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RESULTS AND PERSPECTIVE OF RADAR ORNITOLOGY IN THE USSR.

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For the first time in our country birds were detected by the radar in summer 1935. The beginning of birds observation by the radar we can consider 1964 (Jakoby, 1966). Since that time the study of birds transfer are carried out in the different regions of the USSR. (Jakoby, 1968, 1969, 1972, Jakoby, Jegy, 1970,1972 i.t.c.). The intensive development of birds detection by the radar was in the middle of 1970's. At that time the regular study of birds transfer by the air traffic control radar was started. Radar observations are carried out in Odessa, Kishinev, Kiev, Palanga, Tashkent, Alma-Ata and other places. During estimation outlined two ways: the first-the using of information from plan position indicator (PPI) by means of visual observations or photo-registration for determining of the character of transfering birds,
the second-relates to experimental radiolocation and ornitology.

The law of migration of the different bird types, migration height and speed of migration, daily and seasonal intensity and influence of weather were studied.

The pelican migration over the desert in Turkmenistan were evaluated(Jakoby, 1968). The author made an interesting observation that migration of this type's bird over the desert has a wide front and front get narrow over the river vale.

Radar evaluation of the cleat's migration (Melanitta nigra and Clangula hyemalis) over the Estonia mainland showed, that migration front relatively wide(Jakoby, Jegy,1972).
In the North-West Black Sea land the migratory movement has a big variety. Fig. 1 shows the grey geese migration from 6 to 12 a.m. on the 12th of March, during the north--west wind with the speed 2 mps.

Fig. 2 shows the grey cranes migration on the 29th of March. The bird's flight trajectory has a big curve and quite lengthy(up to 140 km), that conditioned by the height of migration. The flight direction depends on the ascending wind flows and wide using these flows by birds during take off. It was detected by means of weather radar observations that during grey crane's spring migration over North-West Black Sea land migrate two population of crane, which differ from each other by the time of migration and flight direction (Ganja, Komarov,1980).

The cranes are transit migration birds for the North--West Black Sea land, but many of waterfowl birds type use this region for winter stay. Fig. 3 shows the big ducks and teals spring migration. The birds fly away to different directions are observed. The greatest density is 3 flights per 100 km^2 during one hour. In that case the migration dispersion from water stay places are observed. The analogous picture are observed during starling autumn migration from Crimea. The mass migration of starlings stated at 11 and 10 minutes p.m. on the 30th of October. The birds flew by one wave up to past half 3 a.m. on the 31st of October.At the beginnning the birds main mass flew to the west(190°-280°), gradually the direction has changed and to the end they flew to the south ans south-east(120°-200°). This was high altitude flight, the middle height was 3000 m.

In common were registered about 500 flocks during this time. If we take into account, that average value per each flight is equals from 2 to 5 thousand individuals (accordingly to the calculation of the birds during lodging fot the night), than from Crimea migrated about from 1000000 to 2.500000 starlings per one night.

This observatuon confirms the assumption that birds migration even in one region don't remain directionally constant. The fly away and flight front widening from accumulation places before ecological barrier are observed. In this case starlings flew away perpendicularly to arc with length 320 km(it was observed on the PPI with the scale 120 km).

The increasing of flight area and decreasing of flock's concentration promotes to decreasing the probability of birds fly into unfavourable surroundings.

Thus, during birds migration from accumulation places in any season we have the same regularity-birds fly away to different directions. Apaprently such birds migration organization promote to birds type preservation under unfavourable surroundings during spring and autumn.

An estimation of birds flight heght by radar was made. One extraordinary interesting observation was made on the 23 th of May,1980 during autumn migration of melanitta nigra and clangula hyemalis near Saarema island (Estonia). One of birds flock was registered on the height 11500m.

An average flight height correlates with the wind direction and speed and are equal 500-2500 m over land and 100-1500 m over sea.

The flight altitude for grey goose flight was registered by aradar and visually from aircraft during spring migration in north-west Black Sea land and are equal 11500m. The most usable heights for goose flight are equal 1000-3000m.

The altitude of flight are higher over mainland. The highest altitude for wild duck are 2500 m, most usable heights for their flight are 300-2000m. The difference in flight height over mainland and sea are not definied. The highest flight altitude for grey goose are registered and equal up to 5000 m. The flight altitude over sea are higher and average height are 1000-3000m, over mainland are 300-2500 m.

The highest migration altitude for starling are 3000m, an average height over sea and mainland duirng the day are 500-1000 m and during the height are up to 1500m.

The change of flocks flight altitude are pointed out under long observation. Cranes and storks, for example, take off when they fly into ascending wind flow and then the altitude gradually decrease or stay at the same level. The smooth take off and more fast landing of ducks are pointed out.

Thus, equally with biotical factors fro birds of sea and land species the migration height depends on oecological biotop conditions the birds are flying over and atmosphere status.

The connection with biotop during take off becomes lost, the flight becomes more straightforward, but the floght height, direcyion and trajectory more liable to local wind movement influence in the layer the birds are flying.

Summary of the radar birds migration data allows to make a preliminary conclusion that birds class evaluation was going by the way of adaptable transference. One of the development moments of evolution was the forming such migration flight that are energy profitable both in sense of energy resource replenishment due to the stop off at suitable places and in sense of using energy possibilities of atmosphere for increasing the flight efficiency.

This feature determines concentration conditions of birds in the space and by this the connection degree of birds with oecological channels. The migration flight of low flying birds depends on their biotop search which are usable for energy resources replishment. This brings to concentration of flying flocks in certain places. High altitude flight has an even birds distribution in the area and common global direction. Such flight migration organization results in increasing of the survive ability of species as a whole.

In the field of experimental radiolocation was carried out an estimation of the probability of using different radar types for birds' migration study. It was established that transmitter/receiver part of air traffic control radar are able to detect the birds. Processing and representation of information demand an additional equipment which are destined to extract an echo-sygnals from birds. The determination of the distinctive features of the sygnals fro the birds under background was made by means of pulse tracking radar.

A lonely bird has a log-normal amplitude distribution of the echo-sygnals. The target is fluctuating. The frequency of fluctuation corresponds to frequency of wings stroke and usually variates from part of cycle per second for soarer birds to few tens of cycle per second. There is the Doppler frequency encrement caused by angle speed of wings with respect to body. The signals sometimes appear for short time-ones or tens of second. The plot brightness on the PPI screen can change. The target sometimes disappear from the PPI screen at all. The trace on picture has form of a thin curved line which repeats the birds' flight trajectory when the distances are small and the probability of detection are 0,9 and higher. The trace has form of a dot line when the distances are greater and probability of detection are 0,5.

The flight speed depends on the wind speed and can vary from few km per hour to 130 km/ph. The most likehood of such plots appearnce during migration of sparrow species are in the evening and night time. The plots from prey--soarer birds appear during the day time.

The fluctuation frquency of small flock's of birds can coincide with the wings stroke frequency. The target is volume-distributed, the plot is spot like. The brightness of the plot can change. The central Dopper spetrum frequency from bird flocks are higher than central frequency from weather clutter.

This can be explained that the bird's have a speed bigger than weather clutter. The energy level of the signals reflected from the flock are higher than from lonely bird. The trace on the picture has a view thin continuous line or dot line under long exposure time. It often happens the trace line is curved. The flocks flight speed always differ from wind speed. The horizontal dimensions are not bigger tens of metres. The most appearance time probability of such plots are in migration periods. The daily activity can vary considerably. It was observed the flocks often avoid tha bad weather.

There is a bright spot on the PPI screen from the big flocks of bird and the dimensons of this spot are bigger than the thickness of sweep line. The form of spot can has different configuration. The spot contour can change during one or few revolution scans and the flight direction is not coincide with the wind direction.

On the taken under long exposure time picture shown the plot in form of spot and it's diameter is bigger than point plot dimension. The form of spot can be like a circle with sharp cut edges or ellipsis or any form spot with rounded edges. The most appearance time probability of spot are autumn nights in time of winter flocks forming.

A work was done for birds species determining. The birds radar cross section(RCS) was studied for above mentioned purpose(Zavirukha, Stepanenko,1978). The flight was investigated. It well known that distinctive feature of echo-signals from birds is that their amplitude modulated by wings stroke frquency with the near sinusoidal law. It was established under detail investigation that many birds have a nonstationary character of lfight that results in additional Doppler frequency shifts.

In accordance with the above mentioned it is expected that during the nearest future the following problems of radar ornitology in the USSR will be developed:

1. Investigations on different aspects of the birds flight ecology will be continued with the extension of investigations on the birds flight height and velocity. The influence of different atmosphere parameters on birds flight will be revealed.

2. On the basis of birds radar reflectively investigations the developing of special ornitological devices will be started. It will be directed to automation of the evaluation of bird hazrd situation.

3. Investigations on definition of birds quantity in flock and on what species they are will be increased.

4. It is planned in future to cope by radar and aerovisual observations with birds transferences on all south- - west part of the USSR including big area of the Black Sea and Azov Sea. It gives a possibility to study migration laws in mentioned region of Europe and to determine migrant's concentration places and to compile the prognosis of bird migrations and to prepare avia-ornitological description of all region.

5. The special part is planned to give the attention to automatize the evaluation of bird hazard situation. For this purpose is assumed to create the radar- -ornitological station on the Black Sea coast.

REFERENCES

1. Ganja e., Komarov V.," Radar investigations on the spring grey cranes migration through Moldavja" Schtinitsa, Kishinev, 1980.

2. Savirukha V., Stepanenko V.," Radar investigations on ornitological objects. The 4th symposium on radar meteorology. Gidrometeoizdat, 1978.

3. Jacoby V. " Radar visual observations on birds flights during autumn 1964 in Baltic Sea region. The 6th ornitological conference. Vilnjus 1966.

4. Jacobi V. "Visual and radar observations the pelican spring flight in south-east Turkmenian. Coll., "Animals mechanism of mevement and orientation". Kiev, 1968.

5. Jacobi V. "Radar investigations on birds migration." Coll. " Science summary" Zoology, 1969. Moscow.

6. Jacobi V., Jegy A. "Radar and visual observations of melanitta nigra transference. The 7th ornitological conference, Riga, 1970.

7. Jacobi V., Jegy A. " Radar and visual observations of melanitta nigra transference. Reports of Baltic Sea region commission on birds migration investigation." Tartu, 1972.

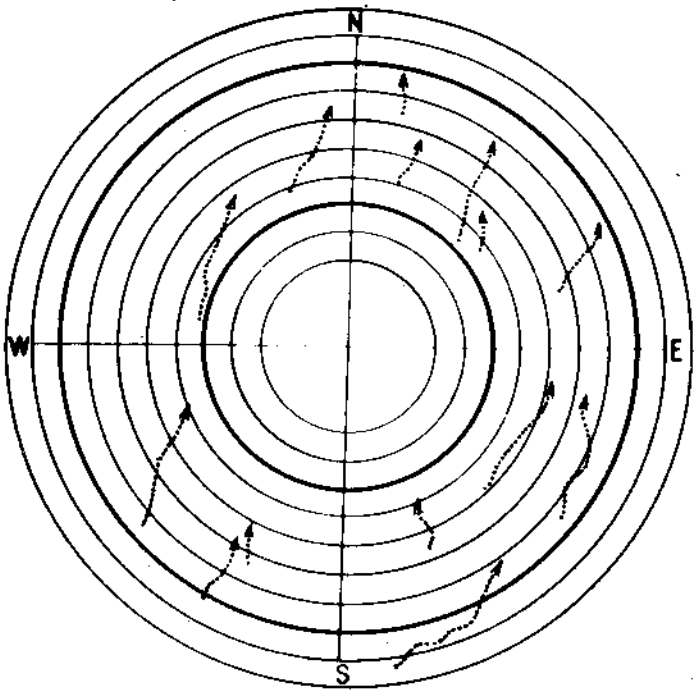

Fig. 1 Overflight of grey geese in the scanning area of 120 km

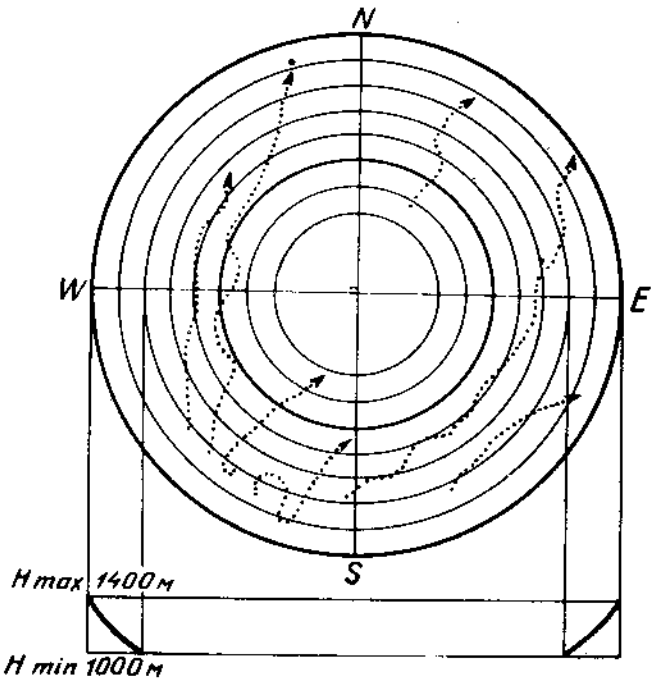

Fig. 2 Overflight of grey cranes

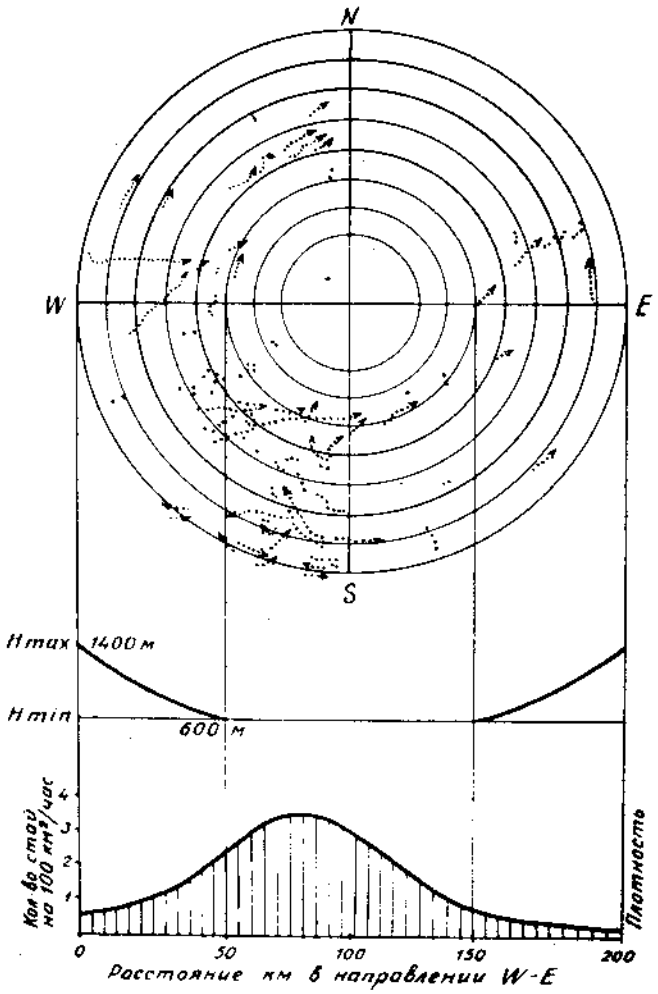

Fig. 3 Migration of water birds in the North-West of the Black Sea area