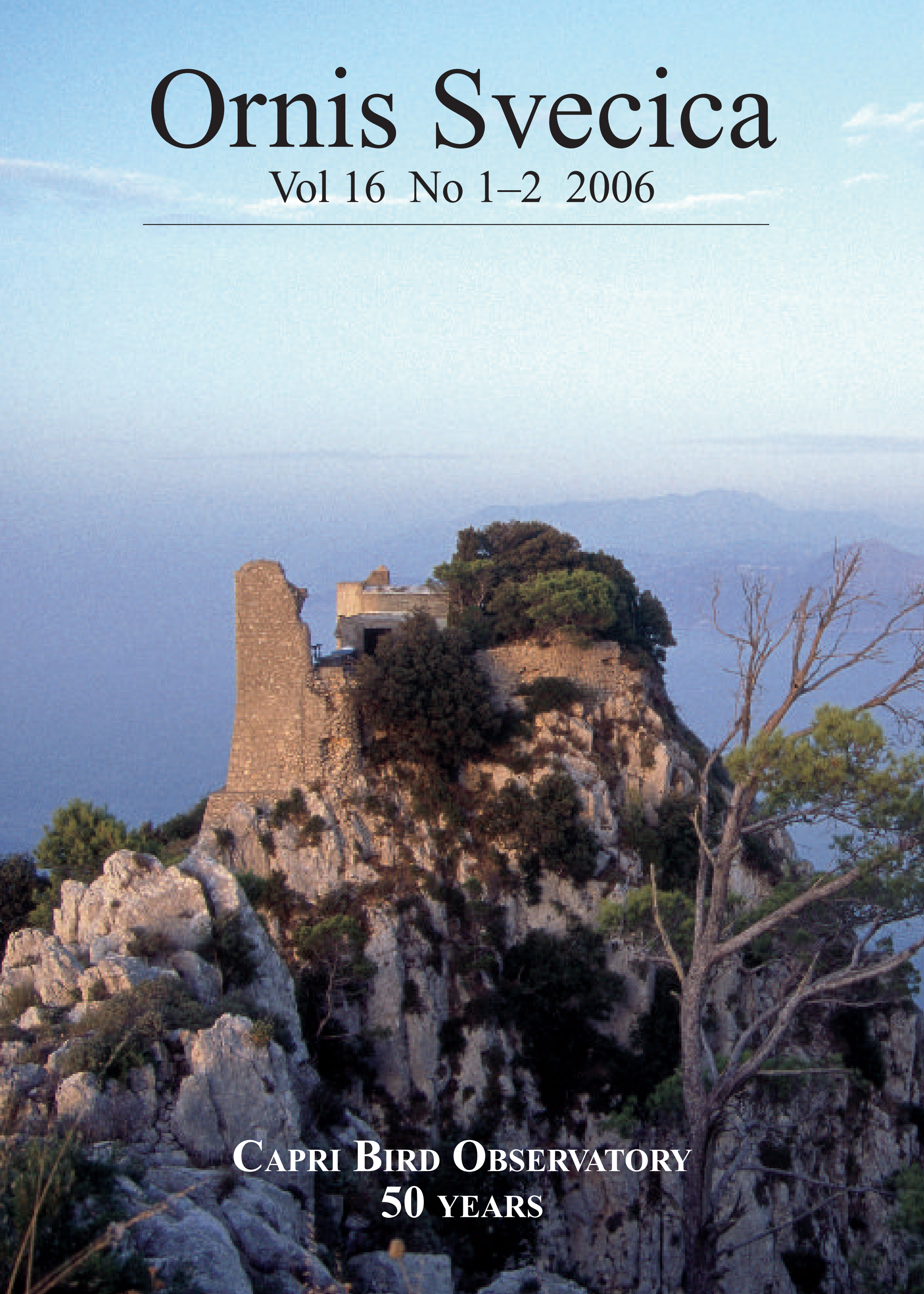
Ornis Svecica

Vol 16 No 1–2 2006



Capri Bird Observatory
50 years

ORNIS SVECICA ISSN 1102-6812

Ornis Svecica is indexed in BIOSIS, CSA/Ecology Abstracts, Zoological Record, and Elsevier Bibliographical Databases. Free access to abstracts in www.eurobirding.com.

ORNIS SVECICA utges av Sveriges Ornitologiska Förening. Tidskriftens mål och inriktning är att utgöra ett forum för primära forskningsrapporter, idéutbyte, debatt och brev rörande ornitologins alla områden. Bidrag som rör Europas fågelfauna prioriteras. Bidrag om generella frågor tas emot oberoend av ursprung. Vi vill särskilt uppmuntra icke professionella ornitologer att sända in sina resultat och idéer men välkomnar givetvis bidrag från professionella forskare. Språket är svenska eller engelska med en utförlig sammanfattning på det andra språket.

ORNIS SVECICA is issued by the Swedish Ornithological Society. The aims and scope of the journal are to provide a forum for original research reports, communications, debate and letters concerning all fields ornithology. Contributions dealing with the European bird fauna are given priority. Contributions on general problems are considered independent of origin. We particularly encourage nonprofessional ornithologists to submit their results and ideas but of course welcome submissions from professional scientists. The language will be English or Swedish with a comprehensive summary in the other language.

Korrespondens *Correspondence*
Manuskript skall första gången sändas till huvudredaktören. Varje bidrag tilldelas en av redaktörerna. Utomstående bedömare kommer att utnyttjas när det behövs. Redaktören bestämmer om och i vilken form bidraget skall accepteras. Under denna process korresponderar författaren med redaktören.

Manuscripts when first submitted should be sent to the editor-in-chief. Each contribution will be given to one of the editors. External reviewers will be used if necessary. The editor decides whether and in what form to accept the paper. During this process the author(s) will correspond directly with the editor.

Prenumeration *Subscription*
Prenumeration på ORNIS SVECICA kostar 240 SEK till svenska adresser och 290 SEK till utländska adresser. Denna avgift inkluderar ej medlemskap i SOF. Medlemsavgiften är 360 SEK (160 SEK för person under 21 år) till svenska adresser och 530 SEK (340 SEK) till utländska adresser. Medlemsavgiften inkluderar både ORNIS SVECICA och VÅR FÅGELVÄRLD.

Subscription to ORNIS SVECICA is 290 SEK to addresses abroad and 240 SEK to addresses in Sweden. This fee does not include membership. The membership fee is 530 SEK to addresses abroad (340 SEK for members younger than 21 years) and 360 SEK (160 SEK) to addresses within Sweden. This fee includes both ORNIS SVECICA and the more popular journal VÅR FÅGELVÄRLD.

Betala till postgiro 19 94 99-5, Sveriges Ornitologiska Förening. Ange noga vad betalningen avser. Glöm inte namn och adress!

Pay to Swedish Postal Giro Account 19 94 99-5, Swedish Ornithological Society, Stockholm or by bank cheque (no personal cheques). Indicate carefully what you are paying for and do not forget to include your name and address!

Adresser *Addresses*
Föreningens kontor *Office of the Society*: Sveriges Ornitologiska Förening, Ekhagsvägen 3, 104 05 Stockholm.
Vår Fågelvärlds redaktion *Editor of Vår Fågelvärld*: Anders Wirdheim, Genvägen 4, S-302 40 Halmstad.
Ornis Svecicas redaktion *Editors of Ornis Svecica*: c/o Sören Svensson, Ekologihuset, S-223 62 Lund.

Omslagsfoto *Cover photo:* Niclas Jonzén.

Ornis Svecica

Vol. 16, 2006

SVERIGES ORNITOLOGISKA FÖRENING

Swedish Ornithological Society

Ornis Svecica utges av Sveriges Ornitologiska Förening, Ekhagsvägen 3, 104 05 Stockholm.
Ornis Svecaica is published by the Swedish Ornithological Society, Ekhagsvägen 3, 104 05 Stockholm.
ISSN 1102-6812

Capri Bird Observatory – 50 years

Editorial

The Swedish Ornithological Society, Ottenby Bird Observatory, and the editors of Ornis Svecica are proud to present this special issue, containing a number of commissioned papers intended to reflect the many aspects of migration research conducted at the Capri Bird Observatory during fifty years. We thank Christian Hjort, who currently is responsible for the work at Capri, on behalf of the Ottenby Bird Observatory. Thanks to his dedicated work, it became possible to publish this issue as a part of the celebrations to take place in connection with the Carpri Bird Observatory's fiftieth anniversary in May, 2006. We also thank the authors who have summarized their own work or reviewed different aspects of Mediterranean bird migration. A special thank goes to Levente Erdeös, who contributed a most entertaining and thoughtprovoking essay as an introduction.

Sören Svensson, Editor-in-chief, Ornis Svecica
Åke Lindström, President, Ottenby Bird Observatory

Preface

This special issue of Ornis Svecica celebrates the 50th anniversary of Capri Bird Observatory in southern Italy. The observatory, housed in the old Castello Barbarossa on its cliff-top some 400 m above the Bay of Naples, combines an optimal scientific location with a pleasant environment for the working ornithologists! Starting as a Swedish venture in the 1950s, it is now since long run jointly by Italian and Swedish scientists, representing the Italian Ringing Centre in Bologna and the Ottenby Bird Observatory in Sweden.

The papers presented here sketch the history of the bird observatory and present results of special studies carried out in recent years. Some also make use of the long sequence of observations available from Capri – one of the longest from the whole Mediterranean area. To this comes an overview of the long-time and large-scale Italian "small-islands" PPI (Progetto Piccole Isole) project on migratory birds, in which work on Capri have played an important role. There is also an overview of Swedish bird migration work in the eastern Mediterranean. The whole issue begins with a literary contemplation on birds and the frailty of life and nature, written by Levente Erdeös, a long-time curator of Villa San Michele, on the grounds of which the bird observatory is situated.

Villa San Michele, once built by the famous Swedish medical doctor and philanthropist Axel Munthe, was at his death in 1949 donated to the Swedish state. It is since then a center for Swedish-Italian cultural integration, a place of inspiration for countless Swedish writers, artists, composers, etc. The bird observatory was founded by Carl Edelstam and colleagues in 1956, after an invitation made by the then curator of Villa San Michele Josef Oliv. The Swedish part of the work was rejuvenated in the mid-1980s by Jan Pettersson, then head of Ottenby Bird Observatory. A very large number of ornithologists have worked there through the years, too many to be mentioned here, but a good number of them, Swedish as well as Italian, are found as authors of the papers in this special issue.

Our very special thanks for all these fruitful years must go to the San Michele Foundation in Stockholm and to Villa San Michele with its competent, helpful, generous and pleasant staff – with its curators from Josef Oliv, as mentioned above, to our present host Peter Cottino.

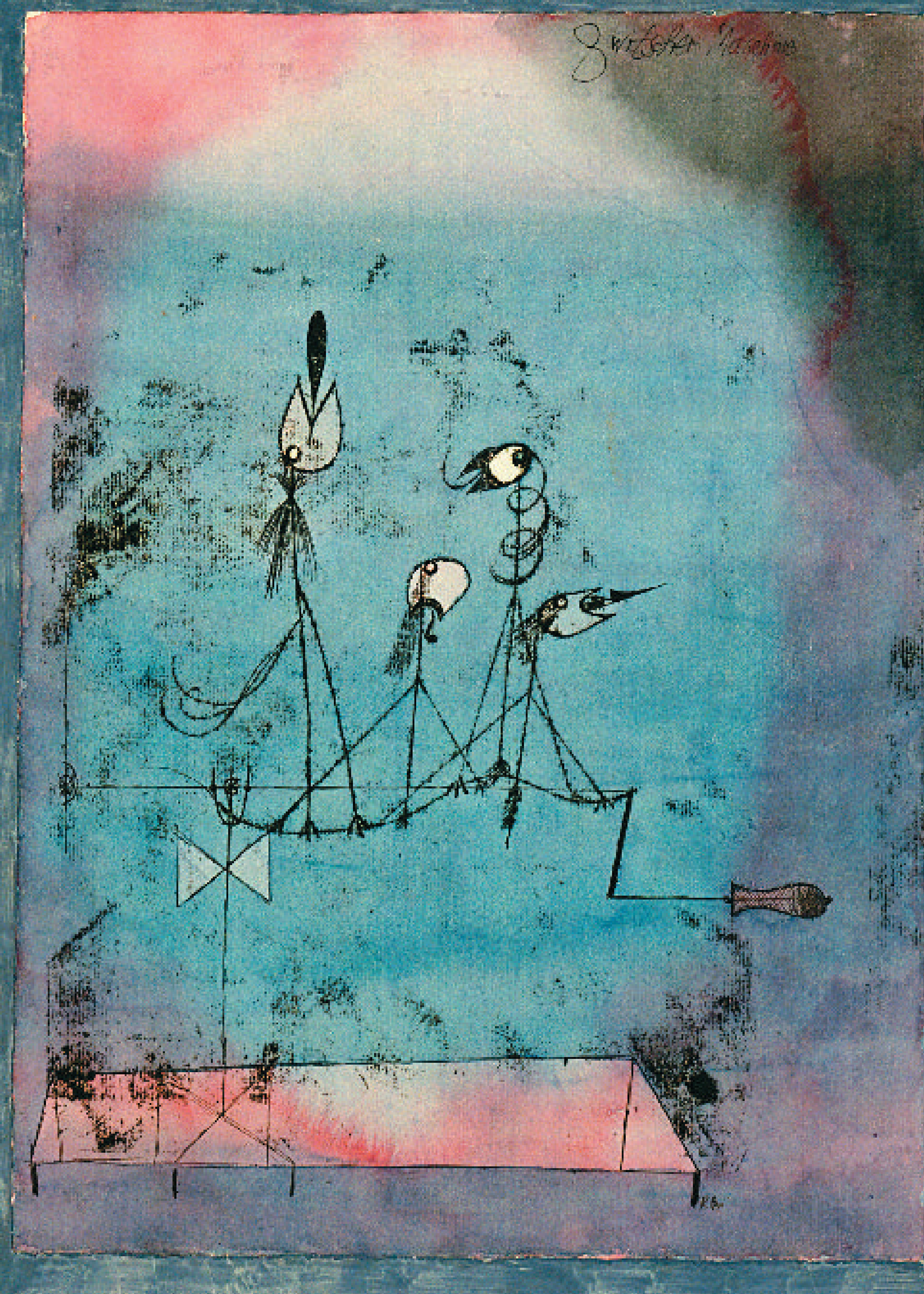
Christian Hjort

Inledande berättelse av Levende A. S. Erdeös

Levente András Sándor Erdeös föddes i Budapest och kom till Sverige som 21-åring år 1956. Han tog arkitektexamen vid Chalmers tekniska högskola i Göteborg. Var yrkesverksam i den staden och i dess omnejd i tolv år. Efter erhållandet av arkitektstipendiet vid Svenska Institutet i Rom blev hans påbyggnadsstudier förlagda till Italien, dit han återkom 1975 för att tillsammans med Romfödda makan Maria Luigia under tjugo år förestå Axel Munthes San Michele på Capri. För den berömda villan skapade han, i samarbete med professor Jan Wallinder, fågelpaviljongen *Olivetum*. Sedan 1995 ägnar han sig åt författarskap. Han har publicerat följande böcker med Capriteman: *Josef Oliv på väg till San Michele* (i samarbete med Enrico Gargiulo), Arte Tipografica, Neapel 1995; *Axel Munthes San Michele – en illustrerad vägledning*, Stiftelsen San Michel, Capri 1997 (utgiven på fem språk); *Boken om Axel Munthes San Michele – hundra år ur Capris historia*, Carlssons Förlag, Stockholm 1998 (engelsk upplaga planerats utkomma 2006) samt *Människor i azurblått landskap – folk, miljöer, arkitektur* på Capri, Carlssons Förlag, Stockholm 2002.

Levente András Sándor Erdeös *was born in Budapest and came to Sweden in 1956, 21 years old. He got his degree as an architect at Chalmers university in Göteborg, in which town he then worked for some years, whereafter he pursued special studies in Rome. From 1975 until their retirement in 1995 he and his wife Maria Luigia were in charge of the Swedish cultural institution Villa San Michele on Capri. He also projected (in collaboration with professor Jan Wallinder) the "Olivetum" garden pavillion for ornithological exhibition purposes. Still living on the island, he nowadays is an author, having written several books about Capri and Villa San Michele, whose monography in English version titled "Axel Munthe's Villa in the Capri Sun" will be published in 2006.*

Paul Klee (1879–1940): *Die Zwitscher-Maschine (Twittering Machine)*, 1922.
Museum of Modern Art, New York. © 2005, Digital Image, The Museum of Modern Art, New York/Scala, Florence, and Paul Klee/BUS. Watercolor, and pen and ink on oil transfer drawing on paper, mounted on cardboard; comp. sheet 41.3×30.5 cm, mount sheet 63.8×48.1 cm.



ORNIS SVECICA 16: 6–12, 2006

En barock historia

A baroque tale

LEVENTE A. S. ERDEÖS

Mitt första möte med *Die Zwitscher-Maschine* ägde rum på en stor Paul Klee-utställning i Bern. Bland en imponerande mängd tavlor fanns det många som tilltalade mig, bättre sagt talade till mig, men i tumultet uppfattade jag inte denna bilds energiska kvittrande riktigt klart. Jag blev varse det först när jag, återkommen till Capri, tog fram utställningskatalogen från vars omslag Klees fåglar högljutt tilldrog sig min uppmärksamhet. Ur bildens linjer och färger bröt en ångestfull melodi emot mig, i ojämn takt. Det var ett svårdechiffrerbart budskap som konstnärens diaboliska mekanism ville förmedla. Och det är just detta som denna berättelse om fåglar och människor tagit vara på.

My first encounter with Die Zwitscher-Maschine took place at a Paul Klee memorial exhibition in Bern. Among an impressive amount of paintings there were many that appeared attractive to me, that is they attracted my attention, but initially this particular picture´s energetic twittering did not come through clear enough! I realized this only when, back on Capri, I looked through the exhibition catalogue again, from the cover of which Klee´s birds loudly attracted my attention! From lines and colours of the picture a melody of agony emanated, a message difficult to interpret which the painter´s diabolic machine wanted to tell. And this is what the present tale of birds and men is all about.

Levente A. S. Erdeös

Föreliggande allegoriska berättelse ingår i en ännu icke publicerad volym vars tema är Capri och det motsägelsefulla förhållandet mellan Capris två ansikten. På denna poesins och legendernas ö finner man nämligen naturens skönhet och harmoni i en fredlig men spänningsladdad samlevnad med den ohejdade materialismens och det så ofta bedrägliga framstegets anda. Tills balansen mellan dem rubbas...

Berättelsens hjältar är dels en åldrig herre, dels några fåglar som lever i trädgården nedanför hans ensligt belägna hus vid foten av Monte Solaro. Han verkar äga magiska krafter med vars hjälp fåglarna lär sig sjunga i kör på hans pianoackompanjemang. En allt större publik samlas för att bevittna detta under. Men idyllen bryts, då området nedanför huset blir föremål för en spekulativ exploatering. Fåglarna tvingas lämna sitt hem.

Kören återupptar efter ett tag sin musikaliska verksamhet men ingenting är längre som det var förut. Även den gamle herrens sista försök att anpassa sig till den nya tiden misslyckas.

This allegoric tale will be part of a not yet published volume, on the theme of the island of Capri in Italy and on the contradicting relationship between its two faces. On this island of poetry and legends one finds the beatuy of nature in a peaceful but tensive coexistence with materialism and the all too often illusive spirit of progress. Until the balance between them is upset...

The heroes of the tale are an elderly man and some birds which live in the garden by his isolated house below Monte Solaro. He seems to possess magic powers, which help the birds to sing in chorus to the ackompaniment of his piano. Larger and larger crowds of people gather to witness the wonder. But the idyllic situation is disrupted when the area below the house is exploited for building purposes and the birds forced to leave their homes.

The choir reassembles after some time, but nothing is like before, and also the old man´s last and radical attempt to adapt to the new times becomes a failure!

Levente A. S. Erdeös
Via G. Orlandi 17, I-80071 Anacapri, ITALIA

Förr i tiden rådde det god grannsämja mellan husen på Capri. De tillhörde ju en och samma stora familj. Där stod svågrar och kusiner i rad och lapade solen eller kröp ihop i en klunga för att skydda varandra från de hårda vindarna. Alla hyste stor respekt för en avlägsen släkting som stod lite grann för sig själv högt uppe i en enslig backe. De tyckte att den individen var så praktfull och förnämlig. I själva verket var den lanthus för en patricierfamilj, alltså något större och finare än de andra. Den långa fasaden, uppförd i en enkel men värdig barockstil, bar pannan högt för att bättre kunna se ut över Neapelbukten.

Men med åren började främlingar blanda sig in i husgrupperna. I sin Pompeji-röda skrud lyste de som vilsekomna paradisfåglar mitt bland sina vitmenade eller varmgrå-rappade grannar. Även klippuddarna blev ockuperade av skrytsamma individer. Till och med i Capris gröna mantel började konstiga utväxter sticka upp huvudet.

Lanthuset högt uppe i backen har visst också fått grannar från höger och vänster, men ginsten bakom byggnaden färgade ännu berget gult ända upp till krönet. Nedanför barockfasaden låg ett stycke grönsaksland. Omgivna av en präktig lund mognade vindruva och frukt i fred. Hus och trädgård utövade en beundransvärt harmonisk växelverkan på varandra. Det ena passade till den andra som handsken passar till handen. Det ena var lika otänkbart utan den andra som yin utan yang. De så att säga höll varandra i jämvikt som skålar på en guldsmeds våg. Ett guldkorn för mycket på den ena sidan, en karat för litet på den andra skulle rubba balansen.

Husets sista invånare, en diplomat som efter tjänsteåren, trött och ensam, dragit sig tillbaka hit, titulerades “Excellensen” av öborna, fast många trodde att han egentligen var en trollkarl. Han var gänglig och tärd. Han bar guldbågade glasögon och odlade ett kortklippt vitt skägg. Ett sådant utseende passade in i denna historia alldeles perfekt – nära nog rent trivialt. Fast kanske skulle historien inte bli tillräckligt otrolig utan dessa detaljer.

Excellensen stod ofta på övervåningens lilla balkong och tittade ned på grönsakslandet, precis som förr i tiden prästen i en barockkyrka blickade från predikstolen ned över församlingen. Därnere pågick en idog verksamhet. Trädgårdskarlen arbetade halvnaken. Han var kort och krokig och brun som en knotig rot utvuxen direkt ur marken. Som om en trädgårdsdvärg hade klätt av sig för att ta itu med göromålen. Tiden var inne för att plantera broccolin och trädgårdskarlen hackade spikraka fåror i den rödbruna jorden för att sedan, en efter en, sticka ner plantorna på jämna avstånd från varandra. Han var en mästare på att göra detta. Excellensen tyckte att synen var så vacker. Han blundade och föreställde grönsakslandet som ett paradfält. Trupperna stod i största ordning. De bar för det mesta grön mundering, bara tomaterna glänste rött likt husarer i paraduniform. Kronärtskockorna med sina spetsiga blad var infanteriet som försvarade de späda huvudena med utåtriktade bajonetter. Vinstockarna liknade ståtliga lansiärer och fruktträden verkade beridna officerare som höjde sig över mängden av meniga.

Plötsligt hördes flygvapnet komma! Han öppnade ögonen och såg en massa fåglar som landade längs den upphackade jordfåran i förhoppningen om att finna en och annan godbit bland utgrävda larver och maskar. Excellensen kände igen varenda en ur folket med de mångfärgade fjädrarna. De hade nämligen satt bo i den omgivande lunden och deras glada läten livade upp hela trakten. De var "hans" fåglar. Bekantskapen gick tillbaka till tiden när den pensionerade diplomaten en vårdag hade installerat sig i huset med sin flygel och började spela Mozart, Schubert, Chopin och alla de andra älskade kompositörerna. Plötsligt såg han fåglar skockas utanför det öppna fönstret. De lockades dit av de underbara tonerna och satt tysta och lyssnade. Det dröjde inte länge förrän Excellensen överraskades med att känna igen de odödliga melodierna som strömmade emot honom ur buskaget. Fåglarna efterapade hans pianospel med varierande särart enligt vad deras strupe förmådde att åstadkomma.

Varje fågelart har ju sitt eget sätt att sjunga Ave Maria på och Excellensen lyckades så småningom tämja fåglarna till den grad att de villigt tog sånglektioner hos honom. Nästa steget var att samstämma koltrastarna med trädgårdssångarna, sommargyllingarna, turturduvorna och med alla de andra sångfåglarna – inklusive de opunktliga gökarna som hade svårt med att hålla sin stämma i takt med ackorderna. Men här kom Excellensens fängslande personlighet fram. Han blev högt älskad av fåglarna. De lydde honom liksom i trans. Det räckte att han öppnade musikrummets fönster eller steg ut på den lilla balkongen. När hans glasögon blänkte i solljuset kom hela skaran från lunden och satte sig nedanför barockfasaden. Vid det laget använde han taktpinne att dirigera fågelkören med. Folk stod på gatan med öppen mun och lyssnade på Chopins bagateller. Människorna hade aldrig hört dem transkriberade på det viset. Nyheten om undret hade spritt sig och det uppstod en verklig vallfart till det förut så ensligt belägna huset.

Excellensen, som sökte ensamhet och accepterade enbart fåglarnas sällskap, blev orolig. Han såg att den underbara harmonin mellan sitt hus och det lilla Eden framför höll på att brytas upp. Just då inträffade det någonting som stjälpte sakernas ordning. En morgon avbröts körens övning av ljudet av en motorsåg. Efter en kort stund stod på lundens plats bara några lemlästade träd kvar. Grenarna och buskarna med fågelbon lades på hög och brändes. Detta skoningslösa dåd kallades "rengöring" och sades vara en nödvändig åtgärd mot vissa mindre preciserade råttor. Dessa anonyma förövare av allehanda brott hade tydligen visat sig överallt på ön med grundliga "rengöringar" i vegetationen som följd.

Excellensen stängde balkongdörren och låste locket på sin flygel. Han sände Mozart och hans kollegor i exil. Fåglarna, nästan lamslagna av sorgen över förlusten av sina hem och familjer, flög iväg. Tystnaden blev fullständig kring huset. Hösten kom och gick. Vintern var hård och till synes ändlös. Det fåtal träd som räddade sig i lunden stod med nakna grenar sträckta mot himlen som stumma vittnen till en massaker. När ingen längre vågade tro att våren skulle komma, stack några cyklamen försiktigt ut huvudet ur marken. Så småningom kunde man se ett par försynta ljusgröna blad på trädgrenarna också. Flyttfåglar sågs flyga förbi i nordlig riktning, men de fåtal färska blad på den gamla lundens plats förmådde inte att locka dem till sig.

Plötsligt blänkte Excellensen guldbågade glasögon till på den lilla balkongen. Den gamle herren var blekare och rynkigare i ansiktet än någonsin förut. Hans skägg var ovårdat. Det syntes att han efter illdådet mot hans fågelvänner hade upplevt många sömnlösa nätter. Nu stod han stilla en stund, varefter han långsamt lyfte sin taktpinne i luften. Han dröjde ett tag innan han modfällt sänkte sin arm. Men i samma ögonblick avbröts tystnaden av hundratals vingars sus. Lundens alla gamla invånare infann sig nedanför barockfasaden! Som på befallning, återkom de till sin vän och körledare. Men deras katastrofdrabbade hem var obeboeliga. Excellensen återtog övningarna och fåglarna kom tillbaka vid varje tillfälle men flög därefter iväg till okänd ort.

Vårsolen lockade ut även trädgårdskarlen som bekymrat kisade upp mot ett Monte Solaro höljt i dimma. Han var försenad med sysslorna, eftersom lundens förstörelse hade öppnat fri väg åt vindarna över grönsakslandet. Fruktträden måste kraftigt beskäras i god tid före blomningen, marken måste snarast sättas i ordning för nyplantering. Men han tyckte att det var ensligt utan fåglarna. Den gode Excellensen åsåg allt detta med sorg i hjärtat och beslöt att hålla en vårkonsert.

Förberedelserna var febrila då Påskhelgen det året inträffade väldigt tidigt. Körmedlemmarna flög fram och tillbaka i skytteltrafik. Trädgårdskarlen i sin glädje planterade genast tre vita liljor i ett hörn av grönsakslandet som tacksägelse åt Madonnan som stod i sin nisch under den lilla balkongen.

Den stora dagen kom snabbare än väntat. Åhörarna trängdes på den smala gången mellan barockfasaden och trädgården. Spänning darrade i luften. Det hördes ett sus när Excellensen steg ut på balkongen. Hans glasögon blänkte när han tittade ner och lät sin blick vila på fåglarna som satt stilla på lundens nakna grenar. Han lyfte och sänkte taktpinnen. Fåglarna började sjunga – först litet osäkert, sedan med växande inlevelse. Men under den långa frånvaron från lunden hade de glömt bort färdigheterna som gjorde dem till en samspelt orkester. De föll tillbaka till sina invanda läten vilka var för sig var så vackra men nu saknade samordning. Föga liknade de ett musikverk. Den oregerliga göken har åter kommit i otakt med melodin. Näktergalen, som ju alltid varit en diva, ville till varje pris sjunga solo men missade helt sin aria. Fåglarna blev så förbryllade att de började sjunga falskt! Till råga på allt glömde de bort att hålla ett öga på Excellensen gester, varpå ett fullständigt kaos uppstod. Åhörarna skrattade och somliga började bua. Fiaskot var fullständigt. När ett elakt dimmoln sänkte sig ner från Monte Solaro, upphörde också Excellensens guldbågade glasogon att blänka och han lämnade balkongen utan att yttra ett ord. Det var det sista tillfället han visade sig utanför huset. Hädanefter förblev musikrummets fönster stängt och inte heller flygeln öppnades mer. De övergivna fåglarna återgick att vara helt vanliga fjäderfän, fast de var mindre lyckliga än förut.

Men det dröjde inte länge, då tunga maskiners ljud närmade sig mot trädgården. Grävskopor bröt sig in i grönsakslandet och deras gapande käftar angrep grönsaksarmén. De tappra soldaternas motstånd var förgäves. Vem vet om inte den gamle trädgårdskarlen troddes vara bara en krokig vinranka och föll offer för angriparna. Till och med fruktträden-officerarna knäcktes och revs ut ur jorden. Sist kom turen till de vita liljorna som skrek till när deras spröda stammar slets itu. Snart började maskinsågar väsnas och lundens kvarstående träd föll. Framåt kvällen lämnades slagfältet öde och bart. Marken låg dödligt sårad av bandhjulen. Den röda jorden liksom blödde i den nedgående solens ljus.

Dagen därpå återkom grävskoporna med sina hungriga käftar och började svälja jorden. De tillfredsställdes inte förrän grönsakslandets mark var bortskrapad så att man djupt nere kunde se den nakna berggrunden. Kvickt restes ett tak över schaktet. Hade Excellensen tittat ned från sin balkong, hade han kunnat se korrugerad plåt med inslag av korrugerade plastskivor som av någon anledning hölls fast med ett antal uttjänta motorcykelhjul. Det dröjde inte länge då inhägnad restes kring tomten. Den bestod av plankverk som i vissa avsnitt omväxlades av vassmattor. Instoppade mellan dessa kunde man också beskåda en intrigerande lokal ingrediens: sängbottnar med utmattade stålfjädrar. Men denna gången användes de i en sådan häpnadsväckande mängd, att det måste nog ha behövts minst ett dussin personer med särskilt oroliga nätter att producera dem.

När dessa förberedelser var slutförda, tog maskinborrarna över arbetet. I tre månaders tid höll de på att under öronbedövande ljud gnaga sig in i berggrunden. Excellensen stoppade huvudet i sina kuddar men kunde inte undvika borrarnas penetrerande effekt. Hela huset skakade och så småningom började murarna vibrera. Sprickor visade sig i vägg och tak. Jerikos murar förstördes av trumpetstötar. Här höll det på att hända samma sak, fast under mindre musikaliska förhållanden. Excellensen var nära att ge upp och lämna sitt hem, då borrarna plötsligt upphörde att väsnas och själva byggarbetet påbörjades.

Ett betongskelett växte ut ur marken, varefter en lyftkran satte förtillverkade byggnadselement in i deras uttänkta platser. Helgjutna kolonner, balustrader och voluter prydde huset. Timpanon krönte ingången. Till och med en hel liten kupol monterades in i taket. Fasaden berikades med stuckatur i form av blomsterkransar och snäckor. Sedan sprutade man chokladbrun och citrongul färg på byggnaden som dolde fogarna mellan elementen. Orangefärgade keramikplattor och aluminiumfönster med glas i livliga kulörer kompletterade verket. Denna stil kallades “Commercial Baroque” och dess hemland var Kalifornien. Parken kring den nya barockbyggnaden bestod av tre jättekaktusar och ett palmträd vilka nattetid belystes av strålkastare.

Nu såg Excellensens spruckna hus med sin lilla balkong ut som en fattig kusin till det nya arkitektoniska miraklet. Kontrasten blev fullständig när det nya barockpalatset öppnade sina portar för ungdom från när och fjärran. Anläggningen ställdes i samhällets tjänst. Den avsåg tillfredsställa den nya generationens behov av musik och samvaro. Den fungerade nämligen som diskotek. Dunkande rytmer i takt med apornas snabba hjärtslag och tidigare aldrig hörda, öronsmärtande ljudeffekter strömmade ut ur nöjespalatset. Någon pojkvasker eller jänta, benämnda rocksångare, försökte med mikrofon i handen överrösta ljudvallen men hade inte den rätta stämman till ett sådant företag. Excellensens tysta hus kom åter i gungning tack vare den heavy metal rock som den nya grannen producerade nätterna igenom.

Excellensen låg sömnlös och utmattad. Skägget var i oordning och det hade bildats röda ringar kring ögonen. Hans värld hade störtat. Han hade överlevt flera historiska epoker vilka lämnat honom som ensligt vittne, oförmögen att befatta sig med de senaste tidernas anda. De som en gång omgav honom var nu borta. Och han som efter ett intensivt liv och leverne funnit att hans enda trogna och uppriktiga vänner varit och förblivit Haydn, Mozart, Beethoven och Franz Liszt, fick på grund av de dramatiska händelserna se sig övergiven till och med av dem. Hans andra stora tröst var musikstunderna med fåglarna från lunden nedanför hans gamla hus. Men även denna lyckliga tid hade tagit slut.

Excellensen insåg att han inte hade något mer att förlora och han tog ett avgörande beslut. Först rakade han av sig skägget, därefter sminkade han sig noga så att han verkade riktigt fräsch. Kinderna fick en lätt rödaktig nyans, ögonen hade maskara. Därefter ersatte han sina guldbågade glasögon med kontaktlinser. En peruk gav honom ett ännu ungdomligare utseende. Slutligen satte han på sig en åtsittande skinnjacka och ett par smårutiga byxor.

Han blev genast anställd som disc-jockey på diskoteket. Nu var Excellensen säker på att lyckas i sitt nya engagemang. Han hade under sina hundra år i diplomatins tjänst blivit van vid triumferna av sin charm, spiritualitet, klokhet och djärvhet men framförallt av sitt betagande pianospel. Hans eleganta sätt att röra sig, klä sig och hans konversationsteknik var vida berömda. Det var han som flydde på karnevalsnatten i Venedig med en contessa utklädd till herdeflicka genom palatsets balkong utefter Canal Grande medan gondoliären höll sin oljelykta högt. Den undersköna dottern till maharadjan tittade länge på honom med sina sammetsögon och viskade lågt under en tigerjakt när deras axlar råkade nudda varandra uppe i korgen på elefantryggen. Han satte hotellgästerna i feber på Raffles i Singapore när han i sin vita smoking satt sig till flygeln och låtit *Månskenssonaten* klinga ut i sommarnatten. Det var också han som räddade Centralafrika när han lyckades skapa fred i det blodiga inbördeskriget genom att arrangera äktenskap mellan stamhövdingarnas söner och döttrar. Arkeologiska sällskapets medlemmar i Peru reste sig och applåderade honom för hans sensationella fynd av inka-skatter. Hans briljanta spel i hästpolo på afganska högplatån var länge ett kärt samtalsämne bland sportens entusiaster. Han var uppskattad organisatör av prinsessbröllop världen runt. Men han var på plats också när det gällde att hjälpa de katastrofdrabbade, att skydda politiska flyktingar, att hemligt stödja frihetskämpar. Den tiden beundrade hela världen honom för hans stora engagemang för de fattiga och förtryckta. Efter en lång karriär organiserade han sin avskedsfest på Sydpolen som enligt alla inbjudna var det århundradets originellaste tillställning.

Nu var han redo att göra ett sista försök att på nytt befinna sig i intressets centrum. Han gjorde en särdeles lyckad debut som disc-jockey. Stämningen på diskoteksdansen nådde sin höjdpunkt, när han under rosafärgat och violett strålkastarljus valde och kommenterade skivorna, när han skickligt skötte ljudstyrkan och specialeffekterna. Han blev genast populär hos det ungdomliga klientelet och ställets go-go girl visade tydliga tecken på att hon redan förälskat sig i honom. Excellensen hade för avsikt att, när allt äntligen tystnar, bjuda in ungdomarna i sitt hem och bekanta dem med de odödliga tonerna av sina gamla vänner Mozart, Schubert, Beethoven och de andra. Han räknade med att hans pianospel skulle oemotståndligt lugna ned diskoteksfolkets upprivna nerver och gripa deras sinnen. Det skulle bli musikterapi satt i praktik innan de första solstrålarna skulle hinna förgylla Monte Solaros topp.

Ännu var natten djup och mörkret utanför barockpalatset var tätt, när diskobesökarna efter en rökpaus fann Excellensen sitta framåtlutad med huvudet vilande på disc-jockeyns tangentbord. De grönt och gult pulserande strålkastarna belyste hans ansikte på vilket sminken började lösa upp sig. Under den röda färgen var kinderna kritvita. Den rufsiga peruken hade lossnat och blottat hans silvergråa hår. Det var klart att den gamles hjärta inte orkat med ansträngningen. Alla stod som slagna kring honom och go-go dansösen strök bort två stora och äkta tårar ur ögonen.

Anteckningar

Excellensen har ofta förväxlats med dr. Axel Munthe. Det är klart att många människor går omkring utan vetskap om sitt alter ego. Kan dubierna skingras om man konstaterar, att den svenske läkarens levnadsdata inte överensstämmer med hjältens i denna historia? Eller var de eventuellt avlägsna släktingar till varandra?

Forskarna är oeniga om var Excellensens hus finns. Det är inte att vara förvånad över. Vilseledda av nya arkitektoniska attraktioner, kastar de på sin höjd bara en förströdd blick på huset som förresten verkar vilja gömma sig på huk bakom några buskar.

ORNIS SVECICA 16: 13–19, 2006

Capri Bird Observatory – a brief historical overview

Capri Fågelstation – en kort historisk överblick

CHRISTIAN HJORT

Abstract

The Capri Bird Observatory is situated in Castello Barbarossa, an old fortification overlooking the Bay of Naples in southwestern Italy. The observatory was founded in 1956 by the Swedish Ornithological Society in cooperation with Villa San Michele. Until the mid-1980s it was entirely a Swedish venture, whereafter also Italian ornithologists joined, first the LIPU bird protection organization, later the ringing center in Bologna through its Piccole Isole project. The aim was to study bird migration between winter quarters in tropical Africa and breeding areas around the Baltic Sea.The main concern has been spring migration, when many birds make landfall on the island after having crossed the Mediterranean. But work has also been done in autumns, and in later years even in winters. To the general study of bird migration, including ringing and the sampling of various biometric and phenological parameters, have been added more specialized studies, like visual observations of raptor migration, experiments on bird orientation, and sampling for the study of bird-born diseases. Recently, studies of butterfly migration have been added to the agenda.

Christian Hjort, Hessle, Munkarp,
SE-243 91 Höör, Sweden.
Email: christian.hjort@geol.lu.se

Received 20 October 2005, Accepted 14 December 2005, Editor: S. Svensson

Introduction

The Capri Bird Observatory (Figure 1) is situated at 40°33´N, 14°15´E, 400 m above sea-level on a cliff-top overlooking the Bay of Naples, in southwestern Italy. It is located in Castello Barbarossa, a small (c. 70×70 m) fortification, originally dating from the 10th or 11th century but later named after the 16th century corsair Keir-ed-Din, better known as ”Barbarossa”. The hill on top of which the castello lies was bought by the Swedish physician Dr. Axel Munthe (Figure 2) and incorporated into his Villa San Michele complex, primarily to protect the bird life in the immediate surroundings. The story of that purchase, as well as the whole Villa San Michele story, is told in Munthe's classic book ”The Story of San Michele” (1929), translated into some 50 different languages. When Axel Munthe died in 1949, Villa San Michele was donated to the Swedish state, to act as a place for cultural interchange between Sweden and Italy.

Munthe had been so influential and so engaged in the protection of birds and other animals that he got the Mussolini government to prohibit hunting on Capri – but it was reintroduced in 1945, when the fascists were gone. However, proceeding in Munthe's spirit, Josef Oliv, the first curator of Villa San Michele, asked the Swedish Ornithological Society if they might be interested in doing research on Capri. Thus, in 1950 the young scientist Carl Edelstam was sent to Capri on a reconaissance mission. Some years before he had been one of the co-founders of Ottenby Bird Observatory in Sweden, a project to which Axel Munthe had contributed financially. Edelstam's verdict was positive and it was decided to create a small Swedish bird observatory on Capri, located in Castello Barbarossa. Much assistance in this initial process was given by Professor Augusto Toschi from Bologna, who helped the Swedes through the Italian bureaucracy, to get permission for trapping birds without paying hunting-taxes, etc.

Work started in 1956, with ringing that year taking place from 26 March through 24 May. It had originally been the intention to do the trapping near the lighthouse (Faro) on the southwestern part of the island, but for logistic reasons that plan was abandoned. The ringing has since been carried out in and around Castello Barbarossa itself, using mistnets of various types, originally intro-

Figure 1. Castello Barbarossa on its cliff-top, housing Capri Bird Observatory and overlooking the Bay of Naples. (Photo: Boris Engström, 1960).
Castello Barbarossa med Capri Fågelstation, överblickande Neapelbukten.

duced there by Dr. A. Schifferli, then head of the Swiss Ornithological Institute at Sempach.

The full story of the creation of the Capri Bird Observatory and of its first six working years and the results from them was told by Carl Edelstam and his pioneer colleagues in 1963, in a paper in the Swedish Ornithological Society's journal *Vår Fågelvärld* (Edelstam et al. 1963). More recently, three popular accounts in Swedish have been published by Engström (2000) and Edelstam (2005) on the early years, and by the present author (Hjort 2000) on later developments.

Capri as a site of ornithological interest

That Capri is an important resting place for migrant birds has been known since time immemorial, as had the inhabitant's almost industrial-scale trapping of birds for local consumption and export. The bishop of Capri got his tithes as part of

Figure 2. Dr. Axel Munthe, founder of Villa San Michele and the protector of birds, as envisaged by Harald Wiberg in 1958.
Axel Munthe, grundare av Villa San Michele och fåglarnas beskyddare, som Harald Wiberg tänkte sig honom 1958.

Figure 3. Capri (filled circle) in its geographical context, with Ottenby Bird Observatory in Sweden and our temporary ringing sites in Nigeria marked by open cicles, and with the Sahara desert and its eastern counterparts given a paler shade.
Capri (fylld cirkel) i sitt geografiska sammanhang, med Ottenby fågelstation i Sverige och våra temporära ringmärkningslokaler i Nigeria markerade av ofyllda cirklar och med Sahara-öknen och dess östligare motsvarigheter med en blekare ton.

this trade and was ironically known as the ”Quail Bishop”. As much as unbelievable 45,000 Quails *Coturnix coturnix*, the economic main target of the trapping, may have been caught in one very good spring season day and these birds were not only exported to nearby Naples, but to such in those days relatively distant places as Rome and Marseille (e.g. Kesel 1983).

The first comprehensive overview of the ornithology of the island was written by the German scientist Alexander Koenig (Koenig 1886), a man later known for his Arctic and African ornithological studies – and in Sweden also credited as being the one who introduced the later so famous birdlife writer Bengt Berg to the Sudan and the enigmatic Shoebill *Balaeniceps rex*, or Abu Markub! Koenig´s (1886) paper was very complete; it discussed the breeding, migrant and wintering birds of Capri and also gave a comprehensive overview of the bird-trapping industry and, like Axel Munthe, argued for protection of the birds. Ironically, as seen through our eyes, it must however be said that Koenig, like most of his contemporary colleagues, shot all birds he was interested in, for their proper identification and for his museum collection in Bonn!

Koenig's observations were only a few years later complemented by Ignazio Cerio, a member of that famous Capri family, through a short chapter in an Italian ornithological volume (Cerio 1890). Additional Capri information was given in papers by Tucker (1927) and Hörstadius (1927), but these two authors basically told the same story and concentrated on the mainland around the Bay of Naples. Today, however, the main work of reference, including most published data from Capri, also on migration, is the monograph by Sergio Scebba on the birds of the Campania region (Scebba 1993).

The reason for creating a Swedish bird observatory on Capri was, however, not to study the local bird fauna, but rather the trans-Mediterranean migration. One idea was to create a half-way checkpoint for migrants en route from tropical Africa to Sweden and the Scandinavian-Baltic area in general (Figure 3), and on the way back southwards in autumn. As to this Palaearctic-African bird migration system, a not inconsiderable knowledge already existed in the 1950s, but of course very much was left to do and still is today – and the best overview of the state-of-the-art in those rather early days is still Reginald Moreau´s classic book on the subject (Moreau 1972).

The first years

During the first six working years of the observatory (1956–1961; summarized by Edelstam et al. 1963), the spring season was covered by a total of 308 working days, representing all the years and spanning the interval 22 March to 20 June, although with a concentration to the end of April and the month of May. Three autumns were also covered, by a total of 230 working days spanning the interval 29 June to 16 November.

It was of course confirmed, as expected, that Capri was much more used by the spring migrants, making their first landfall there when arriving across the Mediterranean, than by birds en route southwards in autumn. The latter can equally well take-off from the nearby mainland. The trapping figures in spring were thus much larger than in autumn and the period of main spring passage identified as between 20 April and 25 May.

The five species with the largest ringing figures were, much like today, the Garden Warbler *Sylvia borin* (six year total, spring and autumn added, 5924), Icterine Warbler *Hippolais icterina* (3204), Spotted Flycatcher *Muscicapa striata* (2408), Whitethroat *Sylvia communis* (2332) and Redstart *Phoenicurus phoenicurus* (1470). Some other birds with interestingly large ringing figures were Woodchat Shrike *Lanius senator* (1078), Golden Oriole *Oriolus oriolus* (467), Nightjar *Caprimulgus europaeus* (183) and even Little Owl *Athene noctua* (6). Of the earlier mentioned symbol bird of the island, the Quail, only one (1) single bird was ringed in those six years – not much, even compensating for the fact that it prefers the lower parts of the island! The birds were all trapped in mist-nets in and around the Castello, in a habitat which in those years, before a succession of devastating fires, were more lush and higher grown than today, e.g. with more pine trees *Pinus halappensis*.

In those early years hunting and bird catching for local consumption was still going strong, even if the Quail trade had declined sharply. An analysis of snap-trap catches done in 1956 showed that almost 80% of these catches where of Whinchats *Saxicola rubetra* and Wheatears *Oenanthe oenanthe* – not so surprising considering that the traps should preferably be set well visible on open ground. A person working with c.100 such traps told the ornithologists that he could catch up to 200 birds in a good day (Edelstam et al. 1963).

Some changes of hands and the initiation of Swedish-Italian cooperation

After the early enthusiastic years the Swedish ringing at Castello Barbarossa continued, through the 1960s and 1970s and into the 1980s, administrated by the Swedish Ornithological Society until 1979 and thereafter by the Natural History Museum in Stockholm. A lot of birds were trapped, ringed, weighed and measured, etc., and many recoveries received – but not much came out of it in the way of publications. Many Swedish and other ornithologists did, however, come here and learn a lot about both the Mediterranean bird fauna and the trans-Mediterranean migration.

From 1983 the Swedish work was discontinued for some years and the ringing at Castello Barbarossa was taken over by Italian ringers, first from the bird protection organization LIPU (Lega Italiano Protezione Uccelli), later from the ringing centre in Bologna. However, after a few years the Swedish Ornithological Society re-allocated the responsibility for Capri to its subsidary Ottenby Bird Observatory and a Swedish renaissance on Capri was initiated in the spring of 1986 (Pettersson 1986a). Ottenby was then already active in the Mediterranean region, studying wintering Robins *Erithacus rubecula* along an east-west transect from Cyprus to Andalucia (Pettersson 1986b, Pettersson et al. 1990a). The resumed Swedish work on Capri was organized by Jan Pettersson, at that time director of the Ottenby observatory. Initially it included parallel work with the Italian ringers on Castello Barbarossa, concentrating on collecting biometric and phenological data for Ottenby´s data base. Much of the older Swedish material from Capri, including all the recoveries of Capri-ringed birds, was now processed and published as the ”Yellow Report” (Pettersson et al. 1990b). In the present issue, a special time series analysis of those spring migration data, combined with later data collected by the Italian ringers, is published (Jonzén et al. 2006), as is a stop-over study on Wood Warblers *Phylloscopus sibilatrix* (Holmgren & Engström 2006) and an orientation-ability study, mainly on Garden Warblers and Tree-pipits *Anthus trivialis* and including displacement experiments versus the Earth´s magnetic field (Åkesson et al. 2006).

One of Ottenby's main interests in the work on Capri was to get Mediterranean biometric and phenological data for direct comparisons with those on the same species from Sweden (Pettersson 1986b, Jonzén et al. 2006), an interest which has later been extended to parallel work in sub-Saharan Africa (e.g. Ottosson et al. 2002, 2005, Gustafsson et al. 2003, Hjort et al. 2004). The migration studies have also been extended to trans-Mediterranean butterfly migration (Brattström 2006).

Autumn work and winter birds

In the mid-1990s it was decided that whereas the Italian ringing (administrated by the ringing centre in Bologna) should continue on Capri during the spring seasons as part of the PPI project (Progetto Piccole Isole; Messineo et al. 2001, and Spina 2006 in this volume), the future Swedish work should be concentrated to the autumns. This work started in 1994 (Jonzén 1995, Hjort et al. 2001) and continued until 2004. When including a few earlier autumn seasons (1959, 1960, 1961, 1963, 1989) a total of 14 autumns have been worked, although with very varying coverage – but the total interval covered is from 29 June to 16 November. These data have now been processed (Waldenström et al. 2006) and visual observations on the autumn migration of raptors were published by Jonzén & Pettersson (1999). Also some of the orientation tests mentioned above have been done in the autumn (Åkesson et al. 2006).

To complement our knowledge of the birds which use Capri for one reason or another during spring and autumn, the Swedish Ottenby team has recently also done some winter work there, during February and earliest March 2002–2004 and in November–December 2004. These data, concerning the wintering birds and the earliest onset of spring migration, including weights and fat-status, are published in the present volume (Hjort et al. 2006).

The future

Whereas the Italian PPI-related work on Capri continues (Spina 2006), with field work from mid-April to mid-May each year, the Swedish standard-type ringing work has now been discontinued. For the future we foresee more short-term, specialized studies. Such work on bird-born diseases, on the isotope composition of Willow Warbler *Phylloscopus trochilus* feathers (as indicators of where different populations winter), and on butterfly migration (Brattström 2006) are already going on.

Acknowledgements

We owe a great debt to Villa San Michele, with its board, curators and helpful personnel through all these 50 years, and to all the ornithologists who have worked at the bird observatory, mostly on slight payment but compensated by all the birds, the interesting scientific problems to be solved, and by the fantastic surroundings! This is contribution no. 207 from Ottenby Bird Observatory.

References

Åkesson, S., Jonzén, N., Pettersson, J., Rundberg, M. & Sandberg, R. 2006. Effects of manipulations on orientation: comparing diurnal and nocturnal passerine migrants on Capri, Italy, in autumn. *Ornis Svecica* 16(1): 55–61.

Brattström, O. 2006. Is there seasonal variation in size and mass of red admirals (*Vanessa atalanta*) on Capri, Italy. *Ornis Svecica* 16(1): 69–73.

Cerio, I. 1890. Sotteregione Peninsulare o Meridionale. Campania. Isola di Capri. Elenco delle specie di ucelli osservate in quest´isola. In E.H. Giglioli, ed. *Primo Resconto dei Risultati dell´Inchiesta Ornitologica in Italia*, Vol. 2: 500–505. Le Monnier, Firenze.

Edelstam, C., Broberg, L., Engström, B., Jenning, W. & Lundberg, S. 1963. Den svenska fågelstationen på Capri och dess verksamhet 1956–61 (The Capri Bird Observatory and its activities in 1956–61). *Vår Fågelvärld* 22: 225–270.

Edelstam, C. 2005. Flyttfågelforskningen på Capri – hur den började. *Sällskapet San Micheles Vänner, Medlemsblad* 15: 11–14.

Engström, B. 2000. Capri – fåglarnas ö, och Capri fågelstation. *Sällskapet San Micheles Vänner, Medlemsblad* 5: 3–7.

Gustafsson, R., Hjort, C., Ottosson, U. & Hall, P. 2003. *Birds at Lake Chad and in the Sahel of NE Nigeria 1997–2000 (The Lake Chad Bird Migration Project)*. Special Report from Ottenby Bird Observatory: 1–15.

Hjort, C. 2000. Dagens flyttfågelforskning på Capri. *Sällskapet San Micheles Vänner, Medlemsblad* 6: 3–6.

Hjort, C., Andersson, A. & Ottvall, R. 2001. Höststämning på Capri. *Vår Fågelvärld* 60(8): 14–18.

Hjort, C., Ottosson, U., Stervander, M. & Waldenström, J. 2004. Kamelkaravankonceptet – vår syn på fågelflyttningen över Sahara. *Vår Fågelvärld* 63(7): 6–12.

Hjort, C., Andersson, A. & Waldenström, J. 2006. Wintering birds on the island of Capri, southwestern Italy. *Ornis Svecica* 16(1): 62–68.

Holmgren, N.M.A. & Engström, H. 2006. Stopover behaviour of spring migrating Wood Warblers *Phylloscopus sibilatrix* on the island of Capri, Italy. *Ornis Svecica* 16(1): 34–41.

Hörstadius, S. 1927. Fågellivet i Neapeltrakten. *Fauna och Flora* 22: 7–25.

Jonzén, N. 1995. Höstflyttning på Capri. *Calidris* 24(1): 5–7.

Jonzén, N. & Pettersson, J. 1999. Autumn migration of raptors on Capri. *Avocetta* 23(2): 65–72.

Jonzén, N., Piacentini, D., Andersson, A., Montemaggiori, A., Stervander, M., Rubolini, D., Waldenström, J. & Spina, F. 2006. The timing of spring migration in trans-Saharan migrants: a comparison between Ottenby, Sweden, and the island of Capri, Italy. *Ornis Svecica* 16(1): 27–33.

Kesel, H. 1983. *Capri – Biographie einer Insel*. Prestel Verlag, München.

Koenig, A. 1886. Die Vogelwelt auf der Insel Capri. *Journal für Ornithologie* 34: 487–524.

Messineo, A., Grattarola, A. & Spina, F. 2001. Dieci anni di Progetto Piccole Isole (Ten years of Mediterranean Islands Project). *Biologia e Conservazione della Fauna*

106: 1–240.
Moreau, R.E. 1972. *The Palaearctic-African Bird Migration System*. Academic Press, London.
Munthe, A. 1929. *The Story of San Michele*. John Murray, London.
Ottosson, U., Bairlein, F. & Hjort, C. 2002. Migration patterns of Palaearctic *Acrocephalus* and *Sylvia* warblers in north-eastern Nigeria. Die Vogelwarte 41: 249–262.
Ottosson, U., Waldenström, J., Hjort, C. & McGregor, R. 2005. Garden Warbler *Sylvia borin* migration in sub-Saharan West Africa – phenology and body mass changes. Ibis 147: 750–757.
Pettersson, J. 1986a. Åter svensk flyttfågelforskning på Capri i Italien. *Vår Fågelvärld* 45: 455–462.
Pettersson, J. 1986b. Weight and fat levels in Robins (*Erithacus rubecula*) wintering in northern Greece. *Proc. First Conf. on Birds Wintering in the Mediterranean Region. Suppl. alle Richerche di Biologia della Selvaggina* 10: 265–274.
Pettersson, J., Hjort, C., Lindström, Å. & Hedenström, A. 1990a. Övervintrande rödhakar *Erithacus rubecula* kring Medelhavet och flyttande rödhakar vid Ottenby – en morfologisk jämförelse och analys av sträckbilden (Wintering Robins *Erithacus rubecula* in the Mediterranean region and migrating Robins at Ottenby – a morphological comparison and an analysis of the migration pattern). *Vår Fågelvärld* 49: 267–278.
Pettersson, J., Hjort, C., Gezelius, L. & Johansson, J. 1990b. *Spring Migration of Birds on Capri*. Special Report from Ottenby Bird Observatory, Sweden: 1–114.
Scebba, S. 1993. *Gli Uccelli della Campania*. Edizioni Esselibri/Litografia Nicola Libero, Napoli.
Spina, F., Piacentini, D. & Montemaggiori, A. 2006. Bird migration across the Mediterranean: ringing activities on Capri within the Progetto Piccole Isole. *Ornis Svecica* 16(1): 20–26.
Tucker, B.W. 1927. A Contribution to the Ornithology of Naples and the Phlegrean Fields, with Notes on some other neighbouring Localities. *Ibis* 69: 87–114.
Waldenström, J., Hjort, C. & Andersson, A. 2006. Autumn migration of some passerines on the island of Capri, southwestern Italy. *Ornis Svecica* 16(1): 42–54.

Sammanfattning

När den svenske läkaren Axel Munthe, bl.a. författare till den internationella bestsellern ”Boken om San Michele”, dog 1949 donerades hans Villa San Michele på den italienska ön Capri till svenska staten. Meningen var att där upprätta ett center för svensk-italienskt kulturutbyte och ett ställe där svenska författare, konstnärer och liknande kunde finna mediterran inspiration – och så har det blivit! Munthe hade också varit mycket engagerad i djurskydd och speciellt i skyddet av fåglarna på Capri, där fångst av särskilt vaktlar och turturduvor på den tiden hade närmast industriell omfattning. Som en följd därav erbjöds Sveriges Ornitologiska Förening att upprätta en fågelstation därnere, halvvägs mellan flyttfåglarnas vinterkvarter i tropiska Afrika och många arters häckningsområden i Sverige och kring Östersjön. Efter recognosering 1950 skedde detta 1956. Drivande krafter var Josef Oliv, den förste intendenten på Villa San Michele, och Carl Edelstam, en av Ottenby Fågelstations grundare. Fågelstationen på Capri är inhyst i den gamla borgen Castello Barbarossa, belägen 400 m.ö.h. på en klippa med utsikt över Neapelgolfen.

Verksamheten på Capri under de första sex åren (1956–61) redovisades i Vår Fågelvärld av Carl Edelstam m.fl. (1963). Man koncentrerade sig på arbete under vårarna, då massor av fåglar landar på ön efter att ha korsat Medelhavet. Men även en del höstarbete genomfördes under de inledande åren, fast på hösten kan fåglarna lika gärna starta från det närbelägna fastlandet och är därför mycket färre ute på Capri än under vårsträcket. De är emellertid mycket fetare på hösten, fulltankade inför passagen över Medelhavet och Sahara, än när de anländer på våren efter att just ha genomfört denna långa resa.

Efter ett kortare avbrott på 1980-talet fortsatte den svenska verksamheten på Capri, fast nu i regi av Ottenby Fågelstation på Öland och ihop med italienska ornitologer. I samband därmed sammanfattades de då uppnådda resultaten i en särskild rapport (Pettersson m.fl. 1990b). Det inledande italienska samarbetet var med fågelskyddsorganisationen LIPU, därefter och till dags dato med ringmärkningscentralen i Bologna, som inom ramen för sitt s.k. öprojekt (Progetto Piccole Isole, PPI; Spina 2006) med samtidig fångst på många småöar runt Italien nu ringmärker på Capri varje vår mellan 15 april och 15 maj.

I mitten på 1990-talet koncentrerades den svenska verksamheten på Capri till höstarna (Waldenström m.fl. 2006), medan italienarna tog hand om hela arbetet på våren. På senare år har även de övervintrande fåglarna därnere studerats (Hjort m.fl. 2006). Sedan 2004 äger dock ingen svensk renodlad, klassisk ringmärkning längre rum på Capri, utan det satsas istället på olika specialprojekt; för närvarande t.ex. kring fågelburna sjukdomar och kring den omfattande flyttningen av fjärilar (Brattström 2006) över och kring Medelhavet.

Denna nu 50-åriga verksamhet, med dess olika inriktningar och resultat, speglas av artiklarna i detta jubileumsnummer av Ornis Svecica.

ORNIS SVECICA 16: 20–26, 2006

Bird migration across the Mediterranean: ringing activities on Capri within the Progetto Piccole Isole

Fågelflyttning over Medelhavet: ringmärkning på Capri inom Projekt Piccole Isole

FERNANDO SPINA, DARIO PIACENTINI & ALESSANDRO MONTEMAGGIORI

Abstract

Palearctic-African spring migrants are faced with the challenging crossing of the double ecological barrier of the Sahara Desert and the Mediterranean Sea. Islands represent unique opportunities to stopover and rest during these prolonged endurance flights. To study spring migration across the Mediterranean, the Italian Ringing Centre at INFS has co-ordinated the Progetto Piccole Isole since 1988 with Capri being among the most active stations. Islands are used as stopover sites by huge numbers of birds belonging to a wide range of species and irrespective of physical conditions of migrants. Clearly defined species-specific seasonal migration patterns are observed, and also differential migration of sex and age classes. Wide-front movements over the sea of typical nocturnal migrants occur also during daytime. Physiological studies confirm the importance of the short stopovers observed on the islands, which permit the birds to adjust their metabolic state, rest and rely, in many cases, on easily accessible nectar as an energetically rich food. Strong links with habitats both in Africa and within the Mediterranean confirm the need for internationally co-ordinated conservation strategies for Palearctic-African migrants.

Fernando Spina and Dario Piacentini, Istituto Nazionale per la Fauna Selvatica, via Ca' Fornacetta 9, I-40064 Ozzano Emilia (BO), Italia
Alessandro Montemaggiori, Via Federico Tozzi 9, 00137 Roma, Italia
Email: fernando.spina@infs.it

Received 9 November 2005, Accepted 23 January 2006, Editor: Å. Lindström

Introduction

Ecological barriers represent the most challenging part of a migrant's journey. For terrestrial birds, crossing large stretches of sea implies the need for prolonged endurance flights. The Mediterranean acts as an important barrier for Palaearctic-African migrants heading north while moving towards their breeding quarters in spring (Moreau 1972, Alerstam 1990). Within the larger historical framework of migration studies in Europe, spring movements have been less intensively investigated than the autumn flyways and migratory patterns. It has also become increasingly clear that bird populations breeding in Europe can be significantly affected by ecological factors acting on the African winter quarters. For these reasons, in 1988 the Istituto Nazionale per la Fauna Selvatica, Italian Ringing Centre, launched the 'Progetto Piccole Isole' (PPI) (Spina et al. 1993). The main aims of the project are to investigate spring migration across the Mediterranean through a network of ringing stations operating together on the basis of standardised field protocols. An important aspect is also to obtain sound scientific evidence of the conservation value of Mediterranean islands and coastal habitats for staging migrants during a particularly delicate phase of their annual cycle. This knowledge is needed in order to develop reliable policies for the conservation of migratory birds within the Mediterranean, a geographical area characterized by intense harvesting (Woldhek 1980, Hepburn 1985, Fenech 1992).

Capri within the PPI

The PPI was started as an effort of Italian ringers, also in order to test their potential in such a network research project. For this reason only four islands were involved at the beginning: Montecristo, Giannutri, Ventotene and Capri. Capri in particular was chosen since the very start of the project based on the long-lasting experience of ringing activities carried on at the Castello Barbarossa of Anacapri (Petterson et al, 1990), firstly by Swedish ringers and later through a cooperation between Swedish and Italian ringers, thanks to the local support kindly offered by the Axel Munthe Foundation.

Since then, Capri has always been active within the project, providing one of the longest time series of ringing data available in Italy and within the Mediterranean. It is important to mention here that such data would have not been collected without the continuous support offered by the Axel Munthe Foundation to ringers working there, and the Italian Ringing Centre is grateful for such a crucial help and for the positive cooperation with the Swedish ringers.

The seasonal and geographic coverage

One of the most fascinating aspects of return migration is represented by the mechanisms governing the start of return migration by birds wintering south of the Sahara, where they have no cues to predict ecological conditions north of the desert. Trans-Saharan migrants are also represented by a significant number of species showing negative population trends in Europe (Burfield & van Bommel 2004). When launching the PPI, we therefore decided to concentrate on long-distance migrants.

The project also aimed at having a good geographical coverage, at least within the Thyrrenian Sea, through the original group of four islands. Given the human resources available, we have decided to concentrate our activities in a period of peak migration of the species we were mostly interested in.

Hence, in order to properly define the seasonal period to be routinely covered, during the first two years different periods were sampled, i.e. mid-April to mid-May in 1988 and mid-March to mid-April in 1989. The earlier phase showed a prevalence of intra-Palaearctic migrants, while trans-Saharan species accounted for more than

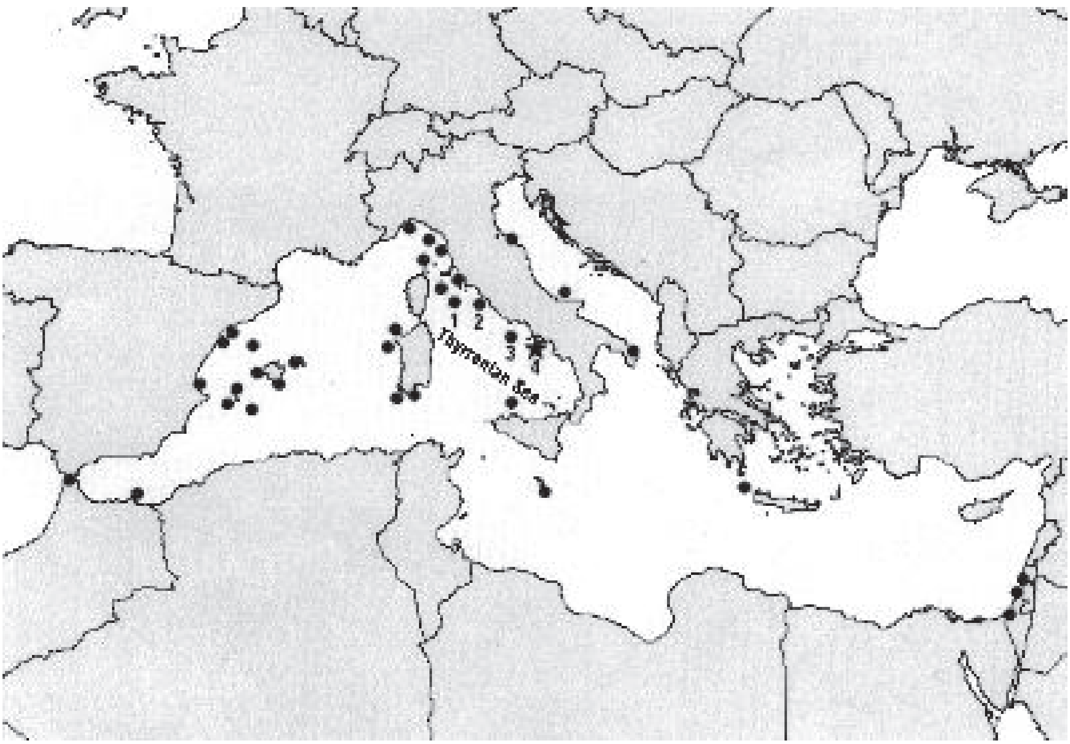


Figure 1. Capri within the network of PPI ringing stations. The four pioneer sites of the project are marked with 1 (Montecristo), 2 (Giannutri), 3 (Ventotene), 4 (Capri).
Capri inom PPIs nätverk av ringmärkningsstationer. De fyra pionjärplatserna inom projektet har markerats med 1 (Montecristo), 2 (Giannutri), 3 (Ventotene), 4 (Capri).

90% of ringings in the later one, which has therefore been chosen as the standard period of activity for the project (Spina et al. 1993).

During the years we have also occasionally sampled earlier and later periods, and we have now data available between mid-March and end of May.

In terms of geographic coverage, the project has surely seen a significant development. During the years, a total of 46 sites in 7 different countries have been covered by over 600 ringers, offering a good sample for the central-western Mediterranean, while more scanty information has been collected in Greece and Israel (Figure 1).

Ringing effort and ringings on Capri

When analysing the activity of a series of Italian ringing stations (Macchio et al. 2002) a total of 476 ringing days have been carried out at Capri between 1985–1994, with a peak of over 80 days in 1994 and an annual mean of over 40 days during the period. In more recent years Capri has always been following the PPI protocols in terms of seasonal coverage. The overall total of birds ringed on the island in the period 1985–2005 amounts to 81,007, with an annual mean of 3857 and a peak of over 6000 in 1993.

Species diversity on Capri

On Capri 91 different species have been mist-netted during the PPI, with an annual mean of 56, and a peak of 68 in 1994. Out of a total of over 34,425 ringings analysed, the first ten species are Whinchat *Saxicola rubetra* (17%), Common Whitethroat *Sylvia communis* (11%), Pied Flycatcher *Ficedula hypoleuca* (10%), Wood Warbler *Phylloscopus sibilatrix* (9%), Garden Warbler *Sylvia borin* (9%), Spotted Flycatcher *Muscicapa striata* (7%), Willow Warbler *Phylloscopus trochilus* (7%), Icterine Warbler *Hippolais icterina* (7%), Wheatear *Oenanthe oenanthe* (5%), Redstart *Phoenicurus phoenicurus* (3%), (Messineo et al. 2001). In terms of community structure, the peak in species richness is reached during the late spring migration period (11 April – 20 May, Macchio et al. 2002), and the minimum in the late autumn passage (21 September – 3 October). Richness values are always higher than the national annual means for the different periods, confirming how the island concentrates a very diverse avifauna.

Seasonality of passage

The standard sampling period offers a good coverage of the peak period for trans-Saharan migrants; in fact, in a sample of over 190,000 birds out of 38 species of long-distance migrants collected on the four islands mentioned above, the mean of median dates of migration was April 30, with a normal and unimodal distribution, i.e. the central date of our sampling period. The different species show a strong consistency in their migration timing in spring, and the inter-annual, within-species variability in the mean date of passage is significantly lower than the variation recorded among species (Rubolini et al. 2005). The general seasonal pattern of passage of trans-Saharan migrants across the Mediterranean has been found to be influenced by factors acting on the wintering and breeding quarters. The importance of Africa is confirmed by the earlier spring movements within the Mediterranean of species wintering in more northern quarters; equally, species overcoming a complete wing moult on the wintering grounds show delayed northward movements. As for the influence of the breeding quarters, we found that early migration is related to cavity nesting, a strategy which implies direct competition for limited nesting opportunities, hence a selective advantage for an early arrival on the breeding grounds (see Rubolini et al. 2005 for a detailed discussion).

The data collected on Capri have also contributed to describe and investigate differential migration of sex- and age-classes, an aspect which the PPI results have shown to be very widespread among spring migrants across the Mediterranean (Spina et al. 1994; Messineo et al. 2001).

Migratory routes

Songbird species are generally characterized by a very low recovery rate, implying the need for a huge effort and long time in order to come to sound recovery samples. Data collected on 21 stations during the PPI offered a first example of the use of ringing (and not recovery) data to describe the geographical distribution of species-specific flyways based on networks of ringing stations across wide geographical areas (Pilastro et al. 1998). This method allowed to show flyways followed by species with particularly low recovery rates, like *Phylloscopus* sp. The case of Bonelli's Warbler *Phylloscopus bonelli* and Melodious Warbler *Hippolais polyglotta* in particular also offered interesting examples of detours in migratory routes

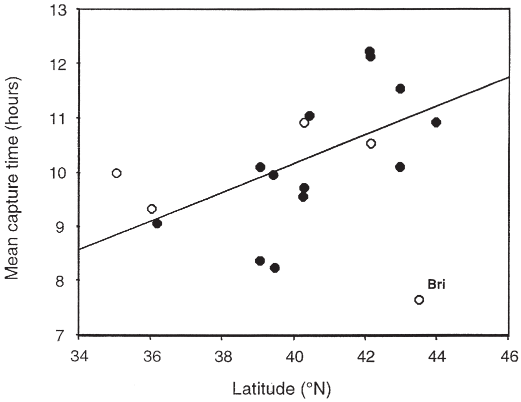


Figure 2. Garden Warbler: the mean time of capture during the day in relation to the latitude of the different ringing stations (open circle= mainland station; filled circle= island station). The line is the least square regression fitted to the points, excluding Monte Brisighella, BRI. From: Grattarola et al. 1999.
Trädgårdssångare: medeltid under dagen för fångst i förhållande till märkstationernas breddgrad (öppen cirkel = fastlandsstation, fylld cirkel = östation). Linjen är minsta kvadrat-regressionen för punkterna, med Monte Brisinghella, BRI utesluten. Från Grattarola et al. 1999.

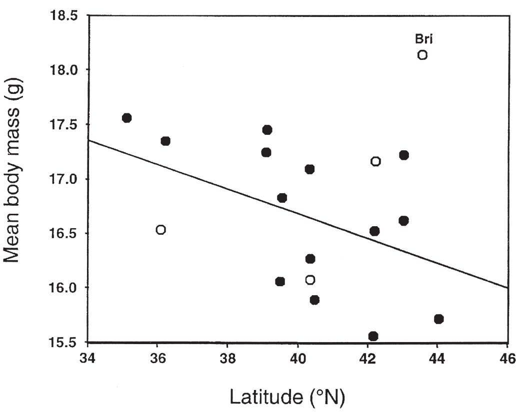


Figure 3. Garden Warbler: mean body mass against latitude of the different ringing stations (open circle= mainland station; filled circle= island station). The line is the least square regression fitted to the points, excluding Monte Brisighella, BRI. From: Grattarola et al. 1999.
Trädgårdssångare: genomsnittlig kroppsmassa i förhållande till märkstationernas breddgrad (öppen cirkel = fastlandsstation, fylld cirkel = östation) Linjen är minsta kvadrat-regressionen för punkterna, med Monte Brisinghella, BRI utesluten. Från Grattarola et al. 1999.

(Alerstam 2001). Both species are extremely rare on islands like Capri, being on the contrary very numerous in the Western Mediterranean Spanish islands and coastal sites, suggesting an avoidance of direct barrier crossing by birds which are regularly breeding also in continental Italy.

The collection of biometrical data on all PPI stations allows also to infer on different populations of a same species crossing different areas of the Mediterranean. In the case of the Garden Warbler, a progressive increase in wing length with longitude has been found (Grattarola et al. 1999), matching the W-E dimensional cline observed in breeding populations across Europe. This suggests similar migratory directions followed by birds heading towards the breeding areas, irrespective of the distance to be covered across the sea.

Progression of the fronts of migration

A network of ringing stations also provides data on the daily distribution of catches at different stages of barrier crossing. In this case, by considering a general S-N pattern of movements across the Central Mediterranean, is has been possible to confirm a progressive movement of fronts of migration, with a delayed arrival on islands at higher latitudes, like in the Garden Warbler (Figure 2, Grattarola et al. 1999). It is interesting to note that such daily patterns refer also to classical night migrants, suggesting that once they have embarked on sea crossing, birds perform prolonged endurance flights, given also the impossibility of stopping over when islands or coasts are not available.

Progressive use of energy reserves

Based on the same model of progressive movements across the sea, we should expect energy reserves being depleted with increased duration of flight and distance migrated. This has been found in the Garden Warbler both for standardized body mass and fat score (Figure 3, Grattarola et al. 1999). In the same species, the observed values on the PPI stations also match the predicted pattern of progressive decrease in body mass as estimated using Pennycuick's model (Pennycuick 1998). This suggests that in fact birds are able to cross the extended barrier represented by the Sahara and Mediterranean in spring without significantly refuelling en route.

Physical conditions of staging migrants and physiology of endurance flights

In spring selection favours an early arrival on the nesting grounds, hence optimal migration theory predicts that spring migrants should minimize time (Lack 1968, Alerstam & Lindström 1990). When thinking of the Mediterranean crossing in spring, we should therefore expect only exhausted migrants to stopover on the islands, with those in better conditions continuing their flight. Equally, we should expect staging migrants to show generally negative physical conditions, with a low within-species variability in conditions among different sites, and a low among-species variability in conditions. Quite interestingly, we found a clearly different situation in a large sample referred to 28 species of trans-Saharan migrants ringed on Ventotene island. Here a clear inter-annual consistency in species-specific average physical conditions was found, but a strong difference among species, with different taxa being represented by large numbers of staging migrants in good, medium or very low conditions, respectively. Hence it is not only exhausted migrants that decide to land on the Mediterranean islands, but also birds with still very high potential flight ranges. One could therefore wonder why species differ so strongly in their physical conditions, and why do all these birds stopover despite being potentially able to continue their flight.

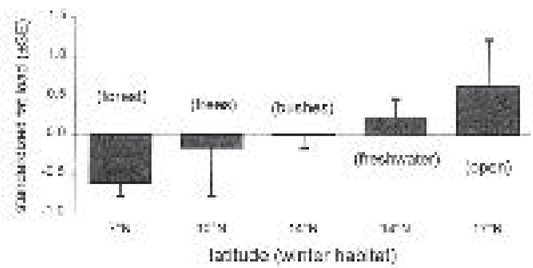


Figure 4. Mean residual fat load, standardised for the flying efficiency of each species, of 28 trans-Saharan passerine spring migrants at their arrival in southern Europe. Species are grouped according to their preferred wintering habitat. The northernmost latitude at which each habitat can be found in tropical Africa is indicated. From: Pilastro & Spina 1997.
Medelvärden för fettlagrets residualer, standardiserade för flygeffektiviteten för varje art, hos 28 tropikflyttare när de anländer till södra Europa efter vårflyttningen. Arterna är grupperade enligt deras favoritbiotop under vintern. Den nordligaste breddgrad är varje habitat kan påträffas i tropiska Afrika har markerats. Från Pilastro & Spina 1997.

Among-species differences in conditions

The most important variable in explaining these between-species differences is represented by the northernmost latitude of the preferred wintering habitat for each species in Africa. Hence, the crossing of the Sahara and the Mediterranean in spring is constrained by the distribution of preferred habitats south of the Sahara (Figure 4, Pilastro & Spina 1997). The overall width of the ecological barrier that the different species will cross without significantly refuelling is not necessarily the same for all species, as not all species are reaching their departure physical conditions in the same geographical area in Africa. This has also been confirmed by the relatively low number of species of Palaearctic songbirds ringed in spring in the Lake Chad region of Northern Nigeria (Ottosson et al. 2002).

Why do so many birds stopover?

This intriguing aspect has been addressed through analyses of the physiology of migrants staging on Ventotene island after a prolonged flight of some 500 km from North Africa (Jenni et al. 2000, Schwilch et al. 2001, Schwilch et al. 2002). Birds with appreciable fat stores are not stressed by endurance flights; however, below a threshold adiposity, the breakdown of proteins regulated by corticosterone levels increases, and an emergency situation of stress, with high corticosterone levels, is reached when muscle proteins get dangerously low. When birds have still over 5–10% body fat, proteins will derive from all organs, but especially from breast muscles. This can be regarded as adaptive, since the decrease in flight muscles matches the one in total body mass. The situation changes when fat stores further decrease; protein catabolism then increases, the mass of the digestive organs is reduced fastest, and flight performance is also reduced.

Nectar for warblers on Mediterranean islands: two birds with a stone!

The already mentioned reduction in mass of different organs entails a reduced digestive capacity in staging migrants after a prolonged flight across a barrier. The risky protein breakdown, together with glycolisys and lipolysis, is triggered by low blood glucose levels. In spring we have recorded intense feeding especially of *Sylvia* and *Phylloscopus* warblers on flowers. On Capri these are chiefly

Brassica fruticulosa; the same plant is visited on Ventotene, together with the tall flowers of *Ferula communis*. Field observations and cage experiments could confirm that nectar is the target food for these birds, rather than pollen or insects. When thinking of the situation of a migrant after an endurance flight, with reduced digestive capacity and an urgent need for recovery, nectar might be the ideal solution, as monosaccharides do not need digestion and are absorbed directly. The uptake of glucose would also reverse the process of protein breakdown and initiate the synthesis of glycogen, lipids and proteins. Hence, nectar feeding would allow migrants to efficiently compromise between the need to minimize the overall duration of their return migration, in the meantime resting after prolonged and energetically very costly flights, and avoid the risk of reaching threshold low levels of blood glucose which would trigger a dangerous process of protein breakdown. Brief stopovers on Mediterranean islands therefore offer spring migrants a chance to 'get two birds with one stone': regardless of their physical conditions, they can rest, get some energy (through nectar or insects, in the case of exclusive insectivores), if necessary increase again blood glucose levels, and still minimize time. It is in fact a common experience on these islands to see 'night-migrants', like warblers or thrushes, resuming their northward migration during daytime.

Conclusions

The Mediterranean is a significant ecological barrier for spring migrants originating from their African winter quarters. Mediterranean islands represent important 'bottleneck areas' for migrants, where intense human activities may represent major threats for their conservation. There is a strong functional link between staging migrants and the islands' habitats; this aspect needs being taken properly into account when planning local and international conservation strategies. Long-term and large-scale monitoring of spring migration in the Mediterranean is useful also to better understand the relationships between ecological factors acting in Africa during the boreal winter and breeding performances of a large array of species within the Palaearctic. Recoveries originating from ringing activities on the Mediterranean islands through the PPI project confirm the key international responsibility of Mediterranean countries within the wider international framework of migratory birds conservation. The case of the long-term ringing activities carried on by Swedish ornithologists on Capri, with the later positive developments of an intense co-operation with Italian ringers through the PPI, is an example of how migratory birds may stimulate international links for environmental research and conservation.

Acknowledgments

We are grateful to all ringers involved in the Progetto Piccole Isole; the organization of such a large-scale ringing program would have been impossible without their enthusiastic participation and support. In particular the opportunity to work together with Swedish ringers on Capri was a very positive experience. Our special thanks to the Axel Munthe Foundation for permission to work at the Castello Barbarossa and for providing facilities during many years of field work. We very much appreciated the opportunity offered by Christian Hjort to publish this review paper on a special issue dedicated to Capri. Results from the Progetto Piccole Isole (I.N.F.S.): paper no. 35.

References

Alerstam, T. 1990. *Bird Migration*. Cambridge University Press, Cambridge.

Alerstam, T. 2001. Detours in bird migration. J. *Theor Biol*. 209(3): 319–31.

Alerstam, T., Lindström Å. 1990. Optimal migration: the relative importance of time, energy and safety. In: Gwinner, E. (Ed.) *Bird migration: physiology and ecophysiology*: 331–351. Springer, Berlin.

Burfield, I., van Bommel, F. 2004. *Birds in Europe: population estimates, trends and conservation status*. BirdLife International. (BirdLife Conservation Series No. 12), Cambridge, U.K.

Fenech, N. 1992. *Fatal flight: the Maltese obsession with killing birds*. Quiller Press, London.

Grattarola, A., Spina, F. & Pilastro, A. 1999. Spring migration of the Garder Warbler (Sylvia borin) across the Mediterranean. *J. Ornithol*. 140: 419–430.

Hepburn, J. R. 1985. *La caccia agli uccelli migratori nei Paesi della Comunità Europea*. U.N.A.V.I., Firenze.

Jenni, L., Jenni-Eiermann, S., Spina, F. & Schwabl, H. 2000. Regulation of protein breakdown and adrenocortical response to stress in birds during migratory flights. *Am. J. Physiol. Regulatory Integrative Comp. Physiol*. 278: R1182–R1189.

Lack, P. 1968. Bird migration and natural selection. *Oikos* 19: 1–9.

Macchio, S., Messineo, A. & Spina, F. 2002. Attività di alcune stazioni di inanellamento italiane: aspetti metodologici finalizzati al monitoraggio ambientale. *Biol. Cons. Fauna* 110: 1–596.

Messineo, A., Grattarola, A. & Spina, F. 2001. Dieci anni di Progetto Piccole Isole. *Biol. Cons. Fauna* 106: 1–244.

Moreau, R. E. 1972. *The Palearctic-African Bird Migration System*. Academic Press, London.
Ottosson, U., Bairlein, F. & Hjort, C. 2002. Migration patterns of Palaearctic *Acrocephalus* and *Sylvia* warblers in north-eastern Nigeria. *Die Vogelwarte* 41: 249–262.
Pennycuick, C.J. 1998. Computer simulation of fat and muscle burn in long-distance bird migration. *J. theor. Biol*. 191: 47–61.
Pettersson, J., Hjort, C., Gezelius, L. & Johansson, J. 1990. *Spring Migration of Birds on Capri*. Special Report from Ottenby Bird Observatory: 1–114.
Pilastro, A., Spina, F. 1997. Ecological and morphological correlates of residual fat reserves in passerine migrants at their spring arrival in southern Europe. *J. Avian Biol*. 28: 309–318.
Pilastro, A., Macchio, S., Massi, A., Montemaggiori A. & Spina, F. 1998. Spring migration routes of eight trans-Saharan passerines through the central and western Mediterranean: results from a network of insular and coastal ringing sites. *Ibis* 140: 591–598.
Rubolini, D., Spina, F. & Saino, N. 2005. Correlates of timing of spring migration in birds: a comparative study of trans-Saharan migrants. *Biological Journal of the Linnean Society* 85: 199–210.
Schwilch, R., Mantovani, R., Spina, F. & Jenni, L. 2001. Nectar consumption of warblers after long-distance flights during spring migration. *Ibis* 143: 24–32.
Schwilch, R., Grattarola, A., Spina, F. & Jenni, L. 2002. Protein loss during long-distance migratory flights in passerine birds: adaptation and constraint. *J. Experimental Biology* 205: 687–695.
Spina, F., Massi, A., Montemaggiori, A. & Baccetti, N. 1993. Spring migration across Central Mediterranean: general results from the 'Progetto Piccole Isole'. *Vogelwarte* 37: 1–94.
Spina, F., Massi, A. & Montemaggiori, A. 1994. Back from Africa: who's running ahead? Aspects of differential migration of sex and age classes in Palaearctic-African spring migrants. *Ostrich* 65: 137–150.
Woldhek, S. (ed.) 1980. *Bird killing in the Mediterranean*. Intern. Council Bird Preserv. Zeist.

Sammanfattning

Vårflyttande fåglar på väg norrut från vinterkvarteren i tropiska Afrika till häckningsområden i Europa måste passera en dubbel ekologisk barriär – först Sahara-öknen och ofta direkt därefter Medelhavet. Öar i detta hav ger dock vissa av fåglarna möjlighet att rasta under dessa utdragna flygningar och sedan 1988 har italienska ornitologer inom ramen för det s.k. öprojektet PPI (Progetto Piccole Isole) studerat dessa rastande flyttfåglar. Ett stort antal ringmärkningsstationer deltar i projektet (Figur 1). Capri har varit en av huvudlokalerna för denna verksamhet och den här uppsatsen ger en översikt över PPI-projektet och dess uppnådda resultat.

Fåglar av många olika arter och i ytterst varierande fysisk kondition rastar på öarna, med väldefinierat säsongsmässigt uppträdande både vad gäller de olika arterna och deras respektive köns- och ålderskategorier. Bredfrontssträck av annars typiska nattsträckare noteras även under dagen – inte oväntat, då fåglarna ju först måste nå land innan de kan rasta. Fåglarna anländer till de olika märkstationerna vid olika klockslag, senare ju längre norrut de ligger. Ett exempel på detta ges i Figur 2 för trädgårdssångare. Olika arter kommer fram i olika grader av fysisk ”utmattning”, alltså med högre eller lägre relativa kroppsvikter. Det beror bland annat på hur långt söder om Sahara deras respektive startområde ligger och därmed hur lång deras totala flygsträcka varit. Figur 3 visar hur kroppsvikten hos trädgårdssångare varierar med läge.Väl framme på öarna i Medelhavet kan fåglarna både vila och justera sitt metaboliska system – det senare inte minst genom att äta nektar från olika blommor och via dess i blodet direktupptagna sockerarter snabbt komma i form igen.

Flyttfåglarna är under olika tider på året beroende av olika biotoper i Afrika, kring Medelhavet, och för många även områden mycket längre norrut i Europa. Dessa olika biotopers gynnsamhet för fettupplagring avspeglar sig i form av olika mängder fett hos fåglar som anländer från olika biotopzoner söder om Sahara (Figur 4). Detta faktum utgör ett starkt argument både för internationell koordination inom naturskyddet och för flyttfågelforskning längs hela vägen från häckningsområdena till vinterkvarteren.

ORNIS SVECICA 16: 27–33, 2006

The timing of spring migration in trans-Saharan migrants: a comparison between Ottenby, Sweden and Capri, Italy

Vårflyttningens tidsmönster hos tropikflyttare: en jämförelse mellan Ottenby, Sverige och Capri, Italien

NICLAS JONZÉN, DARIO PIACENTINI, ARNE ANDERSSON, ALESSANDRO MONTEMAGGIORI, MARTIN STERVANDER, DIEGO RUBOLINI, JONAS WALDENSTRÖM & FERNANDO SPINA

Abstract

Some migratory birds have advanced their spring arrival to Northern Europe, possibly by increasing the speed of migration through Europe in response to increased temperature en route. In this paper we compare the phenology of spring arrival of seven trans-Saharan migrants along their migration route and test for patterns indicating that migration speed varied over the season using long-term data collected on the Italian island of Capri and at Ottenby Bird Observatory, Sweden. There was a linear relationship between median arrival dates on Capri and at Ottenby. The slope was not significantly different from one. On average, the seven species arrived 15 days later at Ottenby compared to Capri. There was a (non-significant) negative relationship between the species-specific arrival dates at Capri and the differences in median arrival dates between Capri and Ottenby, possibly indicating a tendency towards faster migration through Europe later in the season. To what extent different species are able to speed up their migration to benefit from the advancement of spring events is unknown.

Niclas Jonzén, Department of Theoretical Ecology, Ecology Building, Lund University, SE-223 62 Lund, Sweden. Email: niclas.jonzen@teorekol.lu.se
Dario Piacentini, Alessandro Montemaggiori and Fernando Spina, Istituto Nazionale per la Fauna Selvatica, via Ca' Fornacetta 9, I-40064 Ozzano Emilia (BO), Italy
Arne Andersson and Martin Stervander, Ottenby Bird Observatory, P. O. Box 1500, SE-380 65 Degerhamn, Sweden
Diego Rubolini, Dipartimento di Biologia Animale, Università degli Studi di Pavia, piazza Botta 9, I-27100 Pavia, Italy
Jonas Waldenström, Department of Animal Ecology, Ecology Building, Lund University, SE-223 62 Lund, Sweden

Received 17 July 2005, Accepted 12 Jan 2006, Editor: D. Hasselquist

Introduction

Over the past decades many organisms have advanced the timing of spring events, most likely in response to recent climate change (e.g. Stenseth et al. 2002, Walther et al. 2002, Parmesan & Yohe 2003). For instance, recent empirical work has demonstrated changing phenology patterns in the flowering of plant species (Fitter & Fitter 2002), in the emergence from pupae in insects (Roy & Sparks 2000), and in earlier breeding by amphibians (Beebee 1995) and birds (Crick et al. 1997). Most ornithological studies demonstrating temporal trends towards earlier spring arrival or egg-laying dates have been carried out in the temperate region of Europe and North America (reviewed by Lehikoinen et al. 2004, Dunn 2004), whereas only a few publications cover the Mediterranean region or Africa (e.g. Peñuelas et al. 2002, Sanz et al. 2003, Gordo et al. 2005). Thus, at present our understanding of these patterns in migrant birds is somewhat biased towards the situation close to the breeding areas, which makes it difficult to identify to what extent arrival patterns in Northern Europe are caused by processes in Africa or along the migration route through Europe.

One hypothesis to explain how tropical migrants can advance their spring arrival to Northern Europe is that the migration speed through Europe has increased, as suggested by e.g. Hüppop & Hüppop (2003). A more rapid spring migration in response to increased temperature *en route* has recently been demonstrated in the Pied Flycatcher *Ficedula hypoleuca* (Both et al. 2005). However, the ability to speed up migration may be affected by the "normal" speed of migration, which in turn may vary across species.

In this paper, we compare the phenology of spring arrival of seven trans-Saharan migrants along their migration route by analysing long-term data collected on the island of Capri, Italy, and at Ottenby Bird Observatory, Sweden. By analysing the relationship between arrival dates at Ottenby and on Capri we tested for patterns indicating whether migration speed varied over season. Late migrating species may be more time constrained than early migrating species, and they may therefore migrate faster.

Material and methods

Study sites

The island of Capri is situated c. 5 km off mainland Italy, in the bay of Naples, with the trapping site (40°33'N, 14°15'E) located about 400m above sea level (Pettersson et al. 1990, Hjort 2006). In spring, many migrating birds stop to rest, at least for a short time (Holmgren & Engström 2006), on this island after their passage over the Mediterranean Sea. The trapping area on Capri lies mainly within the perimeter of the walls of the old castle Castello Barbarossa and comprises c. 2 ha of macchia vegetation typical for this region of the Mediterranean. However, the plant species and especially the structural composition of the vegetation has changed over the study period, most dramatically by fires (the latest occurred in 1989), which killed the larger pine trees and favoured lower bush vegetation. This could potentially have had an effect on the species composition of the birds trapped, considering that different species have different habitat preferences and the trapping efficiencies of the nets may have changed.

On Capri data have been collected during 45 springs from 1956 to 2004 (no trapping in the period 1982–1985), with the coverage varying from 13 to 89 days per season (Table 1). Birds were trapped with mist nets throughout the study, but the number of nets used varied considerably between, and sometimes also within, years. However, we could not take into account variation in trapping effort in this study. The spring trapping season on Capri is included in the Progetto Piccole Isole, run by the Istituto Nazionale per la Fauna Selvatica (Ozzano Emilia, BO) (Spina 2006).

Ottenby Bird Observatory (56°12' N, 16°24' E) is situated at the southernmost point of Öland, a 137 km long island c.10 km off the coast of southeastern Sweden. The trapping area in the observatory garden is 1.2 hectares and contains most of the higher vegetation within the nearest 2 km. It is surrounded by water on three sides and by grazed meadows to the north. Birds have been caught at Ottenby in funnel traps of Helgoland-type since the first year of trapping in 1946, and mist nets have been used since 1959. Since 1980 the numbers of nets and traps, their position and use in spring have been strictly standardised. We considered data for 53 spring seasons from 1952–2004 as reliable for the purpose of this study. Details on the data collection at Ottenby Bird Observatory are given elsewhere, e.g. in Stervander et al. (2005).

Species analysed

We have compiled data for seven of the most numerously trapped bird species on Capri: Redstart *Phoenicurus phoenicurus*, Willow Warbler *Phylloscopus trochilus*, Icterine Warbler *Hippolais icterina*, Garden Warbler *Sylvia borin*, Common Whitethroat *Sylvia communis*, Spotted Flycatcher *Muscicapa striata* and Pied Flycatcher *Ficedula hypoleuca*. We have used ringing recoveries from birds ringed on Capri and elsewhere in the Campania region (Naples, Sorrento, Amalfi; Scebba (1993)), and recoveries of birds ringed at Ottenby to sketch putative breeding areas, migration flyways and possible wintering areas of the investigated species. An underlying assumption when comparing arrival times between Capri and Ottenby is that the species trapped belong roughly to the same population.

Statistical analyses

We estimated the median spring arrival date for each of the seven species. The estimated medians were not dependent on whether we only analysed data from years including ringing activity on both Capri and at Ottenby, and we therefore decided to keep data from all years. Due to the large samples, any effect of variability in ringing activity within and between seasons was effectively smoothened out.

Because there are observation errors in both the Capri and the Ottenby data sets we performed a reduced major axis (RMA) to test whether the relationship between median arrival on Capri and at Ottenby differed from unity. RMA regression minimize the product of the deviations from the regression line across both the x (Capri) and the y (Ottenby) variables.

Table 1. Ringing details and trapping data from Capri. No ringing in 1982–1985. Species: P.p. = Common Redstart *Phoenicurus phoenicurus*, H.i. = Icterine Warbler *Hippolais icterina*, S.c. = Common Whitethroat *Sylvia communis*, S.b. = Garden Warbler *Sylvia borin*, P.t. = Willow Warbler *Phylloscopus trochilus*, M.s. = Spotted Flycatcher *Muscicapa striata*, F.h. = Pied Flycatcher *Ficedula hypoleuca*.
Fångsuppgifter från ringmärkningen på Capri. Ingen ringmärkning åren 1982–1985. Arter: P.p. = rödstjärt, H.i. = härmsångare, S.c. = törnsångare, S.b. = trädgårdssångare, P.t. = lövsångare, M.s. = grå flugsnappare, F.h. = svartvit flugsnappare.

	Catch period *Fångstperiod*			Number of birds ringed *Antal märkta fåglar*						
Year	Start	Stop	Days	*P.p.*	*H.i.*	*S.c.*	*S.b.*	*P.t.*	*M.s.*	*F.h.*
1956	May 1	May 31	31	25	52	57	77	1	14	16
1957	Apr 1	May 30	60	164	320	227	445	69	125	88
1958	May 1	Jun 11	42	177	501	361	1248	26	339	54
1959	Apr 26	Jun 20	56	199	934	450	1305	53	664	264
1960	Apr 15	May 23	39	618	405	661	1327	235	347	539
1961	Mar 23	Jun 3	73	257	880	563	1472	89	880	286
1962	Mar 9	Jun 5	89	105	103	524	170	204	429	152
1963	Mar 24	May 31	69	196	436	330	683	135	578	343
1964	May 2	May 27	26	44	608	289	993	33	229	37
1965	Apr 14	May 27	44	178	420	451	557	378	203	138
1966	Apr 8	May 27	50	146	427	331	505	108	470	153
1967	Apr 11	Jun 7	58	286	368	240	384	257	194	355
1968	Apr 9	May 23	45	231	265	401	381	288	346	351
1969	Apr 1	May 25	55	197	213	408	163	384	294	180
1970	Apr 7	May 29	53	101	403	593	603	200	382	219
1971	Mar 24	Jun 5	74	140	195	305	223	140	300	144
1972	Apr 25	May 26	32	194	250	200	387	225	193	140
1973	Apr 8	May 26	49	89	403	178	266	101	327	114
1974	Apr 19	May 27	39	75	979	364	910	250	444	89
1975	Apr 11	Jun 2	53	160	374	401	546	124	722	261
1976	Apr 4	May 28	55	44	457	221	233	74	310	108
1977	Apr 19	May 23	35	94	149	188	206	70	241	110
1978	Apr 23	May 30	38	84	358	159	272	81	174	116
1979	Apr 14	May 23	40	108	624	368	666	282	58	183
1980	May 2	May 27	26	37	876	174	423	65	176	46
1981	Apr 15	May 23	39	88	485	171	180	97	195	174
1986	Apr 15	May 22	38	122	730	570	1113	273	474	465
1987	Apr 11	May 24	44	80	600	623	728	259	134	256
1988	Apr 16	May 23	38	41	366	185	237	125	280	176
1989	Mar 18	May 24	68	60	707	614	457	350	258	131
1990	Apr 5	May 23	49	95	757	902	614	197	572	465
1991	Apr 2	May 23	52	90	218	221	170	286	126	341
1992	Apr 5	May 22	48	69	798	419	350	364	538	188
1993	Apr 1	May 21	51	103	522	1105	748	433	324	453
1994	Apr 16	May 15	30	82	314	299	418	226	337	429
1995	Apr 17	May 15	29	81	236	314	302	241	199	357
1996	Apr 16	May 15	30	63	71	262	431	245	49	275
1997	Apr 16	May 15	30	185	334	519	367	422	291	358
1998	Apr 16	May 15	27	83	178	336	338	396	156	362
1999	Apr 16	May 15	29	79	451	448	876	321	245	286
2000	May 1	May 14	13	15	245	287	355	25	117	107
2001	Apr 16	May 15	27	119	79	314	284	457	298	497
2002	Apr 16	May 15	26	133	321	380	266	433	215	297
2003	Apr 16	May 15	30	74	876	320	487	317	260	566
2004	Apr 16	May 15	30	105	448	273	282	364	228	450
Total			1959	5716	19736	17006	23448	9703	13735	11119

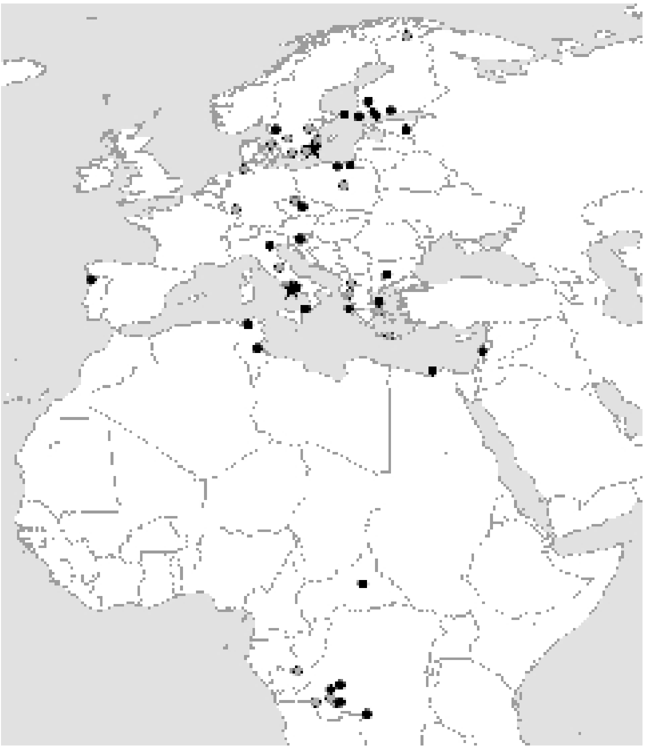


Figure 1. Map showing the recoveries of Spotted Flycatchers *Muscicapa striata* ringed or controlled at Ottenby (grey circles) and Capri (black circles). The black stars indicate the location of Ottenby and Capri. The sample from Capri also includes recoveries of birds ringed or recovered elsewhere in the Campania region (from Scebba 1993).
Återfyndskarta för grå flugsnappare Muscicapa *striata som ringmärkts eller kontrollerats vid Ottenby (grå cirklar) eller Capri (svarta cirklar). De svarta stjärnorna anger Ottenbys och Capris geografiska läge. Caprimaterialet inkluderar återfynd från hela Campania regionen (från Scebba 1993).*

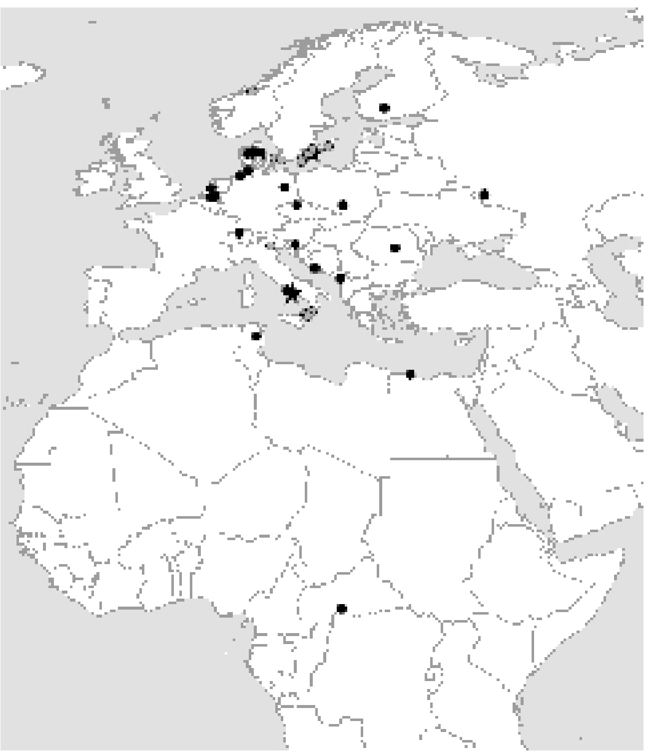


Figure 2. Map showing the recoveries of Icterine Warblers *Hippolais icterina* ringed or controlled at Ottenby (grey circles) and Capri (black circles). The black stars indicate the location of Ottenby and Capri. The sample from Capri also includes recoveries of birds ringed or recovered elsewhere in the Campania region (from Scebba 1993).
Återfyndskarta för Härmsångare Hippolais icterina *som ringmärkts eller kontrollerats vid Ottenby (grå cirklar) eller Capri (svarta cirklar). De svarta stjärnorna anger Ottenbys och Capris geografiska läge. Caprimaterialet inkluderar återfynd från hela Campania regionen (från Scebba 1993).*

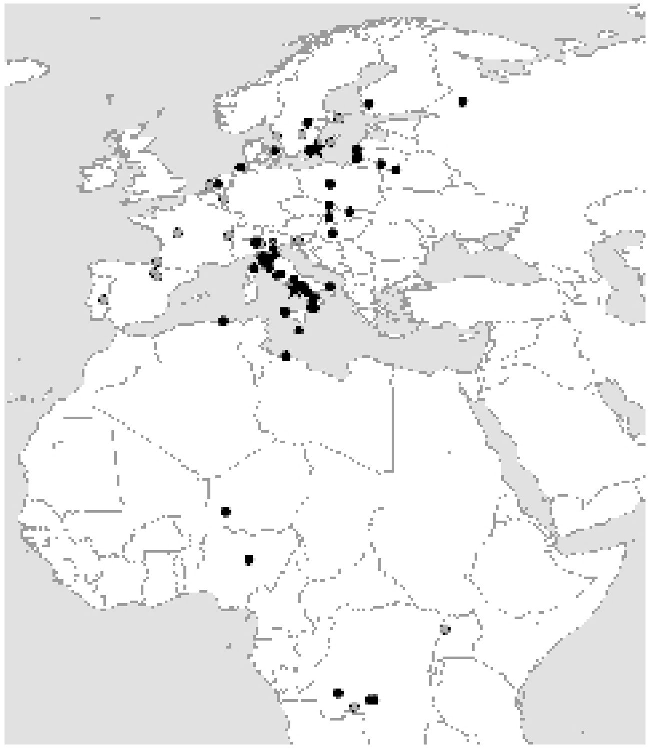


Figure 3. Map showing the recoveries of Garden Warblers *Sylvia borin* ringed or controlled at Ottenby (grey circles) and Capri (black circles). The black stars indicate the location of Ottenby and Capri. The sample from Capri also includes recoveries of birds ringed or recovered elsewhere in the Campania region (from Scebba 1993).
Återfyndskarta för Trädgårdssångare Sylvia borin *som ringmärkts eller kontrollerats vid Ottenby (grå cirklar) eller Capri (svarta cirklar). De svarta stjärnorna anger Ottenbys och Capris geografiska läge. Caprimaterialet inkluderar återfynd från hela Campania regionen (från Scebba 1993).*

Results

The ringing recoveries indicate that Spotted Flycatchers and Icterine Warblers (Figures 1 and 2) passing Capri follow a central flyway in Europe and Africa, and are later found in the general direction of Ottenby. A similar pattern was also found for Redstarts, Willow Warblers, Common Whitethroats and Pied Flycatchers (not shown). On the other hand, the recoveries of Garden Warblers suggest a more eastern origin of the birds trapped at Capri compared with those trapped at Ottenby (Figure 3).

Figure 4 shows the linear relationship between median arrival dates on Capri and at Ottenby for each species. The point estimate of the slope was 0.87 ($t_5 = 8.45$, $P < 0.001$), which is not significantly different from one (95% confidence interval: 0.61–1.14). On average, the seven species migrated 15 days (0.79 SE) later at Ottenby compared to Capri. In order to see if migration speed varied over the season we tested if there was a relationship between species-specific arrival dates on Capri and the differences in median arrival dates between Capri and Ottenby. There was a non-significant negative correlation between the species-specific arrival dates on Capri and the differences in median arrival dates between Capri and Ottenby ($r = -0.57$, $P = 0.18$; Figure 5).

Discussion

The strong and positive relationship between migration dates at Ottenby and on Capri suggests that there are either common underlying environmental factors affecting long-distance migrants along their migration route, or that arrival dates are mainly reflecting a specific endogenous time-programme. In long-distance migrants, the onset of migration is known to be under strong endogenous control (Berthold 1996, Gwinner 1996), although the speed of migration through Europe can be affected by local conditions en route, as recently shown in the Pied Flycatcher (Both et al. 2005).

The difference in median arrival date on Capri and at Ottenby may indicate variation in migration speed between species. We find that the Willow Warbler, being the earliest migrant of the species

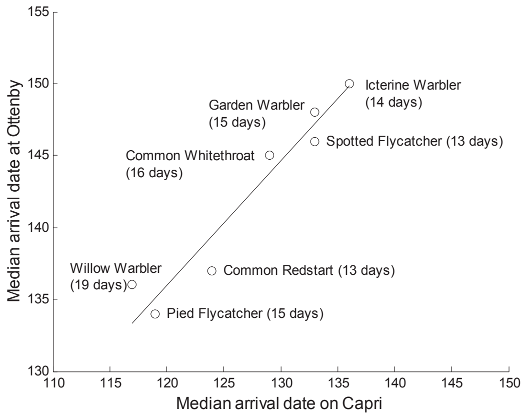


Figure 4. The relationship between median arrival dates on Capri and at Ottenby for seven trans-Sahara migrants, as well as the difference (in days). The line is the estimated slope in a reduced major axis regression (RMA).
Förhållandet mellan mediandatum för vårfångst av sju trans-Saharaflyttare på Capri och vid Ottenby, liksom skillnaden i antal dagar. Den heldragna linjen är den skattade regressionslinjen i en RMA regression.

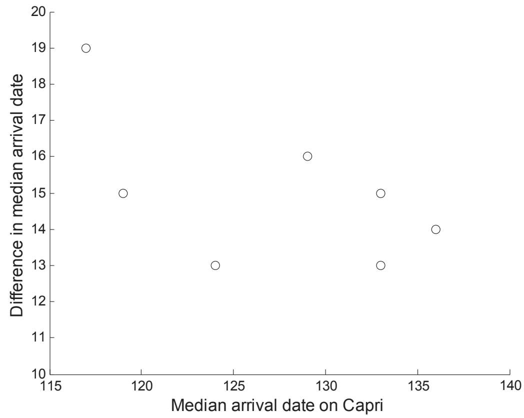


Figure 5. The differences in median arrival dates between Ottenby and Capri plotted against the species-specific arrival dates on Capri. $r = -0.57$, $P = 0.18$
Skillnad i mediananskomst mellan Ottenby och Capri vid olika (artspecifik) mediananskomst på Capri. $r = -0.57$, $P = 0.18$

analysed, is also the species having the largest difference (19 days) in median arrival dates between the two sites. In the same vein, late migrating species such as the Spotted Flycatcher and the Icterine Warbler show a difference of only 13 and 14 days, respectively. However, the overall pattern is weak even though some of the extremes are behaving as expected. It would be interesting to know to what extent the migration speed is limited by the time needed to stop-over. A number of recent studies (e.g. Saino et al. 2004, Both et al. 2005) have shown that arrival time is affected by environmental conditions en route, such that migration speed increases when conditions en route are favourable. If this is a general pattern the timing of migration may not constrain adaptations to climate change as much as previously thought (e.g. Both & Visser 2001, Both et al. 2005).

Competition for territories is an important factor affecting the timing of migration (Kokko 1999). A close look at Figure 4 shows that all species falling below the regression line (i.e., migrating faster than predicted by the linear model) are using cavities as nesting sites. If cavities are limited one may expect severe competition for territories. In fact, comparative evidence indicates that, among trans-Saharan migrants, hole-nesting species migrate earlier than other species in the Mediterranean (Rubolini et al. 2005). However, to what extent different species are able to speed up their migration to benefit from the advancement of spring events is currently unknown.

Acknowledgements

This article is based on the efforts of many Swedish and Italian ringers that have contributed to the running of the long-term trapping series at Ottenby and Capri. Although many people have been involved on Capri, we would like to extend our special gratitude to Carl Edelstam – the founder of the station – and Jan Pettersson. We would also like to thank the present and former staff of Villa San Michele who has contributed significantly to the study of bird migration on Monte Barbarossa – thereby following the intentions of Axel Munthe. N.J. is financially supported by the Swedish Research Council. Finally, we would like to thank Christian Hjort, Dennis Hasselquist and an anonymous referee for constructive comments on an earlier draft of this article. This is contribution no. 208 from Ottenby Bird Observatory, and results from the Progetto Piccole Isole (I.N.F.S.): paper no. 36.

References

Beebee, T. J. C. 1995. Amphibian breeding and climate. *Nature* 374: 219–220.

Berthold, P. 1996. *Control of bird migration*. Cambridge University Press. Cambridge.
Both, C. & Visser, M. E. 2001. Adjustment to climate change is constrained by arrival date in a long-distance migrant bird. *Nature* 411: 296–298.
Both, C., Bijlsma, R. G. & Visser, M. E. 2005. Climatic effects on spring migration and breeding in a long-distance migrant, the pied flycatcher Ficedula hypoleuca. Journal of Avian Biology 36: 368–373.
Crick, H. Q. P., Dudley, C., Glue, D. E. & Thomson, D. L. 1997. UK birds are laying eggs earlier. *Nature* 388: 526.
Dunn, P. 2004. Breeding dates and reproductive performance. *Advances in Ecological Research* 35: 69–87.
Fitter, A. H. & Fitter, R. S. R. 2002. Rapid changes in flowering time in British plants. *Science* 296: 1689–1691.
Gordo, O., Brotons, L., Ferrer, X. & Comas, P. 2005. Do changes in climate patterns in wintering areas affect the timing of the spring arrival of trans-Saharan migrant birds? *Global Change Biology* 11: 12–21.
Gwinner, E. 1996. Circadian and circannual programmes in avian migration. *Journal of Experimental Biology* 199: 39–48.
Hjort, C. 2006. Capri Bird Observatory – a brief historical overview. *Ornis Svecica* 16: 13–19.
Holmgren, N. & Engström, H. 2006. Stopover behaviour of spring migrating Wood Warblers *Phylloscopus sibilatrix* on the island of Capri, Italy. *Ornis Svecica* 16: 34–41.
Hüppop, O. & Hüppop, K. 2003. North Atlantic Oscillation and timing of spring migration in birds. *Proceedings of the Royal Society of London Series B* 270: 233–240.
Kokko, H. 1999. Competition for early arrival in migratory birds. Journal of Animal Ecology 68: 940–950.
Lehikoinen, E., Sparks, T.H., and Zalakevicius, M. 2004. Arrival and departure dates. *Advances in Ecological Research* 35: 1–31.
Parmesan, C. & Yohe, G. 2003. A globally coherent fingerprint of climate change impacts across natural systems. *Nature* 421: 37–42.
Peñuelas, J., Filella, I. & Comas, P. 2002. Changed plant and animal life cycles from 1952 to 2000 in the Mediterranean region. *Global Change Biology* 8: 531–544.
Pettersson, J., Hjort, C., Gezelius, L. & Johansson, J. 1990. *Spring migration of birds on Capri*. Special report, Ottenby Bird Observatory [accessible at http://www.sofnet.org/ofstn/index.html]
Roy, D. B. & Sparks, T. H. 2000. Phenology of British butterflies and climate change. *Global Change Biology* 6: 407–416.
Rubolini, D., Spina, F. & Saino, N. 2005. Correlates of timing of spring migration in birds: a comparative study of trans-Saharan migrants. *Biological Journal of the Linnean Society* 85: 199–210.
Saino, N., Szép, T., Romano, M., Rubolini, D., Spina, F. & Møller, A.P. 2004. Ecological conditions during winter predict arrival date at the breeding quarters in a trans-Saharan migratory bird. *Ecology Letters* 7: 21–25.
Sanz, J. J., Potti, J., Moreno, J., Merino, S. & Frías O. 2003. Climate change and fitness components of a migratory bird breeding in the Mediterranean region. *Global Change Biology* 9: 461–472.
Scebba, S. 1993. *Gli Uccelli della Campania* (Birds of the Campania region). Edizioni Esselibri, Napoli.
Spina, F., Piacentini, D. & Montemaggiori, A. 2006. Bird migration across the Mediterranean: ringing activities on Capri within the Progetto Piccole Isole. *Ornis Svecica* 16: 20–26.
Stenseth, N. C., Mysterud, A., Ottersen, G., Hurrell, J. W., Chan, K. S. & Lima, M. 2002. Ecological effects of climate fluctuations. *Science* 297: 1292–1296.
Stervander, M., Lindström, Å., Jonzén, N. & Andersson, A. 2005. Timing of spring migration in birds: long-term trends, North Atlantic Oscillation and the significance of different migration routes. *Journal of Avian Biology* 36: 210–221.
Walther, G.-R., Post, E., Convey, P., Menzel, A., Parmesan, C., Beebee, T. J. C., Fromentin, J.-M., Hoegh-Guldberg, O. & Bairlein, F. 2002. Ecological responses to recent climate change. *Nature* 416: 389–395.

Sammanfattning

Klimatförändringar har gjort att många organismers fenologi har tidigarelagts i norra Europa. Flera tropikflyttande fågelarter anländer allt tidigare och en förklaring till hur detta är möjligt är att flyttningen genom Europa går allt snabbare då vårtemperaturen ökar. Hur pass mycket olika arter kan öka sin flyttningshastighet är okänt och borde bero på deras ”normala” hastighet. I denna artikel jämför vi datum för mediananankomst på Capri (Italien) och Ottenby (Sverige) på våren hos sju arter som alla övervintrar söder om Sahara. Ringmärkningsåterfynd visar att några arter (t.ex. grå flugsnappare och härmsångare; Figur 1 resp. Figur 2) passerar Capri längs en central flyttningsväg genom Europa och återfinns senare i riktning mot Ottenby. Återfynd av andra arter ringmärkta på Capri (t.ex. trädgårdssångare; Figur 3) pekar på ett östligare ursprung än Ottenby. I Tabell 1 redovisas fångstperioder och antal fångade fåglar under våren på Capri för de sju arter vilkas ankomsttider analyseras i denna uppsats.

Jämför man mediananankomst på Capri och Ottenby (Figur 4) finner man att det är ett linjärt förhållande med en lutning på 0.87 som dock inte skiljer sig statistiskt från 1. I genomsnitt passerar de sju studerade arterna 15 dagar senare på Ottenby än på Capri. Det finns även en icke-signifikant antydan till att ju senare en art flyttar desto snabbare flyttar den genom Europa, att döma av skillnader i mediananankomst på Ottenby och Capri (Figur 5). Det är okänt i vilken utsträckning olika arter skulle kunna öka sin flyttningshastighet för att dra nytta av vårens allt tidigare ankomst i norra Europa. Det är därför viktigt att man studerar vilka egenskaper som gör att en art har (eller saknar) förmågan att anpassa sig till klimatförändringar.

ORNIS SVECICA 16: 34–41, 2006

Stopover behaviour of spring migrating Wood Warblers *Phylloscopus sibilatrix* on the Island of Capri, Italy

Rastningsbeteende hos vårflyttande grönsångare Phylloscopus sibilatrix *på ön Capri, Italien*

NOÉL M. A. HOLMGREN & HENRI ENGSTRÖM

Abstract

Migratory birds are assumed to be under strong selection pressure during migration. It is generally assumed that many species are maximizing speed of migration because of the benefits from arriving early at the breeding grounds. Males' incentives are to occupy the best territories before they are occupied by competitors. Females breeding early usually have a greater reproductive success. In this study, the stopover behaviour of the Wood Warbler is studied on Capri, a Mediterranean island in southwest Italy. Movements of birds on the island are from higher elevations with sparse vegetation, where they presumably arrive, to low elevations with more dense vegetation. Males were found to migrate earlier than females, but were also staying much shorter time than females on the island. Males were estimated to stay on average slightly more than one hour whereas females stayed on average thirteen hours. The results suggest that Capri is not an important refueling site for the Wood Warbler and that males are more inclined to quickly leave this poor stopover site than females.

Noél M. A. Holmgren, School of Life Sciences, University of Skövde, P.O. Box 408, SE-541 28 Skövde, Sweden
Henri Engström, Population Biology, Dept of Ecology and Evolution, Evolutionary Biology Centre, Uppsala University, Norbyvägen 18D, SE-752 42 Uppsala, Sweden

Received 4 August 2005, Accepted 11 February 2006, Editor: Tomas Pärt

Introduction

The migration is a significant part of many birds' lives, both in terms of the time and the energy it requires (Holmgren & Hedenström 1995). It entails a great risk of mortality for birds: predation risks increases when the birds are exposed to predators during flight and during foraging at stopover sites. The birds are also at greater risk of mortality as a consequence of starvation or of severe weather during flight (Alerstam 1988).

The stopover, during which the birds replenish their energy reserves, is the most time-consuming part of the migration, and hence is under strong selection (Alerstam & Lindström 1990). Optimal migration theory suggests that birds should take into account current stopover site conditions, such as local food abundance and current wind, for its decision to stay or leave (Weber et al. 1998). They should also take into account their expectations in the near future of migratory barriers, expected food density at stopover sites along the route (Gudmundsson et al. 1991), and search and settling time at the next stopover site (Alerstam & Lindström 1990). A bird's condition, in terms of energy reserves, protein, water, and sleep deprivation (Schwilch et al. 2002), is also important for the bird to consider.

Because of the risks during migration, and the benefits from arriving early on breeding grounds (see below), birds on spring migration are expected to maximise migration speed (Alerstam & Lindström 1990). While doing this optimization of spring migration, the birds have to consider the conditions mentioned above. The mass gaining rate of birds is usually a function of local food density, but it may also vary between individuals e.g. because of differences in dominance (Lindström et al. 1990) or in foraging efficiency. The dominance situation may change during the stopover at one site (Rappole & Warner 1976), whereas foraging efficiency will have the same effect on a birds intake rate at all its stopover sites. If birds are speed maximizers, and intake rate varies between individuals as an effect of local conditions, a positive correlation between energy deposition rate and departure body mass is expected among birds (Alerstam & Lindström 1990).

During spring, speed of migration is crucial for males. Those males that arrive early benefit from occupying the best territories on breeding grounds (Forstmeier 2002; Smith & Moore 2005). Male Wood Warblers are polyterritorial and some will pair with multiple females (Temrin et al. 1984). Females start to arrive 7–10 days after most males have settled at the breeding grounds (Temrin 1986). In a population of Wood Warblers in central Sweden, secondary females of polygynous males fledged as many young as females of monogamous males and primary females of polygynous males (Temrin et al. 1996). For females, speed of migration is expected to be less critical than for males, because the mating opportunities increase as the number of established males increase. It is still unclear if males depart earlier than females from the wintering grounds or if males migrate faster than females. Little is known about the differences between the sexes on migration. Here we report on fat scores, stopover duration, and changes in body mass of the Wood Warbler *Phylloscopus sibilatrix* at a spring stopover site on Capri, a Mediterranean island in southwestern Italy.

Methods

In 1993, birds were captured and ringed at two sites on Capri, 40°33' N, 14°13' E. One site was located at Castello Barbarossa on a small hilltop of the island, c 400 m above sea level. The other site was located approximately 100 m downhill in typical Mediterranean macchia vegetation with some pine trees, *Pinus* spp. The vegetation gradually became higher and denser down the slope. The ringing at the hilltop was part of "the small island project" (Progetto Picole Isole; Pilastro et al. 1998) of the Italian national ringing centre, Bologna, undertaken from 16 April to 15 May 1993 (Messineo et al. 2001). The ringing on the slope was undertaken from 22 April to 11 May in order to study the stopover behaviour of the birds.

The birds were ringed, measured and weighed immediately after capture. Wing length was measured using maximum chord to the nearest mm (Svensson 1984). Tarsus length was measured with 0.1 mm accuracy, including the folded adjoining joints. Fat score was estimated visually, following a ten-graded scale from 0 to 9 (an extension of the Pettersson & Hasselquist 1985 method). Body mass was weighed to 0.1 g accuracy. Some birds were also recaptured before leaving the island. To control for body size in the statistical analyses, wing length and tarsus length were used as indirect predictors. One may on theoretical grounds argue that a linear relationship with body mass is achieved if wing length and tarsus length are raised to the power of three to reflect the volume of the body. These were tested as alternatives to the linear measurements in multiple regressions but there were only small differences between the alternatives (data not shown).

Stop-over lengths were analysed in two ways. Minimum stopover lengths (MSL), i.e. the time between ringing and last recapture were for each individual recaptured. MSL was used in correlations with initial body mass (IBM), last recapture body mass (LBM), and body mass changing rate (BCR). It is well known that many birds initially loose body mass at a stopover site before they start to gain body mass (see discussion). Birds may be captured and recaptured at any time of their stay at a stopover site. When analyzing recovery data, the obtained measurements of MSL and BCR may therefore depend on IBM as an indicator of when the bird was first captured in relation to its arrival. We could not find any significant correlation between BCR and IBM ($r_p = -0.11$, $t_{45} = -0.76$, $p = 0.45$, partial correlation correcting for minimum stopover length). On the other hand, there was a negative correlation between MSL and IBM ($r_p = -0.32$, $t_{45} = -2.30$, $p = 0.026$, partial correlation correcting for body-mass change rate) indicating that birds with IBM closer to their goal departure body mass stayed shorter than other birds. Since IBM may have an effect on MSL and LBM we controlled for IBM in the tests of optimal stopover theory.

The real stopover length was estimated for all Wood Warblers using the adjusted Jolly-Seber method of Holmgren et al. (1993). The method is developed for analyzing data of birds that are recaptured at least once, and assumes a constant daily stopover probability. Maximum likelihood estimates are given for the mean daily stopover probability and the variance of the estimated mean.

Results

In total for both the hilltop site and the slope site, 774 Wood Warblers were ringed. The Wood Warbler was the most common species on the slope site, with 331 birds being ringed. The body mass of the birds ranged from 6.7 g to 12.5 g, with ninety-five percent of the birds within the range 7.2 g

Table 1. Multiple regression of wing length, tarsus length, and fat score on body mass. Regression coefficient value, the squared semi-partial regression (the proportion of the total variance in body mass explained by this variable), the t-statistics and the probability are shown. The degrees of freedom are 326.
Multipel regression av vinglängd, tarslängd och fettklass mot vikt. Regressionskoefficient, förklaringsgraden på variationen i vikt, t-värde och signifikansvärde anges. Antalet frihetsgrader är 326.

Variable	Coeff.	Prop. Var.	t	p
Intercept	-4.92		-3.20	0.001
Wing length	0.104	0.077	8.09	<0.001
Tarsus length	0.193	0.010	2.95	0.003
Fat score	0.488	0.519	21.0	<0.001

Table 2. Results of univariate linear regressions of wing length, tarsus length, fat score, and body mass over the time of season.
Linjär regression av vinglängd, tarslängd, fettklass och vikt mot tid på säsongen.

Variable	coeff.	t	n	p
Wing length	-0.130	-4.16	331	<0.001
Tarsus length	0.004	0.69	331	0.49
Fat score	0.030	1.92	331	0.055
Body mass	0.015	1.23	330	0.22

to 10.5 g. The body mass of the warblers depended on fat score, wing length, and tarsus length (Multiple R = 0.78, $F3,_{326}$ = 173, P < 0.001, multiple regression). The strongest dependence was by the fat score, which alone explained more than fifty percent of the variation in body mass (Table 1). Wing length explained eight percent, whereas tarsus length explained only one percent of the variation in body mass.

All birds, whether recaptured or not or moving between the sites, were included in the analyses of differences between birds ringed at different sites or different times of the year. Only the measurements taken at ringing were included, and birds were assigned to the site of where they were ringed. The average body mass when ringed (at first capture) at the hilltop, 8.80 g was no different from that on the lower slope, 8.71 g ($F_{1,761}$ = 1.7, P = 0.19). There was no difference between the birds ringed at the different sites regarding fat score, both having an average score of 3.4 ($F_{1,761}$ < 0.1, P = 0.97; Figure 1). Neither was there any difference in average wing lengths between the hilltop, 76.3 mm, and the slope site, 76.6 mm ($F_{1,761}$ = 2.0, P = 0.15). Wing length of captured birds decreased over the season, probably because of a gradually increased proportion of caught females over the course of the season. Fat score exhibited a tendency to increase over the course of the season, whereas tarsus length and body mass showed no such tendency (Table 2, Figure 2).

The ringing yielded 48 recaptures. None of the Wood Warblers ringed on the hilltop site were recaptured at the same place. Eight (8) Wood Warblers ringed at the hilltop were later recaptured at the slope site. The majority of the recaptures were Wood Warblers ringed and recaptured within the slope site. Only one (1) recapture was of a bird moving the slope site up to the hilltop site (P < 0.001, Fisher's exact, recaptures grouped by site and whether recaptures are within or between sites).

Predictions from optimal stopover theory

According to optimal migration theory, some birds may maximize speed of migration (see introduction). The accumulation of fat reserves is the most time-consuming part of a bird's migration. To speed up the migration, birds that accumulate fat reserves at a faster rate than generally expected on a stopover site, should take the opportunity to stay longer and put on larger reserves than on an average stopover site. Under the assumption that birds

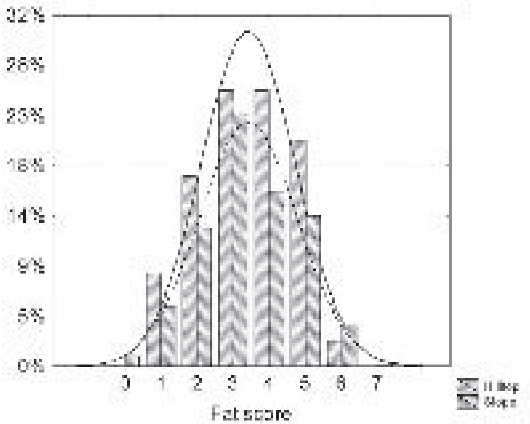


Figure 1. The frequency distribution of fat scores of Wood Warblers ringed at the hilltop and the slope site. The curves depict fitted normal distributions.
Frekvensfördelning i fettklasser av grönsångare ringmärkta på bergstoppen respektive i sluttningen. Kurvorna visar anpassade normalfördelningar.

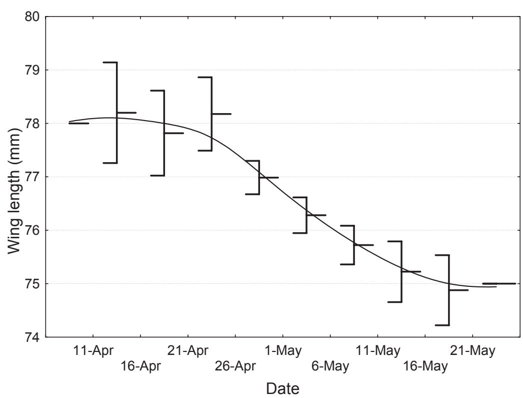


Figure 2. Wing lengths of Willow warblers ringed over the spring migration period. The bars depict the mean and 95% confidence interval of warblers ringed within 5-day periods (dates at tick labels indicate last day of the period). The curve is a second-order polynomial fitted to the means by minimising least squares.
Vinglängder på ringmärkta grönsångare i femdagars-intervall (datumen på x-axeln är sista datum i varje period) under vårflyttningen på Capri. Symbolerna anger medelvärde och 95 procentigt konfidensintervall. Kurvan är ett andragrads polynom anpassat med minsta-kvadratmetoden.

at a stopover site have similar expectancies of fat accumulation rates at alternative stopover sites, or that these expectancies are uncorrelated with fat accumulation rates at a specific stopover site, we would predict that the BCR is positively correlated with both MSL and LBM. Among the 48 recaptured Wood Warblers, 22 lost body mass between ringing and last recpture, 18 had their body mass unchanged, and only 8 increased their body mass. There was no significant correlation between MSL and BCR ($r_p = 0.16$, $t_{45} = 1.10$, $p = 0.28$, partial correlation correcting for IBM; Figure 3a). However, LBM was positively correlated with BCR ($r_p = 0.62$, $t_{45} = 5.30$, $p < 0.001$, partial correlation cor-

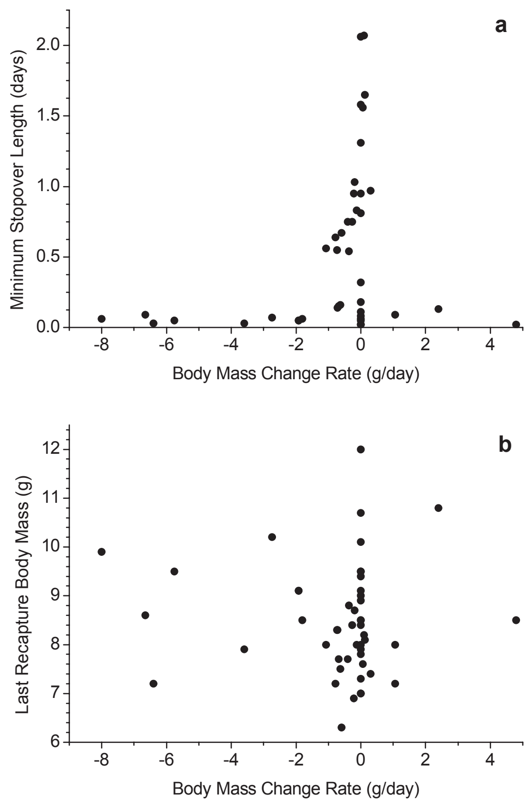


Figure 3. Stopover data of Wood Warblers that were recaptured. (a) Minimum stopover length in relation to body mass change rate and (b) last recapture body mass in relation to body mass change rate. Positive correlations may indicate that birds are maximizing speed of migration.
Rastningsdata för återfångade grönsångare: (a) Observerad rastningstid mot viktökningshastighet och (b) vikt vid sista återfångsten mot viktökningshastigheten. En positiv korrelation kan indikera att fåglarna maximerar flyttningshastigheten.

Table 3. Stopover parameters for Wood Warblers with no night or at least one night between ringing and last recapture. The parameters are: the average time between ringing and last recapture, $\bar{t}$; the minimum time between ringing and last recapture, t_{min}; the estimated average of the actual stopover length, τ; the estimated stopover probability, *s*, and its variance. The difference between estimated stopover probabilities is significant (student's t_{45}= −3.11, p=0.003).
Rastningsparametrar för grönsångare som observerades stanna över minst en natt och de som inte observerades göra det. Tabellen visar den observerade tiden i snitt mellan märkning och sista återfångsten, $\bar{t}$; den minsta observerade tiden mellan märkning och sista återfångst, t_{min}; den skattade faktiska rastningstiden i genomsnitt, τ; den skattade sannolikheten att stanna per dag, s, och dess varians. Skillnaden mellan de skattade sannolikheterna för att stanna per dag är signifikant (student's t_{45}= −3.11, p=0.003).

Nights	$\bar{t}$ (days)	t_{min} (days)	τ (days)	*s* (day^{-1})	var	n
0	0.068	0.021	0.047	0.045	0.0015	28
>1	1.066	0.542	0.524	0.344	0.0078	19

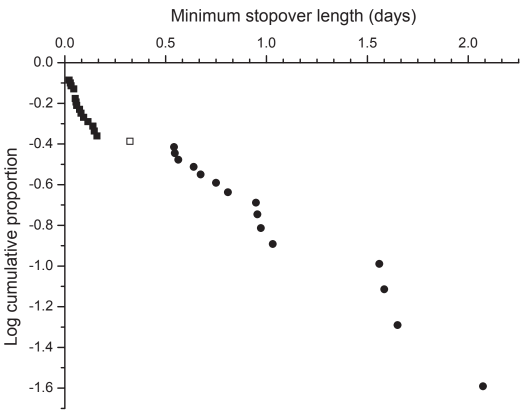


Figure 4. The distribution of minimum stopover lengths of Wood Warblers presented as the logarithm of the cumulative proportion. A linear slope indicates that birds stay with a constant stopover probability. The steeper the negative slope, the lower the stopover probability. Squares depict warblers recaptured within the same day. The slope of these birds is steep and indicates a low stopover probability (calculated without the open square data-point; see Table 3). Dots depict warblers recaptured with at least one night since ringing.
Fördelningen av observerade rastningstider hos grönsångare, här presenterade som logaritmen av den kumulativa fördelningen. En linjär kurva indikerar att fåglarna stannar med en konstant sannolikhet per tidsenhet (t ex dag). Ju brantare negativ lutning på kurvan, ju lägre är sannolikheten att stanna. Fyrkanter markerar fåglar som är återfångade sista gången inom samma dag som de ringmärktes. Prickar markerar fåglar som är återfångade med åtminstone en natt mellan ringmärkningstillfället och sista återfångsten. Lutningarna på fördelningarna för dessa två grupper återspeglas i sannolikheterna att stanna per dag som är angivna i Tabell 4 (den öppna fyrkanten är exkluderad i de analyserna).

recting for IBM; Figure 3b). This could be a self-generated correlation from variation in body mass change rate. Since minimum stopover length was not correlated with body mass change rate, high body mass change rates would on average result in high body masses at last recapture.

Two categories of stopover lengths

The estimated stop-over length of the Wood Warblers revealed two groups of birds. A plot of the logarithmic cumulative frequency distribution of recaptures versus minimum stopover length reveals two linear curves with different slopes (Figure 4). The birds known to have stayed at least one night were inclined to stay longer (daily stopover probability: 0.344) than those recaptured in the same day (daily stopover probability: 0.045; Figure 4, Table 3). On the basis of this result, the data set is divided into two categories by minimum stopover length (MSL): those with a MSL less than six hours, and those with longer. With the exception of one bird with a MSL of almost eight hours, the former group included all birds that were recaptured the last time within the same day as ringing, and the latter group all birds that had at least one night between ringing and last recapture. From now on, we will refer to these groups as the short staying group and the long staying group.

There was no difference in date of ringing between the two groups ($F_{1,46}$ = 0.9, P = 0.34). The short staying group weighed on average more (8.9 g) at ringing than did the long staying group (8.0 g; $F_{1,46}$ = 8.2, P = 0.006). The group with short stopover had an average last recapture weight higher than the long staying group (8.8 g and 7.9 g; $F_{1,46}$ = 9.2, P = 0.004). There was no difference between the groups with regard to fat score, neither that at ringing ($F_{1,46}$=1.9, P=0.17), nor at last recapture ($F_{1,46}$=0.7, P=0.39). It is likely that the difference in body mass between the two groups is to a large extent explained by a difference in body size. The short staying group had significantly longer wings (77.3 mm) than the long staying group (75.4 mm; $F_{1,46}$=11.2, P=0.002). This suggests that the long staying group predominantly consists of females, and the short staying group of males. If females stay longer than males, the short staying group is expected to include some females that were retrapped by chance with a short time interval.

Discussion

Males of most migratory birds benefit from arriving early at their breeding grounds because early males can settle in the best territories with the highest reproductive success (Forstmeier 2002; Smith & Moore 2005). The females lack these incitements and therefore arrive later than males to the breeding grounds. In the Wood Warbler the females arrive 7–10 days after the males have established territories (Temrin 1986). It is not known if this difference in the timing of arrival is a consequence of males leaving the wintering grounds earlier than females, or if it is the result of males migrating at a faster speed than females. Males migrating earlier than females in spring is known from other passerines and also in the new world migratory system (Yong et al. 1998; Izhaki & Maitav 1998; Swanson et al. 1999; Morris et al. 2003). However, males may stay shorter on stopover sites than females as observed in spring migrating Wheatears (Dierschke et al. 2005). On the other hand, studies of spring migrating Common Yellowthroats did not reveal any difference in stopover length between the sexes (Morris et al. 2003).

In this study of Wood Warblers on spring migration at a stopover site on Capri, two groups of birds were detected on the basis of the estimated average stopover length (Table 4). One group only stayed slightly more than an hour, whereas the other group on average stayed slightly less than 13 hours. Wing lengths suggest that the shorter staying group predominantly consists of males, whereas the other group probably is dominated by females. Thus, if wing length reflects sex, the distribution of stopover times of Wood Warblers at Capri suggests that males, compared to females, are more in a hurry to continue their migratory flight or to find richer stopover sites.

The stopover times of the Wood Warblers at Capri are very short compared to other species at other spring stopover sites. Wheatears in northern Germany stayed 1–12 days (Dierschke et al. 2005). Common Yellowthroats on spring migration stayed on average three days at their stopover site in Maine (Morris et al. 2003). Capri as a stopover site may be of low quality for the Wood Warblers, suggested by the low stopover probabilities and short estimated stopover lengths. The pattern of recaptured Wood Warblers indicate that arriving birds are landing at high elevations on the island and then move downhill to lower elevations where they stay for some time to feed (which they were seen to do). There was just one recapture indicating the opposite movement. Feeding opportunities were probably better down the slope where the vegetation was higher and denser. Birds arriving at Capri may have come from Sicily, a distance of approximately 270 km, but they may also have arrived from northern Africa. These distances usually require less than a normal fat deposit. Most of the Wood Warblers ringed at Capri had moderate to high fat scores (i.e. 3–5), suggesting that they were not in urgent need to replenish their energy stores.

The breeding range of the Wood Warblers extends from southern Italy to northern Scandinavia (Cramp 1992). Recoveries indicate that the breeding grounds of the Wood Warblers at Capri is northern and western Europe (i.e. France, UK, Germany and Sweden; Scebba 1993). The Wood Warblers at Capri could easily continue to the mainland on the fat deposits they are carrying, as the island is situated only a few kilometres from the mainland. In the studies of Wheatears at a spring stopover site (Dierschke et al. 2005), birds of the subspecies being more close to its breeding range stayed shorter times, 1–3 days, at the stopover site than did the more distant breeding subspecies (i.e. up to 12 days). Hence, there could be an additional explanation for the short stopovers of some Wood Warblers: birds which are close to their breeding grounds may move directly into their breeding territory in their next flight.

It is difficult from observations in the field and on a single stopover site to determine if migrating birds are maximising speed of migration or minimising energy consumption (Alerstam & Lindström 1990). We may observe differences between the individuals in stopover lengths and departure fuel loads, but we do not know how individuals trade the current stopover site in relation to their expectations of future sites along the migratory route. If we assume that the individuals have the same expectations of future stopover sites along the route, time minimising species are expected to exhibit a positive correlation between fuel increase rates and stopover length, and between fuel increase rate and departure fuel loads. We only observed a positive correlation between body mass change rate and last recapture body mass, which cannot be avoided if there is variation in body mass change rate and stopover lengths are uncorrelated. The length of stopover and the large proportion of birds that do not gain body mass suggest that Capri is not an important refuelling site for Wood Warblers. Males, however, seem to make decisions to leave this poor stopover site sooner than the females, a strategy that is also expected from speed maximisers.

Acknowledgements

We are grateful to the San Michele Foundation and the former Director of Villa San Michele, Levente Erdeös, for letting us undertake the studies on Capri. The Italian ringing center in Bologna provided us with rings and allowed us to use the data from Castello Barbarossa. Special thanks to Allessandro Montemaggiori who was in charge of the Italian ringing team at Capri. Christian Hjort has during the later years been administrating the Swedish ornithological programme on Capri, and has also made useful comments on this manuscript. Tomas Pärt and two anonymous reviewers improved the manuscript with their suggestions. At last, thanks to the late Dr. Axel Munthe, whose engagement for the protection of the birds has rendered a great opportunity for studying the trans-Mediterranean bird migration. Contribution no. 209 from Ottenby Bird Observatory.

References

Alerstam, T. 1988. Ilandflutna döda fåglar avslöjar katastrof bland tidiga vårflyttare, särskilt råkor *Corvus frugilegus*, över södra Östersjön. *Anser* 27: 181–218.

Alerstam, T. & Lindström, Å. 1990. Optimal bird migration: the relative importance of time, energy and safety. Pp. 331–351 in *Bird migration: The physiology and ecophysiology* (Gwinner, E., ed.). Springer.

Cramp, S. (ed.) 1992. *The Birds of the Western Palearctic*, Vol. VI. Oxford University Press, Oxford.

Dierschke, V., Mendel, B. & Schmaljohann, H. 2005. Differential timing of spring migration in northern wheatears *Oenanthe oenanthe*: hurried males or weak females. *Behav. Ecol. Sociobiol*. 57: 470–480.

Forstmeier, W. 2002. Benefits of early arrival at breeding grounds vary between males. J. *Anim. Ecol.* 71: 1–9.

Gudmundsson, G. A., Lindström, Å. & Alerstam, T. 1991. Optimal fat loads and long-distance flights by migrating Knots *Calidris canutus*, Sanderlings *C. alba* and Turnstones *Arenaria interpres. Ibis* 133: 140–152.

Holmgren, N., Ellegren, H. & Pettersson, J. 1993. Stopover length, body mass and fuel deposition rate in autumn migrating Dunlins *Calidris alpina*: evaluating the effects of moulting status and age. *Ardea* 81: 2–20.

Holmgren, N. & Hedenström, A. 1995. The scheduling of molt in migratory birds. *Evol. Ecol.* 9: 354–368.

Izhaki, I. & Maitav, A. 1998. Blackcaps *Sylvia atricapilla* stopping over at the desert edge; inter- and intra-sexual differences in spring and autumn migration. Ibis 140: 234–243.

Lindström, Å., Hasselquist, D., Bensch, S. & Grahn, M. 1990. Assymmetric contests over resources for survival and migration: A field experiment with bluethroats. *Anim. Behav.* 40: 453–461.

Messineo, A., Grattarola, A. & Spina, F. 2001. Dieci anni Progetto Piccole Isole. *Biol. Cons. Fauna* 106: 1–244.

Morris, S. R., Pusateri, C. R. & Battaglia, K. A. 2003. Spring migration and stopover ecology of Common Yellowthroats on Appladore Island, Maine. *Wilson Bull.* 115: 64–72.

Pettersson, J. & Hasselquist, D. 1985. Fat deposition and migration capacity of robins *Erithacus rubecula* and goldcrest Regulus regulus at Ottenby, Sweden. *Ring. & Migr.* 6: 66–75.

Pilastro, A., Macchio, S., Massi, A., Montemaggiori, A. & Spina, F. 1998. Spring migratory routes of eight trans-Saharan passerines through the central and western Mediterranean; results from a network of insular and coastal ringing sites. *Ibis* 140: 591–598.

Rappole, J. H. & Warner, D. W. 1976. Relationships between behaviour, physiology and weather in avian transients at a migration stopover site. *Oecologia* 26: 193–212.

Scebba, S. 1993. *Gli Uccelli della Campania.* Essilibri.

Schwilch, R., Piersma, T., Holmgren, N. M. A. & Jenni, L. 2002. Do migrants need a nap after a long non-stop flight? *Ardea* 90: 149–154.

Smith, R. J. & Moore, F. R. 2005. Arrival timing and seasonal reproductive performance in a long-distance migratory landbird. *Behav. Ecol. Sociobiol.* 57: 231–239.

Svensson, L. 1984. *Identification guide to European Passerines.* Lars Svensson, Stockholm.

Swanson, D. L., Liknes, E. T. & Dean, K. L. 1999. Differences in migratory timing and energetic condition among sex/age classes in migrant Ruby-crowned Kinglets. *Wilson Bull.* 111: 61–69.

Temrin, H. 1986. Singing behaviour in relation to polyterritorial polygyny in the wood warbler (*Phylloscopus sibilatrix*). Anim. Behav. 34: 146–152.

Temrin, H., Mallner, Y. & Windén, M. 1984. Observations on polyterritoriality and singing behaviour in the wood warbler (*Phylloscopus sibilatrix*). Ornis Scand. 15:67–72.

Temrin, H., Åkerström, O., Brodin, A. & Stenius, S. 1996. Reproductive success and parental effort of females in polyterritorial wood warblers *Phylloscopus sibilatrix:* The influence of predation. Ecoscience 3:140–146.

Weber, T. P., Alerstam, T. & Hedenstrom, A. 1998. Stopover decisions under wind influence. J. *Avian Biol.* 29: 552–560.
Yong, W., Finch, D. M., Moore, F. R. & Kelly, J. F. 1998. Stopover ecology and habitat use of migratory Wilson's warblers. *Auk* 115: 829–842.

Sammanfattning

Grönsångaren är en tropikflyttande art som häckar i nästan hela Europa utom längst i söder och längst upp i norr. Precis som för många andra flyttande arter anländer hanarna före honorna till häckningsplatserna. De tidigaste hanarna kan etablera sig i de bästa reviren, så därför finns det en stark selektion för att hanarna skall anlända tidigt. Visserligen finns det fördelar för honorna att också komma relativt tidigt, då tidigare kullar ger ett större reproduktivt resultat än senare kullar, men uppenbarligen har detta inte lika kraftig påverkan som en relativt tidig etablering har för hanarna. Det är inte riktigt klarlagt om hanarna lämnar vinterkvarteren tidigare än honorna, eller om skillnaden i ankomsttid mellan könen är ett resultat av att de flyttar olika snabbt. Man kan förvänta sig att bägge könen, men särskilt hanarna, försöker maximera sin flyttningshastighet. Om man antar att alla fåglar har samma förväntningar på samtliga rastplatser under flyttningen så leder det till att de fåglar som har högst fettpålagringshastighet stannar längre och lägger på sig större fettreserver än övriga.

I den här uppsatsen studerades grönsångarens rastning på Capri, under vårflyttningen 1993. Fåglarna fångades på två platser på ön, dels uppe på en bergstopp, dels cirka 100 m längre ner i sluttningen nedanför berget. Totalt ringmärktes 774 grönsångare varav 48 återfångades under rastningen. De flesta individerna (95 %) vägde mellan 7,2 g och 10,5 g. Variationen i vikt förklarades till mer än hälften av den visuella fettklassningen. Vinglängden förklarade åtta procent av variationen och tarslängden bara en procent av variationen i vikten (Tabell 1). Det var inga skillnader mellan grönsångarna ringmärkta på bergstoppen eller sluttningen, vare sig i vikt eller fettklass (Figur 1). De grönsångare som anländer till bergstoppen verkar lämna den väldigt fort då inga fåglar återfångades där. I sluttningen med dess höga och täta vegetation var det vanligt att grönsångare sågs födosöka intensivt och därför också återfångades oftare än på toppen. Det var också vanligare att fåglarna rörde sig från bergstoppen ner i sluttningen än tvärtom.

Under flyttningsperioden övergick de fångade grönsångarna från att vara relativt långvingade till att vara mer kortvingade (Figur 2). Denna skillnad beror förmodligen på att hanar dominerar under den tidiga delen av säsongen medan honor dominerar under den senare delen. Inga andra uppmätta mått uppvisade någon trend över flyttningssäsongen (Tabell 2).

Det fanns ett samband som normalt indikerar att fåglarna maximerar flyttningshastigheten. De grönsångare som ökade mest i vikt per tidsenhet hade de högsta vikterna den sista gången de återfångades (Figur 3b). Däremot stannade de inte en längre tid än de med lägre viktökningshastighet (Figur 3a). Det senare antyder att fåglarna trots den första korrelationen inte maximerar flyttningshastigheten. Det kan vara så att en variation i hastigheten för viktökningen korrelerar med sista kontrollvikten om rastningens längd är oberoende av viktökningshastigheten. Det faktum att bara 8 av 48 återfångade grönsångare ökade i vikt är också problematiskt för analysen, och indikerar att rastningsplatsen är av låg kvalitet för grönsångarna.

Genom att ta logaritmen av den kumulativa fördelningen av de observerade rastningstiderna (tiden mellan märkning och sista återfångsten) erhåller man en rät linje där lutningen motsvarar logaritmen av sannolikheten för att stanna per dag (Figur 4). Fördelningen av de observerade rastningstiderna indikerade att vi hade två olika grupper av fåglar. En analys av vinglängderna indikerade att den ena gruppen som i snitt bara stannade lite drygt en timme, i huvudsak utgjordes av hanar (Tabell 3). Dessa stannade heller aldrig över natten. Den andra gruppen stannade i snitt knappt tretton timmar, och utgjordes till största delen av honor. Sammantaget kan man säga att Capri inte är en någon strategiskt viktig plats för grönsångare att lägga på sig energireserver för den fortsatta flyttningen. Dessutom verkar hanarna ha mer bråttom än honorna och lämnar därför Capri för att fortsätta sin flyttning med ytterligare en flygetapp, eller för att söka sig till bättre rastplatser – en strategi som är nog så viktig om man vill maximera flyttningshastigheten.

ORNIS SVECICA 16: 42–54, 2006

Autumn migration of some passerines on the island of Capri, southwestern Italy

Höststräcket av några tättingar på Capri i sydvästra Italien

JONAS WALDENSTRÖM, CHRISTIAN HJORT & ARNE ANDERSSON

Abstract

This paper presents and analyses autumn migration data on phenology and biometrics for 12 species of birds trapped at the Capri Bird Observatory, south-western Italy. The material has been collected over 15 years, mainly in two periods, 1959–1963 and 1994–2004. The passage of trans-Saharan migrants (like the Garden Warbler *Sylvia borin*) peaks in late September and these birds generally carry moderate to large fat stores, some probably large enough for the full journey to just south of the desert. The short-distance migrants that are mainly due to winter in the Mediterranean region (like the Robin *Erithacus rubecula*) arrive later, around the beginning of October, and carry less fuel deposits. Mainly resident birds (like the Sardinian Warbler *Sylvia melanocephala*) do not build up any substantial fat reserves and their phenologies do not indicate much migratory movement.

Jonas Waldenström, Department of Animal Ecology, Lund University, SE-223 62 Lund, Sweden, and Ottenby Fågelstation, Pl. 1500, SE-380 65 Degerhamn, Sweden. jonas.waldenstrom@zooekol.lu.se
Christian Hjort and Arne Andersson, Ottenby Fågelstation, Pl. 1500, SE-380 65 Degerhamn, Sweden.

Received 14 February 2005, Accepted 22 November 2005, Editor: R. Sandberg

Introduction

The study of bird migration across the Mediterranean-Saharan topographical and ecological barrier has a long tradition and was summarised by Moreau (1972). Since then a large number of papers have been written on the subject, both regarding the spring and autumn passages. A good overview, containing much phenological and biometrical data from the westernmost part of the Mediterranean, was Finlayson's (1992) book on the migration across the Strait of Gibraltar. Recently Italian scientists have published three reports with a profusion of similar data on the Italian avifauna, covering the whole year and both resident and migrant birds. The report relevant in the present context is the one by Licheri & Spina (2002). The standard work on ornithology of the Naples and Capri area is the book on the bird fauna of the Campania region by Scebba (1993).

The present paper presents autumn migration data on phenology and biometrics for 12 species of birds trapped for ringing at the Capri Bird Observatory in south-western Italy during 15 years between 1959 and 2004. Italy, and the island of Capri, lies on what can be called the "central flyway", where birds from the Baltic basin and areas east thereof, and from much of central Europe pass southwards in autumn en route for winter quarters in eastern West Africa and around the Congo basin – and largely return the same way in spring. At the same time Capri and the surrounding region is the wintering area for many resident species and northern short-distance migrants.

Material and methods

Capri Bird Observatory (40°33'N 14°15'E) resides 400 m a.s.l. in the remnants of an old castle, Castello Barbarossa, on a mountain above Anacapri town. The island of Capri is situated 5 km off mainland Italy, in the bay of Naples, approximately 250 km north of Sicily and 500 km NE of Cape Bon in Tunisia.

Data have been collected during 15 autumns from 1959 to 2004, with the coverage in individual seasons varying from 4 (1989) to 102 days (1961), with a total of 524 working days (Table 1). Birds were trapped with mistnets in the mostly macchia vegetation in and around the castle. However, the

Table 1. Trapping effort in different years.
Fångstinsatsen under olika år.

Year *År*	Trapping days *Fångstdagar*	Period *Period*
1959	58	7 Aug – 3 Oct
1960	32	4 Oct – 4 Nov
1961	102	6 Aug – 15 Nov
1962	32	22 Sep – 23 Oct
1963	8	30 Jul – 13 Aug
1989	4	10 Oct – 13 Oct
1994	64	17 Aug – 19 Oct
1995	44	31 Aug – 13 Oct
1996	25	2 Sep – 5 Oct
1997	12	25 Sep – 6 Oct
1998	42	19 Jul – 29 Aug
1999	21	16 Sep – 25 Sep
2000	41	4 Aug – 13 Sep
2001	11	26 Sep – 6 Oct
2004	28	10 Sep – 7 Oct
Total	524	

number of nets used varied considerably between years, with little efforts of standardisation. The study area has been hit by fire at least twice during the time period, with large if mainly temporal effects on the tree and bush vegetation. Thus, the material is of a heterogeneous nature, but data assembled from so many years still gives a good picture of the general pattern of migration.

We divided the trapping dataset into 24 pentads, starting on 19 July and ending on 15 November. For each pentad we calculated the trapping activity as the proportion of days with active trapping of the total possible days (i.e. for the first pentad: 5 days with active trapping out of a total of 75 possible days (1 pentad, 15 years) = 6.7% trapping activity; Table 2). Generally, coverage was less good in the early and late parts of the study period. Out of the many species caught at the observatory, we chose 12 for the sake of this article. These species were the most numerous in the trappings, ranging from 1847 Robins to 76 Northern Wheatears *Oenanthe oenanthe* (Table 2). With such a large variation in sample size, the number of potential analyses will also vary between species. For each treated species we have produced a phenology chart. However, to adjust these charts for the variation in trapping intensity we divided the number of trapped birds in each pentad by the number of active trapping days. Thus the y-axis in each chart shows the average number of trapped birds per day in each pentad.

Birds were aged according to characters presented in Svensson (1984, 1992), in all but the earliest study years (1959–1963), as either juveniles, adults or birds of unknown age. Individual sex has been determined in species with pronounced plumage dimorphism. Fat stores have, since 1989, been determined according to the scale of Hasselquist & Pettersson (1985), which judge the amount of fat deposited on the abdomen and in the tracheal pit based on seven scores. This scale has later been enlarged to ten scores, by inclusion of three additional classes of really fat birds (Falsterbo Bird Observatory, unpublished). These higher scores are similar to the three largest ones in the scale of Kaiser (1993; see also Bairlein 1995), and have been used on Capri since 1994.

The extent of post-juvenile moult was noted in juvenile birds according to the six score scale of Bensch & Lindström (1992).

Species accounts

Tree Pipit Anthus trivialis

The Tree Pipit is a common breeding bird in most parts of Europe, including Italy. It winters in sub-Saharan Africa in open woodland and wooded savannah (Keith et al. 1992). The first birds trapped on Capri appeared in pentad 6, in the middle of August, but the migration peaks in mid September (median pentad 12; Figure 1A). October records are generally rare in Italy (Licheri & Spina 2002) and only six individuals were ringed during this month on Capri.

Body masses ranged from 17.5 to 35.3g (mean 22.8g and 24.6g for adults and juveniles, respectively), a really remarkable span (Table 3). Mean fat scores were around 4.5–5. There was no difference between the age classes in mass ($F_{1,80}$ = 3.42, p = 0.068), and both juvenile and adult birds increased in mass with the progress of the autumn (adult: Pearson r = 0.505, n = 17, p = 0.030; juveniles: Pearson r = 0.422, n = 64, p = 0.001; Figure 2). Both the phenology of the passage and the pronounced increasing trends in mass with time is similar to data from the rest of Italy (Licheri & Spina 2002).

Blackcap Sylvia atricapilla

On Capri the Blackcap occurs both as a common resident, as a numerous passing migrant and as winter visitor. Many of the wintering birds come from northern populations (Hjort et al. 2006), being generally larger and longer-winged than

Table 2. Number of trapped birds and the trapping activity in different pentads. Species abbreviation: first letter of genus and three first letters of latin species name; see Table 3. Days is the sum of days with active trapping in all years.
Antalet fångade fåglar och fångstaktiviteten i olika pentader. Artförkortning: första bokstaven i släkt- och tre första i latinska artnamnet, se Tabell 3. "Days" är antalet dagar med aktiv fångst alla åren.

		Species abbreviation Artförkortning													
Pentad	Period	*Atriv*	*Satr*	*Sbor*	*Smel*	*Scan*	*Pcol*	*Ptro*	*Psib*	*Rign*	*Ooen*	*Erub*	*Tphi*	Days	%
1	19–23 Jul	-	25	-	30	2	-	-	-	2	-	-	-	5	6.7
2	24–28 Jul	-	19	-	11	1	-	-	1	2	-	-	-	5	6.7
3	29 Jul – 2 Aug	-	7	-	18	7	-	1	2	1	-	-	-	8	10.7
4	3–7 Aug	-	10	2	22	5	-	-	3	3	-	-	-	16	21.3
5	8–12 Aug	-	9	2	26	11	-	2	17	4	1	-	-	20	26.7
6	13–17 Aug	1	4	4	9	4	-	-	2	4	-	-	-	22	29.3
7	18–22 Aug	3	3	11	30	9	-	2	14	3	1	-	-	25	33.3
8	23–27 Aug	7	4	10	21	8	-	3	7	7	3	-	-	25	33.3
9	28 Aug – 1 Sep	2	7	15	22	5	-	3	2	7	6	-	-	24	32.0
10	2–6 Sep	3	12	19	13	3	-	9	15	6	13	-	-	30	40.0
11	7–11 Sep	23	25	46	34	9	-	10	18	12	11	4	-	32	42.7
12	12–16 Sep	19	21	37	25	3	2	8	13	7	8	12	-	28	37.3
13	17–21 Sep	11	33	71	32	14	-	17	7	8	15	16	-	31	41.3
14	22–26 Sep	12	58	146	24	11	3	19	4	9	5	69	-	42	56.0
15	27 Sep – 1 Oct	11	124	127	49	2	14	25	1	23	6	368	1	40	53.3
16	2–6 Oct	2	97	43	38	3	27	20	2	20	-	240	1	49	65.3
17	7–11 Oct	2	130	26	21	-	28	10	-	17	2	337	23	33	44.0
18	12–16 Oct	1	129	8	21	-	52	9	1	15	2	273	48	25	33.3
19	17–21 Oct	1	52	1	2	-	26	2	-	8	2	191	88	18	24.0
20	22–26 Oct	-	25	-	1	-	5	15	-	11	-	102	32	12	16.0
21	27–31 Oct	-	5	-	-	-	8	-	-	5	1	62	34	10	13.3
22	1–5 Nov	-	7	-	2	-	22	-	-	5	-	139	76	9	12.0
23	6–10 Nov	-	5	-	11	-	-	4	-	5	-	27	1	5	6.7
24	11–15 Nov	-	1	-	-	-	1	1	-	-	-	7	1	5	6.7
Total		98	812	568	462	97	188	160	109	184	76	1847	305	519	

bird of the resident population. The phenology diagram, based on 812 ringed individuals (Figure 1B), illustrates this pattern of residents versus migrants, with two peaks in the numbers of ringed Blackcaps. The first peak, in late July, is probably exclusively consisting of breeding local birds. This peak is followed by a period of lower trapping numbers until a marked increase starts from pentad 13, with a peak at pentad 18 in mid-October, after which the numbers drop again. This second peak coincides with that of the Robin and most likely mainly consists of migrant Blackcaps. We divided the material in two groups: birds with ≤ 71mm or ≥ 72mm in wing length (Table 3). The long-winged group was heavier ($t_{1,745} = –11.9$, $p > 0.001$), carried larger fat stores ($t_{1,745} = –10.0$, $p > 0.001$) and peaked on average two weeks later in the season (1 October vs. 16 September; $t_{1,746} = –9.0$, $p > 0.001$).

Garden Warbler Sylvia borin

The Garden Warbler is a widely distributed species in Europe, breeding from the northern parts of the Mediterranean region to northern Fennoscandia, and eastwards from Great Britain well into Russia (e.g. Cramp 1992). It is one of the most frequently trapped birds on Capri in spring (Pettersson et al. 1990, Messineo et al. 2001). The breeding area for birds passing Capri is indicated by recoveries in Lithuania, Finland and Byelorussia, and at least three wintering records have been made in the Congo basin (Pettersson et al. 1990). In autumn, 568 Garden Warblers have been ringed and the phenology shows a distinct peak in the last weeks of September (median passage pentad 14; Figure 1C). However, the earliest birds are trapped already in mid-August and the latest well into October. Adult Garden Warblers pass through the area on average c. 10 days earlier than juveniles (Mann-Whitney $U = 6749.0$, $n = 530$, $p < 0.001$; Figure 1C).

The mean body mass levels were c. 5g heavier than an estimated lean body mass of 15g (Ottosson et al. 2005), and the mean fat scores were between 4 and 5 (Table 3). The heaviest recorded individual weighed 33.1g. These body masses are similar to those observed in Garden Warblers which in central Nigeria prepare for their spring departure across Sahara and the Mediterranean Sea (Ottosson et al. 2005), and are thus probably sufficient to cover the energy demands for the full journey to sub-Saharan Africa without refuelling. There were no trends in mass or fat score within the season (Pearson $r = –0.002 – +0.193$, $n = 44–464$, n.s.) and no body mass differences between age classes ($F_{1,506} = 1.04$, $p = 0.308$).

Sardinian Warbler Sylvia melanocephala

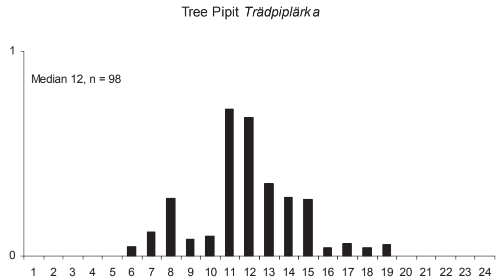
The Sardinian Warbler is mainly sedentary in the Mediterranean region, but some birds, at least some years, winter south of the Sahara (e.g. Urban et al. 1997, Borrow & Demey 2001). It is a common breeder on Capri and most birds trapped in autumn may be local, or from the surrounding region. This view is supported by the phenology diagram with a rather even distribution in all pentads, except for a somewhat higher number in the very first pentad of the season (Figure 1D). The median “passage” for both juveniles and adults is in the second week of September (pentad 11; Figure 1D), but these figures are most likely somewhat affected by increased trapping activity in these pentads. The extent of post-juvenile moult of body feathers shows a marked change from predominantly low scores before pentad 10 to predominantly high scores after (Figure 3), which indicates that before pentad 10 the majority of juvenile birds are still within or near their breeding territories, still in heavy moult of juvenile body feathers. Juveniles trapped after pentad 10, with nearly completed post-juvenile moult, could be either local progeny, dispersing juveniles from neighbouring areas, or true migrants.

The body mass of trapped Sardinian Warblers was very similar between age and sex classes (Table 3), and only marginally lower than corresponding values from other Italian Sardinian Warblers (Licheri & Spina 2002). We found no temporal trend in body mass, neither for adults (Pearson $r = 0.084$, $n = 51$, $p = 0.559$) nor for independent juveniles (post-juvenile moult scores > 3: Pearson $r = –0.087$, $n = 69$, $p = 0.475$). Licheri and Spina (2002) noted an increase in mass during the autumn, most pronounced in October – December. As only few Sardinian Warblers were trapped after mid-October we could have missed that trend.

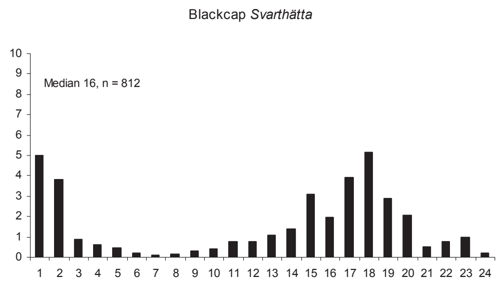
Subalpine Warbler Sylvia cantillans

Breeds in large parts of the central and western Mediterranean region, including the Iberian peninsula and the Mahgreb of North Africa (Cramp 1992), and winters in the northern, drier parts of sub-Saharan Africa (e.g. Urban et al. 1997). The trapping data from Capri indicates four peaks in the migration phenology of the Subalpine War-

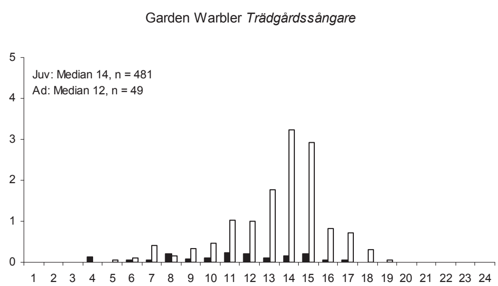
A


Tree Pipit *Trädpiplärka*
Median 12, n = 98

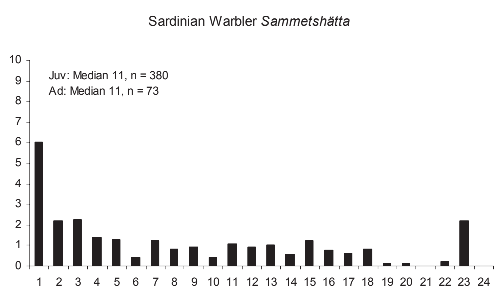
B


Blackcap *Svarthätta*
Median 16, n = 812

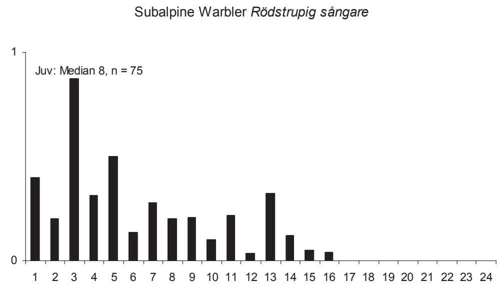
C


Garden Warbler *Trädgårdssångare*
Juv: Median 14, n = 481
Ad: Median 12, n = 49

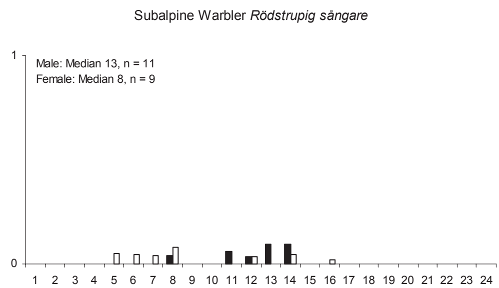
D


Sardinian Warbler *Sammetshätta*
Juv: Median 11, n = 380
Ad: Median 11, n = 73

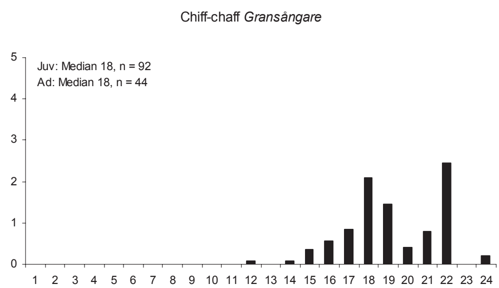
E


Subalpine Warbler *Rödstrupig sångare*
Juv: Median 8, n = 75

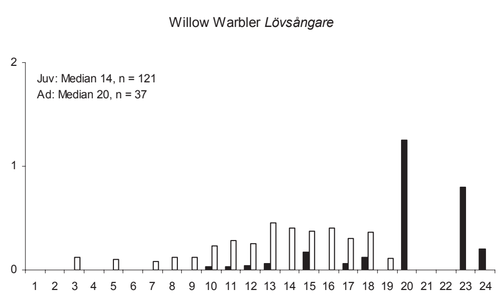
F


Subalpine Warbler *Rödstrupig sångare*
Male: Median 13, n = 11
Female: Median 8, n = 9

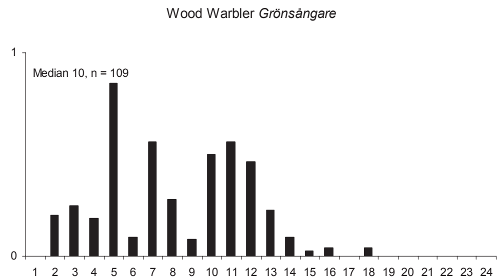
G


Chiff-chaff *Gransångare*
Juv: Median 18, n = 92
Ad: Median 18, n = 44

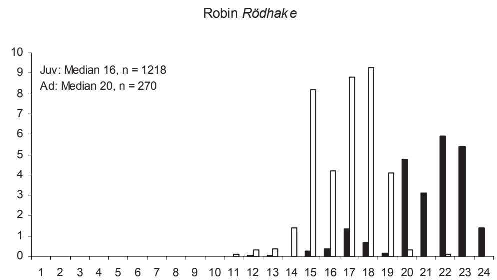
H


Willow Warbler *Lövsångare*
Juv: Median 14, n = 121
Ad: Median 20, n = 37

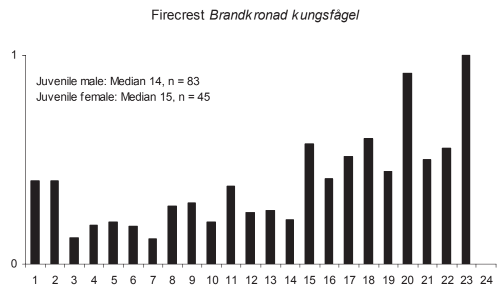
I



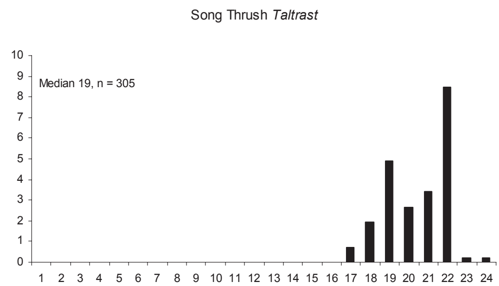
L



J



M



K

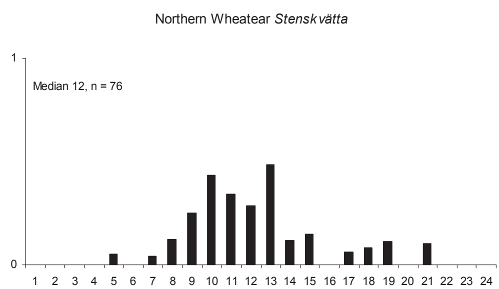


Figure 1. The mean number of trapped individuals per trapping day in each pentad. When distinguished, we give numbers for different ages and sexes, and sample size and median pentad. Solid bars=adults, open bars=juveniles.
Det genomsnittliga antalet fångade individer per fångstdag i varje pentad. Vi ger antal för olika åldrar och kön när vi separerade dem, samt stickprovsstorlek och medianpentad.

bler (Figure 1E). For adults, the first peak consists mainly of females (median pentad 8) and the second primarily of males (median pentad 13; Figure 1F). However, the material is rather small and statistically speaking there was no significant difference in passage time between adult males and females (Mann-Whitney U = 33.5, n = 20, p = 0.216). There is a clear tendency for a bimodal phenology also for juveniles, but very few of this age class have been sexed (Figure 1E). In general, adults peaked later than juveniles (Mann-Whitney U = 478.0, n = 96, p = 0.003).

Body mass ranged from 8.6 to 15.3g (Table 3). There was a positive trend in juvenile body mass with time (Pearson r = 0.647, n = 74, p = 0.044), not found in the smaller adult dataset (Pearson r = 0.129, n = 22, p = 0.566).

Chiffchaff Phylloscopus collybita

The Chiffchaff is a common species in most of Europe, occurring with different subspecies in different parts of the continent (Cramp 1992). The wintering area ranges from the Mediterranean

Table 3. Morphometrics of birds trapped on Capri during 15 autumns, 1959–2004.
Morfometriska data från fåglar fångade på Capri under 15 höstar 1959–2004.

			Body mass *Kroppsvikt* (g)				Fatscore *Fettskala*		
Species *Art*	Age *Ålder*	Sex *Kön*	Mean *Medel*	Range *Spann*	s.d.	n	Mean *Medel*	s.d.	n
Tree Pipit *Trädpiplärka*									
Anthus trivialis	ad		22.8	18.2–28.6	2.7	17	4.5	1.9	17
	juv		24.6	17.5–35.3	3.9	64	5.1	1.9	64
Blackcap *Svarthätta*									
Sylvia atricapilla									
≤ 71 mm wing length			16.2	13.0–20.6	1.2	260	1.8	1.3	259
≥ 72 mm wing length			17.6	13.2–24.6	1.7	487	3.0	1.6	488
Garden Warbler									
Trädgårdssångare	ad		19.4	13.7–29.5	3.2	44	4.5	2.1	44
Sylvia borin	juv		19.9	14.3–33.1	3.2	464	4.8	1.8	464
Sardinian Warbler									
Sammetshätta	ad	M	11.9	10.4–13.4	0.7	29	2.1	1.2	29
Sylvia melanocephala	ad	F	12.0	11.0–13.0	0.6	22	1.6	1.2	22
	ad		11.9	10.4–13.4	0.6	51	1.9	1.2	51
	juv	M	12.0	10.2–15.4	0.8	101	1.8	1.2	101
	juv	F	11.8	10.4–13.6	0.8	124	1.8	1.2	122
	juv		11.8	10.0–15.4	0.7	356	1.9	1.1	352
Subalpine Warbler									
Rödstrupig sångare									
Sylvia cantillans	ad		11.7	8.9–15.3	2.1	22	5.6	1.9	22
	juv		10.8	8.6–14.0	1.2	74	4.5	1.8	74
Chiffchaff *Gransångare*									
Phylloscopus collybita	ad		6.6	5.1–10.3	1.1	41	2.4	1.2	41
	juv		6.5	4.4–9.2	0.8	83	2.4	1.7	83
Willow Warbler									
Lövsångare	ad		10.3	7.4–13.6	2.1	12	4.6	2.1	12
Phylloscopus trochilus	juv		9.1	7.0–13.2	1.2	110	4.3	1.7	110
Wood Warbler									
Grönsångare	ad		10.2	8.8–13.0	1.7	5	3.8	2.2	5
Phylloscopus sibilatrix	juv		10.0	7.6–14.6	2.0	47	4.1	2.1	47
Firecrest									
Brandkronad kungsfågel	ad		5.1	5.0–5.3	0.1	5	1.2	1.1	5
Regulus ignicapillus	juv	M	5.1	4.1–5.9	0.3	78	1.1	1.2	78
	juv	F	5.0	4.2–6.2	0.4	42	1.6	1.5	42
	juv		5.1	4.1–6.9	0.4	129	1.3	1.3	129
Northern Wheatear									
Stenskvätta	ad	M	22.7	21.4–25.6	1.7	5	3.8	1.9	5
Oenanthe oenanthe	ad	F	-	20.2–21.6	-	2	-	-	-
	juv		22.5	17.3–29.2	2.4	43	4.1	1.4	40
Robin Rödhake									
Erithacus rubecula	ad		15.9	10.9–18.9	1.4	70	3.2	1.5	68
	juv		15.8	11.4–22.5	1.5	1130	2.9	1.6	1129
Song Thrush Taltrast									
Turdus philomelos	ad		-	62.0–80.0	-	2	-	-	-
	juv		64.5	48.5–79.5	6.5	48	2.2	1.4	50

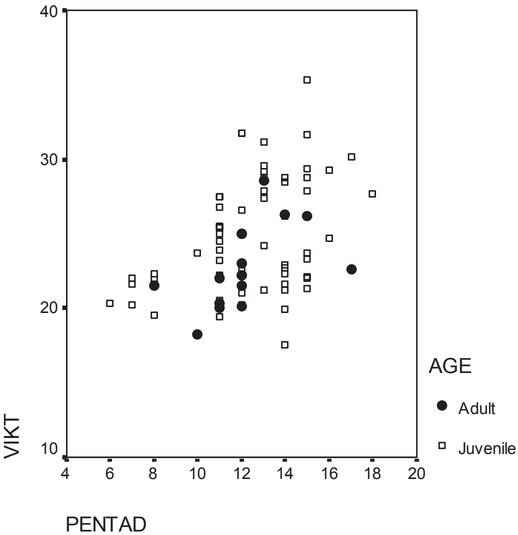


Figure 2. Body mass in relation to pentad in adult (filled circles) and juvenile (open boxes) for Tree Pipits *Anthus trivialis* trapped on Capri in autumn.
Trädpiplärkans Anthus trivialis *viktutveckling under hösten på Capri (adulta fäglar = svarta cirklar, juvenila = öppna kvadrater).*

region to tropical Africa (Urban et al. 1997) and includes the island of Capri (Hjort et al. 2006). Chiffchaffs occur at the study site from the last days of September onwards to early November, with a median passage for both age classes at pentad 18 (Figure 1G). This is similar to a study covering the whole of Italy, where autumn migration peaks in the middle of October, but where good numbers of Chiffchaffs are trapped throughout the winter (Licheri & Spina 2002).

The mean body masses were low, 6.6g in adults and 6.5g in juveniles (Table 3), with no significant differences between ages (F1,122 = 0.70, p = 0.406). These values were approximately 0.5–1.1g lower than in the study of Licheri and Spina (2002). We noted a tendency for a negative temporal trend in adult body mass (Pearson r = –0.306, n = 41, p = 0.051), which was not observed in juvenile birds (Pearson r = –0.093, n = 83, p = 0.401).

Willow Warbler Phylloscopus trochilus

This is one of the most common birds in Europe north of the Mediterranean region, divided into two subspecies: *trochilus* that winters in West Africa, and *acredula*, a northern subspecies, that winters in East and Southeast Africa (e.g. Cramp 1992). The origin of the Willow Warblers passing Capri is not fully resolved, but probably includes central European populations of the *trochilus* subspecies (Zink 1973).

A total of 160 Willow Warblers, of which 37 were adults, have been ringed on Capri in autumn. The period of passage is long and seems to differ between age classes. Juveniles appear already in early August, peak in the last week of September (median pentad 14) and show declining numbers throughout October (Figure 1H). Adult individuals appear later, starting at pentad 10 and are trapped into November. However, the number of adult Willow Warblers is fairly low, and the apparent peak at pentad 20 is largely due to 15 individuals trapped during this pentad in 1961. Body mass ranged from 7.0g to 13.6g (Table 3), and adult Willow Warblers were heavier than juveniles (adults mean 10.3g, juveniles mean 9.1g; $F_{1,121}$ = 8.26, p = 0.005). Furthermore, body mass increased with pentad in juvenile (Pearson r = 0.213, n = 110, p = 0.026), but not in adult warblers (Pearson r = 0.480, n = 12, p = 0.114). The sexes differ in size in this species, with males being larger than females, but the increase in mass was not due to an increased size as indicated by wing length (Pearson r = 0.069, n = 110, p = 0.471).

Wood Warbler Phylloscopus sibilatrix

A widely distributed species in Europe, most commonly found in mature deciduous forest, mainly wintering in forested parts of equatorial West and Central Africa (e.g. Urban et al. 1997). A total of 109 Wood Warblers have been trapped on Capri in autumn and the median passage occurred in the first days of September (Figure 1I), which is similar to previously published data from the whole of Italy (Licheri & Spina 2002). The majority of the aged individuals were juveniles; only five birds were aged as adults. The body masses were close to 10g and fat scores around 4, with no differences between the age classes (F1,51 = 0.35, p = 0.851; Table 3). Juveniles increased in mass (Pearson r = 0.337, n = 47, p = 0.021) and fat score (Pearson r = 0.304, n = 47, p = 0.038) with time, but not in wing length (Pearson r = 0.115, n = 47, p = 0.441).

Firecrest Regulus ignicapillus

Firecrests breed on Capri in gardens and woods and are fairly common in the autumn trappings at the observatory, with a total of 184 birds trapped in the 15 seasons. Nearly all trapped individuals were juveniles. Firecrests were trapped in all pentads except for the last one in mid-November, but the number of trapped birds per pentad was low for the whole period (Figure 1J). The disappearance in pentad 24 may reflect an effect of deteriorating feeding possibilities at the trapping site (at the exposed top of Monte Barbarossa) in winter. This is also indicated by the fairly good trapping numbers of Firecrests at Villa San Michele further down the slope in winter (Hjort et al. 2006)

Northern Wheatear Oenanthe oenanthe

The Northern Wheatear breeds commonly all over Europe, including Italy, and winters in the dry savannah zones south of the Sahara (e.g. Borrow & Demey 2001). Only 76 birds have been trapped on Capri in autumn, the majority juveniles. The very first was trapped already in early August, the last in late October (Figure 1K). The migration period is long and there was no trend in juvenile body mass over the autumn (Pearson r = 0.169, n = 43, p = 0.278). The measured body mass values were similar (mean combined age classes c. 22.5g; Table 3) or slightly lower than the few weights published by Licheri & Spina (2002) – the mean body mass 22.9–24.6 g depending on ten day period.

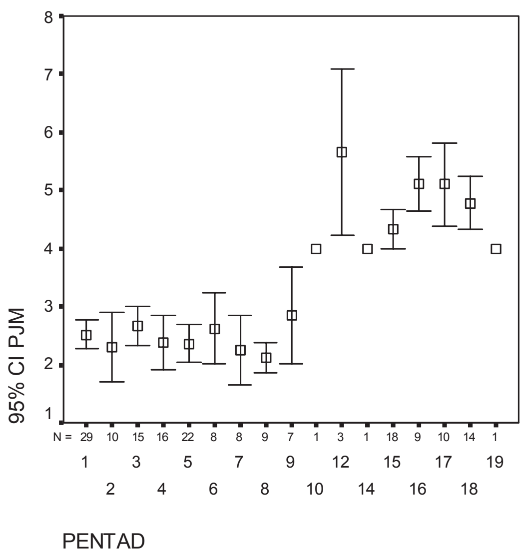


Figure 3. An error-bar plot showing the 95% confidence interval of the mean of post-juvenile moult scores (CI PJM) in juvenile Sardinian Warblers *Sylvia melanocephala* in different pentads. Numbers of investigated individuals are indicated for each pentad. Data on post-juvenile moult is lacking for birds trapped in pentads 20–24.
Förändringen av postjuvenila ruggningsgraden (95% konfidensintervall för medelvärdet: CI PJM) över tiden för juvenila sammetshättor Sylvia melanocephala *vid höstmärkning vid Capri Fågelstation. Antalet undersökta fåglar per pentad anges över x-axeln. Inga datapunkter fanns för pentaderna 20–24.*

Robin Erithacus rubecula

The Robin is the most frequent species trapped, with a total of 1847 ringed individuals (Table 2). The first birds appear in the middle of September and they can thereafter be found at the ringing site throughout the autumn. The trappings of juvenile birds peak in early October (median passage pentad 16), while the catches of adult birds seem to peak later in the same month (median passage pentad 20; Figure 1L). In a large study covering all ringed passerines in Italy, Robins peaked in the middle of October (Licheri & Spina 2002). There were significant negative trends in body mass with progress of the season, for both juvenile (Pearson r = –0.158, n = 1133, p < 0.001) and adult Robins (Pearson r = –0.270, n = 70, p < 0.024). The species winters in fairly large numbers on Capri (Hjort et al. 2006), in gardens, orchards and vineyards, but this is just part of a much larger wintering area covering all southern parts of Italy, including Sicily, as well as parts of North Africa (Cramp 1988). The birds trapped on Capri therefore probably include birds that will winter on the island and others heading further south. The decreasing trends in mass for both age classes suggest a larger proportion of passing migrants during the early parts of the migration period and an increasing proportion of Capri wintering birds in the latter part. The fat stores in many birds are sufficient for onward flight (mean fat deposits 2.9 in juveniles and 3.2 in adults; Table 3), and the heaviest bird weighed as much as 22.5g, more than twice the leanest body masses of c. 11g.

Song Thrush Turdus philomelos

The Song Thrush is a common species in most of Europe, from the northern Mediterranean to Scandinavia (Cramp 1988). It winters in parts of the breeding range, but migrant populations may reach as far south in winter as North Africa – very occasionally also to south of the Sahara (Borrow & Demey 2001). Comparatively many Song Thrushes ringed on Capri have been recovered elsewhere during late autumn and winter, primarily on the

Italian mainland and probably as a result of hunting. There is also one recovery from Tunisia and one from Algeria (Pettersson et al. 1990).

The Song Thrush is a fairly common species in the trappings on Capri in autumn, but only in the years with coverage late in the season. In total 305 birds have been ringed of which all but 29 were juveniles. The phenology diagram shows a distinct peak in October-early November (Figure 1M). The body masses of juvenile Song Thrushes were c. 3g lower than a dataset from the whole of Italy (Licheri & Spina 2002), and showed no temporal trends (Pearson $r = 0.037$, $n = 48$, $p = 0.804$).

Discussion

The analysed species can be divided into three categories that are typical of the Mediterranean region as a whole (Finlayson 1992): (1) tropical migrants, (2) short-distance migrants and (3) resident species. The tropical migrant group was composed of Tree Pipit, Garden Warbler, Subalpine Warbler, Willow Warbler, Wood Warbler and Northern Wheatear and winters in sub-Saharan Africa. For all these species, except the Subalpine Warbler, most of the birds passing Capri in autumn are probably from northern breeding populations, from central Europe, eastern Scandinavia and the Baltic states (Pettersson et al. 1990, Scebba 1993). The Subalpine Warbler, on the other hand, has a generally more southerly distribution in Europe, in and around the Mediterranean area, and it may be that the uptake area for this species at Capri consists mainly of Italy. The Garden Warbler, Wood Warbler and to some degree also the Willow Warbler are confined in winter to the southernmost wooded regions of West Africa, from the Guinea savannah zones south to the rainforest belt. Garden Warblers ringed at Capri, for example, have been recovered in the Congo Basin (Pettersson et al. 1990). The other tropical migrants in this sample are mainly wintering in the dry savannahs in the Sahel, Sudan and Guinea climate zones.

Diagnostic of the tropical migrant species on Capri is that their body masses span large intervals (Table 3); often with the heaviest individuals weighing twice as much as the leanest. Migration strategies might differ between species and individuals, but it seems likely that the heaviest birds carry enough fuel for making the Mediterranean-Sahara passage without refuelling. There was a generally positive relationship between mass and progress of the autumn for this group of birds which, particularly for the species with breeding populations on Capri, was influenced by low post-fledgling mass at beginning of the season.

The second group of birds, the short-distance migrants, consisted of Chiffchaffs, Robins and Song Thrushes. When sampled on Capri, they probably included both birds on passage and birds come to winter in the region. All three species have winter distributions that include Italy and the North African coast (Cramp 1988, 1992). Chiffchaffs are numerous also south of the Sahara, the Song Thrush is only a vagrant there (Borrow & Demey 2001). These species either showed no trend (Song Thrush) or negative trends (Robin and Chiffchaff) in mass with season, indicating that as the autumn progresses the proportion of migratory birds in the trappings diminished. The mean body masses of the different migratory species on Capri were generally slightly lower than those from the rest of Italy (Licheri & Spina 2002).

Lastly, the resident birds, here represented by Sardinian Warblers and Firecrests, did not show much migratory activity. There were no peaks in their phenologies and no trends in body mass with season; rather the trapping pattern seemed mainly affected by the trapping activities. However, for both species the numbers trapped decreased in the latest part of the season in November, which could possibly be linked to low-scale altitudinal movements away from the observatory on the peak of the mountain down to the lower slopes of the mountain.

The Blackcap was the species which most clearly included birds of different types. Those of the breeding population in the region (ssp. *pauluccii*) are smaller and somewhat darker, whereas longer-winged and paler northern birds appear in numbers later in the autumn. Also body mass and fat score data illustrate the differences between the groups, with larger reserves, indicating possibilities for further flights, in the latter group.

To conclude, these autumn data, although patchy, add to our knowledge of annual routines for birds in the region, and should be used in conjunction with similar data from this site in spring and winter (Petterson et al. 1990, Messineo et al. 2001, Hjort et al. 2006) and from the region as a whole (Scebba 1993, Messineo et al. 2001, Licheri & Spina 2002, Spina & Licheri 2003).

Acknowledgements

The board, directors and staff of Villa San Michele are thanked for all their support through the years, and the bird ringers for their good work. This is

contribution no. 210 from Ottenby Bird Observatory.

References

Bairlein, F. 1995. *European-African Songbird Migration Network, Manual of field methods*.

Bensch, S. & Lindström, Å. 1992. The age of Willow Warblers *Phylloscopus trochilus* estimated from different stages of post-juvenile moult. *Ornis Svecica* 2: 23–28.

Borrow, N. & Demey, R. 2001. *Birds of Western Africa*. London, Helm.

Cramp, S. (ed). 1988. *The Birds of Western Palearctic*. Vol. 5. Oxford University Press, Oxford.

Cramp, S. (ed). 1992. *The Birds of Western Palearctic*. Vol. 6. Oxford University Press, Oxford.

Finlayson, C. 1992. *Birds of the Strait of Gibraltar*. T. & A. D. Poyser, London.

Hasselquist, D. & Pettersson, J. 1985. Fat deposition and migration capacity of Robins *Erithacus rubecula* and Goldcrests *Regulus regulus* at Ottenby, Sweden. *Ringing & Migration* 6: 66–76.

Hjort, C., Andersson, A. & Waldenström, J. 2006. Wintering birds on the island of Capri, southwestern Italy. *Ornis Svecica*, 16: 62–68.

Kaiser, A. 1993. A new multi-category classification of subcutaneous fat deposits of songbirds. *Journal of Field Ornithology* 64: 246–255.

Keith, S., Urban, E. K. & Fry, C. H. 1992. *The Birds of Africa*. Vol. 4. London, Academic Press.

Licheri, D. & Spina, F. 2002. Biodiversità dell'avifauna italiana: variabilità morfologica nei Passeriformi (parte II: Aluadidae – Sylviidae). *Biología e Conservazione della Fauna* 112: 1–208.

Messineo, A., Grattarola, A. & Spina, F. 2001. Dieci anni di Progetto Piccole Isole [Ten years of the Mediterranean Islands Project]. *Biología e Conservazione della Fauna* 106: 1–240.

Moreau, R. E. 1972. *The Palaearctic-African Bird Migration Systems*. Academic Press, London.

Ottosson, U., Waldenström, J., Hjort, C. & McGregor, R. 2005. Garden Warbler *Sylvia borin* migration in sub-Saharan West Africa – phenology and body mass changes. *Ibis* 147: 750–757.

Pettersson, J., Hjort, C., Gezelius, L. & Johansson, J. 1990. *Spring migration of birds on Capri*. Special report, Ottenby Bird Observatory

Scebba, S. 1993. *Gli Uccelli della Campania*. Edizioni Esselibri, Napoli.

Spina, F. & Licheri, D. 2003. Biodiversità dell'avifauna italiana: variabilità morfologica nei Passeriformi (parte III: Muscicapidae – Emberizidae). *Biología e Conservazione della Fauna* 113: 1–180.

Svensson, L. 1984. *Identification Guide to European Passerines*. Third Edition, Stockholm.

Svensson, L. 1992. *Identification Guide to European Passerines*. Fourth Edition, Stockholm.

Urban, E. K., Fry, H. C. & Keith, S. 1997. *The Birds of Africa*. Vol. 5. London, Academic Press.

Zink, G. 1973. *Der Zug europäischer Singvögel*. Vol 1. Vogelwarte Radolfzell and Max-Plank-Institut für Verhaltensphysiologie.

Sammanfattning

Medelhavet och Sahara-öknen är två viktiga ekologiska barriärer som palearktiska flyttfåglar möter under flyttningen till och från vinterkvarteren. Flyttfågelforskningen har en lång tradion i Medelhavsområdet, med studier från Gibraltar i väster till Israel i öster. Ett betydande sträck går även genom de centrala delarna av Medelhavsområdet, exempelvis via den italienska halvön vidare mot Nordafrika. Italienska forskare har under en rad år studerat vårflyttningen vid ett antal öar i centrala Medelhavet (Messino m.fl. 2001) och även sammanställt data från höst och vinter från italienska ringmärkningsplatser (Licheri & Spina 2002, Spina & Licheri 2003). Huvuddelen av alla studier omfattar dock det italienska vårsträcket och vi vill därför i den här artikeln sammanställa och analysera höstdata från Capri Fågelstation i sydvästra Italien.

Material och metoder

Capri Fågelstation grundades 1956 av svenska ringmärkare efter att Axel Munthe vid sin död 1949 testamenterat sin egendom till svenska staten. Fågelstationen ligger på toppen av Barbarossaberget ovanför Villa San Michele i Anacapri, i en delvis raserad borg omgiven av macciavegetation. Fågelstationen har mestadels använts för att studera det massiva vårsträcket, men stationen har också varit bemannad i varierande grad under 15 höstar. Sammanlagt fanns data från 524 höstringmärkningsdagar under perioden 1959–2004 (Tabell 1).

För att illustrera sträcket på bästa sätt utifrån detta heterogena material delade vi in materialet i 24 pentader, med start 19 juli och slut 15 november. För varje pentad räknade vi sedan fram ett aktivitetsindex där antalet aktiva fångstdagar i pentaden delades med det totala möjliga antalet dagar. Detta index varierade från 6,7% i de sämst täckta pentaderna (5 dagar med fångst delat med 75 möjliga dagar) till 65,3% i pentaden med bäst täckning (Tabell 2). Då fångstintensiteten uppvisade dessa variationer valde vi att i alla fenologifigurer dela det faktiska antalet fångade fåglar i pentaden med antalet dagar med aktiv fångst. Y-axeln visar således det genomsnittliga antalet fångade fåglar per aktiv fångstdag i varje pentad. Vi valde att bara analysera de 12 arter som fångats i störst antal under höstarna (Tabell 2).

Fåglarna art-, köns- och åldersbestämdes i möjligaste mån enligt karaktärer i Svensson (1984,

1992). Fångade fåglar vägdes och mättes enligt standardmetoder och den visuella fettmängden bestämdes enligt Ottenby-skalan (Hasselquist & Pettersson 1985) utökad med tre steg för riktigt feta fåglar enligt Falsterbo Fågelstation (liknar de tre högsta stegen i skalan utvecklad av Kaiser 1993). Postjuvenil kroppsruggning bestämdes enligt Bensch & Lindström (1992).

Resultat

Följande lista är en kort sammanfattning för varje art. För mer detaljerad information bör man läsa de engelska texterna samt studera de figurer och tabeller som utgör grunden till artikeln.

Trädpiplärka *Anthus trivialis*. De första trädpiplärkorna fångades redan i början av augusti men sträcktoppen infaller först i mitten av september (Figur 1A). Sex oktoberfynd gjordes. Kroppsvikten varierade från 17,5–35,3 g och uppvisade positiva trender över säsongen både för adulta och juvenila fåglar (Figur 2).

Svarthätta *Sylvia atricapilla*. Förekommer i två former i fångsten på Capri, dels den kortvingade lokala rasen *pauluccii* och dels som mer långvingade flyttande former från nordliga populationer. Svarthättan är en vanlig övervintrare på ön. De 812 ringmärkta fåglarna visar två toppar, en tidig redan i slutet av juli bestående av lokala fåglar och en större i oktober mestadels bestående av inflyttade nordliga individer (Figur 1B).

Trädgårdssångare *Sylvia borin*. De 568 fångade trädgårdssångarna uppvisar en distinkt sträcktopp i slutet av september även om enstaka individer fångades betydligt tidigare och senare (Figur 1C). Adulta fåglar passerar ca 10 dagar tidigare än juvenila fåglar. Medelvikten låg ca 5 g över den fettfria vikten och enstaka individer hade dubblerat sin vikt. Det fanns inga skillnader mellan åldersgrupperna med avseende på vikt.

Sammetshätta *Sylvia melanocephala*. Det finns några publicerade fynd av sammetshättor söder om Sahara, men den absoluta merparten övervintrar i Medelhavsområdet. Sammetshättan är en mycket vanlig häckfågel i macciavegetationen på Capri och fenologidiagrammet visar inte heller på någon uttalad sträckbild (Figur 1D). Dock märks en snabb förändring av utbredningen av postjuvenila fjädrar runt pentad 10, vilket skulle kunna antyda att ungfåglarna börjar röra sig mer vid den tiden.

Rödstrupig sångare *Sylvia cantillans*. Sammanlagt har 97 rödstrupiga sångare fångats vid fågelstationen under höstarna, av vilka merparten utgjordes av juvenila fåglar. Rödstrupig sångare häckar i större delen av Medelhavsområdet, inklusive på Capri, och övervintrar i Afrika, mestadels söder om Sahara. Adulta fåglar passerade i genomsnitt senare än juvenila fåglar (Figur 1E,F). Hos juvenila fåglar fanns en signifikant positiv trend i kroppsvikt över säsongen och vikterna varierade från 8,6 g till 15,3 g.

Gransångare *Phylloscopus collybita*. Gransångare är framför allt en senhöstfågel på Capri, med en medelpassage i mitten av oktober (Figur 1G). Enstaka fåglar fångas redan i slutet av september och en del finns kvar på ön hela vintern. Vikterna hos fångade fåglar var generellt låga.

Lövsångare *Phylloscopus trochilus*. De lövsångare som förekommer på Capri om hösten tillhör troligen centraleuropeiska populationer av rasen trochilus (Zink 1973), vilket innebär att övervintringsområdena bör ligga i Västafrika. Sammanlagt har 160 lövsångare fångats, av vilka en hög andel bestämts som adulta fåglar (37 st). Sträckbilden på Capri är utdragen (Figur 1H) och medelpassagerna i viss mån präglad av ett par dagar med riktigt goda fångster 1961, vilket gör att man kan ifrågasätta dess representativitet. Kroppsvikterna varierade från 7,0 g till 13,6 g och adulta fåglar var genomsnittligen tyngre än ungfåglar. Hos juvenila fåglar fanns det en positiv korrelation mellan kroppsvikt och pentader.

Grönsångare *Phylloscopus sibiliatrix*. De 109 fångade grönsångarna uppvisar en relativt tidig sträckbild, med en medelpassage redan i början på september (Figur 1I). Alla utom 5 fångade fåglar var juvenila, vilket kontrasterar mot förhållandet hos lövsångaren. Medelvikten var ca 10 g och juvenila fåglar uppvisade en positiv trend i vikt mot pentad.

Brandkronad kungsfågel *Regulus ignicapillus*. Arten är en vanlig häckfågel på ön och de 184 fångade fåglarna härstammar troligen från närområdet. Brandkronade kungsfåglar fångades under alla pentader utom under de allra sista dagarna av säsongen (Figur 1J). Under vintern förekommer den rikligt i de lägre delarna av berget (Hjort m.fl. 2006) varför avsaknaden under de senaste höstpentaderna antingen är skenbar eller avspeglar förändrade förhållanden på platsen under senhösten.

Stenskvätta *Oenanthe oenanthe*. Sträckperioden förefaller lång för stenskvättan på Capri med fångster från augusti till och med oktober (Figur 1K). Merparten av de 76 fångade fåglarna var juvenila och ingen trend fanns i kroppsvikten över tiden. Medelvikten var ca. 22,5 g.

Rödhake *Erithacus rubecula*. Rödhaken var den vanligaste fågeln vid Capri Fågelstation om höstarna, med hela 1847 fångade individer. De första fåglarna dyker upp i mitten av september varefter arten återfinns i ringmärkningen under resten av säsongen (Figur 1L). Juvenila fåglar har en sträcktopp i början av oktober medan adulta fåglar toppar först i slutet av samma månad. Medelvikten för båda ålderskategorierna minskade med säsongens fortskridande. Detta skulle kunna ses som en indikation på ett skifte av rödhakar med olika flyttningsstrategier under hösten. Under tidig höst dominerar feta fåglar som avser att fortsätta flyttningen söderut medan senhösten domineras av magrare fåglar som är i slutet av flyttningsresan.

Taltrast *Turdus philomelos*. De 305 fångade taltrastarna är alla fångade under senhösten, från oktober in i tidig november (Figur 1M). Ringåterfynden av Capri-märkta taltrastar inkluderar förutom ett antal italienska fynd även ett fynd vardera från Tunisien och Algeriet (Pettersson m.fl. 1990).

Diskussion

De tolv undersökta arterna kan klassas som antingen tropikflyttare, kortdistansflyttare eller stannfåglar. Av de tropikflyttare som fångas vid Capri Fågelstation på hösten härstammar de flesta (trädpiplärka, trädgårdssångare, lövsångare, grönsångare och stenskvätta) från populationer som häckar norr om Italien, exempelvis Centraleuropa, östra Skandinavien och de baltiska staterna. Undantaget utgörs av rödstrupig sångare vilken mestadels häckar i Medelhavsområdet. Generellt var spridningen av kroppsvikter stor bland de fångade tropikflyttarna, där de tyngsta individerna vägde uppemot dubbelt så mycket som de magraste. Troligen bar de tyngsta tillräckligt stora fettdepåer för att flyga den resterande sträckan till söder om Sahara utan att behöva fylla på lagren längs vägen. Generellt uppvisade tropikflyttarna också positiva trender i viktutvecklingen över säsongen.

Kortdistansflyttarna utgjordes av gransångare, taltrastar och rödhakar. Deras vinterutbredning inkluderar Capri och Italien, men även sydligare områden, framför allt Nordafrika och i gransångarens fall även Afrika söder om Sahara. Kortdistansflyttarnas viktutveckling visade antingen ingen förändring (taltrast) eller negativa trender med säsongen (rödhake och gransångare). I det senare fallet skulle detta kunna tyda på ett gradvis skifte av fåglar under säsongen: den första delen domineras av fåglar som skall vidare söderut och den senare delen av fåglar som skall övervintra i närområdet.

Stannfåglarna utgjordes av sammetshättor och brandkronade kungsfåglar. Ingen av dessa arter uppvisar någon sträcktopp eller trender i kroppsvikt. Antalet fåglar minskade i de sista pentaderna, vilket skulle kunna tyda på en altitudinell flyttning nerför berget när vintern närmar sig.

ORNIS SVECICA 16: 55–61, 2006

Effects of magnetic manipulations on orientation: comparing diurnal and nocturnal passerine migrants on Capri, Italy in autumn

Effekter av magnetiska manipulationer på orientering: jämförelser mellan dag- och nattflyttande tättingar på Capri, Italien under hösten

SUSANNE ÅKESSON, NICLAS JONZÉN, JAN PETTERSSON, MATTIAS RUNDBERG & ROLAND SANDBERG

Abstract

Orientation cage experiments were performed on Capri in Italy, with a diurnal passerine migrant (Tree Pipit *Anthus trivialis*), and a nocturnal passerine migrant (Garden Warbler *Sylvia borin*), to study the use of magnetic compass information during autumn passage migration. The experiments were performed outdoors at sunset in: (1) the local geomagnetic field under natural clear skies, (2) a shifted magnetic field (mN −90°) under clear skies, and (3) a shifted magnetic field (mN −90°) under simulated overcast skies. Day migrating Tree Pipits showed a clear shift in orientation compared to controls (i.e. local geomagnetic field and clear sky conditions) corresponding roughly with the magnetic shift (mN −90°) under clear as well as overcast skies, while the Garden Warbler migrating at night, did not respond to the same magnetic manipulations by shifting their preferred directions in the cages. The mean orientation of Tree Pipits did not differ from the sun's position during experiments, while it was clearly different in Garden Warblers. Species-specific orientation responses to experimental manipulations in caged compared to free-flying migrants is discussed.

Susanne Åkesson, Niclas Jonzén, and Roland Sandberg, Department of Ecology, Lund University, Ecology Building, SE-223 62 Lund, Sweden.
Email: Susanne.Akesson@zooekol.lu.se
Jan Pettersson, Storgatan 12E, 386 30 Färjestaden
Mattias Rundberg, Brogatan 52, 302 38 Halmstad

Received: 13 December 2005, Accepted 12 January 2006, Editor: S. Svensson

Introduction

Migratory songbirds are able to use geomagnetic information and celestial cues based on the sun, the pattern of skylight polarization, and stars for orientation (e.g. Emlen 1975, Able 1980, Wiltschko & Wiltschko 1995). Passerine migrants born in the Northern Hemisphere have been shown to possess an inherited tendency to orient away from the rotation centre of the sky, i.e. the pole star in the Northern Hemisphere, in autumn (for review see Emlen 1975), and also an inherited magnetic compass based on the angle of inclination (Wiltschko & Wiltschko 1972). However, the combination of the two sources of information are important for the bird to experience during the ontogenetic phase, to guide a bird from the site where it is born to the population specific wintering area (Weindler et al. 1996).

However, what specific compasses are used under certain phases of the migration route, and if species with different migration strategies and destination areas differ in how they respond to the same type of manipulations of external compass information, and thus if they rely on the same compasses to select a migration course in the same ecological situation, is not clear (Helbig 1990, Able 1993, Åkesson 1994). Different species of songbirds seem to respond differently to cue-conflict experiments (for review, Muheim et al. 2006). In this study we compare the orientation in two species of migrants with different migration strategies, a diurnal migrant, the Tree Pipit *Anthus trivialis*, and a nocturnal migrant, the Garden Warbler *Sylvia borin*. We exposed the birds to the same shift of the magnetic field and recorded their orientation, in circular cages under both clear and overcast skies. Earlier experiments with the same type of experimental set-up suggest that there might be species-specific differences in how the birds respond to the same type of manipulation of external information (e.g. Åkesson 1993, 1994, Åkesson et al. 2002, Sandberg et al. 1991, 2000).

Methods

Study species and study site

We used a diurnal and a nocturnal passerine migrant, Tree Pipit and Garden Warbler captured on Capri in southwestern Italy, to study the use of magnetic compass information for migratory orientation in autumn. The birds were captured in mistnets at Castello Barbarossa near Villa San Michele, Anacapri (44°33'N, 14°15'E) from end of August to the end of September (for further information on capture procedure see Pettersson et al. 1990, Jonzén et al. 2006). Experiments with Tree Pipits were performed in 1995 and 1996, while Garden Warblers were studied 1994–1996.

The birds were kept during the day in individual cages and were tested at local sunset in circular orientation cages (Emlen & Emlen 1966). In the cages the birds were fed with mealworms and water with vitamins. We recorded the birds' body mass to the nearest 0.1 g with a Pesola spring-balance (50 g) and classified the fat levels according to a 10-graded visual scale (0–9) for fat classification (Pettersson & Hasselquist 1985, and extended at Falsterbo Bird Observatory) immediately before the cage experiments were performed.

Tree Pipits are mainly diurnal migrants breeding in northern Europe and wintering in an area from tropical West Africa across Central Africa south of 10°N latitude to East and Southeast Africa (Moreau 1972, Cramp 1988), with an expected migratory direction towards southwest to south at Capri. Garden warbles are night migrants and winter in an area from West and Central Africa south of 8°N latitude and also migrate to East and South Africa (Moreau 1972, Cramp 1992). They are expected to migrate mainly towards southwest to south on Capri.

Experimental procedure and statistics

The migratory orientation of individual birds was recorded in circular cages, so-called Emlen funnels (Emlen & Emlen 1966; lined with Tipp-Ex paper), allowing the birds to see approximately 160° of the sky at zenith. The experiments were performed outdoors at Castello Barbarossa. The mean angle of orientation of individual birds was recorded for one hour under natural clear and simulated overcast (the top of the cage covered with a 3 mm diffusing Plexiglas sheet) skies. The recordings of the birds' activity started at local sunset. The mean orientation of the birds was recorded one time per individual per test category, between 10 and 30 September for Tree Pipits and between 30 August and 30 September for Garden Warblers. All birds were released after the experimental period.

Based on the bird's activity within 24 sectors in the cage, as recorded by claw marks crossing a horizontal line in the pigment of the Tipp-Ex paper (minimum set to 10 registrations, which is a measure of the distribution of the activity around the circle, but not a complete count of all registrations present), we calculated the mean angle of orientation relative to Geographic North by using vector addition (Batschelet 1981). Experiments for which the mean orientation of the individual were not significantly different from random ($p>0.05$ according to Rayleigh test, Batschelet 1981) or with an activity below 10 registrations as scratch

Table 1. Number of Tree Pipits and Garden Warblers tested in orientation experiments on Capri under different experimental conditions (1–3) in autumn.
Antal trädpiplärkor och trädgårdssångare vars orientering registrerats i orienteringsburar på Capri under hösten för olika experimentförhållanden:1) Klar himmel, lokalt magnetfält, 2) Klar himmel, magnetfält vridet -90°, 3) Simulerat mulen himmel, magnetfält vridet -90°)

Species *Art*	Experiment	Inactive	Disoriented	Included	Total
Tree Pipit	1) Clear skies, local geomagnetic field	4	0	10	14
Anthus trivialis	2) Clear skies, mN –90°	5	0	12	17
	3) Simulated overcast skies, mN –90°	6	0	7	13
	Total all three *Summa alla tre*	15	0	29	44
	Per cent *Procent*	34.1	0	65.9	100)
Garden Warbler	1) Clear skies,local geomagnetic field	2	3	62	67
Sylvia borin	2) Clear skies, mN –90°	3	3	34	40
	3) Simulated overcast skies, mN –90°	6	3	36	45
	Total all three *Summa alla tre*	11	9	132	152
	Per cent *Procent*	7.2	5.9	86.8	100

Table 2. Mean fat class (0–9) and mass (g) for Tree Pipits and Garden Warblers for each experimental category as recorded prior to orientation experiments on Capri in autumn. Given is also median±sd activity (number of registrations per test hour) as calculated for all experiments in each category (1–3). For details on visual fat classification see Pettersson & Hasselquist (1986). The visual fat classification scale has been extended by three grades (7–9) at Falsterbo Bird Observatory.
Medelfettklass (0–9) och vikt (g) för trädpiplärkor och trädgårdssångare noterade direkt innan orienterings-experimenten startades för respektive experimentkategori. Angivet är också median aktiviteten (antal registreringar per timme) och ±sd beräknat för respektive experimentkategori (see Tabell 1). För detaljer angående den visuella fettskalan see Pettersson & Hasselquist (1986). Skalan har utökats med tre fettklasser (7–9) vid Falsterbo Fågelstation.

Species	Experiment	Mean fat class±sd	Mean mass (g) ±sd	Median activity ±sd	N
Tree Pipit	1) Clear skies, local geomagnetic field	6.0±1.4	25.8±3.2	22±50.5	14
Anthus trivialis	2) Clear skies, mN –90°	6.0±1.4	27.0±3.6	29±42.8	17
	3) Simulated overcast skies, mN –90°	6.1±1.5	26.2±4.5	16±38.0	13
Garden Warbler	1) Clear skies, local geomagnetic field	5.5±1.6	20.6±3.6	41±54.6	67
Sylvia borin	2) Clear skies, mN –90°	5.7±1.6	21.5±4.0	29±55.6	40
	3) Simulated overcast skies, mN –90°	5.3±2.0	20.5±4.3	43±76.6	45

marks crossing a horizontal line per test hour, were not included in further analyses. Number of experiments classified as inactive, disoriented and included (classifications given above) are given in Table 1. We used circular statistics to calculate the mean orientation of a group of birds recorded for each test category, and the Rayleigh test to analyse if the mean orientation differed from a random distribution (Batschelet 1981). For individuals with a significant axial mean orientation (Tree Pipits: 3 (10.3%) out of 29 experiments; Garden Warbler: 16 (12.1%) out of 132), we used only the side of the axis with the majority of the registrations for further statistical analyses. Differences between groups were compared with Watson's U^2-test (U^2; Batschelet 1981) and Mardia's one-way classification test ($F_{1,df}$, Mardia 1972). We used STATISTICA (StatSoft, Inc 2005) for analysing non-circular data. We used 95% Confidence Interval (95% CI; Batschelet 1981) to analyse if the mean orientation differed from the sun's position in the middle of the test hour calculated relative to Geographic North for each experimental site.

Results

Both Tree Pipits and Garden Warblers carried large fat reserves at the time of the experiments (Table 2), suggesting they were prepared for long-distance flights across the Mediterranean Sea, and perhaps also directly across the Sahara. There were no differences in fat class between the different experimental categories (Median test, Tree Pipits: χ^2=0.14, df=3, P>0.05, Garden Warblers: χ^2=0.43, df=3, P>0.05). We found no difference in mass between the three different experimental categories, neither for Tree Pipits (ANOVA, $F_{2,41}$=0.37, p>0.05) nor for Garden Warblers (ANOVA, $F_{2,148}$=0.81, p<0.05). The Tree Pipits showed slightly lower activity in the cages than Garden Warblers (Table 2), but there was no significant difference in median activity between the different experimental categories for Tree Pipits (Median test, χ^2_2=1.22, df=2, P>0.05) or for Garden Warblers (Median test, χ^2_2=0.14, df=3, P>0.05).

Orientation under natural clear skies in the local geomagnetic field

The mean orientation under clear skies in the local geomagnetic field for Tree Pipits were directed towards west to northwest (Figure 1A), while Garden Warblers showed a mean orientation towards southwest (Figure 2A). The mean orientation was significantly different from the position of the sun in the middle of the test hour for Garden Warblers (95% Confidence Interval, 95% CI, ±17°, p<0.05, Batschelet 1981), but not for Tree Pipits (95% CI, ±41°, p>0.05).

Effects of magnetic manipulations on orientation

The mean orientation recorded for Tree Pipits under clear skies in a shifted magnetic field (mN

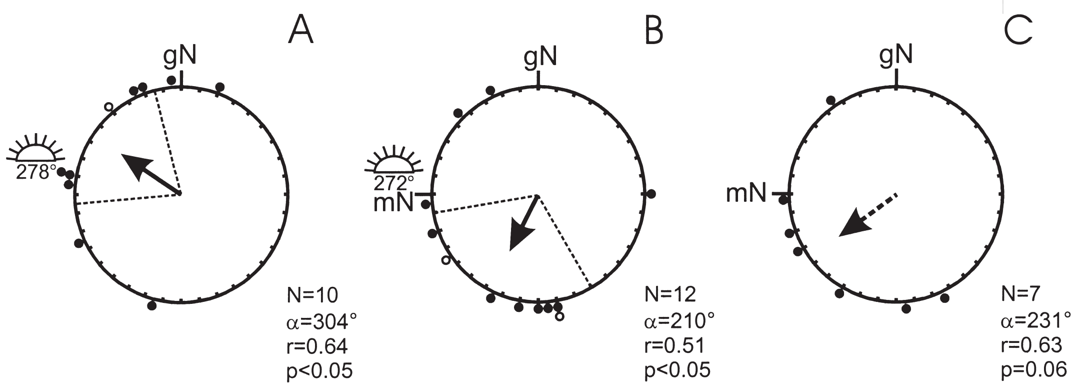


Figure 1. Results of orientation experiments with Tree Pipits under clear sky (A, B) and simulated overcast conditions (C) on Capri in autumn. The experiments were performed in the local geomagnetic field (A), and in a deflected magnetic field (magnetic North, mN corresponds to geographic West, mN −90°, B and C). Each symbol (filled: unimodal, open: bimodal) denotes the mean orientation of an individual bird. The mean angle of the group (α) indicated by the arrow, vector length (r) ranging between 0 and 1, and number of birds (N) tested is given for each circular distribution. Broken arrow indicates distribution not significantly different from random. Significance levels (p) are given according to the Rayleigh test (Batschelet 1981). Mean angle towards the sun in the middle of the test period is indicated for the clear sky experiments. 95% Confidence limits are given as broken lines.

Resultat från orienteringsexperiment med trädpiplärkor under naturligt klar (A, B) och simulerat mulen himmel (C) på Capri under hösten. Experimenten genomfördes i ett naturligt opåverkat magnetfält (A), samt i ett vridet magnetfält (magnetiskt norr vridet till geografisk väster, mN −90°, B och C). Varje symbol (fylld: unimodal fördelning, öppen: bimodal fördelning) visar medelriktningen för en individ. Medelriktningen (α) som visas av en pil med längden (r) och varierande mellan 0 och 1, samt antal fåglar (N) som testats anges för respektive cirkeldiagram. Signifikansnivåerna (p) ges enligt Rayleigh testet (Batschelet 1981). Medelriktningen mot solens position i mitten av experimenttimmen anges för respektive test under klar himmel. 95% konfidens intervall anges som streckade linjer.

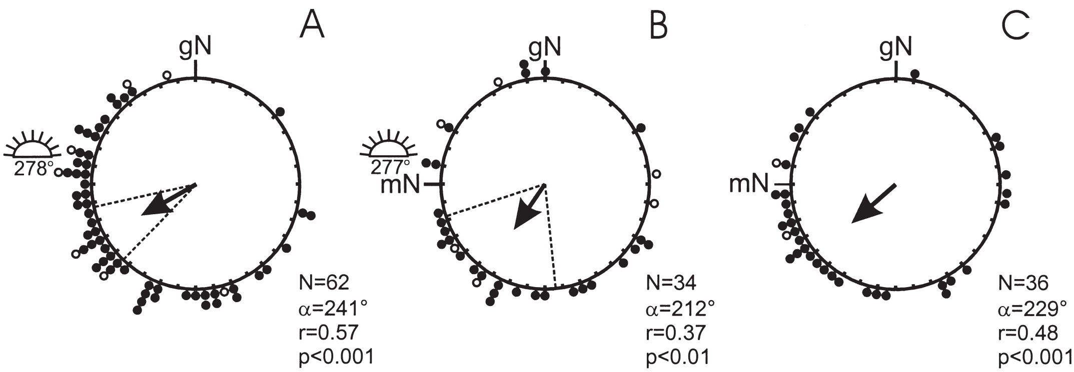


Figure 2. Results of orientation experiments with Garden Warblers under clear sky (A, B) and simulated overcast conditions (C) at Capri in autumn. The experiments were performed in the local geomagnetic field (A), and in a deflected magnetic field (magnetic North, mN corresponds to geographic West, mN −90°; B, C). For further information on symbols and calculated values see Figure 1.

Resultat från orienteringseperiment med trädgårdssångare under klar himmel (A, B) och simulerat mulen himmel (C) på Capri under hösten. Experimenten genomfördes i ett lokalt magnetfält (A), samt i ett vridet magnetfält (mN −90°; B, C). För information om symboler och statistik se Figur 1.

−90°), showed orientation towards southwest, significantly different from the position of the sun (95% CI, ±50°, $p<0.05$) (Figure 1B). Thus, under clear skies there was a significant difference in mean orientation in a shifted magnetic field compared to in the local geomagnetic field (Mardia's one-way classification test, $F_{1,20}=8.39$, $p<0.01$, Mardia 1972). The mean orientations recorded under simulated overcast skies did not differ between tests in the local geomagnetic field and the shifted magnetic field (Watson's U^2-test, $U^2=0.12$, $p>0.05$, Batschelet 1981, Figure 1B &C). Furthermore, we found no difference between clear sky experiments in the local geomagnetic field and experiments under simulated overcast skies in a shifted magnetic field (Watson's U^2-test, $U^2=0.04$, $p>0.05$, Figure 1A & C).

The Garden Warblers showed a mean orientation under clear skies in a shifted magnetic field (mN-90°) that was directed towards southwest (Figure 2B), significantly different from the position of the sun in the middle of the test hour (95% CI, ±39°, $p<0.05$). This mean orientation recorded for the Garden Warblers did not differ from the clear sky experiments in the local geomagnetic field (Mardia's one-way classification test, $F_{1,94}=2.30$, $p>0.05$, Figure 2A & B), nor from the mean orientation in a shifted magnetic field under simulated overcast skies (Mardia's one-way classification test, $F_{1,68}=0.54$, $p>0.05$, Figure 2B & C). We found no difference in orientation in Garden Warblers between clear sky experiments in the local geomagnetic field and simulated overcast experiments in a shifted magnetic field (Mardia's one-way classification test, $F_{1,96}=0.54$, $p>0.05$, Figure 2A & C).

Discussion

Orientation under natural clear skies

Diurnally migrating Tree Pipits in our study clearly showed a west to northwesterly mean orientation in autumn at Capri, under natural clear skies in the local geomagnetic field, directed distinctly more to the north than expected (Cramp 1988). However, the mean orientation was not different from the position of the sun during the experimental period at sunset, suggesting that the birds might have been influenced by the sunset during the experiments. Attraction towards the sun's position during experimentation at sunset has been observed for a number of passerine migrants in circular cage experiments (e.g. Åkesson 1993, 1994, Åkesson & Sandberg 1994, Åkesson & Bäckman 1999, Sandberg et al. 1991, Marchetti et al. 1998). It has been suggested that information available at the horizon is important for the bird's compass orientation during the twilight period (Sandberg 1991, see also Muheim et al. 2006), and free-flying North American *Catharus* thrushes seem to use twilight visual information for compass calibration prior to nocturnal flights (Cochran et al. 2004). Daytime celestial cues, and more specifically the skylight polarisation pattern have been shown to be used to calibrate the magnetic compass by birds (e.g. Able & Able 1990, 1993, 1995)

The experiments with the nocturnal migrant, the Garden Warbler, showed selection of southwesterly courses under natural clear skies in the local geomagnetic field, more or less in the expected migratory direction (Cramp 1992). The mean orientation for Garden Warblers was clearly different from the sun's position during the experiments, suggesting minor or no influence from the sun on the bird's orientation in the cages.

Experiments in cages with migratory passerines at twilight, throughout the night and in the sunset hours have demonstrated a shifted orientation in European robins *Erithacus rubecula*, and between sunrise and sunset also for some tropical nocturnal passerine migrants captured and tested on migration in South Scandinavia (Åkesson & Sandberg 1994). The birds' orientation in circular cages was to a large extent influenced by the position of the sun, during these test periods, suggesting a phototactic response. It is interesting to note the difference between the diurnal and the nocturnal migrant in our study, demonstrating a clear sun attraction in the diurnal migrants, but no such attraction in the nocturnal migrant. Could this difference be related to differences in the use of solar, and/or magnetic cues at the test period? The Tree Pipits predominantly migrate during the day, and are expected to depart from stopover sites in the morning (Cramp 1988). The experimental period used by us might therefore be out of phase with the timing of the natural migratory departure. We observed a slightly lower mean activity in Tree Pipits relative to Garden Warblers, which support these observations. However, observations of free-flying nocturnal migrants (Åkesson et al. 1996, 2001), expected to predominantly depart in the twilight period (for review, see Moore 1984), show that individuals might select to depart at a very wide range of times, covering up to 10h. Many passerine migrants are also selecting their time of departure in relation to the prevailing wind and weather conditions (Åkesson & Hedenström

1996, Åkesson et al. 2001, 2002), rather than strictly departing at a specific time in relation to the availability of celestial orientation cues (Åkesson et al. 1996). This clearly demonstrates their ability to select appropriate migratory conditions during a large range of times within their natural flight period.

Effect of magnetic manipulations on orientation

The Tree Pipits in our study responded to the shifted magnetic field (mN-90°) by shifting the mean orientation under clear skies to almost the same extent (observed angular shift: −94°). However, the Garden Warblers did not show a significant shift in their mean orientation (−29°) relative to the shifted magnetic field. The results suggest a difference in response to the magnetic manipulation between the two species. Why did the Tree Pipits follow the magnetic shift to a high extent, while the Garden Warblers did not follow the shift to any significant degree? Species-specificity in the use of alternative compass cues have been suggested and discussed several times in the literature (Helbig 1990, Able 1993, Åkesson 1994; see also Muheim et al. in press). Both our birds are migrating to tropical Africa for wintering (Cramp 1988, 1992), but may do so by using different migration strategies. The measurements of fat and mass suggest that species were prepared for long migration flights. But as the two species differ in their predominant time of migration, with the Tree Pipits migrating mainly at day and the Garden Warblers mainly at night (Cramp 1988, 1992), we suggest that the observed differences in orientation response relative to the magnetic field, are most likely related to the birds' use of and perhaps calibration of alternative compasses (solar, stellar and geomagnetic) during migration.

Acknowledgements

We thank the board, director and staff at Villa San Michele for letting us use Castello Barbarossa, and all the Swedish and Italian ornithologists working there for logistics support of the project. This study was financed by grants from the Swedish Ornithological Society, Ottenby Bird Observatory, Stiftelsen Olle Engkvist Byggmästare and by a grant from the Swedish Science Research Council to S. Åkesson. This is report no. 211 from Ottenby Bird Observatory.

References

Able, K. P. 1980. Mechanisms of orientation, navigation and homing. Pp. in *Animal Migration, Orientation and Navigation* (ed. S. Gauthreaux). Academic Press, New York.

Able, K. P. 1993. Orientation cues used by migratory birds: a review of cue-conflict experiments. *Trends Ecol. Evol.* 10: 367–371.

Able, K. P. & Able, M. A. 1990. Calibration of the magnetic compass of a migratory bird by celestial rotation. *Nature* 347: 378–380.

Able, K. P. & Able, M. A. 1993. Daytime calibration of magnetic orientation in a migratory bird requires a view of skylight polarisation. *Nature* 364: 523–525.

Able, K. P. & Able, M. A. 1995. Interactions in the flexible orientation system of a migratory bird. *Nature* 375: 230–232.

Åkesson, S. 1993. Effect of geomagnetic field on orientation of the marsh warbler *Acrocephalus palustris*, in Sweden and Kenya. *Anim. Behav.* 46: 1157–1167.

Åkesson, S. 1994 Comparative orientation experiments with different species of passerine long-distance migrants: effect of magnetic field manipulation. *Anim. Behav.* 48: 1379–1393.

Åkesson, S. & Bäckman, J. 1999. Orientation in pied flycatchers: the relative importance of magnetic and visual information at dusk. *Anim. Behav.* 57: 819–828.

Åkesson, S. & Hedenström, A. 2000. Selective flight departure in passerine nocturnal migrants. *Behav. Ecol. Sociobiol* 47: 140–144.

Åkesson, S. & Sandberg, R. 1994. Migratory orientation of passerines at dusk, night and dawn. *Ethology* 98: 177–191.

Åkesson, S., Alerstam, T. & Hedenström, A. 1996. Flight initiation of nocturnal passerine migrants in relation to celestial orientation conditions at twilight. *J. Avian Biol.* 27: 95–102.

Åkesson, S., Walinder, G., Karlsson, L. & Ehnbom, S. 2001. Reed warbler orientation: initiation of nocturnal migratory flights in relation to visibility of celestial cues at dusk. *Anim. Behav.* 61: 181–189.

Åkesson, S., Morin, J., Muheim, R. & Ottosson, U. 2002. Avian orientation: effects of cue-conflict experiments with young migratory songbirds in the high Arctic. *Anim. Behav.* 64: 469–475.

Batschelet, E. 1981. *Circular Statistics in Biology*. Academic Press, New York.

Cochran, W. W., Mouritsen, H. & Wikelski, M. 2004. Migrating songbirds recalibrate their magnetic compass daily from twilight cues. *Science* 304: 405–408.

Cramp, S. (ed.) 1988. *The Birds of Western Palaearctic, Vol V: Tyrant Flycatchers to Thrushes*. Oxford University Press, Oxford.

Cramp, S. (ed.) 1992. *The Birds of Western Palaearctic, Vol IV: Warblers*. Oxford University Press, Oxford.

Emlen, S. T. 1975 Migration: orientation and navigation. Pp. 129–219 in *Avian Biology*, Vol. 5 (ed. D. S. Farner & J. R. King). Academic Press, New York.

Emlen, S. T. & Emlen, J. T. 1966 A technique for recording migratory orientation of captive birds. *Auk* 83: 361–367.

Helbig, A. J. 1990. Are orientation mechanisms among migratory birds species-specific? *Trends Ecol. Evol.* 5:

365–366.
Jonzén, N., Piacentini , D., Andersson, A., Montemaggiori, A., Stervander , M., Rubolini , D., Waldenström, J., & Spina, F. 2006. The timing of spring migration in trans-Saharan migrants: a comparison between Ottenby, Sweden, and the island of Capri, Italy. *Ornis Svecica* 16: 27–33.
Marchetti, C., Bezzi, E. M. & Badlaccini, N. E. 1998. Orientation in relation to exposure to the setting sun in some passerine trans-saharan migrants. *Ethol. Ecol. & Evol*. 10: 143–157.
Mardia, K. V. 1972. *Statistics of Directional Data*. Academic Press, London.
Moore, F. R. 1987. Sunset and the orientation behaviour of migrating birds. *Biol. Rev*. 62: 65–86.
Moreau, R. E. 1972. *The Palaearctic-African Bird Migration Systems*. Academic Press, London.
Muheim, R., Phillips, J. B. & Moore, F. R. 2006. Calibration of magnetic and celestial compass cues in migratory birds – a review of cue-conflict experiments. *J. Exp. Biol*. 209: 2–17.
Pettersson J. & Hasselquist, D. 1985. Fat deposition and migration capacity of robins *Erithacus rubecula* and goldcrests *Regulus regulus* at Ottenby, Sweden. Ring. & Migr. 6: 66–76.
Pettersson, J., Hjort, C., Gezelius, L. and Johansson, J. 1990. *Spring migration of Birds at Capri*. Special report, Ottenby Bird Observatory.
Sandberg, R. 1991. Sunset orientation of robins, *Erithacus rubecula*, with different fields of sky vision. *Behav. Ecol. Sociobiol*. 28: 77–83.
Sandberg, R., Bäckman, J. & Ottosson, U. 1998. Orientation of snow buntings (*Plectrophenax nivalis*) close to the Magnetic North Pole. *J. Exp. Biol*. 201: 1859–1870.
Sandberg, R., Ottosson, U. & Pettersson, J. 1991. Magnetic orientation in migratory wheatears *Oenanthe oenanthe* in Scandinavia and Greenland. *J. Exp. Biol*. 155: 51–64.
Sandberg, R., Bäckman, J., Moore, F. R. & Lõhmus, M. 2000. Magnetic information calibrates celestial cues during migration. *Anim. Behav*. 60: 453–462.
StatSoft, Inc. 2005. STATISTICA (data analysis software system), version 7.1. www.statsoft.com.
Weindler, P., Wiltschko, R. & Wiltschko, W. 1996. Magnetic information affects the stellar orientation of young bird migrants. *Nature* 383: 158–160.
Wiltschko, R. & Wiltschko, W. 1995. Magnetic Orientation in Animals. Springer-Verlag, Berlin, Heidelberg.
Wiltschko, W. & Wiltschko, R. 1972. Magnetic compass of European robins. *Science* 176: 62–64.

Sammanfattning

Jämförande orienteringsexperiment genomfördes under höstflyttningen på Capri i Italien med två arter tättingar, en dagflyttare, trädpiplärka *Anthus trivialis*, och en nattflyttare, trädgårdssångare *Sylvia borin*, för att undersöka hur de olika arterna använder sig av magnetisk information för orientering (Tabell 1). Experimenten startade vid lokal solnedgång och genomfördes utomhus under: (1) naturligt klar himmel i ett lokalt magnetfält, och (2) naturligt klar himmel i ett vridet magnetfält (magnetisk nordriktning vriden mot geografisk väster, mN −90°), samt (3) simulerat mulen himmel i ett vridet magnetfält (magnetisk nordriktning vriden mot geografisk väster, mN −90°). Fåglarnas aktivitet registrerades som skrapmärken i pigment på Tipp-Ex papper som placerats på de sluttande sidorna i cirkelrunda burar, s.k. Emlen-trattar, och deras fett och vikt noterades inför varje experimenttillfälle. Båda arterna hade stora fettreserver vid experimenttillfällena, vilket visar att de var förberedda på flyttning över Medelhavet och Sahara (Tabell 2). De dagflyttande trädpiplärkorna (Figur 1) visade en nordvästlig orientering under klar himmel i ett opåverkat magnetfält, och ändrade sin orientering i samma utsträckning som den introducerade magnetfältsvridningen under klar himmel, vilket antyder att de skulle lita till sin magnetkompass för orientering under skymningsperioden. Trädgårdssångarna (Figur 2) valde däremot en mer sydvästlig riktning under klar himmel i opåverkat magnetfält, och ändrade inte sin orientering med magnetfältvridningen. Resultaten visar på skillnader i orientering relativt ett vridet magnetfält mellan en dag- och en nattflyttande tätting som exponerats för samma experimentförhållanden. Skillnaderna i orientering antas vara kopplade till hur de olika arterna utnyttjar, och möjligen kalibrerar, sin magnetkompass relativt visuella orienteringshjälpmedel under flyttningen. Dessa skillnader är möjligen kopplade till de olika arternas flyttningstrategier.

ORNIS SVECICA 16: 62–68, 2006

Wintering birds on the island of Capri, southwestern Italy

Övervintrande fåglar på ön Capri, sydvästra Italien

CHRISTIAN HJORT, ARNE ANDERSSON & JONAS WALDENSTRÖM

Abstract

We trapped birds on the island of Capri, SW Italy, during February and earliest March 2002–2004 and in November–December 2004. The trapped birds were ringed, and common biometrical parameters measured. In total 247 birds of 17 species were trapped, a rather limited number, whereof c. 70% were either European Robins *Erithacus rubecula*, Blackcaps *Sylvia atricapilla*, Sardinian Warblers *Sylvia melanocephala* or Chiffchaffs *Phylloscopus collybita*. Although the majority of birds handled were probably settled winterers, variations in the trapping figures and cases of high body masses and fat scores suggested that in late November and December some birds may still have been en route for areas further south – and that already in late February some, particularly evident in Chiffchaffs, were on their way north again. The comparatively mild winter climate on the island of Capri may be mirrored by the lower body masses of Robins trapped by us there, compared to birds wintering on the Italian mainland which probably put on some extra fat as insurance against spells of cold weather.

Christian Hjort, Hessle, Munkarp, SE-243 91 Höör, Sweden.
Email: christian.hjort@geol.lu.se.
Arne Andersson, Ottenby Bird Observatory, Pl 1500, SE-380 65 Degerhamn, Sweden.
Jonas Waldenström, Dept. of Animal Ecology, Lund University, Ekologihuset, SE-223 62 Lund, Sweden.

Received 13 May 2005, Accepted 18 November 2005, Editor: R. Sandberg

Introduction

The Mediterranean basin is a major wintering area for many birds breeding in central and northern Europe and parts of northwestern Asia. The ecology, geographical distribution and temporal occurrence of these wintering birds have been the scope of a number of studies. Well-known examples include the one by Erard (1966) on European Robin *Erithacus rubecula* migration, and research on the interdependence between wintering birds and fruiting bushes carried out by Spanish and French workers (e.g. Herrera 1984, Debussche & Isenmann 1992). There also exist extensive studies of the wintering birds in e.g. the Strait of Gibraltar area (Finlayson 1992) and Italy (Spina et al. 2001, Licheri & Spina 2002, Spina & Licheri 2003), and the general concept of wintering birds was also included in the ecological overview of the Mediterranean region by Blondel & Aronson (1999).

The Swedish track record in the study of Mediterranean wintering birds is limited, but includes a study of the morphology, biometrics and plumage of wintering European Robin populations from the easternmost to the westernmost Mediterranean (Pettersson et al. 1990a). The main aim of that study was to map the winter ranges of Robins with different plumage characteristics, indicating different breeding populations, which pass southern Sweden on autumn migration.

Capri Bird Observatory (40°33´N, 14°15´E) is located about 400 m a.s.l. in the old Castello Barbarossa on the island of Capri, situated in the Bay of Naples in southwestern Italy. It was founded by Swedish ornithologists in 1956 (Edelstam et al. 1963) and has since the mid 1980s been run jointly by the Swedish Ottenby Bird Observatory and the Italian Ringing Centre at Bologna, with the Italian work being part of the Progetto Piccole Isole (PPI; e.g. Spina et al. 2006). Results from the Swedish work have been summarized by Edelstam et al. (1963) and Pettersson et al. (1990b). The Italian results have been used in several specific papers and are included in a summary-report from the PPI-project (Messineo et al. 2001). The works listed above have, however, mainly concerned the spring migration. Studies of the much less pronounced autumn migration was initially carried out by Swedish ornithologists during the five year period 1959–1963 and in 1989, and has since then been done more continuously for at least a few weeks each year between 1994–2004. The autumn results are summarized in the present volume by Waldenström et al. (2006).

The bird life of the Campania region, to which Capri belongs, was thoroughly described by Scebba (1993), in a book which also includes a lot of data from Capri Bird Observatory, of both Italian and Swedish origin.

The wintering birds

To complement the data from the spring and autumn migrations and thus getting a more complete knowledge of the annual cycle of bird occurrence on Capri, trapping and ringing were carried out during some winter months in 2002, 2003 and 2004. After a brief pilot study 4–8 February 2002, more extended efforts followed 12–28 February 2003 and 15 February–6 March 2004. Intermittent ringing (in total 20 ringing days) was also done between 1 November–15 December 2004. The grand total from these campaigns was rather low, only 247 birds ringed, belonging to 17 species (Table 1).

During the migration periods trapping is carried out on top of Monte Barbarossa, inside and immediately outside the walls of the Castello. The winter trapping, however, has taken place on the more lush lower parts of the mountain, and in parts of the Villa San Michele gardens. Between 5–15, usually 8–12 mist-nets have been used, and the trapping has normally been done between dawn and mid-day. Ageing and sexing of birds was done according to Svensson (1992). Wing length measurements were taken using the maximum chord method of Svensson (1992) and body mass was measured using Pesola spring balances. Fat stores were determined according to the scale of Hasselquist & Pettersson (1985), which judge the amount of fat deposited on the abdomen and in the tracheal pit based on seven scores. Before doing the statistical analyses we checked whether the data was normally distributed or not, and thereafter computed either parametric or nonparametric tests, using the software SPSS for Windows (version 11.0).

Table 1 lists the birds ringed during the winter efforts, largely representing those birds which normally winter on Capri. The most common of these species were the European Robin, the Blackcap *Sylvia atricapilla*, the Sardinian Warbler *Sylvia melanocephala* and the Chiffchaff *Phylloscopus collybita*. These four made up c. 70% of the ringed birds, were considered our "target species" and are specifically discussed below.

Table 2 summarizes the body mass- and fat-score data for those birds where the trapping figures for at least one period of November/December

Table 1. Numbers of birds ringed on Capri during the winter campaigns in 2002–2004.
Antal fåglar ringmärkta på Capri vintrarna 2002–2004.

Species *Art*	Nov	Dec	Feb	Mar
Wren *Gärdsmyg*	2		6	
Dunnock *Järnsparv*	6		9	
Robin *Rödhake*	25	3	26	2
Black Redstart *Svart rödstjärt*		1	2	
Stonechat *Svarthakad buskskvätta*	1			
Blackbird *Koltrast*	2		7	2
Song Thrush *Taltrast*			1	
Sardinian Warbler *Sammetshätta*	3	2	24	2
Blackcap *Svarthätta*	7	2	30	9
Chiffchaff *Gransångare*	1	2	29	4
Goldcrest *Kungsfågel*			3	1
Firecrest *Brandkronad kungsfågel*			5	3
Great Tit *Talgoxe*			3	
Short-toed Treecreeper *Trädgårdsträdkrypare*			4	1
House Sparrow (italiae) *Italiensk sparv*			6	
Chaffinch *Bofink*	1		1	
Greenfinch *Grönfink*			7	2

Table 2. Body mass and fat score data of birds ringed on Capri during the winter campaigns in 2002–2004. With the exception of the Goldcrest *Regulus regulus*, only birds with at least 5 individuals ringed during one of the periods November/December or February/March are included.

Vikt- och fettdata för fåglar ringmärkta på Capri vintrarna 2002–2004. Bortsett från kungsfågeln är bara arter med minst 5 individer märkta under endera perioden november/december eller februari/mars medtagna.

	November – December				February – March			
Species *Art*	n	Mean weight *Medelvikt*	St. dev.	Mean fat *Medelfett*	n	Mean weight *Medelvikt*	St. dev.	Mean fat *Medelfett*
Wren *Gärdsmyg*	2	8.9	0.4	2.0	6	9.2	0.6	2.7
Dunnock *Järnsparv*	6	19.1	1.6	3.2	9	17.4	6.6	2.7
European Robin *Rödhake*	28	16.0	1.4	2.1	28	17.6	1.2	2.2
Blackbird *Koltrast*	2	90.8	9.5	1.0	9	93.6	9.0	3.0
Sardinian Warbler *Sammetshätta*	5	12.7	0.2	1.6	26	12.4	0.7	2.5
Blackcap *Svarthätta*	9	17.5	0.6	3.2	39	19.0	1.8	3.6
Chiffchaff *Gransångare*	3	8.4	1.3	4.0	33	7.8	0.9	3.5
Goldcrest *Kungsfågel*					4	5.2	0.5	1.8
Firecrest *Brandkr. kungsfågel*					8	5.2	0.2	1.5
Short-toed Treecreeper *Trädgårdsträdkrypare*					5	8.5	0.7	2.0
Greenfinch *Grönfink*					9	23.5	1.2	1.2
	55				176			

or February/March reached 5 birds. The exception is the Goldcrest *Regulus regulus* with only 4 birds ringed, included simply for comparison with its relative the Firecrest *Regulus ignicapillus*.

Species accounts

European Robin

The Robins start to arrive on Capri in the middle of September, with their main passage culminating in October (Waldenström et al. 2006; see also Lövei et al 1986, Scebba 1993). Many continue their journey to winter in Sicily and North Africa, but a considerable number spend the winter on Capri, establishing territories in gardens, vineyards and other wooded areas. The progressing negative trend in body mass seen during the autumn (Waldenström et al. 2006) seems to reach a low in November/December with a mean mass of 16 g (Table 2). This may illustrate an increased proportion of settled local winterers, compared to the heavier birds going for wintering areas further south. In February and earliest March the fattening-up prior to spring migration is already evident (Figure 1A), with the mean body mass having increased to 17.6 g ($t = -4.61$, $n = 54$, $p < 0.001$).

Our Robin body mass figures from the island of Capri show a different pattern from those based on data from the whole of Italy (Licheri & Spina 2002). These birds, mainly trapped on the mainland, rise in mass towards mid-winter, at the time when the island birds trapped by us remained lean.

Blackcap

The Blackcap is a local breeder on Capri, but the main winter population seems to consist of immigrants from northern and central Europe. Lövei et al. (1985) concluded, from a seven year study

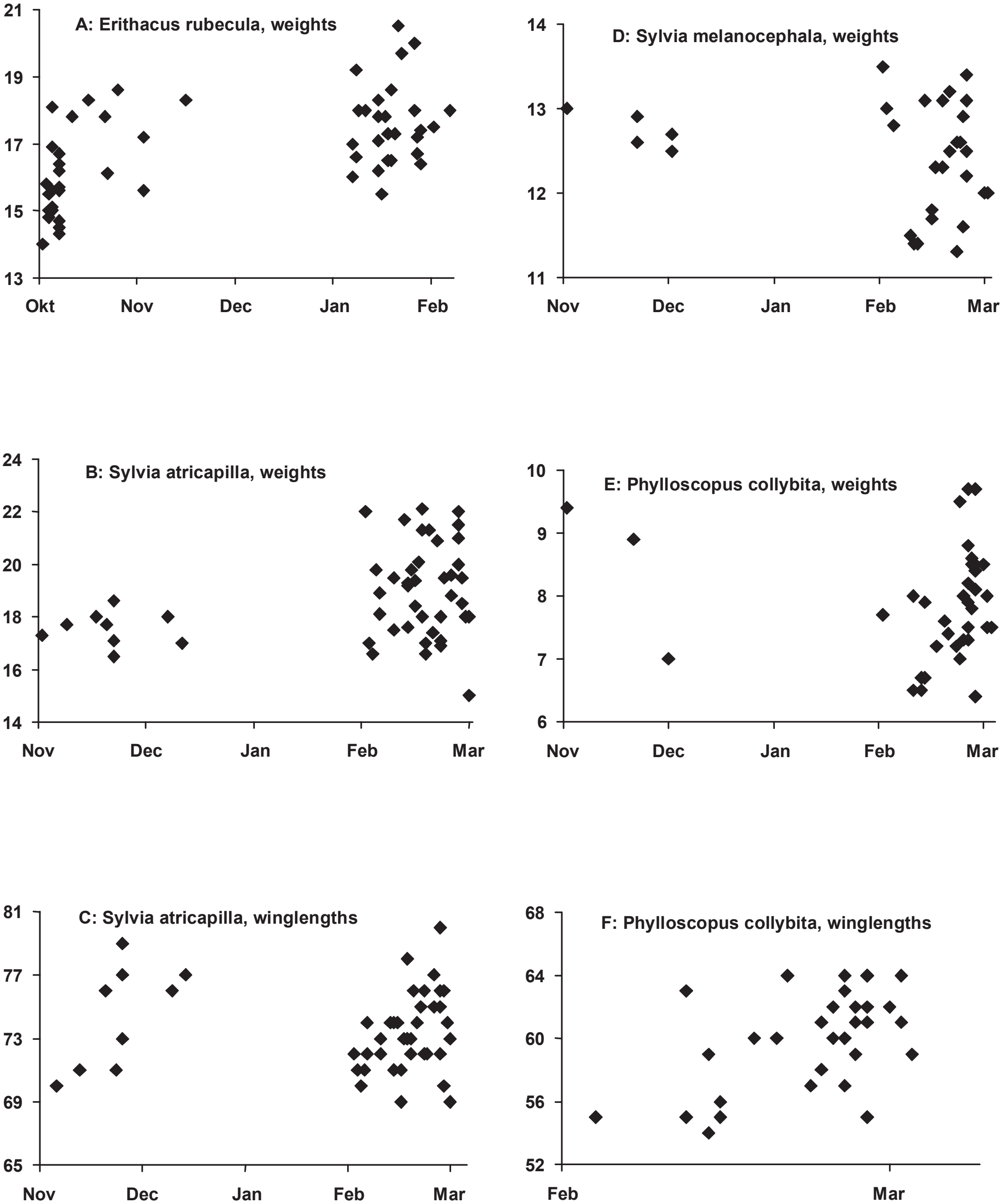


Figure 1. Body mass plots (in g.) for European Robins (A), Blackcaps (B), Sardinian Warblers (D) and Chiffchaffs (E), and wing-length plots (in mm.) for the Blackcap (C) and Chiffchaff (F).
Viktplotter (i gram) för rödhake (A), svarthätta (B), sammetshätta (D) och gransångare (E), samt vinglängdsplotter (i mm.) för svarthätta (C) och gransångare (F).

on the island of Vivara on the northern side of the Bay of Naples, that the local Blackcaps there (of the subspecies *pauluccii*) left for the south in September and that the winterers were all longer-winged birds from the north. This seems to be the case also on nearby Capri, where c. 90% of the Blackcaps in winter have wing lengths of ≥ 70 mm and c. 25% wings ≥ 75 mm, with 80 mm as the longest. Nevertheless c. 10% of the winter Blackcaps on Capri are small (wing lengths ≤ 70 mm) and comparatively dark birds of likely Mediterranean provenance, suggesting that like in southern France (e.g. Berthold 1986) the local population may only be partially migrant.

As with the Robins on Capri, the Blackcaps' mean body mass in November/December (17.5 g, Table 2) was considerably lower than in February-earliest March (19 g; Mann-Whitney U = 80.5, n = 48, p = 0.012). This difference in mass may indicate an early fattening-up in spring of wintering birds preparing for migration. Although there was no statistically significant trend in body mass with date in the February-early March sample (Spearman Rank Correlation r = –0.002, n = 39, p = 0.991; Figure 1B) it is still possible that these birds included early migrating Blackcaps from the south (cf. the Chiffchaff), as wing-lengths increased with time through February into March (February–earliest March: Pearson r = 0.339, n = 39, p = 0.035; Figure 1C). The data from Capri show large resemblance to the all-Italian body mass data from Licheri & Spina (2002), with similar winter weight patterns.

Sardinian Warbler

The Sardinian Warbler is a common local breeder on Capri, with many birds spending the winter there. The island is probably also visited by birds en route to and from wintering areas further south, as is indicated by autumn body masses of up to 15 g (Waldenström et al. 2006) – and perhaps also by the fact that some 20% of the Sardinian Warblers trapped in February–earliest March had moderately increased fat stores (fat score 4). But compared with the Blackcap the Sardinian Warbler is a strictly Mediterranean and mainly sedentary bird, which seems only occasionally and locally (e.g. along the lower Senegal River) to venture south of the Sahara (Borrow & Demey 2001).

The winter body masses of the Sardinian Warbler had similar means (around 12.5 g, Table 2) in November/December and February–earliest March, without any obvious trend (February–earliest March: Spearman Rank Correlation r = 0.068, n = 26, p = 0.741; Figure 1D). These island body mass figures are rather similar to the all-Italian ones given by Licheri & Spina (2002), although the latter have a tendency to be slightly higher (by c. 1 g) in mid-winter.

Chiffchaff

Some Chiffchaffs winter on Capri and many more pass the island on their way to winter quarters further south, including sub-Saharan Africa. Two of the three birds trapped in November/December had body masses around 9 g (Figure 1E), suggesting that they were still on migration. There is then a clear trend towards higher body masses through February into earliest March (Pearson r = 0.391, n = 33, p = 0.024; Figure 1E) which is companioned by an increase in wing-length (Pearson r = 0.527, n = 33, p = 0.002; Figure 1F) and with slightly increasing trapping figures at the end of February. This may indicate an early passage of birds coming up from the south. About 30% of the Chiffchaffs at that time weighed more than 8 g and some as much as 9.5 g (Figure 1E) and the mean weight for the period was 7.8 g (Table 2). An increasing body mass trend in late February–early March is also found in the all-Italian Chiffchaff body mass data of Licheri & Spina (2002).

Retraps and recurrences

A number of the trapped birds were later retrapped within the same season. Weight gains and weight losses were recorded, as might be expected in locally resident wintering birds. There were also a number of retraps between seasons, both of birds which breed on Capri (Sardinian Warbler 4 cases, Wren *Troglodytes troglodytes* 2, and Short-toed Tree Creeper *Certhia brachydactyla* 2), and of such which come there only to winter (European Robin 2 cases, Chiffchaff 2, Dunnock *Prunella modularis* 1 and Black Redstart *Phoenicurus ochruros* 1). These recurrences were all from one year to the next. No birds were retrapped after more than one year.

Conclusions and some speculation

Our dataset from Capri probably includes both a majority of wintering birds and (in November/December) some which are still heading for areas further south, and (in February/earliest March) such which have already begun their northward spring migration. This is indicated by small temporal changes in the trapping figures during these periods and by the occurrence of birds which seem too fat for being settled winterers. Also, the waters surrounding Capri give the island a milder climate as compared to mainland Italy, especially compared to higher altitudes and northern Italy, and such an ”island effect” may be indicated by the mid-winter body masses of the European Robin – a bird utilizing a large spectrum of winter habitats. According to our limited dataset its mean body mass is considerably lower in midwinter on Capri than on the Italian mainland (c.f. Licheri & Spina 2002). Similar discrepancies have been discussed earlier (e.g. for Robins wintering in Greece; Pettersson 1986), and believed to illustrate the mainland winterers' need for extra fat as an insurance in areas where cold spells regularly occur. On the other hand, Lövei et al. (1986), on the island of Vivara only c. 30 km north of Capri found considerable interannual variations in Robin winter weights and had mid-winter (January–February) maxima like on the mainland in two years out of three. Thus more data is certainly needed to prove the "island effect".

Acknowledgements

We thank the Villa San Michele Foundation for allowing us to use the facilities at the Villa during these winter campaigns, and our special thanks go to the two directors in charge during these years; Ann-Marie Kjellander and Peter Cottino, and to their nice and competent staff. The winter trapping and ringing was carried out by two of the authors (AA, CH) and by Ilze Girgensohne, Gunnar Granström, Rolf Gustafsson, Wiveca Hjort, Maria Olsson and Johan Stedt, taking different turns. Much of the financing came from Ottenby Bird Observatory. Clive Finlayson and two anonymous reviewers are thanked for their constructive suggestions. This is contribution no. 212 from Ottenby Bird Observatory.

References

Berthold, P. 1986. Wintering in a partially migratory Mediterranean Blackcap (*Sylvia atricapilla*) population: strategy, control, and unanswered questions. *Proc. First Conf. on Birds Wintering in the Mediterranean Region. Suppl. alle Richerche di Biologia della Selvaggina* 10: 33–45.

Blondel, J. & Aronson, J. 1999. *Ecology and Wildlife of the Mediterranean Region*. Oxford University Press.

Borrow, N. & Demey, R. 2001. *Birds of Western Africa*. Helm, London.

Debussche, M. & Isenmann, P. 1992. A Mediterranean bird disperser assemblage: composition and phenology in relation to fruit availability. *Revue d´Ecologie (Terre et Vie)* 47: 411–432.

Edelstam, C., Broberg, L., Engström, B., Jenning, W. & Lundberg, S. 1963. Den svenska fågelstationen på Capri och dess verksamhet 1956–61 (Capri Bird Observatory and its activities 1956–61). *Vår Fågelvärld* 22: 225–270.

Erard, C. 1966. Sur les mouvements migratoires du Rougegorge *Erithacus rubecula* a l´aide des donnees du fichier de baguage Francais. *L´Oiseau et R.F.O.* 36: 4–51.

Finlayson, C. 1992. *Birds of the Strait of Gibraltar*. T. & A.D. Poyser, London.

Hasselquist, D. & Pettersson, J. 1985. Fat deposition and migration capacity of Robins *Erithacus rubecula* and Goldcrests *Regulus regulus* at Ottenby, Sweden. *Ringing & Migration* 6: 66–76.

Herrera, C.M. 1984. A study of avian frugivores, bird dispersal plants, and their interaction in Mediterranean scrublands. *Ecological Monographs* 54(1): 1–23.

Licheri, D. & Spina, F. 2002. Biodiversità dell`avifauna italiana: variabilità morfologica nei Passeriformi (parte II: *Alaudidae-Sylviidae*). *Biol. Cons. Fauna* 112: 1–208.

Lövei, G.L., Scebba, S. & Milone, M. 1985. Migration and wintering of the Blackcap *Sylvia atricapilla* on a Mediterranean island. *Ringing & Migration* 6: 39–44.

Lövei, G.L., Scebba, S., Minichiello, F. & Milone, M. 1986. Seasonal activity, wing-shape, weights and fat reserve variations of Robins (*Erithacus rubecula*) in southern Italy. *Proc. First Conf. on Birds Wintering in the Mediterranean Region. Suppl. alle Richerche di Biologia della Selvaggina* 10: 229–241.

Messineo, A., Grattarola, A. & Spina, F. 2001. Dieci anni di Progetto Piccole Isole (Ten years of Mediterranean Islands Project). *Biologia e Conservazione della Fauna* 106: 1–240.

Pettersson, J. 1986. Weight and fat levels in Robins (*Erithacus rubecula*) wintering in northern Greece. *Proc. First Conf. on Birds Wintering in the Mediterranean Region. Suppl. alle Richerche di Biologia della Selvaggina* 10: 265–274.

Pettersson, J., Hjort, C., Lindström, Å. & Hedenström, A. 1990a. Övervintrande rödhakar *Erithacus rubecula* kring Medelhavet och flyttande rödhakar vid Ottenby – en morfologisk jämförelse och analys av sträckbilden (Wintering Robins *Erithacus rubecula* in the Mediterranean region and migrating Robins at Ottenby – a morphological comparison and an analysis of the migration pattern). *Vår Fågelvärld* 49: 267–278.

Pettersson, J., Hjort, C., Gezelius, L. & Johansson, J. 1990b. *Spring Migration of Birds on Capri – an overview of the activities 1956–1990*. Special Report from Ottenby Bird Observatory, Sweden: 1–114.

Scebba, S. 1993. *Gli Uccelli della Campania*. Edizioni Esselibri Litografia Nicola Libero, Napoli.

Spina, F., Cardinale, M. & Macchio, S. 2001. Biodiversità dell`avifauna italiana: variabilità morfologica nei Passeriformi (parte I). *Biologia e Conservazione della Fauna* 107: 1–80.

Spina, F. & Licheri, D. 2003. Biodiversità dell`avifauna italiana: variabilità morfologica nei Passeriformi (parte III: *Muscicapidae-Emberizidae*). *Biologia e Conserva-*

zione della Fauna 113: 1–180.
Spina, F., Piacentini, D. & Montemaggiori, A. 2006. Bird migration across the Mediterranean: ringing activities on Capri within the Progetto Piccole Isole. *Ornis Svecica* 16: 20–26.
Svensson, L. 1992. *Identification Guide to European Passerines*. Fourth Edition, Stockholm.
Waldenström, J., Hjort, C. & Andersson, A. 2006. Autumn migration of some passerines on the island of Capri, southwest Italy. *Ornis Svecica* 16: 42–54.

Sammanfattning

Capri är inte enbart en rastplats för flyttfåglar, utan tjänar även som vinterkvarter för åtskilliga arter. För att komplettera den befintliga kunskapen om vår- och höststräcken där med vinterdata genomfördes ringmärkning i februari – början på mars 2002–2004 och i november–december 2004. Totalt märktes under dessa kampanjer blygsamma 247 fåglar av 17 arter, varav 70% var antingen rödhakar, svarthättor, sammetshättor eller gransångare. De flesta fåglar som hanterades var sannnolikt etablerade övervintrare, men tidsmässiga variationer i antalet fångade fåglar och en del fåglar med för övervintring omotiverat hög vikt och fettstatus indikerade att ännu i november–december var en del på väg mot vinterkvarter längre söderut – liksom att vissa, särskilt gransångare, redan i februari rörde sig norrut igen.

Vad gäller rödhaken, en fågel som övervintrar inom ett vidsträckt geografiskt område (från Östersjön till Nordafrika) och i många olika biotoper, verkar det som om övervintrarna på Capri generellt sett har lägre vintervikter än dem på italienska fastlandet. Detta skulle kunna bero på det havsomslutna Capris avsevärt mildare vintrar, med mindre risk för kalluftsinbrott än inne på fastlandet och följaktligen mindre anledning att genom reservbränsle (fett = högre vikt) försäkra sig mot sådana perioder med kyla och nedsatt födotillgång?

ORNIS SVECICA 16: 69–73, 2006

Is there seasonal variation in size and mass of Red Admirals Vanessa atalanta on Capri, Italy?

Finns det någon säsongsberoende variation i storlek och vikt hos amiraler Vanessa atalanta på Capri, Italien?

OSKAR BRATTSTRÖM

Abstract

I present data on seasonal variation in wing length and mass of Red Admirals Vanessa atalanta captured on Capri, Italy, during spring and autumn. The Red Admiral is a migratory butterfly that migrates north throughout Europe each year and then heads back south in the autumn. During the winter they are mostly found in the northern Mediterranean area where they previously were thought to hibernate, but recent data suggest that a new generation is produced before spring migration. The Red Admirals captured on Capri showed no difference in dry mass between the two seasons, when taking size in account, but had significantly longer wings in autumn. This suggests that a new generation is produced during winter.

Oskar Brattström, Department of Animal Ecology, Lund University, Sweden

Received 30 July 2005, Accepted 23 January 2006, Editor: J. Lind

Introduction

The Red Admiral *Vanessa atalanta* is one of the most regular long distance migrants among the European butterflies (Pollard & Yates 1993). It shows a clear bi-directional migration, heading north from the Mediterranean area in spring (Benvenuti et al. 1996) before reproducing (Henriksen & Kreutzer 1982). In late summer it returns south, as reported from field studies made at different locations in northern Europe (Williams 1951, Hansen 2001, Mikkola 2003). The numbers found in the northern parts of Europe are fluctuating, with smaller populations in cold summers, but the Red Admiral is much more regular there than most other migrating butterflies, for example the closely related Painted Lady *Vanessa cardui*. In England, where small numbers of Red Admirals regularly hibernate, the numbers found in early spring before the first true migrants arrive are not correlated with numbers found in the following autumn, suggesting that the population is completely dependent on immigration in the northern parts of Europe (Pollard & Greatorex-Davies 1998). It was initially believed that European Red Admirals migrated short distances and hibernated during winter, and that the same individuals returned north again in spring to produce the next generation (Roer 1961). This was later questioned, as Red Admirals were found to be poorly adapted to hibernation (Lempke 1971). Recently, Stefanescu (2001) found that in north-eastern Spain, reproduction occurred during the winter, and he suggested that the Mediteranean area as a whole is a breeding area rather than a wintering area for the adults of migrant populations of the Red Admiral.

Most studies on butterfly migration have been made on American Monarchs *Danaus plexippus*, that migrate across North America each year (Brower 1996). The majority of the monarch population spends the winter in Mexico, hibernating without additional feeding. To survive the winter, they need to build up large lipid stores before they reach the hibernation areas and the difference in lipid content can therefore vary dramatically during the year. Some individuals have lipid stores as large as 134% of their lean mass, compared to newly hatched individuals which have a lipid store of about 30%, which still is more than butterflies in general (Beall 1948). Not much is known about lipid accumulation in other species of migrating butterflies. The monarch studies show that large variations are likely to occur based on the current need of the butterfly. From these studies we also know that mass is often closely correlated with lipid content if size is controlled for (Brown

& Chippendale 1974). Also in studies where size was not controlled for, lean mass was fairly constant, compared to lipid content which showed much larger differences (Beall 1948). Therefore, mass looks promising as a quick and easy way for measurements of lipid stores in butterflies.

In this paper, I will present some data on size and dry mass differences in Red Admirals caught during spring and autumn on Capri, Italy. Since Capri is located well inside the winter range of the species, seasonal differences between individuals found here might tell us more about the winter ecology in this species.

Materials and methods

Red Admirals were captured on Capri 1–10 October 2004 and 9–20 May 2005. The butterflies were primarily caught to be used in orientation experiments; therefore measurements of hindwing length and dry mass were taken after these experiments, to avoid adverse effects on the orientation results from the handling. Prior to the orientation experiments, usually three days, all the butterflies had constant access to fructose solution which they fed on during the time in captivity. Immediately after the experiments the butterflies were killed with ethyl acetate. The length of the hindwing was recorded to the nearest 0.5mm with a digital calliper (DCA-150, Velleman components) and the head was removed for use in DNA studies. Only individuals with unabraded hindwings were included in the analysis. The thorax and abdomen were placed in plastic test tubes with rubber sealed caps and put in a freezer. The abdomen of all the collected butterflies was dissected to determine sex by inspection of their genitalia. After dissection the butterflies were dried in 70°C for 24 hours and the dry mass of thorax and abdomen was measured separately on a balance (Mettler Toledo AG 245). Since butterflies feed on liquid food which contain high amounts of water their mass can increase much after feeding (Christer Wiklund & Fredrik Stjernholm, personal communication), therefore dry mass is a more reliable estimate of lipid content than wet mass.

Statistics

To get a linear fit between the length of the hindwing and dry mass the wing measurements were raised to the power of three. To analyse differences in dry masses of thorax and abdomen between seasons, Analysis of Covariance (ANCOVA) with length of hindwing3 as covariate was used. To investigate differences in the Red Admirals' length of hindwing between the two seasons I used Mann-Whitney U-Test, since the residuals were not normally distributed. All statistical calculations were performed with Statistical Program for Social Sciences (SPSS) 11.0 for Windows.

Results

A total of 42 Red Admirals were captured, 21 in spring and 21 in autumn. All of the individuals were males. There was a significant correlation between the cube of hindwing length and dry mass of abdomen, and no significant effect of season (Table 1a). The same relationship was found for thorax dry mass (Table 1b) but the variation (Fig 1b) was smaller than for abdomen dry mass (Fig 1a). From the plotted data (Fig 1a & b) it was clear that the autumn individuals have longer hindwings. This difference in mean hindwing length was highly significant (Mann-Whitney U test, $U = 65.5$, $N_1 = 21$, $N_2 = 21$, $p < 0.0001$). The mean hindwing length and standard deviation was 23.79 ± 1.04 mm for the spring individuals compared to 25.71 ± 1.31 mm for the autumn individuals.

Table 1. Results of the ANCOVA test on dry mass of abdomen and thorax from male Red Admirals caught during spring and autumn on Capri, Italy. The interaction between hindwing length and season was nonsignificant (p>0.05) in both cases and thus removed from the final calculations.
Resultat av ANCOVA-test avseende torrvikt för abdomen och thorax hos hanar av amiraler fångade under vår och höst på Capri, Italien. Interaktionen mellan bakvingens längd och säsongen var inte signifikant (p>0,05) i något av fallen och togs därför bort från den slutliga beräkningen.

Variable	S.S.	df	F	P
Abdomen				
Hindwing length^3	1393.3	1	12.61	0.001
Season	15.9	1	0.14	0.707
Error	4307.8	39		
Total	44327.1	41		
Thorax				
Hindwing length^3	2615.2	1	49.48	<0.001
Season	0.2	1	0.04	0.951
Error	2061.4	39		
Total	100509.2	41		

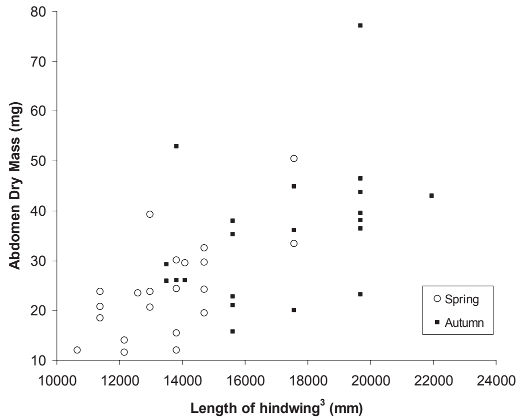
Discussion

There are at least three possible explanations to the difference in hindwing length found in spring and autumn: abrasion, differential mortality or the appearance of a different generation. First, only individuals with undamaged wings were included in the analysis, and therefore abrasion is a highly unlikely cause of the seasonal difference in hindwing length. Second, the difference in hindwing length could be caused by a higher mortality rate during winter for larger individuals. If this is the case the mean value of hindwing length would decrease but the range of lengths found would look similar between the two seasons. The hindwing length of many of the spring individuals was well below the smallest individuals found in autumn (Figure 1). Further, a study of monarchs showed that smaller individuals died in larger proportions during winter (AlonsoMejia et al. 1997). Third and last, the autumn migrants might produce a new generation during winter in areas near Capri, which is the most likely explanation for the difference found in hindwing length between the seasons. This is also supported by the fact that there was no difference in dry mass when size was taken in account. Studies on monarchs that hibernate without extra energy intake during the winter period show that they build up large lipid reserves before hibernation (Beall 1948, AlonsoMejia et al. 1997. To build up large lipid reserves would be maladaptive for a butterfly that is active during winter, since bird predators would catch them easier (Dudley et al. 2002).

Stefanescu (2001) found that Red Admirals start to lay eggs as soon as they arrive in north-eastern Spain in late autumn. The larvae develop throughout the winter, and a new generation of adults appears in early spring. Stefanescu noted that the Red Admirals had very worn wings in autumn, but in spring the wings of the observed individuals were fresh, also suggesting that a new generation had been produced. The result from my study on Capri, adding a new site with a spring generation, supports the suggestion by Stefanescu (2001) that migrant populations of the Red Admiral all over the Mediterranean area are not hibernating but instead breeding during the winter.

One large difference with my study compared to other studies of lipid accumulation is that the butterflies have been allowed to feed in captivity before their mass was recorded. The data might therefore not show natural variations of lipid content. But on the other hand if the butterflies have an optimum level of lipid reserves, results might have looked different using freshly caught individuals since they might not have gained the lipid reserves they were trying to accumulate.

All butterflies in my study were males. The explanation is probably that male Red Admirals are territorial and perform hilltopping behaviours (Brown & Alcock 1990). They often perch on



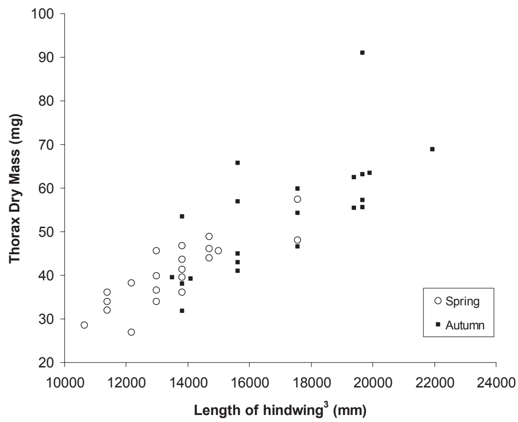


Figure 1. Relationship between hindwing length and dry mass of abdomen (a) and thorax (b) from male Red Admirals Vanessa atalanta caught during spring and autumn on Capri. To make all data points visible, a few of them have been slightly adjusted.
Förhållandet mellan bakvingens längd och torrvikten av abdomen (a) och thorax (b) hos hanar av amiral Vanessa atalanta fångade under vår och höst på Carpri. För att göra alla punkter synliga har ett fåtal flyttats något.

rocks, making them easy to spot in the field. In the future it would be most interesting to include females and analyse the relationship between dry mass and lipid content in detail.

Acknowledgements

I would like to thank Christian Hjort, Jan Pettersson and Rickard Ottvall who initiated the measurements of butterflies on Capri in 1997. Christer Wiklund and Fredrik Stjernholm provided valuable input on the analysis procedure. Anna Nilsson, Christian Hjort, Jonas Waldenström and Susanne Åkesson all gave comments on earlier versions of this manuscript. This study was partly financed by grants from the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (to Susanne Åkesson). This is report number 213 from Ottenby Bird Observatory.

References

AlonsoMejia, A., RendonSalinas, E., MontesinosPatino, E. & Brower, L.P. 1997. Use of lipid reserves by monarch butterflies overwintering in Mexico: Implications for conservation. *Ecological Applications* 7: 934–947.

Beall, G. 1948. The fat content of a butterfly, *Danaus plexippus* Linn., as affected by migration. *Ecology* 29:80–94.

Benvenuti, S., Dall´Antonia, P. & Ioalè, P. 1996. Directional Preferences in the Autumn Migration of the Red Admiral (*Vanessa atalanta*). *Ethology* 102: 177–186.

Brower, L. P. 1996. Monarch butterfly orientation: Missing pieces of a magnificent puzzle. *Journal of Experimental Biology* 199: 93–103.

Brown, J. J. & Chippendale, G. M. 1974. Migration of Monarch Butterfly, Danaus plexippus: Energy Sources. *Journal of Insect Physiology* 20: 1117–1130.

Brown, W. D. & Alcock, J. 1990. Hilltopping by the Red Admiral Butterfly: Mate Searching Alongside Congeners. *Journal of Research on the Lepidoptera* 29: 1–10.

Dudley, R., Srygley, R. B., Oliveira, E. G. & DeVries, P. J. 2002. Flight Speeds, Lipid Reserves, and Predation of the Migratory Neotropical Moth *Urania fulgens* (Uraniidae). *Biotropica* 34: 452–458.

Hansen, M. D. D. 2001. Observations on migrating red admirals (Vanessa atalanta L.) in Denmark 1995–2000. *Flora og Fauna* 107: 1–5.

Henriksen, H. J. & Kreutzer, I. 1982. *The Butterflies of Scandinavia in Nature*. Skandinavisk Bogforlag A/S, Odense.

Lempke, B. J. 1971. Problems around *Vanessa atalanta* Linnaeus. *Entomologist's Record and Journal of Variation* 83: 199–204.

Mikkola, K. 2003. Red Admirals *Vanessa atalanta* (Lepidoptera: Nymphalidae) select northern winds on southward migration. *Entomologica Fennica* 14: 15–24.

Pollard, E. & Greatorex-Davies, J. N. 1998. Increased abundance of the red admiral butterfly *Vanessa atalanta* in Britain: the roles of immigration, overwintering and breeding within the country. *Ecology Letters* 1: 77–81.

Pollard, E. & Yates, T. J. 1993. *Monitoring butterflies for ecology and conservation*. Chapman & Hall, London.

Roer, H. 1961. Zur Kenntnis der Populationsdynamik und des Migrationsverhaltens von *Vanessa atalanata* L. im paläarktischen Raum. *Beiträge zur Entomologie* 11: 594–613.

Stefanescu, C. 2001. The nature of migration in the red admiral butterfly *Vanessa atalanta*: evidence from the population ecology in its southern range. *Ecological Entomology* 26: 525–536.

Williams, C. B. 1951. Seasonal Changes in Flight Direction of Migrant Butterflies in the British Isles. *Journal of Animal Ecology* 20: 180–190.

Sammanfattning

Många dagfjärilar flyttar i likhet med fåglar långa sträckor varje år. Hur fåglar lagrar upp fett inför flyttningen är välstuderat men hos fjärilar är det endast den amerikanska monarken *Danaus plexippus* som är relativt välstuderad. Monarker övervintrar i Mexico och flyttar norrut på våren genom större delen av Nordamerika för att senare återvända på hösten. Under den årliga flyttcykeln varierar mängden fett, precis som hos fåglar, kraftigt beroende på behovet av lagrad energi. I Europa flyttar flera fjärilar långa sträckor men det finns knappast några studier av årliga variationer i fettupplagring. Amiralen *Vanessa atalanta* klarar inte av vinterklimatet i norra Europa utan spenderar huvudsakligen vintern i norra Medelhavsområdet. Under våren sprider de sig norrut genom hela Europa och återvänder sedan söderut på hösten och de individer som observeras på Capri övervintrar troligen i närområdet. I samband med en orienteringsstudie av Amiraler togs vingmått på individer från både höst (1–10 oktober 2004) och vår (9–20 maj 2005), mellankroppen och bakkroppen sparades för kontroll av kön och torrvikt. Endast individer med oskadade vingar togs med i analysen. Studier gjorda på Monarker har visat att större delen av variation i vikt hos individer av samma storlek beror på skillnad i lagrat fett varför vikt kan fungera som ett fettmått. Fjärilarna i den här studien hade haft fri tillgång till fruktoslösning under tiden i fångenskap (runt 3 dagar) så vikten representerar inte exakt vad en ren fältstudie hade producerat utan snarare den mäng fett som fjärilarna strävar efter att uppnå. Totalt samlades 42 amiraler in, 21 på våren och 21 på hösten och alla visade sig vara hanar. Resultaten visade att amiralerna hade längre bakvingar på hösten men det fanns inte någon skillnad i torr vikt i förhållande till storlek (Figur 1). Störst variation fanns hos

bakkroppsvikten (Figur 1 b). Det finns tre möjliga förklaringar till skillnaden i vinglängd: slitage, högre vinterdödlighet för stora individer eller att individerna som fångas på våren tillhör en ny generation. Slitage är inte någon trolig förklaring eftersom endast individer med oskadade bakvingar är medtagna i analysen. Att större individer skulle ha högre dödlighet är inte heller troligt eftersom en stor del av de individer som fångats på våren är mindre än de minsta höstindividerna. Den troligaste förklaringen är att amiralerna förökar sig under vintern och att vårindividerna kommer från en helt ny generation. Detta stöds även av att det inte fanns några säsongsberoende skillnader i vikt. Om amiralerna är aktiva under vintersäsongen behöver de inte lagra upp fett, en stor fettdepå skulle göra dem långsammare och därmed ett lättare byte för predatorer. Slutsatsen är alltså att amiralerna i områdena runt Capri är aktiva och förökar sig under vintern. Individer från den nya generationen som flyttar norrut nästa vår är mindre än de som anlände norrifrån på hösten.

ORNIS SVECICA 16: 74–83, 2006

Fuelling in front of the Sahara desert in autumn – an overview of Swedish field studies of migratory birds in the eastern Mediterranean

Fettupplagring inför höstpassagen av Sahara – en översikt av svenskt fältarbete i östra Medelhavet

THORD FRANSSON, SVEN JAKOBSSON, CECILIA KULLBERG, ROGER MELLROTH & THOMAS PETTERSSON

Abstract

Birds must store fuel prior to the crossing of the Sahara desert, at least 1500 km with few refuelling possibilities. A major question is how inexperienced birds know where to prepare for the oncoming barrier. Experiments with caged birds showed that information from the Earth's magnetic field close to the desert might trigger extensive fuel deposition. Blackcaps *Sylvia atricapilla* trapped on Cyprus in September and October were much heavier than in Sweden during the early phase of autumn migration, typical for birds preparing for crossing the Sahara desert. There is a potential cost of being fat. Fat Sedge Warblers *Acrocephalus schoenobaenus* on Lesvos had much poorer take off abilities than lean birds, making them more vulnerable to predators. Swallows *Hirundo rustica* trapped at a roost site on Rhodes showed a synchronized body mass increase and this is in agreement with their wavelike pattern of passage on Crete. In recent years, studies of fuelling behaviour and stopover duration of first-year Garden Warblers *Sylvia borin* have been started on Crete with the aid of radio-transmitters.

Thord Fransson, Bird Ringing Centre, Swedish Museum of Natural History, Box 50 007, SE-104 05 Stockholm, Sweden. E-mail: thord.fransson@nrm.se
Sven Jakobsson and Cecilia Kullberg, Department of Zoology, Stockholm University, SE-106 91 Stockholm, Sweden.
Roger Mellroth, Eldarvägen 8, SE-117 66 Stockholm, Sweden.
Thomas Pettersson, Härnevigatan 3A, SE-723 41 Västerås, Sweden.

Received 29 September 2005, Accepted 29 January 2006, Editor: Åke Lindström

Introduction

Most of the long-distance migrants breeding in Sweden winter in Africa and about 35 passerine species have their main wintering areas in tropical Africa. Many follow the western flyway and enter Africa after passing the Iberian peninsula, like the Redstart *Phoenicuris phoenicurus* and the Reed Warbler *Acrocephalus scirpaceus* (Fransson et al. 2002, Fransson & Stolt 2005). Only a few long-distance migrants leave Sweden in a southern direction and one of these is the Spotted Flycatcher *Muscicapa striata* (Fransson 1986). Some other species follow the eastern flyway and pass the eastern Mediterranean, like the Thrush Nightingale *Luscinia luscinia* and the Blackcap *Sylvia atricapilla* (Fransson et al. 2005). Large numbers of soaring birds on migration to Africa avoid crossing the eastern Mediterranean Sea and concentrate in the Middle East (cf. Alerstam 1990). Many night migrating passerine birds, however, seem to cross the eastern Mediterranean Sea and this was shown already in the 1960s by radar studies carried out from an aircraft carrier (Casement 1966). In a recent study of migratory directions in SE Romania, Bulgaria and NE Greece, based on the moon-watching technique, the majority of the observed nocturnal autumn flights were directed S–SSW, which means that many birds are heading towards the Libyan desert (Zehtindjiev & Liechti 2003).

When migratory birds pass benign areas with widespread fuelling opportunities, they deposit rather small fuel loads (20–25% of lean mass). The reason for these relatively small fuel loads is probably that the advantage of larger fuel load has to be balanced against costs connected with an increased body mass, such as enlarged flight costs as well as impaired predator evasion (Alerstam & Lindström 1990). Many long-distance migratory birds have to face the challenge of passing the Sahara desert. The desert is a major obstacle for birds that migrate to tropical Africa and distances of at least 1500 km (Figure 1) with hardly any refuelling possibilities have to be passed (Moreau 1961). In spite of this, huge numbers of songbirds regularly pass the desert in autumn and c. 5 billions have been estimated to be involved (Moreau 1972). It is well known that birds close to barriers often are found with very large fuel loads. The migration across the desert has been subject to detailed investigations (cf. Bairlein 1985, Bairlein 1987, Biebach et al. 1986) and it is now believed that two main strategies exist (Biebach et al. 2000). The birds either fly non-stop over the desert or interrupt their flight and rest during the day. They can probably shift between these two strategies depending on local weather conditions (Klaassen & Biebach 2000).

Figure 1. The extension of the Sahara desert and the desert on the Arabian Peninsula (grey).
Ökenutbredningen i norra Afrika och på den arabiska halvön (grå färg).

How do they know when to start fuelling?

A major question is how inexperienced birds can know where to prepare for the oncoming barrier. It has been assumed that both timing and amount of fuelling are governed by the circannual rhythm, which is fine-tuned by photoperiod (Berthold 1996; Gwinner 1996). However, variation in the time of breeding affects the timing of the onset of migration, and unpredictable weather and feeding conditions affect timing en route. Hence, a bird cannot safely deduce its latitudinal position from calendar date. In recent studies carried out at Tovetorp Zoological Research Station in Södermanland, Sweden, we have found that birds might use geomagnetic information to decide where to accumulate the extensive fuel loads necessary for successful trans-Saharan flights. Thrush Nightingales caught in Sweden during their first migration and exposed to magnetic fields simulating a migratory flight with a stopover in northern Egypt extended their fuelling period compared with control birds experiencing the ambient magnetic field in southeast Sweden (Fransson et al. 2001, Kullberg et al. 2003). It has been shown that the magnetic field can affect directional changes in migratory birds as well as in sea turtles, newts and spiny lobsters (Beck & Wiltschko 1988, Wiltschko & Wiltschko 1992, Lohmann et al. 2001, Fisher et al. 2001, Boles & Lohmann 2003). Our findings show that a change in the magnetic field also can trigger processes such as extensive fuel deposition. A non-random distribution of ringing recoveries in some species in the eastern Mediterranean area during autumn migration indicates that species-specific stopover areas occur in front of the desert (Fransson et al. 2005) and this finding supports that migrants also must use some external cues to find these places.

In order to investigate the fuelling behaviour close to the desert in more detail, field studies have been carried out in the eastern Mediterranean in collaboration with Greek ornithologists. Different areas have been visited over the years. This article presents an overview of these visits as well as some examples of results that have been achieved so far.

Fieldwork

The first study was carried out in the western part of Greece during two weeks in September 1988. The year after, in 1989, two weeks (24 September – 7 October) of ringing was carried out in the Akrotiri peninsula on southern Cyprus. In 1997, the island of Lesvos in the Aegean Sea was visited during a three weeks period (28 September – 19 October). During the period 26 September – 10 October 2000, ringing was carried out on Rhodes in the Dodecanese. From 2001 until 2004 fieldwork and ringing was carried out on Crete (9–23 September 2001, 8 September – 6 October 2002, 28 August – 11 September 2003, and 2–30 September 2004). The ringing on Cyprus was carried out with permission from the Cyprus Ornithological Society and in Greece with permission from the Ministry of Agriculture and in collaboration with the Hellenic Bird Ringing Centre. During these periods of fieldwork, a total of 4933 birds were ringed. The locations of the different places are shown in Figure 2.

Results and discussion

Blackcaps and Willow Warblers on Cyprus

The ringing on Cyprus in 1989 took place south of the Akrotiri Salt Lake and close to a small water reservoir called the Bishops Pool. Recoveries show that many Blackcaps from Sweden pass this area in autumn and Blackcaps were indeed present in fairly large numbers. The Blackcaps on Cyprus carried much larger fuel loads than birds on autumn migration in Sweden do (Figure 3). A distribution of body mass data similar to the one found on Cyprus has also been found in northern Israel (Izhaki & Maitav 1998). The Blackcaps trapped on Cyprus and in northern Israel probably consist of a mixture of birds in different state of fuelling, but it is obvious that many of them were in preparation for crossing the Sahara desert, having as high fuel loads as 75% of lean body mass. Blackcaps are wintering on Cyprus, but otherwise only small numbers are found in the Middle East during winter (Cramp 1992) indicating that most of the birds found during migration in this area are heading for wintering areas in East Africa.

The most commonly trapped species was the Willow Warbler *Phylloscopus trochilus*, with 504 individuals ringed. A cold front with some rain showers in the beginning of October forced large numbers of migrants to interrupt migration and to rest in the trapping area. This was probably the reason for the unusually large proportion (38%) of adult Willow Warblers trapped. Most of the adult Willow Warblers were investigated for moult and about one third (34%) of them had unmoulted secondaries. This is the same proportion (34%) as found in Sweden (Hedenström et al. 1995) indicating that some of them had a Swedish origin. The proportion of birds with unmoulted secondaries was much higher in females (<68 mm wing length) than in males (>67 mm), being 46% and 18% respectively. This pattern has also been found in Sweden, where 44% of the females and 23% of the males showed suspended moult (Hedenström et al. 1995). This is a result of that breeding incurs a larger energy stress in females than in males, resulting in a later onset of moult. Compared with the Blackcaps, the average body mass in Willow Warblers on Cyprus was surprisingly low (mean: 9.2g, SD=0.96, range: 6.2–11.7g, n=425). This body mass is similar to that found in Willow Warblers in Sweden during the early phase of migration (Lindström et al. 1996). This indicates that Willow Warblers differ from Blackcaps in how or where they prepare for the desert crossing. It is possible that Willow Warblers, by effectively feeding on small flying insects, can fuel closer to the barrier crossing or even in the desert.

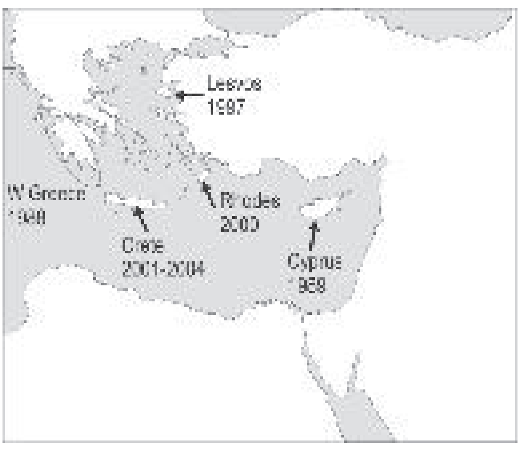


Figure 2. The eastern Mediterranean and places where the fieldwork referred to in this study was carried out during 1988–2004.
Östra Medelhavsområdet och de platser där fältarbetet som beskrivs i denna uppsats utförts under 1988–2004.

Sedge Warblers on Lesvos

In order to follow up a study carried out in Sweden about how an increased body mass affect escape performance in Blackcaps (Kullberg et al. 1996), we went to Lesvos in the autumn of 1997. The plan was to study take off flights in Blackcaps with a natural variation in body masses, also including extremely heavy birds. We used a mobile registration cage where birds could be video recorded during a simulated predator attack in close connection to the trapping. On the southeastern side of the island, at Charamida, we had the possibility to use an already established ringing site during our stay. By means of tape luring we trapped 701 Blackcaps in total during a three weeks period, but the proportion of heavy birds were much less than we expected and also different from the situation on Cyprus. We instead focused on Sedge Warblers where the proportion of heavy birds was very large. We found that an increasing fuel load from 0% to 60% reduced flight velocity by 26% (Kull-

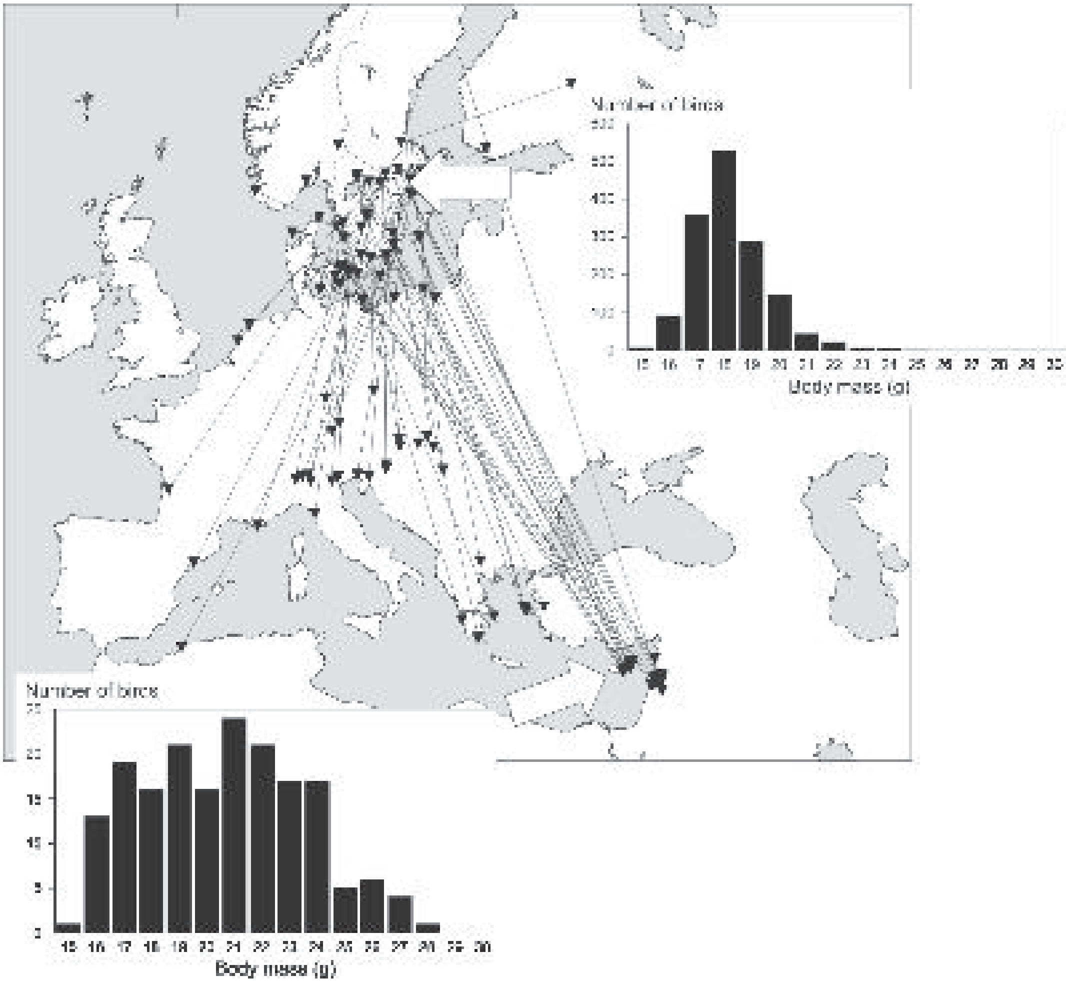


Figure 3. Recoveries during autumn migration of Blackcaps *Sylvia atricapilla* ringed in Sweden, and the distribution of Blackcap body mass data during autumn migration at Tovetorp, Sweden during the years 1994–1997 (mean: 18.7 g, SD 1.32, n = 1591) and at Akrotiri, Cyprus in 1989 (mean: 21.0 g, SD 2.89, n = 181).
Återfynd under höstflyttningen av svarthättor ringmärkta i Sverige och viktfördelning hos fåglar ringmärkta vid Tovetorps forskningsstation i Södermanland 1994–1997 (medel: 18,7 g, SD 1,32, n =1591) samt vid Akrotiri på Cypern 1989 (medel: 21,0 g, SD 2,89, n = 181).

berg et al. 2000). Interestingly, we were unable to demonstrate an effect of fuel load on angle of take off in Sedge Warblers, whereas angle of take off in heavy Blackcaps studied in Sweden was affected to a larger extent than flight speed (Kullberg et al. 1996).

Extremely large fuel loads in migratory birds certainly increase the risk of being taken by predators. In the Mediterranean, the Eleonora's Falcon *Falco eleonorae* breeds during the main passage time of migrants and judging from prey remains at a colony off Crete, Sedge Warblers are the most common prey species among the *Acrocephalus* warblers that migrate through the area (Ristow et al. 1986 in Handrinos and Akriotis 1997). Falcons probably take most of their daily catch of migrants in the early morning, at the end of the migrants' night flights. On 6 October 2000 we made an interesting observation close to the coastline on southeastern Rhodes. In the period of dusk, between 7.15 and 7.30 p.m. we observed about 25 passerines taking off from a small reed bed. We

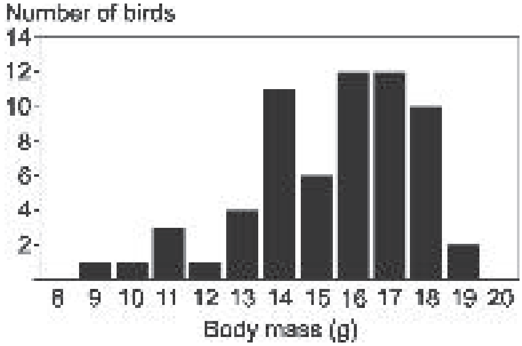


Fig. 4. Distribution of body mass data in Sedge Warblers *Acrocephalus schoenobaenus* ringed on Lesvos, Greece, in the autumn of 1997 (n = 63).
Viktfördelning hos sävsångare ringmärkta på Lesbos, Grekland, hösten 1997 (n = 63).

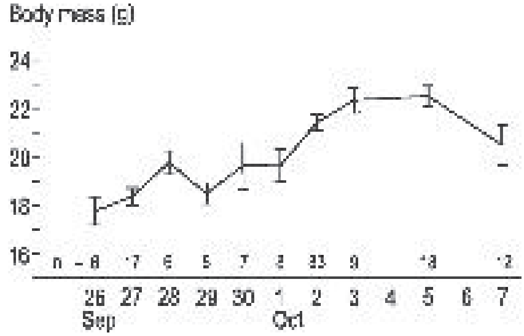


Fig. 6. Mean body mass (± SE) in Swallows *Hirundo rustica* trapped close to dusk at a roost site at Lardos on Rhodes, 26 September – 7 October 2000.
Genomsnittlig vikt (± SE) hos ladusvalor fångade i skymningen vid en övernattningsplats nära Lardos på Rhodos, 26 september – 7 oktober 2000.

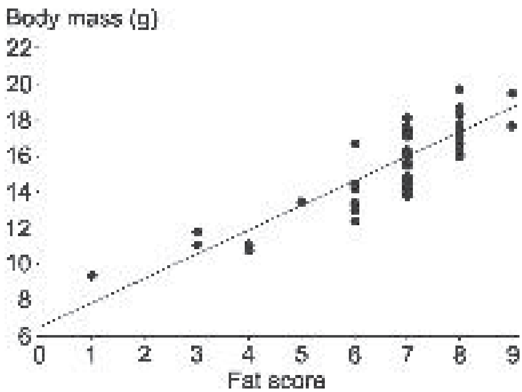


Fig. 5. The relationship between visual fat score and body mass in Sedge Warblers *Acrocephalus schoenobaenus* ringed on Lesvos, Greece, in the autumn of 1997. Fat scores were estimated following a scale modified from that of Pettersson and Hasselquist (1985), which ranges from zero (no visible fat) to six (whole belly covered with fat). Because many of the birds also had stored fat covering their breast muscles, the scale was extended to include three more stages. A bird with a fat score of nine had the whole abdomen including belly and breast muscles covered with fat.
Sambandet mellan fettklassificering och vikt hos sävsångare ringmärkta på Lesbos, Grekland, hösten 1997. Fettklassificeringen har följt Pettersson and Hasselquist (1985), och sträcker sig från noll (inget synligt fett) till sex (hela buken täckt av fett). Eftersom många fåglar också hade lagrat fett över bröstmuskeln, utsträcktes skalan till att också inkludera ytterligare tre steg. En fågel med fettklass nio har hela undersidan, inklusive buk och bröst, täckta av fett.

had the lighter part of the sky in the background and could follow the birds for a short while. Suddenly, an Eleonora's Falcon appeared and we saw the falcon attacking several of the birds even though it was more or less dark. At one occasion the falcon hit one bird without catching it, and it was falling against the ground as if it was seriously injured. This shows that there might be a risk, not only when birds arrive to this area, but also when they depart.

Collecting morphometric measures such as wing length, body mass and fat score from migratory birds in connection with ringing can give important information about migratory strategies. The body mass of Sedge Warblers *Acrocephalus schoenobaenus* on Lesvos varied between 9.4 and 19.7 gram (Figure 4) and the visual fat score showed a strong correlation with body mass (Figure 5). The mean body mass was 15.9 gram and the mean fat score was 6.9 in the 63 Sedge Warblers trapped. The highest body masses indicate that some birds carry a fuel load of about 100% (compared with the lean body mass). Sedge Warblers breeding in Great Britain are known to fuel already in southern England and northern France, well before they reach the Sahara desert (Bibby & Green 1981) and our results from Lesvos indicate that Sedge Warblers might prepare well in advance of the barrier crossing also in this area.

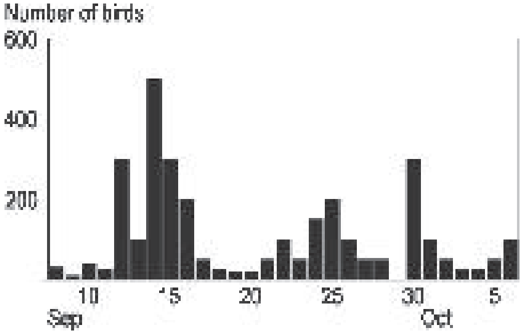


Fig. 7. Estimated daily numbers of Swallows *Hirundo rustica* at Partira Lake on central Crete, 8 September – 6 October 2002 (because of rain no observations were made 29 September).
Antalet ladusvalor observerade under olika dagar vid Partira, centrala Kreta, under perioden 8 september – 6 oktober 2002 (regn den 29 september innebar att inga observationer utfördes).

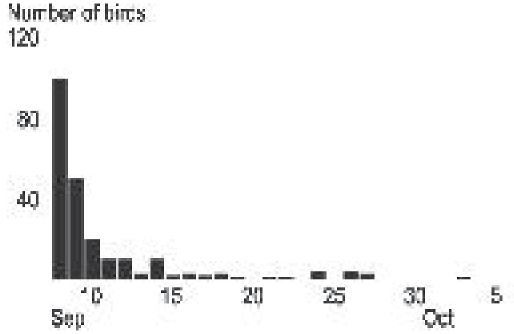


Fig. 8. Estimated daily numbers of Turtle Doves *Streptopelia turtur* in the area of Partira Lake on central Crete, 8 September – 6 October 2002.
Antalet observerade turturduvor olika dagar vid Partira, centrala Kreta, under perioden 8 september – 6 oktober 2002.

Swallows on Crete and Rhodes

It has recently been shown that the distance to be covered across the Sahara desert, following the two main western European flyways, affects the size of the pre-migratory fuel stores in Swallows *Hirundo rustica* in Iberia and Italy (Rubolini et al. 2002). Swallows are common during migration in most of the Mediterranean area and it is obvious that they put on high fuel loads in the same way as other long-distance passerine migrants. Outside the breeding season, Swallows regularly congregate at communal roosts, which often are situated in reed beds. During the visit to Rhodes in the autumn of 2000, we found a roosting site in the vicinity of the hotel area at Lardos on the eastern side of the island. We tape-lured Swallows close to dusk during ten days. The mean body mass varied between different evenings (Figure 6). The mean body mass increased for example by 3.8 grams from 29 September until 3 October, representing an average daily increase of about one gram. After 5 October, the mean body mass decreased, possibly because many heavy birds had continued migration. Our results indicate that large groups of Swallows at this point are synchronised in their fuel deposition. In agreement with this, the estimated daily numbers of Swallows observed at Partira Lake, central Crete, during a four weeks field study suggest that Swallows on Crete have a wavelike pattern of passage (Figure 7).

Temporal patterns and stopover behaviour

In Greece, as well as in most of the Mediterranean area, the summers are normally very dry and the first rain arrives in September or later (Handrinos & Akriotis 1997). Of the species that breed in the Mediterranean area and winter south of the Sahara desert, most leave very early, in July–August, e.g. Olivaceous Warbler *Hippolais pallida* and Subalpine Warbler *Sylvia cantillans* (Handrinos & Akriotis 1997). The area south of the desert receives rain during the northern summer (cf. Moreau 1972) and birds might take advantage of this by an early arrival. Accordingly, few birds of these species were observed during our fieldwork. The Turtle Dove is a relatively common passage migrant in Greece and the number of birds observed at Partira Lake on Crete in 2002 clearly shows that the majority of these birds have left this area after the beginning of September (Figure 8).

In 2001, fieldwork was started on the mainland of Crete and the focus of this work has been to find out where first-year Garden Warblers fuel in relation to the oncoming barrier crossing. All Garden Warblers are heading for wintering areas in sub-Saharan Africa and they are therefore more suitable to study than Blackcaps. The wintering habit of Blackcaps is complicated, with birds staying both in the Mediterranean area and in eastern Africa. For comparison, data has also been collected by Dr T. Akriotis and colleagues from Garden Warblers on Lesvos, which is about one night of migration (400 km) to the north (Figure 2). Tape-lures have been used to attract and trap Garden Warblers in order to collect morphometric measurements. A total of 557 Garden Warblers have so far been trapped on Crete and the peak of first-year birds migration on the island is in the second week of September. The body mass varies drastically (13.3–32.8 g) indicating that birds in very different states of preparation are found on the island. The passage of adult birds is clearly earlier than the passage of first-year birds, which has also been shown for the autumn departure in Sweden (Fransson 1995). It is obvious that it takes some time to build up a large fuel load and it is interesting that an adult bird, weighing as much as 29.5 g, was trapped as early as on 30 August 2003. The first Garden Warblers are also found south of the desert around the beginning of September (Ottosson et al. 2005). To get more detailed information about the stopover behaviour in these Garden Warblers, a study using small radio transmitters (<0.5 g) has recently been initiated.

Seasonal frugivory is common in many migrants and the fact that fruits have a high content of fatty acids facilitate fuelling (Bairlein 2002). Garden Warblers are known to often eat figs *Ficus carica* during migration (Thomas 1979, Handrinos & Akriotis 1997) and it has become very clear during our fieldwork and from the birds attached with radio transmitters that they are strongly attracted to fig trees during autumn stopover periods on Crete. In 2004, when at some occasions we put mist nets around single fig trees it happened that, without using tape lure, we trapped more than ten Garden Warblers during a morning. Handrinos & Akriotis (1997) pointed out that the peak of Garden Warbler migration pass Greece after the end of the main fig season, but on Crete figs regularly seem to be available until the end of September.

Future research

Several studies have been conducted in the desert of Egypt, Algeria and Mauritania, but few detailed studies have so far been carried out close to the desert, where many birds prepare for the extensive passage (but see Bairlein 1987, Ottosson et al. 2002, Ottosson et al. 2005). Such studies will be of great importance in order to improve our understanding about how migratory birds, including many Swedish breeding birds, prepare for crossing large inhospitable areas, like the Sahara desert. The plan is to continue and intensify these studies in collaboration with Greek colleagues and maybe also include field studies at the coast in North Africa, about one night of migration further south. The effort to ring birds during migration in Greece and Turkey has increased during the last decades. In Greece, regular ringing has been carried out on Lesvos, Antikythira in The Sea of Crete and on Gavdos (T. Akriotis pers. comm.). Gavdos is the southernmost island in Europe and situated south of Crete. In Turkey a new national ringing scheme started in 2002 and ringing of migrants is now carried out at six sites (Ö. Kesapli Didrickson, pers. comm.). These activities are very important and will definitely increase our knowledge about both the temporal and the geographical patterns of bird migration in this area.

Acknowledgements

These fieldworks would not have been possible to carry out without the devoted work of several persons. A special thank to Triantaphyllos Akriotis, Christos Barboutis, Michalis Dretakis, Paul Elfström, Milica Ivovic, Nikos Katsimanis and Tuomo Kolehmainen for assisting in the field. Triantaphyllos Akriotis, University of the Aegean, has been very helpful and arranged with ringing permits as well as rings for the work in Greece and a lot of practical assistance when we visited Lesvos in 1997. During the work on Crete, we received very important help and advice from Michalis Dretakis at the Natural History Museum of Crete. Thanks also to Christian Hjort and Åke Lindström for valuable comments on the manuscript. The fieldworks have been financially supported by Helge Ax:son Johnsons foundation, the Swedish Ornithological Society (Danielssons foundation) and the Friendship Association of the Swedish Museum of Natural History.

References

Alerstam, T. 1990. *Bird migration*. Cambridge University Press.

Alerstam, T. & Lindström, Å. 1990. Optimal bird migration: the relative importance of time, energy, and safety. Pp. 331–350 in *Bird migration: the physiology and ecophysiology* (Gwinner, E.,ed). Springer-Verlag, Berlin.

Bairlein, F. 1985. Body weight and fat deposition of palaearctic passerine migrants in the central Sahara. *Oecologia* 66: 141–146.

Bairlein, F. 1987. The migratory strategy of the Garden Warbler: a survey of field and laboratory data. *Ring. & Migr*. 8: 59–72.

Bairlein, F. 2002. How to get fat: nutritional mechanisms of seasonal fat accumulation in migratory songbirds. *Naturwissenschaften* 89: 1–10.

Beck, W. & Wiltschko, W. 1988 Magnetic Factors Control the Migratory Direction of Pied Flycatchers (*Ficedula hypoleuca* Pallas). Pp. 1955-1962 in *Acta XIX Congr. Intern. Ornithol*. (H. Ouellet, ed.), Vol. 2.

Berthold, P. 1996. *Control of Bird Migration*. Chapman & Hall, London.

Bibby, C. J. & Green, R. E. 1981. Autumn migration strategies of Reed and Sedge Warblers. *Ornis Scand*. 12: 1–12.

Biebach, H., Friedrich, W. & Heine, G. 1986. Interaction of bodymass, fat, foraging and stopover period in trans-sahara migrating passerine birds. *Oecologia* 69: 370–379.

Biebach, H., Biebach, I., Friedrich, W., Heine, G., Partecke, J. & Schmidl. 2000. Strategies of passerine migration across the Mediterranean Sea and the Sahara desert: a radar study. *Ibis* 142: 623–634.

Boles, L.C. & Lohmann, K.J. 2003. True navigation and magnetic maps in spiny lobsters. *Nature* 421: 60–63

Casement, M. B. 1966. Migration across the Mediterranean observed by radar. *Ibis* 108: 461–491.

Cramp, S. 1992. *The birds of the Western Palearctic*. Vol VI. Oxford University Press, Oxford.

Fischer, J. H., Freake, M. J., Borland, S. C. & Phillips, J. B. 2001 Evidence for the use of magnetic map information by an amphibian. *Anim. Behav*. 62: 1–10.

Fransson, T. 1986. Flyttning och övervintring hos nordiska grå flugsnappare *Muscicapa striata. Vår Fågelvärld* 45: 5–18.

Fransson, T. 1995. Timing and speed of migration in North and West European populations of *Sylvia* warblers. J. *Avian Biol*. 26: 39–48.

Fransson, T. Ekström, L., Kroon, C., Staav, R.,Sällström, B. & Sällström, U.B. 2002. *Report on Swedish Bird Ringing for 2000*. Naturhistoriska riksmuseet, Stockholm (171 pp).

Fransson, T., Jakobsson, S. & Kullberg, C. 2005. Non-random distribution of ring recoveries from trans-Saharan migrants indicates species-specific stopover areas. *J. Avian Biol*. 36: 6–11.

Fransson, T. & Stolt, B-O. 2005. Migration routes of North European Reed Warblers *Acrocephalus scirpaceus. Ornis Svecica*, 15: 153–160.

Fransson, T., Jakobsson, S., Johansson, P., Kullberg, C., Lind, J. & Vallin, A. 2001. Bird migration: magnetic cues trigger extensive refuelling. *Nature* 414: 35–36.

Gwinner, E. 1996. Circadian and circannual programmes in avian migration. *J. Exp. Biol*. 199: 39–48.

Handrinos, G. & T. Akriotis. 1997. *The birds of Greece*. Christopher Helm, London.

Hedenström, A. Lindström, Å. & Pettersson, J. 1995. Interrupted moult of adult Willow Warblers *Phylloscopus trochilus* during autumn migration through Sweden. *Ornis Svecica* 5: 69–74.

Izhaki, I. & Maitav, A. 1998. Blackcaps Sylvia atricapilla stopping over at the desert edge; physiological state and flight-range estimates. *Ibis* 140: 223–233.

Klaassen, M. & Biebach, H. 2000. Flight altitude of trans-Sahara migrants in autumn: a comparison of radar observations with predictions from meteorological conditions and water and energy balance models. J. *Avian Biol*. 31: 47–55.

Kullberg, C., Fransson, T. & Jakobsson, S. 1996. Impaired predator evasion in fat blackcaps (*Sylvia atricapilla*). *Proc. R. Soc. Lond. B*, 263: 1671–1675.

Kullberg, C., Jakobsson, S. & Fransson, T. 2000. High migratory fuel loads impair predator evasion in sedge warblers. *Auk* 117: 1034–1038.

Kullberg, C., Lind, J., Fransson, T., Jakobsson, S. & Vallin, A. 2003. Magnetic cues and time of season affect fuel deposition in migratory thrush nightingales *(Luscinia luscinia). Proc. R. Soc. Lond*. B, 270: 373–378.

Lindström, Å., Hedenström, A. & Pettersson, J. 1996. The autumn migration of Willow Warblers *Phylloscopus trochilus* in Sweden: results from a nation-wide co-operative project. Ornis Svecica 6: 145–172.

Lohmann, K. J., Cain, S. D., Dodge, S. A. & Lohmann, C. M. F. 2001. Regional magnetic field as navigational markers for sea turtles. *Science* 294: 364–366.

Moreau, R. E. 1961. Problems of Mediterranean-Saharan migration. *Ibis* 103: 373–427, 580–623.

Moreau, R. E. 1972. The Palearctic-African bird migration system. Academic Press, London and New York.

Ottosson, U., Bairlein, F. & Hjort, C. 2002. Migration patterns of Palaearctic *Acrocephalus* and *Sylvia* warblers in north-eastern Nigeria. *Vogelwarte* 41: 249–262.

Ottosson, U., Waldenström, J., Hjort, C. & McGregor, R. 2005. Garden Warbler *Sylvia borin* migration in sub-Saharan West Africa – phenology and body mass change. *Ibis* 147: 750–757.

Pettersson, J., Hasselquist, D. 1985. Fat deposition and migration capacity of Robins *Erithacus rubecula* and Goldcrest *Regulus regulus* at Ottenby, Sweden. *Ring. & Migr.* 6: 66–76.

Rubolini, D., Pastor, A. G., Pilastro, A. & Spina, F. 2002. Ecological barriers shaping fuel stores in barn swallows *Hirundo rustica* following the central and western Mediterranean flyways. J. *Avian Biol*. 33: 15–22.

Thomas, D. K. 1979. Figs as a food source of migrating Garden Warblers in southern Spain. *Bird Study* 26: 187–191.

Wiltschko, W. & Wiltschko, R. 1992 Migratory orientation: magnetic compass orientation of garden warblers (*Sylvia borin*) after simulated crossing of the magnetic equator. *Ethology* 91: 70–74.

Zehtindjiev, P. & Liechti, F. 2003. A quantitative estimate of the spatial and temporal distribution of nocturnal bird migration in south-eastern Europe – a coordinated moon-watching study. *Avian Science* 3: 37–45.

Sammanfattning

De flesta långdistansflyttande fågelarter som häckar i Sverige övervintrar i Afrika och ungefär 35 småfågelarter har sitt huvudsakliga övervintringsområde i tropiska Afrika. Flest arter flyttar mot sydväst genom Europa (t.ex. rörsångare och rödstjärt), några få flyttar söderut (t.ex. grå flugsnappare) och några flyttar mot sydost (t.ex. näktergal och svarthätta). För småfåglarna utgör Sahara en barriär på minst 1500 km som måste passeras och där möjligheterna att födosöka är begränsade (Figur 1). De flesta måste därför lagra upp en stor energireserv i förväg. Antalet småfåglar som varje höst passerar öknen är enormt stort och antalet har uppskattats till ungefär 5 miljarder. En huvudfråga är hur ungfåglar, som aldrig flyttat tidigare, kan veta var de ska fettupplagra inför ökenpassagen. Resultat från experiment utförda i Sverige antyder att information från jordens magnetfält kan vara en bidragande faktor som styr fåglarna att fettupplagra i rätt område. Omfattande studier har genomförts när det gäller själva ökenpassagen men få studier har utförts av fåglar som förbereder sig för passagen.

Sen en tid tillbaka har fältarbeten genomförts på flera platser i Grekland och på Cypern för att hitta en lämplig plats för detaljerade studier av hur flyttfåglar förbereder sig för passagen. Denna artikel ger en översikt över dessa besök och en del exempel på resultat som erhållits. Arbetet har främst koncentrerats till Grekland (Figur 2) där det utförts i samarbete med grekiska ornitologer. Sammanlagt har närmare 5000 fåglar ringmärkts. Akrotirihalvön på södra Cypern besöktes hösten 1989 och de svarthättor som då studerades visade sig vara betydligt tyngre än de svarthättor som lämnar Sverige tidigare på hösten (Figur 3). Detta överensstämmer väl med andra studier som visat att flyttfåglar nära passagen av öknen lägger upp stora energireserver. Ett större antal lövsångare fångades också under detta besök och något förvånande bar de inte på någon större energireserv, vilket kan antyda att de skiljer sig från svarthättorna när det gäller var eller hur de förbereder sig för passagen. Att öka i vikt kan innebära problem för en flyttfågel, inte minst när det gäller att undkomma en attack. För att studera hur en ökad vikt påverkar småfåglars flygförmåga besöktes Lesbos hösten 1997. Avsikten var att följa upp en tidigare studie av svarthättor utförd i Sverige. Svarthättorna på Lesbos visade sig vara betydligt lätttare än på Cypern, men däremot var de sävsångare som fångades mycket tunga (Figur 4 och 5). Med en mobil registreringsanläggning kunde vi videofilma fåglarnas uppflog i direkt anslutning till att de fångats och därmed fastställa hur fåglar med olika energireserv påverkades. För sävsångare visade vi att en ökning av energireserven från 0% till 60% minskade flyghastigheten med 26% men att de samtidigt bibehöll samma vinkel under uppfloget. Att bära på en extremt stor fettreserv påverkar naturligtvis möjligheten att undkomma en attack från en rovfågel. Eleonorafalken föder upp sina ungar under den period som flyttfåglarna passerar Medelhavet och stapelfödan utgörs av flyttfåglar. I Grekland har analyser av bytesrester visat att sävsångaren är ett vanligt byte. De flesta fåglarna som fångas är sannolikt fåglar som efter en natts flyttning fortfarande befinner sig ute över havet när det ljusnar på morgonen. Hösten 2000 gjorde vi en intressant observation nära kusten på södra Rhodos. I skymningen, mot den ljusa delen av himlen, såg vi ett 25-tal småfåglar lätta och påbörja sin nattflyttning. Trots att det var i det närmaste helt mörkt, dök plötsligt en eleonorafalk upp och attackerade flera av småfåglarna. Vid ett tillfälle träffade falken en fågel som livlös föll ner mot marken. Detta visar att det inte bara är riskabelt att anlända till detta område utan att det också finns en risk att bli tagen när flyttningen ska fortsätta.

Ladusvala är en vanlig flyttfågel i hela Medelhavsområdet. Nyligen har det visats att svalorna lägger upp olika stora energireserver i Spanien och Italien under hösten och att detta sannolikt beror på att den sträcka som de behöver flyga för att komma över öknen skiljer sig åt mellan dessa områden. Vid ett besök på Rhodos hösten 2000 fångades ladusvalor vid en övernattningsplats och den genomsnittliga vikten visade ett intressant mönster som antyder att många av fåglarna var synkroniserade i sin viktutveckling (Figur 6). Under fyra dagar ökade medelvikten med nästan 4 gram för att sedan snabbt minska, förmodligen som ett resultat av att många tunga fåglar flyttade iväg. Att flyttningen sker i vågor stöds av observationer från Kreta. Hösten 2002 bedrevs kontinuerlig verksamhet under fyra veckor vid Partira, en bevattningsdamm centralt på Kreta, och det dagliga antalet observerade ladusvalor uppvisade flera svängningar under denna period (Figur 7).

Somrarna i Grekland, liksom i en stor del av Medelhavsområdet, är normalt mycket torra och de första regnen dyker inte upp förrän i september eller senare. De fåglar som häckar i området och som flyttar till övervintringsområden söder om Sahara, t ex rödstrupig sångare och eksångare, flyttar bort redan i juli-augusti och har lämnat området när fåglar från nordliga områden passerar i september. I områdena söder om Sahara faller regn under sommaren och det kan därför vara fördelaktigt att så tidigt som möjligt anlända till dessa områden. Turturduva är en vanlig art under flyttning i Grekland och observationer på Kreta hösten 2002 visar att huvuddelen har lämnat området redan 10 september (Figur 8). Under de senaste åren har arbetet koncentrerats på att studera flyttningen hos unga trädgårdssångare på Kreta och försöka fastställa var de fettupplagrar i förhållande till passagen av Sahara. Eftersom alla trädgårdssångare är på väg mot övervintringsområden i tropiska Afrika är det en lämpligare art att studera än svarthätta, där en del övervintrar i Grekland och en del flyttar till Östafrika. Drygt 500 trädgårdssångare har ringmärkts på Kreta och den huvudsakliga passagen av ungfåglar sker i mitten av september, medan gamla fåglar passerar tidigare. Som jämförelse har grekiska kollegor samlat in biometriska uppgifter från trädgårdssångare på Lesbos som ligger ungefär en nattetapp (400 km) norrut. Vikten hos de fångade trädgårdssångarna på Kreta har varierat mellan 13,3 och 32,8 gram vilket antyder att fåglar i olika stadier av förberedelser förekommer på ön. Att lägga upp en stor fettreserv tar naturligtvis en viss tid och det är därför intressant att en gammal fågel som nästan dubblerat sin vikt och vägde 29,5 g fångats redan den 30 augusti. Att kunna fånga samma fågel vid flera tillfällen är av yttersta vikt när det gäller studier av rastningsbeteende och detta har bara varit möjligt i ett fåtal fall i samband med den vanliga ringmärkningen. För att få mer detaljerad information om hur trädgårdssångarna beter sig på Kreta (rastningens längd, rörelsemönster, viktökning och bortflyttningsvikt) har små radiosändare (<0,5 g) börjat användas med lyckat resultat. Många flyttfåglar äter frukt under höstflyttningen och under arbetets gång, inte minst genom sändarförsedda fåglar, har det blivit mycket tydligt att trädgårdssångarna på Kreta är starkt knutna till fikonträd.

Under de senaste tio åren har ringmärkning av flyttfåglar ökat i östra Medelhavet och förekommer nu på flera platser i Grekland. I Turkiet startades en nationell ringmärkningscentral 2002 och nu ringmärks flyttfåglar på sex platser i landet. Detta är mycket glädjande och kommer definitivt att öka kunskapen om den tidsmässiga och geografiska flyttningspassagen för många arter i detta område. Planerna är att detta projekt ska fortsätta under de närmaste åren i nära samarbete med ornitologer knutna till grekiska universitet. En förhoppning är också att kunna inkludera fältarbete nära kusten i Nordafrika, en nattetapp längre söderut.

Instruktioner till författarna

Instructions to authors

Allmänt gäller att bidrag skall vara avfattade enligt den modell som finns i tidigare häften av tidskriften. Titeln skall vara kort, beskrivande och innehålla ord som kan användas vid indexering och informationssökning. Uppsatser, men ej andra bidrag, skall inledas med en Abstract på engelska om högst 175 ord. Texten bör uppdelas med underrubriker på högst två nivåer. Huvudindelningen bör lämpligen vara inledning, metoder/studieområde, resultat, diskussion, tack och litteratur. Texten får vara på svenska eller engelska och uppsatsen skall avslutas med en fyllig sammanfattning på det andra språket. Tabell- och figurtexter skall förses med översättning till det andra språket. Tabeller, figurer och figurtexter skall finnas på separata blad. Det skall finnas minst 4 cm marginal och texten skall vara utskriven med dubbelt radavstånd. Manus skall insändas i tre kopior inklusive tabeller och figurer. *Såväl text som figurer skall om möjligt levereras på diskett* eller *som bilaga till epost.*

Andra bidrag än uppsatser bör ej överstiga 2 000 ord (eller motsvarande om det ingår tabeller och figurer). De skall inte ha någon inledande Abstract men däremot en kort sammanfattning på det andra språket.

Författarna erhåller korrektur som skall granskas omgående och återsändas. Författare erhåller en pdf-fil av sitt bidrag.

Referenser skall i texten anges med namn och årtal samt bokstäver (a, b etc) om det förekommer referenser till samma författare och år mer än en gång. För litteraturlistans utformning se nedan.

Contributions should be written in accordance with previous issues of the journal. The title should be short, informative and contain words useful in indexing and information retrieval. Full length papers, but not other contributions, should start with an Abstract in English not exceeding 170 words. The text should be divided by no more than two levels of subheadings. The following primary subheadings are recommended: Introduction, Methods/Study areas, Results, Discussion, Acknowledgements, and References. The text may be in English or Swedish and the paper should end with a comprehensive summary in the other language. Table and Figure legends should be in both languages. Tables and Figures must be on separate sheets of paper. Manuscripts should be submitted in three copies with 4 cm margin, printed with double line spacing. Text and figures should preferably be provided on a floppy disk.

Contributions other than full length papers should not exceed 2 000 words (correspondingly less if they contain Tables or Figures). There should be no Abstract but a brief summary in the other language.

Authors will receive proofs that must be corrected and returned promptly. Authors will receive a pdf-file of the paper.

References in the text should be given using name and year, and if there is more than one reference to the same author and year also letters (a, b, etc). How to write the reference list, see below.

Referenser *References*

I texten *In the text*: Andersson (1985), Bond (1913a, 1913b), Carlsson & Dennis (1956), Eriksson et al. (1989), (Andersson 1985), etc.

I referenslistan *In the reference list:*

Andersson, B. 1985. Populationsförändringar hos tranan Grus grus under 100 år. *Vår Fågelvärld* 50:211–221.

Bond, A. P. 1913a. A new theory on competitive exclusion. *Journal of Evolutionary Biology* 67:12–16. (Om tidskriftens namn förkortas används internationell standard. *If name of journal is abbreviated international standard must be used.) J. Evol. Biol.* 67:12–16.

Bond. A. P. 1913b. Breeding biology of the Pied Flycatcher. Pp. 123–156 in *Ecology and Adaptions in Birds* (French, J. ed). Whinchat Publishers, Nairobi.

Carlsson, T. & Dennis, W. A. 1956. *Blåmesens liv.* Tower Univ. Press. Trosa.

Eriksson, S., Janke, V. von & Falk, J. 1999. *Remarkable events in the avian world.* Ph. D. Thesis, Dept of Ecology, Univ. of Lund, Sweden.

POSTTIDNING
Sveriges Ornitologiska Förening
Ekhagsvägen 3
104 05 Stockholm

ORNIS SVECICA Vol 16, No 1–2, 2006

Innehåll – ***Contents***

Grahns Tryckeri AB, Lund 2006