Royal BC Museum and the Spencer Entomological Museum (University of BC).

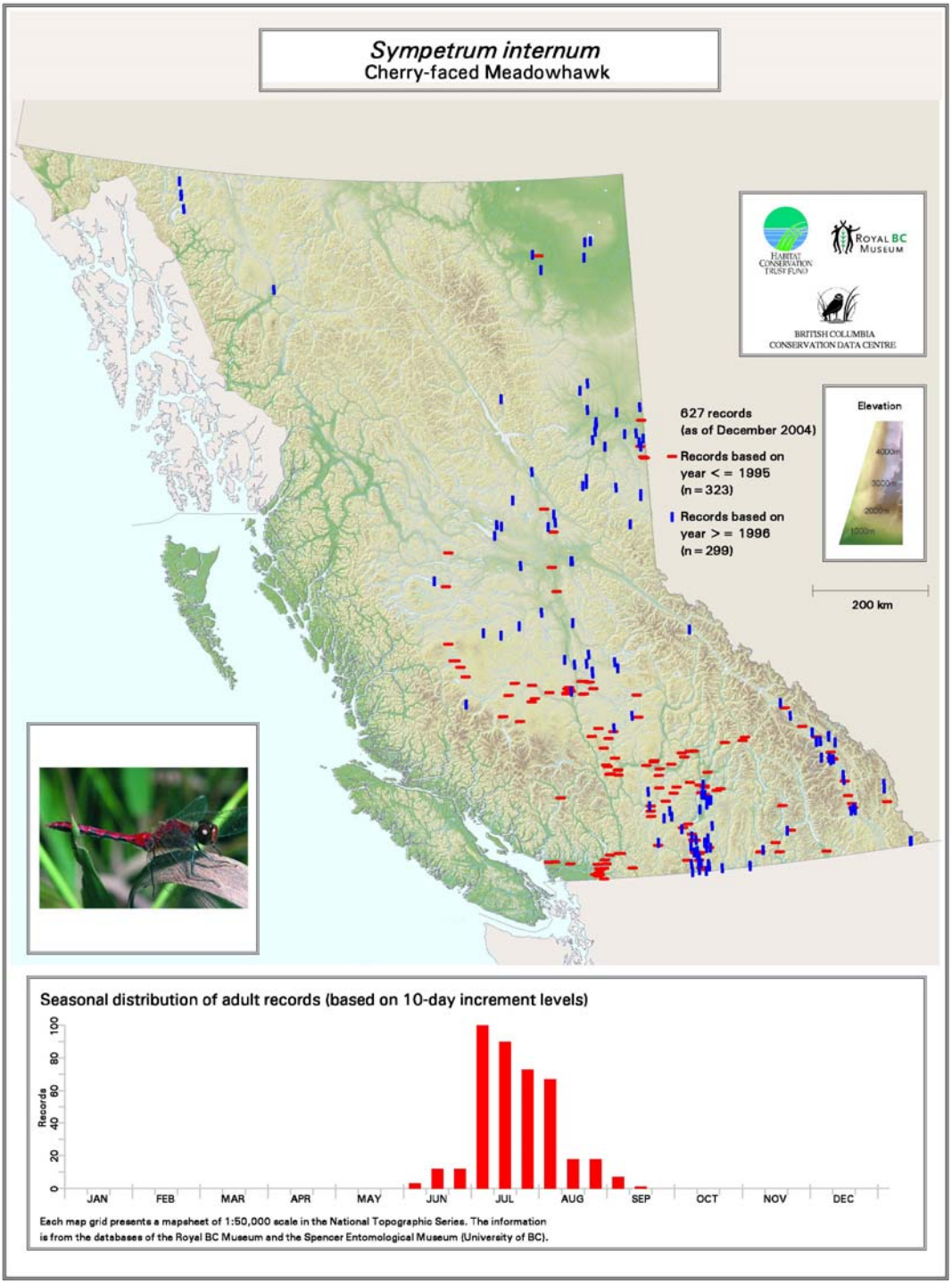
Sympetrum danae Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Sympetrum internum* (Cherry-faced Meadowhawk)**
BC conservation rank: S5. Yellow List.
Description: Similar to *S. obtrusum*, except for the red face and wing veins. Immatures have a yellowish face and yellow-brown body, both becoming red with maturity. The thorax sides are unmarked and the legs are black. The abdomen has black saw-toothed stripes on the sides. Hamule, fig. 19h; vulvar lamina, fig. 20d. Length: male female 34 mm.
Global Range: Alaska east to Newfoundland; south to Missouri, New Mexico and California (Needham et al. 2000). Faunal element: Transition (see Appendix 3).
BC Distribution: Widespread throughout BC, but on the coast known only from the Lower Mainland.
Biology: Common in slow streams (e.g., Wm01), grassland ponds (Wm04, Wm07, GS01-03), cattail and bulrush marshes (Wm05, Wm06) and peatland pools (e.g., Wf07). Tolerates many conditions, including cattle-trodden pools and acid and alkaline waters. Sometimes abundant, especially around grassland ponds. At the northern limit of its range in the dry southern valleys of the Yukon, it lives mainly in sedge marshes (e.g., Wm01). Pairs lay eggs onto moist ground while in tandem, often gathering in large congregations.
BC flight period: mid June to mid October; most collections are from late June to early September.

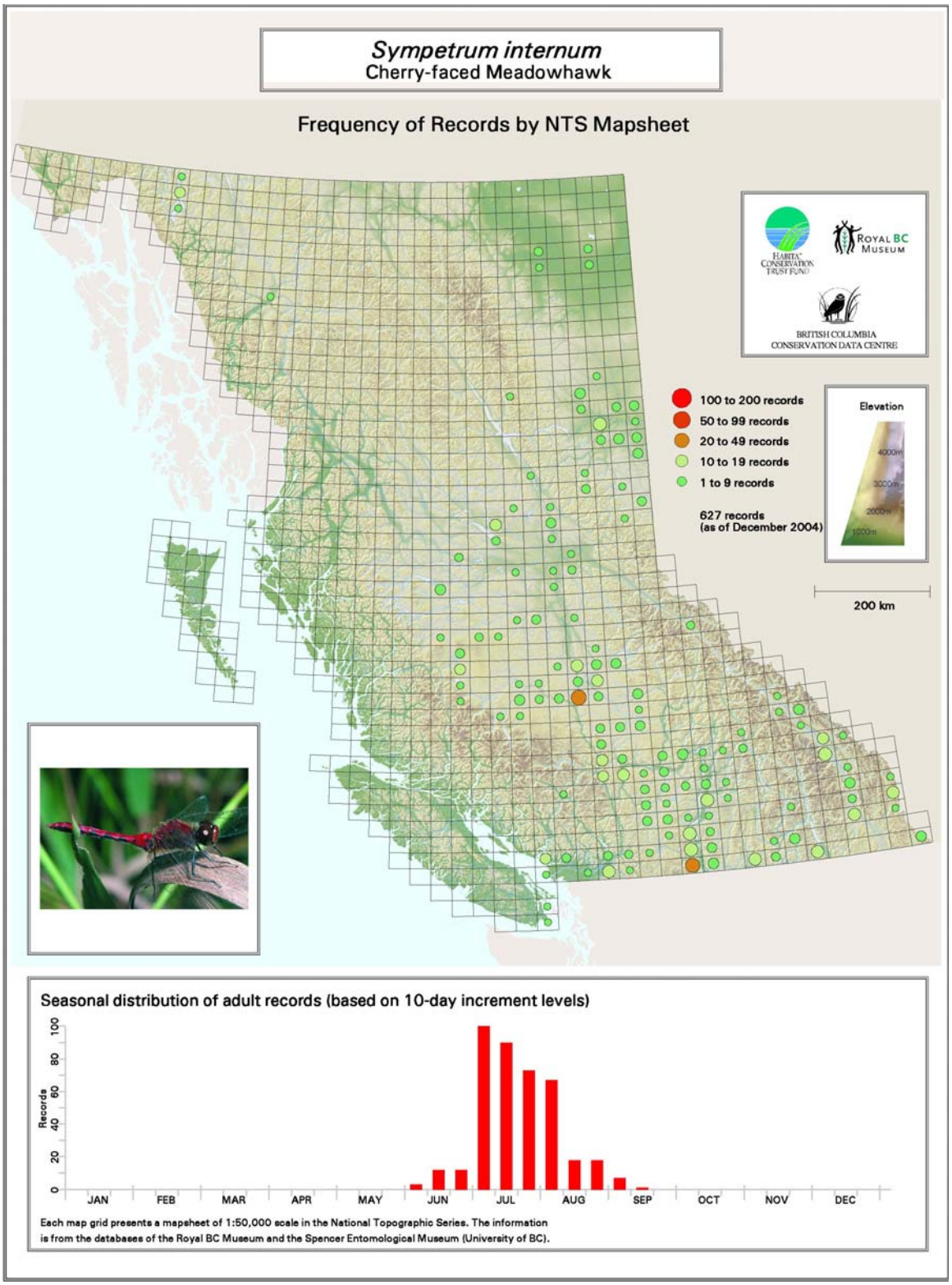
Sympetrum internum male. Photograph: George Doerksen, RBCM



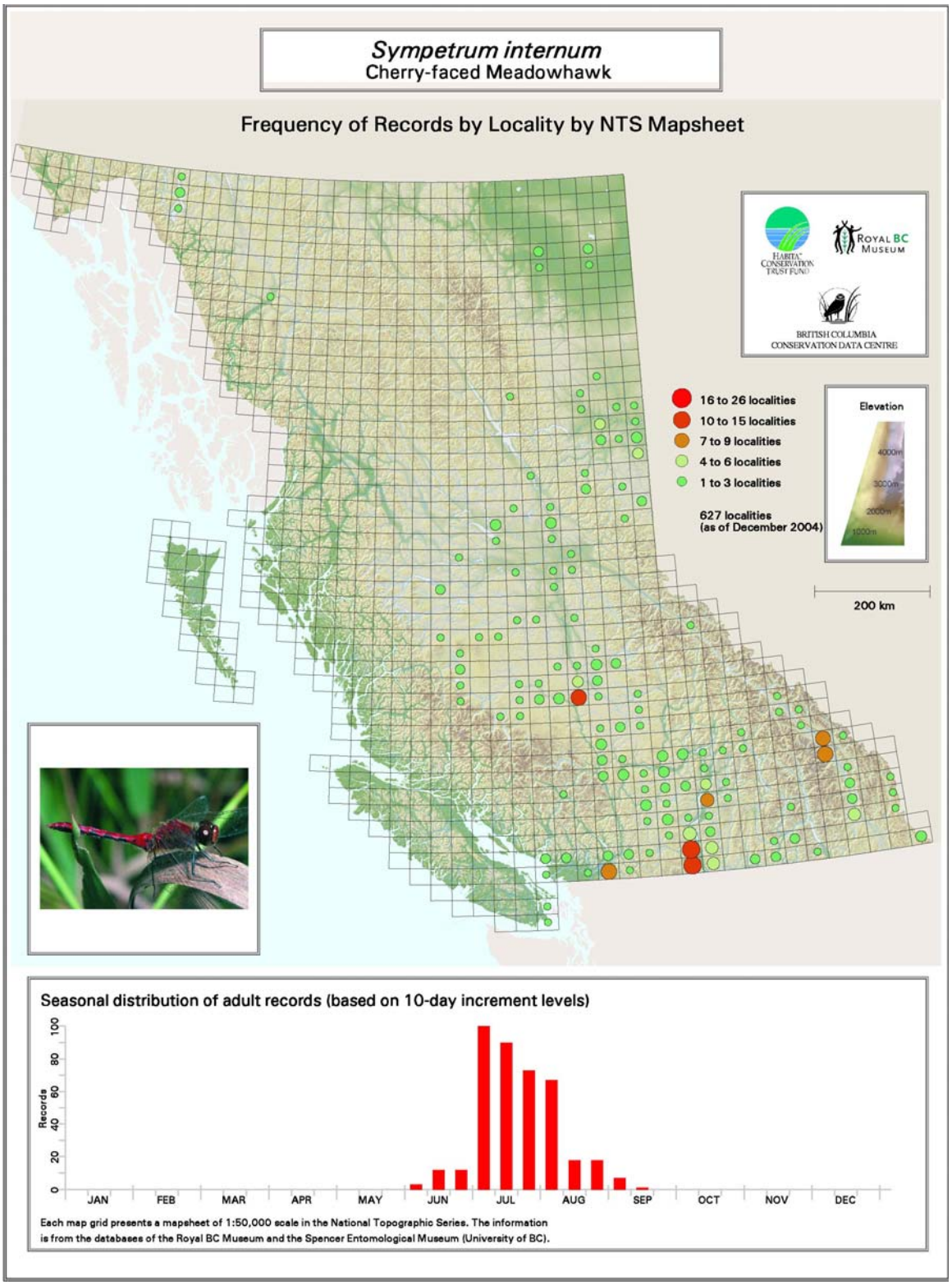
Sympetrum internum Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Sympetrum internum Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



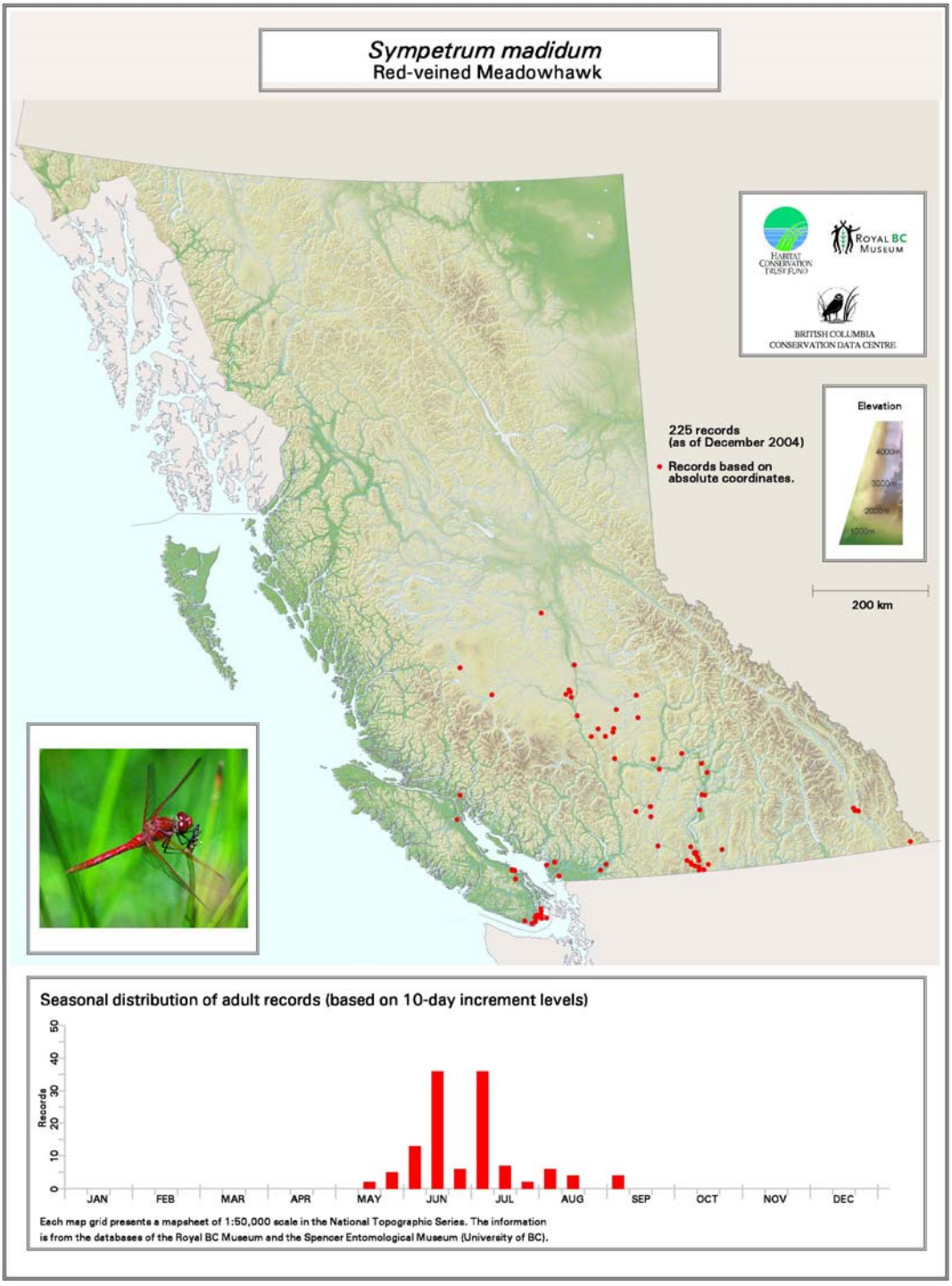
Sympetrum internum Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



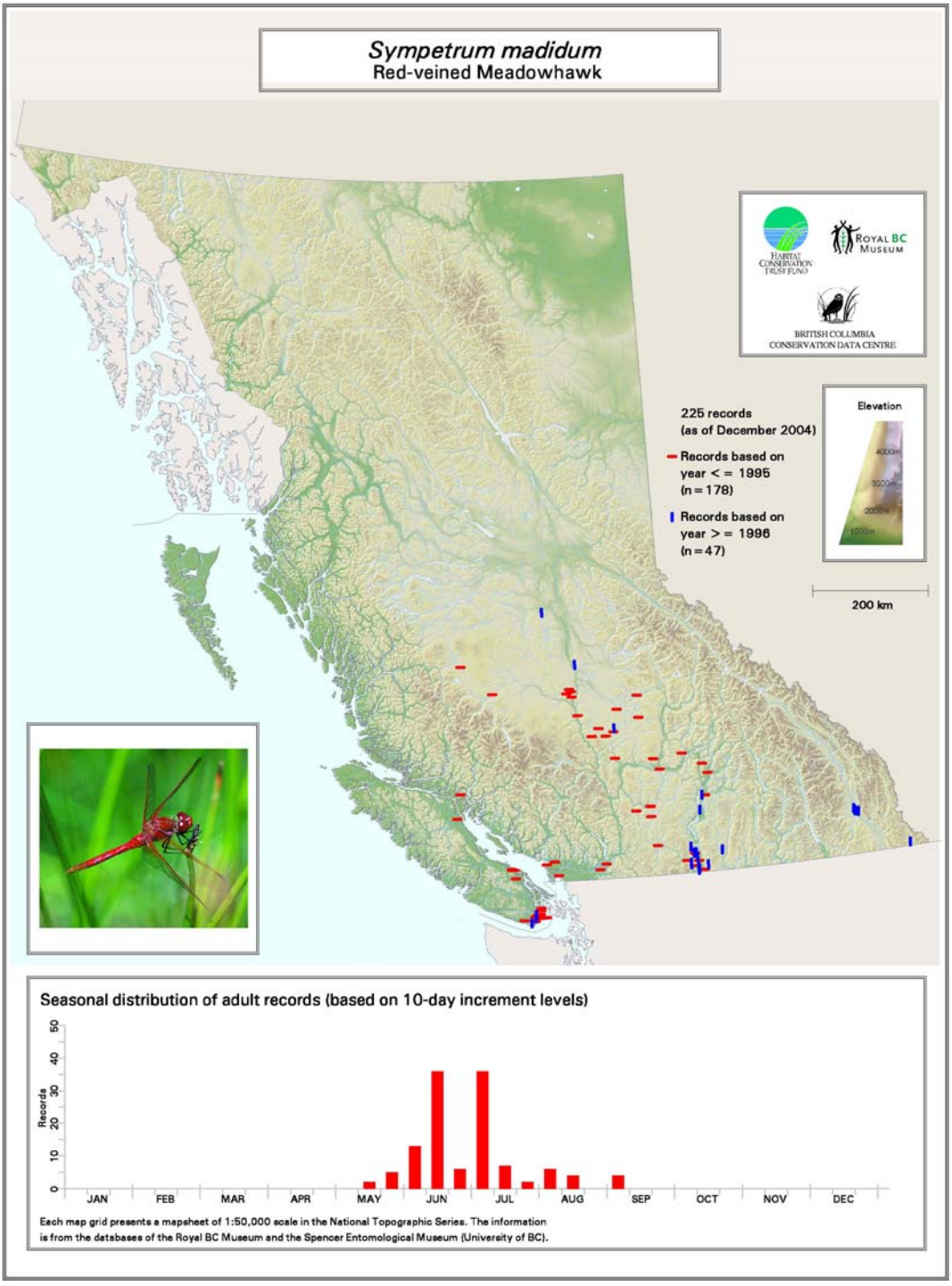
Sympetrum internum Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Sympetrum madidum* (Red-veined Meadowhawk)**
BC conservation rank: S4. Yellow List.
Description: Immatures are grey-brown; males and some females become red and, with age, darken to wine-red. The thorax sides have a pair of white stripes that reduce to spots on mature males. The wing veins are yellow, turning red with age; old ones have brown-tinted wing membranes. The legs are black. The sides of the abdomen bear a white stripe bordered above by black, but these marks fade with age. Hamule, fig. 19c; vulvar lamina a third the length of segment 9, its lobes short and triangular. Length: male, female 39 mm.
Global range: Yukon east to Manitoba, south to California and Missouri (Needham *et al*. 2000). Faunal element: Western (see Appendix 3).
BC Distribution: Widespread in the South, ranging north to about 53°N in the Cariboo-Chilcotin region. Probably occurs sparingly north of this in BC, because there are records from the southern Yukon and Northwest Territories, but surveys have failed to find it.
Biology: Uncommon. Develops in a variety of still-water habitats, including marshes (Wm01, Wm04-07), sedge fens (Wf01, Wf06) and saline grassland ponds (Wm04, Wm07, GS01-03), which often dry up in summer. Females lay eggs in water or on the beds of dry pools. Cannings (1980b, 1981) described the larva and the ecological preferences of *S. madidum* on the Chilcotin Plateau.
BC flight period: late May to late September; most records are from early June to late August.

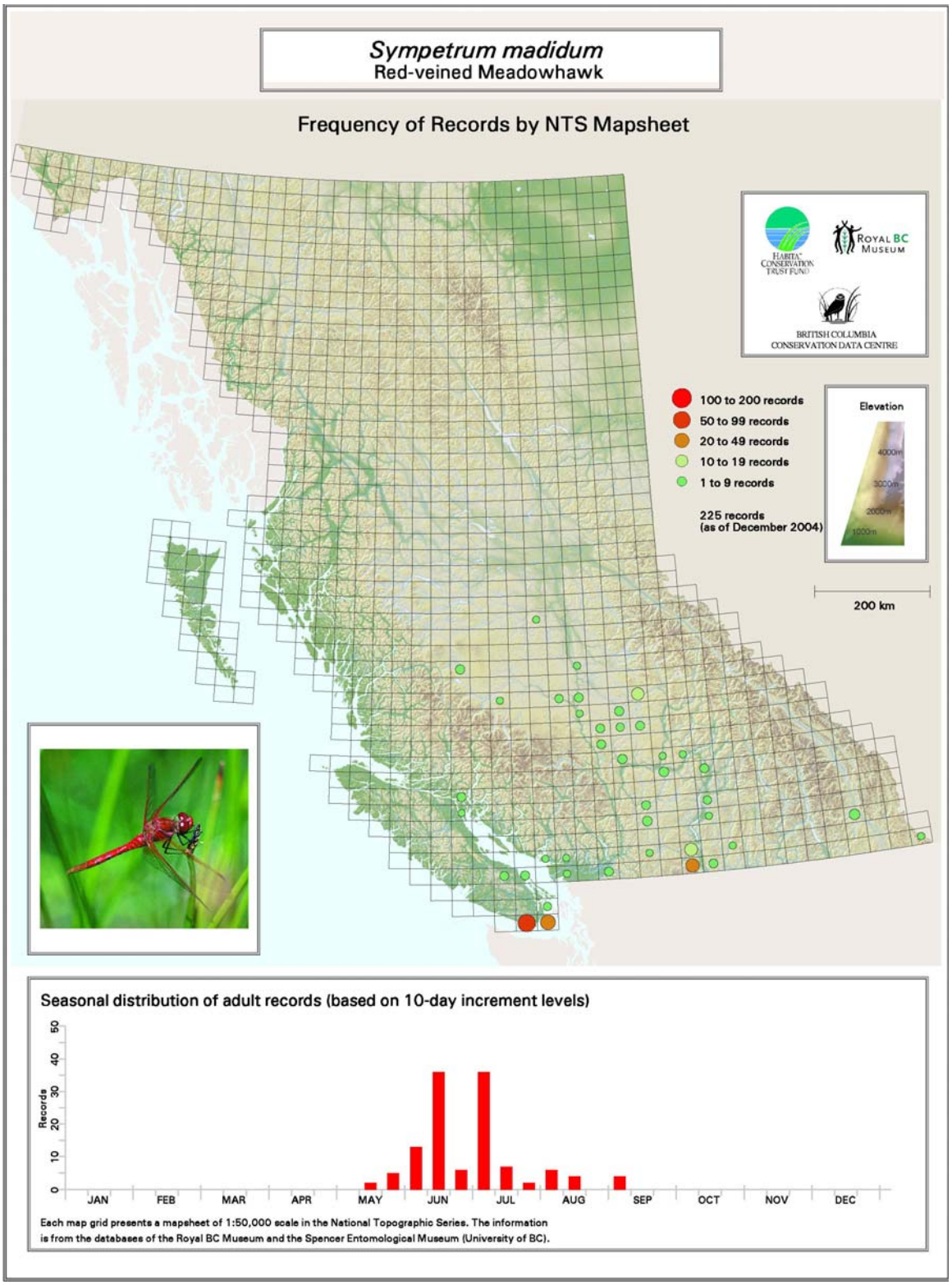
Sympetrum madidum male. Photograph: Robert A. Cannings



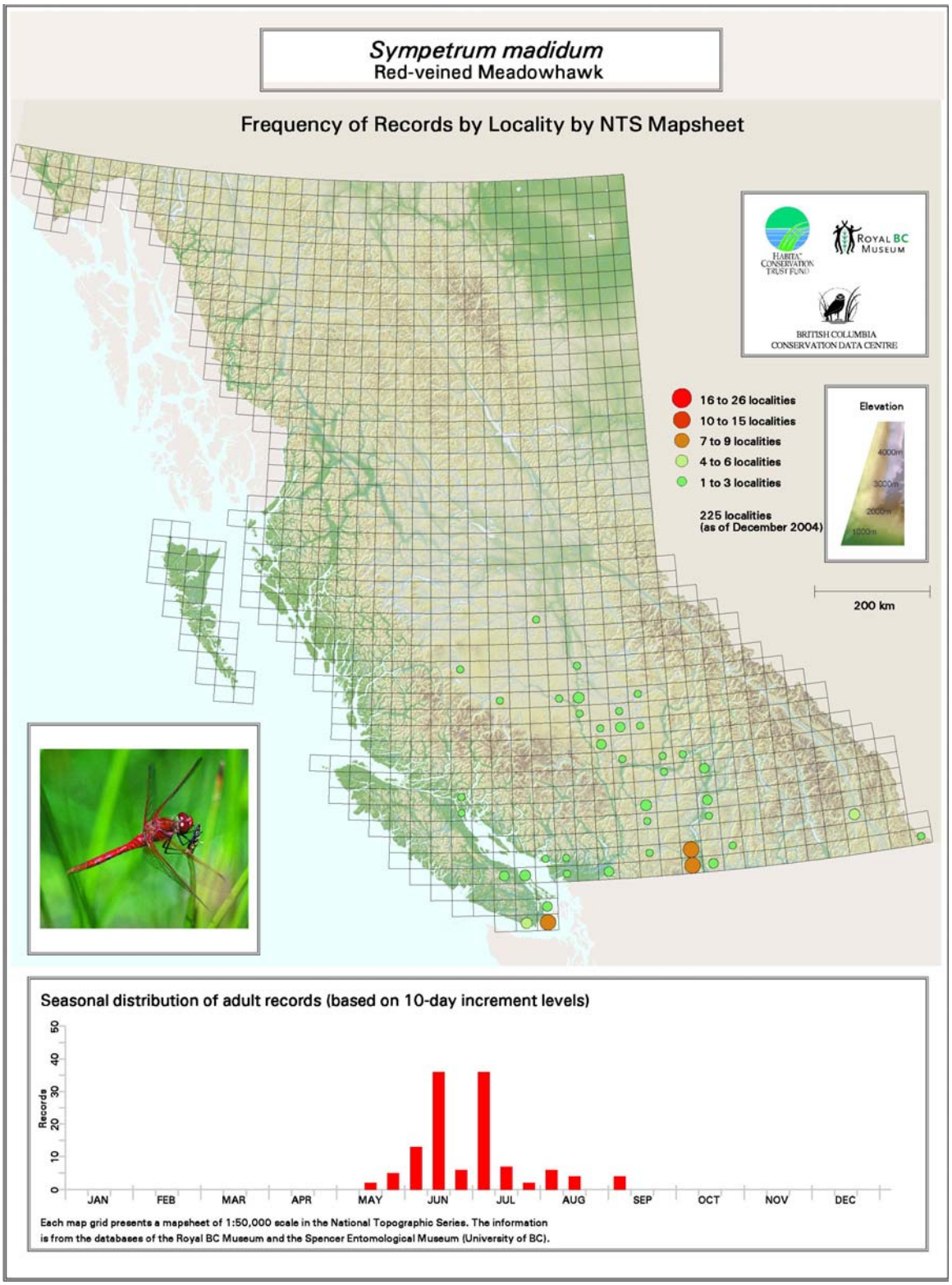
Sympetrum madidum Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Sympetrum madidum Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Sympetrum madidum Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.

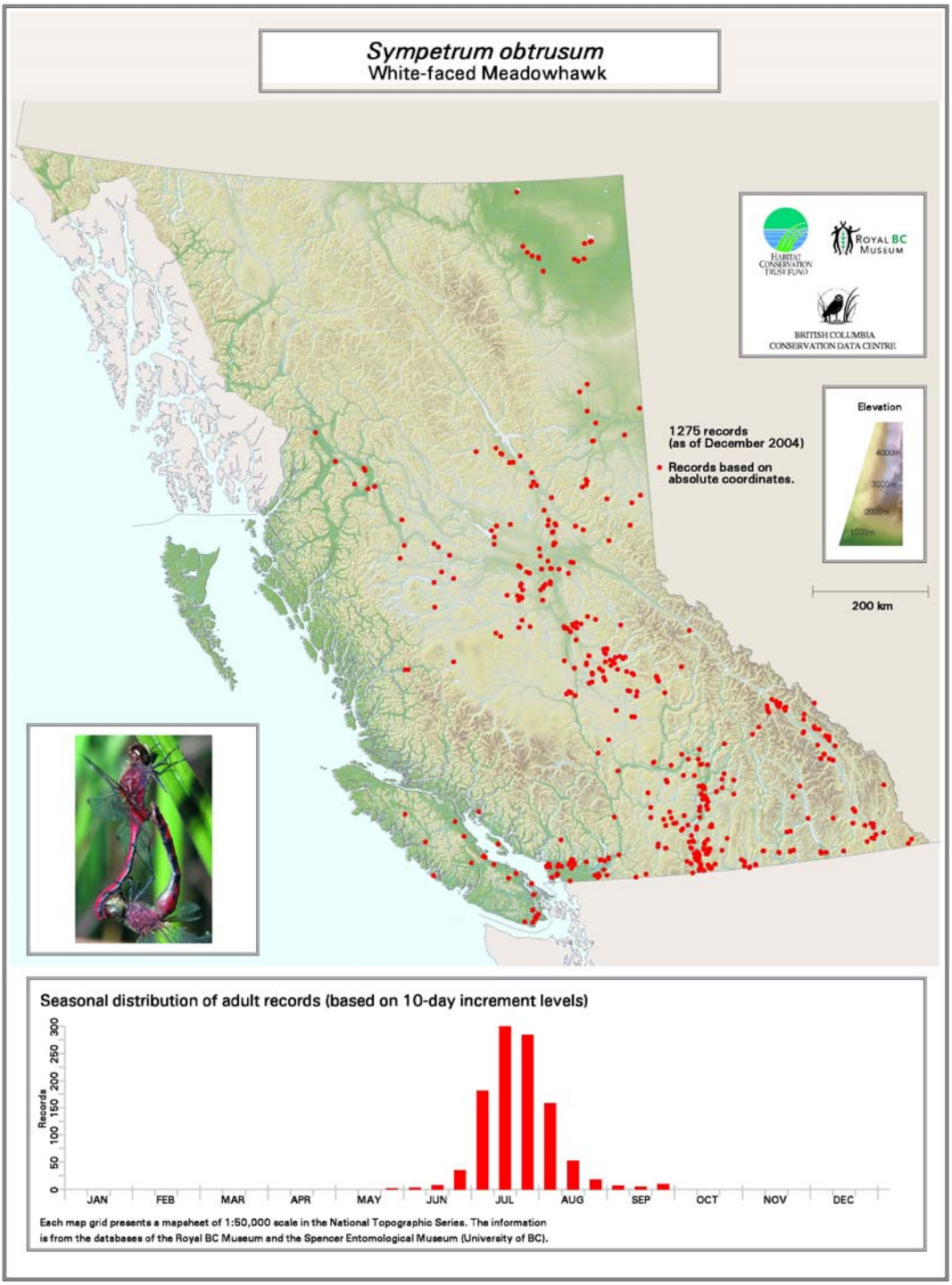


Sympetrum madidum Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

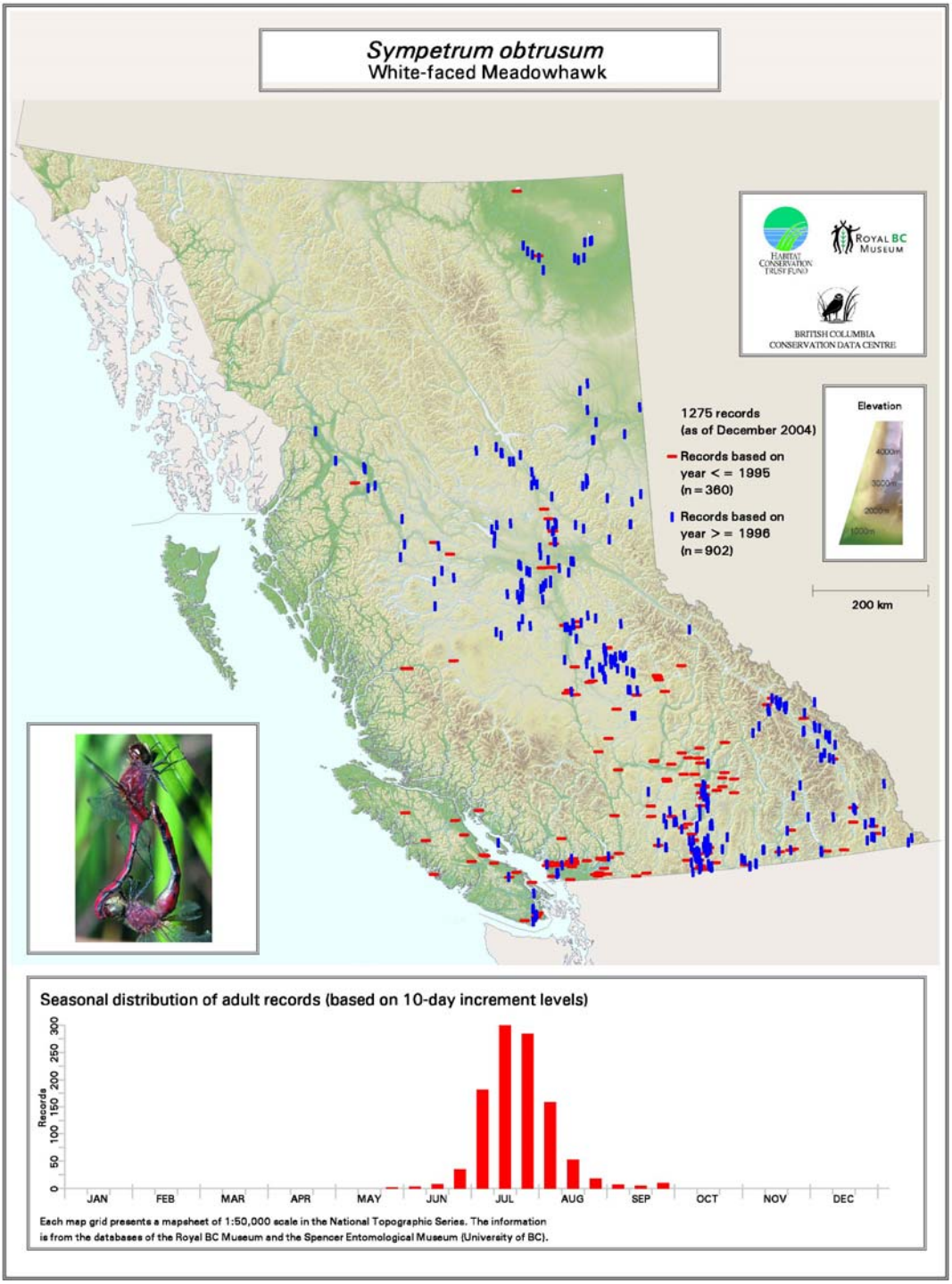
***Sympetrum obtrusum* (White-faced Meadowhawk)**
BC conservation rank: S5. Yellow List.
Description: Similar to *S. internum*, except for the white face and dark wing veins. Immatures are yellow to yellow-brown that becomes red, especially on the abdomen, as males and some females mature. The thorax is unmarked, but the abdomen has black saw-toothed side stripes. The legs are black. Hamule, fig. 19i; vulvar lamina, fig. 20c. Length: male 33 mm, female 31 mm.
Global Range: British Columbia and southwestern Northwest Territories east to Nova Scotia; south to California, New Mexico, Kansas and South Carolina (Needham *et al*. 2000, Dunkle 2000). Faunal element: Transition (see Appendix 3).
BC Distribution:
Widespread as far north as the Yukon border in the East and the upper Nass River in the West.
Biology: Probably the most common meadowhawk in most of southern BC but significantly less abundant farther north and unknown in the far Northwest. Inhabits a variety of ponds, marshes (Wm01-02, Wm04-07) and peatlands (Wf01, 05-08; Wb13) in valleys and mountains. More than most meadowhawks, it can be common in peatlands, and is often more associated with forested areas than *S. internum*, which reaches its greatest abundance in grasslands and open terrain.

BC flight period: early June to mid October; most records are from early July to early September.

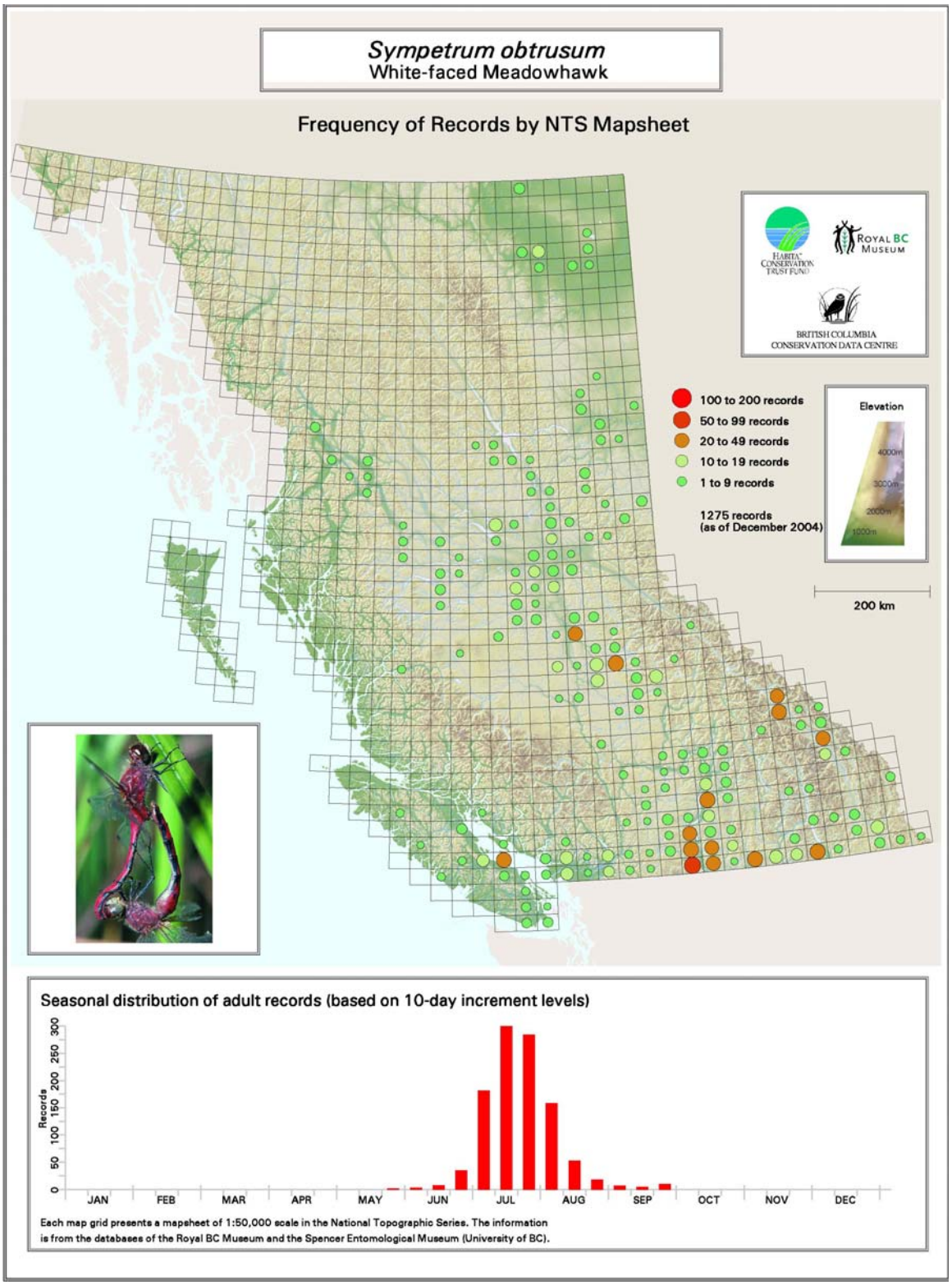
Sympetrum obtrusum mating. Photograph: Robert A. Cannings



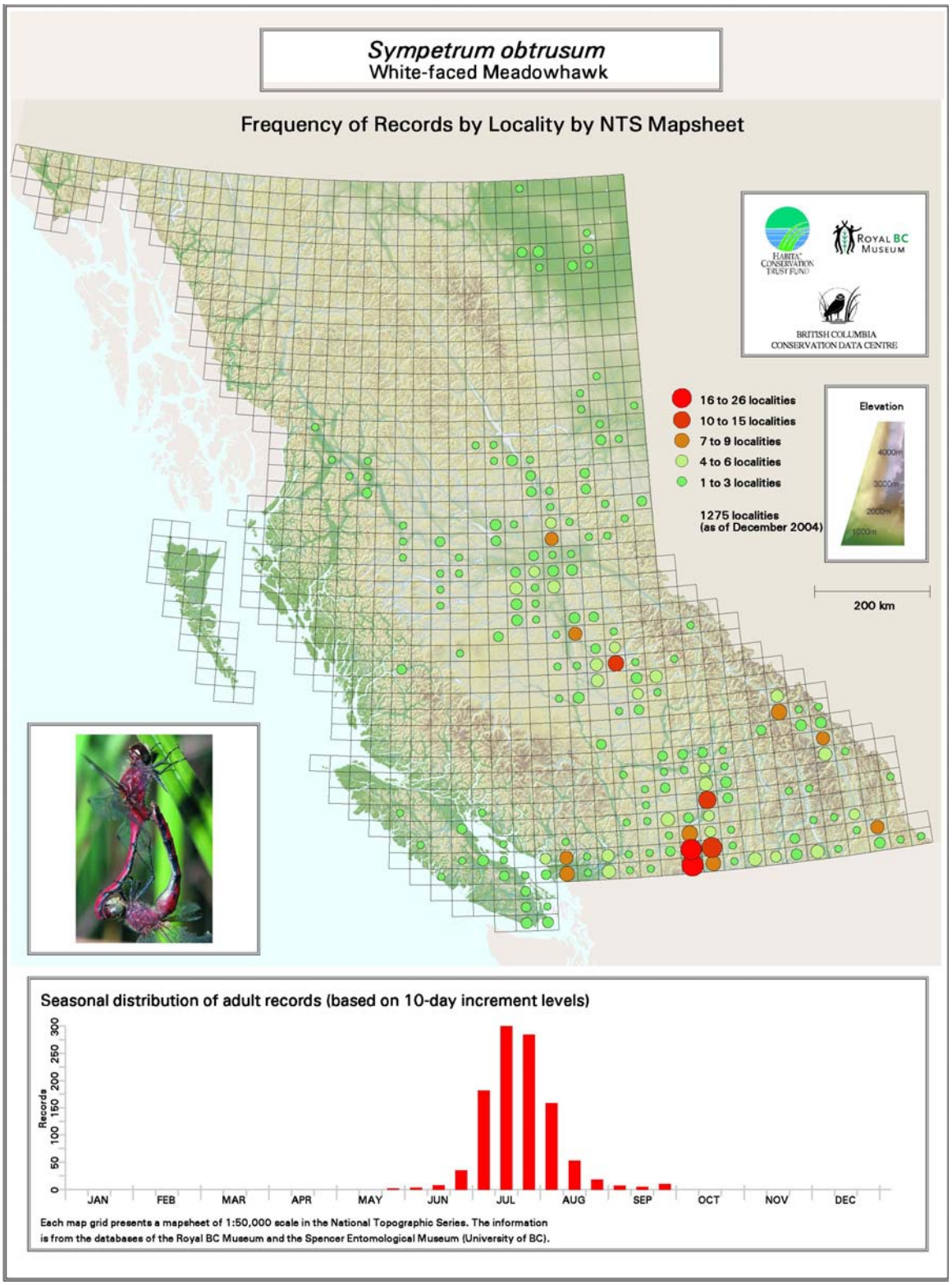
Sympetrum obtrusum Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Sympetrum obtrusum Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Sympetrum obtrusum Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.

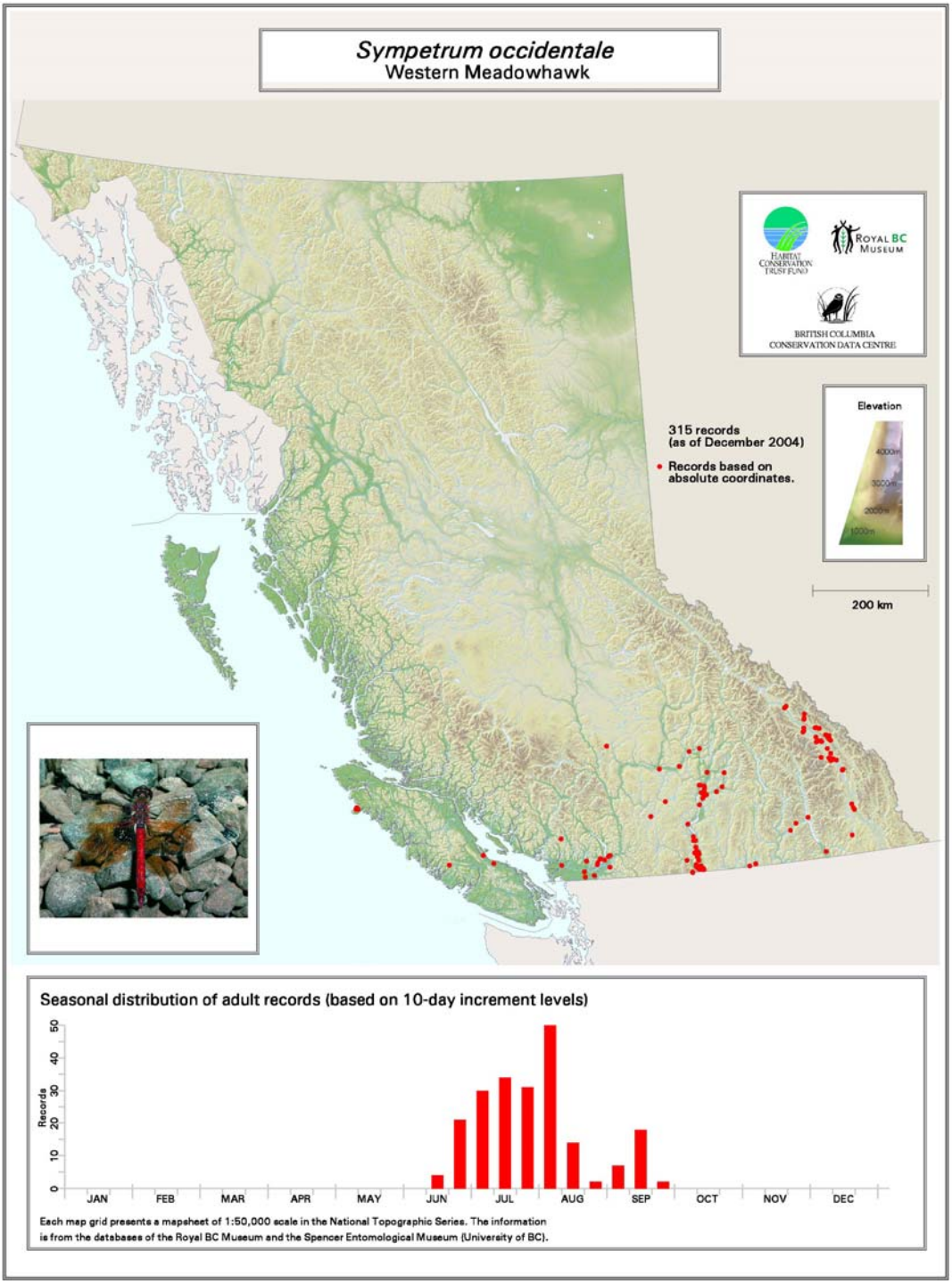


Sympetrum obtrusum Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

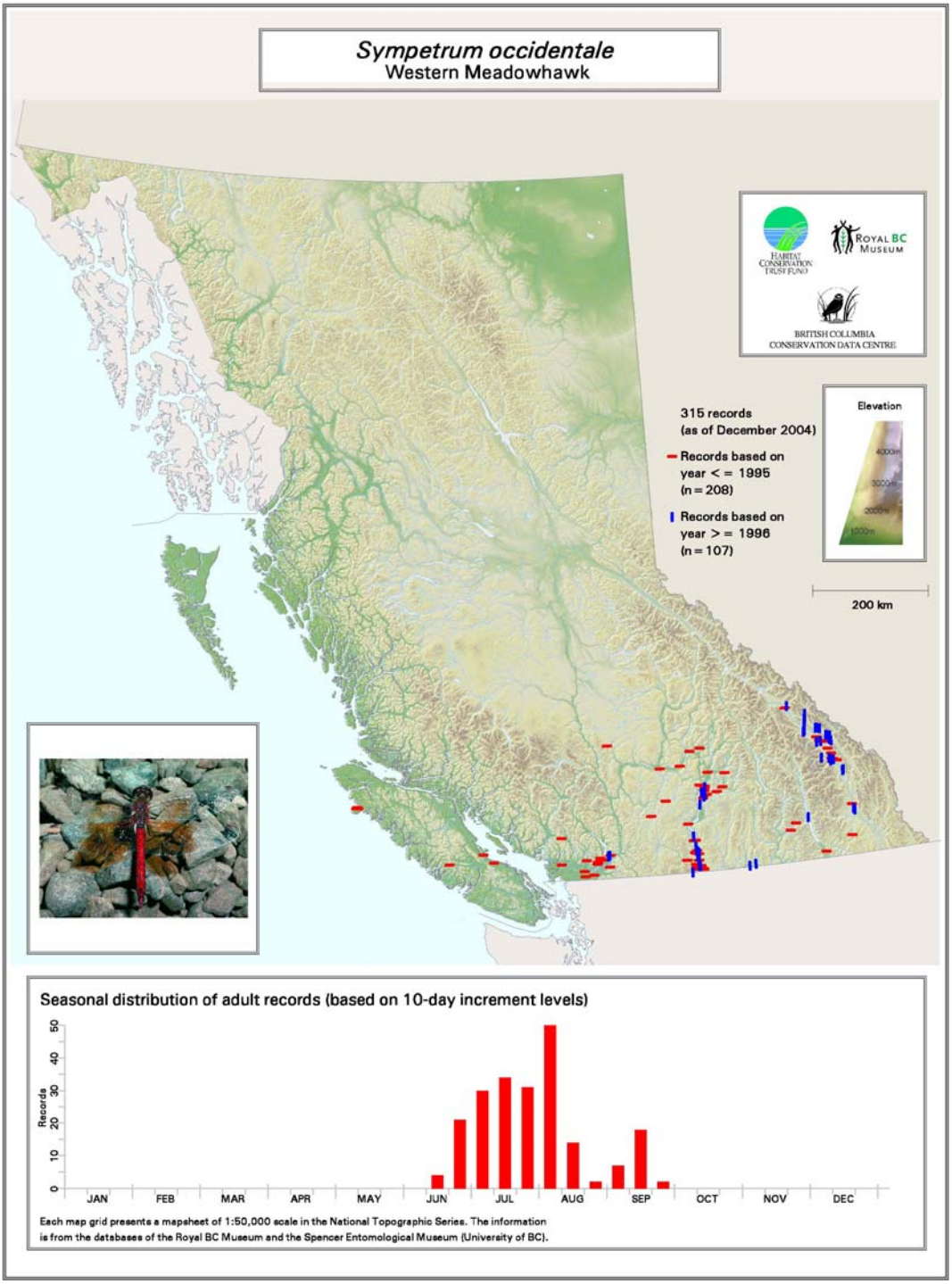
Sympetrum occidentale* (Western Meadowhawk)
BC conservation rank: S5. Yellow List.
Description: Distinguishable from others by the wide band of yellow or brown on the basal half of the wings. The yellowish face darkens to brown with age; the yellow-to-brown thorax has dark lines, thickest around the leg bases; the legs are black. The abdomen has black side stripes against brown on immatures, red on mature males and either colour on mature females. Hamule, fig. 19f; vulvar lamina a short, shallow trough. Length: male 36 mm, female 34 mm.
Global Range: Southern British Columbia and Alberta east to Minnesota and south to California, New Mexico and Missouri (Needham *et al.* 2000). Faunal element: Western (see Appendix 3).
BC Distribution: Widespread south of 52°N. Not known from the northern study area but to be looked for in the Cariboo-Chilcotin region.
Biology: Not as common as some of its relatives, but lives in a variety of ponds, marshes and lakes, especially shallow, grassy or reedy places (e.g., Wm04-07). Foragers and mating pairs often wander well away from water in open country. Some experts consider it a subspecies of the eastern Band-winged Meadowhawk (*S. semicinctum*).

BC flight period: mid June to mid October; all records are from late June to early October.

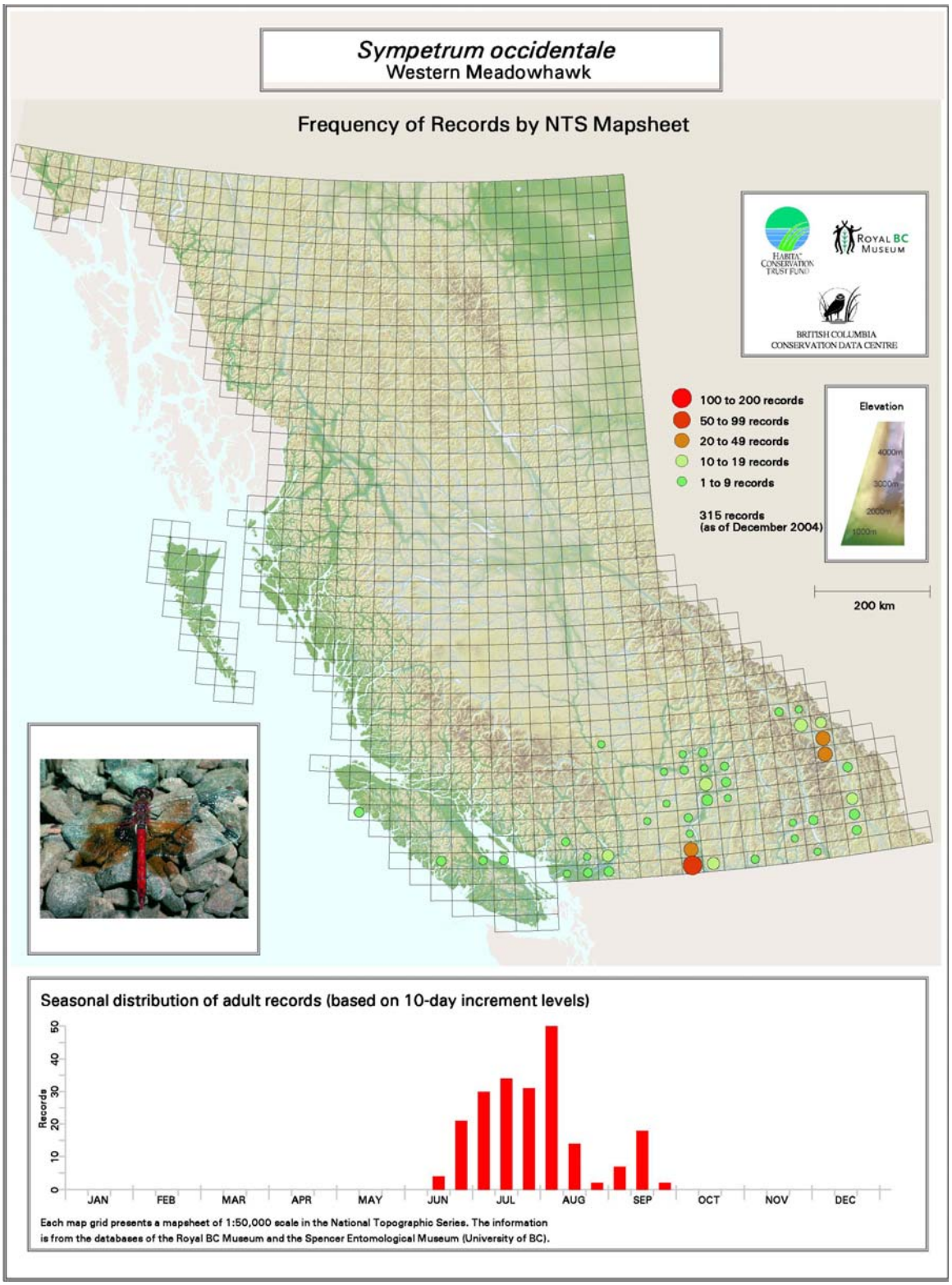
Sympetrum occidentale male. Photograph: George Doerksen, RBCM



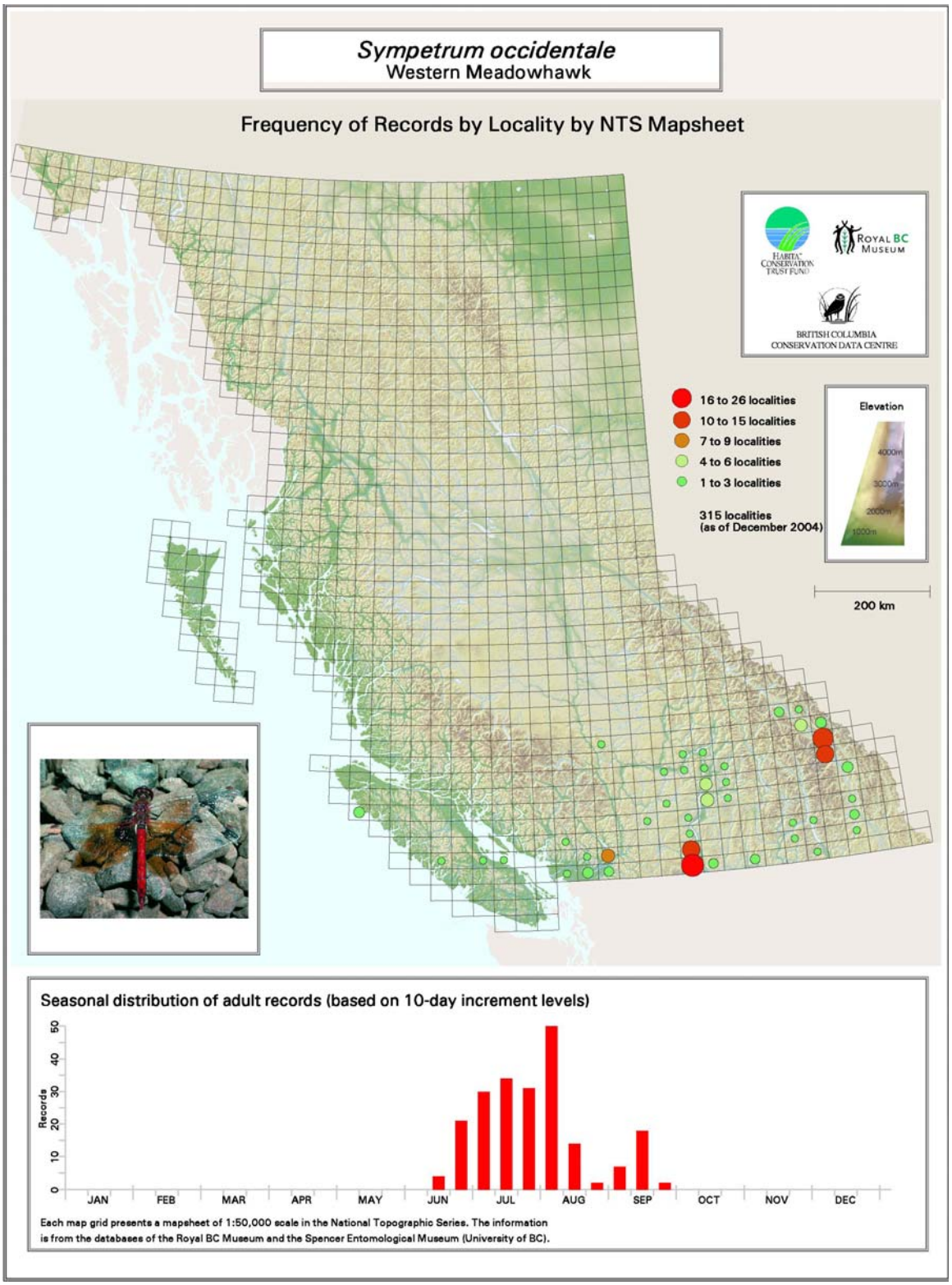
Sympetrum occidentale Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Sympetrum occidentale Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



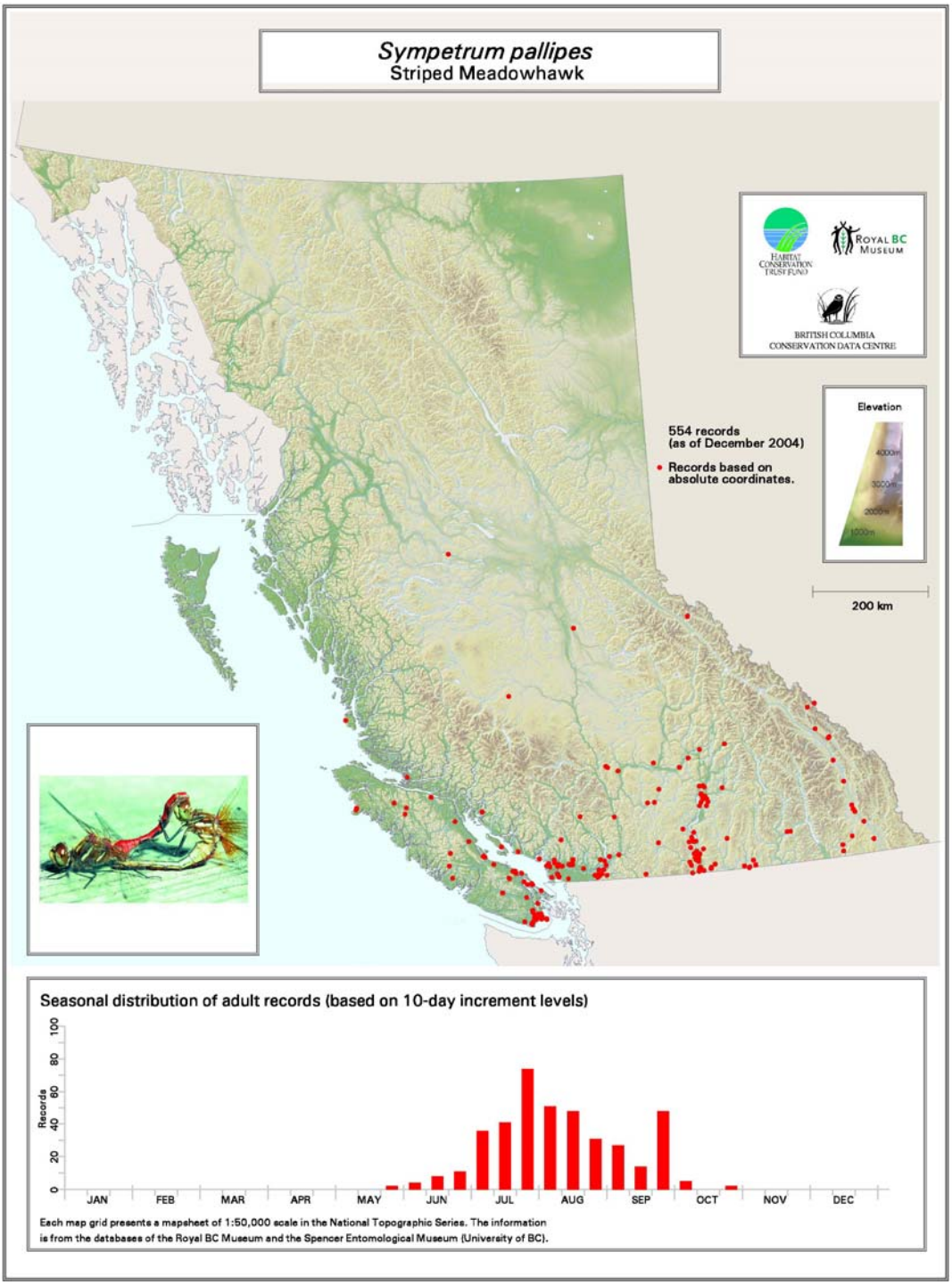
Sympetrum occidentale Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



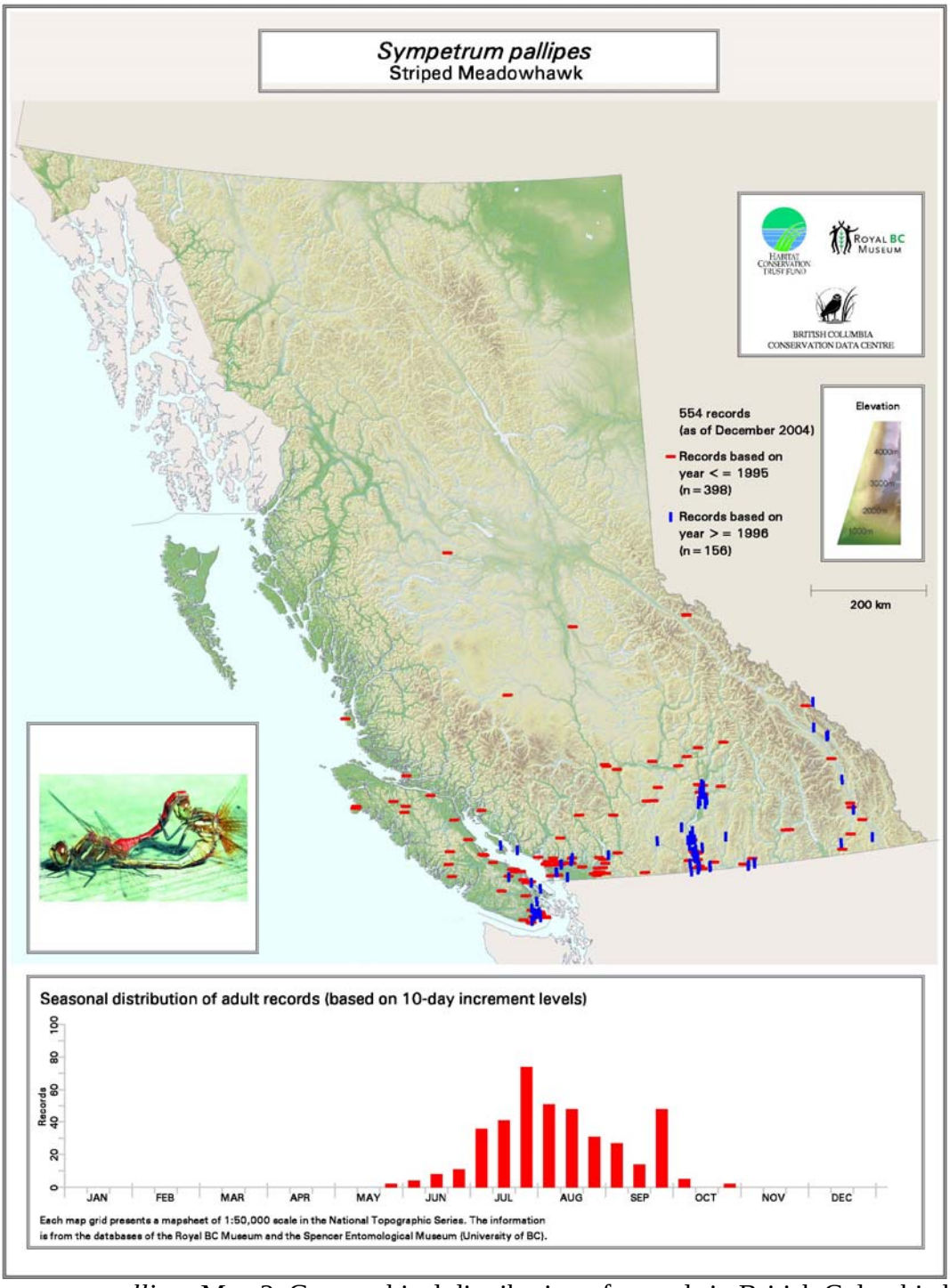
Sympetrum occidentale Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

***Sympetrum pallipes* (Striped Meadowhawk)**
BC conservation rank: S5. Yellow List.
Description: Closely related and similar to *S. obtrusum*, but has a yellow face and a pair of yellow-white stripes on the sides of the thorax and usually a smaller pair on top of the thorax. Immatures are yellow to yellow-brown, becoming red, especially on the abdomen, as males and some females mature. The legs are brown, often with pale markings, usually becoming all black, and the wings are laced with brown veins. The sides of the abdomen have saw-toothed black stripes. Hamule, fig. 19j; vulvar lamina, fig. 20b. Length: male female 35 mm.
Global range: British Columbia east to Saskatchewan and Minnesota, south to California and Texas (Bick and Mauffray 2000). Faunal element: Western (see Appendix 3).
BC Distribution: Widespread south of 54°N.
Biology: Common, especially in southern valleys and on the south coast; rare north of 51ºN. Found at marshy lakes and ponds (e.g.; Wm01, Wm04-06) and in many other habitats from acidic peatland waters (Wb51, Wb52) to temporary saline pools (Gs01-03, Wm07).
BC flight period: early June to early November; most records are from early July to early October.

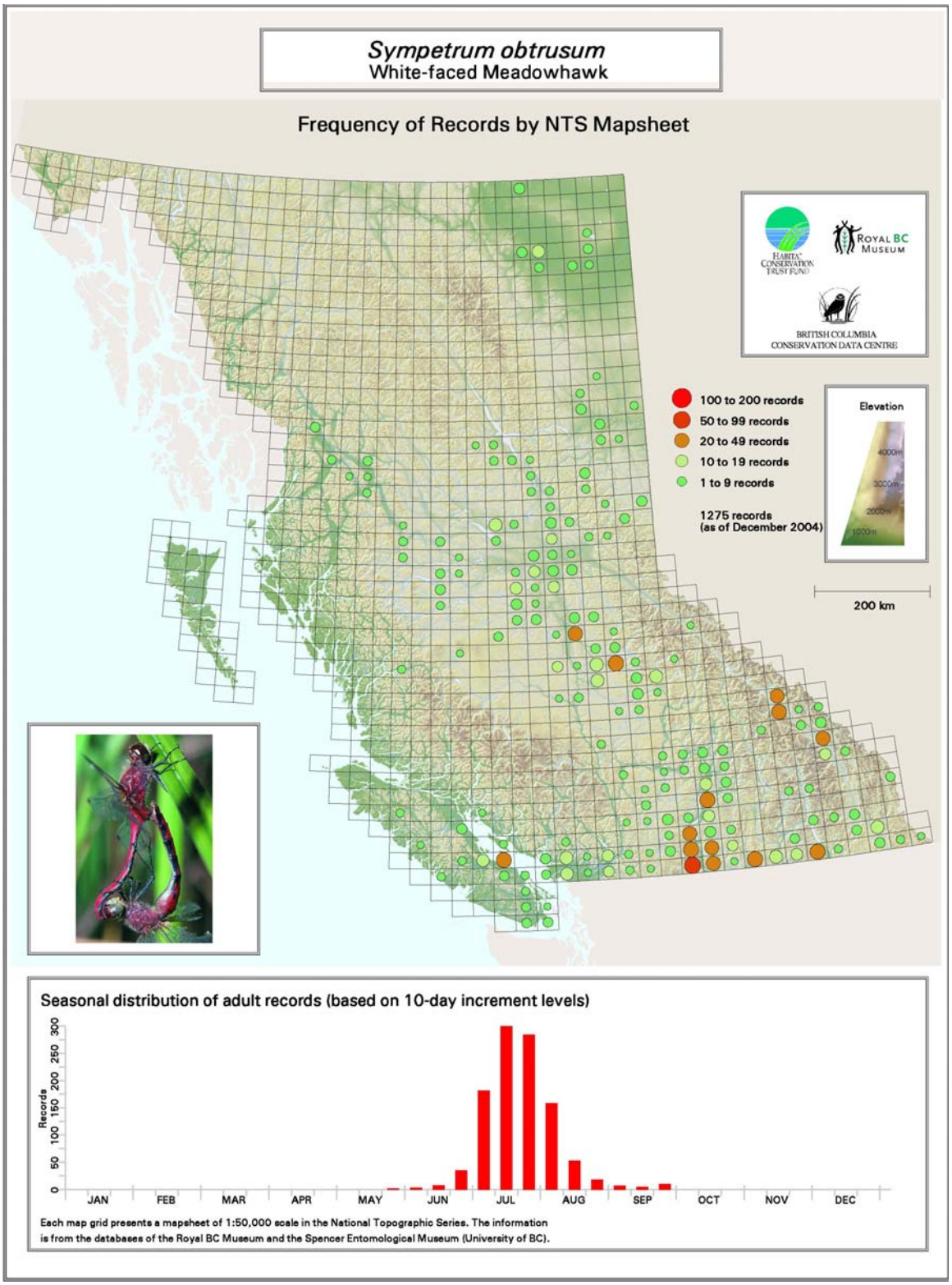
Sympetrum pallipes mating. Photograph: George Doerksen, RBCM



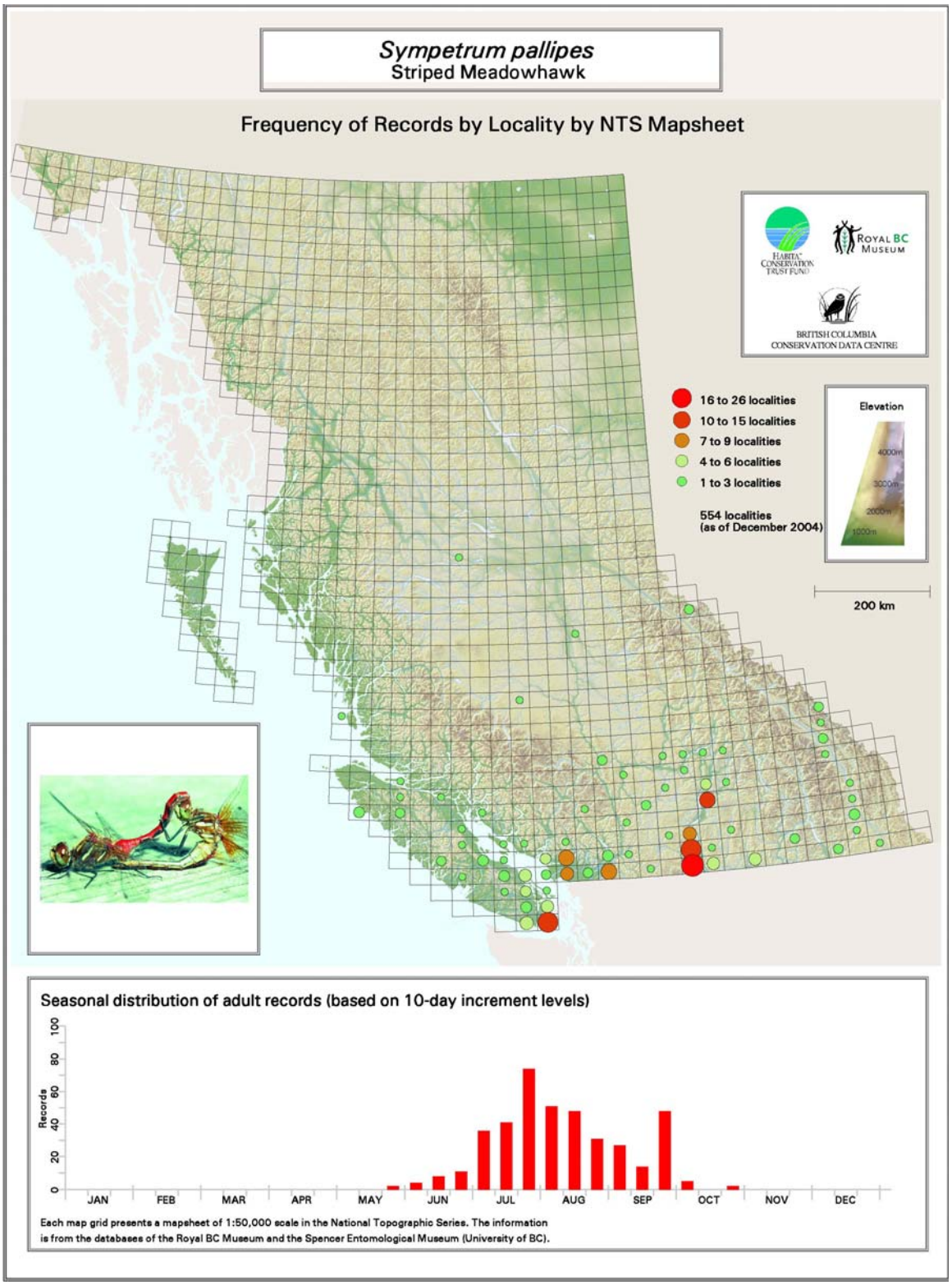
Sympetrum pallipes Map 1. Geographical distribution and seasonal abundance of records in British Columbia.



Sympetrum pallipes Map 2. Geographical distribution of records in British Columbia before and after organized surveys began in 1996.



Sympetrum pallipes Map 3. Frequency of records in British Columbia by NTS 1/50,000 mapsheet.



Sympetrum pallipes Map 4. Frequency of collection localities in British Columbia by NTS 1/50,000 mapsheet.

Appendix 3. Checklist of the Dragonflies of Northern British Columbia and their Faunal Elements.

Sixty-four species are known from the region defined here as Northern British Columbia (north of latitude 52º) At least four additional species probably occur in the region; these are marked (*). The total of 68 species represents 78% of the provincial fauna. As of December 2004, nine of this total of 68 dragonfly species are considered rare and potentially threatened and are marked (**); see also Table 1 and Appendix 5. These species are tracked by the BC Conservation Data Centre. The first column lists the scientific name of the families and species, the second gives the English names, and the third indicates the faunal element of the species. The faunal elements, which categorize the species' range types, are defined below.

Order Odonata **Suborder Zygoptera**	**Dragonflies** **Damselflies**	**Faunal Element**
Family Lestidae (5 species recorded)	**Spreadwings**	
Lestes congener Hagen	Spotted Spreadwing	Widespread
Lestes disjunctus Selys	Northern Spreadwing	Widespread
Lestes dryas Kirby	Emerald Spreadwing	(H) Widespread
Lestes forcipatus Rambur	Sweetflag Spreadwing	Austral
Lestes unguiculatus Hagen	Lyre-tipped Spreadwing	Widespread
Family Coenagrionidae (14 species recorded, 1 additional expected)	**Pond Damsels**	
Amphiagrion abbreviatum (Selys)	Western Red Damsel	Western
Coenagrion angulatum Walker(**)	Prairie Bluet	Western
Coenagrion interrogatum (Hagen)	Subarctic Bluet	Northern Boreal
Coenagrion resolutum (Hagen)	Taiga Bluet	Widespread Boreal
Enallagma boreale Selys	Boreal Bluet	Widespread Boreal
Enallagma carunculatum Morse	Tule Bluet	Austral
Enallagma civile (Hagen) (*/**)	Familiar Bluet	Austral
Enallagma clausum Morse	Alkali Bluet	Western
Enallagma cyathigerum (Charpentier)	Northern Bluet	(H) Widespread Boreal
Enallagma ebrium (Hagen)	Marsh Bluet	Transition
Enallagma hageni (Walsh) (**)	Hagen's Bluet	Transition
Ischnura cervula Selys	Pacific Forktail	Cordilleran
Ischnura damula Calvert (**)	Plains Forktail	Western
Ischnura perparva Selys	Western Forktail	Western
Nehalennia irene (Hagen)	Sedge Sprite	Southern Boreal

Suborder Anisoptera **Family Aeshnidae** (13 species recorded)	**Dragonflies** **Darners**	
Aeshna canadensis Walker	Canada Darner	Transition
Aeshna eremita Scudder	Lake Darner	Widespread Boreal
Aeshna interrupta Walker	Variable Darner	Southern Boreal
Aeshna juncea (Linnaeus)	Sedge Darner	(H) Widespread Boreal
Aeshna palmata Hagen	Paddle-tailed Darner	Cordilleran
Aeshna septentrionalis Burmeister	Azure Darner	Northern Boreal
Aeshna sitchensis Hagen	Zigzag Darner	Widespread Boreal
Aeshna subarctica Walker	Subarctic Darner	(H) Widespread Boreal
Aeshna tuberculifera Walker	Black-tipped Darner	Transition
Aeshna umbrosa Walker	Shadow Darner	Transition
Anax junius (Drury)	Common Green Darner	Austral (also in parts of Asia and the Pacific Islands)
Rhionaeschna californica Calvert	California Darner	Cordilleran
Rhionaeschna multicolor Hagen	Blue-eyed Darner	Western
Family Petaluridae (1 species recorded)	**Petaltails**	
Tanypteryx hageni (Selys) (**)	Black Petaltail	Cordilleran
Family Gomphidae (2 species recorded)	**Clubtails**	
Ophiogomphus colubrinus Selys	Boreal Snaketail	Southern Boreal
Ophiogomphus severus Hagen	Pale Snaketail	Western
Family Cordulegastridae (1 species expected)	**Spiketails**	
Cordulegaster dorsalis Hagen (*)	Pacific Spiketail	Cordilleran
Family Corduliidae (15 species recorded)	**Emeralds**	
Cordulia shurtleffi Scudder	American Emerald	Widespread Boreal
Epitheca canis MacLachlan (**)	Beaverpond Baskettail	Transition
Epitheca spinigera (Selys)	Spiny Baskettail	Transition
Somatochlora albicincta (Burmeister)	Ringed Emerald	Widespread Boreal
Somatochlora brevicincta Robert (**)	Quebec Emerald	Southern Boreal
Somatochlora cingulata (Selys)	Lake Emerald	Southern Boreal
Somatochlora forcipata (Scudder) (**)	Forcipate Emerald	Transition
Somatochlora franklini Selys	Delicate Emerald	Widespread Boreal
Somatochlora hudsonica (Selys)	Hudsonian Emerald	Western Boreal
Somatochlora kennedyi Walker (**)	Kennedy's Emerald	Southern Boreal

Somatochlora minor Calvert	Ocellated Emerald	Southern Boreal
Somatochlora semicircularis (Selys)	Mountain Emerald	Cordilleran
Somatochlora septentrionalis (Hagen)	Muskeg Emerald	Northern Boreal
Somatochlora walshii (Scudder)	Brush-tipped Emerald	Southern Boreal
Somatochlora whitehousei Walker	Whitehouse's Emerald	Widespread Boreal
Family Libellulidae (14 species recorded, 2 additional expected)	**Skimmers**	
Ladona julia Uhler	Chalk-fronted Corporal	Transition
Leucorrhinia borealis Hagen	Boreal Whiteface	Western Boreal
Leucorrhinia glacialis Hagen	Crimson-ringed Whiteface	Transition
Leucorrhinia hudsonica (Selys)	Hudsonian Whiteface	Widespread Boreal
Leucorrhinia intacta (Hagen)	Dot-tailed Whiteface	Transition
Leucorrhinia patricia Walker	Canada Whiteface	Northern Boreal
Leucorrhinia proxima Calvert	Belted Whiteface	Southern Boreal
Libellula quadrimaculata Linnaeus	Four-spotted Skimmer	(H) Widespread
Sympetrum corruptum (Hagen) (*)	Variegated Meadowhawk	Widespread (also in far eastern Russia)
Sympetrum costiferum (Hagen)	Saffron-winged Meadowhawk	Transition
Sympetrum danae (Sulzer)	Black Meadowhawk	(H) Widespread Boreal
Sympetrum internum Montogomery	Cherry-faced Meadowhawk	Transition
Sympetrum madidum (Hagen)	Red-veined Meadowhawk	Western
Sympetrum obtrusum (Hagen)	White-faced Meadowhawk	Transition
Sympetrum occidentale Bartenev (*)	Western Meadowhawk	Western
Sympetrum pallipes (Hagen)	Striped Meadowhawk	Western

Faunal Elements

Dragonfly species may be grouped with others that share similar distributions to form what can be termed faunal elements. The majority of the 68 species known or expected from northern British Columbia are restricted to North America (Nearctic Region), although six are Holarctic (H), and are defined here as species with transcontinental ranges in both North America and Eurasia. Two species (*Anax junius* and *Sympetrum corruptum*) are known from eastern Asia but do not have holarctic distributions. This section describes the Nearctic faunal elements found in the North (species with holarctic distributions are also assigned to a North American faunal element. The faunal elements are:

1. Boreal (28 species, 41%). Species occurring in the northern spruce (*Picea*) forests, across the boreal zone from treeline to the southern margin. In general, these species range from the Atlantic Provinces across the northern New England states, Quebec, northern Ontario, parts of the northern tier of mid-western states, the Prairie Provinces

north of the Great Plains, and northern British Columbia, often ranging considerably southward in the higher mountains and plateaux of the western Cordillera. These species can be further subdivided into:

> **i. Widespread Boreal** (13 species, 19%). With ranges as described above. *Coenagrion resolutum, Enallagma boreale, E. cyathigerum* (also Holarctic), *Aeshna eremita, A. juncea* (also Holarctic), *A. sitchensis, A. subarctica* (also Holarctic), *Cordulia shurtleffi, Somatochlora albicincta, S. franklini, S. whitehousei, Leucorrhinia hudsonica, Sympetrum danae* (also Holarctic).
>
> **ii. Northern Boreal** (4 species, 6%). Species that are common near the northern treeline, but that are virtually absent from the northern contiguous United States and from the southeastern Atlantic Provinces, and do not extend far south into the Cordillera. These species are *Coenagrion interrogatum, Aeshna septentrionalis, Somatochlora septentrionalis* and *Leucorrhinia patricia*.
>
> **iii. Southern Boreal** (9 species, 13%). Species that are uncommon north of 60º N in the West and absent near the Arctic treeline in the East, but range far down the Cordillera and/or into the southeastern Atlantic Provinces and New England states. Some (e.g. *Aeshna interrupta*) are common on the Great Plains. *Nehalennia irene, Aeshna interrupta, Ophiogomphus colubrinus, Somatochlora brevicincta, S. cingulata, S. kennedyi, S. minor, S. walshii* and *Leucorrhinia proxima*.
>
> **iv. Western Boreal** (2 species, 3%). Species not found east of Hudson Bay: *Somatochlora hudsonica* and *Leucorrhinia borealis*.

2. Transition (14 species, 20%). Species generally most common in the southern boreal forests and adjacent montane forests in the West, and mixed and deciduous forests in the East. *Enallagma ebrium, E. hageni, Aeshna canadensis, A. tuberculifera, A. umbrosa, Epitheca canis, E. spinigera, Somatochlora forcipata, Leucorrhinia glacialis, L. intacta, Ladona julia, Sympetrum costiferum, S. internum, S. obtrusum.*

3. Cordilleran (6 species, 9%). Species confined to the western mountains and their intervening valleys and plateaux. *Ischnura cervula, Rhionaeschna californica, Aeshna palmata, Tanypteryx hageni, Cordulegaster dorsalis, Somatochlora semicircularis*.

4. Western (10 species, 15%). Species confined to west of the 100th meridian but otherwise ranging widely in North America. *Amphiagrion abbreviatum, Coenagrion angulatum, Enallagma clausum, Ischnura damula, I. perparva, Rhionaeschna multicolor, Ophiogomphus severus, S. madidum, S. occidentale, S. pallipes*.

5. Austral (4 species, 6%). Species ranging across the continent south of the boreal forests, often extending into Transition areas, but with most of the range in the United States. *Lestes forcipatus, Enallagma carunculatum, E. civile, Anax junius* (also in parts of Asia and the Pacific Islands).

6. Widespread (6 species, 9%). Species with broad distributions in North America, from north to south and east to west, overlapping several of the other elements listed. These species range into boreal regions to varying degrees. *Lestes congener*, *L. disjunctus*, *L. unguiculatus*, *L. dryas* (also Holarctic), *Libellula quadrimaculata* (also Holarctic) and *Sympetrum corruptum* (also in parts of Asia).

Appendix 4. Dragonfly Habitats in Northern British Columbia

There are a wide variety of aquatic habitats available to dragonflies in Northern British Columbia. A general overview is presented below, with a few of the distinctive dragonfly species associated with each. Typical site associations are also given in each species account (Appendix 2). The wetland site association classification used is that of MacKenzie and Moran (2004). Dragonfly associations are much broader than plant site associations, largely because dragonflies (in both adult and larval stages) appear to react to the structure of plants and plant communities rather than plant species.

Some species, such as *Libellula quadrimaculata*, have such wide tolerances that almost any standing freshwater body half a square metre or larger in any habitat is adequate for breeding. On the other hand, *Aeshna subarctica* requires submerged moss for larval habitat. And although it requires peatlands of a certain structure (peatlands characterized by shallow pools supporting short sedges, such as *Carex limosa* and *C. livida*), *Aeshna sitchensis* apparently does not discriminate if the pond is in an acid coastal bog dominated by *Sphagnum* mosses and ericaceous shrubs with *Carex livida* in the pools (Wb52) or if the habitat is a neutral interior fen with a *Drepanocladus* moss mat, shrubby willows and *Carex limosa* in the pools (Wf08). In this case the plant lists from the two places will be radically different, but the dragonfly community will show much less variability. For this reason, at least, the occurrence of any dragonfly species overlaps many of the wetland site associations described in MacKenzie and Moran (2004) and the following discussion is kept relatively general and only the more common and obvious site associations are mentioned.

1. Large lakes (wave-washed shores with little vegetation)

Many northern lakes, such as Fraser, Purden and Moberly lakes, to name only a few, have wave-washed shores with little aquatic vegetation. In some sheltered situations, sparse stands of bulrushes (*Schoenoplectus acutus*, Wm06) or horsetails (*Equisetum fluviatile*, Wm02) may occur. The dragonflies associated with this habitat are: *Enallagma carunculatum* (in bulrush beds), *E. ebrium*, *Aeshna umbrosa*, *Ophiogomphus severus* and *Somatochlora cingulata*. In larger, deeper lakes, such as Atlin, Babine and Stuart lakes, the waters are colder and less productive, and dragonflies are restricted to shallow waters in sheltered bays, where the fauna resembles that found in small lakes and ponds.

Tatlayoko Lake, Chilcotin. A large lake with little aquatic vegetation. Photo: Robert A. Cannings

2. Small lakes and ponds with floating, but little emergent, vegetation)

A wide variety of small lakes and ponds are present in the North. Those lacking emergent vegetation of any significance often support *Nuphar lutea -- Utricularia macrorhiza* communities. Yellow pond-lily ecosystems occur on a variety of sites from deep (5 m) lakes with gravel bottoms to shallow, acidic, peat-degradation pools in coastal bogs (MacKenzie and Moran 2004). In lake habitats, a diverse array of Odonata occurs: *Enallagma ebrium, Aeshna canadensis, A. eremita, A. palmata, A. tuberculifera, A. umbrosa, Cordulia shurtleffi, Somatochlora albicincta, S. cingulata, Leucorrhinia glacialis, L. hudsonica, L. proxima, Ladona julia* and *Sympetrum obtrusum.*

Mitten Lake, Kispiox. A small lake with *Nuphar lutea* association. Photo: Gord Hutchings

3. Saline lakes

These salty lakes occur primarily in grasslands and open forests on the plateaus of the Chilcotin and Cariboo. Site associations in the saline meadows adjacent to the lakes and ponds include *Juncus balticus* (Wm07) marshes, *Distichlis spicata* var. *stricta* (Gs01), *Puccinellia nuttalliana – Hordeum jubatum* (Gs02) and *Carex praegracilis* (Gs03) associations. Some dragonfly species are able to live in this unusual habitat despite the often high salinity, and their life histories enable them to take advantage of the ephemeral nature of the shallower lakes and ponds: *Enallama boreale, E. clausum, Lestes congener, L. unguiculatus, Sympetrum internum, S. corruptum* and *S. costiferum.* These species are not restricted to this habitat.

Rock Lake, Riske Creek, Chilcotin. A saline lake. Photo: Robert A. Cannings

4. Ephemeral ponds (temporary ponds)

In addition to some saline ponds that may disappear during hot weather, fresher ephemeral waters in the southern parts of the study area support the following species: *Lestes dryas, L. unguiculatus, Sympetrum internum, S. madidum* and *S. pallipes.* Some of these species overwinter as eggs in the dry pond basin. These habitats may represent a wide range of site associations, e.g., *Schoenplectus acutus* (Wm06), *Eleocharis palustris* (Wm04), and *Juncus balticus* (Wm07) marshes.

Grassland pond near Rock Lake, Riske Creek, Chilcotin. Such ponds often dry completely in summer. Photo: Robert A. Cannings

5. Cattail/bulrush marshes (including margins of lakes, streams and ponds)

Marshes are permanently to seasonally flooded non-tidal mineral wetlands dominated by emergent grass-like vegetation. Low species diversity is typical with strong dominance by one or two aggressive species that spread vegetatively (MacKenzie and Moran 2004). Tall stands of cattails *(Typha)* and bulrushes *(Shoenoplectus)* are most common in nutrient-rich, warm waters at lower elevations having warm, dry summers. They are most common in the southern parts of the region. *Typha latifolia* marshes are designated Wm05; *Schoenplectus acutus* ones are Wm06. Species associated with these habitats are: *Lestes congener, L. disjunctus, L. dryas, L. forcipatus, L. unguiculatus, Coenagrion angulatum, Enallagma carunculatum, E. cyathigerum, Ischnura cervula, I. perparva, Aeshna canadensis, A. interrupta, A. palmata, Anax junius, Rhionaeschna californica, R. multicolor, Leucorrhinia intacta, Libellula quadrimaculata,*

Blackburn Lake, Fort St. James. *Typha* marsh. Photo: Robert A. Cannings, RBCM

Sympetrum costiferum, S. danae, S. internum, S. obtrusum and *S. pallipes.*

Pond near Como Lake, Atlin. *Schoenoplectus* marsh. Photo: Gord Hutchings.

6. Sedge marshes

Carex utriculata – Carex aquatilis marshes (Wm01) represent the most common and widespread marsh association in BC. This community is frequent on sites inundated by shallow low-energy floodwaters that have some drawdown in the late season. They include flooded beaver ponds, lake margins and floodplains. This association is found on mineral soils rather than on peat (the fen equivalent, Wf01); in general, Wm01 is more deeply flooded, has a more dynamic hydrology and has a higher cover of *C. utriculata* (MacKenzie and Moran 2004). The *Equisteum fluviatile – Carex utriculata* association (Wm02) is similar and occurs more on lake margins and floodplains where there is more water movement. Some swamp associations such as Ws02, Ws04, Ws05 and Ws06 also may be related. Typical species in these habitats are: *Lestes congener, L. disjunctus, L. dryas, L. forcipatus, Coenagrion resolutum, Enallagma boreale, E. cyathigerum, Nehalennia irene, Aeshna canadensis, A. interrupta, A. juncea, A. palmata, Epitheca canus , E. spinigera, Somatochlora semicircularis, S. hudsonica, Libellula quadrimaculata, Leucorrhinia borealis, L. hudsonica, Sympetrum internum* and *S. obtrusum.* Other types of sedge marshes have similar dragonfly faunas.

Lake at head of Yahwa Creek, Mackenzie. *Carex utriculata – Carex aquatilis* marsh. Andrew Harcombe and Tim Vogt collecting *Aeshna juncea.* Photo: Robert A. Cannings.

7. Small peatland ponds with aquatic moss

Peatlands are poorly drained wetlands where decaying moss and other vegetation accumulates as peat. Bogs are nutrient-poor peatlands where ericaceous shrubs and hummock-forming *Sphagnum mosses* form distinctive communities adapted to highly acid and oxygen-poor soils. The rooting zone is isolated from mineral-enriched groundwater (MacKenzie and Moran). Fens are nutrient-medium peatlands dominated by non-ericacious shrubs, sedges and brown mosses, where mineral-bearing groundwater is within the rooting zone. A few examples of site associations are *Carex limosa – Menyanthes trifoliata – Sphagnum* bogs (Wb13), *Ledum groenlandicum – Kalmia microphylla – Sphagnum* bogs (Wb50), *Juniperus communis – Trichoporum cespitosum – Rhacomitrium lanuginosum* bogs (Wb52), *Betula nana – Menyanthes trifoliata – Carex limosa* fens (Wf07) and *Carex limosa – Menyanthes*

Heckman Pass, western Chilcotin. Peatland ponds with submerged and floating aquatic moss. Photo: Robert A. Cannings.

trifoliata – Drepanocladus fens (Wf08).
Standing, open water occurs in many of these habitats; in these ponds and pools, especially if there is floating and submerged moss, a special group of dragonflies may occur along with species having wider ecological tolerances: *Coenagrion interrogatum, A. septentrionalis, A. subarctica, Somatochlora kennedyi, S. septentrionalis, Leucorrhinia patricia*. A few of the more important specific peatland types are summarized below.

8. Water Sedge-Beaked Sedge fens

Sedges (*Carex*) form dense stands in water-saturated areas or around many lakes and ponds. The most common site association type is Wf01 (*Carex aquatilis -- Carex utriculata* fens). It occurs from low to subalpine elevations on sites that are annually inundated by shallow, low-energy flood waters. They occupy wetter zones in larger peatlands but also form extensive pure meadow-like basins (MacKenzie and Moran 2004). Some swamp associations such as Ws02, Ws04, Ws05 and Ws06 also may be related. Some dragonfly species associated with this habitat are *Lestes congener, L. disjunctus, L. dryas, L. forcipatus, Coenagrion resolutum, Enallagma boreale, E. cyathigerum, Nehalennia irene, Aeshna interrupta, A. juncea, A. palmata, Somatochlora semicircularis, S. hudsonica, Libellula quadrimaculata, Leucorrhinia borealis, L. hudsonica, Sympetrum internum* and *S. obtrusum.*

Carex aquatilis -- Carex utriculata fen Fen near Takla Landing. Andrew Harcombe collecting. Photo: Robert A. Cannings.

9. Slender Sedge fens

Common on peat flats surrounding small lakes and ponds or in infilled basins. Prolonged shallow surface flooding is typical. Common associations are Wf05 (*Carex lasiocarpa – Drepanocladus aduncus* fens) and Wf06 (*Carex lasiocarpa – Menyanthes trifoliata* fens). Shrubs such as *Salix pedicellaris, S. candida* and *Betula nana* can occur.

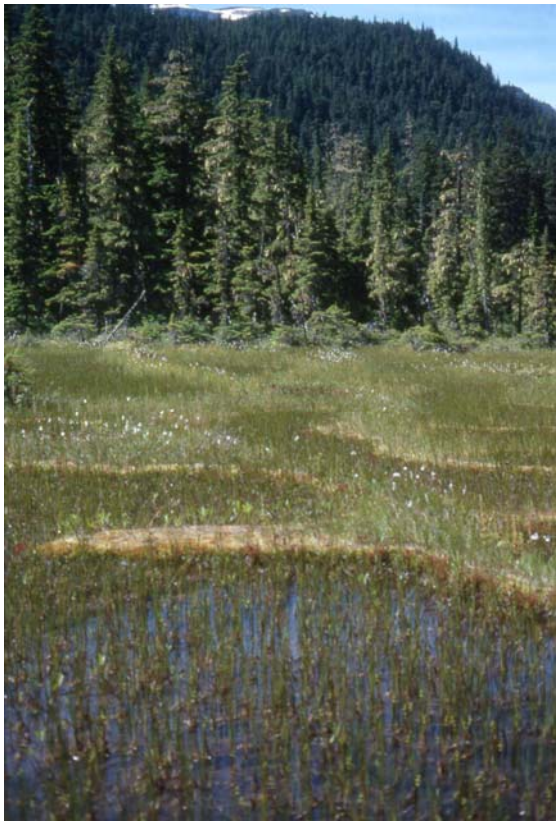
Wf06 has less flooding and greater peat saturation than Wf05; the former almost always occurs as a floating mat adjacent to a lake or pond. This habitat supports a diverse species list, including *Lestes disjunctus, Coenagrion interrogatum, C. resolutum, Nehalennia irene, Aeshna juncea, Aeshna subarctica, Leucorrhinia hudsonica, L. proxima* and *Sympetrum obtrusum.* Along the open edge of the water body, or in associated pools, *A. septentrionalis, A. subarctica, A. tuberculifera, Somatochlora kennedyi, S. septentrionalis, Leucorrhinia patricia,* among others, may occur.

Carex lasiocarpa fen at Bear Lake, north of Prince George. Photo: Robert A. Cannings.

10. Shallow sedge/moss fens: *Betula nana – Menyanthes trifoliata – Carex limosa* (Wf07) and *Carex limosa – Menyanthes trifoliata – Drepanocladus* (Wf08) associations

Peatlands affected by flowing water, evenly vegetated with low sedges and shallowly flooded or dotted with shallow pools only a few centimetres deep. *Carex limosa* rooted in shallow water is the constant characteristic of Wf08, which is typical of patterned fens host a particular assemblage of species: *Lestes disjunctus, L. congener, L. forcipatus, Enallagma boreale, Coenagrion resolutum, Nehalennia irene, Aeshna septentrionalis, A. sitchensis, A. tuberculifera, Somatochlora brevicincta, S. franklini, S. kennedyi, S. semicircularis* and *S.*

whitehousei, Leucorrhinia hudsonica and Sympetrum danae. Widspread species and those noted in #9 above may also occur.



Patterned fen at Williams Creek Ecological Reserve, Terrace. Photo: Robert A. Cannings.

Fen near Takla Landing. Photo: Robert A. Cannings.

11. Outer Coastal bogs

Bogs on the outer coastal lowlands form a blanket mire complex on level or sloping terrain. Hypermaritime climate, high precipitation and humidity and mineral poor bedrock produce. The *Pinus contorta – Empetrum nigrum – Sphagnum austinii* site association (Wb51) and *Juniperus communis – Trichoporum cespitosum – Rhacomitrium lanuginosum* (Wb52) association are typical and are perhaps the most important for Odonata. Stunted *Pinus contorta, Chamaecyparis nootkatensis* and Thuja plicata are common; shrubs such as *Empetrum nigrum, Myrica gale, Ledum groenlandicum* and *Juniperus communis* are common. Ponds and pools usually have firm, peaty margins. *Lestes disjunctus, Enallagma boreale, Aeshna interrupta, Aeshna sitchensis, Cordulia shurtleffii, Somatochlora albicincta, Leucorrhinia hudsonica, Libellula quadrimaculata* and *Sympetrum danae* are typical species.

Tow Hill Bog, Graham Island, Queen Charlotte Islands. A coastal *Sphagnum* bog. Photo: Robert A. Cannings.

12. Streams

Odonata are not normally found in the cold streams of mountainous areas. The following species, when living in flowing waters, are generally restricted to rather warm, slow streams or montane streams that drain lake basins, beaver ponds or peatlands: *Ophiogomphus colubrinus*, *Ophiogomphus severus* and *Aeshna umbrosa.* The latter two species also live in lakes. *Somatochlora minor* inhabits small montane streams and *S. walshii* lives in streams or slowly flowing water in peatlands. Yet to be found in the region, but to be looked for, *Cordulegaster dorsalis* is found in many warm streams draining lakes on the west side of the Coast Mountains south of 52º. It is known from coastal Alaska and from spring-fed streams in the southern Interior.

Tezzeron Creek, Fort St. James. Andrew Harcombe hunting *Ophiogomphus colubrinus*. Photo: Robert A. Cannings.

13. Springs and shallow seeps

Some of the more uncommon species of Odonata are associated with small springs and shallow seeps. *Amphiagrion abbreviatum* is known from only one locality in the region in such habitats. In the northern fringes of its range, *Ischnura damula* is normally restricted to warm springs, such as Liard River Hot Springs. *Somatochlora forcipata* is apparently restricted to spring-fed streamlets through sloping fens. Potential habitat occurs in subalpine fens such as *Salix barclayi – Carex aquatilis – Aulacomnium palustre* (Wf04) and *Eriophorum angustifolium – Caltha leptosepala* (Wf12*). Tanypteryx hageni* larvae burrow in seepage areas in coastal fen associations such as *Eriophorum angustifolium – Sphagnum* (Wf50).

Liard River Hot Springs. Photo: Robert A. Cannings.

Site Association Information (taken from MacKenzie and Moran, 2004)

Ecosystem Type	Association Code	Site Association Name
Saline associations at grassland ponds	Gs01	*Distichlis spicata* var. *stricta* (Alkali saltgrass)
	Gs02	*Puccinellia nuttalliana – Hordeum jubatum* (Nuttall's alkaligrass - Foxtail barley)
	Gs03	*Carex praegracilis* (Field sedge)
Bogs	Wb12	*Scheuchzeria palustris – Sphagnum* (Scheuchzeria – Peat-moss)
	Wb13	*Carex limosa – Menyanthes trifoliata – Sphagnum* spp. (Shore sedge - Buckbean - Peat-moss)
	Wb50	*Ledum groenlandicum – Kalmia microphylla – Sphagnum* spp. (Labrador Tea – Bog-laurel - Peat-moss)
	Wb51	*Pinus contorta – Empetrum nigrum – Sphagnum austinii* (Shore pine – Black crowberry – Tough peat-moss)
	Wb52	*Juniperus communis – Trichoporum cespitosum – Rhacomitrium lanuginosum* (Common juniper – Tufted clubrush – Hoary rock-moss)
Fens	Wf01	*Carex aquatilis* -- *Carex utriculata* (Water sedge – Beaked Sedge)
	Wf02	*Betula nana – Carex aquatilis* (Scrub birch – Water sedge)
	Wf03	*Carex aquatilis – Sphagnum* (Water Sedge – Peat-moss)
	Wf04	*Salix barclayi – Carex aquatilis – Aulacomnium palustre* (Barclay's willow – Water sedge – Glow moss)
	Wf05	*Carex lasiocarpa – Drepanocladus aduncus* (Slender sedge – Common hook-moss)
	Wf07	*Betula nana – Menyanthes trifoliata – Carex limosa* fens (Scrub birch – Buckbean – Shore sedge)
	Wf08	*Carex limosa – Menyanthes trifoliata – Drepanocladus* spp. (Shore sedge – Buckbean – Hook moss)
	Wf09	*Eleocharis quinqueflora – Drepanocladus* (Few-flowered spike-rush – Hook moss)
	Wf10	*Trichophorum alpinum – Scorpidium revolvens* (Hudson Bay clubrush – Red hook-moss)
	Wf12	*Eriophorum angustifolium – Caltha leptosepala* (Narrow-leaved cotton-grass – Marsh-marigold)
	Wf50	*Eriophorum angustifolium – Sphagnum* spp. (Narrow-leaved cotton-grass – Peat-moss)

Ecosystem Type	Association Code	Site Association Name
Marshes	Wm01	*Carex utriculata – Carex aquatilis* (Beaked sedge – Water sedge)
	Wm02	*Equisetum fluviatile - Carex utriculata* (Swamp horsetail – Beaked sedge)
	Wm05	*Typha latifolia* (Cattail)
	Wm04	*Eleocharis palustris* (Common spike-rush)
	Wm06	*Schoenoplectus acutus* (Great bulrush)
	Wm07	*Juncus balticus* (Baltic rush)
Swamps	Ws02	*Alnus incana – Spiraea douglasii – Carex sitchensis* (Mountain alder – Pink spirea – Sitka sedge)
	Ws04	*Salix drummondiana – Carex utriculata* (Drummond's willow – Beaked sedge)
	Ws05	*Salix maccalliana – Carex utriculata* (MacCalla's willow – Beaked sedge)
	Ws06	*Salix sitchensis – Carex sitchensis* (Sitka willow – Sitka sedge)